Electronic Systems for Cancer Diagnosis
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Lecture – 10
Breast Cancer and Oral Cancer Statistics

Hi welcome to this particular module and here we will be focusing on a very important problem which is Cancer. Of course, the course is focused on how to develop electronic system for cancer diagnosis, but within cancer we will be focusing on two types one is Breast Cancer and the second one is Oral Cancer alright. So, there are two different types that we will be focusing on today and let us see in the following slides what are we going to do or what are we going to learn about these cancers. The focus is how can we develop a system for diagnosing tissue related cancers.

And the idea is can we have a system that can understand the change in tissue property as cancer progresses. So, I should say tissue properties because there can be many changes such as electrical changes, such as thermal changes, pH may change, you see the stiffness may change. So, as the cancer progresses how the tissue properties changes and if we can measure those properties, then we can develop a system that can start diagnosing a tissue and tell the stage of the cancer right.

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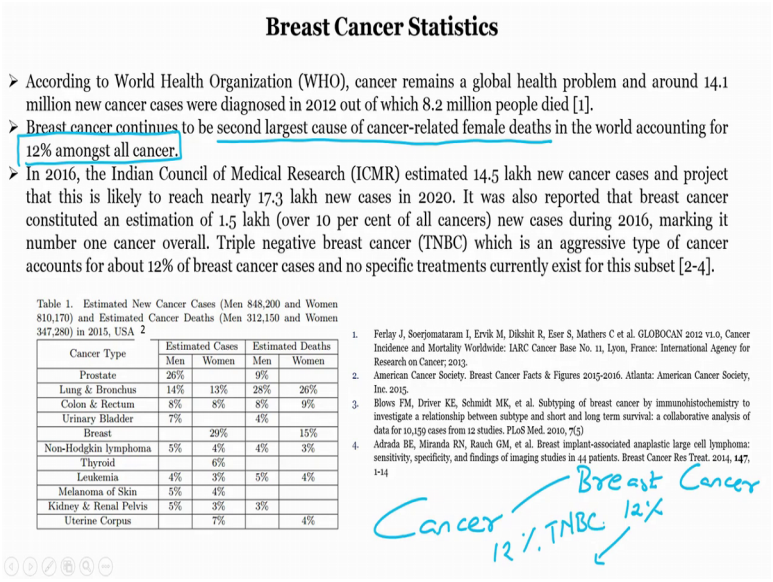

So, let us see first what exactly is a breast cancer and if you see the slide this slide shows the statistics. And which says that, according to the World Health Organization; which is WHO, cancer remains a global health problem and around 14.1 million new cancer cases were diagnosed in 12, out of which 8.2 million died in died and 8.2 is a huge number. And when it when you understand in cancer a particularly breast cancer; then you see that breast cancer continues to be the second largest cause of cancer related, second largest cause of cancer related female deaths in the world accounting for 12 percent amongst all cancer huge value huge problem alright.

So, if you talk about India then in 16 ICMR which is Indian Council of Medical Research estimated that about 14.5 lakh new cancer cases and projected that this is likely to reach nearly 17.3 lakh by 2020. It was also reported that breast cancer constituted an estimation of 1.5 lakh over 10 percent of all cancers, new cases during 16; marking it number one cancer overall.

Now, when you talk about cancer and in particular breast cancer, there is a subset of breast cancer which is called Triple Negative Breast Cancer is also short form is TNBC; we can write it down like that, which is an aggressive type of cancer accounts for about 12 percent of breast cancer cases. So, now, you see that like this if there is a cancer right in that breast cancer accounts for 12 percent of cases of all cancer right.

And when it over breast cancer then about 12 percent amongst the breast cancer cases 12 percent are triple negative breast cancer; triple negative breast cancer. Now what is triple negative breast cancer? Ok we will see that. So, then what is the gold standard? Gold standard is the way of diagnosing a disease which is accepted universally.

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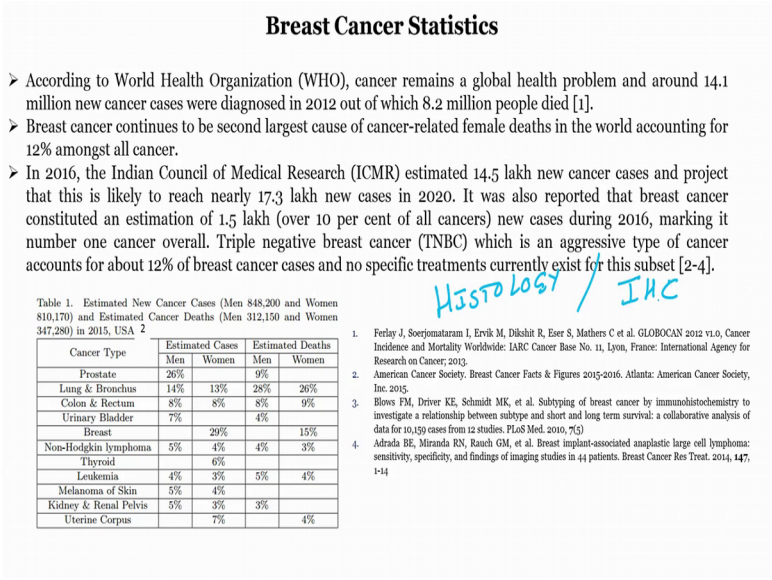

Now, in case of breast cancer we have to rely on histology is also sometimes we say immuno histology; Immuno Histo Chemistry; IHC, where the tissue is taken out from the breast from the affected region in the breast or from the diagnoised suspected region in the breast and we look at different biomarkers.

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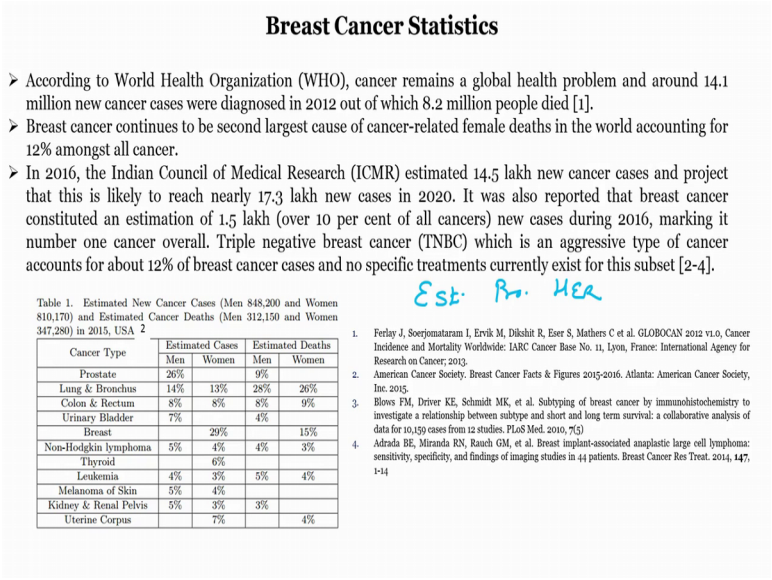

Now, there are several biomarkers one is called estrogen, another is called progesterone, another is called HER. So, there are several biomarkers present when a tissue is cancerous; if all three biomarkers are absent; if all three biomarkers are absent is called

triple negative. So, it is very difficult to understand that is the patient is having cancer, but the gold standard says that there is no cancer because all the biomarkers are absent. So, this is even more aggressive type because even the patient is suffering from cancer; we are unable to recognize the cancer right.

So, 12 percent of the breast cancer cases falls in triple negative results. Now like I said our idea is to develop a system that can diagnose breast cancer and can potentially understand what is a stage of the breast cancer. So, if you see this table you; what you will see? Table shows an estimated new cancer cases as per 2015 data. And what you see here is; so, this is based on the breast cancer facts and figures from Atlanta; I mean it is like a society that there are several cancer cases cancer like we have seen like we can see in the cancer type; prostate cancer, lung and bronchus, colon and nectar, urinary bladder, breast right lymphoma, thyroid, leukemia, melanoma, kidney and renal and uterine corpus.

So, several classes of breast of cancer amongst which when you talk about breast cancer; went over breast cancer 29 percent of the women out of 810170; which is like 810170 identified are in breast cancer cases addressing the cases. And about 15 percent of those will die these estimated death as per the American Cancer Society.

Now, so what exactly we are looking at? We are looking at that this is a very big problem, but when you talk about prostate cancer; when you talk about process cancer then for men it is equally up. Anyway all cancers are danger, but this is what the data shows that process cancer 26 percent of the identified cases 9 percent dies or is estimated death of 9 percent right.

Anyway, now since if you talk about Indian population then we will have oral cancer as a cancer that causes a lot of deaths in India. We will talk about oral cancer in subsequent slides so, this is just about understanding the statistics of the cancer.

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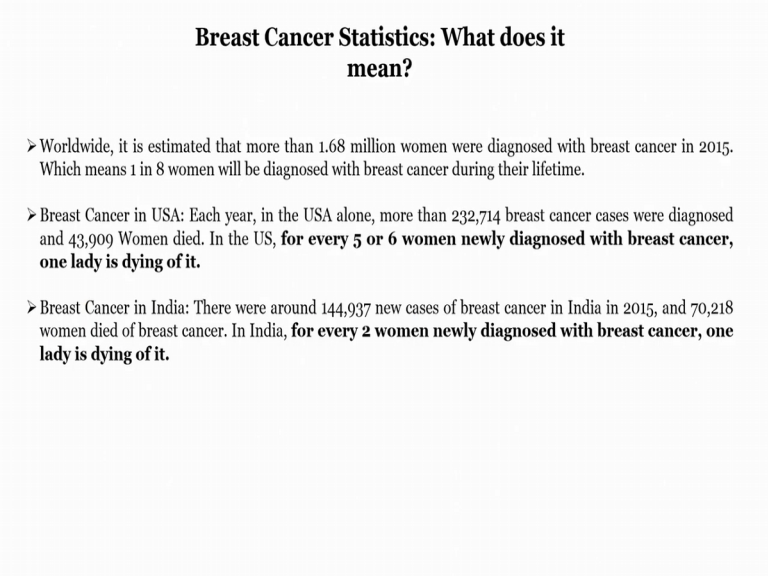

Now, exactly what do we understand from the overall this slide; this one right what do we understand? We understand that worldwide it is estimated more than 1.68 million women were diagnosed and which means 1 in 8 women; 1 in 8 will be diagnosed with breast cancer during their lifetime. Breast cancer in USA; each year in the USA alone more than 232714 breast cancer cases were diagnosed where 43909 women died, thus in the US for every 5 or 6 women nearly diagnosed with breast cancer one is dying.

But when we talk about our country you see that there were around 144937 new cases of breast cancer in 2015 out of which 70218 died of breast cancer; that means, that for every 2 women newly recognized with breast cancer, one is dying a severe problem from for our country as well right. So, what can we do? But before that let us quickly understand what is a breast anatomy and what are the types of breast cancer? Alright.

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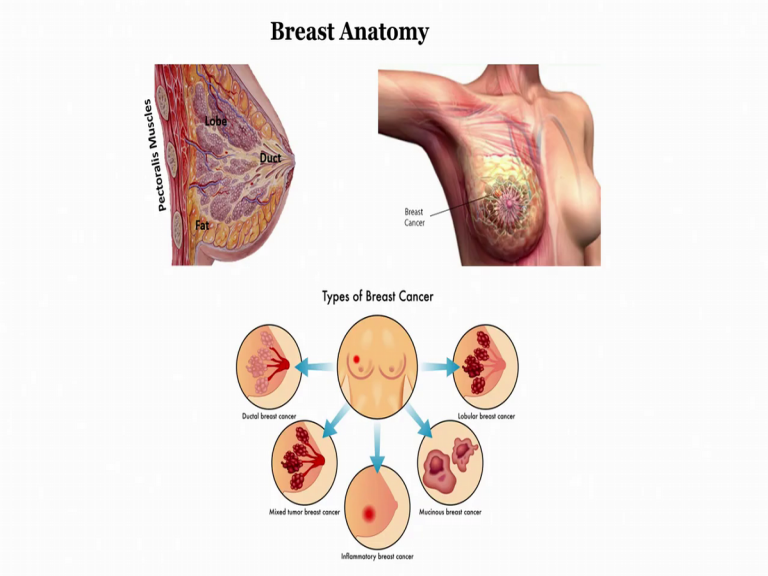

So, if you see the slide what you see is when you talk about the breast anatomy; the breast consists of duct right, it consists of lobes; see duct lobes right fat and pectoral muscles ok.

So, if we talk about types of breast cancer then what you find is you find ductal breast cancer which occurs in duct, lobular breast cancer which occurs in lobes, mixed tumor cancer which is in duct as well as lobes, mucinous breast cancer and inflammatory breast cancer; inflammatory breast cancer. So, the types of breast cancer we can say ductal, lobular, mixed tumor, mucinous and inflammatory. Now 70 percent of the cases in cancer is in ductile region.

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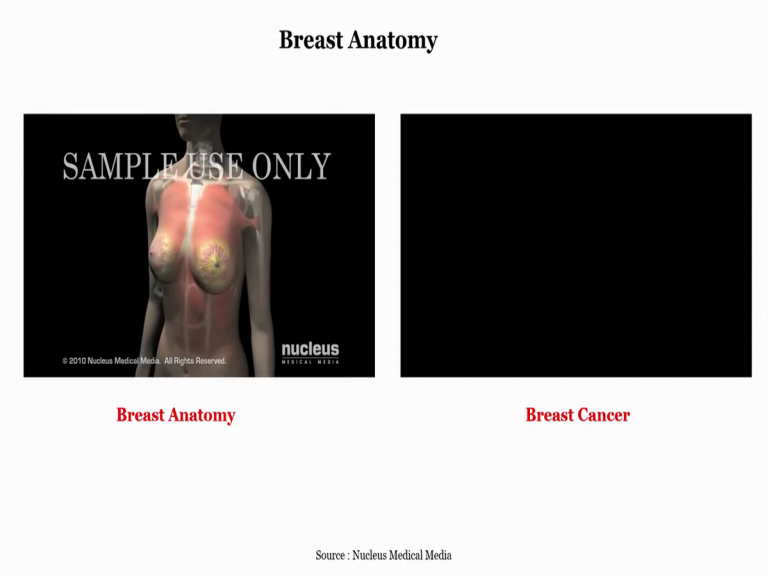

So, let us understand the breast anatomy and what exactly is a breast cancer through this video. First let me play the breast anatomy and then I will play the breast cancer. Breast cancer is the most common form of cancer in women today; knowing more about your own breast anatomy can help you an early cancer detection and prevention.

Your breasts are connected to small masses of tissue called lymph nodes by way of lymph vessels. The lymph nodes are responsible for collecting bacteria, cancer cells and other unhealthy material. You have groups of these lymph nodes under your arms, above your collarbones and behind your breastbone as well as in other parts of your body.

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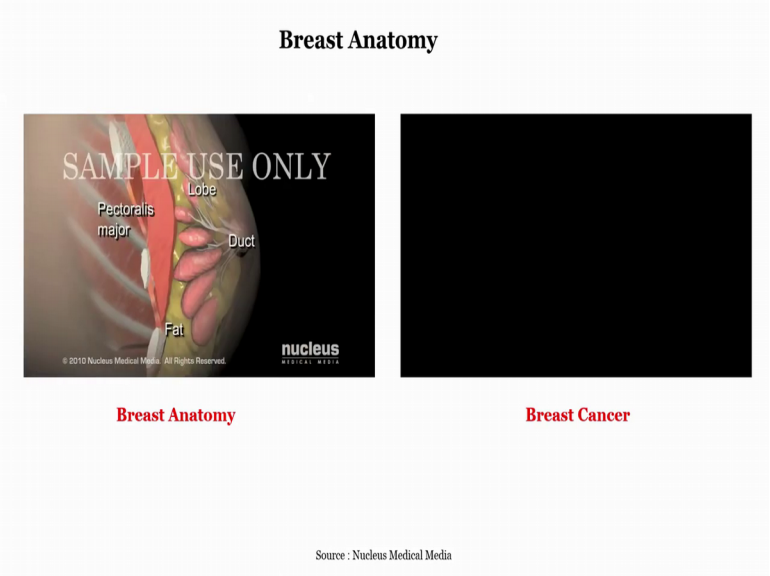

Each breast is made up of lobes, lobules and ducts. The lobes consist of smaller lobules that contain groups of tiny milk producing glands. When a breast is producing milk it passes through the ducts into the nipple where it exits the body. Breast cancer most commonly develops in the lobules, glands and ducts of the breast ok. So, you have seen the breast anatomy video.

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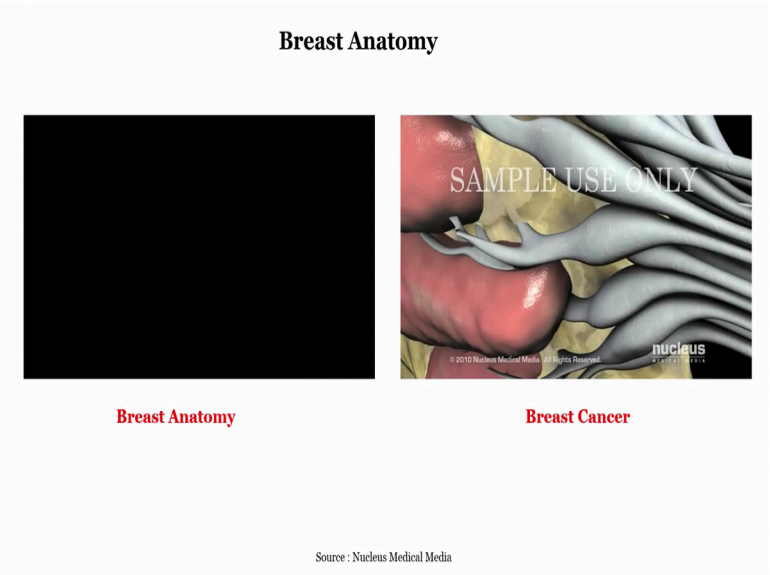

Now, let me play the breast cancer and stages; you will see different stages of breast cancer here. The staging of breast cancer refers to the extent of the disease, the cancer

stage is based on several factors including the size of the tumor, if any lymph nodes are involved, if the cancer is invasive or non invasive and if the cancer has spread areas beyond the breast.

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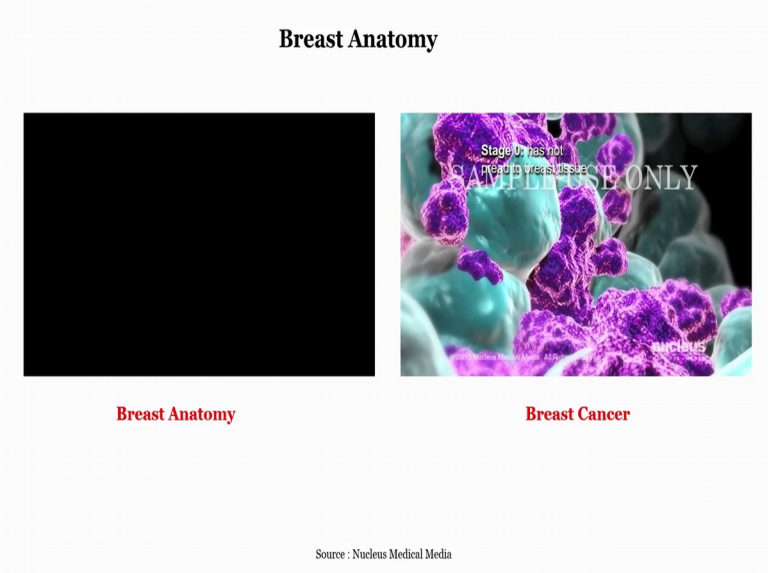

Stage 0 is considered a non invasive breast cancer, in this stage there is no evidence that the cancer cells have spread into neighboring breast tissue beyond the duct or lobule.

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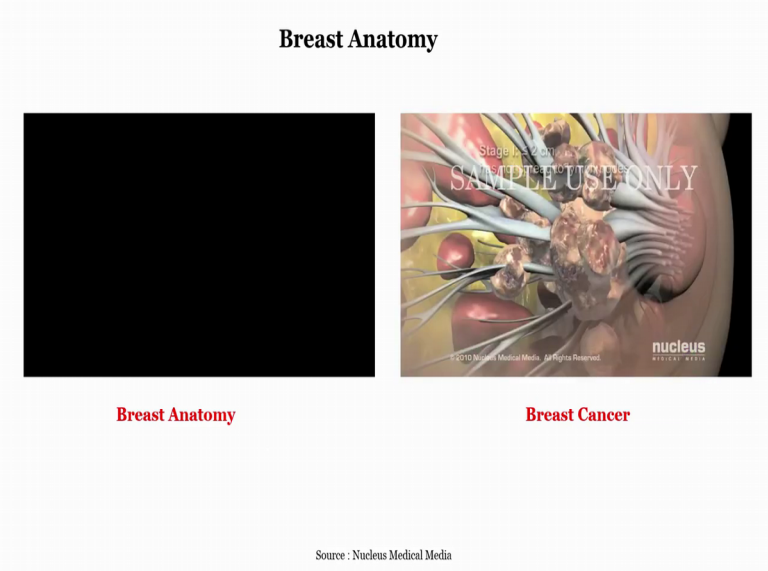

Stage I is considered an early stage of invasive breast cancer when measured the tumor is no more than 2 centimeters in diameter and there is no evidence that the cancer cells have spread beyond the breast.

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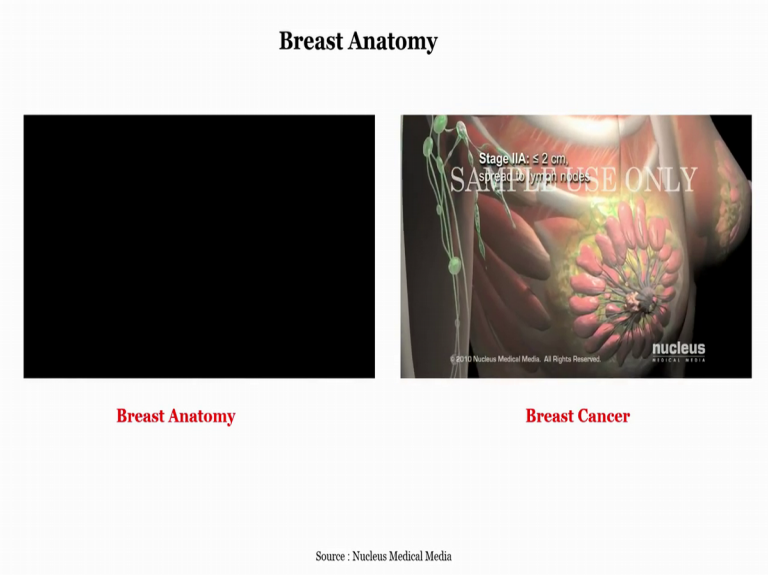

Stage II is divided into subcategories of II A and II B; stage II A is invasive breast cancer where the tumor is either a maximum of 2 centimeters in diameter and has spread to the lymph nodes under the arm or the tumor is between 2 and 5 centimeters in diameter, but has not spread to any lymph nodes stage II B is a little different and that the tumor is either between 2 and 5 centimeters and habe spread underarm lymph nodes or the tumor is larger than 5 centimeters, but has not spread to the underarm lymph nodes.

Stage III is considered a locally advanced cancer and it is also divided into subcategories of III A, III B and III C, there are two main scenarios that can occur with stage III A breast cancer.

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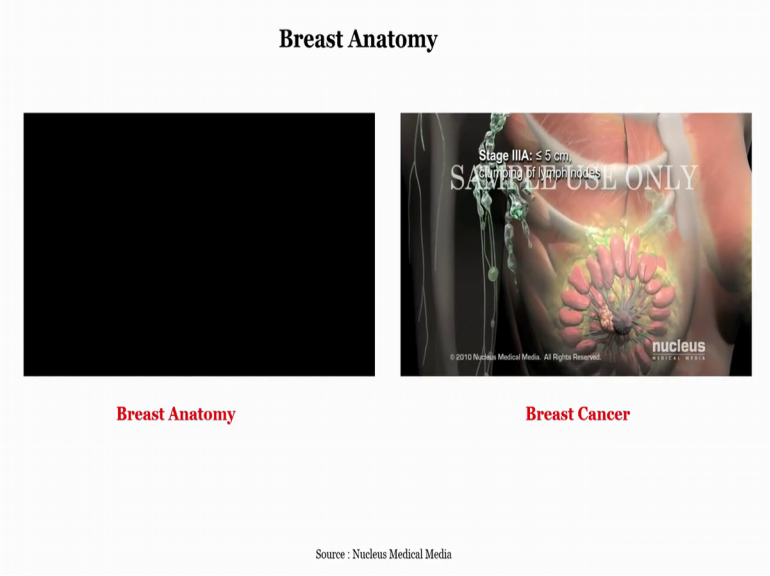

One where the tumor is no larger than 5 centimeters in diameter, but it has spread to underarm lymph nodes; that are growing into each other forming clumps. The cancer may also have spread to the lymph nodes near the breastbone. The second scenario for stage III A is very similar with the exception that the tumor is larger than 5 centimeters in diameter and that the underarm lymph nodes are not adhered to one another or other tissues.

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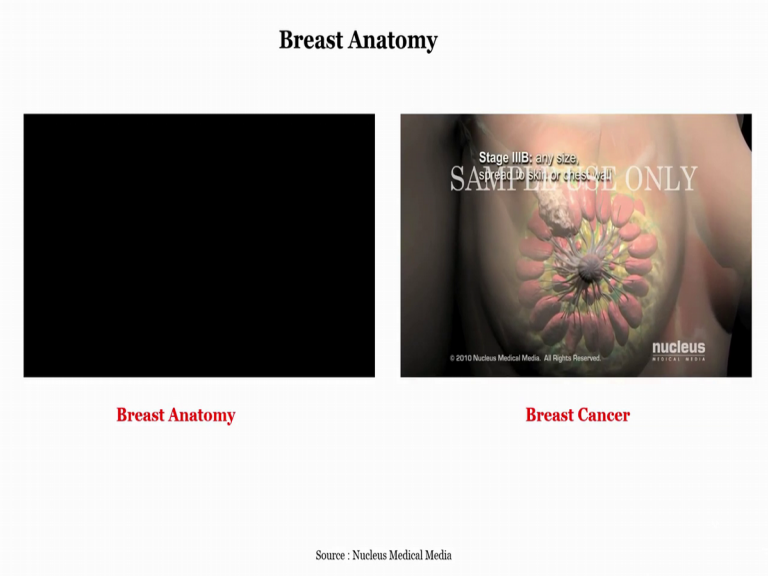

Unlike the other stages, in stage III B, the tumor may be any size and has spread into the skin of the breast or chest wall. This stage may also include lumps in the skin of the breast or swelling of the breast.

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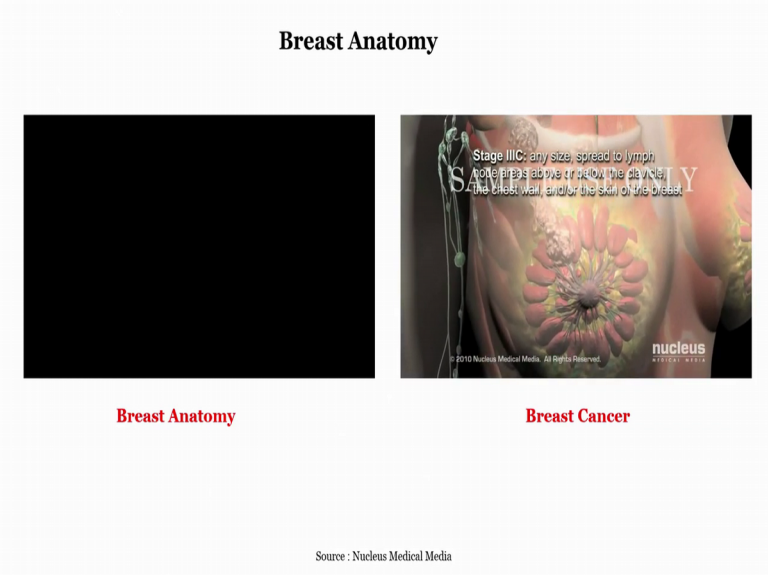

In stage III C, the tumor may also be of any size, but it is also spread to lymph node areas above or below the clavicle; the chest wall and or the skin of the breast.

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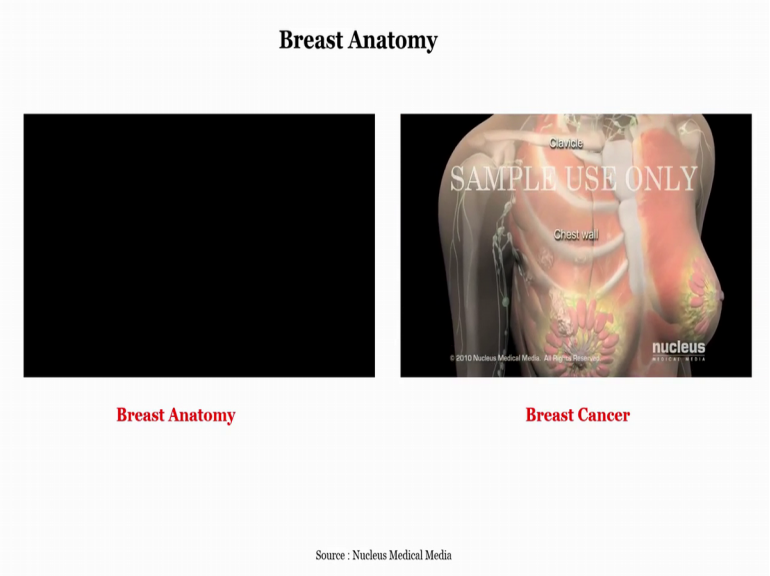

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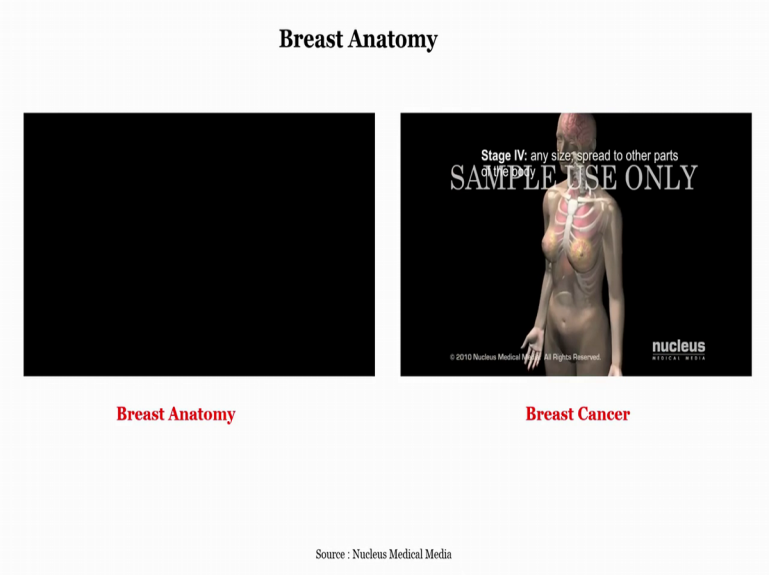

Stage IV is considered distant metastatic cancer meaning the cancer has spread to other organs and parts of the body ok.

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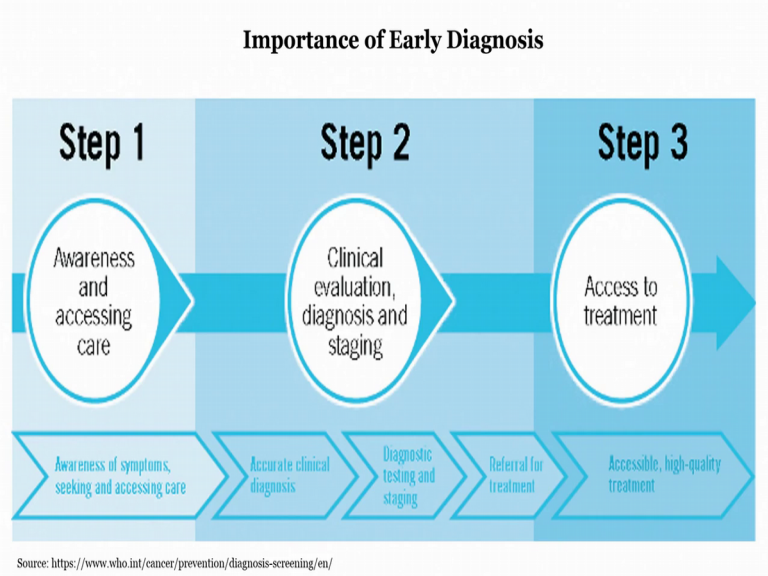

Now, since you know what exactly is anatomy and the different cancer stages; what is the important of early diagnosis? Very very interesting slide and the importance of early diagnosis is step 1; awareness and assessing care; where awareness of symptoms in assessing care, step 2 will be clinical evaluation diagnosing and staging and step 3 will be access to treatment.

So, when you are understandable awareness what awareness means? Awareness is there any inflammation in the breast that can be done using a self test exam right. Once in a month it is advised that a women should go for self test and should check any abnormality with the breast; whether it is an inflammation, where there is a; where there is a mucus formation or any abnormal liquid you know coming out.

Also if there is a stiffer region you know it is better to do a self awareness self testing. And we will see somewhere there that women under 30 and over 30 or under 14 over 40 are advised to go for mammography and MRI. We will see that slide once in a year or twice in 2 years or 1 year; we will see that in the following slides.

Let us right now understand the importance. Importance is as early you diagnose the cancer you can treat it well alright. So, the process is awareness of symptoms living assessing care then followed by accurate clinical diagnosis, followed by darkness staging and referral for treatment and accessible high quality treatments. So, if I talk about this

early cancer diagnosis; this early cancer diagnosis remains same for oral cancer as well in any case of cancer this remains equally important which is early diagnosis.

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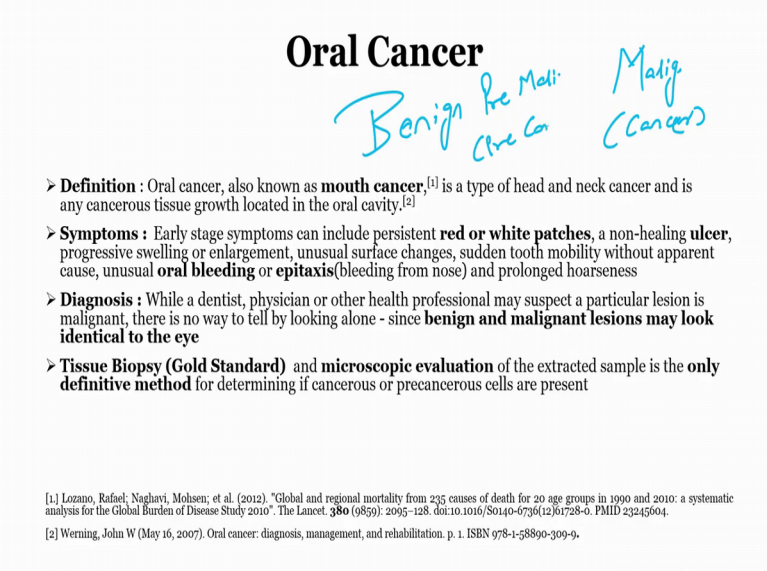

Now, since we are talking about tissue related cancer; the cancer occurs in a tissue. So, let us also understand what is an oral cancer? And then we will see a device that can measure the change in the tissue properties ok. So, oral cancer if I just give a definition then the definition would be is also known as mouth cancer and it is type of head and neck cancer and in any cancerous tissue growth look at it in the oral cavity right. So, that is the oral cancer; the symptoms of oral cancer would be early stage symptoms can include persistent red or white patches, a non healing ulcer, progressive swelling or enlargement, unusual surface changes, sudden tooth mobility without apparent cause, unusual oral bleeding or bleeding from nose and prolonged hoarseness.

So, this is these are some of the early stage symptoms one can identify what are the diagnosis? The diagnosis is while a dentist, physician or health professional may suspect a particular listen is malignant there is no way to tell by looking alone. Since benign and malignant lesions may look identical to the eye.

So, when just looking at the lesions; just looking at the image, it is very difficult to understand whether a person is suffering from malignancy or not. So, what is malignancy? You see benign malignant; that is cancer, pre malignant that is pre cancer alright, benign, pre malignant, malignant.

So, it is difficult to know whether just by looking whether a person has a malignant lesions or it is just benign; so we have to perform for the test. So, the screening cannot help us this really can just help us to understand whether person should go for the histology or not. Now when you cannot understand just by looking; you had go for tissue biopsy. Biopsy is where tissue is taken out from the suspected region and macroscopic evolution of the extracted sample is the only definitive method for determining if the cancerous or precancerous cells are present alright.

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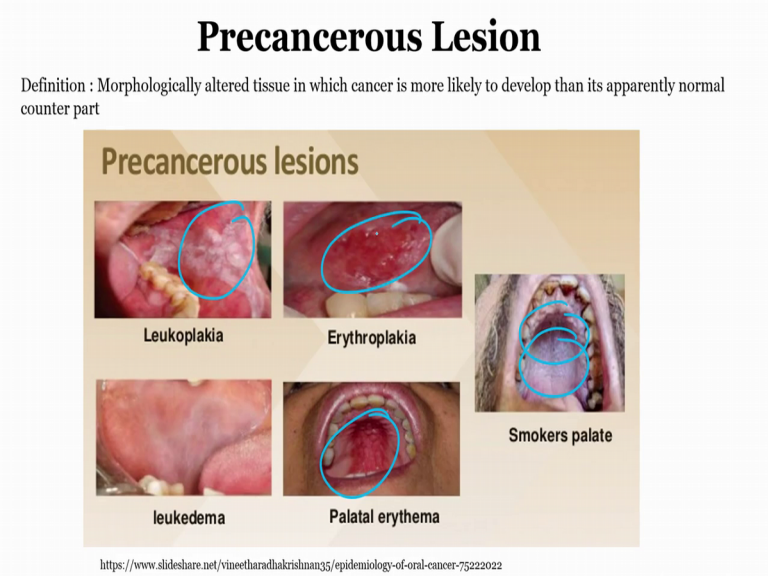

So, this is what is all about oral cancer; you can see here there are morphologically altered tissue in which cancer is more likely developed; then it is apparently normal counterparts, you can very clearly see the different types is can be leukedema, it can be palatal erythema, it can be leukoplakia, it can be smokers palate and it can be a erythroplakia.

So, it is a leukoplakia I am sorry; so you can see a different region site even see this one yeah you can see very clear the pilot right. So, just by looking at this one it is kind of it can be understood that there can be pre cancer lesions, but to make sure it is cancer we have to go for histology. So, that there is a very big screening program; where you where the ASHA workers, accredited social health workers they take the image from the patients mouth and they send it to the oncologist which is the head and neck oncologist

too so that a patient can be called or depending on the image capture; that is screening of the oral cancer patients.

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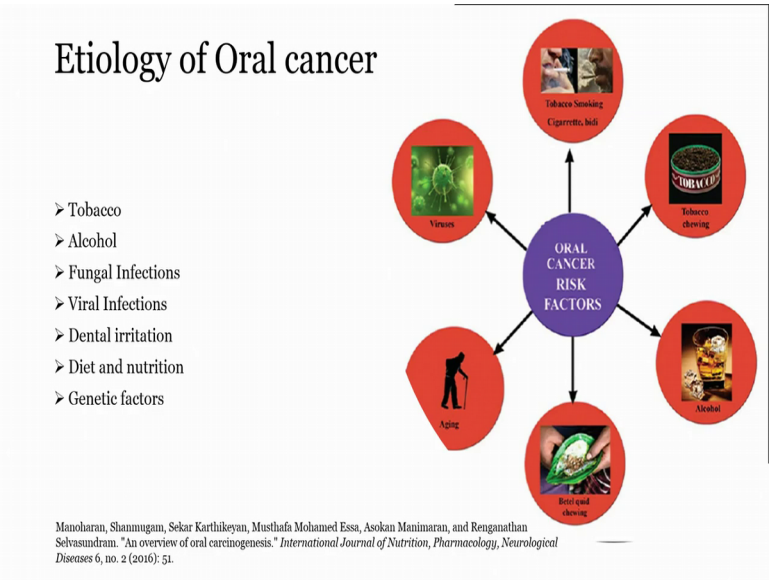

We are not interested, right now to go into detail about screening of it but let us quickly see what are the causes of oral cancer. Oral cancer risk factor is of course, aging, betel squid chewing which is your pan; pan is overall betel is good, betel leaf is good for health, but betel leaf with sorry the leafy that we used for the pan is good, but betel nuts right.

And chewing with tobacco is really harmful; same thing goes for alcohol we have tubercle chewing, smoking cigarettes, viruses. So, if you divide the etiology you will see that from tobacco to genetic factors, from diet to dental to viral to fungal there are lot of causes of oral cancer.

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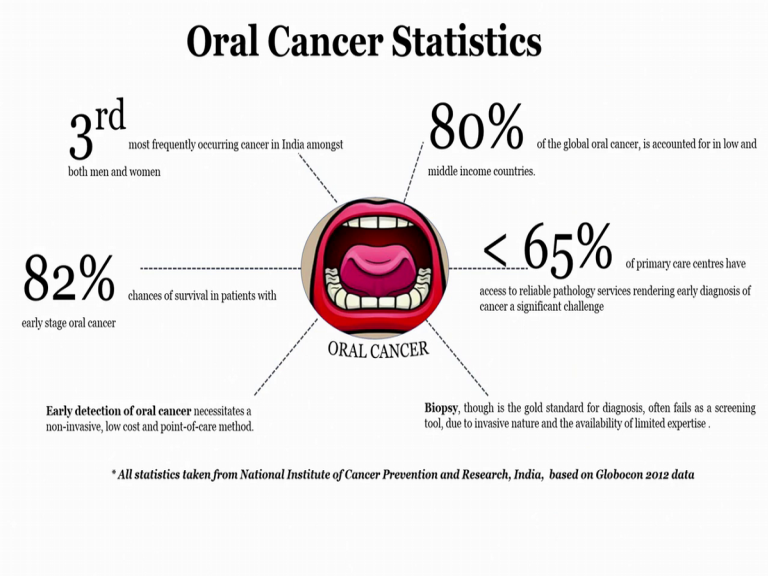

And if you want to further understand the cancer statistics like we understood the breast cancer statistics; what we find? That 3rd most frequently occurring cancer in India amongst both men and women alright; 82 percent cases of survival in patients with early stage. You see this is the very important factor, 82 percent there is a huge chances of survival, if we can determine early stage if you can diagnose in early stage.

80 percent of the global audiences accounted in low and middle income countries less than 65 percent of primary centers have access to reliable pathology services. And learning early diagnosis of cancer is a significant challenge and that is why in this course we will look at a system that can measure the or that can help to screen the patient quickly, it is a portable microscope for screening cytology cases or cytology slides.

Now, biopsied though is the gold standard for diagnosis of unveils as a screening tool due to invasive nature and the availability of limited expertise. Biopsy is how which you are to take out the tissue from the suspected region and then you understand different markers right. Now, understand this thing that we have taken all these data statistics from Globocon 2012 which is a National Institute of Cancer Prevention and Research in India.

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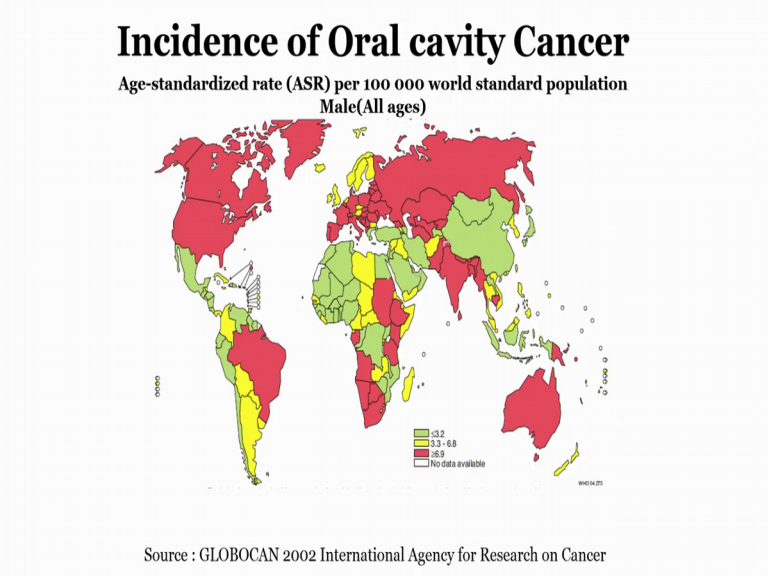

Now, if you further I go then incidence of oral cavity age standardized rate, but 100000 world standard population. And if this is about male all ages then you can see that less than 3; greater than 6.9 is where we fall right. Same thing goes for China and you know in less than 3.2, no data available is different, but most of the countries. So, you can see it is a oral cavity cancer is extremely prevalent, it is extremely important and lot of cases are there.

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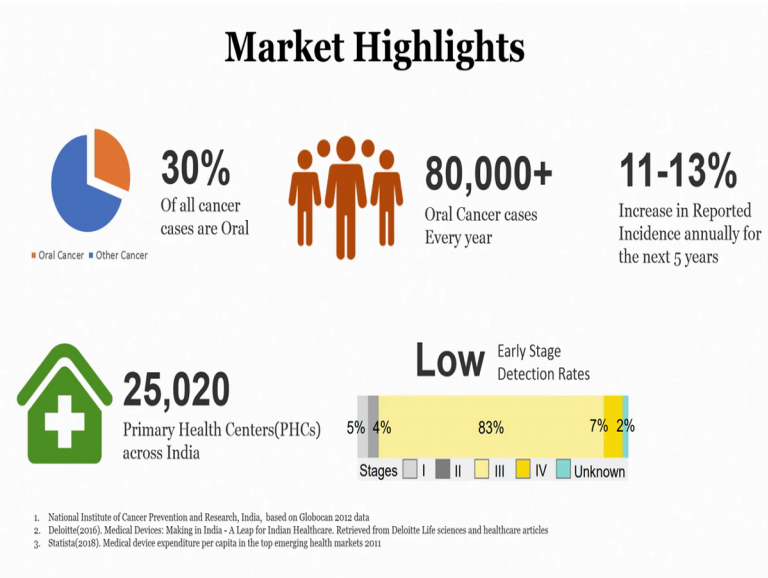

So, the point is can we as an engineer design a diagnosis tool? Now, if you understand from market highlights this is also important, you see guys because what is the point of doing a research, what is the point of making a device?

If you want to make a device that can send to a market you have to understand what are the market highlights? So, if you see oral cancer versus the other cancer 30 percent of oral cancer all kinds of cases are oral 80000 plus or cancer cases every year. 11 to 13 percent increase in the potency entry for next 5 years 25020 that is 25020 primary health care centers across India. And when you say early stage detection rates the stages where I and II is only about 9 percent, while IIIrd and third is about 83, IVth is about 7 percent.

So, you see most of the we had to bring this value down; we have to bring this value down to bring this value up that is the interest. Can we diagnosed cancer at early stages ok?

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So, what to do? Now if you understand quickly the health care market; Indian health care market; then the health care market is among the top 20 in world valued at USD 3.5 billion per capita consumption medical devices lowest as USD 3 compared to developed countries. India medical device industry is under penetrated which presents a huge opportunity for driving growth, 65 percent of annual medical equipment is imported as indigenous manufacture device and are not up to globally recognized tenders.

So, can we develop a system that is that can compare with the globalized with the global devices; globally recognized extenders. And finally, Indian government under the National Health Mission encourages public private partnership models for mass screening and diagnosis programs will boost in vitro diagnostic industries alright. So, when you understand the healthcare market, you will see that it is a huge opportunity also from our country point of view to develop indigenous devices and to make it as per the globally recognized standards by collaborating with public and private or partnership.

And the idea again why we are discussing this thing as a part of this course because what you will do with devices? What you will do with systems? You need to understand what is the role of the system? What is the need of the system? What is the market of the system? Alright. This is very important to understand as a part of any course that what are you going to do when you have a device with you. This is going further right what is a market?

Are you going to sell it if you are going to sell it; is there a market for that? And why you are developing the device. So, everything boils down to a question why you want to develop a system for early cancer diagnosis. Are not there enough systems in market? If yes why are you working on that? So, the point is we need to understand each and everything from market highlights, the product importance and how to develop the system alright.

So, combining everything and of course, for that we need to understand what exactly cancer is. Not to really go into death; into the depth where we understand how the cancer forms, but more about what is cancer, what are the changes in the tissues?

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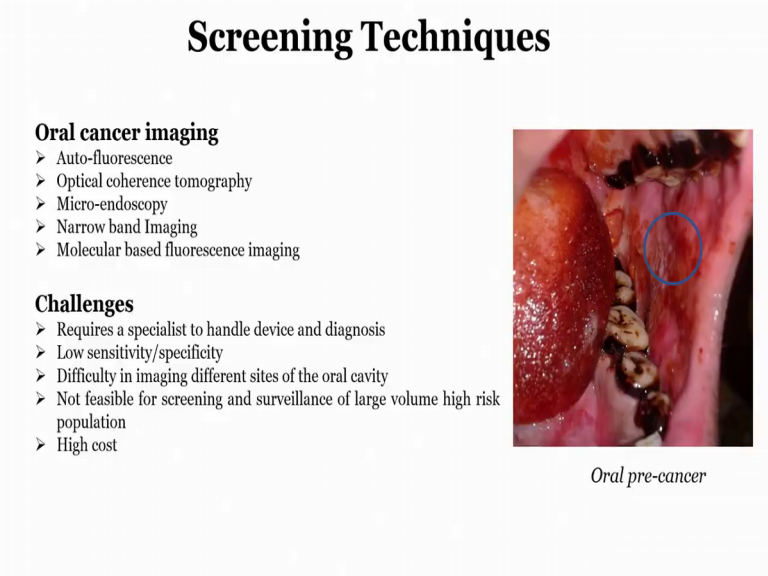

So, if I go further then what I will see is screening techniques so, but before I go for screening techniques let me complete this module here. And in the next module, we will see oral cancer screening techniques followed by the breast cancer screening. And then we will go for the chip design and manufacturing the system; alright till then you take care I will see you in the next module. Just go through it this is more about information about the study about the two different cancer, but which we want to understand one is oral cancer and second is a breast cancer alright. So, I will see in the next class till then you take care bye.