Radon in Utah

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This report presents the current state of radon topics in Utah. Economic burden estimates of radon-related lung cancer are presented. Types of radon data, including data uses and limitations, are discussed. A summary of radon-related policies in Utah, including common policies in the United States, are outlined. Additional state and federal radon resources are provided, along with results from the radon questions included in the 2013 Behavioral Risk Factor Surveillance System survey in Utah.

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OVERVIEW OF RADON

Radon is a radioactive gas that is colorless and odorless. It is released when radioactive elements in the soil break down. Uranium and radium are two elements that are found naturally in the ground that release radon [1]. In the United States, radon is typically measured in picocuries per liter (pCi/L) of air. A curie is a unit of measurement used to describe radioactive decay; a picocurie is one-trillionth of a curie. Radon is released into the environment, where it can get into the air, groundwater, and surface water [2].People are then exposed to radon from these routes. Breathing in radon-contaminated air is the most common route of exposure [2]. Even though outside air naturally has small amounts of radon (about 0.4 pCi/L), it poses its greatest threat when it gets trapped in enclosed spaces, thus increasing the concentration of radon in the air [2]. Cracks in the foundation allow radon to enter homes and buildings as it moves up from the earth below [2, 3].

The two main factors that influence how much radon a person is exposed to are the geologic radon potential and the house or building where a person lives. The term "geologic radon potential" refers to pre-existing geologic conditions that influence how much radon is released into the environment. Conditions such as soil permeability, groundwater, and the amount of uranium and radium in the soil all impact the release of radon [2, 4]. While the underlying geologic conditions of any given area can play a role in determining indoor radon levels, it is ultimately the house or building itself that makes the largest impact regarding people's radon exposure.

Radon is a health hazard because it is the second leading cause of lung cancer [1, 5]. The U.S. Environmental Protection Agency (EPA) estimates that there are about 21,000 deaths from radon-related lung cancer every year in the United States [5]. When people breathe in radon-contaminated air, the radon can travel to the lungs and release a dose of radiation [2]. An individual's risk of developing radon-related lung cancer depends on how high radon levels are in the home or building, and how much time a person spends inside. Smoking is also a very important factor in developing radon-related lung cancer. While anybody who is exposed to radon faces an increased risk for lung cancer, people who have ever smoked (meaning current or former smokers) face an even higher risk. People who smoke and who are exposed to radon face a higher risk of lung cancer than from either radon or smoking alone [6, 7].

The only way to know the radon level of a home or building is to test for it. There are different ways to conduct a radon test. The most common type of test is a short-term activated charcoal test that is typically used in single or double family dwellings. The EPA's radon action level is 4.0 pCi/L [3]. The term "action level" means that if a radon test shows a result equal to or greater than a certain amount, then the home or building owner is advised to install a radon mitigation system. While there are many different types of mitigation systems, they all function to prevent radon from entering the home or building in the first place. A common type of mitigation system vents radon that is under a home or building outside using a pipe and fan [3].

ECONOMIC COST OF RADON IN UTAH

Every year between 2002 and 2011, an average of 541 Utahns were newly diagnosed with lung and bronchial cancer, and on average there were 424 deaths [8, 9]. After diagnosis, the cost for the first year of medical treatment for all lung and bronchial cancers is estimated to be between $36,000 and $48,000 per person [10]. According to the World Health Organization,

14% of lung cancer cases may be attributable to radon [1]. Utah's lung cancer incidence and mortality rates are lower than the national average due to significantly lower rates of smoking. Therefore, it is likely that radon can be attributed to more than 14% of lung cancer cases in Utah.

In Utah, the estimated total cost of the first year of treatment for lung cancer attributable to radon exposure is $2.7 million to $3.6 million [1]. This cost amount only reflects the treatment costs for the first year of lung cancer after diagnosis and does not include the treatment costs accrued in subsequent years after diagnosis. This estimate also does not include additional costs of lost productivity and death that can occur as a result of a lung cancer diagnosis.

An estimated 385 productive years are lost in Utah to ill health, disability, or premature death due to radon-related lung cancers diagnosed each year. These lost years hurt Utah's economy by reducing an individual's ability to contribute to the economy due to changes in lifestyle, psychological distress, and death.

RADON DATA IN UTAH

Three main sources of radon data exist in Utah: geologic potential, test kit data, and the Behavioral Risk Factor Surveillance System (BRFSS) questionnaire. While none of these sources alone can predict individual indoor radon levels or radon exposure, they can provide insight to the state of radon levels and testing behavior in Utah.

Geologic Radon Potential

The term geologic potential refers to how geologic conditions "[influence] the local concentration, release, and migration of radon" [4]. Since radon originates from underlying geologic conditions, it is useful to examine how variations in such conditions have an effect on radon emissions. The conditions that are regarded as having the greatest impact on radon potential are soil permeability; soil concentration of uranium and/or radium; and presence of groundwater [4]. Using knowledge about Utah's geology, geologists are able to estimate areas that are likely to have higher radon levels. The Utah Geological Survey (UGS) provides the most complete geologic radon potential data for Utah.

In 2007, the UGS began the Geological Hazards Mapping Initiative to provide quadrangle-level maps for ten geological hazards, one of which is radon. This initiative produces the most detailed and robust geological radon potential maps to date in Utah. As of 2014, two radon quadrangle maps are available: the Magna quadrangle (2009) and the Copperton quadrangle (2014) [11].

Short-Term Test Kit Data

Since 1990, the Radon Program within the Division of Radiation Control at the Utah Department of Environmental Quality (DEQ) has maintained a database of results from short-term radon test kits. The test result data comes from certified laboratories in the United States. As part of DEQ's agreement with these laboratories, all data provided to the Utah Radon Program is de-identified. The variables sent to the Radon Program are as follows: test number, test result (pCi/L), test date, analysis date, county, ZIP code, and year. From this data, the Radon Program produces a quarterly public dataset using the test kit results data. This dataset

aggregates all data from 1992 to the current quarter by ZIP code, county, and state and provides the following variables: percentage of tests that are less than 4.0 pCi/L; percentage of tests that are greater than or equal to 4.0 pCi/L; maximum test value; average test value; and total number of tests performed.

Behavioral Risk Factor Surveillance System

In 2013, questions about radon were included for the first time in the BRFSS survey in Utah. Four questions were developed and included in two of the three versions of the survey that were used.

- Have you ever had your home tested for radon gas?
- Did the radon test show a high level?
- What health condition is most often associated with radon gas?
- What is the most important reason you have not had your home tested for radon gas?

The results of the survey indicated that 80% of Utahns have not tested their home for radon gas. Of the 18% of Utahns who have tested their homes for radon gas, 90% indicated that the test result was not above the 4.0 pCi/L action level. When respondents were asked why they had not tested their home for radon, 34% indicated that they had not thought about it, 14% answered that they were not at risk and did not need to, and 13% responded that they did not know about radon. Fifty-one percent of respondents knew that lung cancer was the health condition that was most often associated with radon. While it is encouraging that half of Utahns know the health outcomes of radon exposure, the low rate of testing leaves much to be improved.

For the full results of the radon questions on the 2013 BRFSS survey, see Tables 1-4 in Appendix A. Radon questions are included in the Utah Cancer Control Surveillance Plan and a proposal will be submitted for the Utah BRFSS survey in 2016. The questions will be developed collaboratively with stakeholders.

UTAH RADON DATA LIMITATIONS

Geological Potential Data

The only issue surrounding Utah geologic radon potential data is that geologic potential estimations are neither a robust predictor nor an indicator of indoor radon levels or individual exposure. As previously explained, the individual house or building is the greatest determinant on indoor radon levels; it is possible for houses and buildings in areas with a “low” radon potential to have high levels of indoor radon, and vice versa.

Short-Term Test Kit Data

The issues surrounding the quality of short-term test kit data fall into two categories: the thoroughness of data received and inadequate surveillance coverage. These issues reduce the extent to which the current radon surveillance system in Utah accurately captures indoor radon levels in Utah.

- Poor ZIP code reporting: When an individual orders a short-term test kit through the DEQ, the ZIP code that is reported back is the purchasers' ZIP code, which may not be the ZIP code of the actual testing location. This would distort the geographic distribution of the number of tests conducted and the test results.
- No pre- or post-mitigation designator: Test results provided to the DEQ do not indicate whether the test was conducted in a house that has an installed mitigation system or not. Pre-mitigation testing is used to help individuals decide whether a mitigation system would be necessary; post-mitigation testing is used to determine to what extent the mitigation intervention is effective. From a public health perspective, pre-mitigation test results would help target radon intervention programs and allow programs and agencies to efficiently use limited resources. However, mixing pre- and post-mitigation test results dilutes indoor radon test data and leads to underestimating true indoor radon levels for any given ZIP code.
- Multiple tests conducted in the same home or building: It is common to conduct multiple tests in the same home or building; this can be beneficial to understand how radon levels vary in different parts of the same home or building. The radon test kit data does not provide any identification for multiple tests conducted in the same unit. Even though the DEQ receives the test kit number, it cannot be used to link tests conducted in the same house or building. This artificially increases the reported number of tests conducted in a given geographic area. Furthermore, the test kit data does not stratify results for tests conducted on different levels of the same home or building. Because radon levels can vary from room to room and floor to floor, aggregating test results from different locations in the house likely reduces the overall average reported.
- Lack of quality assurance: The individual conducting the short-term radon home test is ultimately responsible to follow the testing guidelines to ensure an accurate result. Failure to follow these guidelines produces incorrect test readings, showing radon levels that are either too low or too high. This issue is inherent to radon test kit reporting and not unique to radon data in Utah.

Furthermore, the DEQ only receives data from the test kits that are specifically purchased through its subsidized program. Tests that are purchased from a different vendor, analyzed by a different laboratory, or conducted as a long-term test are not reported to the DEQ. This presents inadequate surveillance coverage of radon tests in Utah.

Behavioral Risk Factor Surveillance System

As with all surveys, some bias can enter into the results from different avenues. Bias can enter the results when people do not respond to the survey, such as refusing to participate or not being included in the sample frame. Even if a person is chosen to participate and agrees to do so, bias can enter the results if a person cannot recall information correctly or changes his/her response to something more socially acceptable.

The BRFSS also does not call individuals living in group quarters, such as dormitories. The 2013 questions were directed at randomly selected adults and not households, so comparisons with geologic potential data or short-term test kit data should be made with caution.

RADON AND UTAH LAW

Concurrent Resolution on Radon Gas

Substitute Concurrent Resolution on Radon Gas (SCR 11), sponsored by Representative John Valentine, was passed in the 2013 General Legislative Session, and designates January as Utah State Radon Action Month [12]. It urges Utah citizens to prevent radon exposure, and calls specific groups of people such as business owners, home builders, realtors, schools, government agencies, and the media to educate the citizens in Utah in protecting themselves from the dangers of elevated radon gas levels.

Radon Awareness Campaign

Senate Bill 109 (SB 109) was proposed by Utah State Senator Aaron Osmond during the 2014 session of the Utah State Legislature. It was signed by Governor Gary R. Herbert on 28 March 2014 [13]. SB 109 requires the Utah Department of Health in collaboration with the Division of Radiation Control, to "develop a statewide electronic awareness campaign to educate the public" [13]. The Utah Cancer Control Program at the Utah Department of Health received a one-time $25,000.00 appropriation from the general fund with the responsibility to develop and oversee the awareness campaign.

Tenant Rights and the Utah Fit Premises Act

In Utah, there is no legal requirement for rental property owners to test rental property for radon gas or install a mitigation system if elevated indoor radon levels are found [14]. When tenants have concerns about the suitability of their rental property, the Utah Fit Premises Act (Utah Code, Title 57, Chapter 22) defines owners' and renters' responsibilities and provides tools to help solve disputes. The Act explains that rental properties must be "fit for human habitation" and follow all "local ordinances and the rules of the board of health" [15]. As part of keeping a rental property in proper condition, the Act specifies it is the owner's responsibility "to protect the physical health and safety of the ordinary renter" and keep the property "safe, sanitary, and fit for human occupancy" [15]. Similarly, the Act explains tenant responsibilities to maintain "cleanliness and sanitation" and adhere to any local rules that pertain to "physical health and safety" [15]. There is no detailed language about specific contaminants that are harmful to human health; only generalized language exists. Despite the lack of language about specific health hazards, the Act has been used to address health concerns about mold. It is unclear how radon would be interpreted in the Utah Fit Premises Act. In explaining its limitations, the Act states that it "does not apply to […] conditions which do not materially affect the physical health or safety of the ordinary renter" [15]. Considering this, radon would apply as a condition that affects human health.

When dealing with other specific health contaminants, specific regulations and policies exist to protect Utah citizens from exposure. For example, lead is covered by the lead-based paint rule (Rule R307-842, Lead-Based Paint Activities) and the blood-lead reporting injury rule (R386-703-3[h], Injury Reporting Rule, Reportable Injuries). Asbestos is covered by the asbestos rules (R307-801, Utah Asbestos Rule). However, there are no specific regulatory laws for radon.

Mitigator Licensing

In Utah, any individual who installs or repairs a radon mitigation system must be licensed as a contractor under the state's construction trades licensing law (Rule R156-55a, Commerce, Occupational, and Professional Licensing, Utah Construction Trades Licensing Act Rule). Pursuant to the state regulation (Utah Administrative Code R156-55a-302b), in order to obtain a radon contractor license classification, the applicant must hold a current certificate from the National Radon Safety Board or National Radon Proficiency Program.

Building Codes

Building codes guide the construction of new building structures to ensure that a minimum standard of safety and quality are met. In 2013, the Utah State Legislature adopted the 2012 edition of the International Residential Code (IRC) as law [16]. The IRC is issued by the International Code Council.

The IRC has a series of appendices, A through Q, that detail additional standards. Appendix F in the IRC is titled "Radon Control Measures" and "contains the requirements for new construction in jurisdictions where radon-resistant construction is required" [17]. The IRC Appendix F is not adopted in Utah as standard. According to the IRC, the areas where such construction would be required are counties that have a Zone 1 designation, meaning they are classified as having a high radon potential [17]. The counties in Utah that the IRC designates as Zone 1 include Carbon, Duchesne, Grand, Piute, Sanpete, Sevier, and Uintah[17].

Home Sales

Currently there are no laws in Utah that require radon testing to be performed when a piece of real estate transfers owners. However, in 2014, the Utah Association of Realtors agreed to include radon on their Buyer Due Diligence Checklist. The checklist is provided to help home buyers review the home before purchase and assure it is safe for habitation. Radon now appears as its own dedicated item and is listed fourth in the overall checklist. This section contains specific language about radon as a health hazard and provides the link to the Utah Radon Program website. Previously, radon only appeared in the third item, "Hazardous Waste and Toxic Substances," in a non-exhaustive list of common household hazards.

COMMON RADON LAWS IN THE UNITED STATES

Many states have enacted laws that are designed to educate and protect citizens from radon exposure. This section provides information on which states have adopted common radon-related laws. See Appendix B for a table of all states that have enacted common radon laws.

Testing and Disclosure

These are laws that require sellers to disclose whether a property has been tested for radon or if it has a known radon hazard. Many state laws enable agencies to develop appropriate regulations and forms to implement this requirement. Utah *does not* have any radon testing and disclosure laws [18, 19].

Mitigation Certification

These are laws that require any individual who provides radon mitigation services to be nationally and/or state certified. Some states are required to keep a list of certified mitigators. Utah does have radon mitigation certification laws [18, 19].

Construction Standards

These are laws that adopt standards for radon-resistant new construction, and provide that municipalities that elect to adopt a radon-resistant new construction standard must use the state model standard. Utah *has not* adopted any construction standards for radon [18, 19].

Public Education

These are laws that require the state to prepare a public radon education/awareness program or document. Utah does have a public education/awareness campaign for radon [18, 19].

RADON DATA AND RESOURCES

The resources listed below provide more information and data about radon.

State Resources

- Utah Environmental Public Health Tracking Network, Environmental Epidemiology Program, Utah Department of Health
  http://epht.health.utah.gov/epht-view/topic/Radon.html

- Utah Radon Program, Division of Radiation Control, Utah Department of Environmental Quality
  http://www.radon.utah.gov

- Utah Geological Survey, Utah Department of Natural Resources
  http://www.geology.utah.gov/utahgeo/hazards/radon.htm

Additional Resources

- CDC's Promising Practices to Reduce Radon in Homes
  http://www.cdc.gov/cancer/dcpc/prevention/policies_practices/radon/

- CDC's Promising Practices for What States Can Do About Radon
  http://www.cdc.gov/cancer/dcpc/prevention/policies_practices/radon/states.htm

- Environmental Law Institute, Database of Radon State Indoor Air Quality Laws
  http://www.eli.org/sites/default/files/eli-pubs/2014-radon-database.pdf

- Environmental Law Institute, State Radon Legislation-Issues and Options
  http://www.eli.org/sites/default/files/eli-pubs/d1_13.pdf

- Environmental Law Institute, Strengthening State Policy to Reduce Risk and Save Lives
  http://www.eli.org/sites/default/files/eli-pubs/d22_05.pdf

- EPA's Model Standards and Techniques for Control of Radon
  http://www.epa.gov/radon/pubs/newconst.html
  http://www.epa.gov/radon/pubs/#index4

APPENDICES

Appendix A – Responses to the Radon Questions in the 2013 Utah BRFSS Survey

Source: Behavioral Risk Factor Surveillance System, Office of Public Health Assessment, Utah Department of Health

Table 1. Percent of People Who Have Tested Their Home for Radon Gas in Utah, 2013 BRFSS Survey

		95% Confidence Limits	
Response	Percent	Lower Limit	Upper Limit
Yes	18.2	16.9	19.5
No	80.0	78.6	81.4
Unknown	1.8	1.3	2.4

These percentages are based on Utah residents that responded to the question "Have you ever had your come tested for radon gas?"

Table 2. Percent of People Who Reported a High Level* of Radon in Their Home in Utah, 2013 BRFSS Survey

		95% Confidence Limits	
Response	Percent	Lower Limit	Upper Limit
Yes	9.8	7.4	12.1
No	90.2	87.9	92.6

*A high level is defined as test result at or above 4 picocuries per liter of air
These percentages are based on Utah residents that responded "yes" to having theirhome tested for radon gas. These particular percentages correspond to the question "Did the radon test show a high level?"

Table 3. Individual's Belief as to What Health Condition is Associated with Radon Gas, Utah, 2013 BRFSS Survey

What health condition is most		95% Confidence Limits	
often associated with radon gas?	Percent	Lower Limit	Upper Limit
Lung Cancer	51.6	49.0	54.3
Asthma	18.5	16.3	20.6
It is not associated with any condition	17.0	14.9	19.1
Emphysema	3.9	2.9	4.9
Some other condition	3.7	2.6	4.7
Breast Cancer	2.2	1.3	3.1
Heart Disease	1.8	1.2	2.5
Stroke	1.3	0.6	1.9

Appendix A (continued) - Responses to the Radon Questions in the 2013 Utah BRFSS Survey
Source: Behavioral Risk Factor Surveillance System, Office of Public Health Assessment, Utah Department of Health

Table 4. Reason for Not Having Tested for Radon Gas, Utah, 2013 BRFSS Survey

		95% Confidence Limits	
Reason	Percent	Lower Limit	Upper Limit
Haven't thought about it	34.6	32.6	36.7
Not at risk/not needed	14.1	12.6	15.5
Don't know what radon is	13.3	11.6	14.9
Don't own home/rent	8.1	6.9	9.3
House is new	8.0	6.9	9.2
Cost	5.3	4.3	6.2
No time	3.2	2.4	4.0
Not recommended	2.9	2.2	3.5
Don't know how testing is done/how test works	2.8	2.0	3.5
Too lazy	2.6	2.0	3.3
Don't know where to get test	2.3	1.7	3.0
Don't want to know	1.1	0.7	1.5
Planning to do it soon	0.6	0.3	1.0
House is old	0.5	0.2	0.7
House was tested by previous owner	0.4	0.1	0.7
Test doesn't work	0.2	0.05	0.4
Too many other problems with house	0.04	0.002	0.1

Appendix B – Radon Laws in the United States

States that are not listed do not have laws that fall in to any of the four categories.

State	Testing and Disclosure	Mitigation Certification	Construction Standards	Public Education
Alaska	x			
California	x	x	x	x
Colorado	x			
Connecticut	x	x		
Delaware	x			
District of Columbia	x	x		
Florida		x	x	x
Illinois	x	x		
Indiana	x	x		
Iowa	x	x		
Kentucky	x	x		
Maine	x	x	x	x
Maryland	x	x		
Michigan	x		x	x
Minnesota			x	x
Mississippi	x			
Montana	x	x		
Nebraska	x	x		
New Hampshire	x			
New Jersey	x	x	x	x
New York	x	x		
North Carolina	x			
Ohio	x	x		
Oklahoma	x			
Oregon	x			x
Pennsylvania	x	x		
Rhode Island		x	x	
South Carolina	x			
South Dakota	x			
Tennessee	x			
Texas	x			
Utah		x		x
Virginia		x		
Washington	x		x	
West Virginia		x		
Wisconsin	x			x

Source: Environmental Law Institute, 2014; University of Kentucky, 2009

Appendix C – Abbreviations

BRFSS – Behavioral Risk Factor Surveillance System

DEQ – Utah Department of Environmental Quality

EPA – U.S. Environmental Protection Agency

IRC – International Residential Code

pCi/L – picocuries per liter of air

SB – Senate Bill

SCR – Substitute Concurrent Resolution

UGS – Utah Geological Survey

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