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# Smoking Behavior and Attitudes of Employees of a Large HMO Before and After a Work Site Ban on Cigarette Smoking

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## Synopsis .....

*Smoking-related data collected during 1976–87 by anonymous cross-sectional surveys of nonphysician*

*employees of a large medical care organization were used to assess how a work site smoking ban affected employees' smoking behavior and attitudes. The smoking ban was implemented at 11 work sites at various times during 1985–86. All work sites had three or more pre-ban surveys and one or two post-ban surveys. The majority of employees reported support for the smoking ban. The ban's effects were assessed by comparing observed post-ban rates with expected rates projected from secular trends in the pre-ban data by the use of logistic regression models that included age, sex, education, and job class as covariates.*

*The work site smoking ban had a substantial effect on the presence of smoke in the work environment, but no short-term effect on smoking prevalence or attempts to quit. The apparent effect of the ban on quantity of cigarettes smoked was assessed by a pre-ban and post-ban analysis of the 1986–87 survey data. A nonequivalent post-ban and post-ban comparison was used to estimate the secular trend. A significant reduction of 1.4 cigarettes per day ( $P=0.022$ ) was found in smokers' rate during working hours.*

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**M**ANY EMPLOYERS implemented restrictive smoking policies during the 1980s to protect nonsmokers from exposure to environmental tobacco smoke (1, 2). However, few evaluations of restrictive work site smoking policies in medical care settings are currently available in the literature (3–7). These studies demonstrate that work site smoking bans can be implemented without creating animosity and dissatisfaction among coworkers. Biener and coworkers (7) examined the impact over 12 months of a restrictive smoking policy adopted at one general hospital compared with a hospital that had no restrictive policy. They reported reductions in smoking in the work environment and quantity smoked at work. The restrictive policy did not affect the amount smoked outside of work or the prevalence of smoking.

Previous evaluations of work site smoking bans have generally been limited by small numbers of work sites and by failure to consider secular trends in smoking behavior and demographic shifts in employee populations. The research we report uses existing smoking-related data from eight cross-sectional surveys of employees of a large medical care program (Kaiser-Permanente Employee Survey, 1976–78, 1980, 1982, 1984, 1986, and 1987 in Portland, OR,) to evaluate the impact of a smoking ban

implemented at 11 work sites at various times during 1985–86. The impact of the smoking ban was assessed by comparing pre-ban and post-ban reports of smoke in the work environment and smoking behavior and attitudes concerning smoking, smoke in the work environment, and acceptance of the ban.

## Setting and Data

The study setting is a large group practice health maintenance organization (HMO), the Northwest Region of the Kaiser Permanente Medical Care Program. The employee smoking ban was implemented in the region's administrative center, two hospitals, and several medical office facilities during 1985 and 1986. Although the employee smoking ban was promulgated as a region-wide policy, facility administrators were given discretion regarding time of implementation. Covered outside smoking areas were constructed at some work sites.

Table 1 shows the number of respondents by year and work site, grouped by the year that the smoking ban went into effect. The percentage of employees who participated in the surveys exceeded 70 percent except in 1980, when the participation rate was 60 percent and

Table 1. Survey respondents by year and smoking ban status of work site

Work sites	Pre-ban						Post-ban <sup>1</sup>	
	1976	1977	1978	1980	1982	1984	1986	1987
<i>1985 ban sites<sup>2</sup></i>								
Total	409	443	583	603	687	764	1,027	1,074
Medical facilities	116	125	189	203	281	326	397	405
Clinic 1	52	60	68	52	70	95	86	118
Clinic 2	...	...	...	19	54	82	122	112
Clinic 3	54	51	46	47	37	47	60	54
Clinic 4	10	14	18	14	23	26	24	22
Clinic 5	...	...	57	71	97	76	105	99
Nonmedical facilities	293	318	394	400	406	438	630	669
Administration	112	112	159	161	191	226	325	392
Supply, process	181	206	235	239	215	212	305	277
<i>1986 ban sites<sup>3</sup></i>								
Total	820	766	855	708	1,063	1,363	1,352	1,219
Hospital 1	455	433	483	304	640	494	658	608
Hospital 2	302	275	311	292	246	650	441	398
Clinic 6	63	58	61	70	71	85	128	93
Clinic 7	...	...	...	42	106	134	105	120

<sup>1</sup>For 1986 ban sites, only the 1987 data are post-ban.

<sup>2</sup>Smoking ban was implemented during 1985.

<sup>3</sup>Smoking ban was implemented during 1986.

1982, when it was 67 percent. The 163 percent increase in the total number of respondents from 1976 to 1987 parallels substantial and steady growth of the HMO employee population. The work sites where the ban was implemented during 1985 ("1985 ban sites") are medical clinics, the health plans's administrative offices, and the supply and process centers, which include the regional laboratory, pharmacy, and medical records departments. More than 60 percent of respondents at these sites do not have direct responsibility for care of patients. The work sites where the ban was implemented during 1986 ("1986 ban sites") are medical clinics and hospitals; more than 80 percent of respondents were hospital employees.

The shift in the age distribution of the respondent populations over the 1976–87 study period toward older ages (table 2) is the result of aging of the cohort of employees who continued employment during these years and the age distributions of new and former employees. The design of the work site smoking ban evaluation is necessarily cross-sectional, since the anonymity of the surveys precludes a panel analysis of the cohort of continuing employees. Evident from table 2 are trends toward a higher percentage of men in 1987 than in 1976, especially at the 1985 ban sites, and a higher level of education, a higher percentage of managers, and a lower percentage of licensed practical nurses and nurses aides at the 1986 ban sites. Comparable demographic data for the employee populations at these work sites, or for the total HMO employee population, that would allow for assessment of respondent bias were not available. Given response rates generally in excess of 70 percent, systematic trends in differential responses rates over time are unlikely to be large enough to bias study findings.

## Evaluation Methods

Smoking-related questions were included in all eight employee surveys conducted during 1976–87. Surveys prior to 1986 included questions on smoking status, attempts to quit smoking during the previous 12 months, and cutting down during the previous 12 months. The question on smoking taking place in the respondent's work environment was added in 1980. Smoking quantity items, including number of cigarettes smoked daily and during work hours, were added in 1986, as were items concerning the respondent's attitude toward the presence and effects of smoke in the work environment and support for and perceived effects of the smoking ban.

The impact of the smoking ban on smoking-related behaviors and attitudes was evaluated by relating the time when the ban was implemented to changes in the responses to the employee survey. Two types of statistical analyses were used—times series regression analyses of the data from the eight surveys and pre-ban and post-ban analyses of the 1986 and 1987 survey data. Both types of analyses are done separately for the 1985 and 1986 ban sites.

The time series regression analyses were applied to those variables that were available for several pre-ban surveys, including presence of smoke in the work environment, smoking status, and attempts to quit or cut down during the 12 months. Logistic regression models which controlled for year, age, sex, education, and job class were used to compute expected post-ban rates projected from the secular trends in the 1976–84 pre-ban rates, assuming no ban effects. Individual persons are the units of analysis, and the regression models predict individual post-ban behavior and attitudes. The

Table 2. Demographic characteristics of survey respondents, by year and smoking ban status of work site (percentages)

Demographic characteristics	Pre-ban						Post-ban <sup>1</sup>	
	1976	1977	1978	1980	1982	1984	1986	1987
<i>1985 ban sites<sup>2</sup></i>								
Age group:								
Under 29 years	40.1	38.6	33.1	29.1	21.2	15.7	14.3	13.1
30–39 years	30.4	28.3	33.1	36.7	42.5	45.1	44.2	38.4
40–49 years	14.0	17.2	15.2	17.7	20.9	23.8	27.3	33.4
50 years and older	15.5	15.9	18.6	16.5	15.4	15.4	14.2	15.3
Percent female	84.9	81.2	76.8	82.4	83.8	80.2	77.8	77.5
Education:								
College graduate	21.3	24.1	20.3	24.5	24.1	25.7	27.9	32.8
Noncollege graduate	78.4	75.9	60.6	62.7	60.9	59.2	57.5	67.2
Professional, technical school	...	...	19.8	12.7	15.5	15.1	14.6	...
Job classification:								
Management	8.1	7.7	11.0	7.8	12.8	11.4	14.9	14.8
Supervisor	5.7	9.2	8.3	6.3	6.2	8.9	8.5	9.4
Skilled technical	18.3	20.4	15.7	18.9	18.3	19.3	20.4	21.3
Licensed practical nurse, nurse aides	4.5	3.7	4.2	4.6	5.8	5.1	4.7	5.3
Registered nurse	6.6	4.7	6.4	9.3	7.5	6.8	6.8	4.6
All others (mostly clerks)	56.9	54.2	54.4	53.1	49.2	48.7	44.7	44.7
<i>1986 ban sites<sup>3</sup></i>								
Age group:								
Under 29 years	35.7	34.9	31.6	26.2	20.9	17.6	15.6	12.1
30–39 years	29.3	29.8	31.6	38.9	43.2	44.4	44.1	42.8
40–49 years	19.3	19.9	20.3	17.9	20.6	22.6	25.8	30.1
50 years and older	15.7	15.4	16.5	17.0	15.6	15.4	14.6	15.0
Percent female	88.6	88.3	86.6	86.4	86.9	84.0	84.7	83.3
Education:								
College graduate	22.5	27.1	26.7	26.0	33.3	34.8	34.5	37.7
Noncollege graduate	77.5	72.9	50.4	54.1	48.5	46.7	47.6	62.3
Professional, technical school	...	...	22.9	19.9	18.2	18.5	17.9	NA
Job classification:								
Management	6.2	5.9	5.8	5.4	7.4	9.6	10.5	12.2
Supervisor	2.9	3.4	3.4	3.6	2.1	3.8	4.1	4.5
Skilled technical	13.5	14.0	13.8	14.7	14.6	15.4	13.6	15.3
Licensed practical nurse, nurse aides	14.0	13.1	14.3	9.7	7.9	5.7	2.7	3.6
Registered nurse	32.9	31.1	32.9	34.0	39.9	36.8	35.1	31.9
All others (mostly clerks)	30.6	32.4	30.0	32.6	28.1	28.8	34.1	32.6

<sup>1</sup>For 1986 ban sites, only the 1987 data are post-ban.  
<sup>2</sup>Smoking ban was implemented during 1985.

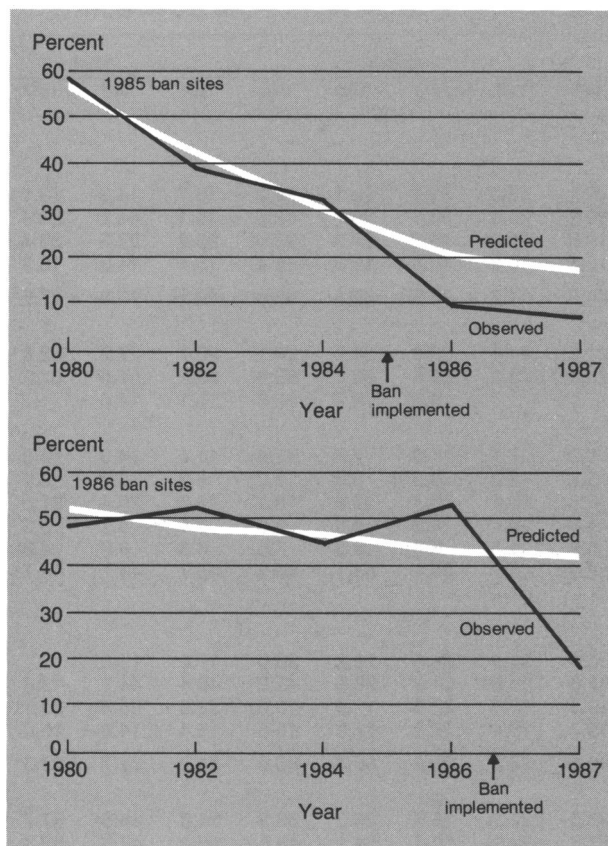
<sup>3</sup>Smoking ban was implemented during 1986.

Table 3. Regression estimates of pre- to post-ban and secular effects, 1986–87, controlled for sex, age, education, and job class

Dependent variable	1986 ban sites				1985 ban sites			
	Regression coefficient <sup>1</sup>	SE	P value	Total R	Regression coefficient <sup>2</sup>	SE	P value	Total R
<i>Logistic regression</i>								
Attempted to quit in the past year (yes-no)	-0.125	0.231	0.589	0.012	0.433	0.242	0.073	0.000
Certain will try to quit in the next year (yes-no)	-0.041	.249	0.010	0.110	0.125	.264	0.636	0.000
Cut down in the past year (yes-no)	-0.157	.223	0.480	0.000	-0.505	.242	0.038	0.000
Presence of smoke in work environment (smokers only, yes-no)	-1.55	0.255	0.000	0.303	-.114	0.401	0.776	0.200
Presence of smoke in work environment (non-smokers only, yes-no)	-1.66	.146	0.000	0.364	-0.446	.252	0.078	0.198
<i>Linear regression</i>								
Total cigarettes smoked daily	0.005	0.95	0.995	0.07	0.810	1.06	0.447	0.048
Total cigarettes smoked during work hours	-1.39	.51	0.007	0.13	-0.067	.436	0.878	0.131

<sup>1</sup>Pre-post ban and secular effects. <sup>2</sup>Secular effect at post-ban sites.

Figure 1. Comparison of observed and predicted percentages of respondents reporting smoke in the work environment



ban effects were assessed by comparing observed and expected post-ban rates. Chi-square tests of the differences between observed and expected frequencies were performed.

A single group pre-ban and post-ban analysis design was used at the 1986 ban sites to test for ban effects on smoking quantity, and on the behavioral and attitudinal variables that were available for only the 1986 and 1987 surveys. Logistic and multiple linear regression models were used to control for changing demographic characteristics of the respondent populations. Lacking concurrent no-ban sites, secular changes over 1986–87 were estimated from nonequivalent post-ban and post-ban differences at the 1985 ban sites. Since the 1986 employee survey occurred before the implementation of the smoking ban at the 1986 ban sites, the responses to questions concerning the smoking ban measure employees' anticipations of acceptance and effects of the smoking ban rather than attitudes resulting from experiencing the ban.

## Results

**Time series regression analysis.** Figure 1 shows a substantial ban-related reduction in the percentage of

respondents reporting that smoke was present in their work environments. The observed post-ban rates were significantly lower than the predicted post-ban rates derived from secular trends in the 1976–84 data with the use of logistic regression models that controlled for changes in the age, sex, education, and job class distributions of the respondent populations ( $P < .05$ ). As expected, the 1985 ban sites experienced the reduction in 1986, the first post-ban survey year, and the 1986 ban sites experienced the reduction in 1987, the first post-ban survey year.

Figure 2 shows that the prevalence of self-reported smoking decreased from more than 30 percent in 1976 to less than 20 percent in 1987. For the 1985 ban sites, the observed post-ban 1986 and 1987 smoking prevalence rates did not differ significantly from the predicted rates. Although the observed 1987 post-ban smoking prevalence rate for the 1986 ban sites was lower than the predicted rate, the difference is not statistically significant as judged by the chi-square test. These findings are consistent with no ban effect on smoking prevalence.

The pre-ban reduction of smoke in the work environment shown in figure 1 was much greater at the 1985 ban sites (primarily nonmedical facilities) than at the 1986 ban sites (medical facilities, primarily hospitals). A similar, although less striking, pattern is seen in the smoking prevalence graphs (fig. 2).

There was a secular increase in the percentage of smoking respondents who reported attempts to quit smoking during the previous year, rising from 30 percent in 1977 to 40 percent in 1987. The smoking ban had no effect on reported attempts to quit smoking.

### Pre-ban and post-ban analyses—smoking behavior.

Table 3 presents the results of pre-ban and post-ban analyses for 1986 ban sites using multiple logistic and linear regression models to control for differences in the distribution by sex, age, education, and job class of the 1986 and 1987 respondent populations. The tabulated regression coefficients are for the ban indicator variable (0=1986, 1=1987), and as such, estimates the joint effects of implementing the ban and secular trends in the dependent variables. Lacking contemporaneous nonban comparison sites that would enable secular trends to be statistically controlled, we used post-ban and post-ban analysis of the nonequivalent 1985 ban sites to provide evidence against substantial secular changes over the 1986–87 period.

The results of these multivariate analyses are consistent with the time series regression analyses. There appeared to be a highly significant ban-related reduction of reports of smoke in the work environment. The ban affected neither the likelihood of cutting down nor attempts to quit smoking.

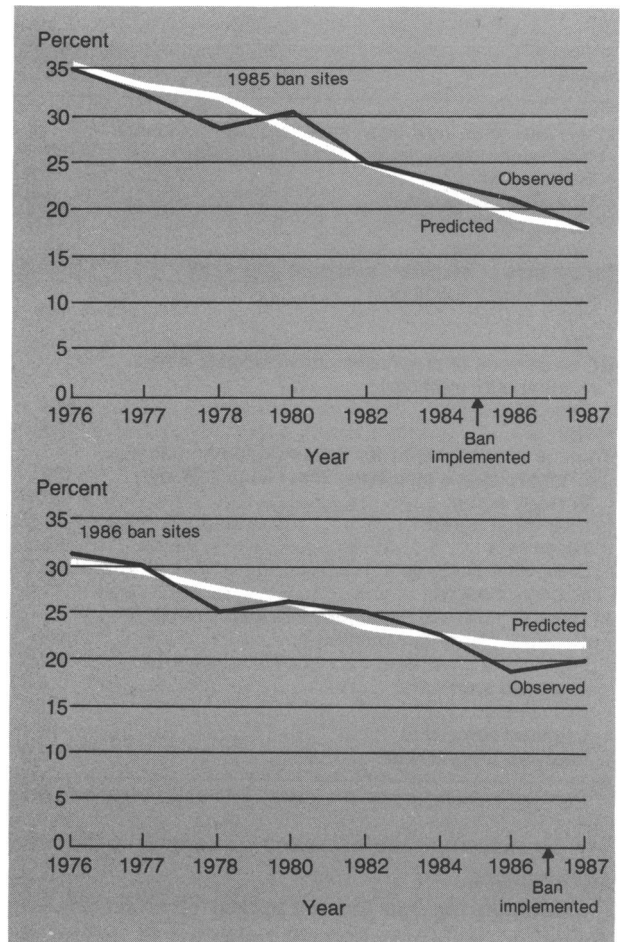
The unexpected finding that the ban appeared to reduce significantly intentions to quit smoking may be due to increased motivation among smokers in anticipation that the smoking ban will require them to quit. After implementation of the ban, their motivation is reduced when they learn that they can adapt by going outside to smoke and by cutting down on the amount smoked during working hours. The ban did not appear to affect the total number of cigarettes smoked per day.

The findings of a significant reduction of 1.4 cigarettes smoked at work per day at the 1986 ban sites and an insignificant secular reduction of less than 0.1 cigarettes at the 1985 ban sites suggests that the ban was effective in reducing the amount smoked during work hours. The ban did not appear to affect the total number of cigarettes smoked per day.

**Pre-ban and post-ban analysis—attitudes related to smoking ban.** Table 4 compares ban-related attitudes of smokers and nonsmokers. The ban was associated with a large reduction in reports of being bothered by someone else's smoke at work: down from 60 percent of nonsmokers and 14 percent of smokers being bothered at least occasionally to 29 percent and 6 percent, respectively. These percentages are based on the 1986 and 1987 responses at the 1986 ban sites. Post-ban exposure to smoke presumably occurred at locations other than work stations where the ban was strictly enforced. Respondents may have considered outside areas and hospital rooms, where patients were allowed to smoke, as part of their work environment. Bathrooms, which are covered by the ban, present special enforcement problems. More than a third of the 1987 survey respondents at the 1986 ban sites (hospitals and clinics) reported that patients or members smoke in their work environment, and almost a fifth reported that employees or physicians smoke in their work environment. The corresponding figures for the 1985 ban sites (primarily administrative offices and the supply-process center) are 10 percent for patients or members and 15 percent for employees or physicians. These items were included only in the 1987 survey. At that time the implementation of a patient smoking ban at the hospitals was incomplete, and some patients were allowed to smoke in their hospital rooms if approval was given by the attending physician.

A larger percentage of nonsmokers (73 percent) than smokers (46 percent) agreed that there is strong support for the smoking ban among the organization's employees that they know. These percentages are based on the aggregate over years and ban sites. Similarly, nonsmokers were more likely to agree that most bad health effects of smoking can be avoided by quitting, that it is easier for smokers to quit smoking if they could not

Figure 2. Comparison of observed and expected smoking prevalence among respondents



smoke at work, that smoke in the environment is unhealthy for nonsmokers, and that health care workers should modify their own behavior a great extent to serve as models for patients. There was strong agreement, among both smokers and nonsmokers, that their employer should provide free programs to help employees stop smoking. Although about a third (31 percent) of smokers anticipated impairment of work efficiency, following implementation of the ban, 83 percent of smokers reported either no difference or improvement in work efficiency, compared with more than 98 percent of nonsmokers. These percentages are based on the 1986 and 1987 responses at the 1986 ban sites.

## Discussion

The findings of this large study are generally consistent with those of Biener's smaller comparative evaluation of a restrictive smoking policy in a general hospital. The smoking ban was supported by the majority of employees and was successful in reducing, but

Table 4. Survey respondents' attitudes related to smoke in the work environment and the smoking bans (percentages)

Variable	Smokers				Nonsmokers			
	1985 ban sites <sup>1</sup>		1986 ban sites <sup>2</sup>		1985 ban sites <sup>1</sup>		1986 ban sites <sup>2</sup>	
	1986	1987	1986	1987	1986	1987	1986	1987
In the past year, how often have you been bothered by someone else's smoke at work? (number) . . . . .	189	161	225	207	688	729	949	838
Bothered often . . . . .	1.6	0.0	1.8	1.0	7.0	4.1	27.0	8.8
Bothered occasionally . . . . .	1.6	3.1	12.0	5.3	19.5	10.2	33.4	20.5
Rarely bothered . . . . .	11.6	8.7	24.4	13.5	25.3	24.3	20.7	27.7
Never bothered . . . . .	85.2	88.2	61.8	80.2	48.3	61.5	19.0	43.0
Do patients or members smoke in your work environment? (number) . . . . .	...	63	...	117	...	212	...	399
Yes . . . . .	NA	9.5	NA	33.3	NA	9.4	NA	36.3
No . . . . .	NA	90.5	NA	66.7	NA	90.6	NA	63.7
Do employees or physicians smoke in your work environment? (number) . . . . .	...	79	...	124	...	256	...	443
Yes . . . . .	NA	13.9	NA	19.4	NA	14.8	NA	18.3
No . . . . .	NA	86.1	NA	80.7	NA	85.2	NA	81.7
There is strong support for the smoking ban among the organization's employees that I know (number) . .	189	160	227	205	704	720	978	830
Strongly agree . . . . .	20.6	21.9	17.2	21.0	46.5	40.1	41.4	39.8
Somewhat agree . . . . .	27.0	30.0	24.7	22.0	27.8	31.8	29.4	33.9
No opinion . . . . .	25.9	28.8	24.2	29.3	21.2	24.6	21.1	21.0
Somewhat disagree . . . . .	15.3	10.6	18.5	16.6	3.6	3.2	5.9	4.1
Strongly disagree . . . . .	11.1	8.8	15.4	11.2	1.0	0.3	2.3	1.3
In general, how has the smoke-free policy affected your work efficiency? (number) . . . . .	188	153	229	202	663	707	928	812
Improved a great deal . . . . .	7.5	5.9	4.8	4.5	27.9	27.6	23.3	22.9
Improved somewhat . . . . .	4.6	5.9	6.6	5.0	18.4	15.8	19.5	17.2
Not affected . . . . .	71.3	70.6	57.2	73.8	53.1	56.0	55.4	58.0
Impaired somewhat . . . . .	10.1	13.1	20.5	12.4	0.6	0.6	1.0	1.6
Impaired a great deal . . . . .	6.9	4.6	10.9	4.5	0.0	0.0	0.9	0.3

<sup>1</sup>Smoking ban was implemented during 1985.

<sup>2</sup>Smoking ban was implemented during 1986.

NOTE: NA = not applicable.

not eliminating, the presence of smoke in the work environment.

Although the ban did not appear to affect smoking cessation, there was a small reduction in the amount smoked at work, but this drop appeared to be compensated for by increased smoking outside of work hours as theories of nicotine dependence might predict. Biener reported no such compensation. Even if not compensated for, the reduction is trivial from both clinical and public health perspectives.

The apparent effect of the ban on intention to quit is consistent with Biener's findings. A significantly higher percentage of smokers in the 1986 pre-ban survey intended to quit than in the 1987 post-ban survey. This finding may indicate that smokers expected that the work site smoking ban would require them to quit. When the ban was implemented and they learned to adapt by going to outside smoking areas and by reducing their smoking during work hours, the motivation to quit smoking may have diminished. As pointed out by Biener, this suggests that the most opportune time for a quit-smoking campaign may be during the early phases of a policy change.

The study design was limited by the nature of available data. However, although the survey design precluded a panel analysis, and did not include

contemporaneous nonban sites, the time series regression analyses controlled for secular trends and changes in the sociodemographic composition of the respondent populations. Whether the HMO work site smoking ban decreases relapse rates among those who had quit or has a long-term impact on smoking prevalence remains to be evaluated.

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