

BIBLIOGRAPHY OF SECONDHAND SMOKE VENTILATION STUDIES

In Descending Chronological Order

December 8, 2008

Hahn, E.J., Lee, K., Robertson, H.E., Vogel, S., Lee, S.; "Indoor air quality in Bowling Green, Kentucky hospitality venues, 2008," *University of Kentucky, College of Nursing*, October 15, 2008.

This study examined the air quality in eleven hospitality establishments in Bowling Green, Kentucky, and compared the levels of particulate matter to those found in air quality studies conducted in Lexington and Louisville before and after implementation of smokefree ordinances in those two cities. Levels of particulate matter in the Bowling Green venues were "...approximately 9.2 times higher than Lexington's post-law and 18 times higher than Louisville after implementation of their comprehensive smoke-free law."

Vainiotalo, S.; Vaananen, V.; Vaaranrinta, R., "Measurement of 16 volatile organic compounds in restaurant air contaminated with environmental tobacco smoke," *Environmental Research* [Epub ahead of print], September 16, 2008.

This study reported the results of an air quality study in ten restaurants in Finland.

Dales, R.; Liu, L.; Wheeler, A.J.; Gilbert, N.L., "Quality of indoor residential air and health," *CMAJ* 179(2): 147-152, July 15, 2008.

This study examined the sources of indoor air pollution, noting that North Americans spend approximately 87 percent of their time indoors. The authors made recommendations to reduce exposure to several pollutants, including cigarette smoke.

[n.a.], "Changes in Air Pollution in Charleston County: pre/post smoking ordinance, executive summary," [Medical University of South Carolina Hollings Cancer Center (HCC)], July 2008.

This study examined levels of air pollution in venues in Charleston, Mt. Pleasant, and North Charleston, South Carolina, and found that air pollution decreased 94% across venues in both Charleston City and Mt. Pleasant following passage of smoke-free legislation.

Gotz, N.K.; van Tongeren, M.; Wareing, H.; Wallace, L.M.; Semple, S.; MacCalman, L., "Changes in air quality and second-hand smoke exposure in hospitality sector businesses after introduction of the English Smoke-free legislation," *Journal of Public Health* [Epub ahead of print], July 23, 2008.

Air quality in 49 businesses and salivary cotinine levels in 75 nonsmoking hospitality establishment employees were sampled one month before and after implementation of England's clean indoor air law. Researchers found that indoor particulate matter fell by 95 percent and that salivary cotinine fell by 75 percent after the law went into effect.

Hahn, E.J.; Lee, K.; Vogel, S.; Robertson, H.E.; Lee, S., "Indoor air quality in bingo halls, Lexington, Kentucky, 2008," *University of Kentucky, College of Nursing*, July 10, 2008.

Indoor air quality was assessed in five bingo halls in Lexington, Kentucky. Fine particulates were measured from February 15 to February 22, 2008, using the TSI SidePak AM510 Personal Aerosol Monitor. The average PM2.5 level from the five locations was compared to the average PM2.5 levels in the Georgetown bingo hall and a sample of Lexington hospitality venues before and after implementation of their smoke-

free laws, as well as the National Ambient Air Quality Standard (NAAQS; 35 g/m³) for 24 hours.

Gorini, G.; Moshhammer, H.; Sbrogio, L.; Gasparini, A.; Nebot, M.; Neuberger, M.; Tamang, E.; Lopez, M.J.; Galeone, D.; Serrahima, E., "Italy and Austria before and after study: second-hand smoke exposure in hospitality premises before and after 2 years from the introduction of the Italian smoking ban," *Indoor Air* [Epub Ahead of Print], April 21, 2008.

This study compared nicotine concentrations in the air of hospitality establishments in two Italian cities, covered by Italy's smokefree air law, to those in Vienna, Austria, where no smokefree law existed. The authors found that nicotine levels in the Italian venues dropped, but not in the Austrian venues. The authors concluded that hospitality workers exposed to secondhand smoke had a much greater lifetime risk of dying from lung cancer, but that, "The drop of second-hand smoke exposure indicates a substantial improvement in air quality in Italian HPs even after 2 years from the ban."

Proescholdbell, S.K.; Foley, K.L.; Johnson, J.; Malek, S.H., "Indoor air quality in prisons before and after implementation of a smoking ban law," *Tobacco Control* 17(2): 123-127, April 1, 2008.

This study examined air quality in North Carolina prisons before and after the implementation of a smokefree law. The study found that respirable suspended particles (RSPs), a marker of secondhand smoke, decreased by 77 percent after the smokefree policies were implemented.

Carter, C.L.; Carpenter, M.J.; Higbee, C.; Travers, M.; Hyland, A.; Bode, A.; Thacker, S.; Alberg, A., "Fine particulate air pollution in restaurants and bars according to smoking policy in Charleston, South Carolina," *Journal of the South Carolina Medical Association* 104(4): 82-85, April 2008.

This study examined the air quality in 64 bars and restaurants in Charleston County, South Carolina in early 2006. The bars and restaurants were not governed by any smokefree air laws and were free to adopt their own policies. The venues where smoking was permitted were significantly more likely to be either bars or a combination of restaurant/bar. The level of air pollution in venues where smoking as permitted was 18 times higher than in smokefree establishments.

University of Wisconsin Population Health Institute; Paul P. Carbone Comprehensive Cancer Center, University of Wisconsin-Madison, "Analysis of indoor air quality in restaurants and bars in Eau Claire County," *Tobacco Free Partnership of Eau Claire County*, March 20, 2008.

This study tested indoor air at eight bars and restaurants in Eau Claire County, Wisconsin, and found that, with two exceptions, "the air quality in all of the establishments was by Environmental Protection Agency (EPA) standard, at or above the hazardous-level (120-150 micrograms of fine particulate/cubic meter)."

Hahn, E.J.; Lee, K.; Robertson, H.; Vogel, S.; Lee, S.; Peiper, N.C.; Powell, R.W.; Troutman, A., "Indoor air quality in Louisville: did passage of a comprehensive smoke-free ordinance clear the air?," *University of Kentucky, College of Nursing and College of Public Health*, February 19, 2008.

This study found that a partial smokefree ordinance resulted in exposure to dangerous levels of air pollutants and that "Air pollution in one Louisville venue with an enclosed smoking room (allowed with the partial ordinance) dropped 94% after compliance with the comprehensive smoke-free ordinance. Enclosed, ventilated smoking rooms do not rid the air of dangerous fine particle air pollution."

Travers, M.J., "Iowa air monitoring study: December 2007 to January 2008," Roswell Park Cancer Institute, February 2008.

This executive summary described the results of a Roswell Park Cancer Institute study, which found that air in Iowa bars, restaurants, and casinos where smoking was permitted was 17 times higher in particulate matter than places with smokefree policies. In addition, employees in the venues where smoking is permitted are exposed to unhealthy air according to U.S. Environmental Protection Agency (EPA) guidelines. Samples were taken from 21 Iowa venues from November 2007 to January 2008.

Tobacco Program Evaluation Group (TPEG), University of Colorado Denver, "Smoking pollution in gaming venues before and after the Colorado Clean Indoor Air Act," Colorado Department of Public Health and Environment, State Tobacco Education & Prevention Partnership (STEPP), January 2008. Abstract not available online.

This air quality study of casinos in Colorado before and after implementation of a smokefree law concluded that, "Before the Colorado smoke-free air law covered casinos, the average employee and patron of a Colorado gaming establishment was exposed to an unhealthy level of indoor air pollution, even in nonsmoking restaurants. Once the law went into effect, air quality was 92% better and met the EPA's good rating."

Vardavas, C.I.; Kondilis, B.; Travers, M.J.; Petsetaki, E.; Tountas, Y.; Kafatos, A.G., "Environmental tobacco smoke in hospitality venues in Greece," *BMC Public Health* [Epub ahead of print], October 23, 2007.

This study measured levels of secondhand smoke "in the non smoking areas of hospitality venues and offices in Greece and to compare the levels of exposure to levels in the US, UK and Ireland before and after the implementation of a smoking ban." The authors found that, "Designated non-smoking areas of hospitality venues in Greece are significantly more polluted with ETS than outdoor air and similar venues in Europe and the United States."

Valente, P.; Forastiere, F.; Bacosi, A.; Cattani, G.; Di Carlo, S.; Ferri, M.; Figa-Talamanca, I.; Marconi, A.; Paoletti, L.; Perucci, C.; Zuccaro, P., "Exposure to fine and ultrafine particles from secondhand smoke in public places before and after the smoking ban, Italy 2005," *Tobacco Control* 16(5): 312-317, October 2007.

This study found that, "The application of the smoking ban led to a considerable reduction in the exposure to indoor fine and ultrafine particles in hospitality venues, confirmed by a contemporaneous reduction of urinary cotinine."

Lee, K.; Hahn, E.J.; Riker, C.; Seithers, P., "Immediate impact of smoke-free laws on indoor air quality," *Southern Medical Journal* 100(9): 885-889, September 2007.

This study concluded that when venues comply with smokefree air laws, there is an "immediate impact on indoor air quality."

Travers, M.J., "Casino air monitoring study East Saint Louis, Illinois," *Roswell Park Cancer Institute, Department of Health Behavior*, September 2007.

This study found that the air quality in an East Saint Louis, Illinois, casino was "very unhealthy" for employees and that, "Despite the expensive, state-of-the-art, ventilation system installed at this casino, employees and patrons are exposed to harmful levels of fine particle air pollution as a result of indoor smoking."

Ott, W.; Klepeis, N.; Switzer, P., "Air change rates of motor vehicles and in-vehicle pollutant concentrations from secondhand smoke," *Journal of Exposure Science and Environmental Epidemiology* [Epub ahead of print], July 18, 2007.

This study examined the effects of open windows and ventilation systems on the levels of pollution in cars from secondhand smoke.

Travers, M.J.; Higbee, C.; Hyland, A., "Fort Wayne Air Monitoring Study May-June 2007," Roswell Park Cancer Institute, July 2007.

This study assessed indoor air quality in fourteen Fort Wayne, Indiana, bars, restaurants, pool halls, and bowling alleys prior to and after the implementation of a smokefree ordinance. The study found that, "The average level of fine particle indoor air pollution declined 94% after the Fort Wayne ordinance went into effect in those venues that went smoke-free as a result of the law." Compliance in the venues studied was 100 percent.

Bolte, G.; Heitmann, D.; Kiranoglu, M.; Schierl, R.; Diemer, J.; Koerner, W.; Fromme, H., "Exposure to environmental tobacco smoke in German restaurants, pubs and discotheques," *Journal of Exposure Science and Environmental Epidemiology* [Epub ahead of print], June 13, 2007.

This study measured levels of secondhand smoke in German restaurants, pubs, and discos, and concluded that, "indoor air concentrations of ETS constituents were high in German hospitality venues and represented a substantial health threat."

Wilson, N.; Edwards, R.; Maher, A.; Nathe, J.; Jalali, R., "National smokefree law in New Zealand improves air quality inside bars, pubs and restaurants," *BMC Public Health* 7(1): 85, May 18, 2007.

This study of the effect of New Zealand's smokefree air law in air quality concluded that, "There was very high compliance with the new national smokefree law and this was also reflected by the relatively good indoor air quality in hospitality settings (compared to the "outdoor" smoking areas and the comparable settings in countries that permit indoor smoking). Nevertheless, adopting enhanced regulations (as used in various US and Canadian jurisdictions) may be needed to address hazardous air quality in relatively enclosed "outdoor" smoking areas."

Klepeis, N.E.; Ott, W.R.; Switzer, P., "Real-time measurement of outdoor tobacco smoke particles," *Journal of the Air & Waste Management Association* 57: 522-534, 2007.

This study measured levels of outdoor tobacco smoke (OTS) at sidewalk cafes, parks, restaurant and pub patios. The study found that, "During periods of active smoking, peak and average OTS levels near smokers rivaled indoor tobacco smoke concentrations. However, OTS levels dropped almost instantly after smoking activity ceased. Based on our results, it is possible for OTS to present a nuisance or hazard under certain conditions of wind and smoker proximity."

Milz, S.; Akbar-Khanzadeh, F.; Ames, A.; Spino, S.; Tex, C.; Lanza, K., "Indoor air quality in restaurants with and without designated smoking rooms: abstract," *Journal of Occupational and Environmental Hygiene* 4(4): 246-252, April 2007.

This study compared air quality in nonsmoking restaurants in Toledo and Bowling Green, Ohio, with restaurants in the same cities that had smoking rooms and concluded that, "The results from this study indicate inadequate fresh air supply in all four restaurants, particularly in the designated smoking rooms, and the possibility that the designated smoking rooms were not containing the environment tobacco smoke, based on the ultrafine particle concentrations measured in the nonsmoking areas of the smoking restaurants."

Repace, J.L.; Hyde, J.N.; Brugge, D., "Air pollution in Boston bars before and after a smoking ban," *BMC Public Health* 6: 266, October 27, 2006.

The authors of this study stated, "During smoking, although pub ventilation rates per occupant were within ASHRAE design parameters for the control of carbon dioxide levels for the number of occupants present, they failed to control SHS carcinogens or RSP. Nonsmokers' SHS odor and irritation sensory thresholds were massively exceeded. Post-ban air pollution measurements showed 90% to 95% reductions in PPAH and RSP respectively, differing little from outdoor concentrations. Ventilation failed to control SHS, leading to increased risk of the diseases of air pollution for nonsmoking workers and patrons. Boston's smoking ban eliminated this risk."

Repace, J.; Hughes, E.; Benowitz, N., "Exposure to second-hand smoke air pollution assessed from bar patrons' urinary cotinine," *Nicotine & Tobacco Research* 8(5): 701-711, October 2006.

This study examined levels of secondhand smoke exposure in bars in Bismarck, North Dakota, by measuring cotinine in bar patrons urine. The authors stated that, "smoking in bars produces levels of personal air pollution for bar patrons that merit air pollution alerts when sustained in the outdoor air."

Johnsson, T.; Tuomi, T.; Riuttala, H.; Hyvarinen, M.; Rothberg, M.; Reijula, K., "Environmental tobacco smoke in Finnish restaurants and bars before and after smoking restrictions were introduced," *Annals of Occupational Hygiene* 50(4): 331-341, 2006.

This study measured levels of secondhand smoke in bars and restaurants in Finland prior to and following the enactment of a clean indoor air law that permitted ventilation systems and smoking sections. The authors concluded from their measurements that "it seems obvious from the present study that improving ventilation will not be a solution to restricting tobacco smoke from reaching smoke-free areas and physical barriers separating smoking from smoke-free areas are required."

Waring, M.S.; Siegel, J.A., "An evaluation of the indoor air quality in bars before and after a smoking ban in Austin, Texas," *Journal of Exposure Science and Environmental Epidemiology*, doi:10.1038/sj.jes.7500513 [epub ahead of print], June 28, 2006.

This study examined indoor air quality and occupancy levels in seventeen bars in Austin, Texas, prior to and after the enactment of a smokefree ordinance; the study concluded that, "the smoking ban has effectively improved indoor air quality in Austin bars without an associated decrease in occupancy."

Travers, M.; Homer, M.; Hyland, A.; Sandefer, R., "Wyoming air monitoring study: WYSAC Technical Report No. CHES-513," *University of Wyoming, Wyoming Survey & Analysis Center Roswell Park Cancer Institute*, August 2005.

This study examined indoor air quality in a sample of bars and restaurants in two Wyoming cities, Laramie and Cheyenne. Samples were taken in Laramie before and after a smokefree ordinance took effect, and the authors stated that, "Overall, across both cities the level of indoor air pollution ... was 95% lower in the venues that were smoke-free compared to those where smoking was permitted."

Ellingsen, D.G.; Fladseth, G.; Daae, H.L.; Gjolstad, M.; Kjaerheim, K.; Skogstad, M.; Olsen, R.; Thorud, S.; Molander, P., "Airborne exposure and biological monitoring of bar and restaurant workers before and after the introduction of a smoking ban," *Journal of Environmental Monitoring* 8(3): 362-368, 2006.

This study examined "the impact of a total smoking ban on the level of airborne contaminants and the urinary cotinine levels in the employees in bars and restaurants." The study found that, "A substantial reduction of airborne nicotine and total dust was observed after the introduction of a smoking ban in bars and restaurants. The urinary cotinine levels were reduced in non-smokers."

Laden, F.; Schwartz, J.; Speizer, F.E.; Dockery, D.W., "Reduction in fine particulate air pollution and

mortality: extended follow-up of the Harvard Six Cities study," *American Journal of Respiratory and Critical Care Medicine* 173: 667-672, March 15, 2006.

According to this study's abstract, "Investigators who extended the Harvard Six Cities fine particulate air pollution study by eight years found that reduced levels of tiny particle pollution during this period lowered mortality risk for participants."

Leavell, N.R.; Muggli, M.E.; Hurt, R.D.; Repace, J., "Blowing smoke: British American Tobacco's air filtration scheme," *BMJ* 332: 227-229, January 2006.

This article described internal tobacco industry documents from the British American Tobacco Company (BAT) regarding the ineffectiveness of air purifiers and ventilation in removing secondhand smoke from the air. According to the authors, "...despite internal acknowledgment that ventilation and air filtration were ineffective at removing environmental tobacco smoke, BAT has extensively promoted these technologies to the hospitality industry since the mid- 1990s. Documents also show that BAT's strategies to promote these initiatives worldwide were seen internally as viable solutions to circumvent smoking restrictions and to gain global marketing opportunities. In 1993, ventilation, heating, and lighting manufacturer Colt International gave BAT an air filtration unit to evaluate the system's ability to remove particulate matter, the constituent that gives tobacco smoke a visible presence and odour. BAT determined that the unit was only 34% efficient at removing particulate matter from cigarette smoke. It reported that the unit did little to remove harmful gas phase smoke constituents including carbon monoxide and volatile organic compounds, but that it significantly reduced 'haze, tobacco-smoke aroma and total perceived smoke' — in other words, particulate matter that could be seen and smelt. Despite this evidence, BAT concluded that the air filtration unit 'was a cost-effective mechanism for removing ETS [environmental tobacco smoke] ... would prove a useful device to incorporate into specific environments where BAT might want to ... gain commercial advantages over its competitors,' and should result in 'direct benefits in terms of ... brand (or corporate) awareness and image transfer.' BAT scientist Nigel Warren also stated that the company's interest in air filtration was primarily, 'To negate the need for indoor smoking bans around the world, particularly when we can provide pre- and post-filter air quality studies showing substantial air quality improvements.'" BAT was responsible for installing Colt's air purifiers in a variety of venues worldwide and urged the hospitality industry to turn to ventilation as opposed to smokefree policies. BAT worked with a group called Corporate Responsibility Consulting to install ventilation "smoking tables" in the Birmingham International Airport, which subsequently revoked its smokefree policy.

Repace, J., "Air pollution in Virginia's hospitality industry," Bowie, MD: Repace Associates, January 9, 2006.

This study measured air quality in various Virginia hospitality locales and concluded that, "Virginia's hospitality industry is delivering highly polluted air to its workers and patrons. Tobacco smoke pollution in Virginia is not being – and cannot be -- controlled by ventilation or air cleaning technology, and is a clear and present danger to the health of hospitality workers and patrons."

"Indoor air quality in bars and restaurants before and after implementation of smoke-free ordinances in Hennepin and Ramsey Counties: technical summary," Minnesota Partnership for Action Against Tobacco (MPAAT), September 15, 2005.

This summary noted that a study of indoor air quality in bars and restaurants in Hennepin and Ramsey Counties, Minnesota, found that a comprehensive law in Hennepin County reduced pollution levels by 99 percent, whereas a partial law in Ramsey County resulted in an only 30 percent reduction in secondhand smoke.

Repace, J., "Displacement ventilation fails to control secondhand smoke: a 3 pub air quality study,"

Abstract accepted for publication, 15th Annual International Society for Exposure Analysis Conference
October 30 - November 3, 2005 Tucson, Arizona.

This abstract described an air quality study conducted in three bars to evaluate the effectiveness of displacement ventilation in removing secondhand smoke from the air; the author concluded, "Displacement ventilation is not a viable substitute for smoking bans in controlling ETS exposure."

Repace, J., "Controlling tobacco smoke pollution," *ASHRAE IAQ Applications* 6(3): 11-15, Summer 2005.

This James Repace study examined air samples from Wilmington, Delaware, before and after that state adopted a clean indoor air law and found that the mechanical ventilation rate required to adequately reduce the health risks of secondhand smoke would need to be 22,500 times more than is found in default smokefree environments; clean indoor air is the only viable means of achieving acceptable indoor air quality.

Schoen, L., "Dilution ventilation of tobacco smoke," *ASHRAE IAQ Applications* 6(3): 1-4, Summer 2005.

Abstract unavailable.

Wakefield, M.; Cameron, M.; Inglis, G.; Letcher, T.; Durkin, S., "Secondhand Smoke Exposure and Respiratory Symptoms Among Casino, Club, and Office Workers in Victoria, Australia," *Journal of Occupational & Environmental Medicine* 47(7):698-703, July 2005.

This study examined "the association between smoke-free policies, exposure to secondhand smoke (SHS) at work, and self-reported respiratory and sensory symptoms of workers." The study concluded, "Airconditioning interventions reduce, but fail to eliminate, exposure of hospitality workers to SHS. Such exposure is associated with measurable increases in the risk of respiratory symptoms."

Travers, M.; Hyland, A., "Indiana Air Monitoring Study, December 2004 - January 2005," Roswell Park Cancer Institute, April 2005.

This study examined indoor air quality in hospitality venues in Bloomington, Indiana. The study found that indoor air pollution was 94% lower in the venues that were required to be smokefree, compared to those where smoking was permitted.

Hahn, E.; Lee, K.; Okoli, C.T.C.; Troutman, A.; Powell, R.W., "Smoke-free laws and indoor air pollution in Lexington and Louisville," *Louisville Medicine* 52(9): 391+, February 2005.

This study found, "...a significant improvement in air quality as a result of implementing a smoke-free law.

Repace, J., "Estimated Mortality from Secondhand Smoke Among Club, Pub, Tavern, and Bar Workers in New South Wales, Australia," The Cancer Council New South Wales, April 2004.

This study estimated mortality due to secondhand smoke exposure among bar workers in New South Wales, Australia, to be, "...more than 73 worker deaths per year among the 40,000 Club, Pub, Tavern, and Bar workers in New South Wales. This estimates deaths from lung cancer and heart disease only and includes nonsmokers and smokers. The estimated range for nonsmoking workers only (never-smokers and ex-smokers) is 18% less (over 59 deaths per year)."

Travers, M.J.; Cummings, K.M.; Hyland, A.; Repace, J.; Babb, S.; Pechacek, T.; Caraballo, R., "Indoor Air Quality in Hospitality Venues Before and After Implementation of a Clean Indoor Air Law --- Western New York, 2003," *Morbidity and Mortality Weekly Report* 53(44): 1038-1041, November 12, 2004.

This study measured respirable particles (RSP) before and after New York's smokefree law took effect and concluded, "a statewide law to eliminate smoking in enclosed workplaces and public places substantially reduced RSP levels in western New York hospitality venues."

Repace, J., "Respirable particles and carcinogens in the air of Delaware hospitality venues before and after a smoking ban," *Journal of Occupational & Environmental Medicine*. 46(9):887-905, September 2004.

This study measured, "respirable particle (RSP) air pollution and particulate polycyclic aromatic hydrocarbons (PPAH), in a casino, six bars, and a pool hall before and after a smoking ban. Secondhand smoke contributed 90% to 95% of the RSP air pollution during smoking, and 85% to 95% of the carcinogenic PPAH, greatly exceeding levels of these contaminants encountered on major truck highways and polluted city streets."

Hyland, A.; Travers, M.; Repace J., "7 City Air Monitoring Study (7CAM), March-April 2004," *Roswell Park Cancer Institute*, May 2004

This study measured the levels of fine particulate air pollution in the bars and restaurants of seven major U.S. cities, three with smokefree laws and four without. The study found that air pollution levels were 82 percent lower on average in venues required by law to be smokefree compared to those where smoking was permitted. In cities without smokefree laws, full-time bar and restaurant employees are exposed on the job to more than four times the average annual limits of fine particulate air pollution recommended by the U.S. Environmental Protection Agency (EPA).

Glantz, S.A.; Schick, S., "Implications of ASHRAE's Guidance On Ventilation for Smoking-Permitted Areas," *ASHRAE Journal*, March 2004.

This article discussed the impact of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) ventilation standards and guidelines regarding secondhand smoke in public places. The paper outlined how the tobacco and hospitality industries have pushed for standards that permit smoking, and are now asking ASHRAE for a separate standard for hospitality venues, with smoking permitted. The article reviewed literature regarding secondhand smoke pollution, the health hazards of secondhand smoke exposure, and what constitutes acceptable indoor air quality for this issue. The authors concluded, "Since ASHRAE seems unwilling to develop a standard based on de minimus risk, perhaps it would be best to simply include a statement in Standard 62, as the Board Policy Committee did in its report to the ASHRAE Board of Directors on June 25, 2002, that 'There is evidence that acceptable air quality cannot be achieved where smoking is permitted,' delete Section 6.1.3.5, the statement in the standard about the need for additional ventilation or air cleaning when smoking is permitted, drop the forthcoming ETS design guide, and leave it at that."

Environmental Protection Agency, "Indoor air facts no. 6: report to Congress on indoor air quality," *Washington, DC: Environmental Protection Agency*, [n.d.].

A summary of the four parts of the Environmental Protection Agency's "Report to Congress on Indoor Air Quality", a report required by Title IV of the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Repace, J.L.; Lowrey, A.H., "An estimate of nonsmokers' lung cancer risk from passive smoking," *[n.s.]*, [n.d.].

The Repace, Lowrey preliminary research study on estimating the risk of secondary smoke.

Cains, T.; Cannata, S.; Poulos, R.; Ferson, M.J.; Stewart, B.W., "Designated "no smoking" areas provide from partial to no protection from environmental tobacco smoke," *Tobacco Control 13(1): 17-22*, March 2004.

This study measured the effectiveness of using no-smoking sections in hospitality establishments and found that, "By comparison with levels in general use areas, nicotine and particulate matter levels were significantly less in the 'no smoking' areas, but were still readily detectable at higher than ambient levels." The authors concluded "Provision of designated 'no smoking' areas in licensed (gaming) clubs in New South Wales, Australia, provides, at best, partial protection from ETS—typically about a 50% reduction in exposure. The protection afforded is less than users might reasonably have understood and is not comparable with protection afforded by prohibiting smoking on the premises."

Repace, J., "Flying the smoky skies: secondhand smoke exposure of flight attendants," *Tobacco Control 13(Suppl. 1): i8-i19*, March 2004.

This paper reviewed and analyzed published air quality measurements, modelling studies, and dosimetry studies in order to determine the role played by secondhand smoke (SHS) in aircraft cabin air pollution and flight attendants SHS exposure compared to the general public. The study concluded, "In-flight air quality measurements in ,250 aircraft, generalised by models, indicate that when smoking was permitted aloft, 95% of the harmful respirable suspended particle (RSP) air pollution in the smoking sections and 85% of that in the non-smoking sections of aircraft cabins was caused by SHS. Typical levels of SHS-RSP on aircraft violated current (PM2.5) federal air quality standards ,threefold for flight attendants, and exceeded SHS irritation thresholds by 10 to 100 times. From cotinine dosimetry, SHS exposure of typical flight attendants in aircraft cabins is estimated to have been .6-fold that of the average US worker and ,14-fold that of the average person. Thus, ventilation systems massively failed to control SHS air pollution in aircraft cabins. These results have implications for studies of the past and future health of flight attendants."

Pion, M.; Givel, M.S., "Airport smoking rooms don't work," *Tobacco Control 13(Suppl 1): i37-i40*, March 2004.

This study cited internal tobacco industry documents to describe strategies to prevent the Lambert-St Louis International Airport from going smokefree and tested whether the smoking rooms in the airport are effective in protecting nonsmokers from secondhand smoke (SHS) exposure. The authors stated that, "Nicotine vapour air monitoring in a non-smoking area of the airport, adjacent to a smoking room located in Terminal C, reveals elevated levels of ambient nicotine vapour in excess of what would be expected in a completely non-smoking environment. This study shows that airport smoking rooms expose non-smokers in adjacent non-smoking areas to a significant concentration of nicotine vapour from SHS." The Missouri Group Against Smoking Pollution Inc (GASP) opposed the construction of the smoking lounges, and sponsored two studies to determine if SHS was leaking from the rooms into the adjacent smokefree areas. [Ed. note: the bibliographic citations were not indexed.]

Cenko, C.; Pisaniello, D.; Esterman, A., "A study of environmental tobacco smoke in South Australian pubs, clubs, and cafes," *International Journal of Environmental Health Research 14(1):3-11*, February 2004.

This study stated, "The data demonstrate an approximate two-fold reduction of ETS within non-smoking areas and suggest that mechanical ventilation is only partially effective in preventing propagation of ETS throughout premises. Risk models suggest that ETS exposures in non-smoking areas may still represent an appreciable health risk. It is recommended that smoking be totally banned in enclosed publicly accessible areas."

Alevantis, L.; Wagner, J.; Fisk, W.; Sullivan, D.; Faulkner, D.; Gundel, L.; Waldman, J.; Flessel, P., "Designing for smoking rooms," *ASHRAE Journal* 45(7): 26+, July 2003.

This article described California's AB 13, a law that created smokefree workplaces. The article stated that the law exempts "breakrooms designated by employers for smoking, under specified conditions." The authors "studied the effectiveness of various smoking-area designs in containing ETS within smoking areas in 23 public buildings." The study found that "enclosed areas with no air recirculation to nonsmoking areas and with exhaust to the outside were clearly the most effective in reducing exposure of non-smokers to ETS." The current study identified the most important design variables in creating a smoking room and provided design criteria for construction of such rooms, e.g., ventilation types, types of doors, exhaust systems. The authors also conducted a survey of local tobacco control jurisdictions in the state and found that many of them have local ordinances that prohibit smoking breakrooms in the workplace.

Carrington, J.; Watson, A.F.R.; Gee, I.L., "The effects of smoking status and ventilation on environmental tobacco smoke concentrations in public areas of UK pubs and bars," *Atmospheric Environment* 37(23): 3255-3266, July 2003.

This study examined the effect of smoking status and ventilation on secondhand smoke concentrations in bars in the United Kingdom and concluded that smoke from smoking sections migrated into nonsmoking sections and that "the use of ventilation systems (sophisticated HVAC systems and extractor fans in either the on or off model) did not have a significant effect ($P > 0.05$) on ETS marker concentrations in either the smoking or non-smoking areas."

Repace, J., "A killer on the loose: an Action on Smoking and Health special investigation into the threat of passive smoking to the U.K. workforce," *Action on Smoking and Health (ASH-UK)* — <http://www.ash.org.uk>, April 9, 2003.

This study stated that, "An estimated 12,000 U.K. nonsmokers die annually from secondhand smoke (SHS) exposure at home, at work, and in social venues." The study estimated how many employees in various types of jobs die as a result of SHS exposure. The report argued, "Under the hospitality-industry-sponsored Public Places Charter on Smoking, which promotes ventilation as a control for secondhand smoke, it is estimated that five of every 100 bar workers would die from workplace passive smoking, yielding 66 deaths per year," and explained why ventilation systems are ineffective at protecting people from SHS exposure. [Ed. note: footnotes were not indexed.]

Repace, J., "An air quality survey of respirable particles and particulate carcinogens in Delaware hospitality venues before and after a smoking ban," *Bowie, MD: Repace Associates, Inc.*, February 7, 2003.

This study examined levels of tobacco smoke pollutants in eight Delaware hospitality venues prior to and following the enactment of a smokefree air law; the establishments were heavily polluted prior to the smokefree law taking effect.

Repace, J., "An air quality survey of respirable particles and particulate carcinogens in Boston pubs before and after a smoking ban," *Bowie, MD: Repace Associates, Inc.*, [2003].

This study measured respirable particles and particulate carcinogens in six Boston, Massachusetts, bars before and after implementation of a smokefree ordinance and concluded that ventilation systems were ineffective in reducing secondhand smoke exposure.

[n.a.], "Indoor air quality: states weigh the science of second-hand smoke," *State Health Notes 23(383): 3+*, November 4, 2002.

This article describes how many states are trying to determine what, if any, ventilation systems might be effective at reducing the health risks of secondhand smoke. The article notes that only California and Delaware have enacted comprehensive smokefree laws, although New York City and Florida are considering ones. The article reviews the science surrounding the health hazards of secondhand smoke, and notes that the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has revised its Standard 62 Ventilation for Acceptable Indoor Air Quality so that it does not set any minimum ventilation rates for areas in which smoking is present. Larry Schoen of the Standard Project Committee 62.1 stated, "With second-hand smoke, until someone says you have to get the [carcinogen] level down to X, we don't know how much air to add to make it safe." The article describes ventilation programs being pushed by Options, Philip Morris USA, the Hospitality Coalition on Indoor Air Quality (HCIAQ), and the National Restaurant Association (NRA) as solutions to accommodate smokers. Tim Filler of the American Nonsmokers' Rights Foundation (ANRF) stated that ventilation "is a tobacco industry tactic to create and institutionalize smoking sections in hospitality venues," and that "The root problem is that ventilation cannot eliminate the harmful components of ETS to a degree that can be claimed safe. Neither the tobacco companies promoting the systems nor the manufacturers selling the equipment claim otherwise." The article also states that public health officials favor relying on sales tax data to measure any economic impact of smokefree laws, while Philip Morris (PM) contends that such data is a flawed measurement tool, and prefers to survey business owners.

Elovitz, K.M.; Gordon, D.; Cashman, D.J., "ETS in restaurants," *ASHRAE Journal: 41-47*, October 2002.

This article reported on a study of 40 Boston, Massachusetts, restaurants, which sought "to determine whether nicotine and other air contaminants generated in the smoking section would migrate to non-smoking areas." The article describes the research methods used, and made recommendations for the most effective type of ventilation system to use to separate a smoking section. However, the article acknowledged that, "This article addresses the smoking/non-smoking dichotomy primarily from the non-smoking customer's point of view. It does not address comfort in the smoking section or the (valid) concerns of the wait staff. Perhaps a restaurant can be laid out so employees who work in the non-smoking area never have to walk through the smoking area. However, no HVAC system can be expected to protect non-smoking staff that work in the smoking area of the restaurant from exposure to tobacco effluents."

[n.a.], "Air conditioning fails to remove all smoke: study," *ABC Online*, September 30, 2002.

A study conducted in South Australia has found that air conditioning and ventilation systems failed to clear the air of secondhand smoke.

Mendell, M.J.; Fisk, W.J.; Kreiss, K.; Levin, H.; Alexander, D.; Cain, W.S.; Girman, J.R.; Hines,

C.J.; Jensen, P.A.; Milton, D.K.; Rexroat, L.P.; Wallingford, K.M., "Improving the health of workers in indoor environments: priority research needs for a national occupational research agenda," *American Journal of Public Health* 92(9): 1430-1440, September 2002.

This study examined the health impacts of contaminants in indoor work environments in the U.S., and the potential health and economic benefits of improving the environments (ventilation research needs were listed); the study estimated that 10-30 million workers are exposed to secondhand smoke, resulting in 2,000-11,000 deaths from cardiovascular disease and 100-600 cases of lung cancer; the economic costs of the exposure are between \$30 to 140 million in health care costs alone; costs of absence from work and other performance losses were not estimated.

Junker, M.H.; Danuser, B.; Monn, C.; Koller, T., "Acute sensory responses of nonsmokers at very low environmental tobacco smoke concentrations in controlled laboratory settings," *Environmental Health Perspectives* 109(10): 1045-1052, October 2001.

This study examined the odor detection threshold and acute sensory responses of nonsmokers for low levels secondhand smoke, the authors concluded that the study "strongly supports the implementation and control of smoking policies such as segregating smoking areas from areas where smoking is not permitted or instituting smoking bans in public buildings," and that ventilation would be an impractical means of protecting nonsmokers.

Fisher, B., "Setting the standard: industry scientists are close to setting a standard for measuring sidestream smoke," *Tobacco Reporter* 128(8): 22+, August 2001.

This article describes attempts by CORESTA to: develop a standard for measuring secondhand smoke in the air; determine the various constituents of secondhand smoke; study the effectiveness of ventilation and smoking area designs; provide recommendations for conducting representative sampling; and "provide guidance on the interpretation of ETS measurements in the context of overall air quality." The group is reported to be close to "standardizing a method for the measurement of sidestream smoke, one of the major contributors to ETS." Jean-Jacques Piade, an employee with Philip Morris International and chair of the CORESTA task force studying the issue, indicated that measuring the components of sidestream smoke was a complicated task. CORESTA hopes to develop an international standard for measurement of tar, nicotine, and carbon monoxide for use by the industry and by government agencies, and plans to submit the standard to the ISO in early 2002. The article goes on to describe how the measurement standard is being developed and the work that it is based upon.

Georgiadis P.; Stoikidou M.; Topinka J.; Kaila S.; Gioka M.; Katsouyanni K.; Sram R.; Kyrtopoulos S.A., "Personal exposures to PM(2.5) and polycyclic aromatic hydrocarbons and their relationship to environmental tobacco smoke at two locations in Greece," *Journal of Exposure Analysis and Environmental Epidemiology* 11(3):169-83, May-June 2001.

This study examined polycyclic aromatic hydrocarbon (PAHs) levels in nonsmokers living in two cities in Greece and concluded that, ETS can have a distinctive effect on the PAH exposure profile of subjects exposed to relatively low levels of urban air pollution."

Ontario Tobacco Research Unit, "Protection from second-hand tobacco smoke in Ontario: a review of the evidence regarding best practices," *Toronto, Ontario: University of Toronto, Ontario Tobacco Research Unit*, May 2001.

This report presents evidence for the best practices to protect nonsmokers in Ontario, Canada, from secondhand smoke exposure; the report concludes that ventilation provides no solution to

the problem and recommends that all workplaces be made smokefree.

Bartholomew, A., "What you don't know about secondhand smoke: and why kids are especially vulnerable," *Reader's Digest*, November 20, 2000.

This article describes the respiratory and other health problems, such as ear infections and Sudden Infant Death Syndrome (SIDS), caused by secondhand smoke exposure in children; the article also discusses the research of Dr. Joseph DiFranza.

Repace, J., "Can ventilation control secondhand smoke in the hospitality industry? An analysis of the document "Proceedings of the Workshop on Ventilation Engineering Controls for Environmental Tobacco Smoke in the Hospitality Industry", sponsored by the Federal Occupational Safety and Health Administration and the American Conference of Governmental Industrial Hygienists," *Bowie, MD: Repace Associates, Inc.*, June 2000.

An analysis of a paper on ventilation and the hospitality industry with sections on the tobacco industry position and appendices with the poisons and chemicals contained in secondhand smoke.

Walker, J.C.; Nelson, P.R.; Cain, W.S.; Utell, M.J.; Joyce, M.B.; Morgan, W.T.; Steichen, T.J.; Pritchard, W.S.; Stancill, M.W., "Perceptual and psychophysiological responses of non-smokers to a range of environmental tobacco smoke concentrations," *Indoor Air 7: 173-188*, 1997.

This study estimated the perceptual, psychophysiological and cognitive impact of secondhand smoke on nonsmokers.

Lambert, W.E.; Samet, J.M.; Spengler, J.D., "Environmental tobacco smoke concentrations in non-smoking and smoking sections of restaurants," *American Journal of Public Health 83(9): 1339-1341*, September 1993.

This study measured two markers of secondhand smoke in the smoking and no-smoking sections of seven restaurants, and concluded that the mean measurements in the no-smoking sections were 40% and 65% lower than in the smoking sections.

Lofroth, G., "Environmental tobacco smoke: multicomponent analysis and room-to-room distribution in homes," *Tobacco Control 2: 222-225*, 1993.

This study evaluated room-to-room distribution of secondhand smoke in homes with low ventilation rates and found that nonsmoking occupants in typical smoking homes will be exposed to ETS in whichever room they stay.

Environmental Protection Agency, "Report to Congress on indoor air quality volume II: assessment and control of indoor air pollution," *Washington, DC: Environmental Protection Agency*, August 1989.

The third of a four part report by the Environmental Protection Agency to Congress mandated by Title IV of the Superfund Amendments and Reauthorization Act (SARA) of 1986, discusses health and economic effects of poor indoor air quality, ventilation and other control mechanisms, and the legislative acts and government agencies that govern control of indoor air quality.

Environmental Protection Agency, "Report to Congress on indoor air quality volume III: indoor air pollution research needs statement," *Washington, DC: Environmental Protection Agency*, August 1989.

The fourth of a four part report by the Environmental Protection Agency to Congress mandated by Title IV of the Superfund Amendments and Reauthorization Act (SARA) of 1986, discusses methods of researching health effects of secondhand smoke and, very briefly, regulatory and physical methods of controlling smoke.

Committee on Airliner Cabin Air Quality, Board on Environmental Studies and Toxicology, Commission on Life Services, National Research Council, "The airliner cabin environment: air quality and safety," *Washington, DC: National Academy Press*, 1986.

This 12-page report was the culmination of 18 months of research into cabin air quality, cabin environment, emergency procedures, cabin regulations, and records; it was found that cabin air quality at the lowest ventilation rate was only acceptable in nonsmoking situations, that secondhand smoke was a hazardous substance, and that secondhand smoke generated the most passenger complaints.

Repace, J.L.; Lowrey, A.H., "An indoor air quality standard for ambient tobacco smoke based on carcinogenic risk," *New York State Journal of Medicine* 85: 381-383, July 1985.

This paper argues that, in order to achieve an acceptable risk level of secondhand smoke in the air, the only effective means are the complete physical separation of smokers and nonsmokers using separate ventilation systems or prohibiting smoking in the workplace altogether.

Repace, J.L.; Lowrey, A.H., "Tobacco smoke, ventilation, and indoor air quality," *ASHRAE Transactions* 88: 895-914, 1982.

This paper examined secondhand smoke and ventilation issues.

THE FOLLOWING DOCUMENTS SHOW TOBACCO INDUSTRY INFLUENCE REGARDING VENTILATION...

Aguinaga Bialous, S.; Glantz, S.A., "ASHRAE Standard 62: tobacco industry's influence over national ventilation standards," *Tobacco Control* 11(4): 315-328, December 2002.

This study analyzed tobacco industry internal documents in order to illustrate how the tobacco industry has influenced the development of ventilation standards in the U.S.. The study outlines the strategies used by the industry to accomplish its goals. The industry has been involved with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and its ventilation standards since the 1980s. A June 1983 Philip Morris (PM) memo noted that the company had been able to block ASHRAE Standard 62-1981 and stated that, if the standard "...were enacted into law, it would take big bucks to bring existing buildings up to standard. The hooker is that, by designating an entire building as a 'no smoking building', no added expense at all would be involved... It is mind boggling to attempt to calculate the harm that this code would have done to our company and our industry had it been adopted...." The study concludes that, "The tobacco industry determined that allowing smoking in ventilation standards for indoor air quality was a high priority and dedicated significant human and financial resources to ensure

that its interests were represented. The health groups, until recently, have largely ignored the policy implications for tobacco control of standard development." The paper includes a timeline of ASHRAE Standard 62 actions from the 1970s to 2000. A table that includes a partial list of people involved at ASHRAE who have tobacco ties is also included. [Ed. note: footnotes were not indexed.]

Barnes, D.E.; Bero, L.A., "Industry-funded research and conflict of interest: an analysis of research sponsored by the tobacco industry through the Center for Indoor Air Research," *Journal of Health Politics, Policy and Law* 21(3): 515-542, Fall, 1996.

This study concerns the Center for Indoor Air Research (CIAR). CIAR was created in 1988 by three U.S. tobacco companies to fund research on indoor air and secondhand smoke. CIAR funds two kinds of research: peer-reviewed projects which are awarded after review by a group of scientists, and special-reviewed projects which are awarded directly by tobacco industry executives. This study found that CIAR's special-reviewed projects were more likely than its peer-reviewed projects to support the tobacco industry position on secondhand smoke. These studies are used by the industry to argue that smoking should not be restricted in public places. The study suggests that the industry may be funding CIAR's peer-reviewed research to give CIAR good publicity and to divert attention from the issue of secondhand smoke.

Drope, J.; Chapman, S., "Tobacco industry efforts at discrediting scientific knowledge of environmental tobacco smoke: a review of internal industry documents," *Journal of Epidemiology & Community Health* 55: 588-594, 2001.

This research study examined internal tobacco industry documents to analyze the use of scientific consultants to discredit research into the health hazards of secondhand smoke. The study concluded that, "The industry built up networks of scientists sympathetic to its position that ETS is an insignificant health risk. Industry lawyers had a large role in determining what science would be pursued. The industry funded independent organisations to produce research that appeared separate from the industry and would boost its credibility. Industry organized symposiums were used to publish non-peer reviewed research. Unfavourable research conducted or proposed by industry scientists was prevented from becoming public." The study focuses primarily on internal documents from 1985-1995, and quotes extensively from these documents to illustrate how the industry worked to develop an international network of scientists and to create controversy around secondhand smoke, in an attempt to ward off the threat posed by what one document called "...the most important single issue facing the industry...."

Dearlove, J.V.; Bialous, S.A.; Glantz, S.A., "Tobacco industry manipulation of the hospitality industry to maintain smoking in public places," *Tobacco Control* 11: 94-104, 2002.

This study analyzed tobacco industry internal documents and found that the tobacco industry in the United States, and in particular Philip Morris (PM) funded hospitality trade associations and created its own associations where none existed, for the purpose of stopping smokefree policies. The study found that the industry used the hospitality groups to push the idea of "accommodating" smokers, and, by false warnings of economic harm from going smokefree, convinced the hospitality industry to invest in expensive ventilation systems. The study quotes extensively from internal documents to illustrate how the tobacco industry has used this strategy internationally and concludes that, "The tobacco industry has effectively turned the hospitality industry into its de facto lobbying arm on clean indoor air." The study includes a chart of hospitality groups with known affiliations with the tobacco industry. [Ed. note: footnotes were not indexed.]

Neilsen, K.; Glantz, S.A., "A tobacco industry study of airline cabin air quality: dropping inconvenient findings," *Tobacco Control* 13(Suppl. 1): i20-i29, March 2004.

This study examined a tobacco industry-funded study on in flight air quality (IFAQ), using internal tobacco industry documents. The authors concluded that the tobacco industry designed, funded, and conducted the study using scientists and attorneys to mask the involvement of tobacco interests. According to the authors, "Industry lawyers and scientists deleted results unfavourable to the industry's position from the study before delivering it to the airline. The published version of the study further downplayed the results, particularly with regard to respirable suspended particulates. The study ignored the health implications of the results and instead promoted the industry position that ventilation could solve problems posed by secondhand smoke." [Ed. note: the bibliographic citations were not indexed.]

Drope, J.; Bialous, S.A.; Glantz, S.A., "Tobacco industry efforts to present ventilation as an alternative to smoke-free environments in North America," *Tobacco Control* 13(Suppl 1): i41-i47, March 2004.

This study examined internal tobacco industry documents to provide a detailed description of how the industry created a network of consultants to promote ventilation systems as an alternative to smokefree policies and laws. The authors stated, "As with its other strategies to undermine the passage of clean indoor legislation and regulations, the tobacco industry used consultants who represented themselves as independent but who were promoting the industry's ventilation "solution" strategies under close, but generally undisclosed, industry supervision. The nature of the industry's use of ventilation consultants evolved over time. In the 1980s, the industry used them in an effort to steer the concerns about indoor air quality away from secondhand smoke, saying SHS was an insignificant component of a much larger problem of indoor air quality and inadequate ventilation. By the 1990s, the industry and its consultants were maintaining that adequate ventilation could easily accommodate "moderate smoking". The consultants carried the ventilation message to businesses, particularly the hospitality business, and to local and national and international regulatory and legislative bodies." The study described industry funded ventilation research and consultants from Virginia Polytechnic Institute, ACVA Atlantic (Air Conditioning & Ventilation Analysis), Healthy Buildings International (HBI), Oak Ridge National Laboratory (ORNL), Chelsea Group, Theodore D. Sterling and Associates, etc., as well as industry programs, such as Philip Morris' (PM) Accommodation Program and Options program. [Ed. note: the bibliography was not indexed.]