MICHAELA STRAZNICKA: OK. Hi. Sorry. We might as well get started. I've got a lot of slides to cover.

Hi. I'm Michaela. I'm one of the thoracic surgeons, and I probably know everybody in this room in some way or another. I'm going to be talking about lung cancer-- lung nodules, lung cancer, lung cancer screening. I have a lot of slides and I tend to talk fast, so if you need me to slow down. We'll try to get questions at the end, but don't hesitate to raise your hand if I'm kind of going way too fast.

And I'm a proud Co-Director of Thoracic Oncology Program. Lynn Rodegaard who's in the back-- I want to say hi to Lynn-- she's our great point person who works on the Pulmonary Nodule Program, and has been instrumental in getting our lung cancer screening program up and running. You may be getting calls from her, letters from her, if there's things missing in the lung cancer screening orders. So please don't get mad at her. She's just trying to make sure everybody gets their scans done and that no one has to pay for it. So thank you very much for your support, Lynne, and we have brochures up here we'll talk about in a second.

So obviously, X-rays are radiographic images or any way that we look inside the body. The basis of all X-rays of different densities will give us different information about tissues. Anything that doesn't belong there can be a potential problem. This includes masses, infiltrates, fractures, or fluid. Obviously, the standard X-ray that we all have the ability to order includes chest X-rays. One views are usually for inpatient setting. We don't do that much in an outpatient setting.

PA/lateral are the most common standard chest X-ray we would order. And decubitous views where the patient lies on their side are mostly designed to look for fluid and whether or not fluid moves when the patient goes from standing to laying down. Helps us also see more fluid. Most PA/lateral chest X-rays you need at least 500 cc's of fluid can be hidden by the diaphragm. When you lay someone lateral you can see a lot better how much fluid there is. So much better test, but mostly for fluid. CT scans. CT scans use radiation. They can be done with and without contrast. There's reasons to do both, with or without, and we can touch base on that.

PET/CTs are pretty much exclusive for patients who either have a known diagnosis of malignancy or a high suspicion for malignancy. MRIs with or without contrast are not that helpful when it comes to lungs, only because looking for lung nodules or lung masses, you're breathing, and they [INAUDIBLE] someone to hold their breath for 40 minutes. And so for lung lesions it's not very helpful, but it is good for paraspinal lesions, things like schwannomas, [INAUDIBLE] tumors, can help with mediastinal spinal masses-- those tend to be pretty stable. But not a test we go to early on.

Bone scans have pretty much been replaced by PET scans now. So what are the things that we'll get an X-ray for? Obviously infections-- pneumonia when you have infection in the lung, emphyema's an infection around the lung. Generally starts as an pneumonia, becomes an empyema. Chronic infections like bronchiectasis, cocci-- you know, valley fever-- tuberculosis. Fluid-- and anything from infection, which, again, common to be post the parapneumonic effusions, which become empyemas. Am And someone that's had a trauma we look for blood, and of course for malignancy. And you see other things like congestive heart failure, primary lesions, pneumothoraces. Those are all things that we would be thinking about when we order an X-ray.

These are some of the symptoms that patients will come to the office and say can I get an X-ray. Any one of those would be a good enough reason to get a chest X-ray, although cough is the one that everyone always asks me about. If you X-rayed everyone that ever had a cough, we'd be doing a lot of X-rays. So probably a kind of persistent cough, cough associated with hemoptysis, or cough that doesn't resolve is one that would lead us to do some radiographic testing.

So, again, why would we get an X-ray? In here I'm talking about any X-ray study. So obviously, symptoms that don't resolve with appropriate treatments. We tend to treat patients with a pneumonia with appropriate antibiotics or appropriate course if they're still not better, chest X-ray is indicated. Any time anyone has hemoptysis, should prompt some kind of a work-up. Again, persistent coughs without any other cause, any dramatic change in symptoms.

And oftentimes, we'll get X-rays for unrelated reasons. It used to be traditional that anyone had a knee replacement, hip replacement, any other surgery would get a pre-operative screening chest X-ray. That's kind of fallen out of favor, but there's still some people that do it and we may find things by accident. Other things that we oftentimes, if you get let's say a CAT scan of the abdomen looking for abdominal pain, we do always get the lower cuts of the lungs on the images, and oftentimes that will spur additional testing. So you do have incidental findings that we wouldn't expect to see.

So what is a regular PA and lateral chest X-ray good for? Pneumonia is the classic thing, and you always want to see resolution after treatments. Congestive heart failure is something that's easily seen on chest X-rays. Wrist fractures, bone fractures. Again, when it comes to fluid effusions, at least 500 cc's for a standard PA and lateral chest X-ray because you can hide all that behind the diaphragm. Again, we can look for parapneumonic effusions, and commonly malignant effusions tend to be large volume. And spontaneous pheumothoraces, think about your young thin, tall male that may or may not be dabbling in smoking that comes in with acute chest pain. Easy to see a pneumothorax.

Again, these are regular chest X-rays. The one up in the upper left-hand corner is kind of classic signs for congestive heart failure. The chest X-ray to the right is a patient with upper lobe collapse, complete collapse of his right upper lobe. You can see that sharp demarcation. And then with the chest PT on that patient shows a large mediastinal mass with obstruction of the right upper lob. So again, it's kind of vague findings. But the obvious findings are easy to see on the chest X-ray.

When it comes to lung nodules, especially when we're talking about lung cancer and lung cancer screening, the [INAUDIBLE] lung nodules have to be pretty big in order for you to see them on a standard chest X-ray. 10 millimeters is about the average size of a lesion that we would see on a chest X-ray. Obviously much better seen in the upper lobe. When you get down close to the diaphragm, the mediastinum or behind the heart, you could have a 3 centimeter mass and not see it on a standard chest X-ray.

By the same token, rib shot over the shoulder blades can actually hide or make it difficult to see. Nipple shadows can look like a nodule and then end up not being anything to worry about. So chest X-ray is pretty non-helpful when it comes to lung nodules as a whole. Most people say, [INAUDIBLE] old chest X-rays to compare it to. We're seeing more and more patients having some old X-rays, but if you don't, you kind of have to presume that this is a new finding. And again, overall, chest X-rays in and of themselves are a poor test for anything small or subtle. The only benefit is they're easy to get and there's a very low radiation dose. And even if you find something, you never end with a chest X-ray.

So what about CT scans? CT scans are significantly more sensitive than chest X-rays. Oftentimes if you see a nodule or a mass on the chest X-ray, the follow-up ends up being a CT scan. And the [INAUDIBLE] CT scans give us not only anatomic information, but a lot more in terms of the content, things like calicifications, densities-- is it a solid, is it semi-solid, is it a ground-glass, what do the edges look like. We can see other things within the chest including the lymph nodes, the other lung, anything on the chest wall. Obviously, the downside of CT scans, there's more radiation than chest X-rays.

Now, even more than CT scans, there's a certain amount of radiation that everyone gets depending on the kind of CT scan that you order. So if you're ordering a CTA to look for a pulmonary embolism, that is 10 times as much radiation as a screening, low dose, non-contrast ET scan because what you're looking for is much finer. So even within the word CT scan of the chest, there's so many variations. The American College of Radiology has had a strong stance on minimizing the amount of radiation for any test that we do. The amount of radiation will depend on the patient's weight, the body habitus, and again, what it is you're looking for.

In general, when it comes to nodules we don't recommend, we don't need IV contrast. I'll tell you about the instances where it may be helpful for the most part. The non-contrast scans are what's recommended because the nodule itself has an infinite contrast with the air around it. So you don't really need the IV contrast.

So again, these are kind of classic examples of lung nodules. You can see the bigger picture-- this really ugly, angry spiculated mass. You can see it's got some post-obstructive pneumonitis behind it, which is this area here. You can see that that's all consistent with some obstruction. This is more like a ground-glass opacity, very faint, difficult to see, usually what we call the semi-solid or migs density lesions.

This is a nice, small calcified [INAUDIBLE] lesion. Those are more likely to be benign. And again, this is another-- when we're looking at the non-contrast, you can see that there's calcium within that. That actually ends up being a chronic infection. So calcification does have a lot to do with it. The radiologist comments on that in their report. If you give someone contrast you lose the ability to see calcium. But in general, calcified lesions are less likely to be malignant than non-calcified. Spiculated is more worrisome than smooth and round.

And actually, the most worrisome of the mixed semi-solid, ground-glassy, like this one here that's got a somewhat solid center or somewhat fuzzy outside have a high instance of malignancy. Again, when you look at CT scans, you can see nodules as small as 2 millimeters in size, which is 10 times more sensitive than a chest X-ray. Again, we look at calcifications.

This is an example of what they call a rounded atelectasis, which is normal lung that's just not being ventilated. And this is one of those cases where a contrast can be helpful. In the non-contrast study you can see that there's almost no enhancement. But then in the contrast study it does, which is normal for normal lung. By the same token, if you look at this one, this is actually a lung cancer. Lung cancer does not enhance either with or without contrast.

By that token, though, I think that the American College of Radiology does not recommend generally doing contrast enhancement because of the risk of contrast-induced complications, and because ultimately, it doesn't help them that much. But they do sometimes favor it. It looks like round atelectasis, but using a contrast scan will show you there's more normal lung as opposed to malignancy. And again, this is another-- this is about a 4 millimeter lesion that you'd never see on a chest X-ray that you can see on the CT scan.

So nodules, obviously the presence of nodules in and of itself is not necessarily dangerous to any patient. Size is important. Size is proportional to the cube of the diameter. So when you think about volumetrically, we're looking at two measurements in a two-dimensional plane, but that's a three-dimensional process. So if something doubles in volume, it's actually eight-fold increase in the number of cells. So that's why when we look at these nodules and we say well let's follow them and see if they change, in a nodule that's doubled in one dimension is actually an eight-fold increase in volume. That's very significant.

Generally, nodules that increase in size or double in size in less than a month are almost always some kind of an infection. Cancers just don't grow that fast. Nodules that are stable over a two-year period of time are also generally not malignant, because you would think a cancer by that time would have grown at least some amount. Would is why one of the recommendations you'll see in some of these screenings studies is radiographic evaluation for up to 24 months. So if at two-years-- from the first time that you saw it to the two-year mark there's essentially been no change, the risk of this being a malignancy is very low. Not zero.

And then we're going to talk about PET scans. So again, PET/CT scans are-- it's a fusion. So this actually uses the functionality of the cells in addition to the anatomical pictures. So the function is how hungry are these cells that are picking up the sugar? The patients get an injection of glucose after fasting overnight. The idea is you want their cells to be as hungry as they can. When you inject the glucose into someone's body, all of your cells will pick up a little bit of glucose-- just the amounts that they need. And even if it picks up more than the baseline, it's considered active.

Now, they use a word called SUV, which is the standard uptake value. That is like the temperature of the nodule. In general, the higher the activity, the hotter it is, which just means it's using up more sugar. Things that are less active will be considered less aggressive, although when it comes to cancer that doesn't always pan out. The benefits of a PET scan is it does look at the whole body, except the brain. Because the brain is so hot, because it only can use glucose as an agent, there was for a while this interest in doing brain PET scans, and that didn't really pan out very well. MRIs are better tests.

AUDIENCE: Can you go back one slide? I just have a question. Point two. Nodules that double in size in less than a month are usually benign?

MICHAELA STRAZNICKA: Yeah, like an infection usually. Some kind of infectious process, like a aspergillus ball or a mnemonic process. In general, if they're growing that quickly, then it's not consistent with most cancers. There's very rare cancers that will grow very fast, sarcomas being one of them. Melanomas can be pretty aggressive. But in general, if you did like an X-ray or something and then they come back in two months and you treat them with the wrong antibiotic and it gets bigger substantially, it's probably not going to be cancer.

So when it comes to the PET scans, the activity level, that SUV, we consider 1 or less to be baseline or inactive. Between 1 and 5 is that crazy, frustrating indeterminant where it could be pretty much anything. 5 and over is considered cancer until proven otherwise. By that same token, there's plenty of lesions that can be super hot on the scan, including active infections, fractures that can have a SUVs of greater than 5. You have to use it in context. You have to remember, all of these are radiographic images. They're not designed to replace our clinical acumen. But in general, if you're looking for a smoker that's got the activity level's 8.5 in an upper lobe spiculated mass, that's going to be cancer until proven otherwise.

So again, everything has its limits. So in general, lesions that are 7 millimeters or higher are considered the threshold. So if you have a 3 millimeter lesion and it doesn't light up on PET scan, it may just be too small for the PET scan to be accurate. Again, they use an SUV of 2.5 being something that picks up, has a sensitivity of 90% to 95%, and a specificity for malignancy of 80% to 90%. Which again, means that there's going to be things have an SUV of 3 that are going to be benign.

By the same token, you'll have these bronchioloaveolar cancers that could be 0.5 centimeters large and have almost no activity, or SUV of less than 2.5, which can be still cancerous. So again, false-positives of an infection, sarcoid, inflammation in terms of bone, things like fractures, the false-negative's the big one that frustrate us. So the bronchioloaveolar carcinoma is what's now called the well-differentiated adenocarcinomas, and some carcinoid tumors which are still considered a cancer, although not of the same magnitude as let's say sqamous or adenocarcinomas.

The other important thing is we find additional Foci in up to 10% of patients. So on this PET scan, you can see in addition to that very, very hot left upper lobe mass, the patient will [INAUDIBLE] a positive axillar lymph node, which you would have never picked up on the routine scan because it's so small. But that activity leads you to another area to biopsy, and potentially change the patient's stage and prognosis.

So the presentation of lung cancer, if you look at the statistics for 2014, there's about 225,000 patients diagnosed in America. The majority of them are men. Age of diagnosis is about 70 years old, but there's a very small fracture that can be young-- younger than 45 years old. The overall lifetime risk of developing lung cancer is 1 in 13 for men, and 1 in 16 for women.

We say smoking is responsible or ri-ssociated with 90% of male lung cancers and 80% of female lung cancers. And men who smoke are 22 times more likely than nonsmokers to develop lung cancer. Women who smoke are 13 times higher times more likely to develop lung cancer than female nonsmokers. And when we talk about smokers, it includes former smokers. Up to 50% of patients will have a history of smoking but not active smoking at the time.

The really troublesome part is the 15% of never smokers, which are oftentimes women who develop adenocarcinoma-- no secondhand smoke, no smoking exposure-- and these are the patients that we almost always catch in advance stages. They're very difficult to cure because no one takes them seriously when they come in with their symptoms. Why would you think a 65-year-old woman who has never smoked, who has a cough have lung cancer. I mean unfortunately, 15% is not a minimal number.

Yes.

AUDIENCE: Question. This is actually presumably tobacco smoking. As more and more people are now smoking marijuana-- it's becoming legal-- any sense of the carcinogenicity of marijuana smoke compared to tobacco smoke?

MICHAELA STRAZNICKA: So the question was with more and more people now smoking marijuana, these are only a statistic based on tobacco use, so it's not specific to marijuana. I don't know of any studies, and I think the challenge with doing the studies, it really hasn't been legal to give a bunch of people a bunch of marijuana and say, smoke this and tell us what happened. I think there's less control of marijuana production, the chemicals in marijuana. I think the tobacco itself has a little bit more of an industry.

I think if you buy it from some guy that's growing it in his basement, probably harder to quantify. And [INAUDIBLE] most marijuana users don't smoke as much. You're not going to smoke 20 joints in the day, as opposed to like a pack of cigarettes, which is very easy for someone to smoke 20 cigarettes in a day.

So to answer your question, I don't know that there's really been a controlled study to look at the carcinogenic effects of marijuana. I think as it becomes legal, there will be more of an interest in doing that.

There was another question.

AUDIENCE: [INAUDIBLE]

MICHAELA STRAZNICKA: Yeah, so none of these patients, they talk about anyone that had a significant smoking history. Depending on which trial you're reading, it was usually about 10 to 20 pack you're smoking. But they could have quit-- some of our 80-year-olds may have smoked when they were between 20 and 40 years old. They're still considered a former smoker.

The argument now is that if you haven't-- and this is what CME's going to come up in a few slides-- CMS or Medicare has deemed that if you quit smoking more than 15 years ago, your risk should go down to a baseline, which is nonsmokers. I don't think that's true. I think that's just another way for CMS to save money and cut down who they're going to be able to study. And my personal experience as a thoracic surgeon, I see lots of patients who quit smoking 20, 30 years ago. They're still coming in with lung cancer.

So in a lot of these studies, they're saying anyone that has smoking exposure at any time in their lifetime. But for the criteria that we're going to talk about for lung cancer screening for Medicare, they're specifying that they have to be smokers within the last 15 years. And I would say a very mortal cancer, out of the 224,000 cases, 190,000 will actually die.

Again, each year there's more men diagnosed with lung cancer, but more women living with the disease, which means we can treat them. In many cases, some of these biologic agents are being tolerated better by female than male patients. The overall rate of new lung cancer has gone down in men, presumably because of smoking cessation. You can't smoke anywhere anymore. A lot of ability to quit smoking, kind of a push towards anything from Chantix, the Wellbutrin, the other smoking cessation activities, but it's actually gone up in women.

Again, these are the nonsmoking. Adenocarcinomas have the highest increase of any of the demographics out there.

In terms of racial and ethnic differences, African Americans are more likely to die from lung cancer than any other racial or ethnic group. And again, the age-adjusted incidence among African American men is 45% higher than Caucasian men, even when they're smoking the same amount of cigarettes a day. I don't know why. I don't think anyone really knows why that is. Same thing for women. Even though women-- the lung cancer instance for African American women is the same as Caucasian women, even if they have the same amount of smoking history. So if the male African American patients with smoking history that are most at risk.

I guess worldwide it's even more of a problem. This is kind of old data, but 1.8 million people died of lung cancer in 2002. Lung cancer is responsible for more cancer related deaths than the four most common cancers, which include colon, breast, pancreas and prostate. 29% of all lung cancer deaths in America are due to lung cancer, and the problem is that they're hard to find in the early stages. And that's the big point that we're trying to get out there. Only about 20% or less are found in the earliest of stages which are considered surgical, resectable, local with no advancement, and possibly curable.

So again, the overall five-year survival for lung cancers of all comers is only about 14%. It's less than 10% in some of the developing countries. You can see we've spend tons of money each year on treatments of lung cancer mostly because by the time you get to them when they're advanced, you're looking at chemotherapy, radiation, more chemo, biologic therapy, more biologic therapy. Oftentimes time some kind of surgical palliative treatments if necessary. So the cost of treating a lung cancer patient found in advanced stages far outweighs the cost of finding someone early stage, resecting them and not having to treat them with any further treatment. And the lung cancer's mostly 70 years and older.

This is a busy slide, but in addition to tobacco smoke, which, again, we say is associated with 80% to 90% of lung cancer patients, radon gas is, again, it's an inert gas. It's in the ground that we live in. They say that some people whose houses are in high radon areas should get all kinds of vents and systems to not let the gas get into the house.

Again, we know about asbestos and asbestos exposure. Mostly it's synergistic. If someone is a smoker and works with asbestos, the incidence of lung cancer's extremely high. Air pollution, again, hard to say how much air pollution we're being exposed to, but we know, again, some of the developing countries-- China where there's a ton of air pollution, but there's also a lot more smoking. So hard to quantify that.

A first degree relative with lung cancer-- a parent, a brother or sister-- although we don't have a genetic basis, there's no way to test someone like you can for BRCA or for some of the colon cancers, there's not a genetic test we can do for screening. In patients who say, oh, my dad and my mom and my brother and my sister all died of lung cancer, we kind of try to take note and increase their screening if we can. Obviously, a person with lung cancer, someone who's had one lung cancer and survived it is two to three times more likely than the general population to have another one in their lifetime. And again, 65 and over is considered the beginning of high risk.

Last one is that nonsmokers who have significant secondhand smoke exposure, again, that's where the family study came in. We'll talk about that in a minute. We talk about people who are in enclosed areas, so this includes people like flight attendants, casino workers, previous restaurant workers where they had extensive secondhand smoke exposure, or spouses where they lived at home, windows were always closed, have a 20% to 30% chance of developing lung cancer, even if they've never smoked themselves.

AUDIENCE: How about firefighters? Is there any study of those that are not smokers? Are they at increased risk of lung cancer?

MICHAELA STRAZNICKA: The question is are firefighters at increased risk of lung cancer? I think in terms of-- that goes under the air pollution category-- I don't know of any specific study that looked at firefighters alone as a demographic for lung cancer. It's something I can look into, but I haven't seen a specific study that looks at all firefighters and looks down their life to see whether lung cancer's more prevalent or not. Nowadays, the firefighters have such sophisticated masks and oxygen tanks, I mean that's only in, I would say, the last 10 to 15 years. I think back in the day they just ran to fires with hoses. So certainly things have changed, but I don't know of any study, and I could look into it.

Again, asbestos, we talk about asbestos. In addition to asbestos we think about some of the other chemicals that people are exposed to. Again, nonsmokers are five times more likely to develop lung cancer, even if they're nonsmoking. Asbestos workers are five times more likely than nonsmokers. But if you smoke and you worked with asbestos, it goes up to 50 or higher.

Interestingly, asbestos is more often associated with, and people think about mesothelioma, which is not a smoking related tumor. That's actually specific to asbestos. But mesothelioma's becoming almost like a historic disease in America because of all the litigation and all the preventatives of using asbestos nowadays in the workforce, and the care that we have in that. But worldwide, asbestos is still widely used in a lot of developing countries. So things like Turkey and some of the Middle Eastern countries, it's very common for mesothelioma to still be diagnosed and identified. So again, we're not seeing as much of it as we used to, but worldwide it'll still be important. We talked about family history.

The last one is radiation. So there is a thing called radiation-induced cancer. This will often happen in patients who were young when they got treated for Hodgkin's disease with high doses of mediastinal radiation, or women that had traditional breast cancer radiation where they really weren't lung-sparing. They didn't have the angles that we use now. So those are patients that are high risk of developing secondary cancers in the radiation field. Although most always are sqamous cell carcinomas, not adenocarcinomas.

Again, lung cancer statistics, 85% of what we'll call non-small cell. For lack of a better term, they're the 'better' lung cancer, if you can say that. Most common are the adenocarcinomas-- those are cancers of the glands of the lung. Sqamous cell carcinomas are cancers of the bronchial tubes. The rest are large cell, carcinoid, mixed histology. Obviously the bad player is small cell carcinoma, and that's exclusively in heavy, active smokers.

Again, mortality's very high. We talked about that being more deadly than colorectal, breast and prostate cancer. And the reason is because we don't catch it early enough. So breast cancer, 70% of patients are diagnosed in early stage. Same thing for colon cancer. 50% of patients are found in early stage. Prostate, almost 80% are found in early stage. But if you look at lung cancer, the predominant findings are stage three and stage four. And it effects your-- Yeah.

AUDIENCE: Always have a problem keeping non-small cell and large cell separated, because it seems like the amount of non-small cell, then your cell is large.

MICHAELA STRAZNICKA: So what's the difference between a non-small cell and a large cell? It's all the way the pathologists look under the microscope. They always classify it. But the most important thing is to separate the non-small cells from the small cells, because the staging is different, the treatment is different, the prognosis is different. So most of these stage one through four, I'm talking about non-small cells. When it comes to small cell, it's actually either limited stage or extensive stage, and the treatment is almost universally chemotherapy-based as opposed to surgically-based. Very few people get surgery for small cell lung cancer. So most of the staging I am talking about is for non-small cell lung cancers.

And again, we talk about the treatment. The early stage one's a 1 and 1/2 centimeter right upper lobe lesion with no lymph node invasion. You take out the lobe, they go home. About anywhere between, depending on who you read, 80% to 95% cure, that number goes down dramatically as we go into higher stages and surgery no longer becomes an option for most stage threes and almost all stage fours, other than palliation, like malignant effusion, bronchial stenosis or narrowing.

Do you have a question?

So stage two and stage three there's usually multi-modality treatments which may include surgery, especially for incidental stage two and stage threes where you go in there, you think they're stage one, you take out the lobe, you take out the lymph nodes and then some of them end up being positive. They've get postoperative or adjuvant chemotherapy with or without radiation. But their results are still not as good as finding really true early stage.

And again, the symptoms are by the time someone has symptoms, it's almost too late. The symptoms include cough, shortness of breath, big one is hemoptysis. Pancoast tumors or the upper lobe tumors are invading into the base of the neck can cause a Horner's syndrome, hoarseness. You can have systemic effect by weight loss, paraneoplastic syndrome, including blood tests that are abnormal. Orthopedic changes, including the joints are abnormal. And then, of course, metastatic disease. Things like seizures if there's brain [INAUDIBLE], neurologic deficits, lymphadenopathy, bony pain for bone mets.

75% of patients that have any symptom at all have either locally advanced or metastatic disease. Or you're looking at stage three or state four if someone comes in with a symptom. So again, the metastatic disease can be anywhere to the bone, to the brain, liver, adrenal gland-- those are kind of the big ones that we see.

So we say, well, how are we going to find these cancers, and if we're going to be looking for them to get them early? What about a chest X-ray? Well, chest X-rays are cheap, they're low radiation, you can get them anywhere, but they kind of suck. They're really not a very good test. There's been numerous studies that have shown that just regular chest X-rays for surveillance or screening to look for lung cancer is an extremely poor test. If there's enough findings that you can see it on a regular chest X-ray, in most cases it's more advanced than you think.

So then we said, well, what about CT scans? Those can find very, very small things. You're not limited by the shadows. The problem is it's more expensive, and it sees everything. So now you're looking at nodules and nodules and nodules. We'll talk about that in a second.

PET scans should never really be a first screening test. PET scans are in patients who either have a known diagnosis or a very high suspicion for diagnosis. Again, it's a much more expensive test, a lot more radiation, and the threshold is about 7 millimeters-- not good for a screening study.

So you get this patient, you send them for a chest X-ray, and then they got a nodule, get them to a CT scan. So what do you do? Well, first talk to the patient. Have you ever had an old X-ray? Have you had TB? Have you had a lung nodule in the past? Did someone ever do a scan on you? See if you can find any old scans, any old history.

What's their symptoms? Do they have a fever? Have they traveled recently? Are they immunocompromised in any way? Have they ever had cancer in the past? Depending on what it looks like, you may want to do a short course follow-up. You may want to do antibiotics and then consider re-addressing. And then, of course, consider some of the risk factors which may add weight to [INAUDIBLE] suspicion.

The problem with the CT scans, well since you see things that are 2 millimeters in size, we find hundreds and hundreds of nodules all the time. Most everyone is going to have a nodule in their lungs. If I scanned everyone in this room, I guarantee we'd find like 30 to 60 nodules. The good news is if they're 4 millimeters or smaller, the risk of cancer is less than 0.01%. It's very small. Micro-nodule could be anything from inhaling a bug when you were a kid, to low grade infection, to a scar, to coccidioidomycosis, valley fever that's endemic in the area.

So micro-nodules are things we just don't get excited about. We oftentimes tell them don't worry about it. More importantly, if there's numerous micro-nodules, it's almost never going to be cancer. But the larger the nodules get, the more we pay attention. So a module between 4 and 8 millimeter have a 5% to 10% chance of malignancy. When you're more than 8 millimeters, there's about 50% chance of malignancy. And 15 millimeters is cancer till proven otherwise. You've got to work those up right away.

I'm not going to go through all the management algorithms because there's really a lot of nuances. But the bottom line is the testing you can do could either be [INAUDIBLE] scans, head scans, biopsies, or resection if it's worrisome enough that you might want to go to surgery kind of almost right away. Most patients who have a big nodule we would oftentimes recommend a PET scan, not only to quantify the lesion itself, but also to look for lymphadenopathy in the other sites of disease.

Special circumstances, again, those ground-glassy lesions are more worrisome. The spiculated 15 millimeter lesions, those are more worrisome, and the risk profile of the patient.

So what about if we wanted to do a biopsy, what are the most common biopsies-- and I left out an important one here. But CT scan guided biopsies are a common test that we see ordered. It's an outpatient procedure. Patient can be lying on their back or their stomach. You can use-- a patient goes into the CT machine, an interventional radiologist gets the needle into that, and gets a sampling of cells.

Benefit is it's an outpatient procedure, a local anesthetic. Downside is you can get a pneumothorax or [INAUDIBLE] about 5% of patients. Literally, never a life-threatening hemoptosis. I've never seen anyone have to go to surgery because of a lung biopsy. But small lesions, lesions along the diaphragm are harder to hit, depending on the radiologist's skill. And if we really think about infection, you don't get a lot of cells. The CT scan guided biopsies are really only good if you really think it's cancer and you want to prove it. If you think it's something like TB or [INAUDIBLE] TB, you're never going to get a big enough sample to actually be able to get to the lab for cultures.

So the problem with CT scan guided biopsies is you get one of these vague, oh, there's some giant cells, some macrophages, some fibrosis. Those are pretty useless pathologic findings. You have to go one step further.

I was going to-- forgot to put in there bronchoscopy is another treatment option, especially with our super D, which allows us to navigate to the lesion. A little bit more invasive, more of an anesthetic, still outpatient procedure. You get much bigger chunks of cells. You can do washings, you can do brushings, you can do actual grasp for biopsies. It's a little bit more sensitive if you're looking for infection, but they're still all incisional biopsies.

Obviously, the most definitive biopsy is a surgical biopsy, what's called video-assisted surgery, which again, you're going to go in there. If you have a high instance of suspicion, lesions that are difficult to access any other way, but it's a surgery. It's a general anesthetic. People are in the hospital for 48 hours. There's a risk of general anesthetic. There's risk of bleeding. And some of these lesions are not easy to find. Like it is really hard to find this lesion in the operating room, even though it's super easy. So sometimes we localize it and we do some other fancy things. But that's your most definitive. And if you have a wedge biopsy that's positive for lung cancer, you would do oftentimes a completion lobectomy at the same time. So there is benefit to doing that.

These are some of the surgical results. They're listed in I-ELCAP. And so these are surgical patients looking at stage one through four. And again, you can see that the I-ELCAP study, which is a research study looking for screening, they have up to 94% five-year survival or cure rates with early stage lung cancers.

So the key is how do we get better? We have to screen these patients, and the problem is we don't have screening until just now-- I was going to say even in lung cancer patients. So the reason that screening is so helpful, but even if you have a stage one, which are any one of these patients by our pathologic criteria, the smaller it is, the bigger your chances of cure rate. So even within the early stages, we know that smaller they are when you get them, the more likely the cure.

So again, lung cancer screening is you want to find a diagnosis prior to developing any symptoms. So the purpose is you want to take a cohort of patients and you want to say I'm going to go and find a disease process that I think you may have, and then I'm going to treat it differently. So again, you can see that when it comes to the cancers that have screening-- colon, breast and prostate-- significant cure rates, versus lung cancers never had lung cancer screening.

So again, you take a group of patients. You say I think I may find this disease in you, even though you don't have any symptoms. You want to use risk factors. The more risk factors you use and the higher the restriction is, then the more likely you're going to find the disease process, but you're also going to miss ones that don't fall into it. Again, in this case, it has to be a treatment that you're going to offer them if you find them early.

If your incidence is too high, if you're finding that cancer in every one you screen, you're losing people on the side. Your risk factors are too high. Whereas if you screen too many people, then you're going to have a low incidence.

So again, what makes the screening test good? It's pre-clinical. You have easy access to the test. It's got to be available to a lot of people. Low risk associated with the test. Most importantly, low false-positives and false-negatives, and has to be cost effective, which has been the key with CT scans up until now.

So talk about early detection, I'm going to jump through some of these screen shots. I want to talk about I-ELCAP because that's the clinical trial we're working on now. It's the International Early Lung Cancer Action Project. It was started in Cornell in 1993. It uses a low dose, non-contrast CT scan for high risk patients. The key here is that we have over 50,000 patients in 50 centers internationally, and these patients are encouraged to undergo ongoing screening.

The key about this is every center could choose their own risk criteria for who they wanted to include, and the problem was you had to pay for it because it wasn't covered by insurance. Some centers had funding through their research program, but most places did not. So in John Muir we chose these as our criteria. Age 40 to 85, at least 10-pack year smoking history. Possibly asbestos exposure, significant radon gas exposure, a primary relative with lung cancer. And the key is you want to pick patients who are healthy to undergo what's going to be the proposed treatment, which is surgery. So you don't want to do a 90-year-old with severe emphysema and a bad heart to go through the screening.

So the idea was that you want to get patients where you know you can get them through the surgical curative treatment that they're going to be recommended to have. Now, that being said, we do now have some really exciting radiation oncology treatments that are also available that have really good results as well. But for the I-ELCAP purposes, the goal was people were going to go to surgery.

The FAMRI trial is also available to John Muir. That's the sister to the I-ELCAP. This is a heavily subsidized trial, so any patients who are lifetime nonsmokers who had significant secondhand smoking exposure can qualify for this study. It's a single CT scan, but it's, again, low dose, non-contrast CT scan. If you find nodules, you treat them and follow them as you would appropriately. Patients who have no nodules fall off the study.

The good news is because it is so heavily subsidized, patients don't have to pay for it. So that's something we're encouraging our patients who have that exposure to participate. So again, this is number we call for. These are the trials that we have available.

Wrapping this up, so yeah, so the treatment is based on what you find. There's recommendations given by the radiologist for what they would say to do. If you biopsy and prove lung cancer, then you follow the NCCN guidelines for treatment. Early stages get surgery, advanced stages chemotherapy, radiation, maybe surgery. And all the treatment options are available at John Muir.

The I-ELCAP conclusions show the 10 year survival for all cancer patients is 80%, and that's because they had a very low rate of advanced or metastatic disease in their patient population. The 10-year survival for clinical stage one when you consider all treatments was 88%. Those patients that had surgery had a 92% survival of 10 years. And their conclusion was they prevented 80% of lung cancer deaths. There were several patients that went through the screening and didn't get treated. They all died within five years from their cancer.

So is CT scan, was screening worth it? You know, right now the rate of detection of the population is about 1.3% at baseline, and 0.3% for annual scan. Again, if you change your-- if we wanted to start at 60, we'd have a much higher incidence, but we'd miss some patients that were younger. When you compare that to mammography, we're actually doing better than mammograms, but it costs more money. It's $275.

But the key here is you're presuming that all these patients are going to live long enough that if you don't find this cancer you're going to be treating their metastatic disease down the line. So when you think about the cost analysis, if you don't find these patients early and you wait three or four years and now they come in coughing up blood and with metastatic disease, you're going to have to treat them. At that point the risk of cure is going to be very low, and 85% of them will die of their disease. So the true cost analysis overall makes sense.

So what's the risk of CT scans for screening? It's the radiation, because there is radiation [INAUDIBLE]. Again, these are low dose, non-contrast CT scans. They're not some of our most sophisticated scans. The risk is developing secondary cancers usually 30 years after the time of the radiation exposure. So if you have a 65-year-old who smoked who has a risk of lung cancer, better to find it now than worry about what's going to happen when he's 95 years old.

This is the trial that changed everything, the NCI trial, which was a national lung cancer screening trial. Much more limited, 55 to 74. Big smokers-- 30-pack year smoking history. They had 53,000 participants. They stopped the trial halfway because they thought 20% mortality reduction for the CT scan versus a chest X-ray arm. So this actually finally prompted CMS, Medicare to approve-- yay-- lung cancer screening. The problem is they're still making it pretty difficult. You have to be 55 to 77 years old, 30-pack smoking, which is actually a lot of cigarettes. One pack a day for 30 years, two packs a day for 15 years. They're either smokers or they've had to quit within 15 years. So if you catch someone at year 16 from the time they quit smoking, they no longer qualify. And they have to be without symptoms of lung cancer.

Now, that being said, a cough, and even the diagnosis of COPD is not considered a true symptom of lung cancer. And most importantly, everything has to be documented in the patient's chart, otherwise it doesn't get covered. So in EPIC we've got a full workout, and Lynn is available to answer questions. I think we have information here about that.

Number one is a smoking history. In the social history it has to say what the smoking status is, when did they quit, how many cigarettes did they smoke, and it calculates the pack years. If you don't put it in there, it doesn't exist. And the problem is sometimes we rely on our assistance in the office to do that. It has to be accurate. You really have to make sure that that's an accurate number, because if they put the wrong number in, you're not going to get the right pack year history.

Again, the best practices should pop up, so if that is populated correctly, you guys have these best practices pop up, and you notice them more than I do. But if that is put in correctly then it would pop up, say hey, your patient would be a candidate for a non-contrast CT scan. Do they fit the criteria and do you want to order this non-contrast CT scan. And it does kind of walk you through it. And again, everything has to be documented.

This is the pack year smoking. It has to be in your progress notes. And again, the number of years that were smoked and when they quit is very important, otherwise these are hard stops that are not going to let you get past it. And then the other most important thing is the shared decision making discussions. So CMS requires that all Medicare patients have a face-to-face meeting to talk about the risk, benefits, alternatives of doing a non-contrast CT scan.

This has to be, again, that includes discussion about smoking, it discusses the risk of radiation, it talks about the what happens if we find a positive lesion. What happens if we don't find a positive lesion. And there is a smartphrase that you can pull into your progress note that says that you discussed it with them. But that has to be documented in the chart.

You can bring patients back to have the shared decision making as a separate visit, and bill for it as a separate visit. I don't know what you get paid. So again, this is what the order would end up looking like. It has the pack years, when they quit smoking, what their smoking history was, that you discussed the shared decision making. And you can give them one of these pamphlets-- that's kind of one way to do it. And that there are paper versions available for non-EPIC doctors. Again, if any of those elements are missing it jumps back, and there's a risk that patients won't get it paid for. They'll have to pay for it out of pocket.

So again, the key is it's kind of a narrow range. So what I'm recommending is if you have patients that fall out of that range, but you have a suspicion because you think they're high risk, I would recommend that they consider enrolling in the I-ELCAP trial, which, again, is broader-- less smoking history, there's no limitations on when they quit smoking. Once the patients are scanned, the radiologists are using what's called Lung-RADS, which is, again, they document exactly what their recommendations are. Any follow-up should be done based on their recommendation.

Here's the code for the shared decision making visit that you can use in your billing to get paid for it. And these are the brochures which you can have available to you. And so far in our experience, we started screening in October of 2015. We've screened 75 patients.

Lung-RADS 1, 2, 3 and 4 is what the radiologists say are suspicious findings, and then they make recommendations. To this point we've had no lung cancer diagnosis at this time. But we've had a lot of patients who didn't get their scan done because some of the documentation wasn't correct. So Lynn has been our interceptor in terms of getting as much information as we can so that the orders are complete.