

BRIEF REPORT

# Impact of a Comprehensive Smoke-Free Law Following a Partial Smoke-Free Law on Incidence of Heart Attacks at a Rural Community Hospital

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## ABSTRACT

**Introduction:** Secondhand smoking (passive smoking) is associated with many negative health effects, primarily respiratory and cardiovascular diseases. Approximately, 46,000 deaths from cardiovascular disease are associated with secondhand smoke exposure annually in the United States, which is roughly 150 deaths in North Dakota. Studies show that passage of smoke-free laws at the community level can reduce the incidence of heart attack.

**Methods:** We conducted a retrospective review of electronic medical records of patients admitted for heart attacks 4 months prior (April 15, 2010 through August 14, 2010) to implementation of the smoke-free ordinance and 4 months following (August 15, 2010 through December 14, 2010) implementation of the comprehensive smoke-free ordinance in Grand Forks, ND, United States.

**Results:** We found an association between the heart attack rate and implementation of the comprehensive smoke-free law. The heart attack rate prior to the ban was 0.5% (83/16,702) compared with 0.3% (63/18,513) after the ban ( $p = .023$ ). Thus, the rate of heart attacks decreased 30.6% and number of heart attack admissions decreased 24.1%, from 83 to 63, after implementation of a comprehensive smoke-free law.

**Conclusions:** We found an implementation of the comprehensive smoke-free law was associated with a decrease in the heart attack rate. The heart attack rate decreased 30.6%. Our finding was similar to previous community level smoke-free law implementation studies and notable for the change going from a partial smoke-free law to a comprehensive smoke-free law.

## INTRODUCTION

Secondhand smoking (passive smoking) is associated with many negative health effects, primarily respiratory and cardiovascular diseases (Institute of Medicine, 2009; U.S. Department of Health and Human Services, 2006). Approximately, 46,000 deaths from cardiovascular disease are associated with secondhand smoke exposure annually in the United States. (Myers, 2010), which is roughly 150 deaths in North Dakota. Secondhand smoke, even in brief exposure, can increase risk of heart attack and those with pre-existing heart disease are at particular risk (U.S. Department of Health and Human Services, 2006). Studies show that passage of smoke-free laws at the community level can reduce the incidence of heart attack (Bartecchi, Alsever, Nevin-Woods, Estachio, Bartleson, & Krantz, et al., 2006; Brintjes, Bartleson, Hurst, Levinson, Hokanson, & Krantz, 2011;

Herman & Walsh, 2011; Lemstra, Neudorf, & Opondo, 2008; Myers, 2010; Naiman, Glazier, & Moineddin, 2010; Sargent, Shepard, & Glantz, 2004). However, another study found no significant difference in the acute myocardial infarction (AMI) mortality in six states with bans compared with other states with no ban (Rodu, Peiper, & Cole, 2011).

On August 15, 2010, Grand Forks, ND, implemented a smoking ban ordinance. Prior to the comprehensive law, the city had a partial smoke-free workplace law that had exempted bars and other select areas and businesses. The purpose of this study was to determine whether a smoking free ordinance was associated with decreased hospitalization for heart attack. Specifically, data from a rural community hospital were used to compare admissions for myocardial infarction (MI) and acute coronary syndrome 4 months prior to and 4 months following the implementation of the comprehensive smoke-free ordinance.

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## Impact of a comprehensive smoke-free law

**Table 1.** Comparison of Clinical and Demographic Characteristics of Patients Hospitalized for Heart Attack, 2010

Characteristic	Total 100% (n = 146)	Prior ban 56.9% (n = 83)	After ban 43.1% (n = 63)	p Value
Heart attack rate <sup>a</sup>	0.42 (146)	0.49 (83)	0.34 (63)	.023
Age, mean ± SD	65.3 ± 14.0	67.0 ± 13.4	63.1 ± 14.7	.093
Gender, men	61.0 (89)	56.6 (47)	66.7 (42)	.218
Death rate	17.1 (25)	21.7 (18)	11.1 (7)	.093

Note. <sup>a</sup>Heart attack rate = number of heart attacks/total admissions.

**Table 2.** Comparison of Clinical and Demographic Characteristics of Hospitalized Patients, 2010

Characteristic	Total 100% (n = 35,194)	Prior ban 47.3% (n = 16,693)	After ban 52.6% (n = 18,501)	p Value
Heart attack rate <sup>a</sup>	0.42 (146)	0.49 (83)	0.34 (63)	.023
Age, mean ± SD	48.3 ± 19.6	48.5 ± 19.6	48.2 ± 19.5	.238
Gender, men	40.4 (14,212)	40.1 (6,695)	40.6 (7,517)	.317
Death rate	2.2 (759)	2.5 (421)	1.8 (338)	.000

Note. <sup>a</sup>Heart attack rate = number of heart attacks/total admissions.

## METHODS

We conducted a retrospective review of electronic medical records of patients admitted for heart attacks 4 months prior (April 15, 2010 through August 14, 2010) to implementation of the smoke-free ordinance and 4 months following (August 15, 2010 through December 14, 2010) implementation of the comprehensive smoke-free ordinance in Grand Forks, ND, United States. The 4-month timeframe was used to reduce any seasonality impact that the severe winter months of January, February, and March may have on heart attack admissions. Heart attacks were defined using International Classification of Diseases, Ninth Revision (ICD-9) codes for the diagnosis for MI and acute coronary syndrome (ACS), specifically: 410.90-AMI of unspecified site, episode of care unspecified; 410.91-AMI of unspecified site, initial episode of care; 411.1-intermediate coronary syndrome. Heart attack rate was defined as the number of heart divided by the total number of admissions for the given period. The institutional review boards of the University of North Dakota and Altru Health Systems approved this study.

### Setting

Grand Forks, ND has a population of 55,600 with approximately 92% being White. Altru Health Systems is a rural, community-based hospital and clinics with 3,800 health professionals serving 200,000 residents of northeast North Dakota and northwest Minnesota. Altru Health Systems hospital, a 262 bed acute care center, is the only one in Grand Forks and within a 70 mile radius. As a result, within the community, the intended public health benefit of the smoke-free law could be more easily assessed compared with larger urban areas with multiple medical centers. Data were limited to patients from the metro area of Grand Forks (zipcodes 58201, 58202, 58203, and 58206). Similar to the Helena, MT (Sargent et al., 2004) and Pueblo, CO (Bartecchi et al., 2006) studies, only patients

that made it to hospital alive were included in the study. Patients transferred from other facilities in the region were not included in the study because in all likelihood the patient lived outside Grand Forks and thus would not be significantly impacted by the ordinance.

SPSS 19.0 for Windows was used to analyze demographic and clinical characteristics of patients. Frequencies and relative percentages were computed for each categorical variable. Chi-square tests were performed to determine which categories were significantly different from one another, and *t* test was used to compare continuous variables. All *p* values were two-sided, and *p* value < .05 was considered significant. Missing data were excluded from analysis.

## RESULTS

Overall, during the entire study period, the heart attack rate was 0.4% (*n* = 146), with 17.1% (25) resulting in death (Table 1). The average age for heart attack patients was 65.3 ± 14.0 years and 61.0% (*n* = 89) were men.

There was an association between heart attack rate and implementation of the comprehensive smoking ban. The heart attack rate decreased from 0.5% (83/16,702) prior to the ban compared with 0.3% (63/18,513) after the ban (*p* = .023, Table 1). Thus, the heart attack rate decreased 30.6% and the number of heart attack admissions decreased 24.1%, from 83 to 63, after implementation of a comprehensive smoke-free law. However, there was no association in the death rate and the comprehensive smoking ban, 21.7% (*n* = 18) prior versus 11.1 (*n* = 7) after (*p* = .093, Table 1). There was no association between gender or significant difference in age in heart attack patients prior or after the implementation of a comprehensive smoke-free law (Table 1).

During the study period, there were a total of 35,215 total admissions. The average age for patients admitted was 48.3 ± 19.6 years and 40.4% (*n* = 14,212) were men (Table 2). There were no significant differences in gender or age between

the total admissions before and after the implementation of a comprehensive smoke-free law. However, the death rate significantly decreased after implementation of a comprehensive smoke-free law compared with before, 1.8% ( $n = 338$ ) versus 2.5% ( $n = 421$ ), ( $p < .001$ , Table 2).

## CONCLUSIONS

We found an association between the heart attack rate and implementation of the comprehensive smoke-free law. The heart attack rate decreased 30.6% and the number of heart attacks decreased by 24.1% after implementation of a comprehensive smoke-free law. This is comparable to results of similar community studies following the implementation of smoke-free laws including Bartecchi et al. (2006), who found a 27.1% decrease in AMI rates. Given that the community in this study already had a partial smoke-free workplace law prior to the study dates, the effect is of particular interest.

There are a number of limitations to our study. Our study was a before and after ecological study design and thus cause and effect cannot be determined, only association. Many other factors may have impacted the results. Also, the study did not measure individual smoking habits or exposure to secondhand smoke. Another limitation is we did not collect data or control for other potential risk factors (i.e., comorbidities, seasonality).

The results of this study and others suggest that smoking bans may be associated with reduction in heart attack admissions (MI and ACS). Future directions should include assessment of any persistent effect of decreased heart attack incidence over longer periods of time and controlling for other risk factors.

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## DECLARATION OF INTERESTS

None declared.

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