One Health
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Lecture No # 05
Module No # 01
Emerging Infectious Diseases

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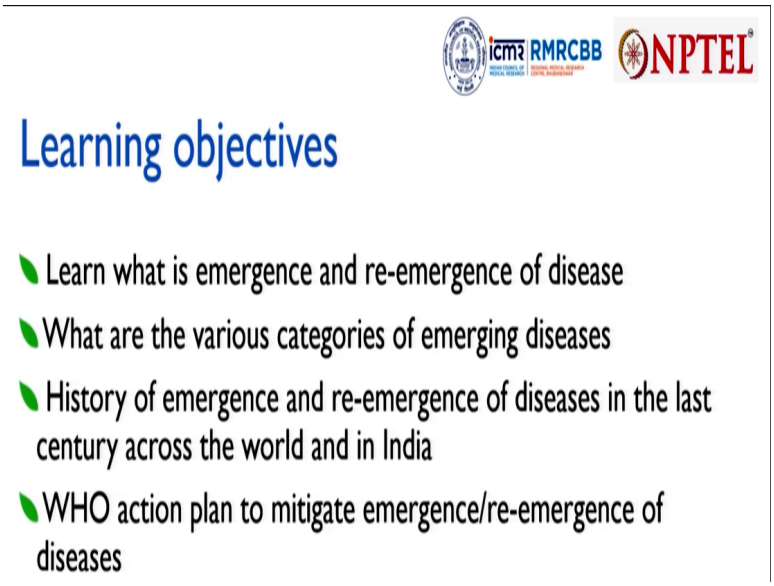

Hello, under the unit emerging infectious diseases and antimicrobial resistance we are going to study the emerging infectious diseases which will have the following learning objectives. You will learn what is emergence and re-emergence of the diseases, what are the various categories of the emerging diseases, history of emergence and re-emergence of diseases in the last century across; the world and in India and the WHO action plan to mitigate the emergence or emergence of the diseases.

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Let us first start with a few definitions. An emerging infectious disease is one that has appeared and affected a population for the first time. Or it has existed previously but is rapidly increasing either in terms of the number of new cases within a population or in its spread to new geographical areas.

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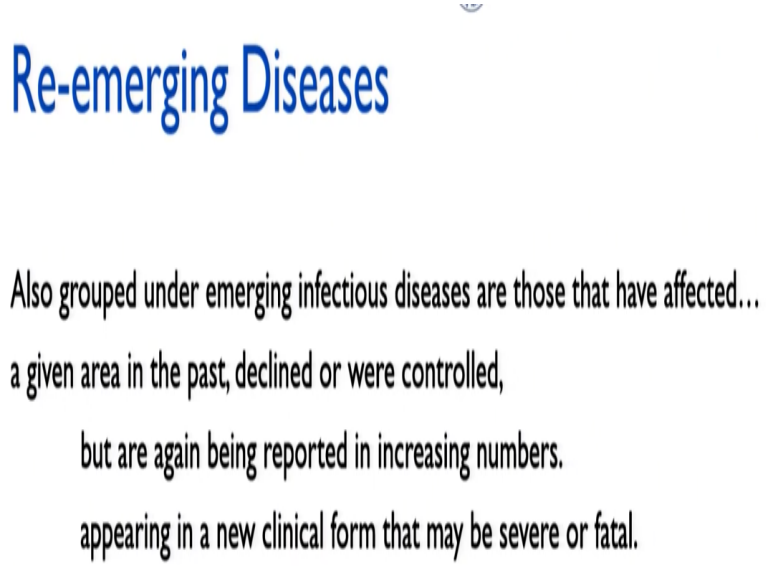

Now what is re-emerging diseases? It is also grouped under the emerging infectious diseases. But these are those that have affected a given area in the past has declined or were controlled but they are again being reported in increasing numbers and appearing in new clinical forms that may be severe or fatal.

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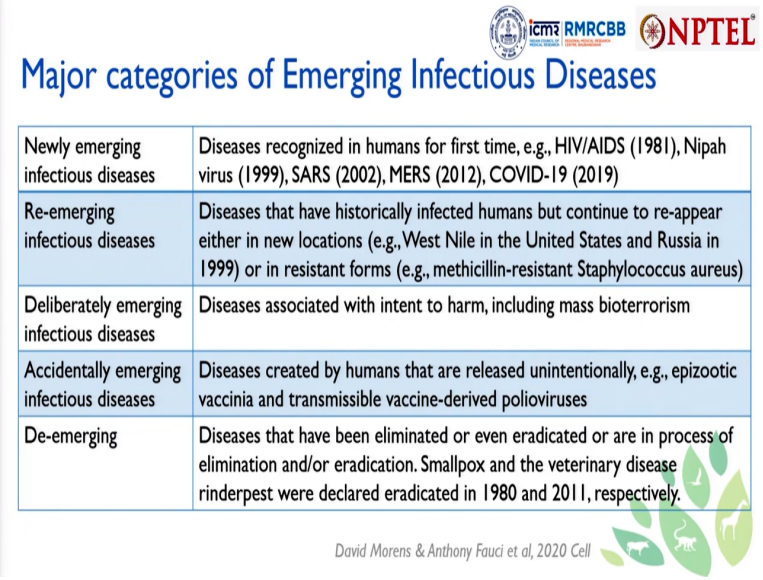

We normally categorize infectious diseases into 5 broad categories. The first is the newly emerging infectious diseases where the diseases are recognized in humans for the first time. For example the HIV Aids which started from recognition in 1981, the Nipah Virus, the SARS, the MERS even the present COVID-19. The re-emerging infectious diseases are those that are historically infected humans but continue to re-appear either in new locations as I said earlier or in new forms.

For example, the West Nile virus in the United States and in Russia in 1999 or the resistant forms of Staphylococcus which is Methicillin resistant. Sometimes diseases are emerging as a result of deliberate release. These are associated with mass bioterrorism. We do not have many examples but there have been cases particularly with Anthrax which I will come to later. There might be accidental emerging infectious diseases. These are diseases that are created by humans that are released unintentionally.

For example the episodic accinia and transmissible vaccine derived polio viruses. De-emerging diseases are those that have been eliminated or even eradicated or in the process of elimination and or eradication. Smallpox is an example which has been eradicated in 1980 and the Renderpest veterinary disease in 2021.

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New Infectious Diseases since 1973

Year identified	Agent	Disease
1973	Rotavirus	Infantile diarrhoea
1975	Parvovirus B19	Aplastic crisis in chronic haemolytic anaemia
1976	Cryptosporidium parvum	Acute and chronic diarrhoea
1977	Ebola Virus	Ebola haemorrhagic fever
1977	Legionella Pneumophila	Legionnaires' disease
1977	Hantaan Virus	Haemorrhagic fever with renal syndrome (HRFS)
1980	HTLV-1	T-cell lymphoma-leukaemia
1982	E Coli O157:H7	HUS
1982	Borrelia burgdoferi	Lyme disease
1982	HTLV-2	Hairy cell leukaemia
1983	HIV	AIDS
1983	H Pylori	Peptic ulcer disease
1986	BSE Agent ?	Bovine spongiform encephalopathy in cattle (Mad cow disease)
1988	HHV-6	Exanthem subitum
1988	Hepatitis E Virus	Enterically transmitted non-A. non-B hepatitis
1989	Hepatitis C Virus	Parenterally transmitted non-A. non-B liver hepatitis
1992	Vibrio cholerae O139	New strain associated with epidemic cholera
1992	Bartonella henselae	Cat scratch diseases
1995	HHV-8	Associated with Kaposi's sarcoma in AIDS patients
1996	Prion	CJD
1997	Influenza A virus (H5N1)	Avian fly (Bird flu)
2003	Corona Virus	SARS
2009	H1N1	Pandemic A (H1N1) 2009 Influenza

This list gives you the number of diseases and the emergence and re-emergence of various infections since 1973. So we start with Rotavirus emergence in 1973, then we had Ebola Virus in 1977 and the Hantaan Virus in 1977. Like that we have the list of several different diseases that have come up in the last few decades since 1973.

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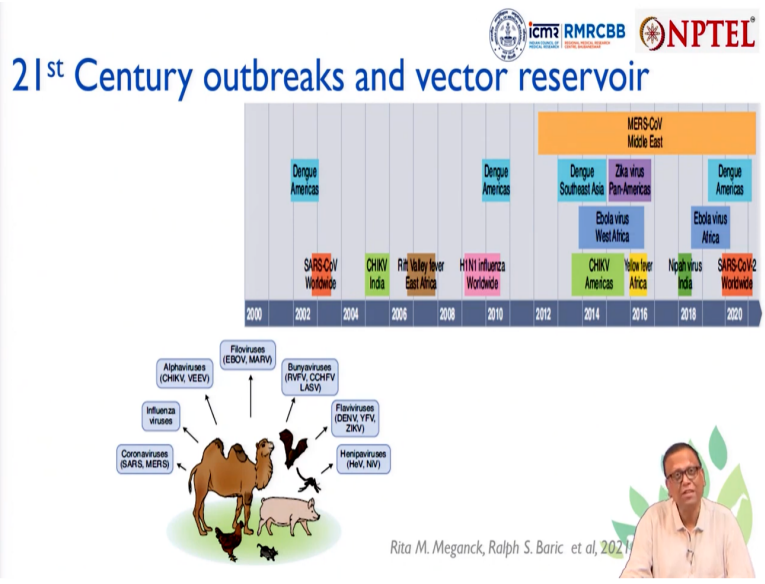

If we look at the timeline of the twenty first century outbreaks and Vector reservoir, then you will see that in 2003 the SARS Coronavirus first one appeared. And then subsequently in 2003 in India, the 2005 in India the Chikungunya Virus appeared. The Rift valley fever in East Africa

appeared in 2007, the H1N1 Swine flu occurred worldwide since 2009. Then the Chinkunguniya virus again affected the Americas in 2014 yellow fever came to America in 2016.

Nipah virus in India in 2018 and then the SARS Coronavirus 2 that; came in 2019, end of 19 and 2022 20. In between there had been Dengue outbreaks in Americas in 2002 in 2010 and in 2020 also. Like that there had been several outbreaks across the world and various reservoir hosts have been identified for most of them.

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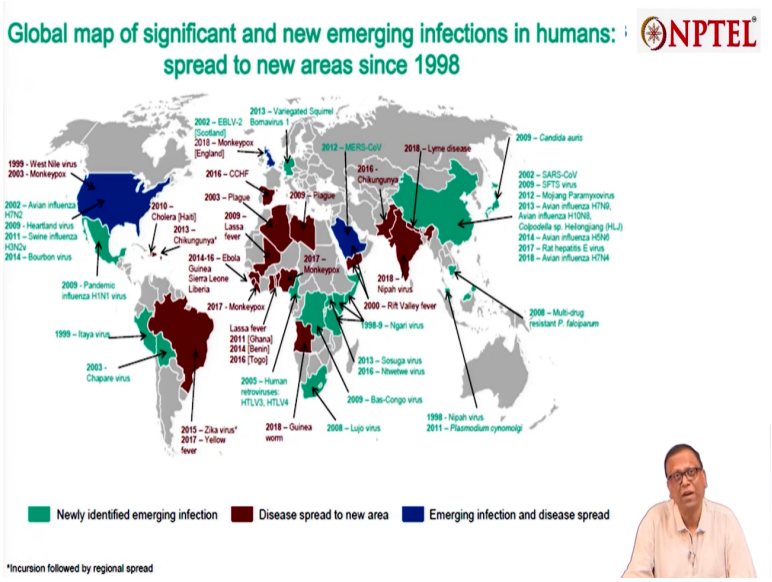

If we look at the global map of significant and new emerging infections in humans which have spread to new areas since 1998 in this particular photograph or this graph you can see the green ones are those which are newly identified emerging infections. And the brown ones are those diseases that are spread to new areas whereas the blue ones are those which are emerging infections as well as spread to newer areas. So there are several diseases listed here which can be seen it has almost spent in entire world.

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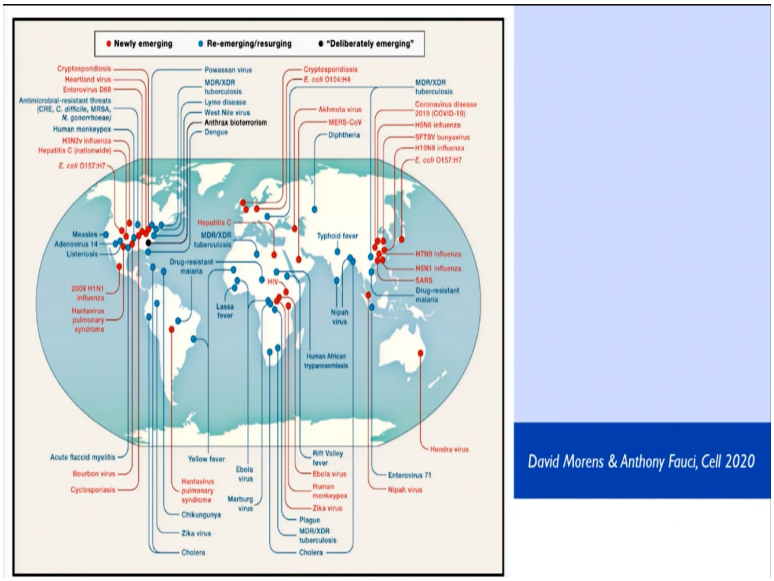

This figure shows the newly emerging disease in red color, the re-emerging or researching diseases in blue color. And deliberately emerging disease in dark blue color if you can see there is only one in the deliberately emerging diseases which is in North America which has been given here as the Anthrax for bioterrorism. If you remember, it came in newspaper envelopes in letter forms, the sports and then it was identified as a potential agent of bioterrorism.

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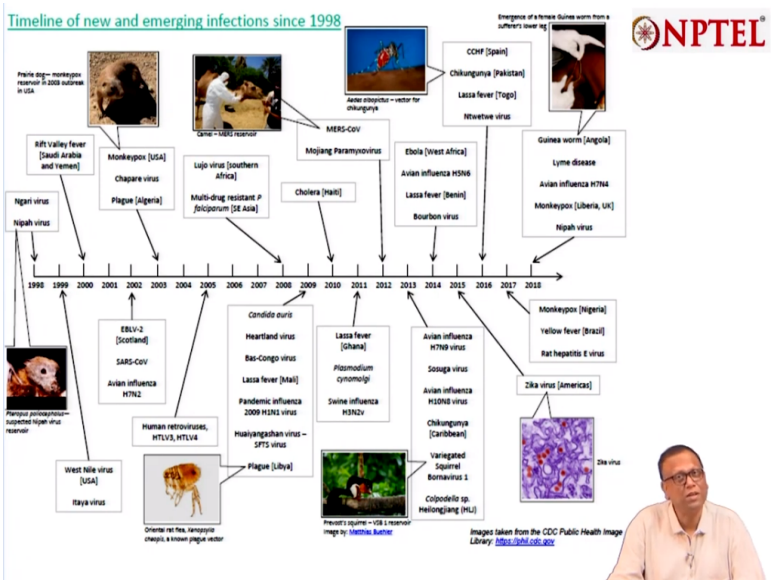

This is a timeline of new and emerging infection since 1988 along with the reservoirs that have been responsible for their spread as well as the vectors that are involved. Again it is a very

complicated and a busy slide and this gives a timeline of how new and emerging infections have affected the world since 1988.

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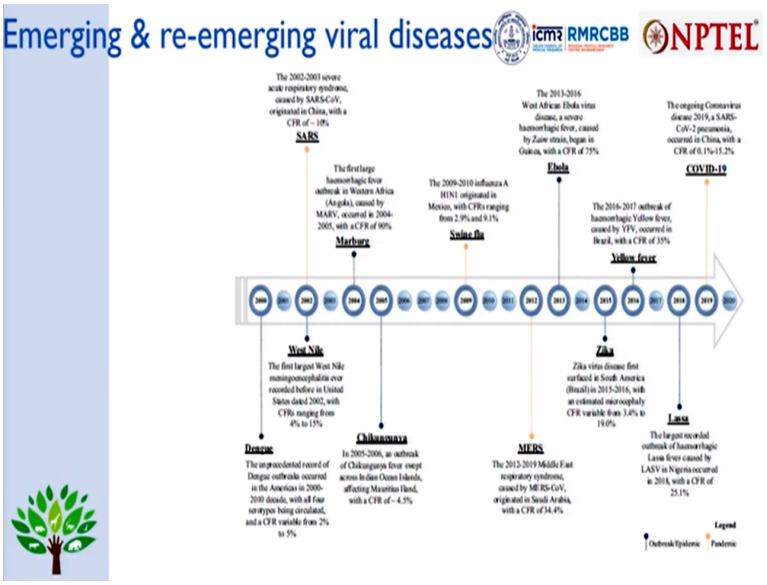

This slide gives those of the emerging and re-emerging viral diseases as you can see on the extreme left we have the dengue followed by the West nile virus. Then the first SARS virus and this also have the reported fatality rates written against each of them and they have been quite variable for various diseases. And as you can see from the beginning from Dengue to the present COVID 19, there are a number of diseases that have been listed including the Marburg Virus, the Chikungunya, Swine flu, MERS, Ebola, Zika and Yellow Fever.

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The WHO research and development blueprint for action to prevent epidemics actually followed after the Ebola outbreak in 2014. It was made on the request of 194 member states in May 2015. The WHO convened a broad network of experts to develop a blueprint for such a development. The experts compiled an initial list of diseases and a general approach and key prioritization areas the criteria was formulated by December 2015.

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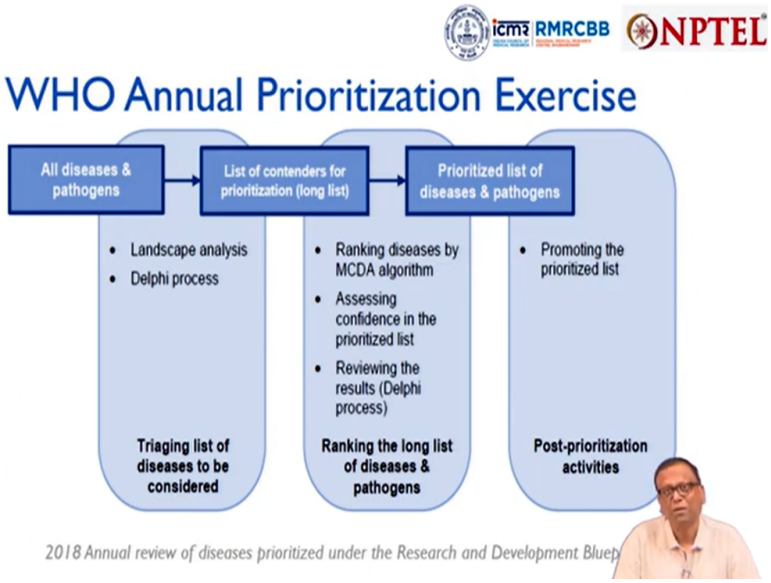

Now how did WHO prioritize these diseases? They have done it by an exercise first where all the diseases and pathogens were listed. Landscape analysis was done and a Delphi process was done taking opinion from various experts and stakeholders. Then triaging was done with the list of these diseases to be considered and from that the list of contenders for prioritization which was a long list was made, it was on ranking if diseases by an algorithm.

And then assessing confidence in the prioritized list reviewing the results again through the Delphi process and then ranking of the long list of diseases and pathogens according to their priority. And then the final list was made the prioritize list of diseases and pathogens for promoting the prioritize list and post prioritization activities were started.

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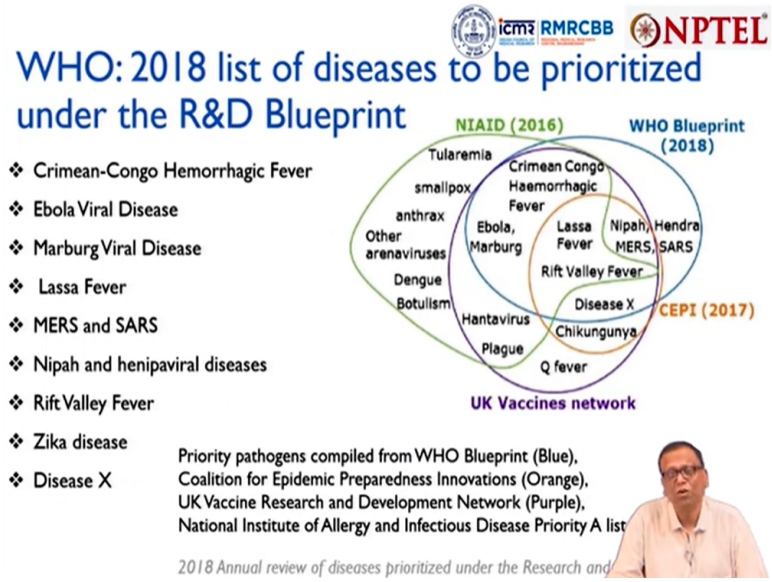

So this is what the WHO had done the WHO 2018 list of diseases to be prioritized under the R and D blueprint. Now point to note here is that there are other agencies also which are actually made this priority list like the coalition for epidemic preparedness innovations which is given in orange in this particular slide in orange circle. Similarly, that of the UK vaccine research and development network is given in purple here on the right side.

And then the National minister of allergy and infectious disease made a priority list which is given in the green and it was made in 2016. As you can see the amount of overlap between the diseases that have been prioritized by all these agencies and as you can see that disease x also is included here which is basically a place holder so to make the countries ready for eventuality of a particular disease that suits that place holder criteria.

So that is how the countries have been, have tried to prepare themselves for emerging or controlling emerging infectious diseases.

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TABLE 3 | WHO priority pathogens list for R&D of new antibiotics.

Pathogen	Resistance
PRIORITY 1: CRITICAL	
Acinetobacter baumannii	Carbapenem-resistant
Pseudomonas aeruginosa	Carbapenem-resistant
Enterobacteriaceae	Carbapenem-resistant, 3rd generation cephalosporin-resistant
PRIORITY 2: HIGH	
Enterococcus faecium	Vancomycin-resistant
Staphylococcus aureus	Methicillin-resistant, vancomycin intermediate and resistant
Helicobacter pylori	Clarithromycin-resistant
Campylobacter	Fluoroquinolone-resistant
Salmonella species	Fluoroquinolone-resistant
Neisseria gonorrhoeae	3rd generation cephalosporin-resistant, fluoroquinolone-resistant
PRIORITY 3: MEDIUM	
Streptococcus pneumoniae	Penicillin-non-susceptible
Haemophilus influenzae	Ampicillin-resistant
Shigella species	Fluoroquinolone-resistant

As we have seen that most of the prioritize conditions are for viral infections but then there are bacterial infections also which are in the priority list. Particularly it arises out of the emergence of antimicrobial resistance. So in priority one the critical ones that have been chosen are Acinetobacter Baumanni, Pseudomonas aeruginosa, Enterobacteriaceae. So these are mostly resistant to Carbepenem and the Enterobacteriaceae is also resistant to third generation Cephalosporin.

Then in the high priority comes the Enterococcus, Staphylococcus, Helicobacter, Campylobacter, Salmonella Species and Neisseria. So and in Medium we have the Streptococcus pneumonia, Haemophilus influenzae and Shigella Species.

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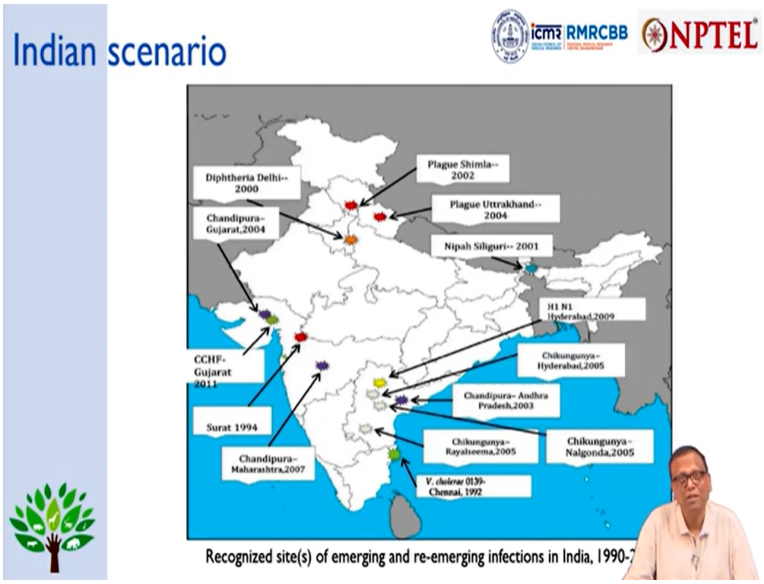

Now we come back to our Indian Scenario and as you can see here the map shows the various recognized sites of emergence and re-emergence of infections since 1990. And as you can see that; in the spot map Diphtheria in Delhi 2000, Chandipura in Gujarat in 2004 and Andhra in 2003. And you have say H1N1 in Hyderabad in 2009 in Surat you have CCHF in 2011 Chandipura again in Maharashtra in 2007. The Nipah in Siliguri in 2001 then we had the Plague in Uttarakhand in 2004 and in Simla in 2002.

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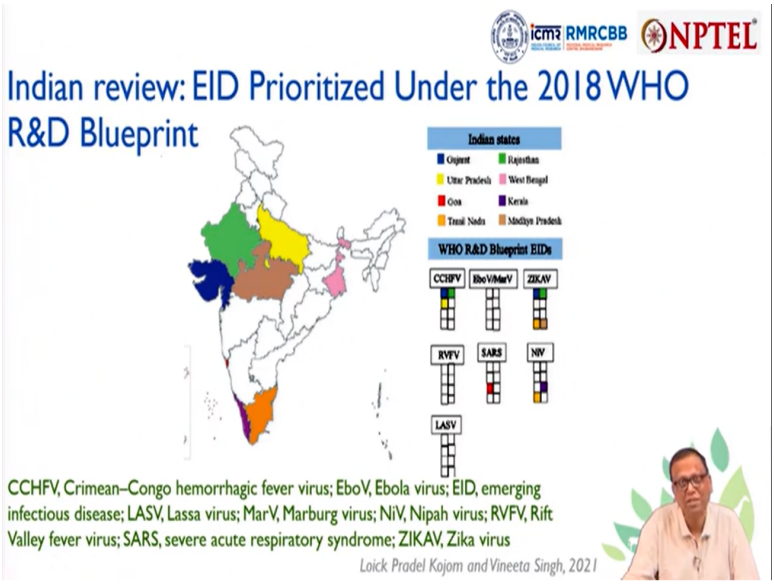

So if the Indian review is taken then the emerging infectious diseases that are prioritized under the WHO R and D blueprint that I have talked about. Then this is what the map would look like

and these states are given in different colors and the vulnerability of these areas as far as these diseases are concerned. Following the WHO R and D blueprint is shown in these checked boxes on the right of the screen.

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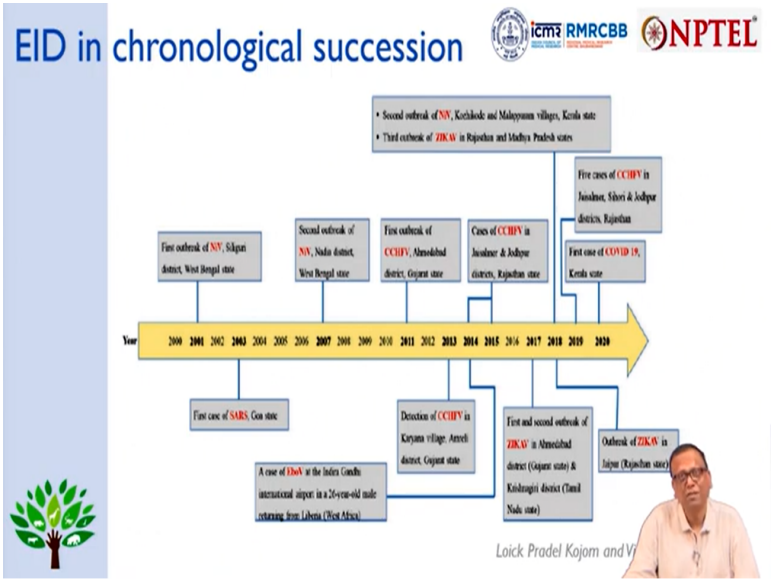

So this is the emerging infectious disease in chronological succession in India. Again taken from the year 2000. I just showed them in the spot map on the Indian map here through the timelines.

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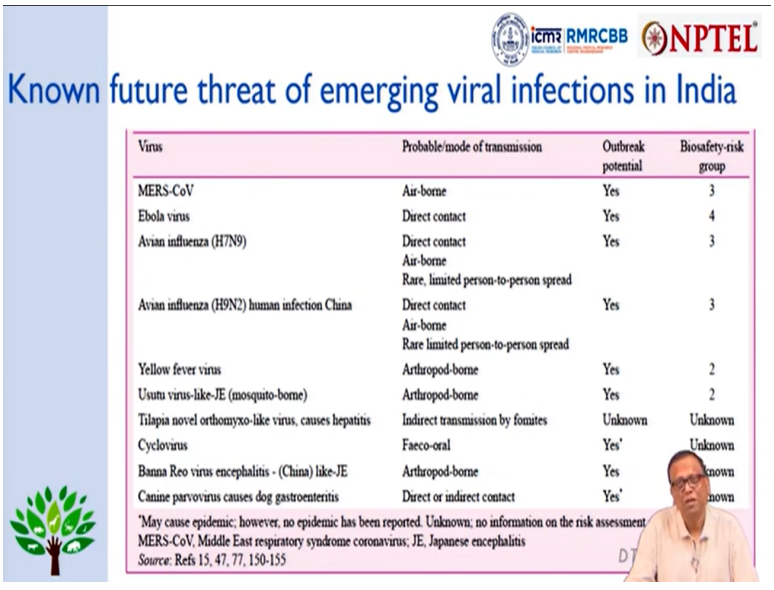

And this slide shows the known threats of emerging viral infections in the country where we have the MERS-CoV which is Air-borne. It has got extremely high outbreak potential. Then

Ebola virus which is through direct contract, with outbreak potential, Avian influenza you have various kinds of Avian influenza. Then the Yellow fever then we have various other diseases that have been listed here.

And some of the outbreak potential is unknown and even the biosafety risk group also in some of the diseases that are listed at the bottom are also unknown.

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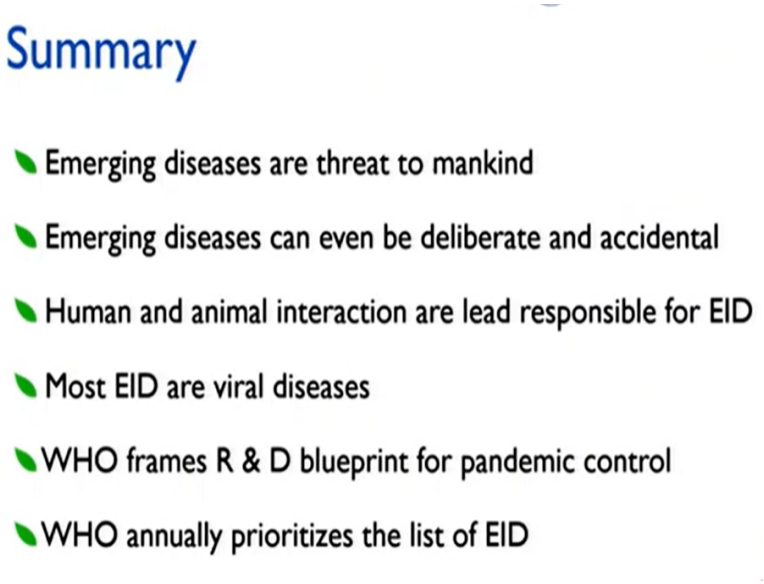

So in summary, emerging diseases are a threat to humankind and emerging diseases can be deliberate or even accidental and human and animal interactions are the lead responsible causes for emergence of infectious diseases. And most of these emerging diseases are of viral nature. WHO has framed the R and D blueprint for pandemic control and it annually prioritizes the list of the emerging infectious diseases and these are being done again in country also depending on their vulnerability and their priorities.

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These are some of the references which you would like to read and learn more about these topics that I talked about.