# Cancer Rehabilitation: Overview and Essentials

Recorded July 12, 2019

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PhysicalTherapy.com Course #3501

- - [Calista] Welcome everybody today. Today's course title is Cancer Rehabilitation Overview and Essentials. And I'd like to welcome our presenter today, it's Steven Wexler. Steven is a physical therapist at Memorial Sloan Kettering Cancer Center outpatient Sillerman Center for Rehabilitation in New York City. Dr. Wexler currently serves as a secretary for the Academy of oncologic physical therapy in the APTA and recognition of his efforts and participation in the APTA, Dr. Wexler was awarded a 20-17 APTA emerging leader award and in 2019, he received the President's Award for his efforts within the Academy of Oncologic PT. He has lectured locally and nationally on the topic of oncological rehabilitation. So we are so pleased to have you here with us today Steven. And at this time, I'm gonna turn the microphone over to you.

- [Steve] Okay, great, thank you very much Calista. And good afternoon everybody, I'm really excited to be speaking on this topic today. It's a topic that I am very passionate about and I think it's a topic that is increasingly important not just if you're going to be in a or if you work already in a cancer rehab specific setting but really any practice setting. In the first couple slides we'll talk about why it is that no matter what setting you currently work in or going to work in you are going to see patients with a history of cancer. And it's really important that you're able to confidently and safely approach these patients and safely evaluate and screen and develop plans of care. So without further ado, we'll jump in, no disclosures. A couple learning outcomes, so here's what I'm hoping we accomplished today. We're gonna start off by describing some current data trends, I'm talking about why cancer rehabilitation services are so important and why we need more of them. We're gonna talk about how to develop a hypothesis for the appropriate stage of rehab in respect to a cancer diagnosis, prognosis and treatment. I think that that's a really helpful way to sort of frame a mindset when you're working with a patient with a history of cancer. We're gonna talk a lot about safety today and we're gonna identify a few red flags that do require immediate referral when working with a patient with a history of cancer. And beyond that we'll talk a lot about precautions and different safety considerations when working with a patient with a

history of cancer. And lastly and certainly not least, this would be a big chunk of today, we'll talk about the various side effects that are commonly seen after some of the more common cancer treatments including chemotherapy, radiation therapy, surgery and hormone therapy. And we'll sort of frame some ideas about how to intervene with rehab. So a growing trend. So unfortunately cancer rates are high, there's no denying that for a few reasons; people are living longer which is a good thing, people are unfortunately living unhealthy lifestyles which is not a good thing and we can't ignore environmental factors influencing cancer rates as well.

So in 2018 there was an estimated 1.7, about 1.7 million new cases diagnosed with just over 600,000 deaths related to cancer. As you can see the numbers compared to 2000, the numbers are obviously growing. Now this number I think is staggering. Approximately 38.4% will round up and we'll say about 40% of men and women will be diagnosed with cancer at some point in their lifetimes. That's a big number. And lastly you know cancer care is expensive. So in 2017 the national expenditures for cancer care in just the United States was $147.3 billion that's a ton of money. Now the good news in all this is that more people are surviving.

So if you look at the 5-year survival rate in this window in the 2000 from 2004 to 2010 at 68% that's considerably higher than the five years survival rate back in the 70s of 49% just below 50%. So more people are surviving which is a good thing. So you can see kinda the trend of this line. If we go back to 1975 in the United States, there was an estimated 3.6 million cancer survivors. You see obviously the positive slope of this line, all the way up to an estimated 26.1 million survivors in 2040, that's what we're anticipating. And you can see kind of a nice breakdown of the age groups. So the the red group is starting at 50 and everything above that is 50 or above. So starting to just kind of frame your mind around the demographics of the population of cancer survivors. So obviously this line is going up, the numbers are going up. There are a lot of unmet needs unfortunately in this population. So this study in 2017 found that 20%

of childhood cancer survivors and 53% of adult onset cancer survivors reported limitation in functioning. So if you think about the millions of survivors that I just spoke of and now these relatively high percentages, we're talking about a large percentage of survivors in the United States with physical limitation. So just to give you an example of that this study, a little bit long ago in 2008 found that as many as 2/3 of breast cancer survivors experienced at least one long-term adverse sequela. That could include fatigue, lymphedema, pain or contractures at least according to this study. And they found even higher rates of impairment with metastatic disease. So they looked at this cohort of a 163 patients receiving treatment for stage four breast cancer and 92% endorsed at least one physical impairment and the average number of impairments was over three. So that's a lot to be dealing with.

And of course unmet needs equals increased costs, I mentioned that. Cancer care is expensive not just for the individual with cancer but for their families and for our healthcare system sort of on the bigger scale. There's estimates that next year in 2020 national costs could reach a $174 billion. Also related to costs, increased physical disability does decrease a return to work which does cost, cancer survivors have been shown to be actually 1.4 times more likely to be unemployed which is not just solely due to physical impairments but also psychological need to be considered there as well. And yet treatment rates for cancer-related disablement, when I'm in front of a classroom giving this lecture, I usually look for people to shout out some percentages.

And I get a 50% or a 25% which would be great because in reality 1% 2%, and this is not a really an old study, this is just from the end of 2017 this paper was published. So that's incredible. So you think about this huge number of cancer survivors and anything about these relatively high percentage of cancer survivors with physical limitations and this really low number of treatment rates. And so why is there this disparity? Is it a low detection of physical needs? It's possible that we're not screening or that medical teams are not necessarily screaming. Could it be because there's difficulty

documenting physical impairments related to cancer treatments and cancer itself, is there no standardized language? Historically, there's been a paucity of literature in regards to cancer rehabilitation but that has changed rapidly in the last several years and it continues to change rapidly. So I don't think that's a fair excuse anymore. There are low referral rates and is it that due to a lack of awareness or an under recognition of the potential benefits of rehabilitation? I think that is a big part in many ways although in my own experience oncologists, whether it's medical oncologist, surgical oncologist, radiation oncologists and everybody sort of in the health care system is starting to get privy to the benefits of physical rehabilitation with cancer survivors. Now we can't overlook some potential systemic issues.

So there is a shortage of cancer rehab specialists which I'm hoping to maybe do my small part in changing that today but there's a lack of standardized education and training. So I remember in my DPT program, I think we had maybe one lecture that even touched on cancer rehabilitation. And aside from that, it's not really built into a lot of curriculum and so people are coming out of school, therapists are coming out into the workforce not really knowing how to treat patients with the history cancer. And we also have to acknowledge that this is, we saw the trend of that line, this is a rapidly expanding population of cancer survivors. And I think just that the the rehab world has had difficulty keeping pace.

So I think that we are starting to catch up, if you think about where the funding in cancer research has gone, it's gone towards finding a cure, finding life-prolonging treatments and it's worked because people are surviving longer now but I think what we're starting to see and what we need to see more of is that research focus sort of shift now to say, okay, people are surviving, now what a survivorship look like? And I think that's really going to help us sort of catch-up prove that what we can do helps. Now we can't ignore that there are barriers. So these patients, these cancer survivors are oftentimes managing multiple providers, multiple comorbidities and impairments

and they oftentimes do have limited fiscal and energetic resources. And there's also, this is sort of a systemic thing, there's been a shift in the cancer care model to a community-based delivery system. So Cancer Care has enlarged in sort of big ways moved from big tertiary Hospital centers out into the community which is great, it means more services for more people, more convenience but the dissemination of cancer rehab services into that setting I think has been a little bit more limited so the treatment is there but again now we have to sort of focus on the survivorship and what the post care looks like.

So I think this quote from Julie Silver in 2011 is pretty striking. In effect, the medical system creates a situation where high functioning individuals are given life-prolonging treatments, that's good, and then left to struggle with how to recover from the toxic adverse effects, obviously not so good. So the good news here is that in past years and currently the evidence is blowing up, there's a lot of supporting evidence for what we can do to help these patients. So first of all just to lay some groundwork, there's been studies that find that sedentary behavior before a diagnosis of cancer increased the risk of certain specific cancers as well as increasing the risk of all cancer mortality. On the flip side, physical activity before a diagnosis of cancer decreases the risk of all cancer mortality.

So one of the themes of today will be that exercise is good, so this is sort of the first supporting evidence that I'll share for that. So furthermore patients who exercised after a diagnosis of cancer had lower relative risk of cancer mortality, lower relative risk of recurrence and fewer and less severe adverse effects. So this right here kind of says it all. And just to go one step further, again exercise after a diagnosis of cancer has been shown to have significant benefits on quality of life and physical function with comparable effects across patients with different demographics and clinical characteristics. And there has been a good deal of evidence that says supervised exercise has greater benefits than unsupervised interventions which is sort of a big

drop in the bucket in support of physical therapy, what we do. So how do we begin to think about individualizing a cancer rehab plan of care? This is a medically complex population, there's no denying that, and once safety and scope of practice are established, you actually have the skills that are needed to treat this population. And so I'm not gonna dive a ton into interventions today because you know the gait training, the balance training, the therapeutic exercise, therapeutic activities, that you already know how to deliver to your clients, they work with cancer survivors. I think it's more important to focus on how to tailor your approach with patients with the history of cancer and how to maintain safety. So with that said, we're gonna dive into safety considerations.

This paper was published in September 2017, a focus review of safety consideration in cancer rehabilitation. I think that this paper is a must read if you are working in the setting of a cancer rehab specific clinic or hospital or wherever you may be but also I think no matter what practice setting you're in, this is an important read. So we're going to talk a little bit more in depth about these safety considerations. We're gonna talk about metastatic disease, osteoporosis and bone loss, myelosuppresion, so low blood counts, DVT and pulmonary embolism. We'll talk about cachexia and malnutrition as well as active malignancy. And so first up is bone metastasis. I think that this can be one of the more intimidating safety considerations when approaching a patient with a history of cancer. So let's talk about it now, I hope I can dispel some of the fear.

So there are some cancers that are more prone to metastasize to bone and those are breast, lung and prostate cancers. Lesions in the long bones, so talking about femurs and humerus as well as the spine present the greatest risk of pathologic fracture. And there are some general safety measures and these are outlined in that paper that I just gave you the title for. So first two, and again these are general safety measures, we generally don't perform formal manual muscle testing in an affected limb with a bony

metastasis as well as no progressive resistive exercises through that affected limb. Reason being the torque and the stress that we put through a bone, if the integrity of that bone is compromised because of a bony metastasis, there's potential to cause pathologic fracture. Now I think that you could fairly put a little asterisks or a little grain of salt next to these two points because I think that more times than not, there is room for a discussion with the referring MD. And I say that, certain examples come to mind, I've worked with for example a young who had a young child and she came in and said this patient did have bony metastatic disease. She came in and said well my child is 20 pounds and like it or not I need to pick up my child to care for him.

And so was it better for us to say no, no strengthening exercises or was it better to have a conversation with the referring doctor talk about maybe certain limits of strengthening or certain considerations and then really emphasize the importance of body mechanics and safe lifting techniques to minimize that patient's risk of injury. So again these are general precautions to keep in the back of your mind but I think if you're encountering a patient with bony disease almost always there should be a discussion with the referring MD if strengthening is indicated in your plan of treatment. We may need to consider offloading weight bearing through an affected limb with an assistive device, so the example that comes to mind. For this one is if a patient has a bony met say in the femoral neck and with the stress the torque that goes through the femoral neck as a patient that goes through the gate cycle that could increase the risk of fracture, we may need to offload with either a cane or crutches or a walker.

Typically if there's bony Mets to the spinal column, we do observe spinal precautions, so BLT, no bending, lifting and twisting. And the last one here is monitor for increasing functional pain. And I did place an asterisk next to this one because in my practice at least I find this one the most important. Increasing functional pain has actually been found to be the single greatest predictor of a pathologic fracture and so when I'm working with a patient with known or even suspected bony disease, I'm asking them

every step of the way how's this feel, any pain with this, tell me how you're feeling. I don't necessarily tell them why I'm being so persistent with my questioning but that is why. Now overwhelmingly so, there have been several studies that show rehab interventions are generally safe and effective and do not increase the risk for fractures. So these are general safety measures that we take with a patient that we know has bony disease, I think it should facilitate a conversation with the referring MD but know that you can work with these patients safely. So next up osteoporosis and bone loss are a little bit different than bone metastasis. So osteoporosis and bone loss in this population is most common in hormonally driven cancer.

So certain prostate cancers, certain breast cancers or with prolonged exposure to hormone therapy. Now similar to a non cancer-related osteoporosis or bone loss, it can increase the risk of fracture. There's been evidence shown in this population of cancer survivors that weight-bearing exercise may have a protective effect. Next up is cachexia, so this is common with advanced cancer. And cachexia is characterized by marked weight loss, not just a fat but also of lean muscle tissue, we see muscle atrophy, fatigue, weakness, loss of appetite. And so you can imagine how this can become sort of a vicious cycle when there's a loss of appetite, the patient's not getting appropriate caloric intake, they're malnourished and a sort of spirals out of control from here. And now this is an important topic because exercise in the absence of appropriate energy balance may pose a risk for further functional decline.

So I recently evaluated a woman who certainly did have PT needs, she was weak she was deconditioned, she verbalized to me that she had lost a lot of weight over the last several weeks, she was hospitalized. And I had to have a conversation with that referring doctor to say hey, can we get a nutritionist on board. And what we actually ended up opting for was a course of home therapy with a little bit less demand on her energy so that she could build up some strength and then return to Outpatient PT when appropriate. So a couple notes about modalities and manual therapy, I feel like

my friends who work more on orthopedic physical therapy always say, okay, well, I assume you're not doing manual therapy with these patients 'cause I think we're led to believe in a little bit of cancer rehab education that we received in school, that manual therapy is usually contraindicated over areas of active malignancy. So we'll address that. So there are different side effects of cancer treatments which we'll talk about during this lecture that can result in impaired sensation, fragile skin, fragile bones and certainly over those areas of impaired skin or bone integrity or decreased sensation, we need to be considerate about how we're delivering modalities or if maybe there's a more effective technique or intervention we can choose.

So certainly in any areas of impaired sensation, we need to really think about our use of heat and cold modalities TENS, neuromuscular electrical stimulation in areas of fragile skin perhaps due to radiation therapy, we'll talk about that later, we may need to modify our manual therapy how we're applying heat and cold areas of bone fragility whether it's because of a bone metastasis or whether it's because of osteoporosis or bone loss, again, we may need to think twice about how aggressive we're being with our manual therapy or our joint manipulation. And when there is an active malignancy or an area with an active malignancy in it, hard contraindications are what we learned in school, so NMES, low-level light laser ultrasound heat really modalities that increase blood flow or stimulate blood flow are typically contraindicated in an area of active malignancy. So now let's talk about some sort of hard red-flags, reasons to refer. When there's a newly onset pain, I think that this is worth mentioning because this is always worth investigating a little bit more.

So some characteristics of more of a red flag kind of pain is pain that's unrelenting, pain that is nocturnal, so if the patient verbalize that they're having it 10 out of 10 at all times definitely during the night, atypical I think is an important word here. So if through your screening process, even if it's just subjective screening, if you can't rationalize this patients new onset pain to be due to a musculoskeletal involvement or due to an injury,

then that may be something that requires further investigation and in a referral. If a patient has atypical shortness of breath, certainly any sort of hemoptysis, any sort of blood being coughed up needs to be referred immediately. Any sort of change in neurological signs, so any change in bowel and bladder which does mean that we need to ask about bowel bladder at the onset or at the initial evaluation, any sort of acute focal or diffuse weakness, any sort of altered reflexes which again does require that we measure reflexes at the get-go so that we can monitor that.

Usually if I have a patient who I know has a sort of neurological or neuro oncological involvement, I will get a baseline measuring for reflexes so that I can help track those in case I'm suspecting a change in status. Any sort of sudden change in cognitive or functional status is certainly a reason to referral. Anything to make you suspect a possible progression of disease, so again going back to that word atypical. If you cannot rationalize this change in status or change in function because of an injury or because of a musculoskeletal issue, you need to think about whether potentially a progression of disease may be causing that new impairment or that new progression. And I mentioned urgent versus emergent. And I think that this is a subtlety that if you work specifically in cancer rehab you'll become more comfortable with but these patients do have, usually in most cases, have regular follow-ups with their oncologists, they're seeing their doctors a little bit more on a routine basis compared to in your normal outpatient setting.

So for instance I've had patients come in and mention one of these things. And if I know that they're seeing their oncologist oftentimes, they'll leave my office and go to their oncologist, there can be some differentiation between something that needs to be emergent and go to the emergency room immediately versus something that they just need to follow up with their doctor on as soon as they can. Now there are some emergencies. And the this is a category that does require immediate referral. And so the first category of oncologic emergency we'll talk about is a structure or mechanically

induced emergency. So spinal cord compression. So this is characterized by localized back pain usually in the thoracic region most metastases to the spine do occur in the thoracic region and that's usually what will cause a spinal cord compression. Again, that nocturnal pain, night pain may be increased with thoracic pressure whether it's valsalva or bearing down to have a bowel movement or a sneeze or a cough, it might present like a spinal cord injury whether it's incomplete or complete. So this does require an immediate emergent referral to an emergency department. This is a rare one but it can it can be seen, a malignant pericardial effusion.

So this is when there is a structural compression on the the pericardium of the heart, it could be because of a primary pericardial tumor or a metastatic pericardial disease. It essentially results in reduced cardiac output and the patient may present with dyspnea, cyanosis, a change in color, they may be hypotensive tachycardic. Really if a patient is arriving in your clinic or if you're seeing a patient bedside and they have these symptoms, I would hope that you're treating it like an emergency anyway but this is just some background as to what may the underlying cause. And now another mechanically induced emergency is superior vena cava syndrome. So this is when essentially tumor burden creates impaired blood flow via the superior vena cava and that results in swelling in the upper thorax, face, neck with jugular vein distension.

So this patient may come in and look generally puffy in their upper thorax face and neck and again that's a reason to get that patient to the the nearest emergency room immediately. And so now some metabolic oncologic emergencies. So hypercalcemia can actually be an emergency. And this may be due to bony mets essentially if there are bony mets that are breaking down bone and releasing high levels of calcium into the blood stream. That can caused a few symptoms including lethargy, fatigue, bone pain, abdominal pain, polyuria weakness. Again if somebody's coming in with this cluster of symptoms, you don't necessarily need to know that hey, that's hypercalcemia. I would hope that you send them to the emergency room anyway with

that cluster of symptoms but some background as to what it may be underlying. There's also a condition called tumor lysis syndrome. So this is something that typically occurs six to even 72 hours following infusion or delivery of chemotherapy. And what happens here is the chemotherapy works but the tumor is breaking down and releasing large chunks of poison essentially of the tumor into the bloodstream. And that causes also these diffuse symptoms of nausea vomiting weakness cramping. So another example of an emergency that needs to be looked at quickly. And finally some hematologic oncological emergencies.

So neutropenic fever, this is typically in the setting of low white blood cells which we'll talk about coming up. I know we're not always used to taking temperature as a vital sign but for this reason in particular I do typically include it as a fourth vital sign may or may not have signs or symptoms of infection to accompany that fever but fever usually is the first sign of a neutropenic emergency. Venothrombolic events, so I mentioned DVT and pulmonary embolism. Certain chemotherapies, certain cancer treatments can increase the risk of DVT and pulmonary embolisms and actually some tumors, some solid tumors actually release a coagulant factor into the blood, so some cancers can actually increase the risk of blood clot.

So I mentioned lower extremities or upper extremities, not just typically looking at lower extremities with the Hoffmann sign as we normally would but looking at upper extremities as well. I've seen more than one patient with a jugular vein DVT can result, you know, looking for the same sort of symptoms swelling, warmth, redness in the upper extremities. So a quick call for clinical reasoning here. So we as PTs and PTAs are fighting to establish autonomy. Direct access continues to expand and grow across the country which is good. And if we can safely and effectively screen and manage patients independently minimizing external referrals, we can decrease healthcare costs which we know are high for this population decrease potentially unnecessary and harmful testing and improve quality of life of our clients. So this is an interesting paper,

came out in 2010, it's mostly in regards to low back pain in the incidence of malignancy in cases of low back pain but I think that this is just an important concept. If you're not experienced in cancer rehabilitation, I think this is something that comes, this is a comfort that grows with more exposure and more experience in the field but just to use your critical thinking to think about what the underlying process may be. Is it a change in status that requires an emergent referral versus something that the patient needs to be worked up for just on an urgent basis or is it something that you can address in the clinic?

So cancer 101 you know to be a to rehab specialists, you do not need to be a cancer specialist but it is really important to have a good foundation of knowledge about cancer. One, so that it can help guide your treatment but also I can tell you from my personal experience, patients have a lot of questions that you wouldn't necessarily anticipate being a physical therapist but the more confidently that you can answer their questions and either reassure them or guide them through their cancer journey, the better your rapport will be with that patient and the better your outcomes will be. So here we go for cancer 101. So cancer by definition is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. So cells are dividing all the time in our body, right, and every now and then probably more often than we know, there are mutations within those divisions.

Now normally, if you're looking at the left side of your screen, when a mutation occurs in the cell, the cell recognizes that there's a mutation goes through apoptosis, excuse me, essentially commits suicide and then that mutation is finished right there and the body can carry on normally. With a cancer cell, there's a mutation and for whatever reason, the cell either doesn't recognize that there's a mutation or the pathway for apoptosis is not triggered appropriately and then that mutated cell divides and divides and divides rapidly and that is what causes a cancer. There are different ways to stage cancer. So now thinking about approaching a patient with a history of cancer reading

through their chart and this may be one system that you see in their chart. So the TNM system. So the TNM stands for tumor nodes, as in lymph nodes and metastasis. So typically if this systems being used for your patient, you'll see the TNM with little subscript numbers following each letter or letters for that matter I guess. So for the tumor it may have a little subscript X and that means the main tumor cannot actually be measured, may it have a zero which means the main tumor cannot be found sometimes cancer can be found, the metastatic disease can be found before the main tumor. And then increasing numbers from one and up refers to the size or the extent of the main tumor.

So essentially the bigger the number after the T, the bigger the main tumor is. After the N, we may find similar letters and numbers. So an X means that cancer in nearby lymph nodes cannot be measured and zero means there is no cancer in the nearby lymph node which is the best case scenario. And similar to with the T increasing numbers one and up refers to the number and location of lymph nodes that contain cancer. And finally with metastasis, MX indicates that metastasis cannot be measured and this system is a little bit easier, it's just either a zero or a one, M0 means the cancer has not spread to other parts of the body, again best case scenario or M1 cancer has spread to other parts of the body. So TNM system. Now there are other ways of staging, okay.

So if we look on the left, there is in situ which essentially indicates that there are abnormal cells present in that area but they have not spread. Then we advanced to localized cancer where cancer is limited to the place where it started, regional cancer where cancer has spread to nearby lymph nodes tissues or organs and then distant where cancer has spread to distant parts of the body which is essentially metastatic disease. Now sort of going along in the same order of at the top being least serious to going down towards more serious, stage zero sort of lines up with insight to where abnormal cells are present but have not spread. They're stage one where cancer is

small and localized but no lymph node involvement, stage two where the tumor is bigger than stage one with possible lymph node involvement. Stage three where there is regional spread and local lymph node involvement. And then stage 4 which is metastatic disease. So just wanting to be a little bit more familiar with how cancer is staged. A note about malignant versus benign tumors. So malignant indicates that a cancer is able to spread locally, it's able to invade locally, it's also able to metastasize throughout the body via the blood or the, excuse me, the lymphatic systems and it can be recurrent. So even if it's surgically removed or treated, malignant cancers can recur versus benign, so these are space-occupying tumors but these tumors do not spread or invade or metastasize, they usually do not grow back if surgically removed.

So usually the prognosis is better but benign tumors can still be life-threatening. So there's space occupying tumors. So if you think about say benign meningioma in the cranium, in the brain, there's not a lot of room for extra stuff in the cranium. So if there's a space occupying tumor pressing on a vital portion of the brain may be on the cerebellum or the fourth ventricle or the brainstem that can certainly be life-threatening, but more often than not benign carries a bit of a better prognosis than malignant. So what are the implications of cancer stage and type? Why do we as physical therapists, why are we even talking about this? So the size of the tumor at diagnosis whether the cancer is benign or malignant, whether it's progressing slowly or quickly, whether it's local versus metastatic, all of these different variables are going to dictate the course of treatment for that patient.

So we look at that the picture on the right side of your screen with the red arrow. So this actually looks to me like a benign meningioma. So we have a benign meningioma, you can see how well-defined the borders are, you can imagine how this may be relatively easily surgically removed potentially without significant functional impairment afterwards versus in the other picture. So now we have a brain tumor very similar location to the brain, I'm sorry, to the benign meningioma but look at how poorly

defined the borders of this tumor are, this is a glioblastoma multiforme which we know is highly vascularized, it infiltrates, it progresses quickly. You can imagine how different the course of treatment is going to be for the GBM, the glioblastoma multiforme, versus the meningioma. So just understanding kind of the the course of treatment and the overall prognosis that your patient is facing is going to influence your course of treatment and how you plan that out. So the patient's status on the continuum, I think continuum isn't important we're to use here, of cancer care will affect assessment goals and the treatment plan. It may actually dictate duration and frequency, often times it does in my clinic.

If we know that a patient is actively receiving treatment, say if they get chemotherapy delivered on a Monday and they know that they're usually good on Tuesday but then they have a crash day on Wednesday and they're out down for the count for Wednesday, Thursday, Friday, I'm not gonna be able to schedule therapy on Wednesday Thursday Friday. So it's just gonna sort of change how you approach scheduling with your patients, may be a little bit different than you normally would with a normal orthapediac patient or someone without active treatment. So think about where the patient is in the continuum. So some different words to describe phases throughout the continuum, there is pretreatment and this is typically where a patient has been recently diagnosed but no treatment has been initiated, so your prehab may fall into this category.

A patient may be receiving active care where they're actively receiving treatment, whether it's chemotherapy, radiation therapy, hormone therapy etc, they may be in a maintenance phase along the continuum where they're receiving long term antineoplastic therapy, anti-cancer drugs. The patient may be in post care or remission where they're considered NED. So NED stands for no evidence of disease, hopefully you're finding that in your patients charts. No evidence of disease is best case scenario obviously. Or the patient may be receiving palliative and/or hospice care. So now a

word about palliative versus hospice care, and versus is actually probably the wrong word to use here 'cause they are certainly not mutually exclusive but they are different. So palliative care, the goal is to relieve symptoms burden and optimize quality of life. Palliative care can be delivered, can be part of a plan of care through all ages, all stages of disease whether that cancer is, quote unquote, curable whether it is a chronic disease or whether that patient is dealing with a life-threatening disease. Hospice care is a specific type of palliative care for people at the end stage of their illness. Hospice care is typically offered to patients with less than six months life expectancy.

So one way you can try and remember this is that palliative care is not always hospice care, hospice care is always palliative care. So I'll say that again. Palliative care is not always hospice care, hospice care is always palliative. Now our role as a PT is pretty much the same in both settings. We're working to control symptoms and manage physical impairments with the goal of optimizing quality of life. So I mentioned stages of rehabilitation. So this is not a new concept at all, this was developed back in 1980 by Dietz but I think that it's a really useful way of framing your mindset around the evaluation and treatment planning of a patient with the history of cancer. So we've got four stages as outlined by Dietz, you've got preventive, restorative, supportive and palliative.

So preventative stage, this is where we try to reduce the impact or the severity of anticipated effects of treatment, this could be preoperative or prehab so to speak but certainly not limited to this, and this would assist the individual and basically learning how to cope, manage, reduce, risk. And we've got the restorative stage of rehabilitation. These are where word, this is where we're delivering interventions to return patients to a previous level of function. This does vary across the continuum of care all the way through survivorship. So whether this is early mobilization in the ICU, whether this is chest PT, all the way working through home PT, getting patients home

and mobilized through Outpatient and so on through the whole continuum through survivorship. Then there's the supportive stage. So these are interventions to help patients accommodate for existing impairments and limit further functional changes. So included in this sort of stage of rehabilitation is the consideration for assistive devices, cognitive strategies, prosthetics, home services. And then there's the palliative stage where we're delivering interventions to optimize the quality of life for our patients and their families. And this is where we're we may be focusing on pain control, energy conservation, skin care, caregiver training, okay.

Now again just to flash back to that slide about palliative care versus hospice care, those interventions that I just listed there are not reserved for patients at the end of their life clearly. So the any of these stages may be appropriate to implement or to work within for really any stage of disease in any stage that your patient may be at, so we'll come back to this concept a few times today. So we'll go through a couple case studies now just to kind of flashback to what we've learned so far and really start to think about how we may apply this to our clients. So first case study. So 56 year old female diagnosed with right stage three breast cancer, excuse me, T1N3M0, so that's that TNM staging system, status post chemotherapy, mastectomy and axillary lymph node dissection, breast reconstruction with saline implant, radiation therapy to the right axilla and chest wall currently taking an aromatase inhibitor.

Okay, well, there's a lot there. Don't be overwhelmed, let's just focus on what we have talked about so far which is really the first part. So right-sided stage three breast cancer, T1N3MO. So does the stage sort of match up with the TNM system that we learned about. T1 indicates the relatively small size of the tumor and three indicates that there is lymph node involvement, M0 indicates that there is not metastatic involvement. So does that fit with stage three? Yes because stage four would indicate that there's metastatic spread of disease, stage three indicates that there is spread to lymph nodes. Okay, we're starting to get it, starting to put it together. Second one here,

so 70 year male diagnosed with stage one lung cancer, T1NOMO, in the right upper lobe status post wedge resection tumor, wedge resection tumor removal excuse me, via video assisted thoracotomy surgery or that's procedure complicated by a pneumothorax, patient then receive radiation to the tumor bed in the right upper lobe. Okay, so here we've got a stage one cancer, does that match with T1N0M0? Yes, so there has not been any spread to lymph nodes. Starting to also think about anatomical considerations for these patients. So you don't necessarily have to fully understand what's involved with a video assisted thoracotomy surgery but starting to picture the right upper lobe, how that sits in the body the surrounding structures if there's surgery in or around the right upper lobe what impairments might we be seeing with a patient who's referred for physical therapy.

We've got our third case study. So this is a 60 year old male diagnosed with stage two oropharyngeal squamous cell carcinoma, T2N2M0, status post excision via modified radical neck dissection with adjuvant radiation therapy. So again focusing on what we've talked about so far, we've got a stage two cancer, T2N2M0. So T2 indicates that the tumor is a little bit bigger than it would be with a T1, N2 indicates that it has spread to the lymph nodes, M0 indicates that it is not metastatic disease. And our fourth case study here we have a 29 year old female diagnosed with a cerebellar medulloblastomas which is grade two, subtotal resection, radiation to posterior fossa, and chemotherapy. Aha, I put in a little trick here. So we actually didn't talk about grades in the staging system for cancer and that is because the staging system for tumors in the central nervous system doesn't follow the normal staging system.

So I put this in here just to kind of whet your appetite reason being that tumors of the CNS don't follow the TNM system so in the central nervous system tumor size is less important than the histology of the tumor and the location of the tumor. So that's why the T part doesn't work. The central nervous system doesn't have its own lymphatic system or lymph nodes, so therefore the N doesn't work in the TNM system. And

cancers of the central nervous system typically do not metastasize so the TNM systems out, so we use a grading system for staging central nervous system tumors grade one, grade two, grade three and grade four. And so the GBM, glioblastoma multiforme, which we are sort of more familiar with is a grade four tumor of the central nervous system. Okay, that just my little preview of neuro-oncology which is a passionate by. So now we kind of get to get into the meat and potatoes here. We're gonna talk about cancer treatments and rehab implications. So first up is chemotherapy and a quick little story about the history of chemotherapy, if you look at on the left side of your page to see these World War I soldiers wearing gas masks, believe it or not during World War I, mustard gas was being used as a means of warfare. And when soldiers who had been killed by mustard gas, when autopsies were performed, what the doctors were finding was that their immune systems were completely wiped out.

And that was sort of the first inkling where doctors said, well, hold on a second, could we use something like this to treat cancer to actually intentionally impact the immune system. And so chemotherapy, believe it or not, has its foundations in a poison of mustard gas. Now there's been there's been incredible advancements, we've come a long way since World War I in terms of medicine and everything else obviously but just sort of an interesting piece of history. So how chemo works.

Chemotherapy is cytotoxic. So the national cancer institute's definition is anti-cancer drugs that kill cells especially cancer cells. So I say this a little bit of tongue-in-cheek, obviously cancer cells are the target of chemotherapy but healthy cells, normal human body cells are going to be impacted and that is why we see so many side effects with chemotherapy. There are different techniques or even timings of administration. So there is a chemotherapy that can be delivered neoadjuvantly and that's prior to surgery or radiation prior to another treatment. There's adjuvant chemotherapy, and I remember this adjuvant after a adjuvant which is chemotherapy that's delivered after surgery or

radiation or another treatment. And chemotherapy can certainly be used as the primary treatment to fight a cancer whether it is primary cancer, recurrent or metastatic disease. Now chemotherapy does have many side effects, and so we'll talk about them now and some of the rehab implications. So I've broken them down into more acute side effects that you may be more likely to see as a patient is currently going through chemotherapy or currently receiving chemotherapy and then we'll talk more about sub acute or chronic side effects that you can see from chemotherapy as well. So as far as a cute side effects go Myelosuppression, so low blood cell counts.

And we'll dive into each one of these deeper in the next couple slides but we'll talk about thrombocytopenia, low platelets, neutropenia or leukopenia, low white blood cells and anemia or low red blood cells. We may also see fatigue or nausea and vomiting, mouth and throat sores. And sort of an interesting point about the mouth and throat source, so chemotherapy is designed to target rapidly dividing cells because more often than not that's what cancer is, a tumor or even blood cancers are rapidly dividing cells. Now there are other parts of the body however that do have rapidly dividing cells, the epithelial lining of the mouth and the throat is one of those areas. And that is why we sometimes see mouth and throat sores or breakdowns of that lining. Patients may experience GI distress as well as cognitive changes.

So I'll pause here for a moment just to say cognitive changes are a really big issue among cancer survivors, it's beyond the scope of this lecture but I'll stop to say that our colleagues in occupational therapy can be really instrumental in treatment of patients who are dealing with cognitive changes or chemotherapy induced cognitive changes, sometimes referred to as chemo brain. This can be something that we can help screen for or we can help pick up on as physical therapists or as PTAs within our treatment sessions. If we're noticing that a patient is either forgetting their appointments altogether or forgetting their exercises or having word finding difficulties, these can all be reasons to reach out to the referring MD and say, hey I know the

patients currently undergoing chemotherapy, notice some cognitive changes might might you wanna see the patient. So to talk a little bit more about myelosuppression now, so thrombocytopenia low platelets, okay. So low platelets means increased risk of bleeding, not just externally though as if you fell and scraped a knee and bled out through the knee but also internally. So we need to be considerate of potential internal bleeding depending on level of platelets whether that's in the viscera or in the abdomen or around the organs as well as bleeding into joints which can be a complication of even weight-bearing exercises depending on the platelet count.

So that paper that I had presented the title of that safety considerations in cancer rehabilitation, I'm pulling this from that paper again, they do a really nice job of outlining. Some general guidelines of the type of therapy that is safe to be delivered depending on platelet level. So as your chart reviewing, as you're looking in the patient's chart, you'll see their platelet count. Oftentimes, the platelet count is listed in thousands so you might just see 150 for example, not 150,000. So either way, less than 150,000 or under 150 really your therapy can be symptom based monitoring the tolerance as you normally would. When a patient's approaching 50 or 50,000 platelets, we are still able to deliver progressive exercises as tolerated whether it's aerobic and resistance exercises as well monitoring for signs and symptoms of bleeding's that might be unusual bruising that we're looking for.

As we continue down anything above 30 or between 30 and 50, now we need to start thinking about limiting our interventions a little bit more, maybe just to active range of motion keeping our exercise sort of at a moderate level. Aquatic therapy may be a good option for these patients. Continuing down, now anything between 20 and 30, now we're really keeping our intervention light just prescribing walking for these patients, ADL's may be enough for these patients assessing fall risk which we certainly shouldn't be reserving to this point on the spectrum of the platelet counts. If a patient's a fall risk, we need to be assessing anyway but understanding that there may be

heightened consequences if there does happen to be a fall. And then anything other, under, excuse me, 20,000 really this is where we need to educate our patients about walking, really keeping ADL's pretty light, patients may warrant a transfusion at this point. So similar to as I said earlier today, I think oftentimes patients low blood cells should facilitate an important conversation with the referring MD. Oftentimes patients who are dealing with chronic disease who have been receiving treatment for a long period of time these patients may live in the 20s in terms of their platelet counts or they may live in the 30s. And so sometimes, we'll oftentimes we'll reach out to referring MDS and discuss sort of the level of exercise, the intensity of exercise that that referring MD thinks is appropriate.

So now neutropenia, so talking about low white blood cells. So light blood, excuse me, low white blood cells does increase the risk of infection. This typically occurs three to seven days after chemotherapy sometimes even 10 days after chemotherapy, as I mentioned increased risk of infection, signs and symptoms may not be present but remember I said that fever is typically the earliest sign, so I'll usually include taking of the temperature at the same time as I'm taking a blood pressure heart rate and an O2 set. There's no real compelling evidence that rehab is contraindicated due to low white blood cells but we may need to modify our plan of care or the treatment that we have planned if a patient is dealing with low white blood cells.

So interventions should be self-limited by the patient and we may need to be considerate of our use of public versus private therapy space. So if a patient is coming in or if you're treating a patient at bedside and you know that they've got low white blood cells, is today the best day to be engaging in a group therapy or bringing them to the gym where they're going to be exposed to other patients and equipment that other patients have been touching or is today a better day to keep the treatment within the room or to utilize a private treatment room? Might we need to have them actually wear gloves and mask, we can wear gloves and mask, a gown, if necessary. Different

institutions have their different protocols but making sure that we're protecting that patient from any risk of infection. And then anemia, so low red blood cells. Cancer related anemia may not be so different than non cancer-related anemia. Anemia does reduce exercise tolerance and endurance. Patients may have increased heart rate or respiratory rate to maintain adequate O2 so we may not be able to utilize heart rate the same way we would to monitor response to exercise. So again these cut-offs are coming from that safety considerations paper but if we see a hemoglobin below 11, typically we establish baseline vitals which we should be doing anyway. The patient may be tachycardic or orthostatic hypotensive.

So really taking a symptoms based approach and monitoring RPE, so rate of perceived exertion, so teaching them either the Borg scale or a similar scale so that we don't have to rely on their heart rate to monitor their exertion. Anything below 8, we are monitoring vital signs more closely limiting ourselves to short periods of intervention limited by the patient's symptoms, we're educating the patient about energy conservation. So not just within our session but also as we are prescribing a home exercise plan talking to the patient about how to fit that best into their daily routine based on their energy. So if they know that first thing in the morning they've got energy, maybe that's the best time for them to exercise or is our ATP better delivered broken up throughout the day and in short bursts of exercise.

Similar to with the low platelet counts, we do see patients who sort of live at these chronically low levels of hemoglobin, so often times we'll have a conversation with the oncologist and talk about if they're comfortable with the patient exercising at that low level whatever they may be at. So those are some of the acute side effects of chemotherapy and some of the rehab considerations that you may need to think about if you're seeing a patient while they are currently receiving chemotherapy. Now we're gonna talk about more of the sub acute and chronic side effects. So you may see these later in the course of a chemotherapy as some chemotherapy side effects are almost

cumulative in nature and you may actually see some of these side effects down the road even once the patient has completed their course of chemotherapy. So alopecia hair loss, this is one of the more common side effects that we know about. And this occurs for a similar reason as the mouth and throat sores, rapidly dividing cells are targeted and the hair is an innocent bystander but can be affected by the chemotherapy. There can be soft tissue fibrosis. So many chemo therapies are IV administered and sometimes there can be spillage of chemotherapy in that local area around the IV and that can actually cause painful soft tissue fibrosis.

We're gonna talk more in depth about cardio pulmonary toxicity but this is an important topic and peripheral neuropathy or CIP an chemotherapy-induced peripheral neuropathy. This is another big topic, I unfortunately don't have a lot of time to dive into the nitty-gritty of it today, but some characteristics of CIP is that it is typically stocking glove distribution, so it starts distally and sort of works its way up approximately in both the lower extremities and upper extremities. Usually there is more of a sensory involvement but it can progress to involve motor nerves. And even when it is just sensory involvement, this can result in subtle or really significant balance impairment, an increased risk of falls. So there there's there's a good deal of evidence out about patients cancer survivors being at increased risk of falls compared to the cancer-free peers.

There's some statistics that show that cancer survivors are actually at up to two times the fall risk, then they're cancer-free peers and then you layer symptoms of chemotherapy peripheral neuropathy on top of that and it can even further raise the risk of falling. So something really important to monitor for if a patient comes in and they say, you know I was doing pretty good and then last week my toe started tingling, that can be a really important thing to communicate to the medical team as that may actually influence the way that they are dosing or delivering the chemotherapy and certainly any sort of fall risk screening is imperative for us to be doing. So let's talk a

little bit more about cardio pulmonary toxicity. This is oftentimes an under screen, under diagnosed condition. It can be multifactorial, certainly, we do need to consider the premorbid cardio pulmonary function and comorbidities of these patients and whether that just means premorbid as in pre cancer diagnosis or whether it means premorbid as in pre progression of disease sort of whatever your marker is or how you're delineating certain functional status.

There are certain chemo therapies that have a higher risk of developing cardiopulmonary toxicity, so there is a class of chemotherapy called the anthracyclines and they typically do result in cardiopulmonary toxicity or have an increased risk. The symptoms are not so different than a non cancer related or non chemotherapy related cardiac or cardio pulmonary dysfunction, you might see systemic edema, shortness of breath, dyspnea, lung congestion. Now this stat I think is shocking and striking but childhood and adolescent cancer survivors, 50% demonstrate cardiac related comorbidity that compromises function 20 to 30 years after completion of treatment. So 50% of child and adolescent cancer survivors 20 to 30 years after completion of treatment have cardiac-related comorbidity that compromises function, it's crazy.

So if you are evaluating a patient, say who is a childhood cancer survivor they had leukemia as a kid, successfully treated, they've been no evidence of disease since then, they walk into your clinic and you think that their cancer history is so far gone that it may not impact your evaluation, your treatment planning, your interventions, think again, it might. So this is something like I mentioned is oftentimes under screened for under diagnosed, it can be sort of a silent comorbidity but we can help screen for this just by taking vital signs monitoring vital signs and intervening and collaborating with the interdisciplinary team as necessary. So just wanted to highlight a few sort of key classes of chemo therapeutic agents that I think are more common than others and I want you to just to be aware of them. Certainly no need to memorize these but just to be aware of them. So first big class is the taxanes. And you'll recognize any

chemotherapy in this class because it has that tax in it. So tax all is a common one, paclitaxel. This class of chemotherapy is oftentimes used for breast cancer ovarian cancer lung bladder. And as far as the rehab impact goes, this is a common chemotherapy that results in peripheral neuropathy, you can see it can cause heart block or bradycardia that cardiopulmonary toxicity, it can also cause respiratory distress. The next class is the vinca alkaloids, and you'll recognize chemotherapy is in this class 'cause they have at VIN in it, so then vincristine is a common one in this class. This is used for more blood cancers, brain tumors, sarcomas, multiple myeloma. This is another common one that results in peripheral neuropathy, sometimes more often sensory motor involvement, so sometimes we'll evaluate patients for wrist or foot drop who have been treated with the vinca alkaloids. And lastly there's the platinum class.

And you'll recognize chemotherapies in the platinum class because you see that plat right in the name, so cisplatin or cisplatin, what-have-you as well as carboplatin. And these are used for, or commonly used for more advanced cancers metastatic cancers, head and neck cancers. These can also result in peripheral neuropathy, and I add in here also that these this class is an ototoxic class of chemotherapy. Ototoxic meaning that it can impact the itty-bitty hair cells in the vestibular end organs and can actually result in a bilateral vestibular hypofunction. And so this is I'm gonna get on a tiny little soapbox here. I think that this is something that also is oftentimes under screened and under diagnosed, I do treat vestibular dysfunction within our Outpatient cancer rehab clinic and I think often times we attribute balance impairment to the peripheral neuropathy because it's easier to screen for one but I think that it is relatively common but I wonder how often are we missing an underlying bilateral vestibular hypofunction because of ototoxic chemotherapies. Just something to keep in the way back your brain or maybe move up to a middle burner as you're evaluating patients. So chemotherapy, the timeframe and dosing schedule may impact your plan of care. As I mentioned before, if you know that a patient has a typical crash day where they're not

gonna be able to make it into physical therapy, obviously we're not going to schedule PT on that day because you're going to end up with a missed appointment and an empty treatment slot. We must assist in monitoring for toxicities, so we do see these patients often times more frequently than their medical oncologists or they're referring MD. So we can help screen for these side-effects communicate them effectively to the the medical team or the interdisciplinary team so that if need be, intervention can be managed or monitored at least from there on out.

There's evidence that exercise may increase the effectiveness of certain chemotherapies, there's also evidence that exercise may improve the tolerance of some chemotherapies. So I add these two important points in here to say that chemotherapy is not an excuse for patients to not be exercising. On the contrary, I think that we as cancer rehab specialists need to lean on the available research and say, listen, I know you don't feel like exercising right now but there's evidence that exercise may actually help the effectiveness of chemotherapy may actually help you feel better while you're on chemotherapy. And of course as I've outlined, there are many side effects of chemotherapies and many side effects that are amenable to rehabilitation.

So let's go back to our case study, I have a feeling we're gonna understand, just a little bit more now. So we've got a 56 year old female diagnosed with a right-sided stage three breast cancer, T1N3MO, we got that, check status post chemotherapy and all that other stuff. So we know that this female has been treated with chemotherapy, now we need to think about the timeframe. So is she in a period where we might be seeing acute side effects from the chemotherapy, sub acute side effects from the chemotherapy or chronic side effects from the chemotherapy. Might that explain why she's being referred to PT for balance impairment say or maybe generalized deconditioning, could there be an underlying cardio pulmonary toxicity depending on where she is in the continuum of care? So again, thinking about the timeline and the

potential impact of chemotherapy and its side effects. Okay, so moving on pivoting a little bit now to hormone therapy. So hormone therapy is a systemic therapy, similar to chemotherapy used to target some types of breast cancer and prostate cancer. So in regards to breast cancer, about two thirds of breast cancers are hormone receptor-positive. And for those cancers high estrogen levels help the cancer cells grow and spread. So hormone therapy for breast cancer either works to reduce the levels of estrogen in the body or hormone therapy works to stop estrogen from acting on the breast cancer cells? So similar story with prostate cancer but now we're talking about androgens or male sex hormones, they stimulate the growth of both normal and cancerous prostate cells.

So testosterone is sort of the most common androgen or the one that we at least talk about the most. And the goal is very similarly for hormone therapy for prostate cancer are to reduce the levels of androgen or to stop them from acting on prostate cancer cells. Now the goals or the the methods of delivery can be different similar to chemotherapy. It can be delivered neoadjuvantly say to make a tumor smaller before surgery or radiation, it may be delivered adjuvantly, remember adjuvant after, to lower the risk that cancer will recur. And in some cases it can be used to treat the cancer directly particularly if the cancer has recurred or spread. Now talking about hormone therapy specifically for breast cancer, so there's a class of hormone therapy is called selective estrogen receptor modulators.

So these drugs work to block estrogen receptors in the breast cancer cells but allows estrogen to work sort of normally throughout the rest of the body. So tamoxifen is a common one in this class. And then there are aromatisse inhibitors which is another class of hormone therapy. This is typically used in postmenopausal women. So even in postmenopausal women, there are levels of estrogen that are produced commonly in fat cells and aromatase inhibitors works to stop at estrogen production in those postmenopausal women. Letrozole, anastrozole and eczema stain are kind of the

heavy hitters, are the big names in this category. And there are a few more options for prostate cancer. So there is a surgical hormone therapy an orchiectomy where the testicle is removed to stop production of antigens, there is a class called luteinizing hormone releasing hormone agonists and this lowers the amount of testosterone made by the testicles and then there's anti androgens which bind to androgen receptors so that androgens cannot. So of course hormone therapy is not without its side-effects or else it wouldn't be in this lecture probably.

Tamoxifen is one of those drugs that increases the risk of blood clot and remember I said, osteoporosis and bone loss related to cancer is more common in hormonally driven cancers and cancers that are treated with hormone therapy which kind of goes hand in hand but tamoxifen can result in bone loss. As far as the aromatase inhibitors go, aromatase inhibitors can result and oftentimes do result in muscle and joint pain. So often actually that there's a an acronym, aromatase inhibitor induced arthralgias, AIIA. This can be really distressing, it can be diffuse muscle and joint pain, hips, knees, back, shoulders, it can be really limiting for patients often to the point where patients will opt to stop taking their hormone therapy because the side effects are so bad which does increase the risk of recurrence, increases the risk of cancer spread so that's never a recommended course of action but oftentimes this is a reason why patients are referred to PT in the first place.

So we'll talk about what we can do to help keep these women on their drugs. And as far as androgen deprivation therapy side effects here, look at this list; osteoporosis, decreased muscle mass, fatigue, anemia, weight gain, depression. It's quite list to be dealing with when you're already dealing with other cancer treatments. So a hormone therapy can be really detrimental obviously and the good news is aromatase inhibitors looking at exercise, this study in 2018 looked at aerobic and resistance training, it looked at both healthy postmenopausal women versus women on aromatase inhibitors and they found similar improvements in both groups. They found increased lower body

strength, increased Vo2 max and decrease body fat mass. And so I think kind of the interesting conclusion that the authors of this paper drew, they delivered the same prescription of exercise to both groups and they found similar improvements in both groups. So their conclusion was well do we really need to modify how we're delivering aerobic and resistance training to women who are on aromatase inhibitors versus women who are postmenopausal. So just sort of just sort of an interesting conclusion but you can see exercise works. Similarly, we look at androgen deprivation therapy and exercise.

So this study back in 2014 also looked at aerobic and resistance training without all these benefits, muscular strength increased, cardiorespiratory fitness improved, improved functional task performance, lean body mass, decreased fatigue. That's a pretty good list all with exercise being the drug or the medication so to speak. So again just underlining my point exercise is good. So hormone therapy, it can last for several years following primary treatment and side-effects can certainly impact daily function and quality of life. We talked about this list of weakness, weight gain, muscle and joint pain fatigue, osteoporosis. Exercise as we just saw can mitigate some side effects and patient education is key. So I mentioned a lot of these women and men come in distress because of this long list of side effects that's possible.

Many of them are at their and many of them are ready to jump off of these medications which can have really serious consequences. And so educating these patients about how we can use exercise to combat some of these side effects is really important to improve adherence with the medications and ultimately improve survival and length of survival. So now let's go back to our case study. So we've got a 56 year old female diagnosed with right sided stage three breast cancer, status post chemotherapy, mastectomy, with XI lymphnode dissection, breast reconstruction with saline implant, radiation therapy to right excellent chest wall and she's currently taking an aromatase inhibitor. Okay, so the potential side effects are starting to pile up here, right. So not

only are we dealing with the potential side effects from the chemotherapy, acute, subacute or chronic depending on where she is in the continuum, but now she's currently taking an aromatase inhibitor. So now we need to think about the potential side effects from that. Is she being referred for an aromatase inhibitor induced arthralgia or might that just be underlying her, what's been screened as low back pain, might it actually be due to the hormone therapy that she's on. So that may help help drive your evaluation and ultimately your plan of care. So next up we're gonna talk about radiation therapy.

So radiation, damages, cellular DNA, killing or slowing the growth of cells, eventually those cells stop dividing and they die and they're broken down and removed by the body. Unfortunately, cells do not die immediately. It actually takes days sometimes even weeks for a DNA to become damaged enough and then cells actually continue dying for weeks and months following radiation treatment. So with radiation, oftentimes this is the reason why we see side-effects come up either towards the end of radiation treatment or even once radiation therapy has been completed, sometimes side effects can pop up at that point and can cause significant impairment we'll talk about now. So different techniques of administration in addition to different timing of radiation therapy they're actually different kinds of radiation therapy.

So sort of the most traditional thought of radiation therapy is external beam radiation therapy and this is where essentially radiation is shot at the body from either one or multiple points to target the cancer. There is internal radiation therapy. So sometimes the medical team will opt for a brachytherapy, where they actually implant solid radio seeds in or around the tumor bed to target residual cancer cells, if there are some. Radiation can also be delivered systemically, usually liquid via the blood. And radiation can have different goals. Different intended outcomes. So it could be delivered in a curative sense, in a preventive way to prevent the recurrence or prevent the spread of cancer cells and it can be delivered in a palliative way as well. So oftentimes patients

with metastatic disease, metastatic bone disease can be quite painful, so sometimes they will radiate a bony met to reduce the size to reduce the pain and have good palliative results. So a lot of side effects to go through with radiation. So radiation can also cause myelosuppression. or low blood cell counts. It can also cause hair loss, alopecia it can cause fatigue, nausea, vomiting, oftentimes when the radiation field involves the abdomen or the GI tract, it will cause nausea and vomiting. It can cause pulmonary fibrosis.

So again thinking about the radiation field. So radiation is not necessarily a systemic delivery, unless it is delivered via the blood as I just mentioned. So in more cases than not, you need to think about the radiation field, what are all the structures within that radiation field, in this case if the lungs are involved, it can cause radiation pulmonary fibrosis. It can cause a plexopathy and neuropathy or neuropathy. And this is different than the chemotherapy neuropathy where again, we need to think about the radiation field. So with our case study, with the upper lobe, the right upper lobe radiation therapy, think about what's going through that area, brachial plexus, if the patient is coming in with upper extremity neuropathy, we at least need to put that in our differential diagnosis as the radiation field was including the brachial plexus.

Radiation can cause radiation myelitis or inflammation at the spinal cord. It can also cause bone loss or joint necrosis, cause muscle atrophy. This is a big one it can cause skin irritation which can progress to desquamation, we're going to talk about this more on the next slide which can ultimately lead to soft tissue fibrosis which can be a big causative impairment and we'll talk about that more in depth as well. So I mentioned skin irritations. A skin irritation which can lead to desquamation. So if you've ever had a sunburn and then your skin peels, you've experienced desquamation. You've experienced dry desquamation if that's what you've experienced. Radiation can cause dried desquamation. It can also cause wet desquamation, where these patients actually experience ulceration of the skin or the membranes. So we talked about

having to modify perhaps our approach with manual therapy in areas of radiated skin or areas of skin breakdown. So certainly if there's an area with red or tender or blistered skin, that's typically a contraindication from manual therapy and we may actually need to limit our interventions to active range of motion, active assisted range of motion or just gentle therapeutic exercise trying to balance or walk the fine line between promoting healing while also working towards therapy goals and maintaining range of motion.

Radiation can cause bone loss or joint necrosis which may increase the risk of fracture. We may need to consider precautions or seek input from the referring MD. So depending on where the radiation was delivered, so if radiation was delivered to the spine typically, we do adhere to spinal precautions. You know, if radiation was delivered safe to the proximal femur, as I keep using as an example, we may need to consider weight-bearing status or offloading that limb. And fatigue, fatigue is a big one and it's again sort of beyond the scope of this lecture. Cancer related fatigue, but I just want to mention it as this is really common with radiation therapy. The etiology of cancer related fatigue is definitely multifactorial. What I mentioned here is it an effective treatment or an effect of the treatment schedule, oftentimes with radiation therapy a patient will receive radiation five days a week for five or six weeks straight and that can certainly be exhausting, particularly if they're schlepping into Manhattan as they are, where I am currently sitting in New York City that can be exhausting.

But radiation also causes inflammation which is known to be one of the underlying factors of fatigue. So radiation induced fibrosis , we'll talk a little bit more in depth about. So this has been found to be influenced by not only the dose, but the volume, the schedule of radiation whether that patient has received radiation previously, there's actually a genetic susceptibility to radiation induced fibrosis and certain comorbidities most namely diabetes can increase the risk of developing fibrosis because of radiation. The underlying process is essentially that radiation causes micro vascular injury which

may lead to ischemic hypoxia and inflammatory changes in the surrounding tissue and essentially what that can cause is loss of tissue compliance, development of strictures in hollow organs and even impaired gaseous diffusion in both the lungs and the capillaries in the circulatory system. So, oftentimes we'll see patients who are referred say for a limited shoulder range of motion and the biggest thing that is leading or the biggest underlying impairment, that's leading to that shoulder dysfunction is a loss of tissue compliance because of radiation induced fibrosis.

So, as I mentioned side effects of radiation are frequently seen following treatment. So radiation induced fibrosis can even be seen six months even up to five years or beyond following treatment. And this is kind of a scary thing about radiation induced fibrosis is that it can progress indefinitely. Early initiation of active and passive intervention is key and the way, we usually do that is with soft tissue mobilization, either we're delivering it or even teaching the patient's how to do their own myofascial release or soft tissue mobilization. We know that that increases blood flow, it can help increase the pliability of skin to then be followed up with active range of motion exercises, neuro re-ed exercises again those same interventions that you already know how to deliver. We do find that this may impact the muscles ability to stretch or strengthen.

So if a patient has received radiation therapy, it may just impact your overall rehab prognosis. So certain specific precautions, you know, I mentioned this early on, the use of modalities in any area with decreased blood supply or decreased sensation. Manual technique certainly in areas of skin breakdown are contraindicated. Lymphedema precautions, may need to be observed, lymphedema is another topic beyond the scope of this lecture but radiation can impact lymph nodes and lymphatic vessels which can increase the risk of developing lymphedema. So precautions may need to be adhered to there and weight-bearing precautions as I mentioned because radiation can impact bone integrity. So when it comes to radiation therapy, remain anatomically focused. So know the irradiated area. Establish all the structures within that area,

whether it's vascular, neurological, lymphatic bone, soft tissue. And then, my strategy is to go then one or two steps outside of that radiated area. So it's not just enough to say, okay this patient received radiation to her right chest wall so therefore the PEC minor might be tight. Well, that's probably true the PEC minor is tight but then go one to two steps outside.

So what impact is that radiated area and that tight PEC minor gonna have on shoulder function, neck function, you know vascular function out into the arm etc. I think the big picture always relate back to function and again, this is potentially progressive so patient education is key, really stressing the point of everyday stretching, self myofascial release, any technique that the patient needs to maintain their range of motion in their function. So we go back to our case study here. The second one now. So this is a 70-year old male, diagnosed with stage one lung cancer in the right upper lobe. Status post, the wedge resection remover, excuse me, removal via video assisted thoracotomy surgery or the VATS procedure, complicated by a pneumothorax, patient then received radiation to the tumor bed in the right lobe.

So this goes right in line with the example I was giving about potentially the brachial plexus being involved. So back up a minute and just think about everything in the potential radiation field. If that right upper lobe was being targeted. so certainly the upper thorax, the upper ribs, clavicle might be involved, brachial plexus might be involved, think about the muscles PEC minor, PEC major. If first rib is involved , then we're going one or two steps further are there scalenes involved, could that be contributing to neck dysfunction. If this patient was receiving radiation to their lung, might they have developed a radiation induced pneumonitis or an inflammation in the lung and maybe that was contributing to deconditioning. So again just things sort of big picture about the anatomy, all these structures that may have been impacted by the radiation and why or how that may influence your approach to this patient and why they're even being referred for PT So last step is surgery. So surgery is essentially that

surgeons go in and they resect either part of or all of the cancerous tissue. And that could be soft tissue, could be bony tissue there are different goals of a surgical intervention when it comes to oncology. So ideally, there will be a total resection of a tumor or total removal of the tumor. The goal could be a debulking surgery in conjunction with other treatments. So getting most of the tumor out and then utilizing radiation therapy or chemotherapy to target the rest of it. It could be a palliative surgery or it could be a prophylactic surgery.

So the most common prophylactic surgery in the world of oncology of course is a prophylactic contralateral mastectomy. If a woman has a unilateral breast cancer to reduce the risk of cancer recurrence and cancer spread. Now rehab considerations after a cancer surgery. So we have considerations after cancer surgery may not be significantly different than your considerations after a typical orthopedic surgery. So for instance if a patient has a distal femur osteosarcoma so that's a tumor of the bone in the distal femur, typically the surgical oncologist will go in and remove the tumor, remove the distal femur and essentially rebuild with a total knee arthroplasty. Now different surgeons have their own protocols and that's gonna vary institution to institution, surgeon to surgeon, but your rehab interventions for that total knee replacement essentially at the end of the day is not going to be significantly different than your interventions for an orthopaedic total knee arthroplasty.

Working for flexion, working for extension, working to rebuild and strengthen the extensor mechanism of the knee. Gait training, balance training etc. That being said, in many cases, I find that surgery is related to cancer are creative for lack of a better term. It is amazing what surgical oncologists can do to go in remove as much cancer as possible while maintaining or restoring function cosmesis. It's incredible! So there are some specific considerations that we may need to think about in regards to cancer surgeries. So was bone removed? Was muscle sacrificed? Was muscle removed altogether? I worked with a patient who had the entire gluteus medius removed

because of a soft tissue sarcoma. So how is that going to impact your evaluation and your goal-setting and your treatment planning. We're muscles transferred? Certainly that's gonna impact how you look at a patient and that region of their body. We're specific nerves sacrificed? We'll talk about a good example of that in a moment? Was a lobe of the brain impacted? So obviously thinking about brain tumors here, similar to focal impairments that we see after a stroke, we see focal impairments after a brain tumor removal if a specific lobe was impacted. Were lymph nodes removed?

Again, this is something that can result in increased risk lymphedema and that may impact our overall treatment progression or how we plan out our treatment. Might we need to consider weight-bearing status, lifting precautions, range of motion precautions, post surgically, these are all things that need to come from the referring MD and I throw in functional potential and prognosis here. So going back to that patient that I mentioned with the missing gluteus medius, I think some of the onus in terms of functional potential and prognosis needs to needs to fall back on the surgical oncologist. This is my mini soapbox here. Oftentimes, these patients will come to us and say okay, I had this done, I had no idea it was gonna be like this after surgery, what do you think? Am I gonna be able to run? Am I going to be able to do X,Y&Z? And we can certainly give our professional opinion, taking into account their level of physical functioning, prior level of physical functioning, the same way we would.

But I think we do need to look to the surgeons a little bit I'd hold them accountable to say okay, you did this surgery what are your expectations in terms of my goal setting, the patient's goal setting and how can we work together as a team to get this patient back to optimal function. So again, remain anatomically focused when it comes to surgery. Consider the impact of scar tissue. So not just externally but internal scar tissue as well. So externally speaking, you'll be able to tell if a scar is tight and restricting movement. Again, we see patients oftentimes following treatment for breast cancer, which oftentimes does include a surgery. If that scar is tight oftentimes that

leads to postural impairment and limited shoulder range of motion. But think about the impact of internal scar tissue as well. So many cancers do require big abdominal surgeries. So if you see a patient coming in for low back pain for example, they've had a big abdominal surgery, maybe it's a a total or excuse me, a hysterectomy or a bilateral salpingo-oophorectomy with the ovarian, ovaries out and the fallopian tube is out. If that patient comes in for low back pain, their forward flexed, you tell them to sit up straight and they can't because of that deep scar tissue running through their abdomen, you better believe that is going to require intervention and attention from you and serious consideration in your plan of care before we can expect them to achieve a neutral sitting posture and impact their back pain.

So just think about the internal scar tissue and the impacts that it can have. Certainly postoperatively or even post radiation fibrosis or post skin breakdown because of radiation, we do need to facilitate tissue healing, while preventing restrictions and function and optimizing functional status and how will the surgical report impact our goal setting. So I'll bring it back to this case, I need to sort of exemplify that point. We've got our 60-year old male diagnosed with an oropharyngeal squamous cell carcinoma, status post excision via modified radical neck dissection also with adjuvant radiation therapy. So he had a radiation therapy after the surgery.

So modified radical neck dissection is a surgery common in head and neck cancers, frequently removes not only the cancer but lymph nodes and in some cases they remove other surrounding structures in the head and the neck. In some cases, the spinal accessory nerve, cranial nerve 11 can sometimes be completely removed with this surgery. And even when it's not completely removed, it can be tensioned and injured during a surgery. So if you think about the spinal accessory nerve, what that innervates, SCM as well as the trapezius muscle, if that nerve is completely removed, think about what impact that's gonna have on the patient's shoulder function, neck function and what's your goal setting gonna be like if you know that you don't even

have access to those muscles anymore. What's your treatment plan gonna focus on. Are you gonna work on optimizing the use of serratus anterior to get that upward elevation of the scapula. Just different considerations, but again this will impact your treatment planning. So to close things out today, I'm gonna talk a little bit, I'm gonna provide you in fact with a cancer rehab cheat sheet. So this is sort of how I go through preparing to evaluate and treat a patient with the history of cancer. So step one, no matter what setting you're in whether it's outpatient inpatient home care or anything in between should be a chart review.

So with this chart review, we have to understand the patient's cancer stage which we talked about and where are they in the continuum of cancer care. So in the chart review, we're trying to figure out first of all why are they being referred, what's their medical history, could there be underlying comorbidities that may be impacting their function. What's their oncologic history. Where are they in the continuum of care? Could they be having side effects from current treatment, past treatment, are there any surgical precautions, if you're seeing this patient post surgically are there any weight bearing considerations either because of bony involvement with metastatic disease or radiation impacting bony integrity or hormonally driven cancers, what's the patient's lab value, are they in a safe range where we can provide the intervention or do we need to modify how we're gonna approach this patient as well as psychosocial considerations.

This is sometimes something that you can get from the chart Sometimes something that you need to wait and get from the patient, but psychosocial considerations whether it's anxiety, depression, family support is really an important aspect of the care for these patients So next up after we do our chart review, this is where you form a hypothesis about the appropriate rehab stage. Remember, those four stages from Deitz. And this should be a dynamic and working hypothesis. So again, remember those four stages are preventative, restorative, supportive and palliative. And this

should be a dynamic and working hypothesis and so, for that I'll bring it back to this case which is very similar to a case of a patient that I evaluated reading this on paper. I guessed, I formed my hypothesis that maybe we were gonna be working more in the supportive phase, maybe in the preventative phase or the stage of rehab to prevent falls etc etc. So I'm gearing up for that kind of evaluation. This young woman comes into the clinic and basically says I need to be able to walk in high heels because I work in this super high powered job.

And so, well there goes my plan out the window and low and behold she was incredibly fit before her diagnosis, she was able to go back to plyometric training with me, we did running and we got her walking and the high heels. So you know you can form your hypothesis to prepare for your evaluation, but prepared to change it based on the patient's goals and how they present. So next up, listen to the patient's subjective and history. This is really important. So are the patient's chief complaints indicative of any potential red flags. So are they describing that nocturnal or unrelenting pain. Any sort of atypical pain or any sort of recent change in status. So I saw a patient who came in, walking with a walker and she said you know, it's so weird eight weeks ago, I didn't need anything to help me walk and then four weeks ago, I had to start using a cane and then last week, I had to start using a walker.

Again, that's sort of a typical, we don't expect that kind of decline in function unless maybe there's something driving that underneath it all. So that facilitated a conversation with the referring MD and she indeed excuse me, she indeed did need to get evaluated by the medical team. Are the patient's goals in line with her hypothetical rehab stage? So I just gave a good example, where my patients goals were beyond my hypothetical rehab stage. So that drives an important conversation between you and the patient. Are their goals realistic? Can you work with them to make their goals more realistic? It needs to be a dynamic conversation between you and that patient. Next up, screen for red flags and concerns. Both yours and the patients. And so, I say yours as

in the last point that we talked about, are that are the chief complaints indicative of any potential red flags? Are you worried about the nature of this patient's pain etc. As well as the patients. And so this I think I include here just to remind you to take sort of a global perspective with the patient. So if they're referred for some shoulder impairment, but they come in and they say you know I woke up today and you know my left leg is swollen and it feels weak or it's red and it's kind of warm to the touch. Sure that's not necessarily included in a script for a shoulder impairment, but understanding the potential systemic impact of cancer treatment and cancer itself, you really need to look listen to the patient and kind of look far and wide to make sure that everything is is safe to proceed with your treatment.

And lastly, assess and treat the patients chief complaint while not losing sight of the patient as a whole. That goes without saying across any practice setting, across any diagnosis, but really it is important here. So my final thoughts here, this is a medically complex patient population and there have to be certain considerations to maintain safety. But, as I mentioned once safety and scope of practice is established you have the skill needed to treat this population. So it's nothing new for you. These patients have been through or are currently on a challenging journey. There's no there's no refuting that.

And each patients experience and cancer story is unique and important and I don't mean to get too touchy-feely at the end here, but this is really what I love about what I do and what I feel like I get to do every day. We have the opportunity to provide a positive environment and a positive experience and to make a positive change in this journey which is incredibly rewarding at times, it's incredibly challenging but if this isn't an area of your practice that you have explored and developed, I'd encourage you to because I think you'll love it. And with that thus concludes my portion of the presentation and so, I think what we'll do is we have a few minutes to open it up to

questions and I think Calista, if you're standing by you can come back on and open it up.

- [Calista] All right, well thanks so much Steve. Yes I like to remind everybody there is one question. I can see already in the Q&A, but to remind everybody to use that Q&A. Go ahead and start placing any questions that you have for him. The first one here, it says in terms of heat applied to a patient with active malignancy, can I apply heat for an unrelated shoulder pathology with a patient with cancer in prostate or a liver, if the cancer is away from where the heat is applied and are there risks?

- [Steve] It's a good question. And then I think the the quick answer is yes, you can. You know, if you think about really the impact of a localized heat intervention, that's not gonna change anything really systemically. So I think you are safe doing that. Certainly, if there has been any spread of the cancer so that you you may suspect or know about any underlying cancer in that area, I would hold off and maybe think about a safer or alternative intervention. Just to just to stay on this topic just for a second. In some cases particularly in the more palliative cases or certainly in in the more hospice focused cases, sometimes the the risk versus benefit needs to be weighed, so listen to this point carefully, please don't misconstrue what I'm saying, but sometimes I've had conversations with with medical teams where we know a patient has active cancer in a specific area, but if that patient really knows that they are brought come and pain relief by same manual therapy or by warmth or heat or cold, sometimes that can be a conversation between them and the medical team or between you as a professional and the medical team, to say listen what's the risk versus reward of us providing this modality, teaching the patient how to do it properly with skin checks and whatever else to provide them comfort. So anyway the answer to your question, sorry I've gone on about it is is yes, I think that is safe to do and I think that there's again wiggle room and need for conversation in many other cases.

- [Calista] All right, I don't see any other questions. Is there anybody else still have any questions about the quiz? We'll open those up as well and while we're waiting for any questions, is there anything else that you would like to leave us with Steve, before we close out the classroom for today.

- [Steve] I think I've said it all. Again, I really do appreciate the opportunity and I appreciate that you all have chosen to attend this lecture, because I just think it's such an important area to learn more about, whether or not you're working directly with these patients or in any practice setting with any diagnosis. You will see patients with a history of cancer in their chart. So I'm hoping that after today, you feel more prepared to to work with them.

- [Calista] All right, well, we did have one pop up here before we close up. It's a question related to cancer related osteoporosis I believe, how is that different than ordinary osteoporosis is what the question is asking. How is cancer related osteoporosis different than ordinary osteoporosis?

- [Steve] So this I think maybe related specifically to a question on the quiz, but regardless it's really not that different other than the etiology of it. So the consequence is that this sort of what happening at the cellular level of the bone is the same You know, the increased risk fracture is the same. You know, the one piece of evidence that I presented with my slide on cancer related osteoporosis is that weight-bearing exercises can be beneficial and can have a protective effect. So really no real difference in your PT approach and treatment of cancer related osteoporosis or bone loss. Just a different etiology.

- [Calista] All right, we do have another one. Andrew asked, how do you maintain your empathy or sympathy when you are surrounded by suffering all day and something that I personally struggle with. Do you have any insight on that?

- [Steve] I mean that's oftentimes kind of the first reaction that I get when I share that I am a cancer rehab specialist and it can be tough. There's no real denying that. I will say in my experiences the positives far outweigh the negatives or the wins sort of outweigh the losses. I think it's a really sort of inspiring group to work with, a population to work with. I started my work working in neuro rehab, working with patients after stroke and brain injury and spinal cord injury. And what I love so much about that setting was that these patients were going through these life-changing oftentimes catastrophic events, right? But you have an opportunity to again provide a positive environment and experience and and help them regain function, help them regain mobility. And I've found a very similar, very similar line in cancer rehab. And I gotta say more than I am made sad by these cases, 'cause often times they are sad or sometimes they're sad, the inspiration that I get from so many of these patients who again read on paper like they should be down and out, they should be staying home and wallowing, they're out there and they are trying to regain their function, they're trying to make it to their grandkids graduation or they're trying to make it to their trip to Europe or they're just trying to close the door on this chapter of their life and get back to life as they know it. I think it's just so awesome to be able to help them at whatever stage they're in or whatever their goal may be.

- [Calista] All right, well that looks like it was our last question for the day. And so, we'll go ahead and close out the course but before I do, I wanna thank you again Steve for presenting for us today and thank you everyone for attending. Have a great day everyone!

- [Steve] Thank you very much.