NATIONAL AND LOCAL PERSPECTIVES ON RADON RESISTANT NEW CONSTRUCTION POLICIES

Allison K. Nesseth, BSN, RN
Montana State University
lanesseth@gmail.com

Laura S. Larsson, PhD, MPH, RN
Montana State University

Abstract

The primary study aims were to conduct a national inventory of radon resistant new construction (RRNC) policies, test the association between geographic risk and policy adoption, and survey local building industry members to learn their perspectives on RRNC policy. Comparison and contrast of existing policies revealed a heterogeneous approach to RRNC. An odds ratio analysis was conducted to test if RRNC adoption was associated with high EPA zone designation. States with more radon risk were five times more likely to have implemented RRNC ($\chi 2 = 2.34$, OR = 5.00, 95% CI 1.2 - 19.3, $p < .05$). Local industry members reported 100% of projects included radon system installation at least occasionally despite the lack of RRNC policy in Montana. Given the heterogeneous nature of RRNC policies, the authors recommend including building industry members' perspectives as partners in drafting future policy.

Introduction

Radon, a known carcinogen, is the second leading cause of lung cancer in the U.S. after smoking (Environmental Protection Agency, 2008). Epidemiological studies have provided convincing evidence of an association between indoor radon exposure and lung cancer, even at the relatively low radon levels commonly found in residential buildings (Lubin & Boice, 1997). Radon, a natural air pollutant comes from radioactive decay of Uranium-238 present throughout the earth's crust. Indoor levels of radon are higher than the naturally occurring outdoor levels, significantly in homes and other small buildings. Radiobiological research suggests bronchial epithelium exposed to radon progeny is damaged at the cellular level proportionate to number of cells exposed. For most of the population, exposure to this radiation is determined mainly by the concentration of radon in the home (Gray, Read, McGale & Darby, 2008).

Approximately 2.1 million of the 76.1 million existing single-family homes in the United States in 2005 had radon reducing features in place (Environmental Protection Agency, 2008). Socioeconomically stressed populations are at a higher risk for radon related lung cancer. This population is not only exposed to higher rates of cigarette smoking, but additionally reside in homes built without radon resistant construction or mitigation systems. Addressing this health disparity poses several different approaches.

Background

In 2005, the World Health Organization established the International Radon Project to identify effective strategies for reducing the health impact of radon and to raise public and political awareness about the consequences of long term exposure to radon. International Radon Project members published their recommendations for reducing the radon health risk including an evaluation of six radon control options for the construction industry and building professionals (World Health Organization, 2009). The radon prevention strategies for new construction focused on "sealing radon entry routes and on reversing the air pressure differences between the indoor occupied space and the outdoor soil through different soil depressurization techniques" (World Health Organization, 2009). Often it is a combination of strategies that provides the most effective reduction of radon concentrations where active radon levels are compared with mitigation needs and policy.

At the national level, the Environmental Protection Agency (EPA) (2011), the Department of Health and Human Services (2010a), and the President's Cancer Panel (2009) have all established a public health agenda in response to the radon threat that include adoption of radon resistant construction practices. Noteworthy, however, is that the recommended approaches to RRNC policies vary from wholesale adoption of the International Building Code to limited implementation in high radon areas. The members of the President's Cancer Panel recommended sweeping "building code changes" to reduce indoor radon concentrations. This recommendation called for venting in all new construction whereas the architects of the Healthy People 2020 advocated for a more selective approach. Their recommendation proposes 100% of the homes in high-radon geographic areas to be built using RRNC in Objective EH–15 (U.S. Department of Health and Human Services, 2011). Suggested methods for RRNC practice defer to maintaining consistency with national programs, regulations, policies, and laws, such as the International Residential Building Code (Appendix F) which provides building instruction and layout of systems.

Montana has 56 counties, 49 of which are designated by the EPA as Zone 1. This is the highest-geographic risk designation and means that the average indoor radon level is above the EPA's designated action level of 4.0 pCi/L (Environmental Protection Agency, 2013). Montana is well placed to introduce radon policy due to its radon risk, lack of state wide policy and rural demographic suggesting increased health disparity among housing and access to services. All new buildings constructed in Montana both residential and commercial must comply with the Montana energy code as of 2010 (Montana Department of Environmental Quality, 2012). This precedent of introducing statewide building code policy ensures the people of Montana have comfortable, energy efficient, cost effective homes and commercial buildings. The state of Montana is primed to receive equal treatment in their comfort and knowledge of safe indoor air quality in their homes and public buildings. Additionally, there are currently no disclosure laws for rental properties regarding indoor radon levels. As a result, rental properties are less likely to have been tested for radon or to have been remediated if levels are known to be high. Low-income homeowners may find remediation cost prohibitive as well. By addressing new construction policies, radon can be controlled at the onset of building thereby reducing some of this health disparity burden.

Locally, only one county in Montana has preempted Montana state law and adopted a building code addressing RRNC. Building industry members in Billings, the seat of Yellowstone County, recently adopted RRNC into their local practices. As awareness of radon health effects continues to grow within the housing communities, Montana may continue its course in affecting RRNC policy setting trends for other like-minded Western states with similar radon risk.

Because of the high risk for radon in the state of Montana and uncertainty about the national regulatory framework, a study with the following three aims was crafted. These three aims were to: 1) conduct a national inventory of radon resistant new construction (RRNC) policies in state or county-level laws, 2) test for an association between geographic risk and existing policies, and 3) administer a survey to building industry members to learn their perspectives on RRNC.

Method

A literature review of municipal, state, and national radon-related policies was conducted in each of the 50 states. A query of statutory, administrative or constitutional statutes was performed using LexisNexis Academic; a searchable electronic database of legal documents, for any statute that had contained the term "radon" at least five times. Results were cross-referenced with the EPA's database of states and jurisdictions with RRNC code. See results of the query in Appendix 1. Additionally, results were compared to articles in the Radon Reporter (Barber, 2010), the popular media (McCanna, 2012), and the Environmental Law Institute (Environmental Law Institute, 2013) for confirmation. For example, articles announcing the adoption of new laws in Maine confirmed findings using the LexisNexis search engine. Alternatively, discrepancies were noted in the case of Washington state where the EPA lists six Zone 1 counties but identifies seven on their map (Environmental Protection Agency, 2013). This however did not negate the overall findings of radon policy enactment in that state.

Next we created categories describing each state according to the presence or absence of state or local-level statutes (see figure 1). The categories were 0 = no statewide or local policies related to radon resistant new construction, 1 = no statewide statutes but instances of local jurisdictions (i.e., city or county) adopting RRNC; 2 = statewide adoption of RRNC with local jurisdictions allowed local control over whether to adopt RRNC; and 3 = statewide adoption of RRNC with designations for which local jurisdictions must conform. All states fit into this organizational framework except California where the radon policy is not governed through the building code, but rather through the public health department. As this divergence does not fit with any other state's RRNC procedures, they were not included in this analysis.

A Chi-square analysis was performed to test for an association between EPA risk designation and RRNC. States were dichotomized into high and low risk groups. A low-risk state was defined as having more than 50% of the counties designated by the EPA as moderate (Zone 2) to low risk (Zone 3). A high-risk state was defined as having more than 50% of the counties designated as moderate (Zone 2) to high risk (Zone 1). States were then further sorted on the presence or absence of any existing RRNC policy (see Appendix 1).

After analysis of trends in state and local level RRNC policy, qualitative interviews were conducted with affected building industry members and officials to gain a better understanding of the issues and concerns experienced in their state when an RRNC policy was added to the building code. Subjective data from the telephone interviews were assessed for common themes using qualitative descriptions. From these interview themes a survey was crafted to gather the opinions of local tradesman in a region with high radon risk and no current RRNC policy. This survey was then administered to local tradesmen through the Southwest Montana Building Industry Association (SWMBIA) and through the Building Division office in Bozeman, Montana. Completion of this anonymous survey was voluntary.

The 20-item survey was a combination of multiple choice, Likert type scale and open-ended questions. Participation was voluntary and no identifying information was collected. Four questions were created to establish demographic information. Five of the survey items were used to establish level of trade and market affiliation of the participant. Five survey questions were used to ascertain current RRNC practice. The remaining six questions were crafted to explore local opinion related to RRNC policy and practices. The questionnaire data were then entered into an excel spreadsheet for descriptive statistical analysis.

Results

The first aim of this study was to conduct a national inventory of RRNC policies in state or county-level statutes, laws or ordinances (see Figure 1). States colored in blue (category 0) indicated states where no policies had been adopted either at the state or local level (n = 21). Orange (category 1) indicated states where local policies in one or more counties or jurisdictions were adopted even though no state law had been adopted (n = 19). Red states (category 2) indicated adoption of RRNC at the state level with the provision that each jurisdiction/county had to vote to adopt the regulation at the local level (n = 5). In these cases, the state law was not a mandate. Finally, states colored green (category 3) indicated a state law that required high-risk counties to adopt RRNC. In these cases, local adoption was not optional for the high-risk counties or jurisdictions. California did not fit into any of these four categories as their state law requires the health department, rather than the building division, to implement RRNC. In this state, health department radon testing requirements must be met before a building permit may be granted. At the time of this writing, the California state law had not been operationalized.

The second aim was to test for an association of policy with high radon-potential areas as set forth as a goal in the HP2020 objective EH-15 (U.S. Department of Health and Human Services, 2010b). In order to complete an odds ratio (OR) analysis the states were separated into high and low risk groups. The states were defined as low risk when more than 50% of the counties were designated by the EPA as moderate (Zone 2) to low risk (Zone 3). They were defined as high risk when more than 50% of the counties were designated as moderate (Zone 2) to high risk (Zone 1). States were then further sorted on the presence or absence of any existing RRNC policy. The odds were five times greater that states with more radon risk had adopted at least some level of RRNC compared to states with less radon risk (χ^2 = 2.34, OR = 5.00, 95% CI 1.2 - 19.3, $p < .05$). While this is a descriptive analysis and includes states where only one or two counties have adopted RRNC in an overall high-risk state, the results indicate that the policy initiatives are directionally positive and associated with geographic risk.

The third aim was to survey local industry tradesmen in order to provide feedback as to current local practices and opinions on implementation of RRNC. Twenty-two individuals, all males, completed the project survey and reported their specialty in the following areas: general/sub-contractor (n = 11), plumbing contractors (n = 5), electrical contractors (n = 2), and one HVAC contractor. Participants documented a wide range of years in the construction industry with an average of 10-20 years (range from <5 to > 20 years). Participants recorded the types of projects they typically worked on as single family homes (n = 19), custom homes (n = 19), speculation “spec” homes (n = 12), townhome/condominium projects (n = 11), multiple family homes (n = 8), subdivision/tract housing (n = 6), and commercial (n = 1). The average range for the market prices of the respondents’ projects was $200,000 - $400,000 with some projects costing more than $600,000 and none less than $200,000. Respondents identified themselves as extremely (13.6%, n = 3), very (46%, n = 10), or somewhat (41 %, n = 9) knowledgeable on the subject of radon in building structures. No one reported having no knowledge at all. Respondents documented their educational preparation in the following range: high school/GED equivalent (n = 2), some college or trade (n = 8), completed 2-year degree (n = 3) to completed 4-year degree (n = 9). The majority of respondents were white non-Hispanic with two respondents not reporting ethnicity and one not reporting race. One participant identified himself as Hispanic and one as Native American.

Participants next answered questions regarding RRNC in their work. Participants reported that their projects had radon systems installed always (n = 6), most of the time (n = 10), or occasionally (n = 6). The average cost of including a radon system to the project was estimated by six participants with a noteworthy range of responses ($300, $300 – $800, $800, $1200, $1500, $2000, $2000, $1500 - $2000, $1500 - $2500, and $10,000). When installing radon systems, 18 reported using PVC pipes, 15 reported using a vapor barrier, and 14 reported installing exhaust fans. The terminology “PVC pipe” was used in the survey. Perforated PVC pipe is the more descriptive term to explain the piping used in RRNC. Two of the 22 respondents indicated “perforated” in their responses as an “other’ method. These responses were incorporated into the total of 18 respondents reporting use of “PVC”.

When participants were asked their reason for installing RRNC, 10 reported client preference, five stated local building practice, 11 reported builder preference, three stated local policy, 10 stated health and safety and three reported real estate value. When participants were asked, “How often do your clients express interest in having radon systems installed in their homes,” participants responded always (n = 1), often (n = 11), sometimes (n = 5), rarely (n = 3), and never (n = 1). Range of costs varied but could have been a function of interpreting the project costs as just to the particular specialist. Also, the high cost estimate was correlated to an individual who built very high-end homes.

The final section of the survey included questions for participants about their opinions on future RRNC policies. Responses to the question, “Should radon systems be included in the building code” were split with nine in agreement and 13 against. If RRNC were adopted into the building code, three participants chose to adopt Appendix F, while five felt an alternative approach should be used. Most (n = 17, 77.3%) participants did not want to have a certified radon contractor for system installation. Participants indicated if radon systems were adopted into the building code a local building inspector should be used for system inspection (n = 11) or a state certified inspector (n = 3) should be used. Most participants (n = 14, 63.6%) did not think an exhaust fan should be mandatory equipment in RRNC. (The installation of an exhaust fan is the difference between an active and passive radon mitigation system.)

Construction Specialty	Estimated Cost to Project	Approach Used	Average market price in US dollars (x1000)
General/Sub	$300	PVC, Vapor barrier & exhaust fan	$200 – 400
HVAC	$300 - $800	PVC, Vapor barrier & exhaust fan	$200 - 400
General/Sub	$800	PVC, Vapor barrier & exhaust fan	$200 – 400
General/Sub	$1200	PVC & Vapor barrier	$200 – 400
Plumbing	$1500-2000	PVC, Vapor barrier & exhaust fan	$200 – 400
General/Sub	$2000	PVC, Vapor barrier & exhaust fan	$200 - 400
General/Sub & Construction Mgr/ Real Estate	$1500	PVC, Vapor barrier & exhaust fan	$400 – 600
Sales/Real Estate	$1500 – 2500	PVC, Vapor barrier & exhaust fan	All ranges
General/Sub	$2000*	PVC & Vapor barrier	More than $600
General/Sub	$10,000	PVC, Vapor barrier & exhaust fan	More than $600

*Passive system without fan.

Table 1. Participant estimate of current RRNC approach by method and market price of project (n=10).

Discussion

The first aim of this study was to conduct a national inventory of radon resistant new construction (RRNC) policies by state and county. We learned that the regulatory framework is diverse with at least five approaches to adopting policy. The least structured approach is a non-regulatory position, found in 25 states, with no state or local policy regarding radon reduction in new construction. Of the remaining states, 20 provide limited regulation with some local jurisdictions taking the lead and implementing their own policies when their states had not, while other states have adopted a state wide policy that local counties and jurisdiction must vote on to be utilized locally. The most selective approach to RRNC was established in four states where a statewide policy was used to regulate only the Zone 1 counties—those with average indoor radon levels at or above the EPA designated action level.

Not all states fit into the framework norm or fit into expected patterns of regulation. A unique approach to RRNC can be found in California. This state has partnered with public health in its bid to address indoor air quality. California does not have statewide or local jurisdictions with RRNC building codes. However radon testing and necessary mitigation plans based on test results must be submitted through the public health department and building permits are not issued until compliance is met. The state of California has also reserved the authority to adopt any future Environmental Protection Agency RRNC standards prospectively unless the Department of Housing and Community Development adopts standards, in which case only the latter standards may be adopted (Environmental Law Institute, 2013).

Another standout in the policy framework is Florida. Florida implemented statewide RRNC into their building code despite the fact that the entire state is designated as EPA Zone 3. Recall that Zone 3 designation indicates low geographic risk for radon. While eight of the nine states with some level of RRNC adoption are high-risk states, the case of Florida suggests that perhaps factors apart from high-geographic risk lead some communities to adopt RRNC. Perhaps Floridians have high smoking rates and RRNC is one solution to improving indoor air quality and reducing lung cancer deaths.

The second aim of this study was to test for an association between geographic risk and existing policies. An odds ratio analysis of the differences in existing policies compared with geographic radon risk level revealed critical distinctions for future policy framework. The odds were five times greater that states with more radon risk had implemented at least some level of RRNC compared to states with less radon risk. It is important to recognize this is a descriptive analysis and includes states where only one or two counties have implemented RRNC in an overall high-risk state. However, the results indicated that the policy initiatives are directionally positive and associated with geographic risk. This demonstrates an increasing awareness in states where radon is prevalent.

Increased awareness however does not address health disparity in many cases. For instance in Idaho, a high radon risk state with 40.9 percent and 47.7 percent of counties in EPA Zones 1 and 2 respectively, RRNC policy has been passed only in high income pockets around ski resort towns. The majority of its rural counties have not enacted nor can they generally afford the infrastructure required for increased code requirements. This is a cause for discussion of risk-based or statewide policy in efforts to avoid increasing health disparity predicated on socioeconomic status.

The third aim of this study was to administer a survey to building industry members to attain their perspectives on a local RRNC policy. In order to make the most promising attempt at a state response to the HP 2020 objectives and the reported trend, it is important to hear the voices of those Montanans who would adopt an RRNC policy and bear the weight of its costs in this state.

Analyses of interviews with industry members in other states that have adopted statewide RRNC reveal differing themes on the success of the program. Themes varied depending on industry member role. Building officials reported the program a success while industry members in the field find the new codes ineffective and prohibitive. Additionally industry tradesmen reported fewer construction projects with RRNC in place than before the policy adoption due to "loopholes." These opinions are anecdotal but attest to the difficulty of adopting useful and effective policy without engaging appropriate industry members who would bear the weight of implementation.

While survey results were limited in number, generalized implications toward local viewpoints can be drawn from the data. Almost two dozen local industry members (n=22) reported that their projects included installation of radon systems at least occasionally with 72.7% (n=16) stating that most or all projects included a radon system. The common practice of installing radon systems in new homes is indicative of both industry awareness and client preference. Survey results showed respondents identified themselves as extremely (13.6%, n = 3), very (46%, n = 10), or somewhat (41 %, n = 9) knowledgeable on the subject of radon in building structures. No one reported having no knowledge at all. When asked the reason for installing radon systems a majority of respondents indicated client and/or builder preference as well as health and safety concerns. Additionally 52% of survey participants indicated clients often expressed interest in having radon systems installed in their homes. Despite the common practice of installing radon systems, respondents were divided on the issue of incorporating an RRNC policy into the Montana Building Code.

In the next phase of research the variety of approaches implemented by states where RRNC has been adopted need to be shared with stakeholders in Montana. This information is important to share as it may facilitate next efforts toward an ultimate goal of utilizing members of the building industry as public health partners in adopting an RRNC policy. It would be ideal to collaborate with all of the partners—public health officials, tradesmen, building inspectors, and regulators to adopt a policy that has buy-in from all of the vested parties.

Limitations

A limitation of this study was the limited location and sample size for specific aim 3. The locality of this study is a microcosm of higher income and housing market price that does not necessarily convey to the state as a whole. While Southwest Montana maintains a rural designation, it is surrounded by two ski resorts and a university which has created an area with high real estate and housing costs. In terms of the small sample size, the lack of survey results may indicate a methodological error or a lack of interest in RRNC within the membership of the local building industry. A small incentive for survey-based research is a typical way to engage participants that was not employed in this study due to budgetary constraints. Despite these limitations, this study is one of only a few to examine local industry perceptions and current practices in RRNC as it relates to Healthy People 2020 objectives.

Conclusions

Residential radon exposure presents a significant health risk. Health care and environmental health have similar professional values such as disease prevention and social justice. Nurses are responsible for addressing the environmental hazards that present a risk for their patients and community. As the population continues to age, adverse health effects from radon will continue to increase without a successful program to reduce exposures. Several cost/ benefit analyses have clearly indicated mitigation of existing homes along with adopting RRNC systems can be justified on a national level. High-risk states can and are setting precedent by addressing some of these issues through building code and policy. It is imperative as we move forward to create a policy that is evidence-based and informed by local industry members in order to create the changes that will result in improved indoor air quality and improved health.

References

Barber, M. (2010). Reducing Community Exposure to Radon: A Plan for Community Action. *Radon Reporter, Winter/Spring*.

Environmental Law Institute. (2013, April). Radon Control in New Home Construction: Developments in State Policy. Retrieved September 16, 2013, from http://www.eli.org/Buildings/Radon/index.cfm

Environmental Protection Agency. (2008). Radon second only to cigarette smoking in causing lung cancer - Home testing for radon is one way to fight it. Retrieved January 19, 2013, from http://yosemite.epa.gov/opa/admpress.nsf/2008+press+releases/503243c79c5bcf35852573c50065ae42?opendocument

Environmental Protection Agency. (2011). Protecting people and families from radon: A federal action plan for saving lives. www.epa.gov/radon/pdfs/Federal_Radon_Action_Plan.pdf

Environmental Protection Agency. (2013). EPA Map of Radon Zones. Retrieved December 6, 2013, from http://www.epa.gov/radon/zonemap.html

Lubin, J. H., & Boice, J. D., Jr. (1997). Lung cancer risk from residential radon: meta-analysis of eight epidemiologic studies.[see comment]. *Journal of the National Cancer Institute, 89*(1), 49-57.

McCanna, B. (2012, June 12). New building code coming to 34 towns, *Morning Sentinel (Waterville, ME)*. Retrieved from http://www.onlinesentinel.com/news/new-building-code-coming-to-34-towns_2012-06-09.html

President's Cancer Panel. (2009). 2008-2009 Annual Report Reducing Environmental Cancer Risk: What We Can Do Now. Retrieved February 8, 2013, from http://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf

U.S. Department of Health and Human Services. (2010a). *Environmental Health Objective 15: Increase the proportion of new single-family homes (SFH) constructed with radon-reducing features, especially in high-radon-potential areas*. Retrieved from http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=12.

U.S. Department of Health and Human Services. (2010b). HP2020 Proposed Objectives EH-15. Retrieved September 5, 2012, from http://www.healthypeople.gov/hp2020/Objectives/TopicArea.aspx?id=20&TopicArea=Environmental+Health

U.S. Department of Health and Human Services. (2011). *EH-15 increase the percentage of new single family homes (SFH) constructed with radon-reducing features, especially in high-radon-potential areas*. Retrieved from http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=12.

World Health Organization. (2005). WHO Launches Project to Minimize Risks of Radon. Retrieved October 10, 2010, from http://www.who.int/mediacentre/news/notes/2005/np15/en/index.html

World Health Organization. (2009). WHO Handbook on Indoor Radon: A Public Health Perspective. from http://whqlibdoc.who.int/publications/2009/9789241547673_eng.pdf

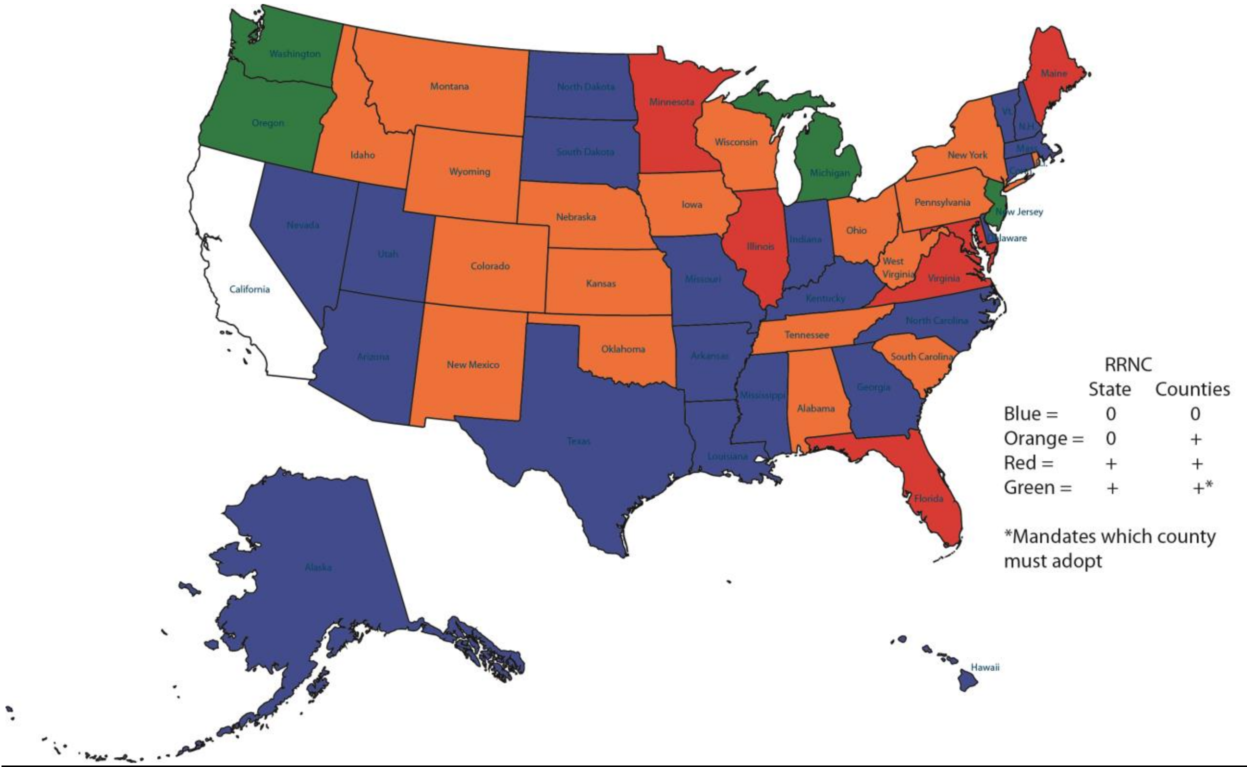

Figure 1. United States map of existing RRNC policy

State	RRNC*	% Zone 1	% Zone 2	% Zone 3	RRNC	At Risk	Sum - Zones 1 & 2
DC	0	0	0	100	No	Less	0
HI	0	0	0	100	No	Less	0
LA	0	0	0	100	No	Less	0
MS	0	0	9.8	90.2	No	Less	9.8
OK	1	0	11.7	88.3	Yes	Less	11.7
FL	2	0	13.4	86.6	Yes	Less	13.4
TX	0	0	15.4	84.6	No	Less	15.4
AR	0	0	18.7	81.3	No	Less	18.7
SC	1	2.2	17.4	80.4	Yes	Less	19.6
AK	0	0	24	76	No	Less	24
DE	0	0	33.3	66.7	No	Less	33.3
GA	0	2.5	34.6	62.9	No	Less	37.1
NC	0	8	31	61	No	Less	39
MI	3	10.8	38.6	50.6	Yes	Less	49.4
WA	3	17.9	35.9	46.2	Yes	More	53.8
OR	3	0	58.3	41.7	Yes	More	58.3
MD	3	33.3	33.3	33.3	Yes	More	66.6

AL	1	19.4	49.3	31.3	Yes	More	68.7
VA	2	45.9	23.7	30.4	Yes	More	69.6
TN	1	40	33.7	26.6	Yes	More	73.7
NY	1	54.8	21	24.2	Yes	More	75.8
RI	2	40	40	20	Yes	More	80
NE	1	57	25.8	17.2	Yes	More	82.8
NJ	3	33.3	52.4	14.3	Yes	More	85.7
VT	0	0	85.7	14.3	No	More	85.7
CT	0	50	37.5	12.5	No	More	87.5
ID	1	40.9	47.7	11.4	Yes	More	88.6
WV	1	36.4	52.7	10.9	Yes	More	89.1
MA	0	21.4	71.4	7.1	No	More	92.8
KY	0	25	68.3	6.7	No	More	93.3
MO	0	84.3	9.6	6.1	No	More	93.9
NV	0	52.9	41.2	5.9	No	More	94.1
IL	3	54.9	42.2	2.9	Yes	More	97.1
PA	1	73.1	25.4	1.5	Yes	More	98.5
AZ	0	0	100	0	No	More	100
NH	0	10	90	0	No	More	100
UT	0	24.1	75.9	0	No	More	100
IN	0	62	38	0	No	More	100
SD	0	72.7	27.3	0	No	More	100
ND	0	100	0	0	No	More	100
NM	1	21.2	78.8	0	Yes	More	100
WI	1	38.9	61.1	0	Yes	More	100
OH	1	60.2	39.8	0	Yes	More	100
KS	1	61.9	38.1	0	Yes	More	100
CO	1	80.6	19.4	0	Yes	More	100
MT	1	87.5	12.5	0	Yes	More	100
WY	1	91.3	8.7	0	Yes	More	100
IA	1	100	0	0	Yes	More	100
ME	2	75	25	0	Yes	More	100
MN	3	78.2	21.8	0	Yes	More	100

Appendix 1. Existing RRNC policy versus Environmental Protection Agency zone designation with odds ratio.

*0 = no state or local RRNC policy; 1 = no state but some local RRNC policy; 2 = state RRNC policy with local choice of adoption; 3 = state RRNC policy that selects for specific high risk areas