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Welcome to Yale Cancer Answers with doctors Anees Chagpar and Steven Gore. I am Bruce Barber. Yale Cancer Answers features the latest information on cancer care by welcoming oncologists and specialists who are on the forefront of the battle to fight cancer. This week, it is a conversation about the impact of radon exposure with Allison Sullivan. Allison is an Environmental Analyst at the Connecticut State Department of Public Health. Dr. Chagpar is a Professor of Surgery at the Yale School of Medicine and the Assistant Director for Global Oncology at Yale Comprehensive Cancer Center. Chagpar Allison, maybe you can start off by telling us what exactly is radon?

Allison Radon is a naturally occurring radioactive gas. Sounds pretty scary, right? It comes from the ground, from soil and rock, and it actually originates in uranium and when uranium decays, it becomes radon gas that can seep into our homes and it is the leading cause of lung cancer in nonsmokers.

Chagpar How does radon get into our homes? I know that people talk about testing for radon and we are going to get into that later, but if it comes from the ground and it comes from uranium, how much of that is there really in our homes; should we be worried about this?

Allison We should. We should enough that we want to do a test to determine whether or not we have elevated levels of radon in our homes. Basically, all homes have normal pressure differences. So, it is easy for the radon gas to get drawn up into a home through these negative pressure differences, especially in the winter time which is when we should do our radon testing.

Chagpar So, the radon can kind of seep into your house due to these pressure differences. But, if it comes from the ground from uranium, how much uranium is there in the state of Connecticut that it should come into our homes? You know if I was living near a nuclear reactor that had uranium, well then maybe I should be more concerned, but we live in Connecticut.

Allison That's right. We do have a lot of radon potential in New England and throughout Connecticut. We have high to moderate potential zones in most of our state because we do have a lot of uranium in our geology. So, to have radon gas, we need the uranium under our buildings and the only way we can test for radon is once a building

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is occupied, we can do a radon test, we cannot test the soil or the air beforehand; it is something that we need to test once we are in a home, and the lowest living area is where we want to do our radon test.

Chagpar Okay. So, uranium exists in New England. And it can seep into

our homes and so we need to test for it once a building is built and presumably we need to test for it in our basements because you said the lowest possible point. How exactly is a radon test done?

Allison A radon test is very simple, and it should be done in the lowest occupied portion of a house. So, not necessarily always the basement. I think a lot of people just assume they should do the test in the basement, but only if you use the basement space for over 2 hours a day, like if there is a play room or an office down there. But radon testing is very simple, actually in January local health departments, most of them who partnered with my radon program at the State Department of Public Health have free test kits to distribute to their community, and hardware stores have radon test kits for around 30 dollars, and the American Lung Association typically has them for around 14 dollars. So, it is very low cost, and as long as you can follow the directions and you wait until the winter months to do the test, you should have a very good valid test to go off of.

Chagpar How complicated are the directions?

Allison You need to keep all the windows closed in your home and you want to decide on a place in your lowest occupied level and you want to put the test in the breathing zone. So, not too close to the ground or not too high up – you want to have it in an open airflow area, so not in a book shelf, on a coffee table would be a good spot, away from any animals that might get to it. There is nothing harmful in the test, but it is something you want to keep away from small children or animals, and you leave the test for around 3-7 days if it is a short-term test that you decide to buy or get for free from the local health department, and once you set it out, basically it is just leaving the test kit open, closing it when your test is done and sending it to the analytical laboratory, and then within a week or so, you will get a radon test result.

Chagpar Cool. That sounds easy enough. So, what do you do with the result once you get it?

Allison Once you get your result, you will decide whether or not it is a level you are comfortable with in your home. The EPA, the Environmental Protection Agency, gives us an action level of 4 picocuries per liter of air. Basically, at 4 that is considered a high level. So, anything at 4 picocuries per liter or more, you would want to reduce that

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level with a mitigation system. Even levels between 2 and 4, you should consider mitigation depending on how you use the space. Because no amount of radon is healthy and you want to have it as close to average as possible. So, under 2 is really what you are shooting for in your occupied areas of your home, school, workplace, any building that you spend a lot of time in.

Chagpar Let's say you get a level that is above 2, what exactly is the mitigation like?

Allison Mitigation is simple, but it is something we do not suggest you try to do yourself no matter how handy you are. We do have a list of qualified professionals on our department of public health website and in 1 day they can install what is called sub-slab depressurization system, which is a mouthful, but it is basically a radon reduction system and what it does is, it is a PVC pipe with a fan attached and it starts in your basement space from a hole, the PVC, and it runs along the outside of your home. So, basically it acts as a vacuum. It sucks the radon from the source under your foundation and exhausts it above the roof where no one can breathe it in. So, essentially, you are trapping all that radon into a pipe and exhausting it above the roof instead of it accumulating in your home and having it be a problem for your lungs.

Chagpar So, the pipe is installed entirely on the exterior of your home. It is not like somebody has to drill a hole through the foundation of your house?

Allison They do need to drill a hole in the basement space. It is a small hole where the PVC pipe will start and they will usually remove about a 5 gallon bucket worth of material from under the slab because you want to have good communication for that vacuum to work. So, there is going to be a hole in the foundation, one suction point typically for each home and then they are going to take that PVC pipe with an elbow and stick it on the outside and run it along the house, and typically the fan is on the outside of the house, where in case there is an issue with it, it is not going to leak into an occupied area, it is on the outside and once you figure out what this radon system is all about, you are going to start seeing them all over. It is very prevalent in Connecticut. I know on my street knowing what one looks like, there are certainly at least 3 on my street and it is something that you have to test for if your neighbor has a high level of radon, that does not necessarily mean you do. It all depends on the dynamics in your home, whether you have that uranium underneath your foundation. So, it is really something I suggest doing a test for and not just during a real estate transaction, because if you have only done a radon test during a real estate transaction, typically that is done in the warmer month of the year, when it should be done in the winter, and unfortunately it is a test that can be tampered with. So, you definitely want to redo a radon test after you have bought your home and you have control of the environment and it is winter time, that is when you want to do your radon test.

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Chagpar Does the mitigation system that goes through with that small hole through the foundation, does that in any way kind of cause any problems with the foundation of the home? Is it going to devalue your home when you go to sell it or in fact is it actually going to be something that is a positive that has that your home has a radon mitigation system?

Allison It is definitely looked at as a positive, because it is a problem that has been identified and is now fixed. Also, a lot of times these sub-slab depressurization systems can actually cause moisture issues in homes too. So, it is definitely an asset to have one, especially when you are thinking about how radon kills over 21,000 American citizens in the US every year. We do not want to have any sort of added risk for lung cancer and smokers are even at a higher risk. So, it is definitely something that I suggest every Connecticut resident do in the winter time after they have bought their home.

Chagpar How much does the mitigation system cost generally?

Allison It costs about 1200 dollars and it is something that every 2-3 years if you have a mitigation system, you would want to retest to make sure that the system is still working. It does have a visible alarm on it called the manometer, a little U tube with liquid in it. And you can always look at that to make sure you are getting a pressure difference. So, the U-shaped tube; if the liquid is higher on one side than the other, then you know you are getting a pressure difference. If they are equal, you know that there is a problem and usually that is the tip-off that you will need to replace your fan and that happens about every 10-12 years, you may have to replace the fan on the system, but other than that, it is not a system that has to be maintained a lot. Once you install it, it runs all the time, you never shut it off. In fact, it is bad to shut it off. And it is not something to worry about; once you have put in the system, it is reducing your radon, it is no longer a worry.

Chagpar And if you have to replace the fan, it is significantly less than the 1200 dollars of the initial cost, I would imagine?

Allison Yes, definitely, maybe closer to 150-200 dollars.

Chagpar A good thing to think about especially in Connecticut that has this medium-to-high prevalence of radon, especially because of the cancer risks that it has. Let's talk a little bit more about that. You talked a little bit about radon causing lung cancer, can you tell me a little bit more about that, how often it causes lung cancer and how bad that is.

Allison Why it causes lung cancer is because when radon gas decays, it lets off a pesky alpha particle. As we know, the 3 forms of radiation being gamma, alpha and beta – alpha is

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a form of radiation that you don't want to mess with. It is like a cannon ball. It is slow moving, it cannot pass through a piece of paper, but it packs quite a punch. And when you are inhaling radon gas and that alpha is released and touches your sensitive lung tissue, it actually does damage to the DNA and that is when it mutates, and it can make an abnormal cell and that is when you can get lung cancer over the long term. So, it is an easily preventable thing, if you have done a test and you have fixed the elevated level. Oftentimes, we

say you want to test, you want to fix, and you are going to save a life from radon-induced lung cancer.

Chagpar Does radon cause lung cancer more frequently in younger people, so in children or in the elderly?

Allison It does not. The only population of people that it affects more is smokers. Smokers are definitely at a higher risk. I have a stat that I can never quite remember, but I have it written down here. So, at the EPA action level of 4 picocuries per liter, you remember I said that that is the action level. So, anything over 4 is a level that you would want to fix with a reduction system. For a never smoker, if you have a level of 4, about 7 out of a 1000 people could get lung cancer. Whereas, for a smoker that number jumps to 62 out of a 1000. So, it is very significant. Obviously, we would love it if you quit smoking and did your best to do that but you can also reduce your risk by testing for radon and reducing your level should you find a high one.

Chagpar Perfect.

Allison We know that even at baseline, even if you had radon levels that were well below 2, which is normal, smokers have a way higher risk of developing lung cancer than people who do not smoke. But radon just adds to that.

Chagpar We are going to take a short break for a medical minute. And then, we are going to come back and learn a whole lot more about the impact of radon with my guest, Allison Sullivan. Support of Yale Cancer Answers comes from AstraZeneca, dedicated to providing innovative treatment options for people living with cancer. More information at [astrazeneca-us.com](http://astrazeneca-us.com).

This is a medical minute about smoking cessation. There are many obstacles to face when quitting smoking as smoking involves the potent drug nicotine, but it is a very important lifestyle change especially for patients undergoing cancer treatment. Quitting smoking has been shown to positively impact response to treatments, decrease the likelihood that the patients will develop second malignancies and increase rates of survival. Tobacco treatment programs are currently being 14:23 into mp3 file [https://cdn1.medicine.yale.edu/cancer/2019-YCA-0127-Podcast-Sullivan\\_350364\\_5\\_v1.mp3](https://cdn1.medicine.yale.edu/cancer/2019-YCA-0127-Podcast-Sullivan_350364_5_v1.mp3) offered at federally designated comprehensive cancer centers and operate on the principles of the US Public Health Service Clinical Practice Guidelines. All treatment components are evidence based and therefore all patients are treated with FDA approved first-line medications for smoking cessation as well as smoking cessation counseling that stresses appropriate coping skills. More information is available at [YaleCancer-Center.org](http://YaleCancer-Center.org). You are listening to Connecticut Public Radio. Chagpar This is Dr. Anees Chagpar and I am joined tonight by my guest, Allison Sullivan. She is here from the DPH to talk about the impact of radon, and right before the break, she was telling us about how Connecticut actually has a medium-to-high potential of having radon in our homes and how this is one of the leading causes of lung cancer particularly for non-smokers. Allison, we talked a little bit before the break about how when you buy a home, you frequently get it tested for

radon. Often, that is a requirement for getting a mortgage these days is that right?

Allison That's true. Residential radon testing is not a requirement in Connecticut. However, most mortgage companies do require you to conduct a radon test before they will give you money to buy your home. So, it is certainly something that happens a little bit more, but like we spoke about before, most real estate transactions happen in the warmer months of the year. So, that is not the best time of the year to do radon testing. Radon is typically highest in the winter time when the ground is frozen, when our windows are all shut, when we are getting a really significant negative pressure in our homes. So, you definitely want to do a test in the winter time. Also, I mentioned briefly that radon testing can be tampered with, some of the short-term devices. So, you want to have control of the environment before you do this test. Typically in a real estate transaction, you do not have that kind of control and also you want to make sure you are testing in your lowest occupied level, which may be different once you occupy a home rather than the people who are currently in it.

Chagpar And I understand that while real estate transactions in general do not mandate having radon testing, now new construction does. Is that right?

Allison As part of building code, as of October 1, 2016, it is in our Connecticut State Building Code for 1 and 2-family homes and townhouses that brand new buildings like townhouses and homes, need to be built radon resistant and that is a very easy thing to do when a home is being built, before the slab is poured. They can roughen the materials needed and it is much more cost effective and also you can most often put the system on the interior of the home instead of it running on the outside. So, if you are building your dream home, you can kind of hide your radon system by talking to

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your builder and discussing that you would like to have that roughed in. And then, once the home is ready for occupation, you would do a test to determine if you wanted to activate that system with a fan.

Chagpar So, when you say that they have to be built radon resistant, that pretty much means that no matter whether you have a radon problem or you do not have a radon problem, the builder has to put in a radon mitigation system somewhere in that home, is that right?

Allison A passive system, yes. And it is PVC pipe and it incorporates things that are already part of the building code like putting down sheeting and gravel so you have that good communication under the slab and making sure that there is room for the fan to be plugged in. So, there are different things and we do have educational materials on our website for builders to look up to determine how they are going to design this type of system or we always recommend

that people go to qualified radon measurement and mitigation professionals for advice.

Chagpar So, they roughen the system. That is a passive system. It is not necessarily a system that is turned on. Is it a system that automatically has a fan so that if, as you said most real estate transactions occur during summer months most houses get built during summer months too, so if you are buying a new home and the building code says you have to have this passive mitigation system in, would it work such that in winter I get my radon test done, it is high and I just have to flip a switch and turn it on or would it be oh! It is a passive system, so now I have buy a fan and I have to get the fan installed and now I have to flip it on?

Allison You would do a test because if it designed perfectly, which oftentimes unfortunately it is not because sometimes builders roughen these systems and they are not necessarily radon professionals, but sometimes when done correctly, a passive system can sometimes work without a fan to reduce your radon, but what you would want to do, if it is your first winter in the home, you would test. If you find you have a level that you are not comfortable with, so whether it is between 2 and 4 or definitely 4 and you want to fix it, you would activate that system with a fan but it is something that again you would call a radon mitigation professional to help you install that fan and make sure that the passive system that the builder put in is designed properly to be able to use that roughed in PVC pipe for your reduction system.

Chagpar This is all great when we talk about our homes, and I think that we now have a good understanding of how we test in our home and how we can mitigate a problem if there is one. But we only spend about half the time in our homes sometimes. We spend a

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lot of time at work, at school - what about those places? How do I know that when I am working in the hospital that the hospital actually did a radon test and that I am safe?

Allison I can tell you in Connecticut, we do have regulations that all public schools, K through 12 are tested for radon and fixed when an issue is found. Also all of our daycares in Connecticut have to be tested for radon upon licensure. So, they have to do a test before they can gain licensure and if they have an issue, it needs to be addressed. And in daycares, they actually have to post their radon test results on the wall for anybody to view to make sure that it has been done. Workplaces in Connecticut are not required to be tested, but we certainly encourage buildings to be tested anywhere that is occupied that has lower levels. I do not know where you are at Yale, but if you are an upper level, then it is probably not an issue for you. Radon is basically more of an issue on the lowest occupied level. So, anything in contact with the ground, so we are talking basement level or first floor.

Chagpar You would think that hospitals that are so in the mindset of public health and protecting patients that is would be mandated to have radon testing and mitigation.

Allison I agree, and of course coming from the Department of Public Health, we definitely want to instill that in everybody, but in Connecticut, the only places where it has to be done is in schools and daycares.

Chagpar Is there any advocacy going on, on that front?

Allison No too much. It is hard with so many other worries and so many other things, trying to convince every company or every state building to be tested, I know a lot of state buildings are tested, especially our office on Capital Avenue because the radon program is housed there. When we had some test kits, we certainly did some testing and Hartford is actually a low potential area, but it is certainly something that we encourage everybody to do. Unfortunately, it is only required in schools and daycares. It is a disclosure law also, I do not think I mentioned that for real estate transactions, so if you find an elevated level of radon, it is something you have to disclose once you sell a home.

Chagpar What about kids who are on college campuses? They are living in a college campus, they do not own this home, can they assume that a radon test and mitigation has already been done, and if not, can they test their little dorm?

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Allison They should and they would have to speak with their landlord if they find a high level and open up the discussion of what we can do to fix it to make a healthy home because obviously we want all homes to be healthy for everyone. However, the way the statute is written from the state department it is only public schools K through 12 that have the requirement at this time.

Chagpar We talked about radon in buildings, but we also said that the way that the radon gets there is from the ground and from uranium. And so, if because of this pressure differential it can seep into our homes, what is the risk for people who are outside? I mean, presumably they are in contact with the ground, yes there is no negative pressure differential there, but are they still at risk walking around in the environment?

Allison You are never going to get 0 with radon, and we know there is no safe level and ideally we want it below 2, but just to give you an idea, just walking around outside, you are exposed to about a 0.3 picocurie per liter level. The average indoor level is typically about a 1.3-1.4 picocurie per liter. So, we do get calls to the health department of people stating they want 0, they want no radon, they want no exposure to this cancer-causing naturally occurring element, but unfortunately, it can never be 0 and you are always exposed to a little bit of it, but we want to reduce anything that is over that 2 picocurie per liter level. And we talked a lot about radon in air, which is where we get our

primary risk for radon-induced lung cancer, but I should also talk about another source we have and that is that radon can also be in the water. Certainly, if you get your water from a private well source, this is something that you should do a test for as well if you have done your air first and you found a high level and you definitely want to fix it, another avenue is if you are getting your water from a private well, you should also sample your well water for radon because it can also be in your water. It is not really ingesting the water that is the issue, it is still an off-gassing issue. So, when you are showering or washing dishes, the waters agitated radon gas can escape and you breathe it in. So, it is still sort of a radon and air issue, but a different source not coming from soil gases. So, if you get your water from a public system, in Connecticut mostly we get that from a reservoir, so that is already off-gassing because it is surface, but definitely if you are served by a private well, it would good to also do a radon and water test.

Chagpar How does one do that? Presumably, it is not the same test kit.

Allison It is not. It is typically vials that you would fill up with no air bubbles in it. So, it is kind of a different method where you submerge the vial into water as it is coming out of the faucet, you would remove the aerator from your faucet to try to avoid any radon escaping before you can collect that sample. And you can certainly have a professional

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come out and do it if you are worried about it or you can get the test kit yourself, you just want to make sure the most important thing is that there is no air bubbles within the vial; otherwise, it will not be a valid sample.

Chagpar So if you test, the first thing to test is the air and if you have a high level, then presumably you are going to get a mitigation system. And even if you have a mitigation system, then you should still test the water, is that right?

Allison Yes you should because it is two completely separate sources with two separate fixes. You could have radon in air and radon in water and you would need two separate systems to reduce those levels.

Chagpar How would you fix the radon in the water?

Allison Radon in water is a little bit different. There are two types of systems depending on how high your level is. If you have levels over 5000, that is when we suggest you mitigate. So, if you have levels of radon in water, we suggest going off of two samples. So, in other words, if you take one sample and you get your result, you want to confirm it with a second one and take the average of the two samples. So, if your average is over 5000, we suggest you mitigate. Levels between 5 and 10,000, you would put in a granular activated carbon system to reduce those levels. Anything over 10,000 picocuries per liter in the water, you would want to install an aeration system and you can speak again to your qualified radon mitigation professional on what type of system is

best for you. Radon in water tends to be a little bit more expensive than the radon in air, the granular activated carbon system can be around 3000 dollars, whereas the aeration system is a little more money upfront at 5000, but less maintenance involved, no charcoal filters to clean out. So, it is something that you would want to openly discuss with your professional that you decide to hire.

Chagpar But presumably this radon is getting into your water from this private well, let's say that you have, and presumably the private well is getting the radon from the ground which is where radon lives with the uranium and everything else that we talked about before the break. So, why would not it behoove us to mandate that the private well fix the problem at the source instead of having everybody who is using water from that source pay out these thousands of dollars for this mitigation system?

Allison That's a good question. The Environmental Protection Agency gives us the action level for radon in air of 4 picocuries per liter, but for water, there is not an action level. There is not a number to go off of, so with the Department of Public Health regarding radon in water, we have a guidance level and our guidance is protective because it is getting you as close to average background as possible. If you were to go to another

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state, the guidance level could be more like 10,000. It is different in every state. So, it is very hard to have a mandated issue when there is not even an action level from the EPA to go off of, but certainly, in your home if you have radon in water, you would want to fix it with a mitigation system the same way you would want to fix the radon in air. Allison Sullivan is an Environmental Analyst at the Connecticut Department of Public Health. If you have questions, the address is [canceranswers@yale.edu](mailto:canceranswers@yale.edu) and past editions of the program are available in audio and written form at [YaleCancerCenter.org](http://YaleCancerCenter.org). I am Bruce Barber reminding you to tune in each week to learn more about the fight against cancer here on Connecticut Public Radio.