Introduction to Maternal Infant Young Children Nutrition
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Lecture - 21
Session - 5

Golden Hour

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So, focusing on the golden hour, because there is so much of science in that one hour, what is happening in that hour/ So, I am going to discuss that.

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And if I have some time, then I will go more into nutrition aspect of 6 months and above.

But let us just focus on first golden hour. So, what happens, we know about 1000 days. So, 1000 days, so out of 1000 days, your 270 days are your pregnancy. So, in that pregnancy time mother probably has nutritionist mother has access to OBGYN doctors, or whoever any doctor that takes care of a pregnancy part.

While paediatrician and nutritionist they take care of the rest of the 730 days. So, once the baby's born, that is when the paediatrician and then again, the nutritionist has come in, in the picture. Now, there is an overlap of about an hour. What is it hour? As soon as child is born and when the paediatrician is called in the delivery room to take care of the baby's initial important time, you have OBGYN in the room, you have paediatrician in the room, and you have that support which has been given by a nutritionist to the mother during ANC.

So, she has that knowledge. So, with three of us we can influence it lifelong health, in a sense. For example, when we have birthday party, when child is born child has first birthday party, second birthday party, and we always arrange so much we spend so much time making all this planning your birthday cake, planning food, planning party for birthdays. Think about it, you are bringing this newborn.

And the first hour you have this beautiful baby born in your hospital or in your PHC. And you have to celebrate it. And the way you celebrate it is by giving. What you are giving to the child, you are giving the perfect start. How are you giving the perfect start is, as soon as baby is born, you are putting the child to mother's breast, that is called your breast crawl skin to skin attachment because that is going to give the perfect start. And you are giving that perfect gift to that baby, and it is lifelong and let us see why it is lifelong.

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And that is why it is called golden hour because that hour will never come back and the time lost in this one hour, you will never get it back. And it has a lifelong implication on child's health. And of course, breast milk has, I mean, there is a whole science do it in its optimum nutrition, it has bioactive component, it has host defense protein.

But what I am going to focus on is it is an important source of commensal bacteria for gut colonization. So, what happens when the baby is born? The baby has little bit of bacteria, which is coming on from amniotic fluid from mother's womb. And then when baby is pretty much has little bit, but it is pretty much arrived. So, now let us happen, let us see what happens when the baby's arrived.

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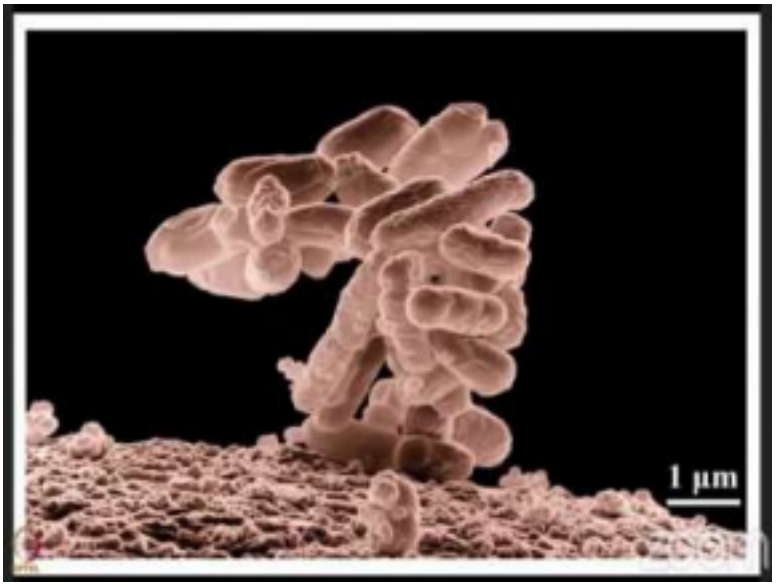

So, here this is a gut microbiome with breast milk, we will go a little bit more detail and exactly what happens in baby's gut when the colostrum passes on. So, here is electron microscopic picture of your gut bacteria, extremely small, and you will be amazed to understand gut microbiome and it is like the whole world in human body. I am going to focus on of course, just babies.

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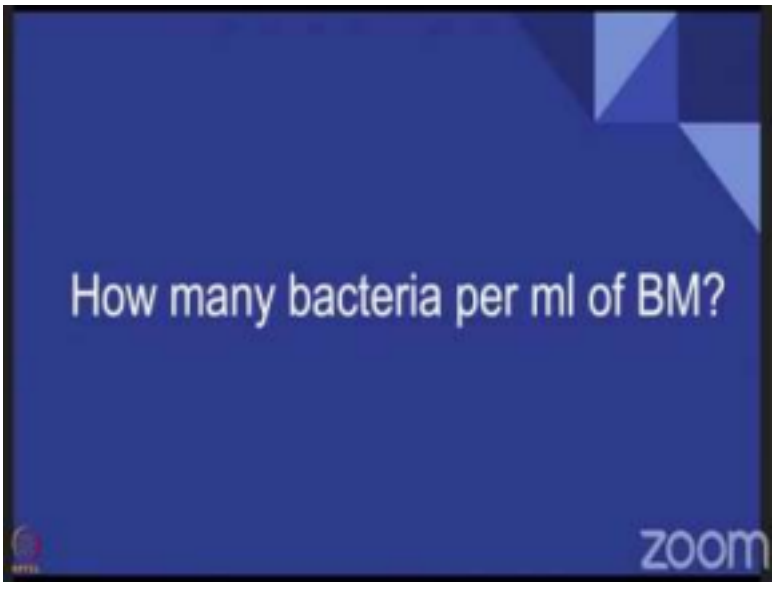

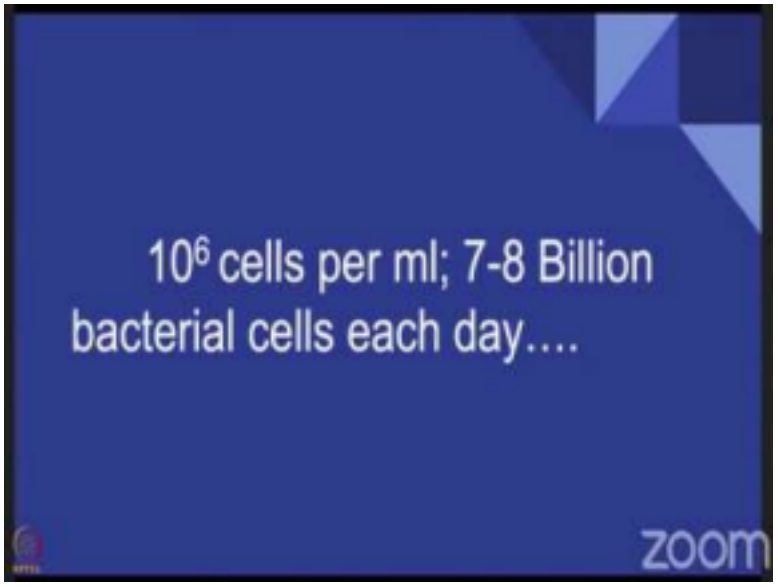

How many bacteria per ml of breast milk? 10,006 cells per ml. And 7 to 8 billion bacterial cells each day, which are formed in the gut.

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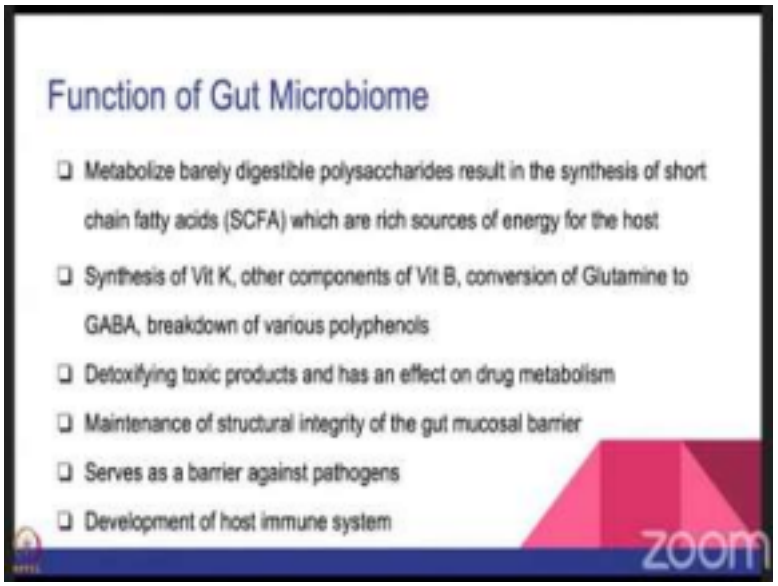

What is the function of gut microbiome? So, these are the gut microbiome which are being developed in baby because baby is getting breast milk. So, what it does? It is microbiome, it metabolizes the polysaccharides which are oligosaccharides which are present in the milk and results in synthesis of short chain fatty acids to some essential fatty acids, you guys know, short chain fatty acids, which are a rich source of energy for the host.

And basically, it also involves and synthesis of vitamin K. It is important for formation of components of vitamin B. We also know B12, a lot of this gut bacteria release B12, it is also important for conversion of glutamine. Now, glutamine is amino acid, it is important.

This particular information is very important, because there are new hypothesis coming in,

what they are saying is gut microbiome of mother and the baby is also probably related to autism, autism spectrum disorder, and autism rate is clearly going up, especially in America, and it is going up in India too.

And probably they are thinking of this could be the reason of conversion of children who have autism, they have decreased conversion from glutamine to GABA. GABA is a neurotransmitter, which is important in your brain. And then also, gut microbiome is very important for a breakdown of various polyphenols.

Now as nutritionists, we all know that this Polyphenols are so important, we get it from fruits, from vegetables from green tea, and so many other amazing vegetables and fruits, but fortunately, if you have a good microbiome, it is going to help you to break down these polyphenols. Now, the thing, microbiome is also important for detoxifying toxic products. And it also has effect on drug metabolisms.

So, for example, if child is taking a medication for a reason, then the microbiome in baby's gut will have an effect on your drug metabolism. So, we have to change the dosage, depending upon gut microbiome. Also, which is -- One thing, which is extremely important is your maintenance a structural integrity. So, again, I am going to explain in a bit more detail that what is the structural integrity of gut mucosal barrier, because gut is your, there is one thing which is completely open to outside is your gut.

Another one is your nose and your mouth, but mainly you are intestine is completely open to outside. So, whatever you are eating, basically, if you do not have a proper gut integrity, if you do not have proper maintenance of those gut cells, then anything can get absorbed into your vascular system into your blood vessels. So, gut microbiome is extremely important for integrity of this gut mucosal barrier.

And it also serves as a barrier. So, it causes, I am going to go a little bit detail about it, how it causes barrier against all the pathogenic bacteria, and viruses, not only bacteria, but a lot of other microorganisms and it also important for development to host immune system. So, look at all these effects that gut microbiome have. So, you want to have effect gut microbiome for the baby who is just born, because there is all these effects that baby's going to have.

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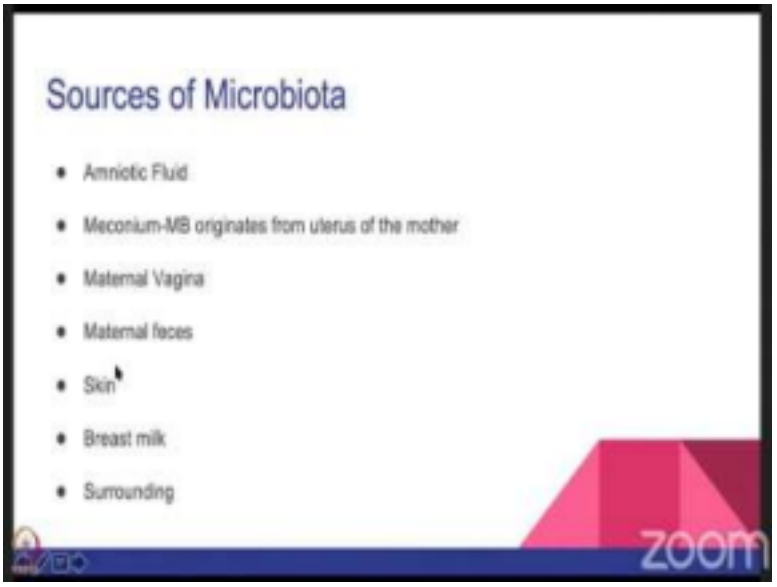

Again, we want to find out, where do those gut microbiome come from? What are the sources of this microbiome because we want to be a perfect one. So, we want to, it is like giving a perfect cake, and perfect ingredients. So, we want to have a perfect chain of events, the child gets a perfect start in her life.

So, microbiota comes from amniotic fluid, it comes from meconium, and meconium originates from uterus, so meconium, a lot of time when the baby is born when they pass stool you will see the green liquidly stuff that they pass in the stool, that is called meconium. So, they can get those micro bacteria from the meconium.

It also comes from maternal vagina, extremely important, this is really, really important to have a vaginal birth to get again, the perfect gut microbiome. Another time, sometime, it also comes from maternal faeces, it comes from the skin, it comes from breast milk, and it comes from surrounding, so we want to have surrounding as clean as possible. And all these other factors are extremely important because it is going to give them mother's gut microbiome.

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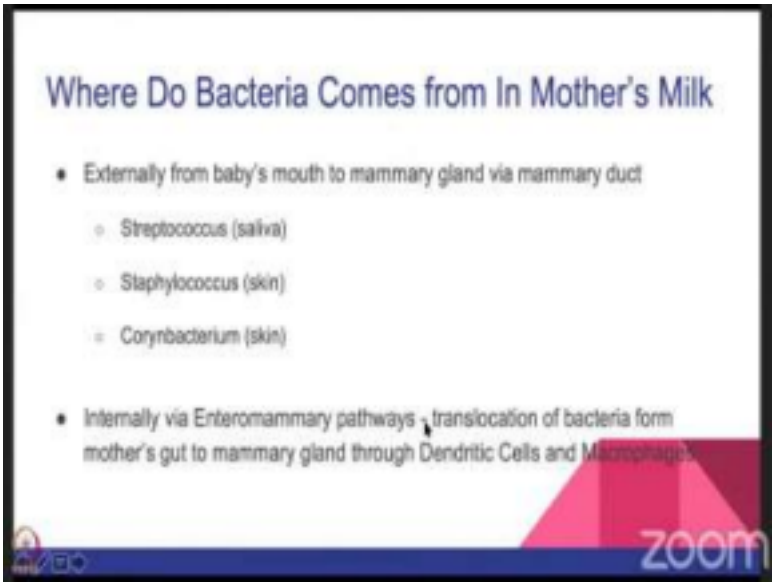

So, externally, it can come from baby's mouth. So, what happens is when the baby's sucking on breast, the areola, the bacteria which are present in baby's saliva, it can go back into in the duct collecting duct, and it can go back in the mammary duct, and that can create a lot of this reaction, and then it will go back to a baby. So, that is, again, it is really another important source of micro bacteria in mother's milk.

And another way which some of the studies have found is what happens when there is a translocation of bacteria in mother's gut. So, for example, mother's gut has say some of the good bacteria's which can get transferred, which can go through a special pathway to mother's mammary gland. Can you imagine this is such a beautiful way of nature's helping that baby to give the perfect microorganism from mother to baby. So, this I will again discuss a little bit about the dendritic cells. So, what are these dendritic cells?

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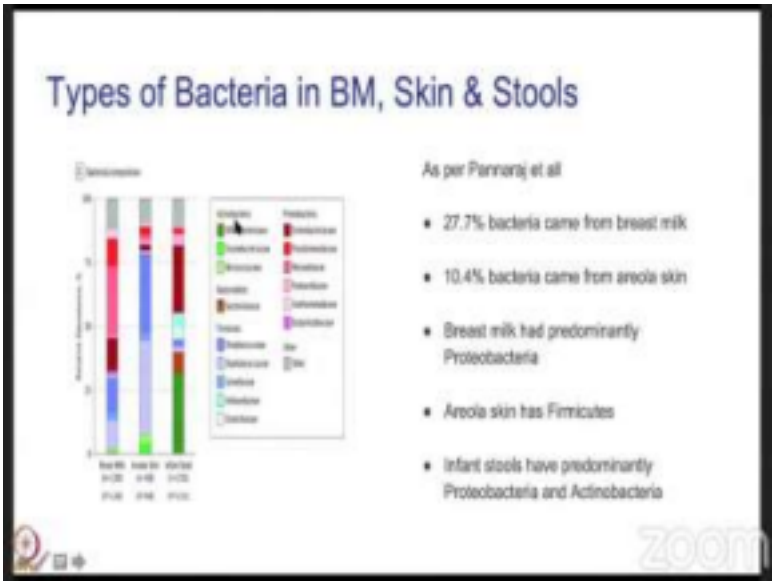

And these are the organisms which are found, these are some of the organism which are found in breast milk, these are some of the organism which are found in areola skin, and these are some of the organism which are found in infant stool. So, look at, let us look at what is found in breast milk. So, if you look at this pink colour over here, pink colours are mainly your Proteobacteria, so breast milk this was one of the study which was done by Dr. Pannaraj.

So, in that what he found that mother's milk had a lot of this Proteobacteria. Areola skin, so mother's areola skin had all skin bacteria. So, skin bacteria's are called Firmicutes. So, what are your Firmicutes bacteria? Your staphylococcus, your streptococcus was all your by and large your skin bacteria. But if you looked at infant stool, the infant stool had lot more Actinobacteria. So, Actinobacteria is your bifidobacteria.

These are all species of bacteria. So, why do you think the infant stool has lot more this bacteria although breast milk has Proteobacteria. But what happened in baby's gut that the infant stool has lot more bifidobacteria and that is because again, this is I am again going to go a little bit more in detail to understand exactly what happens in baby's gut.

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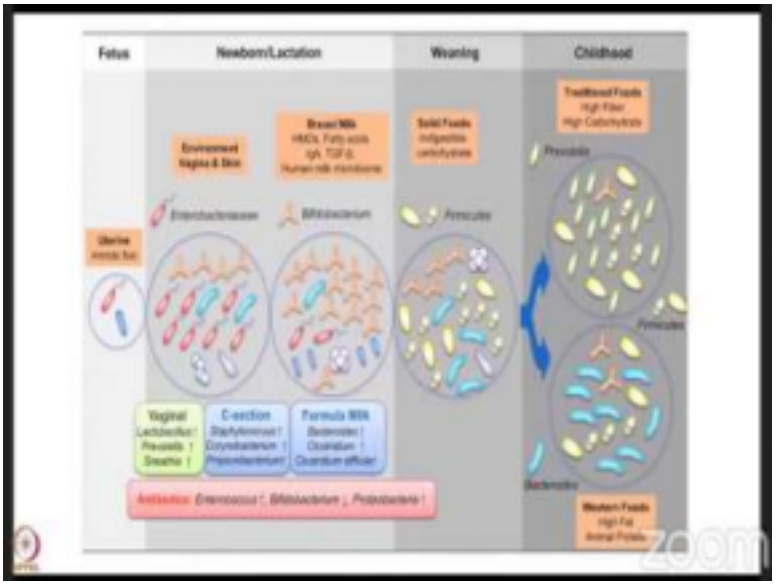

Now, these are all the different bacterias that you see in children, baby's gut, and they all are different. So, if you look at the babies who are born by vagina, so vaginal delivery babies, they have much higher level of species like lactobacillus, prevotella, sneathia, these are some of the very good bacterias which are very important in babies and babies who are born vaginally, they have this really good bacterias.

Now, babies who are born by caesarean, they have different kinds of bacteria. So, if you

look at in the gut microbiome, they will have more of staphylococcus again, because the skin is cut. So, you have a lot more this Staphylococcus, Corynebacterium, Propionibacterium those are the bacteria that you see in babies who have C-section. And the babies who are formula fed.

Now, those formula fed babies have completely different bacteria. So, they will have more of a bacteroides, Clostridium, a lot of these other more of a pathogenic bacteria, which will cause a lot more problems. So, you will know, like a lot when we give formula and those babies are crying a lot, they may have a lot more gas, they have a lot more bloating is because they bacterias are completely gone haywire.

And mothers who get antibiotics for babies who get antibiotics or during delivery, pre delivery, those babies have different bacteria. So, look at the bacteria change in different bacterias. And also, when you are weaning the children, when you are starting the complementary food depending upon what food you are starting their children will have different bacteria.

So, these are the bacterias when a child is given a lot more high fiber food, they will have more of prevotella versus children who are given a lot more like the high fat, animal protein diet, they will have bacteria, so they will have a different bacteria. So, basically, bacteria will change. And by and large by 3 years of age children's bacteria is pretty much similar to your adult gut bacteria.

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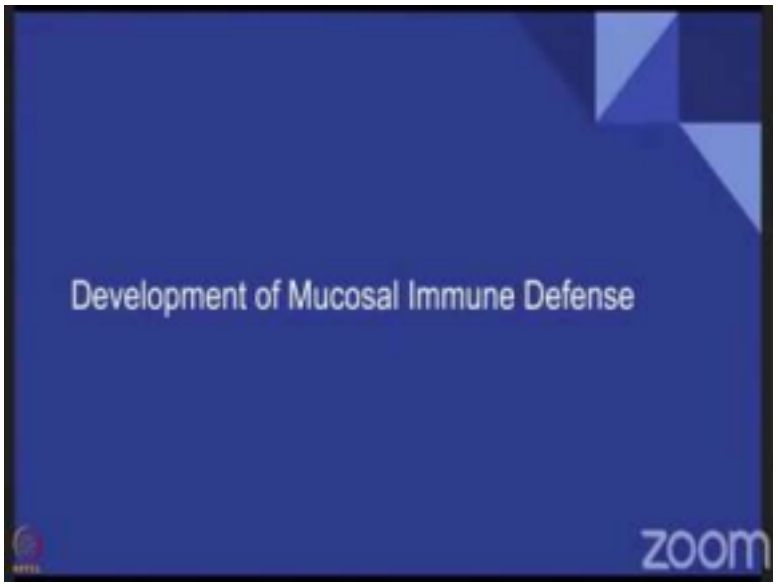

Now, let us see what happens now, how the nature prepares his baby to come on the planet Earth. So, let us see how the mucosal immune defense develop.

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So, here, so this is baby's intestine, this is the intestinal wall. Now, here what the first thing that we have in our intestinal guts cell lining, this is the M cells, M cells it looks like M. So, this is important, these are M cells. Then you have something called this all payers patch. So, this how you will lymphoid, payers patch, number 2. So, this is your payers patches, you have your T cells, your B cells is all your cells, your immunological cells.

Then you have your third one your two lamina propria this was your cells which are present just outside the cellular this thing and they again have lot of this plasma cells, they have the CD4 T cells. Again, those are all the immunological cells. And then you have intraepithelial lymphocytes. So, these are your intraepithelial lymphocytes.

So, these are all the cells are extremely important to start the immune function, because babies absolutely imagined baby was in mother's womb, baby was protected by mother's immunity. Now, baby's out baby has to function on his own. So, baby requires that little bit of stimulation to have the immune function stem stimulated.

It just like, for example, if we get, say, viral load of COVID, that when what is going to happen. Suppose, if you are exposed to somebody who has COVID, what is going to happen in the body? Your body is going to react. Now, here is a foreign virus coming into your body, your body's immune function is going to start reacting very fast, it will start increasing your T cells.

Your B says all this you must be understanding of the cytokines and all these levels go up. Exactly similar way when the baby is out from mother's womb, baby is now preparing, or nature is preparing baby for that immunity. Now, to increase that immunity baby will

require that stimulus, baby will require something which will tell body okay you start immune function and protect this baby. So, this is what it is.

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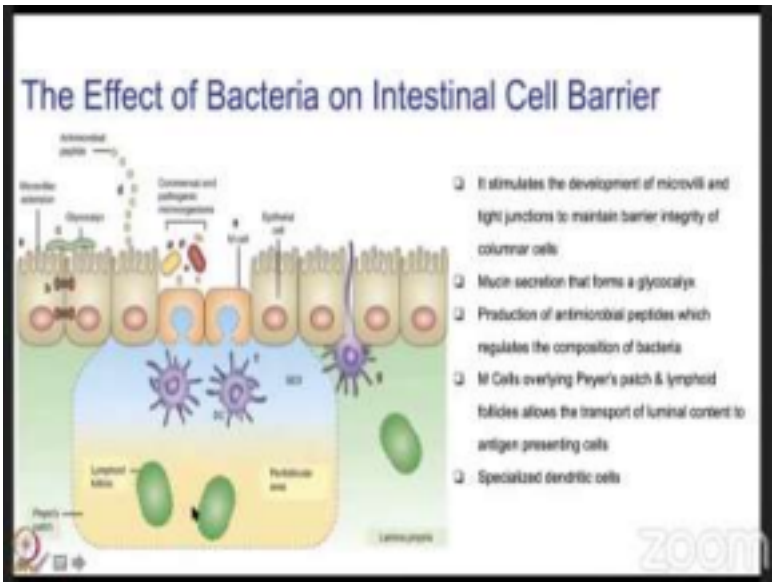

Now, again, going back a little bit more into science. So, what happens once the baby takes this milk mother's milk, which has mother's good bacteria. So, those bacteria has an effect on these columnar epithelial cells. So, the one which I showed you over here. So, how it affects the columnar epithelial cells this slide over here. So, what it does? So, first thing what it does, it creates these microvilli.

So, do you see microvilli over here? These are columnar epithelial cells. This is a gut lining. This is a lining. This is your lumen, this is your gut lumen, this is where the milk comes in. And this is your just underline the guts cells, your columnar cells, you have lot of this immune cells over here. So, this all these immune cells are waiting for something to stimulate them, so they can start acting up.

So, the first thing what the bacteria in mother's milk, which it does it, it tells columnar epithelial cells to have a microvilli extension. So, here this is important, a microvilli extension, it is not only important for absorption of your lot of nutrients that you guys know, but it has other functions also.

Second thing what it does, normally what happens when you have this columnar epithelial cells, this all the cells, normally in the newborn, fresh newborn, there is some gap in between this columnar epithelial cells, so they are not attached to it, there is no addition there is little bit of gap. So, now you have this, suppose you have a gap. So, anything that you put in the mouth, lot of things which should not get absorbed from that food that you

are eating, it will get absorbed, because then you have this gap.
But thanks to bacteria and mother's milk, immediately the gap becomes sealed. So, do you see there is a seal, so it seals them. So, this is the first level of defense. It is like literally, your soldiers coming close to one another and saying no, we will not let you in. So, this is the second level, first level of defense. The second level of defense what it does, it tells lot of cells, like there are different cells in your columnar epithelial cells, you must have already known this, there are paneth cells, there are goblet cells they are all different cells.

So, what it is going to tell all the cells to start producing something called glycocalyx, also called mucin, mucin like a mucous layer. So now it has beautiful nucleus level, all over the columnar epithelial cells, this is your second level because what happens to be very difficult for any bad bacteria to go into the epithelial cells, you do not want any bad bacteria. So, this is a second level of defense where it will not allow anything to enter your colon epithelial cells.

Third thing what this bacterias will do, it will cause a stimulation of these peptides. These peptides are formed from your amino acids as you know. And then what it will do, it will these peptides are very important for as a anti-microbial effect. So, it has a anti-microbial effect. Fourth thing what it will you do basically, it will, so do you see this area, this is do you remember that which spoke about M cells, there are M cells.

And I told you to remember those M cells. Now, there is one particular area in your intestine and baby's intestine where there is no mucus production, there is no mucin, there is no microvilli. Why do we have that because it is important for these immune cells to get exposed to mother's bacteria. So, if you have everything covered, you will not have stimulation of the immune cells.

So, here this M cells will allow basically, your good bacteria and your bad bacteria to enter the intestinal wall, and then it will stimulate all your cells underneath. So, this is important. Now, one more thing, which is really important is your DC, this is dendritic cells. Remember I talked about dendritic cells.

Dendritic cells are special cells, and what it does, it attaches the good bacteria, probably like a commensal bacteria, and then it takes it inside, and it exposes all these other cells to those bacteria. So, this is another very specialized dendritic cell. So, this is the basis of your immunity that how, now loud let us see what happens when mother's milk comes in.
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Now, this is the beautiful picture that I found from study that I was reading and it is the electron microscope of the microvilli. So, this is your columnar epithelial cells, this is the cell and these are all the microvilli. So, it is beautiful picture.

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So, now, what happens, now, let us see how the immunity develops. So, here I discussed about those columnar epithelial cells. This is your dendritic cells. So, what it is doing it is taking all these bacterias and it is bringing into sub epithelial area, where you have those lymphocyte cells. Now, normally what happens, initially you have this T helper cells which are naive cells, naive cells means they are not exposed.

And then normally what happens you have this, there are different, T cells of naïve cells are get transferred converted into your T helper 1 cells T helper 2 cells, T regulatory cells, these are basically, so it starts to be stimulating. And normally, babies born with a lot of Th2

cells. So, here this, here if you look at it, where is my cursor, yeah. So, basically, normally they have predominance of these cells, why?

Because there should not be any rejection, when the baby is developing in mother's womb, they should not be rejection. So, not to have a rejection, what nature has done, there is predominance of Th2 cells. So, there is no rejection. But once a baby is born, now baby is out of mother's womb, there has to be regulation. So, you cannot have Th2 like dominance otherwise child will have lot of autoimmune diseases, a lot of allergies.

So, what it has to do with it has to make, balance all this Th cells. And another thing what it does, again it also takes these bacteria to your B cells. Now, what is a function of B cells? B cells are important for your IgA. So, what happens the IgA gets secreted and that IgA helps with, it contains bacteria attachment and penetration. So, your Secretory IgA is extremely important.

And I just read a paper yesterday, where they found that children who, like younger children, the reason they are not getting COVID infection, because they have very high level of secretory IgA, which prevents the attachment of bacteria and virus to your cells, to your cells. So, that is why it is important that children get the right. And obviously, you want mother's bacteria to stimulate all these cells, you do not want cow milk or formula to stimulate all this cells.

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So, now there is another very beautiful presentation on development of immune tolerance. What do you mean by immune tolerance? Mean, suppose if you are exposed to any allergens. So, it could be allergens to any food any, like allergens, you have to develop the

immunity so that you do not have this reaction, imagine if somebody had anything in there had allergic reaction. So, that is called immune intolerance.

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So, here again, talking a little bit about science, because this is again, I find it extremely important and very interesting also, so if you look at it, I spoke about the DC which is your dendritic cells. So, and this is mother's milk, so mother's milk, have your microbiota. So, I spoke about all the bacterias that it has, I also spoke about some of this microbial proliferation.

So, it has human milk oligosaccharides, which I am going to talk about a little bit later. And it has all other anti-microbial. So, they all work in synergy. And it helps in prevention of allergies. So, let us see what it does. So, any antigen is taken up by your dendritic cell. And it is taken to lymph node, remember I told you that it takes those bacterial cells to those lymph nodes and those cells and it stimulates your transforming growth factor which basically induces remember I told about the cells, changing into T regular all that.

So, this is one reaction which is happening when mother's milk is going in. Second reaction what is happening, there is something called interleukin 22. These are again, you must have read a lot about COVID, you must have read about all of these interleukins and cytokines and all that. So, of course, you do not want too much of cytokines, but you need some amount of cytokine to fight your infections.

So, another thing what happens is there is a production of the interleukin 22. And that interleukin 22 is extremely important, why is it important, because it is important for formation of this peptide. So, remember I spoke about the peptide it produces this peptide.

And this peptide production results in your making of your mucin production that the lining of the gut, so for that interleukin 22 is very important.

And that is it is important for strengthening of gut barrier. Third thing what it does basically, this particular gut barrier near the mucin will prevent the transfer of dietary antigen across the barrier. So, then you will have this beautiful layer it will not allow any antigen to enter, and for that, you need that interleukin 22, which will stimulate your goblet cells, it will stimulate your paneth cells and it will produce your mucin production.

Then there is another enzyme, there is an enzyme it is called indoleamine 2,3-dioxygenase. So, there is a, we call it IDO. I know I am going a bit too into details, but this I think a really interesting topic that we have to, if we understand we will never let child have anything but colostrum that too within half an hour. There is an enzyme called IDO and which gets activated in response of allergen.

So, if there is a exposure to any allergen, this IDO gets activated. And what does IDO do? It metabolizes, there is a few I mean, of course, you guys know tryptophan. That is another amino acid. So, what it does, it converts your tryptophan to kynurenin and which has the tolerogenic effect. So, again, basically, this kynurenin is extremely important in baby and that will prevent any immune reaction.

And what it does it again, affects your Tregs. And this is how it is going to prevent allergy. So, these are a few of the components which are important in prevention of allergy development. And being a nutritionist, we guys know that it is so, I mean a lot of people have so many allergies. And now when you ask them, do ask them one question.

Ask them that when you were born, in how much time did you get mother's milk? Whether did you get mother's milk? Or did you not get mother's milk? If you did not get mother's milk? What did you get? All this thing? If you asked a question in a lot of people who have allergies, by and large, you get the answer that they were not fed colostrum right away.

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Another signs which is coming up, it is your microbiome gut and brain access. So, what happens basically, again you must have studied in your nutrition, that sometime when we are very stressed, when you are extremely worried if we have exams a lot of time we have stomach pain, we have diarrhoea, we have like nausea like feeling, why do they have, why do we have that? Think about it.

So, I mean, of course, there is autonomous nervous system, you have vagal, vagal nerves, you have all this connection between gut and your brain. So, it is similarly when you have issue with gut through loss of this nervous connection especially vagal nerve, largest metabolite of gut microbiome it can affect brain.

So, what they are saying in larger research, recent articles, they saying that if there are a lot of neuro immune conditions like multiple sclerosis, Alzheimer's, autism, anxiety, depression, stress, all these lot of these the disease are probably involved because of gut

microbiome. I mean, of course, nothing is proven as yet, but as more and more studies are coming out it is just as amazing.

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So, again, let us see how it functions. So, as I mentioned, it is like a bidirectional biochemical communication. Remember, I spoke about GABA, like how your gut microbiome is important for formation of GABA, it is also important for formation of serotonin. Now, if you remember, serotonin is another neurotransmitter, it is important for happiness. If you have a low serotonin, you will be depressed, you will be sad.

So, it is really important to have this really important neurotransmitter serotonin. And basically, so your gut microbiome influences all this production, expression of all this important neurotransmitter. So, imagine if you do not have, you will have, of course, you will have some neurological issues. This one is also important. Remember, I mentioned about the intestinal barrier and tight junction.

So, if you do not have those tight junctions, a lot of these toxic metabolites can pass through hypothalamic pituitary adrenal axis and cause issues. Another important thing about short chain fatty acids. So, again as I mentioned, short chain fatty acids, serotonin, kynurenin, they all have a effect on brain. So, think about it when you are putting anything in your mouth.

I am not talking about babies now, I am talking about adults, you do not want to do anything which can affect your microbiome. Because it has effect, and you will see it like lot of time, when you eat something, when you have bloating, next morning, you will wake up you will have headache, you will have something called brain fog, so you will notice it,

you have to now really be aware of a lot of these symptoms, which you may not realize.

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So, again, picture depiction of how the hypothesis of autism and gut dysbiosis again, nothing is proven this was hypothesis. But this was another very good, beautiful article that I had just read three days ago, and this is again this is the altered gut microbiome and mothers and babies and then it affects your brain through various signals, various pathways.

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Now, another thing, which is really important, is all these bacterial cells that we have, now that so we live in harmony. When we have good bacteria, we have good immunity, because it is going to protect us, when we have good immunity, we will have better bacteria and those bacterias will. So, it is like a full synergy. When you have a dysbiosis, dysbiosis means your commensal bacterias are lower, and your pathogenic bacterias are higher.
So, now you will have lot more this gut problem of bloating, irritable bowel syndrome, diarrhoea, then, of course, you eventually what you are going to develop, you are going to develop a lot of your immune disease because you again your gut lining is not, your gut lining is not well prepared. It has all these holes your mucus is not protecting, your mucus level is gone or mucous layer is gone, then lot of these toxins are getting absorbed.

And then your body is reacting and you saw there are a lot of this B cells, T cells waiting just underneath your intestinal wall to react. So, then people who have this gut microbiome problem, they have a risk, they are at risk for atopic dermatitis, there is for food allergies, IBD, necrotizing enterocolitis, which we see in paediatric and NICU we see it all the time in small babies, we see necrotizing enterocolitis, we see metabolic syndrome, and we see like there is so much of information out there on gut microbiome and disease.

But if you have excellent gut bacteria, you are eating right food, babies that getting colostrum, babies getting mother's milk, mother is eating right food, then obviously baby will develop immune tolerance, baby will have intestinal homeostasis, they will be healthy metabolism. So, it is like a win-win situation. And it is very important to keep ourselves in a synergy with the gut microbiome.

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Now, let us see what affects gut bacteria. Now I spoke a lot about what exactly does in the body, you want to make sure that we protect it. So, in babies, how do you protect those gut bacteria? You want to have a positive, so green, all your green factors are your positive factors. So, you want to have proper vaginal delivery as much as possible.

Of course, maybe 15 percent of the time, mother may need their caesarean section, which is okay, but I see that most of the time, like almost just there was a news at 57 percent patients get a caesarean section. So, you want to ask gynecologist, why I am getting caesarean section, so you be on top of it, and try to get as much as possible vaginal delivery.

If there are complications obviously there is no choice, then you want to have as much as possible term delivery because babies who are born premature have a different gut microbiome bacteria. Then you want to have skin to skin touch, skin to skin attachment, breast feeding right away within as soon as possible, you know as possible as just try the

baby and put the baby we have a beautiful video on Spoken Tutorial.

You want to avoid antibiotics as much as possible. So, avoid antibiotic in mother's, avoid antibiotics in babies. What will alter this gut bacteria? Caesarean delivery, preterm delivery, early bath, lack of skin-to-skin contact, formula feeding and antibiotic exposure. So, formula feeding also includes cow's milk. So, any milk other than mother's milk will create a problem in gut bacteria and if there is antibiotic exposure, so you want to prevent all this as much as possible.

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This again, some of the other factors which can create gut disruption and causing asthma, atopy, diabetes, all that. Of course, later on diet is also very important. So, child may have perfect nutrition for 6 months, and then they continue breastfeeding for 2, 3 years.

But if they start food, which can be damaged into gut macrobacteria, and some of them are like sugar, jaggery, Omega 6 loaded fatty acids, lot of these are transfat, lot of this thing are very detrimental to our gut microbiome. So, we have to be very careful what we are putting in our stomach.

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This is another one, another article which just came out just few months ago, and what they found is lot of time when mothers come to us, they said, can I get a pump, can I just pump the milk and give the baby through spoon or bottle. So, in this study, what they found is mothers who had, who are pumping their milk and giving them milk through bottles, those baby had different microbiota, then the mothers who were directly attaching.

So, remember I told you when you have a direct attachment that areola microbiota, areola bacteria is also very important. So, those factors who are not going in mother's milk. And also, what was happening, basically, there was probably a lot of contamination of breast pumps, so however hard you try to clean it. It is not direct mother's milk going into baby, so those babies had different gut bacteria. So, this is important to understand.

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So, and what is dysbiosis? Dysbiosis, as I said, is when there is a symbiotic relationship is

lost, that is when it is dysbiosis, means you have a lot more pathogenic bacteria than your normal good bacterias.

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And what are the implications? Though these are the studies which have which have been done so far. So, again, high risk of infections, asthma, and celiac disease again, a very good study which came out almost 30 to 40 percent reduction of celiac disease in mothers or babies who got mother's milk. So, it decreases the prevalence of celiac disease also.

Your IBD, autoimmune diseases, your irritable bowel syndrome, IBD inflammatory bowel diseases, obesity, look at his all this so many. And this one is the new really too much going on in this arena of neurodegenerative disorders and your mental disorders. Your autism stress, depression, schizophrenia, Parkinson's, if you get chance, you do reading on this articles on gut microbiome and neurodegenerative diseases.

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Now, so now we spoke about bacteria. We always say, which is a good probiotic, which is a good prebiotic, what should I do for my gut, but you would not believe it, as God has given beautiful bacteria and mother's milk. God has given food for that bacteria, that is called prebiotic, that is called human milk oligosaccharides. So, it is amazing, the nature is just mind blowing, that God is given perfect food for those beautiful commensals, like good bacteria.

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So, you guys know about prebiotic definitions. I am not going to go too much in detail, but those are food for your, for bacteria. And basically, it allows the specific changes, it changed, it allows the change in composition and activity of micro flora.

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So, these ate human milk oligosaccharides, a lot of effects on again, gut microbiome and also an intestine, very interesting, so again, I am going to go a little bit in science. So, this is your structure of human milk oligosaccharides. So, it has few codes, it has Silac acid, it has n acetyl glucosamine, galactose, glucose. So, this is your structure of HMO.

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What are they, they are glycans. They are found, like abundantly in breast milk. Colostrum has high amount, you see, look at this, 20 to 23 grams per litre of HMO in your colostrum. It goes down as when the mother starts getting mature milk. Preterm babies have higher amount of HMO, why because that those babies need a lot more protection from infection, they need lot more protection from lot more other allergic conditions.
Because many times what happens preterm babies, they get formulas. And as soon as we start formulas, especially in US, lower these babies have developed something called necrotizing enterocolitis. So, again, I am going to go a little bit detail in that what happens when we start, not start mother's milk and start formula. And then what happens in these HMOs they need to, they have to be resistant to gastric acidity, because those are food for microbiota which are present more in the lower intestine.

So, it has to be done is it has to resist to gastric acidity, it has to be prevented from hydrolysis by enzymes, and it has to be prevented from absorption. So, it has to go intact lower down in baby's intestine. So, when those HMOs reaches the distal small intestine and the colon, they are at a very high concentration. And then some of the bacteria they grow well, on this HMO. Some of the bacteria they do not grow well.

And then these bacteria, they produce short chain fatty acids. So, remember I told you about the short chain fatty, those are metabolites, those are powerful metabolites. And if you read a little bit more about short chain fatty acid, there is like a whole bunch of 100 papers, you will find not effector short chain fatty acids on our body. And what it does, it favours the growth of commensals over potential pathogens, so it allows good bacteria to grow and prevents the bad bacteria to die down.

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So, now again, there is a little bit of science I am going to go directly to, I am going to explain this because this is what I have explained in the previous slide. So, what it does, so these HMOs are basically food for good bacteria. So, these are your green ones are you good bacterias, your the purple ones are your bad bacteria. So, when you have food for good bacteria, and bacterias does not have HMOs, so they are going to die, without food they are going to die.

So, obviously, you want mother's milk and baby because if by chance a baby's getting bad bacteria from say somebody's dirty hand or somebody touched the baby or put finger in babies mouth and all these bacterias which are going in baby stomach, those are most likely bad bacteria. So, if you have a human milk oligosaccharides and mother's milk, those bad bacterias will not going to survive.

Same thing you what it does it basically, it acts like a decoy, decoy means it, the cells over here, they look like your epithelial cells over here, so that those bad bacterias get attached over here, and then they take it away from columnar epithelial cells, it works like a decoy, it trick the bad bacteria to go away from your epithelial cells. So, it does not get absorbed. Then what it does is it causes the cell modulation.

So, this is where there is an immune modulation, where it allows your plasma cells to produce IGA, so there a lot of this epigenetic factors that it does, so there is lot of immunomodulation. I again, do not go too much in detail. This particular one, or this I mentioned, a babies are born with T helper cell to predominance, because they do not want to get rejected in baby's mother's womb, but when you have a human milk oligosaccharides. It tried to you see how that causes balance. So, there is a balance of this, so not only those gut microbiome causing balance, but also human milk oligosaccharides that also causes balance of this Th1 and Th2. This will prevent allergies in future extremely important step in baby. Now, this E1, this is what happens. So, you remember that we have neutrophils, we have WBC, we have all these cells.

Those are all cells, which comes in when there is infection. But you do not want too much cells going into your cells, in your epithelial cells. So, these are the neutrophil, so your neutrophils, so what HMO does, it prevents the roll, it prevents the rolling of the cells on the endothelial cells. So, these are endothelial cells, it is prevent the rolling. So, when you prevent the rolling, then it will not allow the neutrophils to go into your vascular system.