HHS Public Access

Author manuscript

Prev Med. Author manuscript; available in PMC 2016 May 01.

Published in final edited form as:

Prev Med. 2015 May ; 74: 67–73. doi:10.1016/j.ypmed.2015.01.025.

A Comparison of Three Policy Approaches for Tobacco Retailer Reduction

Allison E. Myers, MPH[1,2], **Marissa G. Hall, MSPH**[1], **Lisa F. Isgett, MPH**[1,2], and **Kurt M. Ribisl, PhD**[1,2,3]

[1]Department of Health Behavior, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

[2]Counter Tools, Carrboro, NC

[3]Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, NC

Abstract

Background—The Institute of Medicine recommends that public health agencies restrict the number and regulate the location of tobacco retailers as a means of reducing tobacco use. However, the best policy strategy for tobacco retailer reduction is unknown.

Purpose—The purpose of this study is to test the percent reduction in the number and density of tobacco retailers in North Carolina resulting from three policies: (1) prohibiting sales of tobacco products in pharmacies or stores with a pharmacy counter, (2) restricting sales of tobacco products within 1,000 feet of schools, and (3) regulating to 500 feet the minimum allowable distance between tobacco outlets.

Methods—This study uses data from two lists of tobacco retailers gathered in 2012, one at the statewide level, and another “gold standard” three-county list. Retailers near schools were identified using point and parcel boundaries in ArcMap. Python programming language generated a random lottery system to remove retailers within 500 feet of each other. Analyses were conducted in 2014.

Corresponding author information: Allison E. Myers, MPH, Department of Health Behavior, UNC-Chapel Hill, 135 Dauer Drive, 302 Rosenau Hall, CB #7440, Chapel Hill, NC 27599-7440, aemyers@live.unc.edu, Telephone: (919) 593-5822, Fax: (919) 966-2921.

Financial disclosures:

AE Myers is the Executive Director, KM Ribisl is the Chief Science Officer, and LF Isgett is a GIS Analyst/Cartographer at the 501(c)(3) nonprofit organization, Counter Tools (http://countertools.org), from which they receive compensation. Counter Tools provides technical assistance on point of sale tobacco control issues and distributes store mapping and store audit tools. KM Ribisl, AE Myers and LF Isgett also have a royalty interest in a store audit and mapping system owned by the University of North Carolina at Chapel Hill. Neither the store audit tool, nor the mapping system, was used in this study. Further, KM Ribisl has served as an expert consultant in litigation against cigarette manufacturers and Internet tobacco vendors and is a Special Government Employee for the FDA Center for Tobacco Products - the views expressed in this paper are his and not those of the FDA. MG Hall has no financial disclosures.

Results—A minimum allowable distance policy had the single greatest impact and would reduce density by 22.1% at the state level, or 20.8% at the county level (range 16.6% to 27.9%). Both a pharmacy *and* near-schools ban together would reduce density by 29.3% at the state level, or 29.7% at the county level (range 26.3 to 35.6%).

Conclusions—The implementation of policies restricting tobacco sales in pharmacies, near schools, and/or in close proximity to another tobacco retailer would substantially reduce the number and density of tobacco retail outlets.

Background

Tobacco remains the leading cause of preventable death and disability in the United States, resulting in the premature loss of over 480,000 lives and $289 billion in economic costs annually.[1] Tobacco products are sold in approximately 378,000 locations in the US including convenience stores, gas stations, grocery stores, and pharmacies.[2]

The density of tobacco retail outlets in a defined geographic area (e.g. school catchment area or census tract) is associated with the tobacco use behaviors of the people who live or study in that neighborhood.[3,4] One potential mechanism to explain this relationship is that residents of high tobacco retailer density areas have greater physical access to tobacco products, and therefore reduced retrieval costs, which can increase consumption.[5] In addition, residents in areas with high retailer density are exposed to more branded advertisements for tobacco products at stores, which can stimulate demand and increase tobacco use.[5–8] US tobacco companies collectively spend over $7 billion each year marketing and promoting tobacco products in retail outlets.[9]

Given this compelling evidence, the Institute of Medicine recommends that public health agencies restrict the number and regulate the location of tobacco retailers as a means of reducing tobacco use.[10] By implementing policy, systems, and environmental interventions to reduce the number and density of tobacco retail outlets, states and localities have the potential to mitigate the burden of tobacco and decrease tobacco consumption.

Several policy solutions can reduce the number and density of tobacco retailers.[11] One option is to prohibit the sales of tobacco products in pharmacies or stores with pharmacy counters. The primary function of pharmacies is to dispense medications and provide health care services; however, pharmacies deliver a conflicting message when they also sell tobacco products. The display and availability of tobacco products in what is perceived as a "healthy" store wrongly suggests that tobacco is a safe and acceptable product.[12] For these reasons, bans on the sale of tobacco products are supported both by the pharmacy community and the general public.[13–18] In 2014, CVS voluntarily removed tobacco products over 7,600 U.S. stores.[19] A second option is to restrict the location of tobacco retail outlets, for example, prohibiting outlets within 1,000 feet of schools or other youth serving locations.[11,20] The presence of tobacco retailers near schools puts children at particular risk: in school areas with high outlet density, smoking experimentation[21] and prevalence[3] are higher, and students are more likely to report buying their own cigarettes rather than getting them from friends or other sources.[22] Finally, a third policy option is to require a minimum distance between outlets, for example, 500 feet. Tobacco outlet density is higher in US

communities with lower median household income[5, 23, 24] or a higher percentage of African American[5, 23] or Latino families.[5, 23] This policy, therefore, may have the potential to reduce tobacco outlet clustering and density in communities where density is already highest, as has been shown from similar policies to restrict the number of alcohol retailers.[25, 26]

Tobacco control practitioners and policy makers would benefit from an analysis of the potential impact of these three unique policy solutions. Only one study in New Zealand has assessed the relative effectiveness of various policy solutions for reducing the number and density of tobacco retailers (e.g. 95% reduction in the total number of outlets, permitting sales only at 50% of alcohol outlets, eliminating sales within 1 or 2 km of schools).[27] No study has compared multiple retailer reduction policies in the US context. This study aims to quantify and compare the reduction in the number and density of tobacco retailers in North Carolina resulting from three potential policy solutions: (1) prohibiting sales of tobacco products in pharmacies and stores with pharmacy counters, (2) restricting sales of tobacco products within 1000 feet of schools, and (3) regulating to 500 feet the minimum allowable distance between tobacco retail outlets.

Methods

Identification of tobacco retail outlets

North Carolina does not require retail tobacco outlet licensing, therefore no comprehensive list of retailers was available. Two alternate lists were used: (1) a statewide list based on “malt beverage/off-premise” alcohol retailers that is used by law enforcement to conduct youth access compliance checks for tobacco products[28] because many stores that sell beer and wine (e.g., supermarkets, gas stations, pharmacies) also sell cigarettes and a (2) three-county, field verified gold standard list created for research purposes described elsewhere.[29, 30]

The first, statewide list was retrieved on February 6, 2012 from the North Carolina Alcohol Law Enforcement Agency (ALE) and it contained 7,950 stores. The list was formatted for geocoding, and cleaned to remove 373 (4.7%) stores with incomplete or non-geographically-referenced P.O. Box addresses, 134 (1.7%) stores known to *not* sell tobacco at the time of data collection in 2012 (e.g., Target, but not CVS who abandoned sales in 2014), and 29 duplicates (0.4%), leaving 7,414 stores for analysis.

The second, three-county list contained tobacco retailers in Buncombe, Durham, and New Hanover counties, and was generated via neighborhood canvassing as part of the Healthy Stores Healthy Communities study (HSHC).[29, 30] The HSHC list represents a gold-standard true census with field validation and the collection of GPS coordinates for each tobacco retail outlet (eliminating error introduced by geocoding of retail outlet addresses). The HSHC list contained 654 tobacco retail outlets: 218, 231, and 205 each in Buncombe, Durham and New Hanover counties, respectively.

Identification of pharmacies and stores with pharmacy counters

Current bans on tobacco sales in pharmacies apply not only to stand-alone pharmacies but also to retail establishments that operate health care institutions within them, such as a grocery store with a pharmacy counter.[31] In both lists, stores known to be pharmacies (e.g. CVS, Walgreens) and stores known *not* to be pharmacies (e.g., Exxon) were coded using SAS version 9.3. Next, two methods were used to determine whether the remaining stores were pharmacies or contained a pharmacy counter. In the HSHC list, online store locators were used to verify whether each store had a pharmacy. The ALE list contained over 1,000 stores belonging to supermarket chains (e.g., Wal-Mart and Kroger which sometimes, not always, contain a pharmacy counter), so it was not feasible to determine the status of each store. Instead, online store locators were used to determine the proportion of stores in a supermarket chain that had a pharmacy counter in one large North Carolina city, and that chain-specific percentage was applied to the ALE list.

Tobacco retail outlet proximity to schools

North Carolina public and private school point location data (latitude/longitude coordinates) were obtained from the National Center for Education Statistics (NCES) and applied to retailers on both lists.[32] For the HSHC counties only, digital countywide parcel (property) boundary data were obtained from county governments. School point locations were overlaid on the parcel data to identify school parcel boundaries, then Google Maps and the parcel owner (e.g. county government) were used to verify point locations and parcel shapes. Given that digital parcel boundary files are not available for every county in North Carolina and it is very time consuming to collect them, only the schools located in HSHC counties were matched to parcel boundaries. Schools in the other 97 NC counties statewide were mapped as points. The average distance from the parcel centroid to the parcel boundary for the three HSHC counties was 611 feet. Using this information, a 1,000-foot buffer was generated around school parcel boundaries for the three HSHC counties, and a 1,611-foot buffer was generated around school points statewide to accommodate for the average distance from the point location to the parcel boundaries. ArcMap 10.1 (ESRI, Redlands, California) was used for all geospatial analyses.

Tobacco retail outlet proximity to another tobacco retail outlet

ArcMap was used to identify all tobacco retailers within 500 feet of another tobacco retailer. A custom script was written in Python to randomly select one tobacco retailer to be deleted from the list. This process continued iteratively until the list contained zero tobacco retail outlets within 500 feet of another retailer. This random-choice analysis yields different results each time the process is run (see Figures 1 and 2). Thus, the process was run 1,000 times and the mean number of retailers was removed from each list. Further description of these methods is available in the supplementary material.

Outcome measures

Retailer density was calculated as the number of tobacco retailers per 1,000 residents at the county and state level. Population measures were taken from the American Community Survey 2012 5-year estimate. For each of the three policy solutions, outcomes of interest

were (a) the number of retailers removed, and (b) the percent reduction in retailer density (which is mathematically the same as the percent of retailers removed).

Results

Table 1 presents the results of analyses to test reductions in the number and density of tobacco retailers resulting from three policy solutions. Analyses were conducted in 2014.

State-level outcomes

State-level outcomes were computed using the NC ALE list containing 7414 retailers. Implementation of a pharmacy ban would remove 1,031 retailers and reduce density by 13.9%, a 1000-foot near-schools ban would remove 1,323 retailers and reduce density by 17.8%, and a 500-foot retailer proximity ban would remove 1,640 retailers and reduce density by 22.1%. If both a pharmacy ban and a near-schools ban were implemented together, 2,169 retailers would be removed, and statewide tobacco retail outlet density would be reduced by 29.3%.

County-level outcomes

County-level outcomes were computed using both lists. Based on the ALE list, in Buncombe, Durham or New Hanover counties, a pharmacy ban would reduce current retailer density by an average of 16.2% (range 13.1%–18.3%), a near-schools ban would by an average of 22.3% (range 17.7%–28.1%), and a retailer proximity ban by an average of 22.2% (range 20.4%–24.6%). Implementation of both a pharmacy-ban and a near-schools ban would reduce retailer density by an average of 35.5% (range 32.8% – 38.7%).

Based on the gold-standard HSHC list and parcel-boundary geographic referencing, in Buncombe, Durham or New Hanover counties, a pharmacy ban would reduce current retailer density by an average of 16.8% (range 16.1%–18.0%), a near-schools ban by an average of 15.4% (range 11.7%–21.5%), and a retailer proximity ban by an average of 20.8% (range 16.6%–27.9%). Implementation of both a pharmacy-ban and a near-schools ban would reduce current retailer density by an average of 29.7% (range 26.3% – 35.6%).

Discussion

Any of the three potential policies would lead to substantial reductions in tobacco retailer density. Calculations with the statewide list demonstrate that implementing a policy to restrict tobacco sales in pharmacies, near-schools, or within close proximity to another tobacco retailer would reduce density between 13.9% and 22.1% percent at the state level and between 13.1% and 28.1% percent at the county level. Using the gold-standard county-level list, analyses indicate that implementing *any one* of the three policies would reduce tobacco retailer density at the county-level between 11.7% and 27.9%. Of note, both lists produced similar results: that restricting retailer proximity resulted in the most significant reduction in density, and that the range of density reduction for any single strategy was roughly 12% to 28%.

This is one of few studies to estimate the impact of policies that reduce the number and density of tobacco retail outlets. A 2011 geospatial study found that restricting tobacco advertising or sales within 1000 feet of schools would affect 22% in Missouri and 51% in New York.[20] In comparison, restricting tobacco sales within 1000 feet of schools in North Carolina would impact nearly 18% of tobacco retail locations, which is similar to Missouri, but much lower than a more urbanized state such as New York. Further, a 2014 New Zealand study identified that a 1-km (3280.84 feet) buffer zone around schools would impact 89% of retail locations.[27] A very large buffer zone like the one in New Zealand was not used here because it is likely not feasible to implement policies that would prevent tobacco sales at the majority of existing outlets in the US. With regard to pharmacy bans, evidence from Massachusetts suggests that a pharmacy ban would remove nearly 10% of tobacco retailers in the state, based on the number of licensed pharmacies also holding a tobacco retailer license.[33] Our results indicate even greater reductions from a pharmacy ban in North Carolina, removing nearly 14% of retailers. The variation in estimated effects shown here given policy type, buffer zone distance and geographic locality offers support for estimating policy effects prior to policy selection. Our study also shows that the same policy has different effects depending on the county or geographic unit selected. For instance, banning stores near schools had a greater impact in Durham, which is a more urban area than the coastal or mountain county.

Despite emerging science on estimated impacts, in practice, several US locations have already implemented proximity-based restrictions on tobacco sales and pharmacy bans. In 2008, the City of New Orleans limited the sale of tobacco products within 300 feet of schools, churches, playgrounds, libraries or other youth-serving entities.[34] Santa Clara County followed in 2010 with a retailer licensing law that prohibited any new tobacco retailers to locate within 1000 feet of a school in any unincorporated county area.[35] A 500-foot buffer zone between tobacco retailers is indicated by ChangeLab Solutions as model retailer licensing policy in California[36] and has been implemented in Santa Clara County and the City of Huntington Park.[37] In 2008, San Francisco, California implemented the first ban on tobacco sales in pharmacies via local tobacco retailer licensing law.[11] From 2008 to February 20, 2014, an additional 80 cities in Massachusetts banned tobacco sales in pharmacies.[38] Empirical support for the long-term behavioral impact of retailer reduction policies is emerging: recent findings from India demonstrate that banning tobacco sales near schools may reduce student risk for tobacco use.[38]

Policy interventions affecting the environmental level (e.g., tobacco outlets) can have strong and sustainable health impact and high population reach,[39] however, policy implementation is a complex and challenging process. Policy theorist Kingdon articulated that policies are adopted most readily if an effective policy solution, awareness of a problem and political support come together in a ‘window of opportunity’.[40] Whereas this study provides support for effective policy solutions, public health professionals must partner with community citizens, the media, legal teams, and public health advocacy groups to generate awareness of the problem and build political support.[41] Given that any of the policies examined in this study can substantially reduce the number and density of retailers, jurisdictions might consider selecting the policy strategy that is most feasible and could gain the highest political support.

Given sufficient political support, several legal mechanisms may be used to reduce the number of tobacco retailers, and each works differently for implementation. Stand-alone ordinances are introduced, passed, signed into law and enforced to directly regulate tobacco retailing at either the local or state level.[11, 42] *Licensing* grants rights to a person or business (e.g., tobacco retailers) whereas *zoning laws* issue rights to the land (e.g., specific neighborhoods within a city).[11, 42] State or local licensing laws require a license for retailers that sell tobacco, and may restrict licenses from being issued to retail outlets that violate certain conditions of operation or eligibility requirements (e.g., if they are located near schools).[43] Local zoning codes can create specific land areas where tobacco sales are prohibited.[43] To date, retailer reduction strategies enacted through land use or zoning laws have been applied only to *new* tobacco retailers, and have "grandfathered in" existing retailers that fail to comply with the new density restrictions, though this is not legally necessary except in rare cases.[44] Grandfathering has been done to protect against a potential legal challenge on the theory that the government has "taken" a tobacco retailer's property rights (the "right" to sell tobacco), which is protected under the 5th Amendment. However, under the law of regulatory takings, a business owner has a viable "takings" claim only if application of the new law would deprive the business of *almost all* economic viability, which is not the case for tobacco retailers that sell other goods. Jurisdictions that are considering implementing retailer reduction policies should consider (1) using a tightly-drafted licensing law (which does not create any property rights claims) rather than zoning/land use,[42, 43] and (2) phasing out existing retailers that do not comply with the law through "amortization" (giving them a reasonable amount of time to phase out their existing stock of tobacco products) or by "lottery" to determine which businesses can continue to operate when there are several existing nonconforming retailers clustered together,[44] as was modeled in this study.

This study is unique because it is the first to prospectively estimate the potential impact of three unique tobacco retailer reduction policies in the US context. Strengths of the study are that it uses two datasets, one smaller field validated "gold-standard" list and a second statewide "silver-standard" list. Another strength is real world application for practitioners and policy makers as they pursue place-based public health interventions. Our findings inform the selection of politically feasible policy solutions and community education for policy change. Our study, however, has several limitations. First, our analyses are specific to North Carolina and are not generalizable to the rest of the United States. Second, gold-standard retailer lists and geographic referencing techniques were limited to only three counties and may further compromise external validity; for example, our pharmacy coding protocol may have overestimated the number of pharmacies in rural areas. Given the similar pattern of policy impact between the gold-standard and the statewide lists, we feel this limitation is mitigated. Third, the statewide list of off-premise alcohol retailers is only a proxy measure for tobacco retailers, yet is a promising alternative for many jurisdictions that lack an updated list of licensed tobacco retailers. Finally, this study examines only the estimated impact of these policies, because we cannot predict real-world policy implementation.

The implementation of policies restricting tobacco sales in pharmacies, near schools or in close proximity to another retailer would reduce the number and density of tobacco retail outlets, an important step in decreasing physical access to tobacco products and limiting exposure to tobacco marketing. Future research should establish the potential impact of tobacco retailer reduction policies on mitigating or reversing disparities in retailer density by neighborhood aggregate income level or racial/ethnic composition. Future studies should also evaluate the effect of reducing tobacco retailer density on discouraging smoking initiation and promoting cessation at the population level.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to acknowledge Ian McLaughlin, JD, for his contributions to discussing the legal implications of our findings.

Funding for this study was provided by the University Cancer Research Fund to UNC Lineberger Comprehensive Cancer Center at UNC Chapel Hill. Funding was also provided by a grant from the National Cancer Institute to Dr. Ribisl (Multi-PI) — “Maximizing state & local policies to restrict tobacco marketing at point of sale,” 1U01CA154281. The funders had no involvement in the study design, collection, analysis, writing, or interpretation.

References

1. US Department of Health and Human Services, Public Health Service. The Health Consequences of Smoking -- 50 Years of Progress: A Report of the Surgeon General. Rockville, MD: Office of the Surgeon General; 2014.
2. Center for Public Health Systems Science. Point-of-Sale Report to the Nation: The Tobacco Retail and Policy Landscape. St. Louis, MO: Center for Public Health Systems Science at the Brown School of Social Work at Washington University in St. Louis and the National Cancer Institute, State and Community Tobacco Control Research; 2014.
3. Henriksen L, Feighery EC, Schleicher NC, Cowling DW, Kline RS, Fortmann SP. Is adolescent smoking related to the density and proximity of tobacco outlets and retail cigarette advertising near schools? Prev Med. 2008; 47(2):210–214. [PubMed: 18544462]
4. Scully M, McCarthy M, Zacher M, Warne C, Wakefield M, White V. Density of tobacco retail outlets near schools and smoking behavior among secondary school students. Aus N Z J Public Health. 2013; 37(6):574–578.
5. Schneider JE, Reid RJ, Peterson NA, Lowe JB, Hughey J. Tobacco outlet density and demographics at the tract level of analysis in Iowa: implications for environmentall based prevention initiatives. Prev Sci. 2005; 6(4):319–325. [PubMed: 16163568]
6. Loomis BR, Kim AE, Busey AH, Farrelly MC, Willet JC, Juster HR. The density of tobacco retailers and its association with attitudes toward smoking, exposure to point-of-sale tobacco advertising, cigarette purchasing, and smoking among New York youth. Prev Med. 2012; 55(5): 468–474. [PubMed: 22960255]
7. Robertson L, McGee R, Marsh L, Hoek J. A systematic review on the impact of point-of-sale tobacco promotion on smoking. Nicotine Tob Res. 2014; 00(00):1–16.
8. Henriksen L, Schleicher NC, Feighery EC, Fortman SP. A longitudinal study of exposure to retail cigarette advertising and smoking initiation. Pediatrics. 2010; 126(2):232–238. [PubMed: 20643725]

9. Federal Trade Commission. Federal Trade Commission Cigarette Report for 2011. 2013. http://www.ftc.gov/sites/default/files/documents/reports/federal-trade-commission-cigarette-report-2011/130521cigarettereport.pdf
10. Institute of Medicine of the National Academies. Ending the tobacco problem: A blueprint for the nation. Washington, DC: The National Academies Press; 2007.
11. Center for Public Health Systems Science. Point-of-Sale Strategies: A Tobacco Control Guide. St. Louis, MO: Center for Public Health Systems Science at the Brown School of Social Work at Washington University in St. Louis and the National Cancer Institute, State and Community Tobacco Control Research; 2014.
12. Katz MH. Banning tobacco sales in pharmacies: The right prescription. JAMA. 2008; 300(12): 1451–1453. [PubMed: 18812536]
13. Hudmon KS, Fenlon CM, Corelli RL, Prokhorov AV, Schroeder SA. Tobacco sales in pharmacies: time to quit. Tob Control. 2006; 15(1):35–38. [PubMed: 16436403]
14. Smith DM, Hyland AJ, Rivard C, Bednarczyk EM, Brody PM, Marshall JR. Tobacco sales in pharmacies: a survey of attitudes, knowledge and befs of pharmacists employed in student experiential and other worksites in Western New York. BMC Res Notes. 2012 Aug 6.5:413. [PubMed: 22867129]
15. Kotecki JE, Hillery DL. A survey of pharmacists' opinions and practices related to the sale of cigarettes in pharmacies-revisited. J Community Health. 2002 Oct; 27(5):321–333. [PubMed: 12238731]
16. Farley SM, Coady MH, Mandel-Ricci J, Waddell EN, Chan C, Kilgore EA, Kansagra SM. Public opinions on tax and retail-based tobacco control strategies. Tob Control. 2014 Feb 25. Epub ahead of print.
17. Patwardhan P, McMillen R, Winickoff JP. Consumer perceptions of the sale of tobacco products in pharmacies and grocery stores among U.S. adults. BMC Res Notes. 2013 Jul 9.6:261. [PubMed: 23837647]
18. Kroon LA, Corelli RL, Roth AP, Hudmon KS. Public perceptions of the ban on tobacco sales in San Francisco pharmacies. Tob Control. 2013 Nov; 22(6):369–371. [PubMed: 23172399]
19. PR Newswire CVS Caremark. CVS Caremark to Stop Selling Tobacco at all CVS/pharmacy Locations. 2014 Feb 5. http://www.cvshealth.com/newsroom/press-releases/cvs-caremark-stop-selling-tobacco-all-cvspharmacy-locations.
20. Luke DA, Ribisl KM, Smith C, Sorg AA. Family Smoking Prevention And Tobacco Control Act: banning outdoor tobacco advertising near schools and playgrounds. Am J Prev Med. 2011 Mar; 40(3):295–302. [PubMed: 21335260]
21. McCarthy WJ, Mistry R, Lu Y, Patel M, Zheng H, Dietsch B. Density of tobacco retailers near schools: effects on tobacco use among students. Am J Public Health. 2009 Nov; 99(11):2006–2013. [PubMed: 19820214]
22. Leatherdale ST, Strath JM. Tobacco retailer density surrounding schools and cigarette access behaviors among underage smoking students. Ann Behav Med. 2007 Feb; 33(1):105–111. [PubMed: 17291176]
23. Hyland A, Travers MJ, Cummings KM, Bauer J, Alford T, Wieczorek WF. Tobacco outlet density and demographics in Erie County, New York. Am J Public Health. 2003 Jul; 93(7):1075–1076. [PubMed: 12835184]
24. Loomis BR, Kim AE, Goetz JL, Juster HR. Density of tobaco retailers and its association with sociodemographic characteristics of communities across New York. Public Health. 2013 Apr. 127:333–338. [PubMed: 23515009]
25. Livingston M, Chikritzhs T, Room R. Changing the density of alcohol outlets to reduce outlet-related problems. Drug Alcohol Rev. 2007 Sep.26:557–566. [PubMed: 17701520]
26. Campbell CA, Hahn RA, Elder R, Brewer R, Chattopadhyay S, Fielding J, Naimi TS, Toomey T, Lawrence B, Middleton JC. Task Force on Community Preventive Services. the effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. Am J Prev Med. 2009 Dec; 37(6):556–569. [PubMed: 19944925]

27. Pearson AL, van der Deen FS, Wilson N, Cobiac L, Blakely T. Theoretical impacts of a range of major tobacco retail outlet reduction interventions: modelling results in a country with a smoke-free nation goal. Tob Control. 2014 Jul 18. Epub ahead of print.
28. North Carolina Alcohol Beverage Control Commission. 2012 Feb 6. http://abc.nc.gov/permits/default.aspx
29. Rose S, Myers AE, D'Angelo H, Ribisl KM. Retailer adherence to Family Smoking Prevention and Tobacco Control Act, North Carolina, 2011. Prev Chronic Dis. 2013 Apr 4.10:E47. [PubMed: 23557638]
30. D'Angelo H, Fleischhacker S, Rose SW, Ribisl KM. Field validation of secondary data sources for enumerating retail tobacco outlets in a state without tobacco outlet licensing. Health Place. 2014 Jul.28:38–44. [PubMed: 24742811]
31. Tobacco Control Legal Consortium. Prohibiting the sale of tobacco products in pharmacies. 2012 http://publichealthlawcenter.org/sites/default/files/resources/tclc-guide-prohibiting-tobacco-pharmacies-2014_0.pdf.
32. National Center for Education Statistics. 2012 Feb 6. http://nces.ed.gov
33. Seidenberg AB, Hong W, Liu J, Noel JK, Rees VW. Availability and range of tobacco products for sale in Massachusetts pharmacies. Tob Control. 2013 Nov; 22(6):372–375. [PubMed: 23138526]
34. Eggler B. New Orleans City Council bans tobacco sales near schools, in The Times-Picayune. 2009 Jul 24. http://www.nola.com/news/index.ssf/2009/07/new_orleans_city_council_bars.html.
35. Santa Clara County Supes Pass Tobacco Ordinances. 2010 Oct 19. http://www.ktvu.com/news/news/santa-clara-county-supes-pass-tobacco-ordinances/nKz4t/.
36. Public Health Law & Policy (Changelab Solutions). "Plug-in" policy provisions for a tobacco retailer license. 2012 http://changelabsolutions.org/sites/default/files/documents/Plug-in_TobaccoRetailerLic_FINAL_20120120.pdf.
37. American Lung Association in California, The Center for Tobacco Policy and Organizing. Matrix of strong local tobacco retailer licensing ordinances. 2013 Sep. http://center4tobaccopolicy.org/wp-content/uploads/2013/09/Matrix-of-Strong-Local-Tobacco-Retailer-Licensing-Ordinances-September-2013.pdf.
38. Mistry R, Pednekar M, Pimple S, Gupta PC, McCarthy WJ, Raute LJ, Patel M, Shastri SS. Banning tobacco sales and advertisements near educational institutions may reduce students' tobacco use risk: evidence from Mumbai, India. Tob Control. 2013 Aug 19. Epub ahead of print.
39. Frieden TR. A Framework for Public Health Action: The Health Impact Pyramid. Am J Public Health. 2010 Apr; 100(4):590–595. [PubMed: 20167880]
40. Kingdon, JW. Agendas, Alternatives and Public Policies. Updated Second Edition. Boston: Longman; 2011.
41. Leeman J, Myers AE, Ribisl KM, Ammerman AS. Disseminating policy and environmental change interventions: insights from obesity prevention and tobacco control. Int J Behav Med. 2014 Jul 19. Epub ahead of print.
42. McLaughlin I, Pearson A, Ribisl KM. Legal issues surrounding tobacco retailer reduction strategies. In preparation.
43. ChangeLab Solutions, National Policy & Legal Analysis Network to Prevent Childhood Obesity. Licensing & Zoning: Tools for Public Health. 2012 http://changelabsolutions.org/sites/default/files/Licensing%26Zoning_FINAL_20120703.pdf.
44. McLaughlin I. Hall M. Personal email communication: Question about policy to reduce tobacco retailer density. 2014 Mar 19.

Highlights

- Impact of tobacco retailer reduction policies was estimated using two NC lists
- Policies ban tobacco sales in pharmacies, near schools, or near another retailer
- Minimum allowable distance policy reduced density by 22.1% at the state level
- Pharmacy and near-schools ban together reduced density by 29.3% at the state level
- Policies can substantially reduce the number and density of tobacco retailers

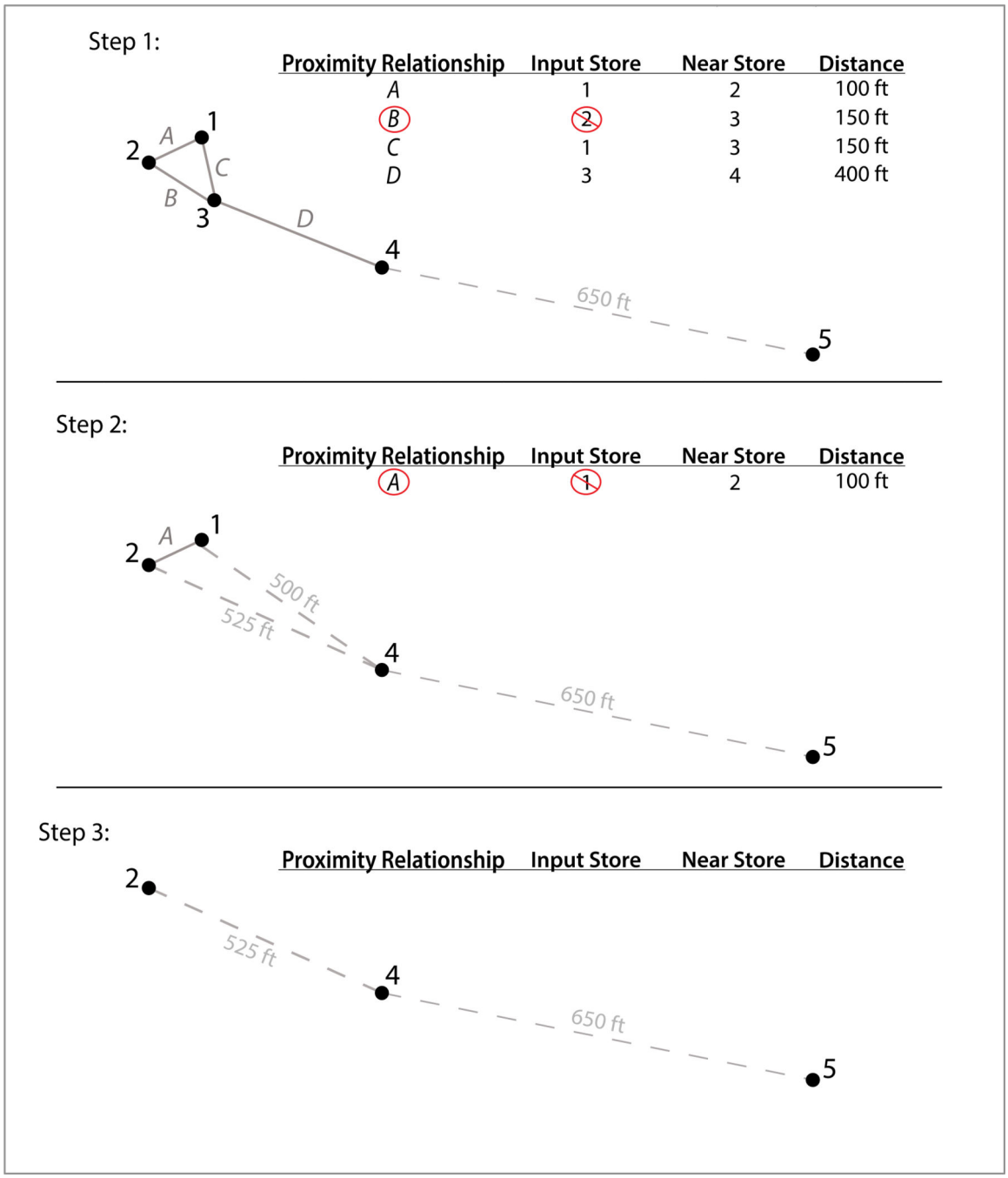

Figure 1.

Scenario 1 of random choice-removal proximity analysis used to compute the impact of a proximity ban. Step 1: A point distance analysis of all tobacco retailer locations within 500ft of another tobacco retailer is calculated and results in a nearest table of 4 proximity relationships. A proximity relationship is two retailers within 500 feet of each other. Proximity relationship B is randomly selected from the 4 possible relationships. Stores 2 and 3 are in proximity relationship B. Store 3 is randomly selected from the pair to be removed. Step 2: Store 3 is removed from the table and a new point distance analysis is calculated,

resulting in a new nearest table. There is one remaining proximity relationship left: A. Store 4 is no longer in a proximity relationship. Stores 1 and 2 are in proximity relationship A. Store 1 is randomly selected from the pair to be removed. Step 3: Store 1 is removed from the table and a new point distance analysis is calculated. The resulting nearest table has no proximity relationships, signaling that the process is complete.

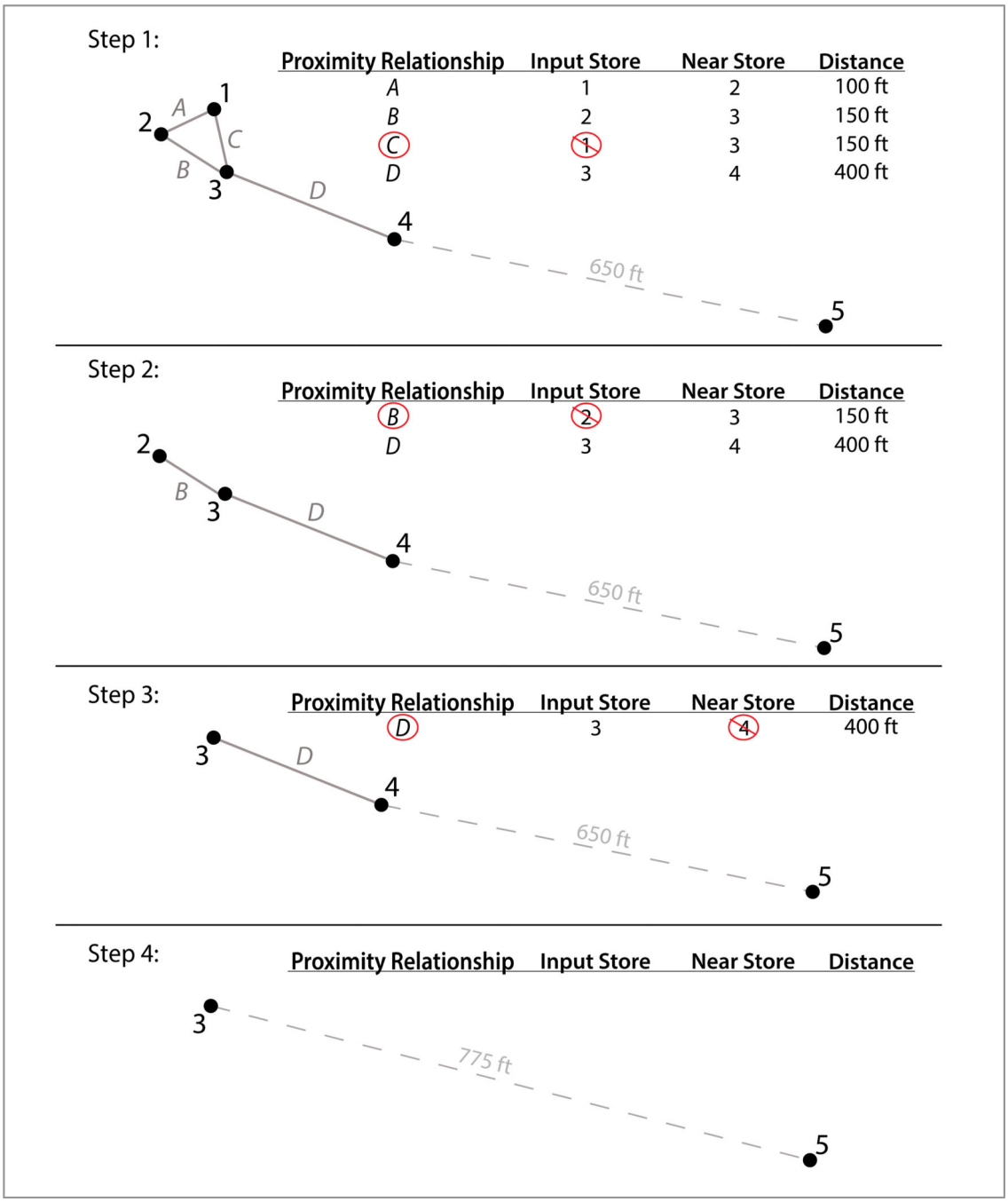

Figure 2.

Scenario 2 of random choice-removal proximity analysis used to compute the impact of a proximity ban. Step 1: A point distance analysis of all tobacco retailer locations within 500ft of another tobacco retailer is calculated and results in a nearest table of 4 proximity relationships. A proximity relationship is two retailers within 500 feet of each other. Proximity relationship C is randomly selected from the 4 possible relationships. Stores 1 and 3 are in proximity relationship C. Store 1 is randomly selected from the pair to be removed. Step 2: Store 1 is removed from the table and a new point distance analysis is calculated,

resulting in a new nearest table. There are two proximity relationships left: B and D. Proximity relationship B is randomly selected from the 2 possible relationships. Stores 2 and 3 are in proximity relationship B. Store 2 is randomly selected from the pair to be removed. Step 3: Store 2 is removed from the table and a new point distance analysis is calculated, resulting in a new nearest table. There is one remaining proximity relationship left: D. Stores 3 and 4 are in proximity relationship D. Store 4 is randomly selected from the pair to be removed. Step 4: Store 4 is removed and a new point distance analysis is calculated. The resulting nearest table has no proximity relationships, signaling that the process is complete.

Table 1

Reduction in number and density of tobacco retail outlets in North Carolina.

		State of North Carolina				Buncombe County				Durham County				New Hanover County			
		Population: 9,544,249				Population: 239,000				Population: 269,283				Population: 203,276			
		Number of tobacco retailers removed	Number of tobacco retailers remaining	Tobacco retailer density *(a)*	% Reduction in density from baseline *(b)*	Number of tobacco retailers removed	Number of tobacco retailers remaining	Tobacco retailer density *(a)*	% Reduction in density from baseline *(b)*	Number of tobacco retailers removed	Number of tobacco retailers remaining	Tobacco retailer density *(a)*	% Reduction in density from baseline *(b)*	Number of tobacco retailers removed	Number of tobacco retailers remaining	Tobacco retailer density *(a)*	% Reduction in density from baseline *(b)*
Statewide cleaned ALE list	Baseline	-	7,414	0.78	-	-	186	0.78	-	-	199	0.74	-	-	191	0.94	-
	l. After Pharmacy Ban	1,031	6,383	0.67	13.9%	34	152	0.64	18.3%	26	173	0.64	13.1%	33	158	0.78	17.3%
	2. After Near-Schools Ban (1000 feet)	1,323	6,091	0.64	17.8%	33	153	0.64	17.7%	56	143	0.53	28.1%	40	151	0.74	20.9%
	1 + 2. After Pharmacy & Near-Schools Ban	2,169	5,245	0.55	29.3%	61	125	0.52	32.8%	77	122	0.45	38.7%	67	124	0.61	35.1%
	3. After Retailer Proximity Ban (500 feet)	1,640	5,774	0.60	22.1%	40	146	0.61	21.5%	49	150	0.56	24.6%	39	152	0.75	20.4%
Field-validated HSHC three-county list	Baseline					-	222	0.93	-	-	233	0.87	-	-	205	1.01	-
	1. After Pharmacy Ban					40	182	0.76	l8.0%	38	195	0.72	16.3%	33	172	0.85	16.1%
	2. After Near-Schools Ban (1000 feet)					29	193	0.81	13.1%	50	183	0.68	21.5%	24	181	0.89	11.7%
	1 + 2. After Pharmacy & Near-Schools Ban					60	162	0.68	27.0%	83	150	0.56	35.6%	54	151	0.74	26.3%
	3. After Retailer Proximity Ban (500 feet)					40	182	0.76	18.0%	65	168	0.62	27.9%	34	171	0.84	16.6%

(a) Density = Number of tobacco retailers per 1000 population [Calculated as number of retailers*1000/population]

(b) Percent reduction in density from baseline is calculated [(Old value − new value)/[(ABS)Old value]

ALE, Alcohol Law Enforcement
HSHC, Healthy Stores Healthy Communities