

Effect of Uruguay's National 100% Smokefree Law on Emergency Visits for Bronchospasm

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Introduction: Implementation of smokefree laws is followed by drops in hospital admissions for cardiovascular diseases and asthma. The impact of smokefree laws on use of non-hospital medical services has not been assessed. The purpose of this study is to evaluate the impact of Uruguay's national 100% smokefree legislation on non-hospital emergency care visits, hospitalizations for bronchospasm, and bronchodilator use.

Methods: The monthly number of non-hospital emergency care visits and hospitalizations for bronchospasm, as well as monthly puffs of bronchodilators (total and per person), from 3 years prior to the adoption of the 100% smokefree policy on March 1, 2006, through 5 years after the policy were assessed using interrupted time series negative binomial regression. Data analysis was conducted in 2014.

Results: The incidence of non-hospital emergency visits for bronchospasm decreased by 15% (incidence rate ratio [IRR]=0.85, 95% CI=0.76, 0.94) following implementation of the law. Hospitalizations for bronchospasm did not change significantly (IRR=0.89, 95% CI=0.66, 1.21). Total monthly puffs of salbutamol and ipratropium administered in the non-hospital emergency setting decreased by 224 (95% CI=-372, -76) and 179 (95% CI=-340, -18.6), respectively, from means of 1,222 and 1,007 before the law.

Conclusions: Uruguay's 100% smokefree law was followed by fewer emergency visits for bronchospasm and less need for treatment, supporting adoption of such policies in low- and middle-income countries to reduce the disease burden and healthcare costs associated with smoking. (Am J Prev Med 2014;■(■):■■■-■■■) © 2014 American Journal of Preventive Medicine

Introduction

Evidence about the benefits of smokefree legislation¹ is increasing. Uruguay, the first Latin American country to implement a comprehensive smokefree national law as part of its nationwide tobacco control campaign, has banned smoking in indoor public places and workplaces since March 2006.² Hospitalizations for myocardial infarction decreased after

Uruguay's smokefree law,^{3,4} consistent with other countries.⁵ Adult smoking prevalence in Uruguay was 29.7% in men and 19.1% in women in 2011.⁶ The 2008–2010 Global Adult Tobacco Survey found that 11.8% of adults in Uruguay were exposed to secondhand smoke (SHS) in the workplace, 4.4% in restaurants, and 6.9% in government buildings.⁷

A 2012 meta-analysis found that smokefree laws were associated with a 26% decrease in hospitalizations for respiratory disease, with significant reductions in asthma and pulmonary infections but not for chronic obstructive pulmonary disease (COPD).^{1,8–12}

The impact of Uruguay's national 100% smokefree policy on non-hospital emergency visits for bronchospasm, hospital admissions for bronchospasm, and the number of administered puffs of inhaled β 2-agonists and anticholinergic agents was evaluated. We hypothesized that visits for bronchospasm and bronchodilator administration would decrease after the law was enacted.

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Methods

Study Design

Interrupted time series analysis evaluated the number of visits for bronchospasm from the Servicio de Urgencia, Asistencia y Traslado (SUAT, Emergency, Assistance and Move Service) non-hospital emergency medical service serving approximately 180,000 people in Montevideo, Uruguay. SUAT provides medical assistance outside of the hospital (e.g., at home, outpatient clinic, or public location). Most hospitalizations in Montevideo occur through such services.

A doctor and nurse are present at each emergency visit. The protocol followed for bronchospasm appears in [Appendix Table 1](#); patients with incomplete or no response to treatment of moderate and severe exacerbations are accompanied to the hospital. At each visit, the physician documents the patient's diagnosis and disposition (e.g., hospital or home) in the electronic medical record using a cellular telephone. After each visit, the physician writes a handwritten note, and the nurse documents the names and doses of administered medications. These forms are later transcribed into the electronic medical record by the Department of Medical Informatics of SUAT Medical Emergency Service. For discrepancies between the diagnosis code entered via telephone and on the physician's note, the latter is used.

The 100% national smokefree law was implemented on March 1, 2006. Data were collected for March 1, 2003, through February 28, 2011 (3 years prior to and 5 years after implementation of the law). Data were analyzed in 2014.

Data Collection

De-identified data were retrieved from the electronic medical record by the chief of medical informatics of SUAT Medical Emergency Service, including date of visit, diagnosis code, total puffs of inhaled bronchodilators, and disposition. The investigators were provided with aggregate monthly statistics and had no access to individual patient-level data.

Study Population

Participants were individuals aged ≥ 15 years with a non-hospital emergency visit for bronchospasm, defined as both (1) a diagnosis of asthma (ICD-10 J45) or COPD (ICD-10 J44) and (2) requiring inhaled β_2 -agonists during emergency care. As a retrospective review of medical records was performed, only patients meeting these two criteria were included.

Measures

The primary outcome was the number of monthly visits for bronchospasm from the non-hospital emergency service. Secondary outcomes included the number of individuals subsequently hospitalized and total and average (per patient treated) puffs of salbutamol (100 $\mu\text{g}/\text{puff}$), a short-acting β_2 -agonist, and ipratropium (20 $\mu\text{g}/\text{puff}$), a short-acting anticholinergic agent, administered by metered dose inhaler per patient per month in the non-hospital emergency setting and, when applicable, during transfer to the hospital.

Statistical Analysis

Negative binomial regression assessed changes in non-hospital emergency visits for bronchospasm after the smokefree law, with a dummy variable set to 0 before the law and 1 afterwards. Time was included to control for secular trends, and dummy variables for calendar month controlled for seasonal variations. Multiple linear regression assessed changes in amounts of inhaled medications using the same independent variables. No serial correlation was seen in residuals using the Durbin-Watson statistic ($d=1.7$). Stata, version 13, was used for all analyses.

Results

The incidence of monthly non-hospital emergency visits for bronchospasm decreased by 15% after the law ([Table 1](#)). The fitted values for non-hospital emergency visits were lower for the model including the smokefree law compared to a model containing the counterfactual of no law, obtained by setting the value for the dummy variable "smokefree law" to zero in the regression equation ([Figure 1](#)). There was no change in hospitalizations for bronchospasm ([Table 1](#)). (The minimum detectable effect was seven hospitalizations with 0.80 power based on 337 and 533 total hospitalizations before and after the smokefree law, respectively, with a standard deviation of 30 hospitalizations.) Total monthly puffs and average puffs per patient of salbutamol and ipratropium administered in the non-hospital emergency setting decreased ([Table 1](#)). Total yearly events and administered medications are shown in [Appendix Table 2](#).

Discussion

Uruguay's national 100% smokefree law was followed by a 15% reduction in monthly non-hospital emergency visits for bronchospasm. These visits are typically the first interaction between patients having acute exacerbations of asthma or COPD and healthcare providers in Uruguay; after the smokefree law, there were fewer episodes requiring this immediate medical attention. Reduced emergency department visits for asthma have been seen after smokefree legislation in Kentucky.¹³

Smokefree policies improve symptoms of respiratory and sensory irritation^{14,15} and spirometry parameters¹⁶ in hospitality workers. Smokefree workplaces are associated with voluntary home smokefree policies, including in Uruguay,^{17,18} and also may encourage smoking cessation¹⁹ and enhance cessation success among smokers.²⁰ This is particularly important for decreasing home SHS exposure and respiratory symptoms for susceptible individuals.

Uruguay's tobacco control program, which also included tobacco tax increases, restrictions on tobacco advertising, educational campaigns, graphic cigarette

Table 1. Changes in Care for Bronchospasm Following Smokefree Law

Rate of non-hospital emergency visits and hospital admissions for bronchospasm per month after smokefree law implementation			
Event	IRR	95% CI	p-value
Non-hospital emergency visits	0.85	0.76, 0.95	0.003
Hospitalizations	0.90	0.66, 1.22	0.50
Changes in puffs of salbutamol and ipratropium administered per month in the non-hospital emergency setting			
Medication	Change after law	95% CI	p-value
Total puffs of salbutamol per month ^a	-224	-373, -76	0.003
Average puffs of salbutamol/month per patient treated	-0.154	-0.70, 0.39	0.57
Total puffs of ipratropium per month ^b	-179	-340, -18.6	0.03
Average puffs of ipratropium/month per patient treated	-1.11	-2.2, -0.2	0.045

Note: Models also included time to control for secular trends and calendar month to control for seasonality (results not shown). Boldface indicates statistical significance ($p < 0.05$).

^aAverage total doses of salbutamol per month before the law=1,222.

^bAverage total doses of salbutamol per month before the law=1,007.
IRR, incidence rate ratio.

warning labels, and a ban on misleading tobacco packaging, was associated with a 4.3% decrease per year in per-person cigarette consumption and a 3.3% decrease in current tobacco use from 2005 to 2011.^{21,22} Decreased SHS exposure in workplaces and public places were also seen after Uruguay's smokefree law.²³

The lack of change in hospitalizations for bronchospasm after the smokefree law may be because milder exacerbations were primarily affected or because bronchospasm was unrelated to SHS exposure. As bronchospasm from asthma and COPD were evaluated together, direct comparison to past studies on asthma hospitalizations is not possible. Studies on smokefree laws and COPD hospitalizations have had varied findings, with one study¹¹ showing no significant difference and two^{24,25} showing reduced hospitalizations.

Limitations

This study has several limitations. Bronchospasm among both smokers and nonsmokers was included, and age-adjusted data were not available. Medication requirements for bronchospasm may be underestimated, as patients may have used inhalers prior to care. As above, Uruguay implemented multiple tobacco control measures during the time of this study, but given substantial overlap in dates of implementation, these could not all be controlled for. Finally, a comparison city was not used, and because these data were collected from one emergency service in one city, generalizability to other cities is unknown.

Conclusions

The drop in non-hospital emergency visits for bronchospasm following Uruguay's 100% smokefree law adds to the growing body of evidence supporting the health benefits of such policies. Replication of Uruguay's successful policy in other low- and middle-income countries can help reduce the burden of disease and costs associated with smoking worldwide.

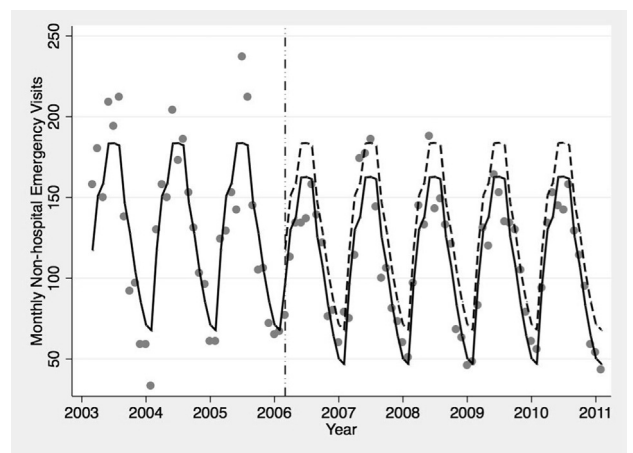


Figure 1. Total non-hospital emergency visits for bronchospasm

Note: The data points show the number of non-hospital emergency visits for bronchospasm during each month. The solid line represents fitted values. The dashed line shows the counterfactual of no law obtained by setting the "law" dummy variable to zero in the regression equation. The dashed dot vertical line indicates when the national 100% smokefree law went into place in Uruguay (March 1, 2006).

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References

1. Tan CE, Glantz SA. Association between smoke-free legislation and hospitalizations for cardiac, cerebrovascular, and respiratory diseases: a meta-analysis. *Circulation*. 2012;126(18):2177–2183. <http://dx.doi.org/10.1161/CIRCULATIONAHA.112.121301>.
2. Sebrié EM, Schoj V, Travers MJ, McGaw B, Glantz SA. Smokefree policies in Latin America and the Caribbean: making progress. *Int J Environ Res Public Health*. 2012;9(5):1954–1970. <http://dx.doi.org/10.3390/ijerph9051954>.
3. Sebrié EM, Sandoya E, Hyland A, Bianco E, Glantz SA, Cummings KM. Hospital admissions for acute myocardial infarction before and after implementation of a comprehensive smoke-free policy in Uruguay. *Tob Control*. 2013;22(e1):e16–e20. <http://dx.doi.org/10.1136/tobaccocontrol-2011-050134>.
4. Sebrié EM, Sandoya E, Bianco E, Hyland A, Cummings KM, Glantz SA. Hospital admissions for acute myocardial infarction before and after implementation of a comprehensive smoke-free policy in Uruguay: experience through 2010. *Tob Control*. 2014;23(6):471–472. <http://dx.doi.org/10.1136/tobaccocontrol-2012-050954>.
5. Lightwood JM, Glantz SA. Declines in acute myocardial infarction after smoke-free laws and individual risk attributable to secondhand smoke. *Circulation*. 2009;120(14):1373–1379. <http://dx.doi.org/10.1161/CIRCULATIONAHA.109.870691>.
6. National Statistics Institute. National Statistics Institute Household Survey 2011; 2011.
7. King BA, Mirza SA, Babb SD. A cross-country comparison of secondhand smoke exposure among adults: findings from the Global Adult Tobacco Survey (GATS). *Tob Control*. 2013;22(4):e5. <http://dx.doi.org/10.1136/tobaccocontrol-2012-050582>.
8. Braman SS. The global burden of asthma. *Chest*. 2006;130(1 suppl):4S–12S. http://dx.doi.org/10.1378/chest.130.1_suppl.4S.
9. Millett C, Lee JT, Laverty AA, Glantz SA, Majeed A. Hospital admissions for childhood asthma after smoke-free legislation in England. *Pediatrics*. 2013;131(2):e495–e501. <http://dx.doi.org/10.1542/peds.2012-2592>.
10. Mackay D, Haw S, Ayres JG, Fischbacher C, Pell JP. Smoke-free legislation and hospitalizations for childhood asthma. *N Engl J Med*. 2010;363(12):1139–1145. <http://dx.doi.org/10.1056/NEJMoa1002861>.
11. Kent BD, Sulaiman I, Nicholson TT, Lane SJ, Moloney ED. Acute pulmonary admissions following implementation of a national workplace smoking ban. *Chest*. 2012;142(3):673–679. <http://dx.doi.org/10.1378/chest.11-2757>.
12. Sims M, Maxwell R, Gilmore A. Short-term impact of the smokefree legislation in England on emergency hospital admissions for asthma among adults: a population-based study. *Thorax*. 2013;68(7):619–624. <http://dx.doi.org/10.1136/thoraxjnl-2012-202841>.
13. Rayens MK, Burkhart PV, Zhang M, et al. Reduction in asthma-related emergency department visits after implementation of a smoke-free law. *J Allergy Clin Immunol*. 2008;122(3):537–541. <http://dx.doi.org/10.1016/j.jaci.2008.06.029>.
14. Eisner MD, Smith AK, Blanc PD. Bartenders' respiratory health after establishment of smoke-free bars and taverns. *JAMA*. 1998;280(22):1909–1914. <http://dx.doi.org/10.1001/jama.280.22.1909>.
15. Schoj V, Alderete M, Ruiz E, Hasdeu S, Linetzky B, Ferrante D. The impact of a 100% smoke-free law on the health of hospitality workers from the city of Neuquen, Argentina. *Tob Control*. 2010;19(2):134–137. <http://dx.doi.org/10.1136/tc.2009.032862>.
16. Menzies D, Nair A, Williamson PA, et al. Respiratory symptoms, pulmonary function, and markers of inflammation among bar workers before and after a legislative ban on smoking in public places. *JAMA*. 2006;296(14):1742–1748. <http://dx.doi.org/10.1001/jama.296.14.1742>.
17. Cheng KW, Glantz SA, Lightwood JM. Association between smokefree laws and voluntary smokefree-home rules. *Am J Prev Med*. 2011;41(6):566–572. <http://dx.doi.org/10.1016/j.amepre.2011.08.014>.
18. Nazar GP, Lee JT, Glantz SA, Arora M, Pearce N, Millett C. Association between being employed in a smoke-free workplace and living in a smoke-free home: Evidence from 15 low and middle income countries. *Prev Med*. 2014;59:47–53. <http://dx.doi.org/10.1016/j.ypmed.2013.11.017>.
19. Zablocki RW, Edland SD, Myers MG, Strong DR, Hofstetter CR, Al-Delaimy WK. Smoking ban policies and their influence on smoking behaviors among current California smokers: A population-based study. *Prev Med*. 2014;59:73–78. <http://dx.doi.org/10.1016/j.ypmed.2013.11.018>.
20. Gilpin EA, Messer K, Pierce JP. Population effectiveness of pharmaceutical aids for smoking cessation: what is associated with increased success? *Nicotine Tob Res*. 2006;8(5):661–669. <http://dx.doi.org/10.1080/14622200600910801>.
21. Abascal W, Esteves E, Goja B, et al. Tobacco control campaign in Uruguay: a population-based trend analysis. *Lancet*. 2012;380(9853):1575–1582. [http://dx.doi.org/10.1016/S0140-6736\(12\)60826-5](http://dx.doi.org/10.1016/S0140-6736(12)60826-5).
22. ITC Project. *ITC Uruguay National Report. Findings from the Wave 1 to 3 Surveys (2006-2011)*. University of Waterloo, Waterloo, Ontario, Canada; Centro de Investigación para la Epidemia del Tabaquismo (CIET Uruguay); Universidad de la Republica, Facultad de Ciencias Sociales; 2012.
23. Blanco-Marquizo A, Goja B, Peruga A, et al. Reduction of secondhand tobacco smoke in public places following national smoke-free legislation in Uruguay. *Tob Control*. 2010;19(3):231–234. <http://dx.doi.org/10.1136/tc.2009.034769>.
24. Hahn EJ, Rayens MK, Adkins S, Simpson N, Frazier S, Mannino DM. Fewer hospitalizations for chronic obstructive pulmonary disease in communities with smoke-free public policies. *Am J Public Health*. 2014;104(6):1059–1065. <http://dx.doi.org/10.2105/AJPH.2014.301887>.
25. Naiman A, Glazier RH, Moineddin R. Association of anti-smoking legislation with rates of hospital admission for cardiovascular and respiratory conditions. *CMAJ*. 2010;182(8):761–767. <http://dx.doi.org/10.1503/cmaj.091130>.

Appendix

Supplementary data

Supplementary data associated with this article can be found at <http://dx.doi.org/10.1016/j.amepre.2014.12.009>.