

One Health
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Lecture - 13
What are Zoonotic Diseases & its Role in our Changing World

A very warm welcome to all of you I am very happy that you have enrolled for this course and today's brief lecture would be on the, you know, introduction of the concept of One health, what is one health, how do we view one health from a public health perspective, how do we manage the different partners and stakeholders in this one health complex. So, when we say one health what exactly do we mean. It has become a very buzzword or a fashionable term to use especially after Covid-19 pandemic.

But do we really understand the final nuances or of the subject or how complex and how, you know, it will be complex to deal with so many stakeholders partners. So, we will go through the different aspects of one health management of these zoonotic infections. One health is a big umbrella where lot of other topics also come but I will be focusing on zoonotic infections only because coming from the background of communicable diseases and zoonosis are communicable diseases which spill over from animals to humans and human beings suffer.

So, that is a public health concern from human animal, but human health cannot be divorced or cannot be separated from animal health, from environmental health from plant health. So, seeing that human health in the context of all the other, you know, units of environment is extremely important.

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Unit-3. One Health Application in Management of Zoonotic Diseases

Topic. What are zoonotic diseases & its role in our changing world.

Understanding of bacterial, viral and parasitic zoonotic diseases; critical evaluation of its control measures, awareness of local, national and global factors and Influences Biogeography of zoonosis

So, we will talk about one health application in management of zoonotic diseases as explained earlier. One health can be a big umbrella even food security, food safety, pesticide use, antimicrobial resistance, climate change everything comes under one health where you need multiple disciplines, but here we will focus today on zoonotic diseases.

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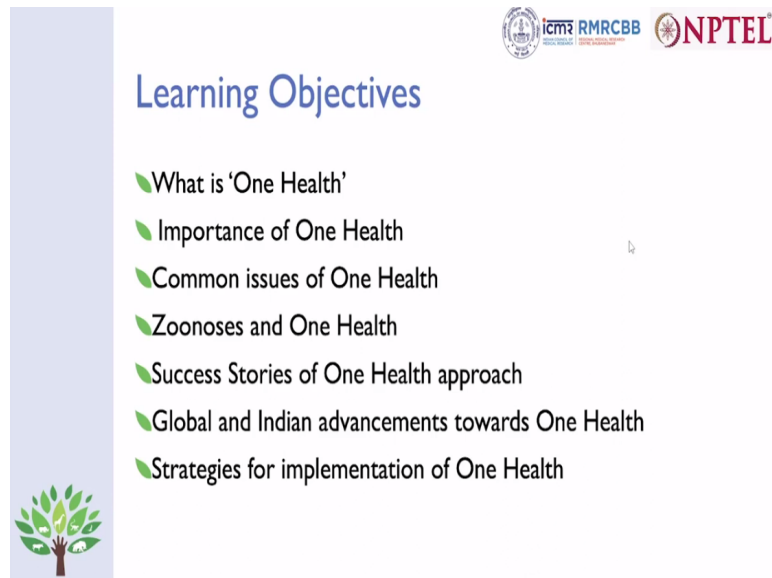
Topics

- What are zoonotic diseases & their role in our changing world
- Understanding of bacterial, viral and parasitic zoonotic diseases; awareness of local, national and global factors and Influences, critical evaluation of its control measures
- Biogeography of zoonosis

The topics which we will cover today are what are zoonotic disease and the role in a changing environment, changing world, understanding of bacterial viral parasitics zoonotic diseases. These diseases can be more. They can be fungal, they can be any other pathogen as well and how are

local and national governments and these factors they influence and how do we assess our programs and the spread of zoonotic infections.

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Learning Objectives

- ✔ What is 'One Health'
- ✔ Importance of One Health
- ✔ Common issues of One Health
- ✔ Zoonoses and One Health
- ✔ Success Stories of One Health approach
- ✔ Global and Indian advancements towards One Health
- ✔ Strategies for implementation of One Health

So, today we will come to understand what is one health, what is the importance of one health, what are the issues surrounding the concept of one health. Then we will focus on zoonotic infections in one health. What have been the success stories, do we have any success story where the partners have come together and they have delivered something very well? We will come to that. What are the global advancements and Indian advancements towards one health?

India being a developing country, we are taking baby steps towards it, but definitely we are on track then what are the different strategies which can be used for implementation of one health as a concept.

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So what is one health? So, when we say one health, one planet now something it has become very in slogan one nation one rule something all those political slogans also are there, but when we say one health we means everybody's health it has to be seen in together, you know, as a continuum of one another, it cannot be separated, right. When you see one family if the head of the family is not well the effect will extrapolate or percolate to the all members of the family.

Similarly, our environmental health, animal health will effect human health as well. So, here we are from the public health concern, we are worried about the human health here which is affected by animal health, environmental health and all the other factors now we are also talking about economic statuses, equities, availability, accessibility, all these issues will also affect the human health.

So, this is basically collaborative. What do you mean when we say collaborative? So, it works at multiple levels and a lot of people involved in it not only one single discipline of human health or only ministry of health. It has to be ministry of urbanization, urban health, rural development, public works department, engineering section, legal section all these people need to come together and it is meant multisectoral.

All different kind of peopl; botanist, veterinary people, environmental specialists all this will come together towards one goal of achieving better help for animals as well as humans. So, one

health concept is also transdisciplinary. How this term is different from multisectoral. So, when we say transdisciplinary the control programs or the research or any mitigation activity has to flow seamlessly from one sector to another.

Being multisectoral means everybody is working in their own offices and rooms. When we say transdisciplinary it flows from one sector to another sector and they are all interconnected. See all these are theoretical references which you will always be these PPT will be available to you, they are available on these links as well, you can go through the links, but I am just sharing you a brief glimpse of the different terminologies used in the paradigm of one health and these are not only just catchphrases, they have very deeper meaning attached to it.

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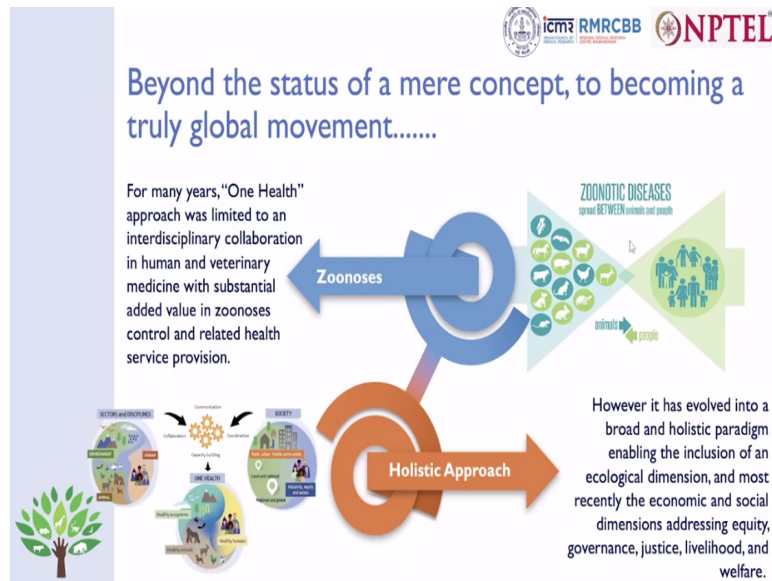


So, definitions of one health I am looking at one health from past many years now and I think it is an evolution of the concept as well. So, earlier like I am talking about 2012 or 13 or 2010, we used to feel one health means even that term was not used very often. We used to be only restricted to zoonotic infections which transmit to humans from animals, but now we are talking about one health.

Different organizations have given kind of a similar and maybe little different definitions. 2021 is the latest definition coming, from WHO and many other partner organization which is in the red one. So, this is a beautiful pencil which shows the continuum of our understanding of our

concept of one health. 2017 WHO gave this definition then there is a CDC definition but more or less to name multiple sectors have to come together to address the issues of animal health and human health.

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So, it is beyond the status of a mere concept to become a truly global movement. So, people after COVID pandemic they understood we all have read news and in COVID-19 pandemic everybody is much more educated because ease of information is available on internet, how it started all from Wuhan in December 2019, they were live animal markets and still it is a mystery in an enigma how the infection was it from a live animal market.

Whether did it jump the species to human beings or whether it was always there in human beings, but at a very, very low level or whether it was laboratory made we are not getting into that controversy, but because of the Covid-19 pandemic we understood we cannot separate human health from animal health and because of the close proximity of animals to humans they will always be interlinked, they cannot be separated.

So, this was many years it was limited to interdisciplinary collaboration in human, veterinary and also someone to wildlife, but now we know it is much more than that. So, this is a paradigm shift, but we you know always call, it is an understanding also is a major shift how one health is

affected by many of the factors and it is not only zoonotic infections or not only a concept, but it has to be truly accepted and worked upon, it is a holistic approach.

So, if you see this simplistic diagram so where there are wheels here of communication, collaboration, capacity building coordination all this starting with c then what are the different sectors, you know, involved animal environment, human, at society level, urban, rural, peri urban communities. The peri urban communities are far more at risk susceptible. So, all these things will evolve and they will influence human health.

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So, it involves everyone if you see this simple figure of a cow and a dog is there, plant are there, human beings are there and because of wide and global travel now no part of the world is isolated one. America cannot think what is happening in India does not bother us, of course it will bother everybody a small outbreak in Somalia will have an impact on Europe and monkeypox the latest one is a beautiful example how this particular outbreak has shown that disease from African countries has reached earlier also Europe and America.

So, coordination of partners is extremely important, there are many relevant players besides health so that includes law enforcement, policy makers, agriculture, communities pet owners, veterinarians, animal handlers all these people are involved in affecting human health. Of course

there is a set of professional people, medical non-medical paramedical or veterinary all these need to come together environmentalist. So, lot of mutual collaboration will be required.

So, this will involve many sectors and many kind of professionals. So, one health means diverse background people working towards one goal, one aim that is improving the health of humans primarily, but I would like to take it to of animals as well.

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So, why it is important that suddenly it has gained so much of importance. There are many factors why people are now sitting up and staring at the screens and talking about one health. It is not only in India, but internationally as well. Intensive agricultural practices have led to somewhere degradation of environment, use of more chemicals and pesticides into environments and not all these years have also leading to somewhere in changes in the climate, climate change is the latest buzzword now.

And it is a climate crisis now that is what it is called. So, 1.5 degree rising temperature will create havoc in an environment and you can always appreciate how now winter, summers and rains have changed overtime. How in Delhi especially pollution levels are such thick high and we are not able to do anything we are so helpless. So, all these factors are influencing disease patterns also in India and across the world.

People are, you know, located very densely in the urban areas, people living close to closer together, transmission of infection is much frequent, and much higher intensities, this is the more of global travel. I was at the airport yesterday and I felt everybody is in the plane and everybody at the airport and it is a close proximity. It is so easy to exchange infections nowadays.

So, animals are just more than food because the, you know, animals are being reared in at a scale of a factory for food, but they are not just food they transmit infections also within themselves within the species and to human beings.

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So, we have some common one health issues so one health is not just as I said earlier zoonotic diseases even though I mean I work in this area, but I fully understand. There are many many other important health topics which are connected to one health. So, these are besides zoonotic infections, antimicrobial resistance which will become our biggest threat in coming time, it has become a threat you look at multi-drug resistant TB, drug resistant malaria.

A common infection to a common antibiotics the broad spectrum antibiotics are not working like you know streptomycin or a commonly used drugs will not work. So, antimicrobial resistance is a very important topic and it is being recognized one of the biggest threats to human beings where the drug discovery cannot happen at that pace and development of a new drug.

New molecule will take long years, but if we keep on, you know, making the available drugs unusable it will become very difficult to treat infections especially for the elderly and for the immunocompromised children it will become a major problem. Food safety and security is another issue with a disease in food in animals, plants, food products to threaten food security and security of the food safety.

And security among the people because with the climate change they will be, you know, I mean the change in the rains it spoils the entire crop and there the availability of that particular crop becomes very less. Price is skyrocket, people are not able to afford those expensive food. So, it does not because all this will have effect on the on the day-to-day living of the human beings.

So, that is the problem; vector borne diseases. We all understand vector borne disease be a mosquito-borne infection like malaria, dengue, chikungunya or tick and mite borne infections, they are sensitive to climate, they are showing different endemicity patterns now, they are like Himalayan region where there were no mosquitoes, no malaria. Now you can see these things, dengue is a special threat across the globe.

And the transmission windows broaden and expand in these, you know, earlier they were not recipient areas like Himalayan region or let us say Northeast or you know Jammu Kashmir, you know, all of these have seen invasion of the mosquitoes and they bring disease. Tick borne and mite borne infections are on the rise in India. I will give you KFD and CCFH. So, vector borne infections are very sensitive to climate change.

And they are definitely a good example where one health as a concept should work well. Environmental contamination, as I said extreme or high usage of chemical pesticides is leading to environmental degradation. It's a perfect example how use of pesticide has wiped out, you know, drastically reduce the honeybees and all these pollinators. How the use of tetracycline has decreased the propensity of vultures.

And you know so all these animals have been affected by our environmental contamination and there are many more subjects as I said climate change, poverty all these are under the umbrella of one health.

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Zoonoses

Zoonoses is any disease or infection that is naturally transmissible from vertebrate animals to humans or from humans to animals (reverse zoonoses), there are over 200 known types of zoonoses

Zoonotic pathogens can be bacterial, viral or parasitic

They represent a major public health concern and can spread to humans, by direct contact with domestic, agricultural or wild animals, or through food and water.

Examples of zoonotic diseases include:

- Rabies
- Salmonella infection
- West Nile virus infection
- Q Fever (*Coxiella burnetii*)
- Anthrax
- Brucellosis
- Lyme disease
- Ringworm
- Ebola

Focusing just on zoonotic infections if we see, so these are the infections which are naturally transmissible between humans and animals in either direction, but we are more concerned when do they come from animals to humans; humans become the recipient of the infection and we keep on suffering. There is also called as reverse zoonosis where from humans, the infection goes back to animals.

So, those are fewer ones, the common ones are from animals to humans. So, there are over 200 known types of zoonotic infections. They can be bacterial, viral, parasitic, fungal, there can be many more etiological agents to it, but majorly bacterial, viral, parasitic. So they cause a major public health concern and they can spread by direct contact or indirect contact through domestic, agriculture, wild animals.

Through food and water, through environment, through touch, through frequent handling of animals, species, urine or even, you know, eating of dead animals or handling of carcasses. Best example is Anthrax. So any of the roots of transmission can happen, the common example which all of you must have heard; rabies we all know it happens with the dog bite most probably.

Then Salmonella infection; you always make fun, panipuri has e coli or, you know, Salmonella you know that kind of food, certain foods are more prone for food borne pathogens, infections are quite common. West Nile virus infections, Q fever is under recognized, but is a very important infection. Anthrax, brucellosis, also is lyme, ringworm, Ebola, Nipah Zika. So, Nipah Zika, Ebola they began as zoonotic infection.

Later on they became human-to-human transmission right? But they all began as a zoonotic infections that is why they are in the list. So, there are many more examples they are just the beginning of them.

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And when we say emerging and re-emerging zoonotic infections, they become a specific one health challenge because when we say emerging that means the healthcare worker or the doctor they are not well versed with these diseases clinically, how to treat them, how to handle them in people, what messages to give to the community it is very unsure. So, we do not know how to handle these diseases that happened with Covid-19 also right.

We did not know, we said it is spread by somebody will cough on the surface, clean the surface, don't handle parcel packets, wash the vegetables, we were not even sure of the sure of the roots of transmission. So, it was all hit and trial method because it was a new disease. We were not

knowing what to do with the disease and the infection, how to stop the infection. So all hit and trial method, but after a lot of research we know.

So, it is not a surface contaminant, it happens by a spread, wearing a mask will protect us. We do not need that suit, the entire protective suit, mask is good enough, washing our hands is good enough, so on and so forth. So Covid-19 is the best example how an emerging infection in the shortest window of one and a half or two years we have come up with such robust scientific evidence and we have kind of, you know, it's a dynamic process.

We kept on changing our thinking and as evidence came up which also changed our recommendations also for the treatment part, for the diagnostic part, for the community messages so that's how it is. So, when we say emerging infections where will they emerge from? It can happen from live animal market just the example in COVID-19 or Avian influenza or coming from animals, wildlife animals.

By virtue of hunting or their people go into interior of forest for collecting fodder or food and they get exposed to all these wild animals. So, they can bring in the disease like monkeypox has come up from people who go into wild areas. So, domestic animals can spread Nipah, Avian influenza, rabies coming from pet animals or wildlife farming. So, animals from different you know sources be pet animals or domestic farming animals, milch animals, all wildlife.

They can all be source of infections for emerging zoonotic disease. I will encourage you all of you to look into definition. When do you call any infection emerging and re-emerging infection? When it is endemic, when it is epidemic, when it is outbreak? These are not simple terms, they are epidemiological terms with some objective criteria attached to it, how do we define these terms?

So, I will encourage all of you to take notes, see the latest you know reference material of WHO, CDC or even government of India, see the definitions of these infections, when do you call elimination, when do you call eradication. So, zoonotic infection per se, it is very tough to

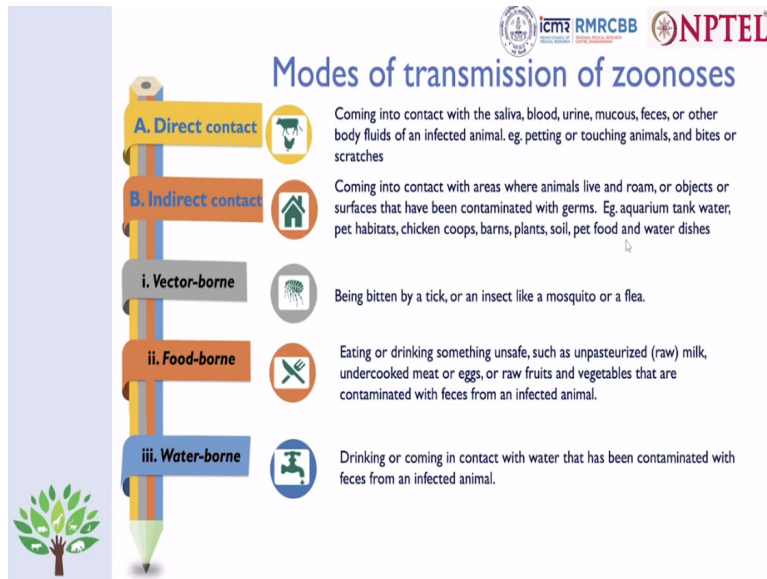
eradicate or eliminate because there is an animal reservoir, but still we can do that. So, there is a target of zero human Rabies death by 2030 for Rabies.

So, there are definite objective targets attached to it, but as I said, these terms which I am just using in this half an hour lecture please look up to them, look into literature, search and try to remember these terms and when you use them in your conversation, use them intelligently, don't use them loosely like eradication people, you know, kind of interchange the words. Elimination, eradication, control, they are different meanings.

So, we need to stick to those. So, when I say emerging please look up what is emerging and re-emerging infection over the terms which I said earlier. So, it is said that, you know, currently all the human infections, 60 percent of them are coming from zoonotic origin and emerging infection more or less will be coming from zoonotic origin. So, we need to be very careful.

And we need to pay a lot of attention to the infections originating from the animal source. It can be the animal meat or animal product like mink, fur, it can be leather, it can be it can be milk and milk products, it can be faeces, urine, animal handling, saliva, it can be anything related to animal, can be a source of infection and it has also been used as a bioterrorism agent like this thing anthrax botulism. So, they are plague, so many of the disease have the potential to be a bioterrorism agent.

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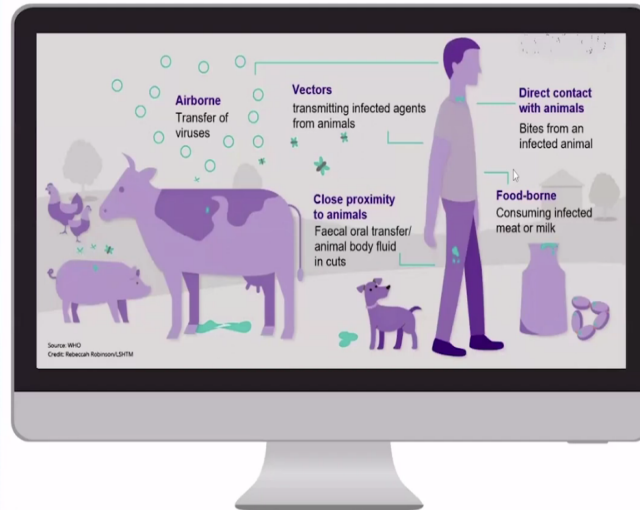
So, what are the usual modes of transmission of zoonotic? As any infectious disease commonly we bracket them into direct and indirect contact. So, when we say direct contact, it can be through saliva. Blood, urine close skin-to-skin contact when you are petting your animal and children tend to kiss their pet dog on nose or mouth so there is exchange of fluids between the animal and the human beings faeces, mucus, body fluids, petting touching, bite, scratches.

All this will lead direct deposition of the infected infective organism into the human beings. It can be direct mouth-to-mouth touch by a dog or whatever, you know, skin your skin is broken, you already have a cut and you are petting an animal it licks you on the cut directly the organism goes into the body because there is also a breach on the skin. So, these are all direct contacts.

When we say indirect contacts so people can you know acquire these infections via mosquito via food or via water borne, all enteric infections are a perfect example of water borne infection, food borne infections which are infected with the faeces or any animal product. So, these are the usual transmission roots. I also encourage you to read textbooks for remembering what infection are spread by what roots? That is surely going to come in your not only exams, but it is also good for your own understanding.

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Transmission of Zoonoses

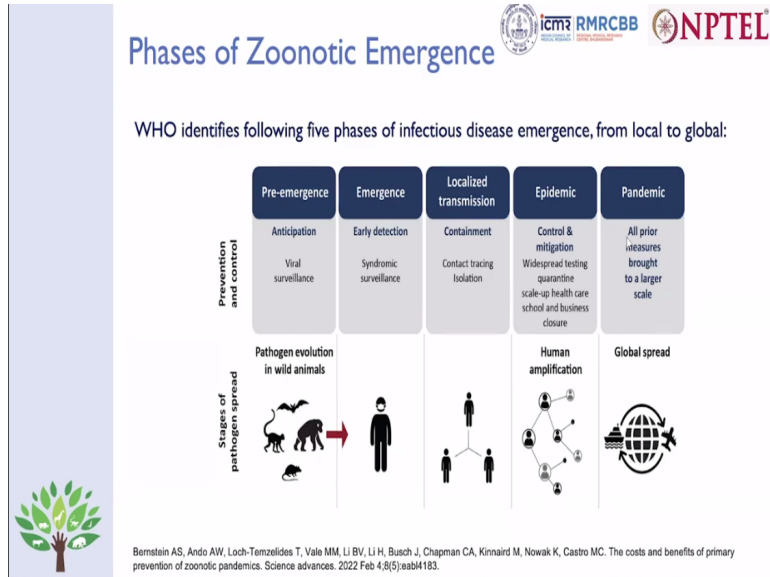


So, transmission of the zoonosis, so we say airborne, transmission of viruses, droplet infections so an ease of transmission. We also understand if it is an airborne infection you do not even need an animal in between, you know, it is it is already in the air you just need to inhale it as in Covid-19. So, we said you wear a mask where you do not inhale those droplets. So, luckily it is a bigger droplet which will be filtered off by even a simple cloth mask.

If it is a very finer one which should not be filtered except by N95; too bad because that is going to add a make it more complex to prevent infections and if it is spread through animal touch, okay you tell people that do not touch the animal it can still be curtailed, but by the method of transmission, you have to give messages to community how to prevent right? So, it is a vector it is a bite of the vector.

Be it a mosquito or a sandfly or a tick or a mite or a direct contact with animals like bites. So, you have to break the chain of transmission at that point how the infection is getting transmitted whether it is through urine and faeces like in Toxoplasmosis whether it is through meat whether that is Salmonella. So, you have to see how that particular organism is getting transmitted to break the chain you have to act at that level.

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So, this is a very nice and simple slide. How to understand at what stage of, you know, zoonotic infection will emerge? and how it will get established in the in the communities or in the population? So, first is pre-emergence I am just giving you example of viral infection it can be anything so anticipation. So, when you say okay this infection is in the animals, so what is in the requirement from public health angle?

You need a constant surveillance mechanism or a vigilance mechanism on animals. So, when it is in animals, we need a constant surveillance mechanism of screening of the animals and detecting any pathogen in them early on. Imagine I mean the picture they are shown bat and monkey and you know, langurs or orangutans whatever animal they are so primates. So, there is also a rat these can also be in the wild animal.

They can also be the bridge population between wild animal and the domestic population. So, there are the fringes of the forest so they become bridge. So, what is required? If there are reports of monkeys dying in the forest in large numbers. So, there is an alert system. Okay, 100 monkeys have died in past let us say one week. So, there must be some outbreak of an infection in the monkeys now that has to be tested.

Faeces can be picked up, droppings of this animals can be picked up for detection, but you what you require is a very robust alert system in the wildlife, in the forest, in the fringe animals, okay

which are the bridging population between wild animal and the domestic one. So, if these two population you see deaths of the animal, that has to be alerted and that has to be detected.

So, that means when these two populations are affected wildlife in the bridge population. Next where the infection will flow? To the domestic animal and to human beings at that point it has to be curtailed by surveillance and by prompt management of the patients. So, when it comes to human beings, early detection is the backbone of any successful, management, clinical management program, you do syndromic surveillance.

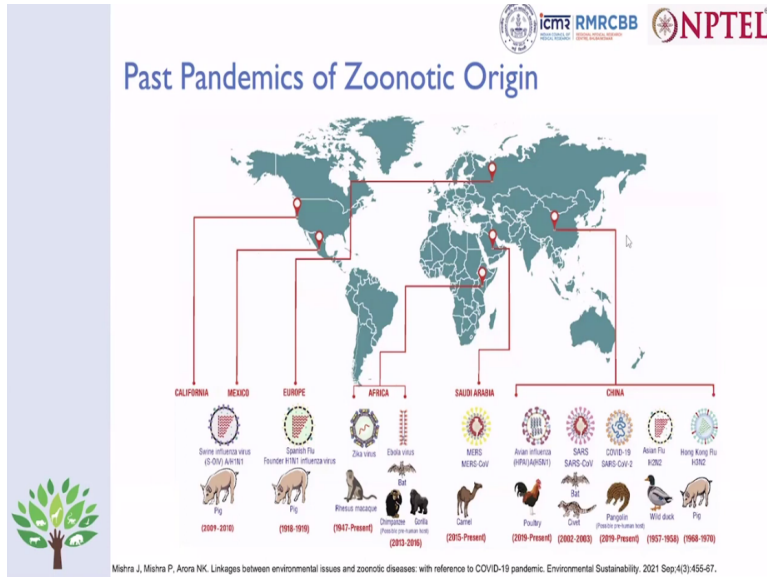
So, when a patient comes to you he comes to you with fever, with respiratory infections, skin lesions something. So, you treat them run a battery of tests, possible differential diagnosis run all the possible pathogens you can carry, run the test, detect, treat so that you curtail it, but when that does not happen, it goes into localized transmission. One person will spread it to another one and third one.

And that is how it becomes you know the spread happens between the humans. Now in the third column, you do not need a wildlife animal here. It is happening within human beings like Zika or like I mean Zika is a vector bone thing, but let us say Nipah. So, human-to-human transmission was happening in Nipah in Kerala. So, that is how the contact tracing becomes important for containing the spread.

So, when that is not good, it becomes more spread than you put on the measures of quarantine, contact tracing, strictly restricting the people with the infection, their movement and then if that is also not control, it becomes a global spread because of the, you know, very rampant travel and people are coming from one country to another, they are in the asymptomatic phase.

They are in the incubatory phase, you cannot detect, all traveling people with the diagnostic test and they will escape detection and spread infection on one place to another.

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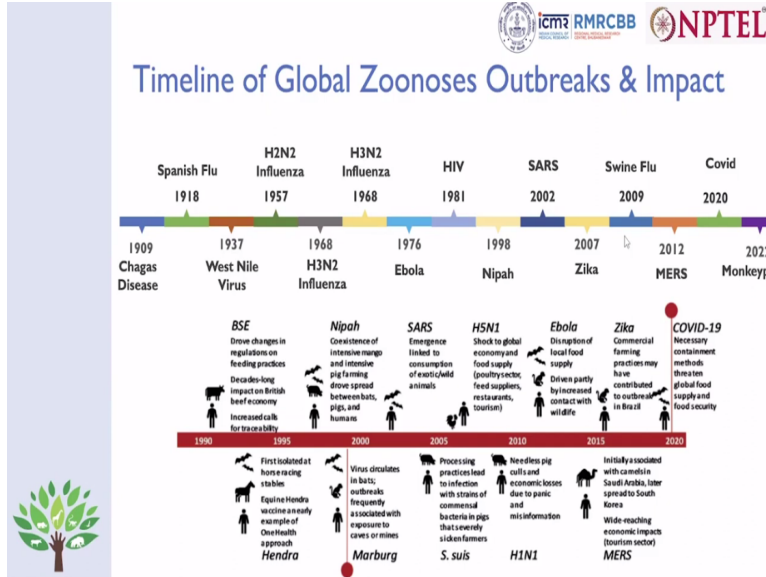


So, this is just a glimpse of past pandemics of zoonotic origin, history is extremely important and very interesting and one has a lot of lessons to learn from in from history. Spanish flu is a perfect example what all could be learned and COVID pandemic could be maybe handled better or also it was done very well, but there are some very crucial lessons in the past pandemics of the zoonotic origin.

And this slide is showing the country of origin where these pandemics happened, the slide will be with you I will encourage you to read this paper and there are many more the papers also on these outbreaks. It is very interesting, you will see some common lessons in all these pandemics and then we can also responses we could have mounted even in COVID-19 what could have been done differently to prevent such high death rate in COVID-19 pandemic.

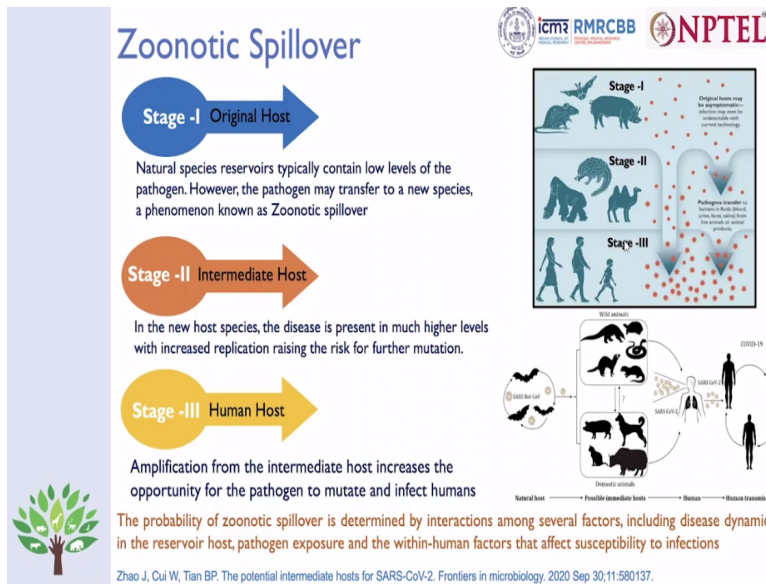
Even USA or in India, there were so many problems of black fungus, oxygen shortage, we were not prepared enough, people were not counseled enough. So, there is always a lesson to pick up from any pandemic. So, these are just a glimpse of zoonotic origin pandemics across the world and since past many years.

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So, if you see the timeline this is kind of a carry forward of the previous slide where I was talking about pandemics and beginning from the Spanish flu is a famous example. It took around, you know, a couple of years to settle down then it was all fine, but at multiple time points these pandemics of global zoonosis I mean a global impact have happened over the years.

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So, what do you mean by zoonotic spillover? and how do these infections come from animals to human beings, how do they occur? So, what do we mean by spillover? The first stage is the original host is animal. So, natural species reservoir typically contain low level of pathogen because they are the natural reservoir they have reached an equilibrium with the pathogen.

Pathogen will not harm the animal much because pathogen wants the animal to survive so that pathogen can continuously transmit itself.

So, there is equilibrium in terms of sufficient immunity to prevent death and prevent lot of morbidity and disease, but inner susceptibility so that the pathogen keeps on getting transmitted. So, that means natural species contain low level of pathogen it may transmit to a new species this is known as zoonotic spillover. So, when it goes to the new species, the new species of animal or human they are not immune to the pathogen.

They are totally susceptible, that is where the pathogen will multiply much faster because there is absolutely no immunity to that pathogen in the new host and there is replication which leads to more mutations and it becomes pathogen become more virulent and third is when it reaches the human host. Amplification becomes much more aggressive from the intermediate host increases.

It is for the opportunity for the pathogen to mutate and infect more and more humans and it become more virulent. So, you can see how the stage one two, three can happen. There are many examples of such diseases. Also we have given you the references please go through these papers for the basic understanding how these things happen.

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So, what are the pathways which will facilitate this spillover? and what are the barriers we can create to minimize the spillover? So, spillover of a pathogen from wildlife reservoir into human or livestock host requires a pathogen to overcome hierarchical series of barriers which are described on the right and interventions can be planned at different stages if a system will be a developed country, if you are developed country.

So, we will have multiple, you know, multiple possibilities where we can intervene and create barriers for these spillover and prevent spillover from animals to humans. So, we can see from the beginning reservoir host distribution where the host density is manageable, pathogen prevalence is there, but manageable. Infection intensity can increase if there is a spillover.

Pathogen released from reservoir host so on and so forth and you can intervene at any level, but the more further down we go for intervention it will become difficult to control. We should try to control in the initial stage when they are still restricted to wildlife or to animal population for that you need a constant dialogue with the animal sector that is where the importance of one health comes.

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Components of Economic Costs due to Zoonotic outbreaks

	Outbreak in Animals	Outbreak in Humans
Direct Impact	Death from Disease	Medical Cost
	Control measures	Mortality
	Lower productivity (farm losses)	Morbidity
Indirect Impact	Reduced demands	Illness and absenteeism behaviour
	Spill over effects in other sector	Avoidance in behaviour

Economic impact of bird flu outbreak on India's Rs 1.75 lakh crore poultry industry

Cost of emerging zoonotic outbreaks 1996-2009: USD 80.2 billion

Estimated cost of a pandemic: USD 600 billion

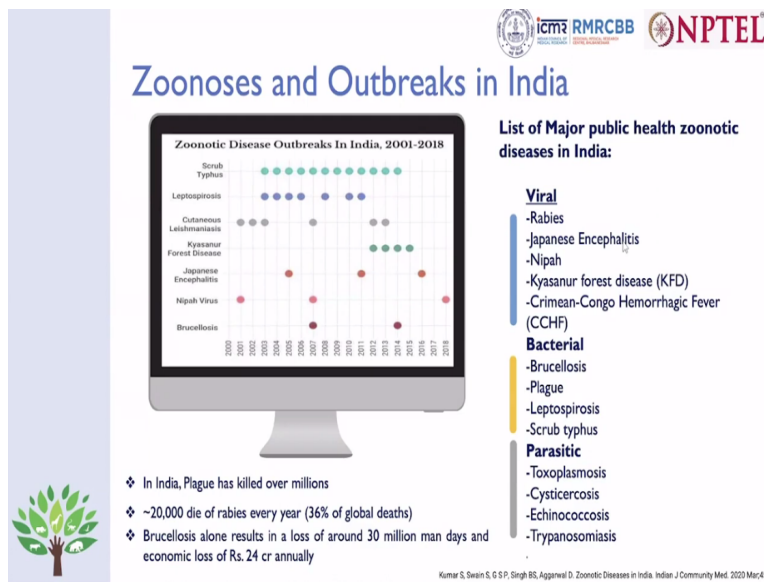
So, why it is important that human beings are so concerned about animal and animal health besides affecting human health? Animal health also is affected and that is the economic cost to the population, to the human being, where you lose millions and millions of dollars or rupees and

you also take away food security from people. Outbreak in animals, response to disease animal will become unhealthy they will die.

So, productivity will be lost. Imagine if all the cows suffer from some infection where the milk production cannot be there. So, milk will be less and the demand will be more, meat will not be available, eggs will not be available from poultry, it can affect fishes, it can affect any animal which is seen as food so that economic loss is there. What will happen if it happens in human beings?

There is a medical cost, zoonotic infections need to be treated, people will get admitted to hospitals, there is mortality and morbidity. When you say mortality it means death, morbidity means illness and there will be the workforce will be affected, there will be no productivity. If you see in the quantum of money, economic impact of bird flu was 1.75 lakh crore in the poultry industry and so you can see in how worst has been affected. So, economic cost definitely is a big challenge to us.

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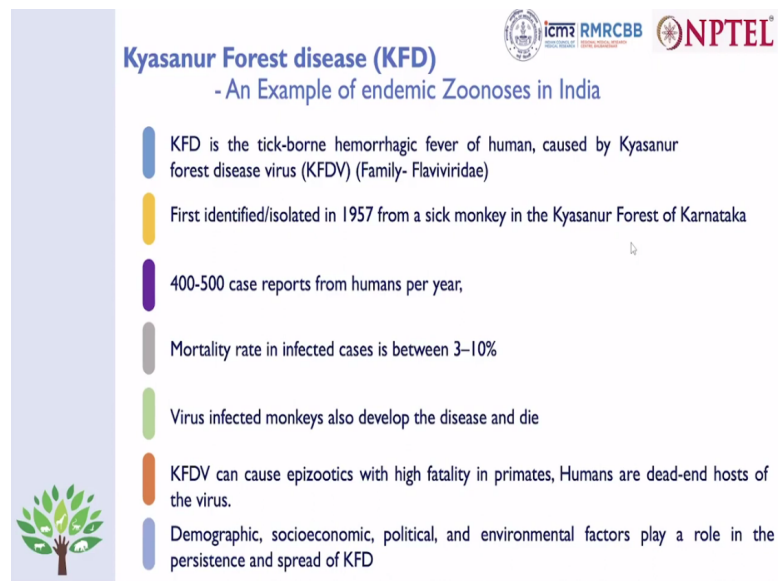


So, in this slide there are I mean I am just listed in these three baskets, what are the common, but very, important zoonotic infections from public health viewpoint, viral, Rabies, Japanese encephalitis, Nipah, KFD, CCHF, bacterial brucellosis understudied, but it affects the domestic

animals and so on and so forth. There are many parasitic, we do not even understand the true burden of these diseases.

So, you can see the year of outbreaks from 2001 to 18, how so many outbreaks have happened and they continually affecting our human health.

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Kyanasur Forest disease (KFD)
- An Example of endemic Zoonoses in India

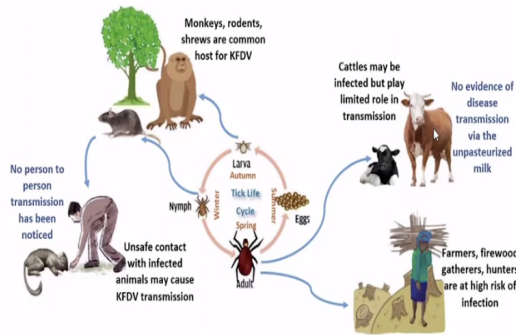
- ICMR, RMRCBB, NPTEL
- KFD is the tick-borne hemorrhagic fever of human, caused by Kyanasur forest disease virus (KFDV) (Family- Flaviviridae)
- First identified/isolated in 1957 from a sick monkey in the Kyanasur Forest of Karnataka
- 400-500 case reports from humans per year,
- Mortality rate in infected cases is between 3-10%
- Virus infected monkeys also develop the disease and die
- KFDV can cause epizootics with high fatality in primates, Humans are dead-end hosts of the virus.
- Demographic, socioeconomic, political, and environmental factors play a role in the persistence and spread of KFD

So KFD is an example of endemic zoonotic infections is in India. There has been ICMR, the National Institute of Pathology in Pune, they have been at the forefront of studying this disease in depth and so this was diagnosed and detected way back in 1957, mortality rate in the infected cases is between 3 percent to 10 percent which is pretty high and it causes outbreaks in the animal population and humans also get affected and there is a vaccine which is not very good, but that is the only one we have currently.

We are trying to make efforts to improve the vaccine, but the spread of KFD from animals to humans need to be prevented and here comes a role of multiple partners and multiple sectors as well.

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Reservoir, Host and Transmission of KFD



- Reservoir of KFD virus are the Hard ticks (*Hemaphysalis spinigera*)
- Common hosts for KFDV include rodents, shrews, and monkeys after being bitten by an infected tick.

Mouyia DT, Yadav PD. Recent scenario of emergence of Kyasanur forest disease in India and public health importance. Current Tropical Medicine Reports. 2018 Mar;3(1):7-13.
Majumdar A, Debnath T, Sood SK, Balakrishna KL. Kyasanur forest disease classification framework using novel external optimization tuned neural network in fog computing environment. J of medical systems. 2018 Oct;42(10):1-6.

So, these are the transmission and, you know, how the transmission happens of the Kyasanur Forest disease. So from the ticks and it can transmit to let us say first to monkeys or a rat it goes to wildlife and where you interact with those animals in any way, you know, when I am talking about the bridge population there are some wild rodents which are the field rodents and people go for farming and these rodents are there they act as bridge population between wildlife and human beings or they can be your pet animals.

So, person-to-person transmission has not been noticed, but only with exposure to animals with their ticks so this can happen or it can go into domestic animals and when you are, you know, handling the domestic animals it can be transmitted to humans and even when the person goes to the forest for firewood and all those things. So there are multiple routes of exposure of human beings to ticks and these two animals.

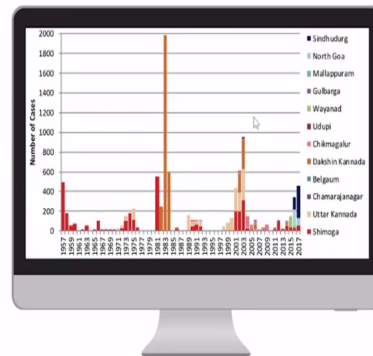
So, that is why it is important for people to be very aware, they should take preventive measures to prevent themselves from getting affected.

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KFD status in India



KFD positivity in human, ticks and monkeys recorded in different states of India during 2012-2016



Prevention, early detection, supportive care, and management of symptoms are the primary responses to reduce the effects of illness caused by this virus.

Chakraborty S, Andrade PC, Ghosh S, Uhlman J, Ruiz MO. Historical expansion of Kyasanur forest disease in India from 1957 to 2017: a retrospective analysis. *GeoHealth*. 2019 Feb;3(2):44-55.

So, this is the KFD status. There are several papers published on KFD you can go through the literature, you can just go on pubmed google scholar KFD in India and a plethora of papers will come out of NAV, Pune work in VCRC work now. So, you can see the, you know, the studies done and where the incidence of the whether it has been detected in the newer areas you can see the spread in the you know Western Ghats of Kerala these are seen.

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One Health in Action: A Success Story



- In 2021, Goa became India's first state to achieve human dog-mediated rabies elimination
- Since September 2017, Goa State has reported no human deaths from rabies
- Over 4,00,000 doses of rabies vaccine have been delivered to dogs in Goa since 2013 in the largest continuous rabies control effort to have ever taken place in India
- Achieved by a combination of intervention and inter-sectoral coordination using a 'One Health' approach:
 - Mass dog vaccination
 - Door-to-door vaccination
 - Catch-vaccinate-release
 - Treatments
 - Education
 - Surveillance



<https://www.nytimes.com/2019/07/22/science/rabies-dogs-india.html>

So, now coming to the happy story of where one health can become a success. So, till now we have been dealing with the challenges, quickly I will tell you how Goa has achieved the distinction of being, you know, Rabies death, no Rabies death has happened there so it is Rabies

free. So, this is the first state to achieve that distinction and that you know it is an achievement for us.

So, there was a, you know internationally funded project which looked into Goa's epidemiological scenario of Rabies, they intervened, provided vaccine, supported the State government and they drastically brought down the death rate and now to zero. So, multiple efforts were made and as I said in a one health approach because the animal husbandry, communities, catching older stray dogs, getting them vaccinated.

All were tried and done and the Goa state being Goa being a very progressive state, they could achieve this feat, but India there is a huge burden of Rabies. I think India contributes largest to the you know as a country to the burden of Rabies related deaths to the world numbers.

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The slide features a light blue background with a vertical bar on the left containing a tree icon. At the top right, logos for icmr, RMRCBB, and NPTEL are displayed. The main title is 'WHO advancements in One Health approach'. The text describes the formation of a Quadripartite One Health Joint Plan of Action (OH-JPA) and lists its goals: promoting multi-sectoral approaches and preventing health challenges. It also mentions the formation of the One Health High-Level Expert Panel (OHHLEP) in May 2021. Logos for FAO, WHO, UNEP, UN Environment, OIE, and The World Bank are shown on the right side.

WHO advancements in One Health approach

WHO formed a Quadripartite One Health Joint Plan of Action (OH-JPA) to integrate work on human, animal and environmental health

It works towards :

- promoting multi-sectoral approaches to reduce health threats at the human-animal-ecosystem interface
- prevention and mitigation of impact due to current and future health challenges at global, regional and country levels

The **One Health High-Level Expert Panel (OHHLEP)** was formed in May 2021 to advise FAO, UNEP, WHO and WOA on One Health issues.

Logos: icmr, RMRCBB, NPTEL, FAO, World Health Organization, OIE, UN Environment, UNICEF, THE WORLD BANK

So, WHO advancements in one health approach. Recently on October 22 there has been the latest document on one health. How country should view and develop their programs, again as I said, all this organization as I said food security also the one health issue, animal health is a one health issue. So all this international organizations have come together, developed an expert panel where they guide and guide the countries in driving and leading their own local programs towards making the human health better from the one health perspective.

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Strategies for implementing One Health

- More preventive action at the human-animal-ecosystem interface
- Building robust public and animal health systems compliant with international standards, with a shift from short-term to long-term intervention
- Strengthening the national and international emergency response capabilities to prevent and control disease outbreaks
- Better addressing the concerns of poor by shifting focus from developed to developing economies
- Promoting institutional collaboration across sectors and disciplines
- Conducting strategic research to enable targeted disease control programmes.



So, what are the strategies for implementing one health? So more than catch phrases they require, real action on the ground. So, what do we need? First of all for any program to succeed we need political leadership, we need political commitment so that we are able to function in the country, we are able to secure the support what we need from different sectors. So, having said that when, you know, honorable Prime minister comes on TV and talks about vaccination for COVID-19.

The entire nation sits up and talks about it and take note of it and that is how the ownership of the program happens. Similarly, so you require Ministry of health and other ministries who are dealing with it to own the program and to carry out the work with the cooperation and support of all the related departments. That is how we need to begin talking about it. So, we need robust public and animal, health systems.

And also to comply with the international standards of our functioning and we should also think of the poorest man in the society. So, when we say climate change is a big issue for the entire world, but if you say cut down emissions do not use fossil fuels developing in poor nations will not be able to cut down the resilience on fossil fuels. So, they should be given more opportunities and more options for cleaner fuels.

So, developed countries need to step in where they have more wealth. Similarly, if you see within India, it is the poorest of the poor who will be most affected by the zoonotic infection. Persons who are going into the wildlife to collect food and water and powder and you know firewood they are the ones get affected most because they are more exposed to animals. So as in general as any society with any disease the compromised socially disadvantaged section of society gets most affected. We need to work around that how to protect and empower that growth.

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The slide features logos for ICMR, RMRCBB, and NPTEL at the top right. The title 'India's One Health Framework' is in blue. A vertical bar on the left contains colored segments corresponding to the text points. A tree icon is at the bottom left.

India's One Health Framework

- India established a National Standing Committee on Zoonoses in 1980s
- Multi-disciplinary Road Map to Combat Zoonoses laid in 2008
- Department of Animal Husbandry and Dairying (DAHD) launched several schemes to mitigate the prevalence of animal diseases and planning to establish a 'One Health' unit within the Ministry
- ICMR's National Institute for One Health at Nagpur
- ICMR's dedicated research efforts towards One Health cutting across disciplines.
- DBT 'One Health consortium' consisting of 27 organizations led by DBT-National Institute of Animal Biotechnology, Hyderabad (2019)

So, we have a framework of, you know, India is taking some step towards they were developing this one health framework. So, it has been many years you know not by the catchy phrase of one health, but we have been working on zoonotic infections from very long time. So, India established National Standing Committee on zoonosis which is hubbed or housed or in the National center for disease control under ministry of healthy welfare where multiple sectors are take participate including ICMR including many other organizations.

And they sit on one table and talk about it. So, multidisciplinary roadmap to combat zoonosis was laid down in 2008 and this is being followed up. Now NTDC ministry of health has a very robust and a vibrant program on one health. You please look up into the documents. So there is development of department of animal husbandry and dairy which launches the program then schemes for the prevention of animal diseases in a one health paradigm.

And ICMR has been in discussion now finally the institute is coming up in Nagpur which is dedicated to one health with the BSL 4 laboratory facility, NIV Pune has a BSL port. It means we have a laboratory which is very capable of handling high risk pathogens possibility of animal origin, but with no risk or very minimal risk of, you know, transmission to the outer environment.

So, we have dedicated research efforts toward one health and DBT also recently launched one consortium, where many of the organizations across departments are participating.

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Looking Ahead

icmr RMRCBB NPTEL

- Covid-19 pandemic showed the relevance of 'One Health' principles in the governance of infectious diseases, strengthening cross-sectoral collaboration
- Increasing policy coordination and coherence support by a more systematic use of robust scientific evidence
- Development of integrated indicators and safeguards to address upstream drivers of disease, with a focus on prevention
- One Health approach will not only contribute to the prevention of future pandemics but will help to build more resilient and equitable systems, environments, economies and societies.

One Health, One Future

So, what is the future of one health and how should we see it? So, COVID-19 pandemic as I said earlier opened many doors of our thinking, of our understanding and that is how we have gone ahead to, you know, consolidating our plans on one health and increasing policy coordination, coherence supporting one another, bringing all stakeholders together via and generating scientific evidence is extremely important and that is how all sectors are needed together for a more resilient and equitable systems from the poorest man standing in the line from that angle.

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Its everyone's health

Together, we can find concrete solutions for a healthier, and more sustainable world.



So, I think this is the last slide. So, with one health it is possible that we prevent outbreaks. It is possible that we control our endemic infections, control epidemics and pandemics, we reduce antimicrobial resistance which is the next threat or the threat even currently now, we increase the food safety and security for people for the poorest of the poor people especially in the neglected areas, in the hard to reach remote areas.

So, overall we improve human and animal health and also maybe my slide should also have a component of environmental health that also is so important because of the climate change and all these factors affecting environmental health. So, it is everybody's health together we have to take it together not piecemeal, but we need to, you know, carry forward everybody is in every creature's agenda with each other that is the only way we can we can sustain health for everyone including animals.

So, with this we have come to the end of the end of the class. So, these lectures will be available online to you and you can feel free to contact through the course coordinators. Any query or questions can be answered. I will encourage you to read a lot on one health, how best we can use our resources and of course we will require more resources on capacity building, training of the systems and the people. So, thank you so much for listening to this lecture.