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Retailer Density Reduction Approaches to Tobacco Control: A Review

Allison M. Glasser, MPH[1], **Megan E. Roberts, PhD**[1]

[1]The Ohio State University, College of Public Health, Columbus, Ohio, USA

Abstract

Tobacco retailer density is consistently associated with poor tobacco-use outcomes. The aim of this review was to synthesize the international evidence on density reduction policies. Searches in multiple databases resulted in 31 studies covering various policy approaches evaluated for their impact on retailer density. Findings indicate that bans on tobacco sales in pharmacies reduced retailer density, but perhaps not equitably. Prohibiting sale of tobacco near schools produced greater density reductions in higher-risk neighborhoods. Policies in combination were most effective. Future studies should measure the impact of these policies on tobacco use. Density-reduction policies offer a promising approach to tobacco control.

Keywords

tobacco control; retail environment; policy; review

INTRODUCTION

Tobacco retailer density contributes to the continued burden of tobacco use globally. Tobacco retailers across the United States (US) are more concentrated in areas with a higher proportion of Black and Hispanic residents and residents of lower education and income, indicating density is highest in areas where people are at greater risk for poor health.[1] Similar disparities in tobacco retailer density exist in other countries, with greater density found in immigrant neighborhoods in Canada[2] and in socioeconomically disadvantaged neighborhoods in both Canada[2] and Australia.[3–6] Across multiple countries, tobacco retailer density has been found to have a positive linear relationship with adolescent smoking (lifetime, past-year, past 30-day, and susceptibility to smoke).[7–13] Higher density of tobacco retailers has also been associated with current smoking among adults,[14] reduced smoking cessation,[15,16] greater risk of smoking relapse,[17] and heavier smoking among adolescents[18] and adults.[19] Increased tobacco use behaviors in areas with a higher concentration of retailers can be explained by not only increased access to tobacco, but also exposure to

Corresponding Author: Allison Glasser, MPH, The Ohio State University College of Public Health, Cunz Hall 380-2, 1841 Neil Ave. Columbus, OH 43210, glasser.24@buckeyemail.osu.edu.

point-of-sale marketing,[20,21] price promotions,[22] and inequities in compliance with youth access restrictions.[23,24]

Policy approaches to reduce the density of tobacco retailers often begin with retail licensing laws, which are necessary for tracking who is selling tobacco. Tobacco licensing laws can directly be used to reduce retailer density through requiring a fee for the license, which can be a disincentive to sell tobacco.[25] Indirectly, licensing can also improve compliance with retail regulations[26] and be used to leverage other strategies, such as limiting the number of licensed businesses by population size.[25] As of September 30, 2018, 36% (n=21) of US states or territories require a license to sell tobacco products including e-cigarettes, 41% (n=24) of states/territories require a license to sell tobacco products not including e-cigarettes, and 22% (n=13) of states/territories do not require a license.[27] All but five of the states with license requirements impose an annual fee, ranging from $5 to $500, which is generally used for funding enforcement activities.[27] Licensing schemes have also been enacted outside of the US, including in Canada, Scotland, Ireland, and Fiji, where tobacco retailers are required to be registered with the government if they sell tobacco, and in Australia (five out of eight states),[28] Singapore, Finland, and Hungary, where tobacco retailers are required to apply and pay for a license before being able to sell tobacco.[29] In Australia, price increases in licensing fees have been associated with reductions in license renewals and purchases.[30]

The primary policy approaches to reducing tobacco retailer density include prohibiting sales in specific retailer types and near youth-populated areas, targeting clusters of retailers, and capping the number of retailers to a certain amount within a community (Table 1).[31] San Francisco was the first city in the US to ban sale of tobacco in pharmacies, and many cities have since followed suit.[31] Sale of tobacco in pharmacies is also prohibited in Canada (except in British Columbia), the United Kingdom, France, and Italy.[28] Creating a buffer around schools has been implemented in many cities in the US and has strong political support.[31,32] Tobacco retailers are prohibited within 100 meters of schools in India,[12] and within 100 meters of places of worship in the United Arab Emirates.[28] De-clustering retailers and capping them at a maximum number are strategies that have been implemented in alcohol control and are being increasingly used in tobacco control,[31] such as requiring a minimum distance of 150 meters between tobacco retailers (unless they exceed a sales threshold) in Spain.[33]

The aim of this paper is to present a comprehensive review of the peer-reviewed published literature, as well as grey literature, on tobacco retailer density reduction and to answer the following questions:

1. What tobacco retailer density reduction policies have been implemented and formally evaluated?
2. Have these policies been evaluated for their impact on a) reduction in retailer density (proximal) and b) reduction in tobacco use (distal)?

MATERIALS AND METHODS

Search Strategy

Databases and Keywords—A search of the published literature on tobacco retailer density reduction strategies indexed in PubMed, CINAHL, Embase, Scopus, or CAB Global Health was conducted through May 2019, using the following search terms: "tobacco retail* licens*" OR "tobacco retail* density." No cut-off year was established, as retailer density reduction is a relatively recent policy approach in tobacco control. Accordingly, the grey literature was also searched (via Google search) to supplement the published literature to capture additional non-published density reduction policies. Additional relevant peer-reviewed journal articles were included based on backward citation (cited articles) searching of included studies in Google Scholar.

Abstract/Title and Full Text Review—Original research (qualitative and quantitative) and systematic reviews from any country that present information on the retailer reduction policies in Table 1 were included in this review. Ineligible publication types included commentaries, editorials, letters to the editor, conference proceedings, research protocols, and non-systematic reviews. Other exclusion criteria included: study was not published in English, study was not available online in full text, or study was not relevant to tobacco retailer density or licensing laws (e.g., studies examining the influence retail environment on tobacco use, those examining retailer licensing but not focused on a particular licensing ordinance to reduce density, and those examining retailer density but not approaches to reducing it). AG conducted all abstract/title and full text review. References were managed in EndNote X8.

Data Extraction—AG extracted the data from included studies. The following study characteristics were captured for synthesis in a standardized form: year, country where the study was conducted, scope of the setting (e.g., country, state, county), topic of work (e.g., policy perceptions, policy simulation modeling), policy approach (described in the next paragraph), measures assessed (e.g., % reduction in density), results, and limitations.

We coded for four main policy approaches represented in the literature: (1) rate or number reduction ("capping"), (2) ban of sales in specific retailer types, (3) decreasing proximity of retailers to schools ("school buffer"), and (4) decreasing proximity of retailers to each other ("retailer buffer" or "declustering"). Study findings will be presented by study topic and policy type.

RESULTS

One hundred ninety-four papers were included at the abstract/title review phase (Figure 1). After full text review, 31 studies met the inclusion criteria for this review. Twelve of the studies were based in New Zealand (NZ),[37–48] and the remainder was based in the US.[32,49–66]

Studies covered the following topics: (1) *policy perceptions*, including one newspaper content review article,[57] nine cross-sectional surveys assessing public opinion,

[32,37,46,47,51,58,63–65] four qualitative studies assessing store representative or tobacco control expert opinion,[38,43,44,55] and one hypothetical policy experiment;[41] (2) *policy landscape and evaluation*, including nine studies measuring change in retailer density or smoking prevalence (following actual or hypothetical policy change),[49,50,52,56,59–62,66] and one study analyzing the current policy landscape;[54] and (3) six *policy simulation modeling* studies (employed a computational model, such as agent-based modeling).[39,40,42,45,48,53] The number of studies relevant to each of the four main policy approaches is presented in Table 2.

Policy Perceptions

Longitudinal Changes—Over time, news coverage of tobacco retail environment policies has increased, and retailer density reduction policies have received the most attention. Myers and colleagues (2017) examined national (n=5) and state newspapers (n=268) for content in the domain of tobacco retailer licensing, locations and density in the US. In 2007, 36.1% of the articles covered topics in this domain (compared to other domains, including advertising and taxing), which increased to 80.3% in 2014.[57] There is also some evidence of increased support for these policies over time. The Action on Smoking and Health in NZ survey of students ages 14–15 years from 2009 to 2012 found increasing support for policies limiting youth access to tobacco,[37] from 48–65% of youth in 2009 to 57–71% in 2012.[37]

Rate or Number Reduction in Retailers—One qualitative study interviewed tobacco retailer store owners or managers in NZ (n=21) to assess their perceptions of capping the number of licensed retailers in a geographic area, among other policies.[44] Most participants supported this policy if it would first be introduced to new businesses, instead of immediately being applied to existing stores.[44] Another qualitative study measured the opinions of tobacco control experts (n=25) on retailer density reduction approaches in NZ in 2014.[43] A majority of the participants saw tobacco retail licenses serving as a first step toward retail reduction policies and deterring some retailers from selling tobacco, in addition to strengthening enforcement of existing tobacco control laws. Prohibiting transfer of licenses as an approach to reducing density was supported by participants.[43] A survey of a commercial internet panel of adults in NZ in 2013 found that most occasional and former smokers, as well as non-smokers, supported reducing the number of stores selling tobacco, while daily smokers were neutral.[47] One city-wide cross-sectional survey (Tobacco Behavior and Public Opinion Survey) of adults in New York City (NYC) (n=1440) in 2012 found that about half of participants favored limiting the number of retail licenses to sell tobacco and a little less than half (46%) favored not granting new licenses moving forward.[32] Support was higher among non-smokers compared with smokers.[32]

Ban of Tobacco Sales in Specific Retailer Types—Six representatives from grocery stores in New York (NY) (n=5) and Ohio (n=1) who voluntarily elected to end tobacco sales within the previous five years (2007 to 2012) discussed their motivations to stop selling tobacco.[55] The primary reasons to end sale of tobacco was health/ethics or business (e.g., declining tobacco sales or poor fit with store's image). Most of these stores reported a loss in

sales as a result of the decision, but the loss was not substantial enough to impact overall profits.[55]

Researchers from another qualitative study queried store owners in NZ (n=36) about their opinions about a potential ban of tobacco sales in convenience stores.[38] Owners were apprehensive about discontinuing sale of tobacco because most perceived that a high proportion of their customers purchase tobacco. Many owners expressed a willingness to comply with laws the government may implement, but worried about competition for customers if only certain types of retailers were restricted and not others.[38] A similar study also found a lack of support for policies banning sales of tobacco at certain retailer types because it was unfair.[44] Tobacco control experts had mixed opinions banning sale of tobacco at certain retail types, only allowing sales at stores in which you need to be 18 years of age or older to enter (some participants viewed these as unfair policies and likely unacceptable to stakeholders), or prohibiting sale of tobacco at alcohol-licensed premises.[43]

Among adults residing in NYC (Tobacco Behavior and Public Opinion Survey) in 2012, 46% favored selling tobacco only in tobacco exclusive stores, about half favored prohibiting sale of tobacco in grocery stores, and 57% supported prohibiting sale of tobacco in pharmacies; support for all of these was higher among non-smokers compared with smokers.[32] In NZ, there was strong support in 2013 for banning sale of tobacco products where alcohol was sold among former smokers and non-smokers, but minimal support among daily and occasional smokers.[47]

One of the earliest studies examining perceptions of banning tobacco in pharmacies, Hudmon et al. (2006) found a small minority of licensed pharmacists and pharmacy students in CA supported selling tobacco in pharmacies (both 2%) and almost all pharmacy consumers (96.8%) reported that if sales were banned, they would still shop there just as often or even more often.[51] Another study of pharmacists in NY in 2010 reported consistent findings.[64] Two nationally representative samples of US adults from 2011[58] and 2014[65] showed similar findings. In 2011, the majority of adults reported that tobacco sales should be restricted in pharmacies (hidden from view: 26%; no sale at all: 31%) and grocery stores (hidden from view: 30%; no sale at all: 24%). Forty-two percent reported a preference to purchase medications from a pharmacy that does not sell tobacco products, which was highest among non-smokers, followed by former smokers, then current smokers.[58] In 2014, 66.1% of adults favored prohibiting sales of tobacco in pharmacies.[65] A convenience sample of shoppers at pharmacies in San Francisco following the 2008 ban of sale similarly expressed that the policy had little impact on their shopping at pharmacies; more smokers reported no longer shopping at pharmacies.[63]

Contrary to the approach taken by CVS pharmacies in the US to ban tobacco to be consistent with a mission of health,[68] a possible policy option in NZ is to restrict sale of tobacco to only pharmacies, where cessation advice from professionals can be provided. A recent study of pharmacists in Wellington found that although there are some advantages to this approach (e.g., fewer tobacco outlets), only about 26% of the pharmacists thought it was likely that their pharmacy would sell tobacco even with the policy.[46] Another NZ-based study surveyed an online panel of adult current smokers (n=623) on policy perceptions after

randomly allocating them to one of six conditions where they read a policy scenario and were asked to report on their perceived effect of that policy.[41] Two policies rated as most likely to reduce smoking initiation and increase smoking cessation were allowing tobacco to be sold only at 50% of liquor stores and allowing tobacco to be sold *only* at pharmacies (compared with school buffer policies and prohibiting sales at alcohol licensed premises).[41]

School Buffer—Qualitative studies of tobacco retailer store representatives[44] and tobacco control experts in NZ[43] found that most participants supported school buffer policies. In addition, two-thirds of adults in NYC reported support of a school buffer policy in a 2012 survey,[32] and there was strong support for a ban of retailers within 500 meters of a school in 2013 in NZ, regardless of smoking status.[47]

Retailer Buffer—No studies assessed perceptions of a retailer buffer ("declustering").

Summary—Most studies assessing perceptions of tobacco retailer density reduction policies were focused on retailer type bans. Support was strongest for a ban of tobacco sales in pharmacies.[38,51,58,65] While adult consumers supported selling tobacco only in tobacco exclusive stores, tobacco control experts viewed this as likely unacceptable to stakeholders.[32,43] Adult consumers support a ban of tobacco sales in grocery stores,[32,58] and some stores have voluntarily removed sales in some states.[55]

Adult consumers and tobacco control experts additionally support capping the number of licenses, prohibiting issuing of new licenses, or preventing transfer of licenses to reduce density of retailers;[32,43] however, store owners believe these restrictions should only apply to new businesses.[44] Studies showed strong support for school buffer policies,[32,43,44] while no studies assessed perceptions of retailer buffer policies.

Policy Landscape and Evaluation

Studies reporting on the policy landscape or assessing reductions in retailer density following a hypothetical or actual policy are all based out of the US.[49,50,52,54,56,59–62,66]

Policy Landscape—A national study of tobacco control program representatives' report of state-level variation in tobacco control policies was conducted in 2012 (no representative from Connecticut or Virginia) and 2014 (no representative from Ohio or Pennsylvania).[54] Along with efforts to regulate e-cigarettes, states were most active in reducing or restricting the number, location, density, and type of tobacco retailers, with 80% of states reporting such activity.[54] Activities specifically included licensing fees for tobacco retailers (63% implemented), minimum distance policies from places youth frequent (7% had implemented, but 28% reported planning), prohibiting sales at certain retailer types (15% planned), and limiting/capping the total number of licenses (17% planned).

A search of the grey literature found a policy scan and other resources that provided additional data on where retailer reduction strategies are being implemented across the US.[25] In 2017, Contra Costa County, CA capped the number of retailers at 90 for unincorporated areas, while Little Canada, Minnesota (near Minneapolis-St. Paul) capped the number of retailers attributing more than 90% of their revenue ("significant retailers") to tobacco to

2%.[25] Unincorporated Sonoma County, CA began in 2016 restricting retailers to one per 2,000 residents (about 75 total retailers), and nearby Oroville restricts significant retailers to one per 4,000 residents. San Francisco began capping retailers to 45 per electoral district in 2015,[69] and Philadelphia has also capped retailers to one per 1000 per planning district.[25]

Policies limiting proximity to other retailers has ranged from 200 feet in Huntington Park, CA to 500 feet in Palo Alto, CA and 1000 feet in Benton County, Oregon.[25] Two locations (Bishop, CA and Renville County, Minnesota) adopted policies limiting retailers within 1000 feet of schools, while pharmacy bans are spreading throughout municipalities in CA, Massachusetts, and Minnesota.[25,70]

Policy Evaluation—Seven studies measured density reduction after a hypothetical[50,56,59,60] or actual[49,52,62] density reduction policy was implemented. Two studies measured changes in smoking behavior following a density reduction policy.[61,66] Table 3 provides a summary of the estimated percent reduction in retailer density and smoking resulting from the four main density reduction approaches of focus in this review.

Rate or Number Reduction in Retailers: Although many jurisdictions have put in place policies to reduce the rate or number of retailers, there have been no published formal evaluations of these policies in peer-reviewed journals. However, one evaluation was published in a report found through the grey literature search: San Francisco's cap of retailers to 45 per electoral district in 2015 resulted in a 7.5% decrease across the city within 10 months of implementation, and was as high as 13% decrease in one city district.[69] In addition, an editorial reported preliminary evaluation data indicating a 9.8% decrease in the total number of licenses issued in Philadelphia the first year after implementing several density reduction approaches, including a density cap of one retailer per 1,000 residents in each planning district in the city.[62]

Ban of Tobacco Sales in Specific Retailer Types: Five studies evaluated policies to ban tobacco sales at specific retailers, all of which examined pharmacy bans.[50,52,56,60,61]

Pharmacies in NYC were required to stop selling tobacco by the end of 2018, so Giovenco et al. (2018) examined tobacco retailer density in NYC neighborhood tabulation areas (NTAs; groups of Census tracts), which approximate historical neighborhoods, with and without pharmacies.[50] Adjusting for population size, the average retailer density per 1000 residents across NTAs was 0.97 prior to implementation of the law. After removing all pharmacies from the sample (6.2%; n=510), average retailer density reduced to 0.91 per 1000; average percent reduction was 6.8%, which ranged from 0% to 50%.[50] These laws disproportionately resulted in greater density reduction in neighborhoods predominated by non-Hispanic white residents, those with higher household income, those with greater than a high school education, and those who had health insurance. There was a significant inverse relationship between percent reduction in retailers for a neighborhood and percent Black residents in that neighborhood ($\beta = -0.46$, 95% CI = −0.81–0.10). However, NYC has also recently implemented other retailer density reduction policies (50% licensing cap), which were not controlled for in their analyses, a choice that the study authors justified.[50]

Case cities that had a pharmacy ban in place in 2012 (San Francisco and Richmond in CA, 37 municipalities in Massachusetts (MA)) were compared to control cities with no ban.[52] Overall, density reduction in CA was 1.4 times as great in case cities compared with control cities, and in MA, reduction was 3.2 times as great in case compared with control cities.[52] These same data, combined with smoking prevalence data from the Behavior Risk Factor Surveillance System, showed that cities with a tobacco-free pharmacy law had a slight, but non-significant, effect on reducing smoking prevalence.[66] Tucker-Seeley and colleagues (2016) measured correlates of retailer density by census tract in Rhode Island before and after removing CVS and other pharmacies from statistical models.[60] As tobacco retailer density of a tract increased, household income and educational attainment decreased, and the proportion of African Americans, Hispanics, and families living in poverty increased. After removing all pharmacies from the models, the demographic correlates of density remained the same,[60] indicating that a pharmacy ban in Rhode Island may not reduce disparities in density.

Although North Carolina does not have a pharmacy ban in place, Myers et al. (2015) estimated the impact of this policy at the state and county level.[56] At the state level, implementation of a pharmacy ban would reduce density by an estimated 13.9%, and was found to be about the same across three different North Carolina counties. The policy resulted in the greatest reduction at the state-level when combined with a school buffer policy (29.3% reduction).[56]

An ecological analysis examined smoking during pregnancy before and after tobacco products were banned from CVS pharmacies (2011/2012 to 2015/2016) in the Southeastern US; however, this effect was confounded by corporate decisions during the same period by two large dollar-store chains to begin selling tobacco. Overall, this study found that smoking during pregnancy decreased across counties, and a greater decrease was found in counties where the decline in retailers due to the CVS ban outweighed the gain in retailers from the dollar-store uptake.[61]

School Buffer Policies: Four studies examined the impact on density reduction of school buffer policies, one each at the state,[56] neighborhood,[59] county,[49] and city levels.[62]

The North Carolina study previously described also examined the impact of a school buffer policy.[56] At the state level, implementation of a 1000-foot school buffer would reduce density by 17.8%.[56] Ribisl and colleagues (2017) examined the potential impact in Missouri and NY of a school buffer policy of 1000 feet on tobacco retailer density.[59] In this study, the school buffer would reduce retailer density greater in predominately lower income, African American, and Hispanic neighborhoods compared with higher income and white neighborhoods, indicating this policy may have potential to reduce inequities in retailer density. For example, density reduction post-policy in low-income neighborhoods was 71.9% compared with 46.4% in high-income neighborhoods in NY. Similarly, neighborhoods with a high proportion of African Americans in Missouri would experience a 34.0% reduction in retailer density post-policy, compared with an 18.1% reduction in neighborhoods with a low proportion of African Americans. Results were similar for Hispanic neighborhoods and across both states.[59]

In Santa Clara County, CA, a comprehensive licensing ordinance was implemented in 2010 that prohibited licenses to any new retailer within 1000 feet of a K-12 school.[49] Focusing only on unincorporated Santa Clara County, after implementation of the ordinance, three retailers (out of 36) decided to stop selling tobacco that were located within 1000 feet of a school.[49] Density reduction since 2010 has not been evaluated. Preliminary evaluation data from Philadelphia indicated a 9.8% decrease in the total number of licenses issued in the first year after implementing several density reduction approaches, including a 500-foot school buffer.[62]

Retailer Buffer Policies: Two studies estimated the impact of a retailer buffer on tobacco retailer density reduction.[49,56] The licensing ordinance in Santa Clara County, CA required an annual fee of $425 per retailer,[49] no new retailers within 500 feet of another tobacco retailer, and no transferring of licenses after a business closes.[49] After implementation of the ordinance, 31% (n=11) of retailers decided to discontinue selling tobacco because of the cost of the fee, one of which was located within 500 feet of another.[49]

Myers and colleagues' analysis of a potential retailer buffer in North Carolina estimated that at the state level, a 500-foot retailer buffer policy would reduce density by 22.1%, which was similar at the county level (three counties in the state).[56]

Summary—Over time, states have increasingly implemented policies at the state and local level to reduce retailer density. In local jurisdictions, the most common policies include pharmacy bans, school buffers, and capping the number of licensed retailers. Only one evaluation has been conducted on reduced rate/number-based policies. All but two studies[52,66] evaluating pharmacy bans were hypothetical (i.e., statistically removed pharmacies from current density estimates).[50,56,60] These all found a significant reduction in retailer density following a pharmacy ban; however, one study found no difference between high-risk and low-risk Census tracts in reduction,[60] while another found lower reduction in high-risk neighborhoods.[50] This later finding suggests retailer density disparities may persist or worsen if other policies are not considered in combination with a pharmacy ban. In contrast, school buffer policies may reduce disparities in retailer density.[59] Comparison of a pharmacy ban to a school buffer and a retailer buffer found the greatest reduction in density resulting from a retailer buffer.[56] Only two studies examined changes in smoking behavior following a density reduction policy, finding minimal effect of pharmacy bans on smoking prevalence.[61,66]

Policy Simulation Modeling

This review included six simulation modeling studies, and all but one[53] were based in NZ.[39,40,42,45,48] One study compared all four main types of policy approaches,[53] two compared three policy approaches,[39,40] and three only projected the impact of one approach.[42,45,48]

Rate or Number Reduction in Retailers—In NZ, Pearson et al. (2015) projected the 10-year impact (up to 2025, NZ's target date to reduce smoking prevalence to <5%) of various retailer reduction policies, including reducing the number of retailers by 95% (50% reduction in the first year and 5% each subsequent year).[40] By 2025, this policy approach

would result in a 0.3% greater reduction in smoking prevalence compared with the status quo scenario (9.6% vs. 9.9%).[39,40] Effects were largest in rural compared with urban areas.[40] Researchers refined their 10-year models and examined health gains, as measured by quality adjusted life years (QALYs).[39] A similar policy simulation reduced the number of outlets over 10 years by 90% plus imposed a quota on the number of licenses granted per population size (one per 10,000 residents), which declined over time.[48] This policy would result in a 7.3% reduction in daily smoking among non-'Māori' New Zealanders and 17.8% among 'Māori' New Zealanders.

Another potential policy in NZ explored by Robertson and Marsh (2018) was to prohibit new retailers from selling tobacco after 2020.[42] Using the mean annual closure rates from 2006 to 2016, by 2025, the combined total number of retailers would decrease by an estimated 27% and would reach 84% by 2050, thus falling short of the endgame goal with this particular policy approach.[42]

Hypothetical towns were simulated by Luke et al. (2017) in the "Tobacco Town" agent-based model, which examined four potential policy approaches individually and in combination: (1) retailer cap (50–90% of initial number of tobacco retailers), (2) school buffer (500–1500 feet), (3) retailer buffer (500–1500 feet), and (4) retailer type restriction (pharmacies and convenience stores).[53] Town types included urban rich, urban poor, suburban rich, and suburban poor, and at baseline, retailer density was highest in urban and poor areas. These towns were generated based on data from California (CA) neighborhoods.

In the "Tobacco Town" model, as expected, density reduction was projected to be greatest with higher levels of each intervention across town areas. For example, in urban poor areas where baseline retailer density is 12.03 per square mile, retailer caps of 90%, 80%, 70%, 60%, and 50% would result in densities of 10.83, 9.62, 8.42, 7.21, and 6.03 stores per square mile, respectively.[53] Combining higher intensity policies across approaches resulted in greater density reduction than combining moderate policies.

Ban of Tobacco Sales in Specific Retailer Types—The Pearson et al. model in NZ also showed that by 2025, permitting sale of tobacco in only 50% of liquor stores resulted in a 94% reduction in number of stores in the country.[40] The estimated cigarette smoking prevalence was lowest for the 50% of liquor stores policy (9.1%) compared to the status quo estimation (9.9%) and other policy approaches.[39,40] Similar to the 95% reduction policy, effects of the liquor store policy were largest in rural compared with urban areas.[40] This policy resulted in an estimated 129,000 QALYs gained, which was 1.5 times higher than the next most effective intervention (school buffer of two km). The liquor store intervention also shows the potential to reduce disparities, as five times more QALYs were estimated to be gained by 'Māori' compared to non-'Māori' New Zealanders.[39] Researchers in NZ also modeled the 10-year projected effect of a step-by-step process toward restricting sale of tobacco to only pharmacies (eventually 26% of community pharmacies plus brief opportunistic cessation advice once per year), finding that the policy would reduce smoking among 'Māori's by 50.1% and among non-'Māori's by 51.8%.[45] This would also gain 41,700 QALYs and avoid 0.24% of all future healthcare expenditures over the remainder of the lives of the cohort examined in the model.

In the "Tobacco Town" model, banning tobacco sales in convenience stores resulted in a greater decrease in density compared with banning sales in pharmacies across town types (about 54% vs. 10%).[53]

School Buffer Policies—In NZ by 2025, Pearson et al. projected that a school buffer of two km (6,561 feet) would result in the largest estimated reduction in retailers (96%) compared to other policy approaches, and a school buffer of only one km (3,280 feet) would reduce density by 89%.[40] The estimated cigarette smoking prevalence was predicted to be 0.6% lower at 9.3% for the two km buffer compared with the status quo (9.9%). The one km buffer was estimated to result in a smoking prevalence of 9.7% by 2025.[39,40] Effects were larger in rural areas than urban areas.[40] The one km buffer was estimated to result in 32,000 QALYs gained, while the two km buffer would result in more than double the QALYs gained (84,800).[39]

The US-based "Tobacco Town" model, similar to retailer caps, projected the greatest density reduction with higher levels of the intervention, resulting in a density of 11.27, 6.75, and 3.23 retailers per square mile for a 500-, 1000-, and 1500-foot school buffer compared with 12.03 at baseline.[53] The 500-foot buffer resulted in very little reduction in density (0.2% in suburban towns and 0.5% to 0.6% in urban towns), while the 1500-foot buffer resulted in much larger reductions in density (26.5% to 35.5% in suburban towns and 59.3% to 73.2% in urban towns). The density reduction was greatest for urban and poor towns compared with suburban and rich towns.

Retailer Buffer Policies—Similar results to the school buffer policies were found for retailer buffer policies in the "Tobacco Town" model.[53] Density reduction was higher in urban and poor towns compared with suburban and rich towns, and for greater buffer distance.[53] For example, a 70.5% reduction was estimated to occur following a 1500-foot ban in urban poor neighborhoods compared with only 8.1% reduction following a 500-foot ban.[53] No other studies projected outcomes based on a retailer buffer policy.

Summary—NZ-based models predicted that while a two km school buffer would result in the greatest reduction in retailers, permitting sale of tobacco in 50% of liquor stores resulted in the greatest decline in smoking prevalence, QALYs gained, and money saved over time.[39,40,42] In the US, the only modeling study found the most effective policies to reduce density are school and retailer buffer policies of 1500 feet for urban towns and convenience store bans and retailer caps in suburban towns.[53] Across towns, combining high intensity policies is the most effective density reduction strategy.

CONCLUSIONS

All tobacco retail reduction policies reviewed in this paper demonstrated either actual or predicted reduction in the proximal outcome of interest, retailer density reduction. Modeling studies suggest modest benefit, in terms of reducing smoking prevalence and increasing QALYs, of these policies over time compared to the status quo.[40] Only two studies examined our distal outcome of interest, smoking prevalence. One found that counties that experienced a net benefit from recent corporate policy changes (i.e., those that lost more

tobacco retailers following CVS's discontinuation of tobacco sales, relative to their gains in tobacco retailers following Family Dollar and Dollar General's decision to sell tobacco) experienced a greater decline in smoking during pregnancy, compared to counties without this net benefit;[61] the other found minimal reduction in smoking prevalence following a pharmacy ban.[66] Policy perception studies also demonstrate high levels of support for these approaches. Included studies in this review were mostly qualitative studies or cross-sectional surveys, and policy evaluations consisted primarily of hypothetical policy scenarios or predictions into the future.

Overall, this review found strong preliminary evidence to support certain retailer reduction policies. Bans on sales of tobacco in pharmacies appear effective at reducing retailer density, but perhaps not equitably.[50,60] Restricting sale of tobacco to *only* pharmacies, while projected to be effective,[41,45] has modest support,[46] and may perpetuate inequities between 'Māori' and non-'Māori' smokers.[45] Restricting purchase of tobacco to half of liquor stores has support from smokers[41] and may be the most cost-effective and equitable approach with the greatest impact on smoking prevalence.[39,40] This approach is specific to NZ and was not examined in US-based studies. Prohibiting sale of tobacco within a certain radius of schools has support from all stakeholders and is effective in reducing retailer density.[32,43,44] Unlike pharmacy bans, greater decreases in density are seen in low-income neighborhoods with a high proportion of racial or ethnic minority residents.[59] Reducing the rate of retailers by 90% in NZ could be both effective and reduce disparities in smoking between 'Māori' and non-'Māori' residents.[48] For both school buffer and retailer buffer policies, greater distances required around establishments result in much greater reduction in density.[40,53] Policies in combination were found to be the most effective in reducing retailer density.[53,56]

Limitations to the Current Body of Literature & Areas in Need of Future Research

A limitation to all studies examined in this review is that they may only be generalizable to the city, state or country in which they were conducted. Similarly, US-based policies may perform differently in the policy environment in NZ and vice versa. In NZ, tobacco products are not permitted to be displayed at the point-of-sale, an important difference from the retail environment in the US.[71] Other key differences include that standardized (plain) packaging is required for all tobacco products in NZ, and pictorial warning labels are required on cigarette packages that cover 75% of the front of the package. The public quitline logo must cover 100% of the other side of the package. These differences highlight the potential feasibility of implementing stricter density reduction policies in NZ (e.g., banning sale of tobacco in half of liquor stores), although none have been implemented to date. The studies in this review may also not be generalizable to the policy context in countries beyond, of which no studies on these approaches are currently published.

In 2000, Lawrence Gostin proposed criteria for justifying public health regulation related to public risks, the intervention's effectiveness, economic costs, personal burdens, and the policy's fairness.[72] When evaluating the findings from the current review against these criteria, there are some areas where research is needed to demonstrate full justification of policy approaches. In addition, there are specific types of policies that have received little evaluation, and require further investigation before conclusions can be drawn about their

effectiveness. Guided by Gostin's criteria, we note the following specific areas in need of more research.

Demonstrate Intervention's Effectiveness—Studies included in this review suggest that retail reduction approaches are effective for impacting the proximal outcome, retailer density.[49,50,52,56] However, only two studies measured change in the distal outcome, tobacco use, following policy implementation.[61,66] Results from these studies were largely descriptive and the relationship between density reduction and smoking may be confounded by other factors. At the population level, changes in tobacco use may not be seen for years, and most of these policies were implemented recently (within the last five years). In addition, it make take years to observe even the proximal effects of some policies, such as ceasing to issue new licenses after a certain date, which Robertson and Marsh predicted would take 30 years to reduce density by 84%.[42] Other simulation modeling studies included in this review reveal that stricter versions of policies (e.g., larger buffer around schools or retailers) will have the greatest impact on retailer density and smoking reduction over time.[39,40,53] Combining approaches will also be more effective than implementing one approach alone.[53,56] Long-term evaluation of existing policies using consistent measures is needed.

Although strong evidence has accumulated to support some types of retail density reduction policies, particularly for pharmacies and school buffers, more research is needed on the impact of reduced retail density on tobacco use behaviors and other co-occurring behaviors (e.g., alcohol use). In addition, these policies should be evaluated using a health equity lens to understand what approaches may affect more advantaged groups than disadvantaged groups so that future policy development can address inequities. Regarding particular policies that need further examination, although many local jurisdictions have been implementing rate- or number-based policies to reduce tobacco retailer density, only two have been evaluated.[25,62,69] As described in the Introduction, many countries have implemented tobacco retail licensing schemes, but none outside of the US have published formal evaluations. Additionally, there is some evidence that simply increasing the price of a license can reduce the number of retailers selling tobacco products,[30,49] so future research should examine the impact of fee amount on retailer density and tobacco use behaviors.

Assess Economic Costs—Three studies included a cost-effectiveness analysis,[39,45,48] and it was found that only permitting half of liquor stores to sell tobacco was the most cost-effective approach among those examined, saving NZ about $1.23 billion (US).[39] Luke et al. (2017) projected cost increases per pack of cigarettes as this would theoretically reduce demand for the products; however, cost-savings were not assessed. Qualitative studies of retail store owners showed that while owners are concerned about the economic impact of no longer selling tobacco, those who have stopped selling the products have not seen a notable loss in profit.[38,55]

Assess Burdens on Individuals—The greatest burden of tobacco retailer reduction policies falls on the business owners and managers. Licensing ordinances typically require licenses to be renewed annually and with fees up to $500.[25,27] Representatives from retailers expressed apprehension about losing customers as well as needing to pay an annual fee, but

many reported a willingness to comply if laws were put in place.[38,44] In theory, the burden of these policies will also fall on smokers who will have more limited access to tobacco; however, only two studies examined changes in smoking behavior.[61,66]

Assess Fairness of Policy—A population level reduction in retailer density is a desired outcome of the policy approaches reviewed in this paper. However, there is the potential that these policies may inequitably impact different communities, thereby perpetuating or increasing health disparities. Pharmacy bans show great promise for reducing retailer density, but they may not reduce existing socioeconomic disparities in density and may even increase those disparities.[50,52,60] School buffer policies also have reduced retailer density, and unlike pharmacy bans, have been shown to reduce density predominately in more high-risk neighborhoods.[59] Policies that have been implemented across cities and counties in the US, as well as in other countries, will need to be evaluated by examining trends in behavior in addition to assessing other neighborhood characteristics. For store owners, there was concern about the fairness of policy approaches that restrict sales in certain retailer types, where competition with stores that continue to sell tobacco may damage others' business.[38,43,44] In general, support for these policies was high, especially for school buffers and pharmacy bans, as people understand the need to protect youth and to restrict sales to health-promoting products in pharmacies.[32,37,43,51,58]

Limitations of this Review

This review has two main limitations. First, the study authors did not quantify risk of bias of included studies. Given the heterogeneity of the samples and study designs, comparing across studies by quality metrics was not seen as informative. Second, only one author (AG) conducted all steps of the review and analysis. Therefore, it is not possible to eliminate the potential for bias in terms of inclusion of studies and interpretation of data; however, the author followed inclusion and exclusion criteria and filled out a standardized form for data extraction.

Summary

Tobacco retail reduction policies are being increasingly implemented internationally. Policies vary in their acceptability, feasibility, and effectiveness in reducing density, but all show promise as approaches to decrease access to tobacco products. Future long-term policy evaluations are needed to determine the impact of these policies on tobacco use behaviors.

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HIGHLIGHTS

- Retailer reduction policies continue to be implemented at the state and local level
- Policies vary in acceptability, feasibility, and effectiveness in reducing density
- Long-term evaluation is needed to assess the impact of the policies on tobacco use

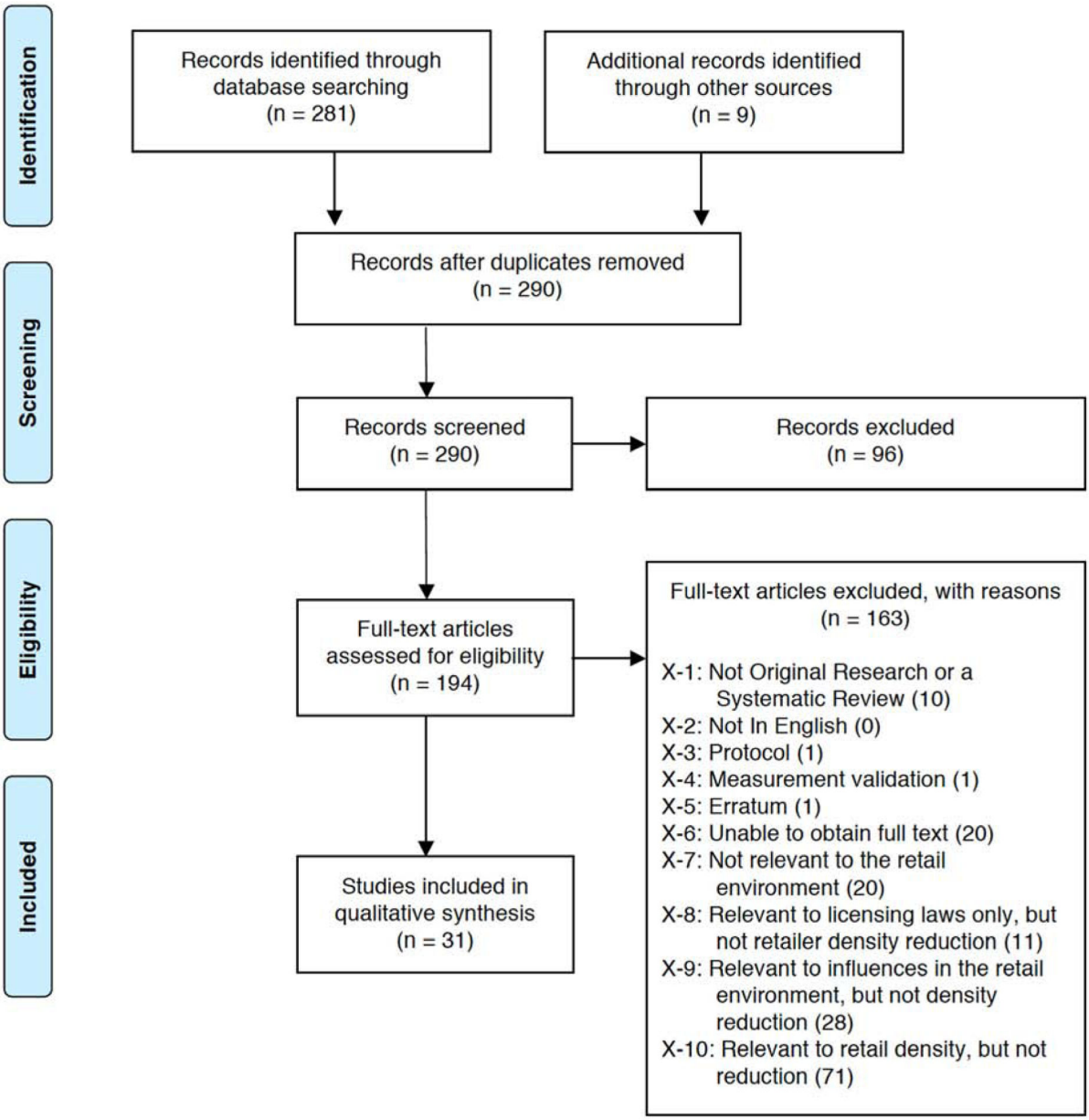

Figure 1.
Flow diagram of studies included in the review (format adapted from Moher 2009)[67]

Table 1.

Retailer reduction policies and examples

Policy Approach	Definition	Example
Rate or number reduction (“capping”)	The number of retailers permitted to purchase a license to sell tobacco is capped at a certain number within a geographic area or at a rate per population density.	In Philadelphia in 2016, there was a cap set on the number of licensed tobacco retailers of 1 per 1,000 people per planning district.[34]
Ban of sales in specific retailer types	Purchasing of a license to sell tobacco is prohibited in specific types of retailers, often because of the retailer’s sale of other goods is in conflict with tobacco.	In San Francisco in 2008, sale of tobacco was prohibited in pharmacies, the first policy of its kind in the country.[25]
School buffer	Retailers licensed to sell tobacco are required to be outside of a minimum distance from schools.	In Renville County, Minnesota, in 2015, licensed tobacco retailers were prohibited from operating within 1,000 feet of schools, playgrounds, houses of worship, or other youth-oriented facilities.[35]
Retailer buffer (“declustering”)	Retailers licensed to sell tobacco are required to be outside of a minimum distance from each other, breaking up “clusters” of retailers.	In Benton County, Oregon, in 2016, new licensed tobacco retailers are prohibited from opening within 1,000 feet of another tobacco retailer.[36]

Table 2.

Retailer reduction policies examined by papers in this review (n=31)

Reference	Country	Rate or Number	Retailer $_k$ (Type	School Buffer	Retailer Buffer	Other
Policy Perceptions (n=15)						
Jaine, 2015[37]	NZ					X
Paynter, 2016[38]	NZ		X			
Petrovic-van der Deen, 2018[46]	NZ		X			
Robertson, 2015[44]	NZ	X	X	X		
Robertson, 2017a[41]	NZ		X	X		
Robertson, 2017b[43]	NZ	X	X	X		
Whyte, 2014[47]	NZ	X	X	X		
Farley, 2015[32]	US	X	X	X		
Hudmon, 2006[51]	US		X			
Kroon, 2013[63]	US		X			
McDaniel, 2014[55]	US		X			
Myers, 2017[57]	US					X
Patwardhan, 2013[58]	US		X			
Smith, 2012[64]	US		X			
Wang, 2016[65]	US		X			
Total		4	13	5	0	2
Policy Landscape and Evaluation (n=10)						
Coxe, 2014[49]	US			X	X	X
Giovenco, 2018[50]	US		X			
Hall, 2019[61]	US		X			
Jin, 2016a[52]	US		X			
Jin, 2016b[66]	US		X			
Lawman, 2019[62]	US	X		X		X
Luke, 2016[54]	US	X	X	X	X	
Myers, 2015[56]	US		X	X	X	
Ribisl, 2017[59]	US			X		
Tucker-Seeley, 2016[60]	US		X			
Total		1	6	4	3	1
Policy Simulation Modeling (n=6)						
Pearson, 2015[40]	NZ	X	X	X		
Pearson, 2017[39]	NZ	X	X	X		
Petrovic-van der Deen, 2019[45]	NZ		X			
Robertson, 2018[42]	NZ	X				

Reference	Country	Rate or Number	Retailer $_k$ (Type	School Buffer	Retailer Buffer	Other
van der Deen, 2018[48]	NZ	X				
Luke, 2017[53]	US	X	X	X	X	
Total		5	4	3	1	0
Overall Total	--	10	23	12	4	3

Table 3.

Estimates of % retailer density and smoking prevalence reduction following policy implementation.

Reference	Location	Level	Rate or Number	Retailer Type*	School Buffer	Retailer Buffer
Retailer Density						
Bright Research Group, 2016[69]	San Francisco	City	7.5%	-	-	-
Lawman, 2019[62]	Philadelphia	City	9.8%**	. -	9.8%**	-
Giovenco, 2018[50]	New York City	Neighborhood	--	6.8% (0% - 50%)	-	-
Jin, 2016a[52]	California, Massachusetts	City	--	50.7% 28.5%	-	-
Myers, 2015[56]	North Carolina	County/State		13.1%- 18.3%/ 13.9%	17.7%-28.1%/ 17.8%	204% to 24.6% / 22.1%
Tucker-Seeley, 2016[60]	Rhode Island	Census Tract	-	0% - 1.5%	-	-
Coxe, 2014[49]	Santa Clara County (uninc.)	County	-	-	8.3%	2.8%
Ribisl, 2017[59]	New York	Neighborhood			Lo Inc: 71.9% Hi Inc: 46.4% Lo % AA: 36.0% Hi % AA: 67.0% Lo % Hisp: 25.0%	
	----------	----------	--	--	Hi % Hisp: 71.9% ----------	--
	Missouri	Neighborhood			Lo Inc: 30.5% Hi Inc: 22.9% Lo % AA: 18.1% Hi % AA: 34.0% Lo % Hisp: 20.9% Hi % Hisp: 23.8%	
Smoking Prevalence						
Hall, 2019[61]	6-State Region***	County/State		15.6%		
Jin, 2016[66]	California, Massachusetts	City/County		CA: 0.05% (case) - 0.06% (control) MA: 0% (control) - 8.6% (case)		

*All studies examined pharmacy bans

** This is the % reduction in the number of licenses issued, and is in combination with a 500-foot school buffer, an increase in license fees from $50 to $300, and the loss of license eligibility if retailers have 3 youth sales violations in 2 years. uninc.=unincorporated; Lo=Low; Hi=High; Inc=income; AA=African American; Hisp=Hispanic

*** Florida, Mississippi, North Carolina, South Carolina, Tennessee