Title
Health and Economic Impacts of the Proposed Florida Smokefree for Health Initiative

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Foreword

This new version of "Health and Economic Impacts of the Proposed Florida Smokefree for Health Initiative" is an outgrowth of the feedback we have received from this report. Since its publication, the state of Florida passed the Smokefree for Health initiative by 73% in 2002. The report has been downloaded from the University of California, San Francisco website hundreds of times. We have been contacted by public health officers around the United States and from foreign countries for assistance in duplicating this analysis for their cities, states, and countries.

Some of the feedback we have received have pointed out errors in our calculations and typographical errors. We would especially like to acknowledge Farzad Mostashari and Barbara Pizacani for their comments on the first edition of this report. We are putting out a revision of our first report in order to update the methodology. These changes include updating:

1) the quitters generated by statewide smoke-free workplaces
2) the disease incidence for heart attacks, strokes, low birthweight births, asthma, and sudden infant death syndrome
3) the number of asthmatics prevented by statewide smoke-free workplaces
4) the long-term total reduction in medical care expenditures due to statewide smoke-free workplaces

We hope that in so doing, we will continue to support public health analysts provide policymakers with their work in showing the beneficial effects of smoke-free workplaces in the United States and around the world.

Michael Ong
James Lightwood
Stanton Glantz
November, 2003

Executive Summary*

Florida was an early and important battleground for local nonsmokers' rights advocates vs. the tobacco industry. In the early 1980s, several cities in Florida passed what were at the time state-of-the art local clean indoor air ordinances. The tobacco industry responded by working through the state restaurant association and others to enact a weak statewide law that overturned these local ordinances and forbade passage of additional laws. While the state voluntary health agencies initially opposed this bill, in the end they supported it and claimed that it represented a reasonable compromise which represented a step forward. In fact, passage of the Florida Clean Indoor Air Act (FCIAA) effectively arrested progress on protecting nonsmokers from secondhand smoke in the state of Florida. As of 1999, Florida was twenty-fourth among the fifty states plus the District of Columbia in percentage of indoor workers protected from passive smoking in the workplace (68%).

The Smoke-Free For Health Initiative proposes a constitutional amendment for the state of Florida that would prohibit smoking in the workplace. Specifically, it would prohibit tobacco smoking in enclosed indoor workplaces except in retail tobacco shops, designated smoking guest rooms in public lodging establishments, stand-alone bars, and private residences not used for to provide child care, adult care or health care. The initiative is sponsored by many organizations, including the American Cancer Society, American Lung Association, American Heart Association, Campaign for Tobacco-Free Kids, American Association of Retired Persons, and the Center for Florida's Children.

This analysis evaluates the effects that this strong, comprehensive clean indoor air amendment would have in Florida, assuming that the Legislature enacts appropriate implementing legislation and that the Executive branch makes a good faith effort to enforce the resulting state law. These effects include reductions in smoking behavior, cigarette use, tobacco company revenues, and tobacco-related illnesses.

The benefits realized in the *first year* after implementing the policy include:

1. 1.5 million Floridians would no longer be passive smokers
2. 81,400 Floridians would quit smoking
3. 48.6 million packs of cigarettes would go unsmoked (worth $114 million in pre-tax sales to the tobacco industry)
4. 120 acute myocardial infarctions and 20 strokes would be prevented
5. 50 deaths among the people suffering myocardial infarctions and strokes prevented
6. 300 low birthweight births would be prevented

* Supported in part by a grant from the Richard and Rhoda Goldman Fund to the third author. Opinions expressed reflect the views of the authors and do not necessarily represent any sponsoring agency or the University of California. This report is available on the World Wide Web at http://www.library.ucsf.edu/tobacco/fl2002. Other reports on state tobacco policy making are available at http://www.library.ucsf/edu/tobacco/state.html.

7. 80 new cases of asthma would be prevented
8. 2 cases of sudden infant death syndrome would be prevented
9. $6.8 million in medical cost savings would be realized during the first year, consisting of $5 million in direct medical cost savings from prevention of cardiovascular disease, $2 million in savings from prevention of low birthweight infants, and $1 million saved from prevention of excess respiratory illnesses in children aged 0-5.

Over time, additional health and economic benefits would be realized from the reduction in active and passive smoking. At steady state (assuming no population growth or medical cost inflation), reduction in cancer and emphysema, as well as further reduction in heart disease, would lead to annual savings of:

1. 1820 early deaths prevented, consisting of 1090 from cardiovascular disease, 480 from cancer, and 250 from respiratory disease
2. 300 low birth weight infants
3. Yearly health care savings of $220 million, consisting of savings of $196 million from ex-smokers and at least $24 million dollars from reduced exposure to secondhand smoke

The effects in future years would be larger because the population of Florida will continue to grow, and this growth has not been taken into account in these estimates.

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Introduction

Tobacco use damages health in many ways. The dangers of smoking are incurred not only by individual smokers, but also by other individuals exposed involuntarily to secondhand tobacco smoke. Passive smoking has been causally associated with multiple medical conditions. These conditions include fetal growth retardation resulting in low birthweight, sudden infant death syndrome, acute lower respiratory tract infections in children, asthma induction and exacerbation in children, lung cancer, coronary heart disease morbidity and mortality[1]. For example, passive smoking increases the risk of cardiac disease by 30%. Passive smokers have cardiac effects after only thirty minutes of exposure; a recent study in young healthy adults showed that passive smoking altered nonsmokers' coronary arteries so their ability to adjust blood flow in response to changing demands on the heart was no different than habitual smokers[2]. The most immediate effects (and benefits associated with reduced smoking) are on cardiovascular disease, effects on pregnancy, and effects of secondhand smoke on children. Other important tobacco-related illnesses, such as lung cancer, have impacts that take longer to develop. Overall, cardiovascular disease makes up 43% of smoking-related mortality, lung cancer makes up 29%, and other respiratory illnesses 20%[3].

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The Smoke-Free For Health Initiative proposes a constitutional amendment for the state of Florida that would prohibit smoking in the workplace. Specifically, it would prohibit tobacco smoking in enclosed indoor workplaces except in retail tobacco shops, designated smoking guest rooms in public lodging establishments, stand-alone bars, and private residences not used for to provide child care, adult care or health care. The initiative is sponsored by many organizations, including the American Cancer Society, American Lung Association, American Heart Association, Campaign for Tobacco-Free Kids, American Association of Retired Persons, and the Center for Florida's Children.

This analysis evaluates the effects that this strong, comprehensive clean indoor air amendment would have in Florida, assuming that the Legislature enacts appropriate implementing legislation and that the Executive branch makes a good faith effort to enforce the resulting state law. These effects include reductions in smoking behavior,

cigarette use, tobacco company revenues, and tobacco-related illnesses. We analyze the short-term benefits (during the first year after implementation) of the reduced smoking that would accompany enactment of smoke free workplaces statewide in Florida in terms of the three health areas most immediately affected by smoking: cardiovascular disease, pregnancy, and childhood respiratory illnesses. Specifically, effects on acute myocardial infarctions, strokes, low birthweight births, childhood asthma, childhood upper respiratory illnesses, and sudden infant death syndrome will be examined. Long-term health benefits, including slow-developing and resolving illnesses such as cancer, are also assessed. Economic consequences of these tobacco-related illnesses are also analyzed.*

Estimates of Effects

Effects on Cigarette Smoking and Sales

In order to determine the effects of the smoke free workplace, estimation of the number of indoor workers was required. The number of workers who worked indoors was determined from the 1999 Occupational Employment Statistics Survey[6]. There were 6,735,940 workers in Florida; to estimate the number of employees who would be affected by smoke free workplaces, we excluded people who did not work indoors: (1) athletes and sports competitors (1,280); (2) police and sheriff's patrol officers (37,620); (3) crossing guards (3,840); (4) maids and housekeeping cleaners; pest control workers; landscaping and groundskeeping workers; pesticide handlers, sprayers and applicators; tree trimmers and pruners (134,690); (5) couriers and messengers (6,910); (6) farming, fishing, and forestry occupations (28,010); (7) construction and extraction occupations (317,270); (8) occupations involved with installation (46,350); and (9) transportation and material moving occupations (459,030). These criteria excluded a total of 1,035,000 workers, leaving 5,700,940 representing the total number of workers who worked indoors. This figure was then extrapolated to 2000 Florida population numbers using the ratio of the total population in 2000 to the total population in 1999 (1.0576). This procedure resulted in a total number of 6,029,588 indoor workers.

The number of workers not currently working in a smoke-free workplace was identified from an analysis of the 1999 Current Population Survey Tobacco Use Supplement[5]. In 1999, 68.4% (95% CI $\pm$ 1.4%) indoor workers were employed in smoke-free worksites. Indoor workers were defined as individuals who were (1) 15 years of age or older and employed at the time of the interview; (2) currently employed outside the home but not self-employed; (3) not working outdoors or in a motor vehicle; (4) not traveling to different buildings or sites; and (5) not working in someone else's home. Smoke-free worksites were defined as such if the employer had an official workplace policy that restricted smoking that did not allow smoking in any public or common areas of the workplace nor in the work area. Identification was based on survey responses. It

*Figures are reported in this analysis to three significant digits. However, calculations for this analysis take into account all significant digits reported in the source material. As a result, simple addition and multiplication of reported figures may show slight discrepancies.

was assumed that there was no change between 1999 and 2000 in the proportion of indoor workers employed in smoke-free worksites.

Smoking prevalence data was obtained from the Centers for Disease Control via the Behavioral Risk Factor Surveillance Survey (BRFSS), a state based, random digit dialed telephone survey of the non-institutionalized U.S. population, 18 years old and older. To determine current cigarette smoking, respondents were asked, "Have you ever smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Current smokers were defined as those who reported having smoked more than 100 cigarettes during their lives and who smoked at least once in the past 30 days. Estimates were weighted to the age, race, and sex distribution of each state's population[7]. Smoking prevalence among Florida adults in 1999 was 20.7%; 22.3% of adult men smoked and 19.2% of adult women smoked.

The mean number of cigarettes smoked by a Florida adult was based on data from *The Tax Burden on Tobacco*, a serial originally produced by the Tobacco Institute (the tobacco industry's now-disbanded lobbying organization) and now produced by the economic consulting firm of Orzechowski and Walker[8]. The per capita packs sold in Florida in 2000 was 82.5. Given the Florida smoking prevalence, the average Flordia smoker consumed 82.5/0.207 = 399 packs per year.

An alternative calculation of the mean number of cigarettes smoked by a Florida adult was 18.6 cigarettes per day based on data from the Behavioral Risk Factor Surveillance Survey in 1999[9]. The number of packs per year smoked by an average Floridian adult smoker was estimated to be: 18.6 cigarettes/day x 365.25 days/year x 1 pack/20 cigarettes = 340 packs per year. The problem with this procedure is people under-report their cigarette consumption on such surveys[10]. As a result, this calculation serves as a lower bound estimate for the amount of cigarette consumption.

Average cost per pack of cigarettes in Florida were based on data obtained from *The Tax Burden on Tobacco*[8]. In 2000, the weighted average price per pack in Florida was $3.023. The combination of state and federal tobacco taxes amounted to 67.9 cents. Thus, the average pre-tax price for a pack of cigarettes in Florida was $2.344 in 2000.

The total number of Florida indoor workers in 2000 was estimated to be 6,029,588. With 31.6% of Florida workers not covered by a smoke-free worksite policy, the total numbers of individual at risk from passive smoking was equal to 0.316 x 6,029,588 = 1,904,747 workers. Assuming proportionate distribution of smokers, the number of smokers not working in smoke free workplaces was 0.207 x 1,904,747 = 394,283 smokers. Nonsmoking workers exposed to secondhand smoke totaled 1,510,464.

The effect of creating a smoke free workplace on cigarette consumption was derived from Woodruff et al[11]. Based on the 1990 California Tobacco Survey, only 13.7% of people in smoke-free workplaces were regular smokers compared with 20.6% in workplaces with no restrictions. A logistic regression showed that the odds ratio of

being a smoker in a workplace with no restrictions compared to a smoke-free workplace was 1.26 after controlling for demographic factors. In other words, working without smoking restrictions increased the likelihood of being a smoker by 26%. In addition, continuing smokers in smoke-free workplaces also showed a 13% decline in per-smoker consumption of cigarettes.

Introduction of smoke-free worksite policies would result in a 20.7% decline in smoking prevalence, which would be equivalent to 81,400 quitters. Assuming immediate cessation, the number of packs forgone in one year by this number of quitters is 81,400 x 399 packs per year = 32,400,000 packs. Among the remaining 313,000 smokers, a 13% decline in cigarette consumption would cause 16,200,000 packs (313,000 x 0.13 x 399 packs per year) of cigarettes to be forgone in one year, assuming an immediate effect. In total, the number of cigarette packs forgone with immediate cessation is equal to 48,600,000 packs during the first year.

This reduction in consumption will result in a reduction in gross revenue to the tobacco industry of $2.34 x 48,600,000 packs = $114,000,000 (2000 dollars). Use of the lower bound estimate for smoker consumption would change the total number of packs forgone to 41,500,000 packs and the gross revenue forgone to $97,200,000 (2000 dollars).

Immediate Health Effects: Cardiovascular Disease

Determination of smoke free workplace effects on cardiovascular diseases requires estimation of quitters by gender due to gender differences in risk for acute myocardial infarctions. To account for these effects, we estimate the percentage of men and women of working age in Florida based on data from the 2000 Census[12]. The number of men aged 18 to 64 was 4,710,082 and the number of women aged 18 to 64 was 4,818,359. Thus, women made up 50.57% of Florida's population between the age of 18 to 64. We assume this proportion holds for all age ranges, including ages 35 to 64. Cardiovascular risks are based for individuals aged 35-64[13]; these individuals within the working population have the highest risk of incurring early cardiovascular disease. Estimates of the workforce within those age ranges are based on the assumption that the workforce age distribution matches the population age distribution. Age distribution for Florida's population was based on 2000 Census data[12]. Given the age distribution in Florida, it was assumed that individuals 35-64 comprised 60.3% of the working population.

The total number of quitters generated by a smoke-free workplace law (81,400) was then multiplied by 60.3% to generate the total number of quitters at risk for early cardiovascular disease (49,100). The number of female and male quitters within this age range were determined by multiplying the number of quitters between ages 35 to 64 by 50.57% and 49.43%, respectively. Thus, 24,800 female quitters and 24,200 male quitters were used as the population whose risk for cardiovascular disease would be affected by a smoke-free workplace. We assume equal distribution of quitters within age ranges and between genders.

Calculation of the decline in cardiovascular diseases is based on Lightwood and Glantz[13]. Relative risks for cardiovascular disease decline rapidly over time once smoking cessation occurs. The model used by Lightwood and Glantz to describe this decline is used in this analysis was

$$RR(t) = (RR(0) - RR(s))e^{-t/T} + RR(s)$$

where

RR(t) = relative risk at time t
RR(0) = initial relative risk
RR(s) = steady state relative risk
t = time t (in years)
T = time constant for the fall in risk after cessation

The relative risk for acute myocardial infarction declines from 2.88 for current male smokers to 2.08 in one year after quitting, and reaches a steady state relative risk of 1.17 after 91.4 months. The relative risk for female smokers drops from 3.85 for current smokers to 2.71 in one year after quitting, eventually reaching a steady state relative risk of 1.40 after 84.5 months. The relative risk for strokes declines from 2.80 for all smokers to 2.16 in one year after quitting, and reaches a steady state relative risk of 1.42 after 80.6 months. The time constant for acute myocardial infarctions was 19.1 months and 16.2 months for strokes.

The number of prevented conditions in one year is equal to the number of quitters x general population incidence rate x (prior relative risk – current relative risk). As cardiovascular risk is gradually reduced over time within a given year, a midpoint adjustment was modeled by multiplying the effect observed at the end of a given year by 0.5. The never-smoker population incidence rate for all acute myocardial infarction (fatal and non-fatal combined) is 0.00311 events per person for males and 0.00089 events per person for females. The never-smoker population incidence rate for strokes is 0.00137 events per person. Never-smoker population incidence rates are extrapolated from discharge rates for these hospitalizations as reported by Lightwood and Glantz[13]. This may be an underestimation due to deaths occurring prior to arrival at a hospital.

The number of prevented deaths in one year is the sum of two numbers, the number of prevented immediate deaths and the number of prevented deaths occurring within one year of the acute myocardial infarction. Each number is based on the number of prevented acute myocardial infarctions multiplied by the expected annual survival probability. For the number of prevented immediate deaths by acute myocardial infarction, this number is calculated by multiplying by the probability of immediate death. The number of prevented deaths by acute myocardial infarction one year after an event uses the aforementioned product and multiplies that by the probability of immediately surviving an acute myocardial infarction and multiplies again by the probability of dying from an acute myocardial infarction within one year of the event.

These deaths were then adjusted to account for gradual reduction in risk over time using the methodology listed previously. Survival probabilities event survival probabilities from Vaccarino et al[14] and Longstreth et al[15] and annual survival probabilities reported in Lightwood and Glantz[13]. Vaccarino et al reports short-term mortality rate for acute myocardial infarction to be 0.115 for men and 0.167 for women. Longstreth et al identifies the short-term mortality rate from stroke to be 0.043. Lightwood and Glantz note that annual survival probability for males at risk for acute myocardial infarction is 0.99163, for females at risk for acute myocardial infarction is 0.99497, and for individuals at risk for stroke is 0.99334. The annual survival probability in the first year after an event for males with acute myocardial infarction is 0.812, for females with acute myocardial infarction is 0.765, and for stroke patients is 0.663.

In the first year after implementation of smoke-free worksites, 30 and 13 acute myocardial infarctions would be prevented in male and female quitters, respectively. Among these prevented acute myocardial infarctions, 8 male quitter deaths and 5 female quitter deaths would be prevented. Three of the male quitters and two of the female quitters would have died from their acute myocardial infarctions. The other deaths are due to complications following the acute myocardial infarctions. In addition, 24 strokes would be prevented among quitters. Of these strokes, 9 would have led to death in the first year. One quitter would be prevented from death by the initial stroke, while the other 8 would be prevented from death via complication following stroke.

The cardiovascular disease relative risks for passive smokers are 1.30[1] for acute myocardial infarction. The risk of stroke due to passive smoking is not included in this analysis. Although a recent study has reported elevated risk of stroke due to passive smoking[16], more studies are needed to corroborate this finding and thus more accurately define the relative risk. We estimate that the relative risk of acute myocardial infarction in passive smokers declines to 1.21 after 12 months, assuming the steady state relative risk is 1.11[17] and that the time constants are identical to that used for quitters. (These relative risks are not reported by gender.) Calculation of effects follows the same procedure as listed above. The number of prevented acute myocardial infarctions among passive smokers was 80 in the first year. Twenty-six deaths among passive smokers would be prevented, including 11 directly due to acute myocardial infarction and 15 deaths from subsequent complications. The number of deaths prevented among passive smokers is larger than the numbers for active smokers because of the large drop in population exposure to secondhand smoke.

Based on this analysis, a smoke free workplace would prevent 40 acute myocardial infarctions and about 20 strokes in quitters in the first year. An additional 80 acute myocardial infarctions would be prevented in passive smokers, and a total of 40 deaths due to acute myocardial infarctions among both active and passive smokers plus 10 deaths due to strokes among active smokers would be prevented. These deaths include both initial deaths due to the event and also within the first year due to subsequent morbidity.

Immediate Health Effects: Low Birthweight Infants

Estimation was also performed on the effect of smoke-free workplaces on low birthweight births, which is defined as birthweights less than 2,500 grams (5 lbs 8 oz). Low birthweight births are important as these children incur significant medical costs through intensive care unit stays and also are more susceptible to illnesses, such as lower respiratory tract infections[18]. Very low birthweight births (birthweights less than 1,500 grams) were not analyzed separately; no estimates were found regarding the risk of these births from passive smoking. Measuring the effect of a smoke free workplace on low birthweight births requires estimation of the number of pregnancies affected by tobacco. Determination of the number of pregnant women in Florida affected by tobacco required estimation of the indoor worker pregnant population. These estimates were based on the 2000 Census sex distribution[12]. The percentage of women calculated for the cardiovascular disease estimates was again used for this portion of the analysis, so that 50.57% of indoor workers were female. The percentage of individuals aged 15-44 among all Florida residents aged 15-64 was found to be 64.22%. This age range was used to match the population used in fertility rate determinations. These percentages were then multiplied together and with indoor worker subpopulation estimates to determine the number of quitters and passive smokers of childbearing age.

The number of female quitters in their childbearing years was equal to 26,400 and was derived by multiplying 81,400 quitters by 0.6422 (percentage of Floridians aged 15-44) and by 0.5057 (percentage of females). The number of pregnant women in both groups was determined by the fertility rate, which is equal to live births per 1,000 women aged 15-44 years. In 1999, the Florida fertility rate was 65.1[19]. The number of pregnant quitters was calculated by multiplying 26,400 female quitters of childbearing age by 65.1 pregnancies per 1,000 women, which is equal to 1,720 pregnant quitters.

The incidence rate of low birthweight per birth is 0.0741, and was determined by dividing the total number of low birthweight births by adding the number of non-smoking pregnant mothers to the product of the total number of pregnant smokers[19] and the relative risk of low birthweight births to smoking mothers for the state of Florida in 1999[19]. The relative risk for low birthweight births to pregnant smokers is 2.0[1]. The fall in risk following tobacco cessation is almost immediate; the excess risk derived from tobacco is eliminated if a pregnant woman stops smoking prior to the end of the first trimester[18]. The number of low birthweight births prevented due to smoking cessation is estimated by multiplying the number of pregnancies (1,720) by the incidence rate (0.0741) and by the reduction in relative risk (from 2.0 to 1.0), and is equal to 130 low birthweight births. In the first year, one must account for pregnancies in which smoking cessation occurred after the first trimester; we multiply the number of low birthweight births by 0.5 and derive the total number of low birthweight births prevented in the first year to be 60 births.

The number of low birthweight births avoided due to cessation of passive smoking is based on the number of passive smokers in their childbearing years. This calculation is similar to that described above for quitters, and is equal to the product of

the total number of passive smokers (1,510,464) multiplied by the percentage aged 15-44 (0.6422) and the percentage of females (0.5057), or 490,500 women. The number of pregnancies among this population was derived by multiplying the 490,500 women by the fertility rate (65.1 pregnancies per 1000 women) and was equal to 31,900 pregnant passive smokers. For passive smokers, the estimated relative risk of low birthweight birth is between 1.2 and 1.4[1]; this analysis uses 1.2 as the relative risk. The number of low birthweight births prevented among passive smokers is estimated by multiplying the number of pregnancies (31,900) by the incidence rate (0.0741) and by the reduction in relative risk (1.2 to 1.0), and is equal to 470 low birthweight births. After accounting for first year effects, the number of low birthweight births among passive smokers prevented are 240.

Overall, the first year effects of implementing smoke-free worksites would prevent 60 low birthweight births due to pregnant women who quit smoking. An additional 240 low birthweight births would be prevented among passive smokers due to the reduction in passive smoke exposure. In the first year, 300 low birthweight births would be prevented.

Subsequent years would accrue full benefits of prevention, preventing 600 low birthweight births per year. The number of low birth weight infants avoided because of the reduction in passive smoking is larger than that on quitters again larger because of the differences in reduction of population exposure.

Immediate Health Effects: Respiratory Illness Among Children

Passive smoking has also been shown to be a significant risk factor for new cases of childhood asthma and for other childhood respiratory illnesses. Two effects are measured in this analysis: the effect of smoking cessation by mothers on childhood asthma induction and on pediatric respiratory illnesses. This analysis focuses on children aged 5 or younger since these children are exposed to likely only parental smoking and that prior evidence indicates that younger children are at most risk for passive smoking-related respiratory illnesses[20].

Determination of the effect on excess respiratory illnesses due to tobacco required an estimation of the number of young children living with maternal smokers affected by the intervention. A key assumption is that children under the age of 5 have mothers between the ages of 15 to 44. The number of female smokers that fall within this age range who would quit with introduction of smoke-free workplaces is 26,400; this sub-population is the same as the childbearing female quitter group described in previous sections. The number of children expected per female was derived by dividing the total number of children aged less than 17 in Florida 2000 by the total number of females in Florida 2000 aged 15 to 45. This ratio of children per female age 15 to 45 was 1.1032, resulting in an estimation of 29,100 children whose exposure to maternal smoking changes due to the smoke free workplace. The number of these children aged 0-5 was derived using the ratio of children aged 5 and under compared to the population under 18 (0.2553), and is equal to 7,440. On one hand, this figure is a slight overestimation of the

true number of children per female as some children may be in households run only by males or by individuals older than 45. On the other hand, our calculations do not account for the fact that some children will have reduced secondhand smoke exposure because their fathers stop smoking because of smoke free workplaces; we do not include this effect. These 7,440 children aged 0 to 5 would no longer be exposed to passive smoking.

Passive smoking increases the risk of childhood asthma for children aged 0 to 5[21]. We estimate the incidence of childhood asthma among passive smoking children aged 0 to 5 using data from the Third National Health and Nutrition Examination Survey (1988 to 1994). The prevalence of childhood asthma in children aged 0 to 5 who never were exposed to passive smoke was 0.051[21]. We assume equal likelihood of childhood asthma incidence in every year; thus we calculate the incidence of childhood asthma in never-passive smokers to be 0.051 divided by 5, or 0.0102. The relative risk of asthma induction by passive smoking has been estimated to be 2.0[1], and the change in this risk was assumed to be immediate, due to elimination of the inciting cigarette smoke exposure.

The number of children at risk for exposure was based on the estimated number of children living with female quitters. The number of new pediatric asthmatics prevented by female quitters was calculated by multiplying the risk population (children of female quitters) by the reduction in relative risk and incidence rate for childhood asthma. Thus, the number of pediatric asthmatics prevented is equal to the number of children living with female quitters (7,440) multiplied by the incidence rate of asthma (0.0102 cases per child) and by the relative risk reduction (2.0 to 1.0), resulting in 75 new asthma cases prevented.

Immediate Health Effects: Sudden Infant Death Syndrome

Sudden Infant Death Syndrome (SIDS) is defined as the sudden death of any infant which is unexpected by history and in which a thorough postmortem examination fails to demonstrate an adequate cause of death[22]. While the exact mechanism is still unknown, several studies have shown a relationship between active maternal smoking during pregnancy and SIDS, with odds ratios ranging from 1.6 to 4.4[1]. DiFranza and Lew calculated the pooled odds ratio for maternal smoking and SIDS to be 2.98[23]; this estimate is used as the relative risk for SIDS associated with maternal smoking during pregnancy. The estimated number of SIDS cases prevented due to implementation of a smoke-free workplaces in Florida is based on the calculated number of pregnant smokers who subsequently quit (1,720). The number of pregnant smokers are used as a proxy of infants who have been exposed to maternal smoking. The incidence of SIDS is based on 1995 data. The number of SIDS cases in the United States during 1995 (birthweights over 500 grams) was 3,064[24]. The total number of births in the United States during 1995 was 3,900,089[25]. Of these, 86.6% or 3,377,477 had non-smoking mothers and 13.4% or 522,612 had mothers who smoked[24]. The incidence of SIDS per birth in the non-passive smoking population is 0.00062 cases per birth, and is calculated by dividing the total cases (3,064) by the sum of the passive smokers (522,612) multiplied by the relative risk (2.98) plus the non-passive smokers (3,377,477).

We estimate the number of prevented SIDS cases to be the product of the number of pregnant smokers (1,720), the prevalence of SIDS (0.00062), and the relative risk reduction of SIDS with maternal smoking (2.98 to 1.00). This results in 2 cases of SIDS prevented by implementation of smoke-free workplaces in Florida in the first year.

Immediate Health Effects: Economic Implications:

Medical costs of cardiovascular diseases[13], low birthweight[18], and pediatric respiratory illnesses[20] were estimated in 1995 dollars originally. All costs were inflated to 2000 dollars using the medical cost component of the Consumer Price Index. Prices were assumed to be from July of the listed calendar year. The costs for cardiovascular disease are taken from Lightwood and Glantz[13]. For acute myocardial infarctions, the first year cost in 2000 dollars is $36,600. These costs account for the initial costs of treatment, expected cost of major surgical procedure (angioplasty or coronary artery bypass surgery), and follow-up and rehabilitation costs after the initial hospitalization. Most costs are accrued during the first year.

First year savings due to prevented acute myocardial infarctions is equal to the difference between prevented acute myocardial infarctions and the number of prevented immediate deaths from acute myocardial infarction, multiplied by the first year cost of acute myocardial infarction. This calculation sums up estimates for both quitters and passive smokers. This first year total is equal to 120 prevented acute myocardial infarctions minus 20 immediate deaths multiplied by $36,600, or $3,878,000.

For strokes, the first year cost in 2000 dollars is $34,400[13]. These costs are derived from direct medical short-term care costs of treatment, rehabilitation costs, and cost of care in nursing facilities. First year savings are equal to the difference between prevented strokes (24) and prevented immediate deaths by stroke (1), multiplied by the first year cost of stroke ($34,400). This calculation results in $798,000 in savings due to smoke-free worksites.

Lightwood et al[18] calculate the excess costs of low birthweight births; the costs in 2000 dollars are $6,200. These costs include hospital costs, such as intensive care unit stays and surfactant for pulmonary distress, as well as professional fees. The first year savings accrued by the 60 prevented low birthweight births to quitters is equal to $397,000, while the first year savings accrued by the 240 prevented low birthweight births to passive smokers is equal to $1,474,000. The total savings in the first year are equal to $1,871,000.

Stoddard and Gray[20] estimate the net increase in medical expenditures due to excess respiratory illnesses in children aged 0-5 exposed to passive smoking. These respiratory illnesses include asthma, but include a much wider range of respiratory illnesses (ICD-9-CM codes 460 to 519). This cost includes hospital care, outpatient care, emergency room visits, professional fees, and prescription medications. This figure in 2000 dollars is $142 per child per year. We estimate that 7,440 children aged 0 to 5

would no longer be exposed to passive smoking due to implementation of smoke-free workplaces in Florida. The savings in medical costs due to excess respiratory illnesses avoided is equal to $142 x 7,440 = $1,057,000.

Long Term Health Effects

The effects reported previously are first year effects. Annual effects, including deaths from cancers, are realized after several years. This section estimates prevented early mortality due to implementation of smoke-free workplaces. Long-term health effects due to direct quitting are calculated using population level smoking-attributable mortality data combined with the reduction in smoking due to smoke-free workplaces.

The total number of smokers in 2000 is equal to the total adult population of Florida[12] (11,960,658) multiplied by the prevalence of smoking in Florida[7] (20.7%), or 2,475,856 smokers. As noted above, the estimated number of individuals who would quit smoking with implementation of smoke-free worksites is 81,400. Thus, the percent of smokers who would quit due to this amendment would be 81,400/2,475,856 = 3.29%. The reduction in smoking-attributable deaths is calculated using estimates of smoking-attributable mortality for the state of Florida in 1998 extrapolated to 2000 figures, multiplied by the percent reduction in smoking. The total number of smoking-attributable deaths in 1998 were 29,450, including 10,342 deaths due to cardiovascular disease, 11,849 deaths due to cancer, and 7,259 deaths due to respiratory illnesses[26]. Extrapolation to 2000 figures was based on the ratio between the 1998 total adult Florida population (11,203,522) and the 2000 total adult Florida population (11,960,658), or 1.068. Thus, the expected total smoking-attributable mortality for 2000 is 31,440, with 11,041 due to cardiovascular disease, 12,650 due to cancer, and 7,750 due to respiratory illnesses.

These extrapolated totals are then multiplied by the percent reduction in smoking due to smoke-free workplaces (3.29%). At steady state, the calculated annual reduction in premature mortality among smokers who quit is 1030 deaths prevented, including 360 deaths due to prevented cardiovascular disease, 420 deaths due to prevented cancers, and 250 deaths due to prevented respiratory illnesses.

Estimates of annual mortality prevention for passive smokers are based on estimated smoking-attributable mortality among passive smokers reported by the National Cancer Institute[1]. These estimates include 3,000 lung cancer deaths and 35,000 to 62,000 ischemic heart disease deaths annually in the United States. These figures are extrapolated to determine the long-term effect of smoke-free workplaces in Florida.

Estimation of effect in Florida is made for each condition for the year the estimate was performed (1992 for lung cancer, 1994 for cardiovascular disease), and begins with multiplying the estimate by the ratio of the Florida to national population for the given year (0.05 for both years). In the calculations for ischemic heart disease, the 35,000 figure is used to account for changes in smoking patterns not captured with this extrapolation. The resultant Florida-specific figures are multiplied by a ratio of the total

Florida population in 2000 and the given year. In 2000, 188 lung cancer deaths and 2,149 ischemic heart disease deaths are due to passive smoking. Calculation of disease reduction due to smoke-free workplaces requires estimate of the prevalence of passive smoking in Florida, which we estimate to be 37.4%[27]. Based on Florida's 2000 population[12], we estimate the total number of passive smokers in the state is equal to 0.374 multiplied by 11,960,658, or 4,473,286. The percent reduction in passive smokers due to implementation of smoke-free worksites is 1,510,464 divided by 4,473,286, or 33.8%. This percentage is applied to the passive smoking-related deaths, resulting in an annual reduction in deaths of 60 by lung cancer and 730 by ischemic heart disease, for a total of 790 deaths prevented annually.

Thus, the total premature deaths prevented (including both the fact that fewer people would be smoking and fewer people would be exposed to secondhand smoke) would be 1,820, consisting of 1,090 from cardiovascular disease, 480from cancer, and 250 from respiratory disease.

Long Term Economic Effects

Long-term economic benefits from quitting generated by smoke-free workplaces is calculated using medical care expenditures attributable to smoking in Florida[28], which was estimated to be $4.63 billion in 1993. This estimate includes costs for ambulatory care, prescription drugs, hospital stays, home-health care, and nursing home care. This figure was then converted into 2000 dollars by multiplying by the increase in the consumer price index for medical care costs between 1993 and 2000 (1.29), equaling $5.98 billion. The amount saved due to quitting from smoke-free workplaces was estimated to be 3.29% of Florida's expenditures, or $196,000,000. These calculations do not account for discounting or future inflation.

There are no published calculations of medical care expenditures due to passive smoking in the United States, as this is an area still under research. However, we estimate some of the savings from prevention of passive smoking by including the savings from acute myocardial infarction, low birthweight births, and respiratory illnesses. All savings are calculated in 2000 dollars and are not adjusted for discounting or future inflation. For savings from prevented acute myocardial infarction, we estimate the prevented direct medical costs from initial hospitalizations for acute myocardial infarctions in passive smokers after five years. This calculation uses the same methodology as described above.

To model the gradual reduction in acute myocardial infarction risk, only half of the calculated benefit is realized in the given year. In subsequent years, the full benefit is realized. The cost of an acute myocardial infarction in these calculation not only includes the first year costs described previously, but also costs in the second and third years following acute myocardial infarction due to follow-up and rehabilitation care. These costs are described by Lightwood and Glantz[13], and are calculated in 2000 dollars to be $2,274 in the second year and $1,500 in the third year following an event.

The cumulative annual undiscounted savings at five years is equal to $5,900,000 from prevented acute myocardial infarctions among previous passive smokers.* The savings from low birthweight births among passive smokers is estimated to be double the savings from the initial year. As noted previously, the estimate of prevented low birthweight births was halved for the first year to account for pregnant women whose pregnancies were far enough along to not realize the benefits from prevented passive smoking. Thus, the long-run annual savings from prevented low birthweight births among passive smokers is equal to $1,500,000. The annual savings from prevented respiratory illnesses for children aged 5 or younger is assumed to be the same as that calculated for the first year, or $1,100,000. In total, the cumulative five-year undiscounted savings are $24,400,000.

Summary

This estimation is not a complete estimate of the costs and benefits of a smoke-free workplace law. It does not account for health costs accrued to patrons of workplaces, which would increase the number of individuals exposed to passive smoking under current law. It also does not estimate the costs of implementation, although other experiences with similar laws show that smokefree workplaces are not costly to implement, especially when coupled with the kind of anti-tobacco educational campaign already present in Florida.

Implementation of a complete smoke-free workplace law in Florida would accrue significant benefits. About 1.5 million Floridians would no longer be exposed to passive smoking, in part because 81,400 Floridians would quit smoking. The tobacco industry

* The long term cost calculation is derived using the following formula:

$$[C_3\{2k^2(A_x - B_x) - 2j^2A_x\}] + [C_2\{2k(A_y - B_y) - 2jA_y\}] + C_1(A_z - G_z)$$

where

A_n = the number of prevented acute myocardial infarctions in year n
B_n = the number of prevented acute myocardial infarctions total deaths in year n
G_n = the number of prevented acute myocardial infarctions immediate deaths in year n
k = the annual survival probability (0.9933)
j = the annual death probability for acute myocardial infarction survivors more than one year after the event (0.0368)
C_m = the average cost of acute myocardial infarction in the m^{th} year following the event
x = two years prior to the given year
y = the prior year
z = the given year

This formula is used to derive the savings from prevented acute myocardial infarctions in a given year. In year 1, only $C_1(A_1-G_1)$ is used. In year 2, + $[C_2\{2k(A_1 - B_1) - 2jA_1\}] + C_1(A_2-G_2)$ is used. In year 3, the full equation is used. In year 4, the full equation is used, but x = year 2, y = year 3, and z = year 4. Similarly, in year 5, the full equation is used (x = year 3, y = year 4, z = year 5). The 5 year total savings are a summation of the savings derived in each of the five years.

would face a decrease in consumption of 48.6 million packs in one year, costing the tobacco industry $114 million in pre-tax sales.

This decline in tobacco industry sales is unlikely to have adverse effects on the Florida economy. A simulation of the economic effects of tobacco consumption reduction in a non-tobacco state showed an overall increase in employment following tobacco consumption reduction[29] because the money that would have been spent on tobacco would be spent on other products on which a greater portion of the funds would remain in the state economy rather than leaving the state to tobacco manufacturers. These findings would likely be duplicated in Florida.

Health benefits would be substantial; 120 heart attacks and 20 strokes would be prevented in the first year alone, including 50 deaths, as well as 300 low birthweight births and 75 new cases of asthma prevented. Avoiding these illnesses would save Floridians $6.8 million in direct medical costs during the first year.

Over time, even more substantial benefits would occur. Overall, 1,030 early deaths due to tobacco-related illnesses would be avoided: 1,090 from cardiovascular disease, 480 from lung cancer, and 250 from respiratory disease. Total savings from prevented tobacco-related illnesses would be at least $220 million each year.

Many of these health benefits are due to reductions in passive smoking, due to the high numbers of passive smokers. Implementation of smoke-free workplaces would reduce the number of smokers in Florida by 3.3%. At the same time, 33.8% of passive smokers in Florida would no longer be exposed to secondhand smoke. The ratio of passive smokers no longer exposed to secondhand smoke to quitters induced by smoke-free workplaces are nearly twenty to one. The total effects on cardiovascular disease in passive smokers are nearly twice that seen with quitters, and the effects seen in low birthweight births among passive smokers is nearly four times that seen due to low birthweight births among quitters. All effects in childhood respiratory illness are due to passive smoking.

Table 1: Immediate (first year) effects on cigarette use and the tobacco industry

	Effect
Indoor workers not currently covered by a smoke free workplace	1,904,747
Quitters induced following a smoke free workplace	81,360
Passive smokers prevented by a smoke free workplace	1,510,464
Packs forgone by quitters following a smoke free workplace	32,426,048
Packs forgone by remaining smokers following a smoke free workplace	16,213,024
Total packs forgone following a smoke free workplace	48,639,073
Gross revenue lost by the tobacco industry after a smoke free workplace	$114,009,986

Table 2. Immediate (First Year) Health Effects and Economic Consequences

	Effect
Acute Myocardial Infarctions prevented	122
Acute Myocardial Infarction deaths prevented	39
Acute Myocardial Infarction cost savings	$3,877,717
Strokes prevented	24
Stroke deaths prevented	9
Stroke cost savings	$797,767
Total cardiovascular disease cost savings	$4,675,485
Low birthweight births avoided by quitters	64
Savings from LBW births avoided by quitters	$396,921
Low birthweight births avoided by passive smokers	237
Savings from LBW births avoided by passive smokers	$1,473,784
Total LBW birth savings	$1,870,705
New asthmatics prevented	76
Passive smokers aged 0-5 prevented	7,441
Savings from excess respiratory illnesses in children aged 0-5	$1,056,568
Sudden Infant Death Syndrome cases prevented	2
Total savings	$6,804,990

Table 3: Long-Term Annual Health Effects and Economic Consequences

	Effect
Cardiovascular disease deaths avoided by quitters	363
Cancer deaths avoided by quitters	416
Respiratory disease deaths avoided by quitters	255
Lung cancer deaths avoided by passive smokers	63
Ischemic heart disease deaths avoided by passive smokers	726
Total deaths avoided	1822
Total savings from tobacco-related illnesses avoided by quitters	$196,357,154
Savings from tobacco-related illnesses avoided by passive smokers	$24,429,749
Combined savings from avoided tobacco-related illnesses	$220,786,903

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