One Health
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Lecture No # 06
Module No # 02
Process of Emerging Diseases and Assessment of the Risk Factors

Hello and welcome. In the unit on emerging infectious diseases and antimicrobial resistance, this topic is dealing with the process of disease emergence and assessment of the risk factors.

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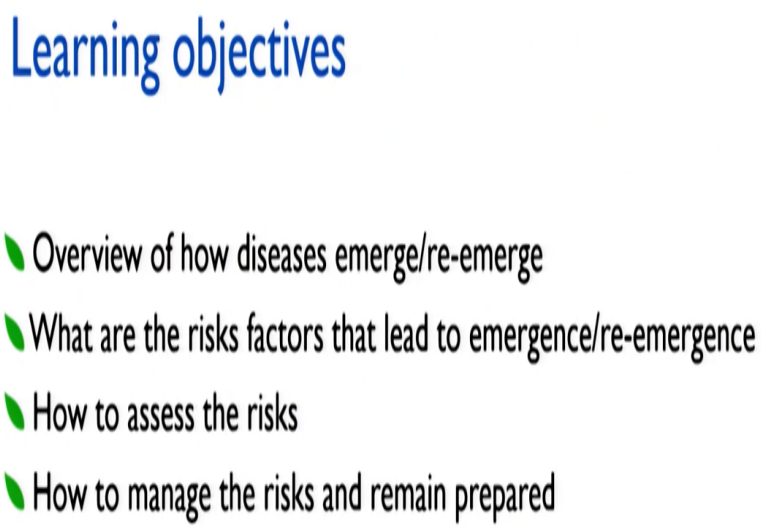

The learner objectives will be an overview of how diseases emerge or re-emerge. What are the risk factors that lead to emergence or re-emergence. How to assess the risks and how to manage the risk and remain prepared.

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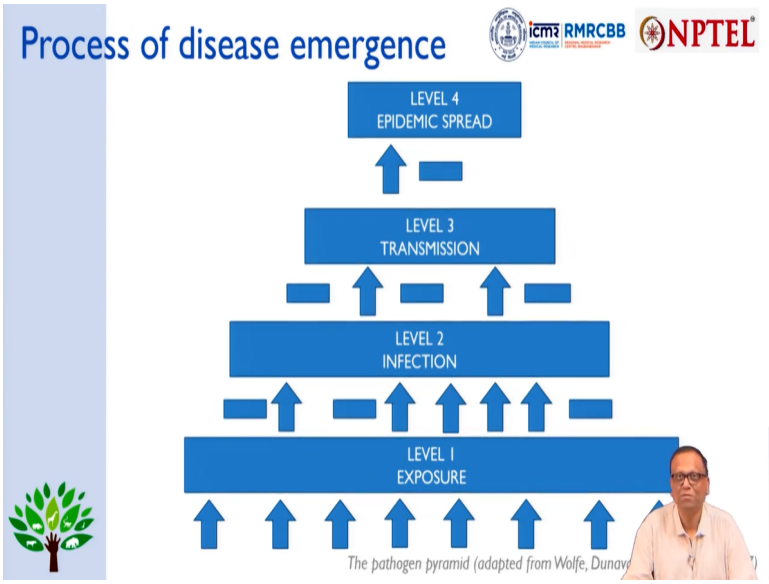

The process of disease emergence is extremely important if we can see if we proceed from the bottom to top the first level is the exposure. So when one gets exposure to the pathogen then there is a possibility that it goes into level 2 which is infection. So once infection occurs then there is a possibility that there can be a transmission so it may occur it may not occur. But if it occurs then it goes to the level 3 where then from transmission level it will become epidemic when it spreads to the other people as well.

So it goes on to level 4 so there is a chance of getting exposure once exposure occurs there is a chance of getting infection. Once infection occurs, there is a chance of transmission and once transmission occurs then there is a likelihood of epidemic spread.

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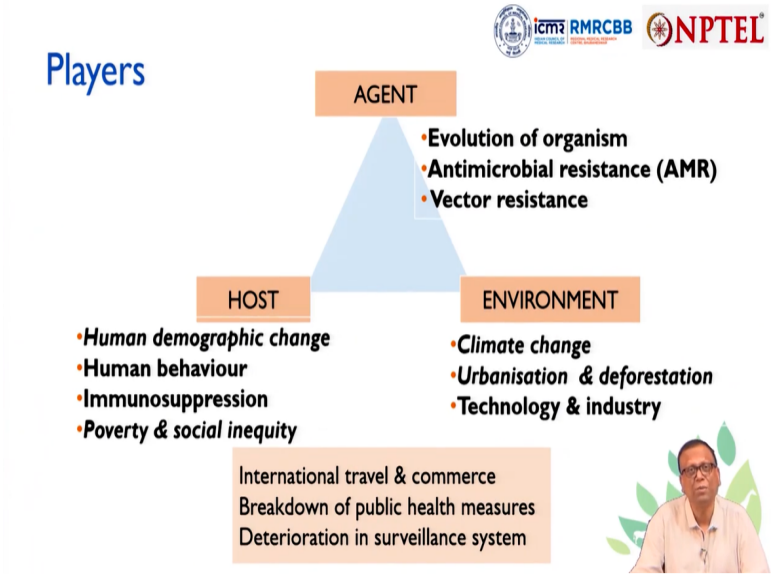

There are 3 key players in this emergence: the first is the agent itself which is on the top of the pyramid. So it is actually the organism which is actually causing the disease so it evolves on its own; it can get antimicrobial resistance if it is a bacteria. It can get a vector resistance if it is a vector borne disease so depending on that there are quite a numbers of factors of the agent itself or the organism itself that can change over time and nature.

Then comes the host factor here, the humans we are talking about where the human demographic changes actually matter. I will come to this in detail in some of the slides. The human behavior Immunosuppression, poverty and social inequality so these are things which; actually are the host component. Say for example, if in a particular area there are more aged people then naturally their chances of getting some infections become more.

But then since if they had got past exposure to these infections then they may not be getting these infections because they already have circulating antibodies. So these are kind of just an example that I have talked about changes in demographics. Then human behavior, again I will come to that again in subsequent slides and Immunosuppression as you know the Immunocompromised people are more vulnerable to various infections.

And therefore it affects them much more than the normal healthy people. The environment is a very key factor in determining or connecting the host and the agent. Here climate change, urbanization and deforestation development of technology and industry have played vital roles in

changes in the environment and has led to emergence of several new infections that we have seen in the last few decades.

And today since we are part of one health so we give equal importance to all aspects of that be it from the humans or from the pathogens or the vector and the environment. And in today's world International travel and commerce has no boundaries. There are all the more chance of any individual person or place getting some kind of infections which may likely to travel across the globe and reach any remote part of the world.

There are breakdowns of public health measures particularly with the huge amount of population that the earth actually supports. And it is often not very feasible to have proper public health measures in place to control all kinds of infections at one time. And sometimes deterioration of surveillance systems play a major role in not able to identify emergence of diseases early and control them early which leads to even bigger infections or epidemic spread.

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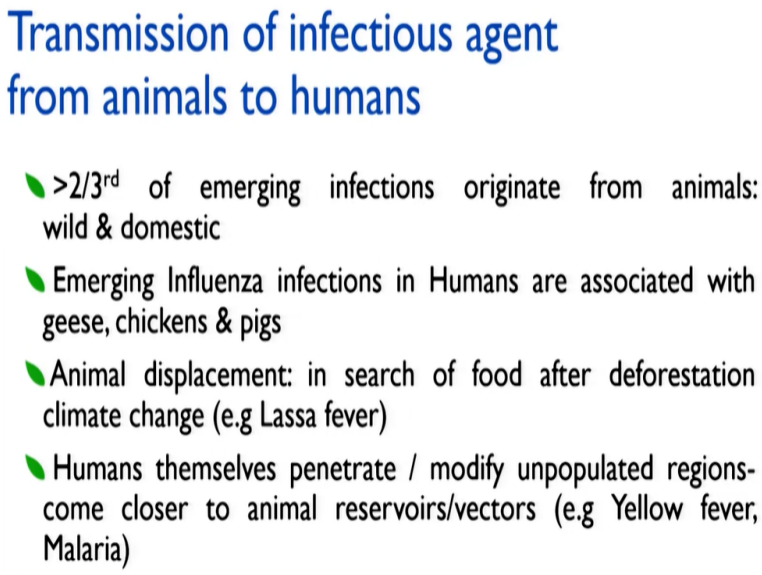

So transmission of infectious agents from animal to humans when we look at it, we will see that about 2 thirds of emerging infections originate from animals both wild and domestic. The SARS COVID too, the present COVID 19 pandemic is a live example and I think that has given a quite number of lessons to people across the globe whatever be the professions. Emerging influenza infectious in humans are associated with Geese, Chicken and Pigs which has been a matter of much discussion before the SARS COVID 2 came.

Animal displacement, animals in search of food after deforestation and climate change, for example; Lassa fever. Humans themselves penetrate or modify unpopulated regions and come closer to animals or their reservoirs and even vectors. Examples are Malaria and yellow fever.

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So I will come to the climate and environmental changes first and foremost is deforestation. We are now left with a small fraction of the forest that we already had centuries ago. So therefore animals are forced to come out of their habitats and come closer to human contact and it increases the chances for agents to breach the species barriers between humans and animals. EL Nino; which is again climatic it triggers natural disasters and related outbreaks of various infectious diseases.

Examples are Cholera and malaria. You know there are evidences where there had been a linkage of cholera to the planktonic blooms in the ocean in the coastlines. So therefore climate has got a role to play in various emergence of infectious diseases. Global warming it has resulted in spread of mostly many vector borne diseases and it is a matter of great concern and it is still the world is getting warmer and warmer.

And then the seasonal and natural calamities where normally food and water-borne diseases increase when we have such natural calamities and people are displaced with a breakdown in the public health system. Agriculturala development, the expansion and intensification of

agriculture; leading to massive habitat conversions increasing use of antibiotics mostly in the agriculture sector. And growth promotes pesticides and contamination with; animal waste so these also lead to changes in the ecosystem.

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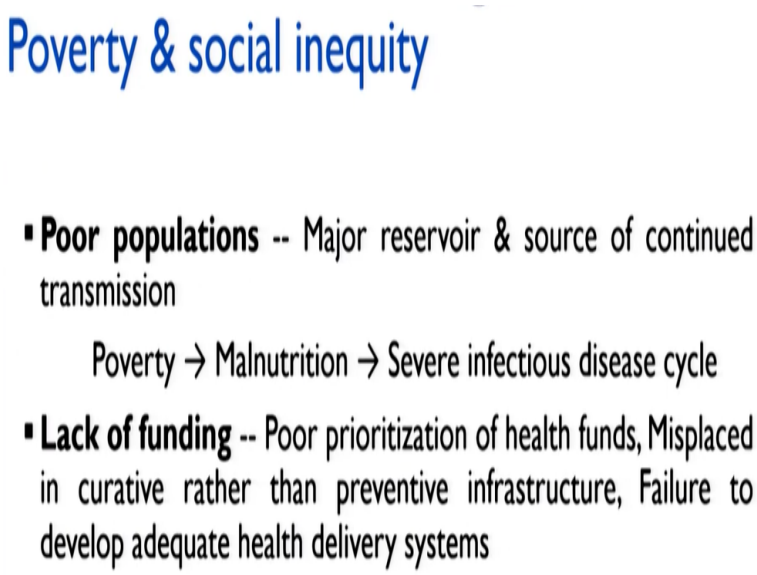

Poverty and social inequity. We all know that poor populations are the major reservoir and source of continued transmission. From poverty it leads to malnutrition and malnourished people are more vulnerable to getting infections. And therefore the severe infections disease cycle continues and this is made even worse with lack of funding particularly for poor prioritization of health funds.

Sometimes they are misplaced in curative rather than in preventive infrastructure, sometimes failure to develop adequate health delivery systems result in not mitigating these problems of social equity and poverty.

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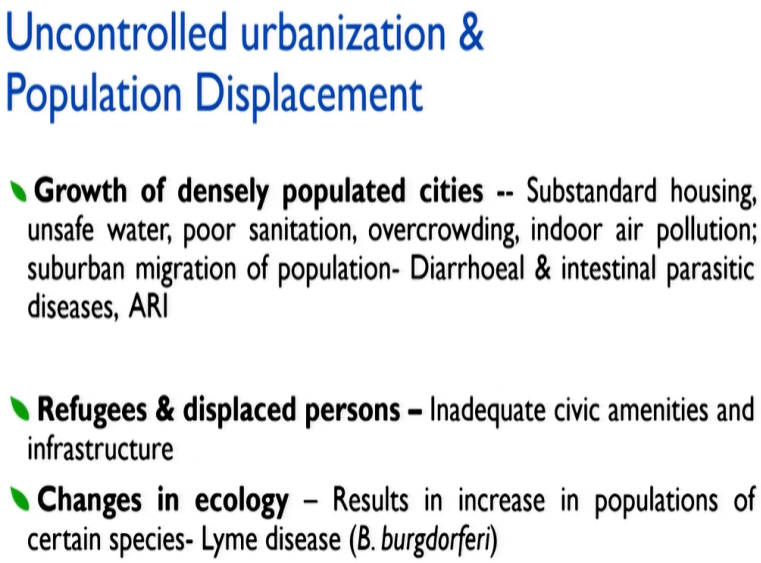

Uncontrolled urbanization and population displacement. In this we know that the growth of the cities and urban substantial over the last few decades and housing had often not been of the required standards particularly for the urban poor. And there has been unsafe water, sometimes poor sanitation, overcrowding, indoor air pollution is one of the major areas not only in urban settings but also in some of the settings which have been associated with the Northeast part of the country.

Urban migration of population; many people had been moving towards the cities and that has resulted in congestion there. So these lead to emergence of various diseases for example Diarrhoeal diseases, intestinal parasitic diseases and acute respiratory infections. Refugees and displaced persons; so any inadequate civic amenities and infrastructure are normally associated with refugee camps and persons who are displaced from one place to another.

And naturally without the civic amenities there are chances of getting infections particularly food and water borne infections and even vector borne infections. The changes in ecology that results in increase in the populations of certain species of the vectors or the causative organisms itself for example the Lyme disease.

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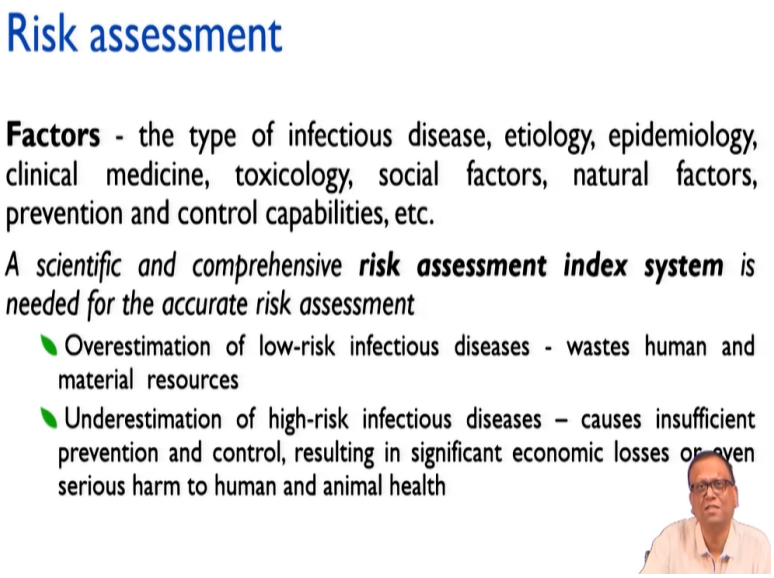

Now how do we assess risk? There is nothing as no risk in this world in every area, every place as to some risk or the other. It is at what stage that we take risks as acceptable is what matters, so therefore there is a need to assess the extent of risk. There are various factors which actually determine that. So these factors are the type of infectious disease itself, what is the kind of the disease, its etiology what actually causes this disease.

The epidemiology how the disease flows and how it spreads, the clinical medicines which are available for this, the toxicology of the disease, the social factors there are some natural factors prevention and control capabilities that exist in that system at that particular place. All these forms the various factors based on which risk assessment is made. A scientific and comprehensive risk assessment in that system is needed for accurate risk assessment.

Over estimation of low risk infectious diseases it wastes human and material sources whereas on the other side. Under estimation of high risk infectious diseases causes insufficient prevention and control measures resulting in significant economic loss or even serious harm to both humans and animal health.

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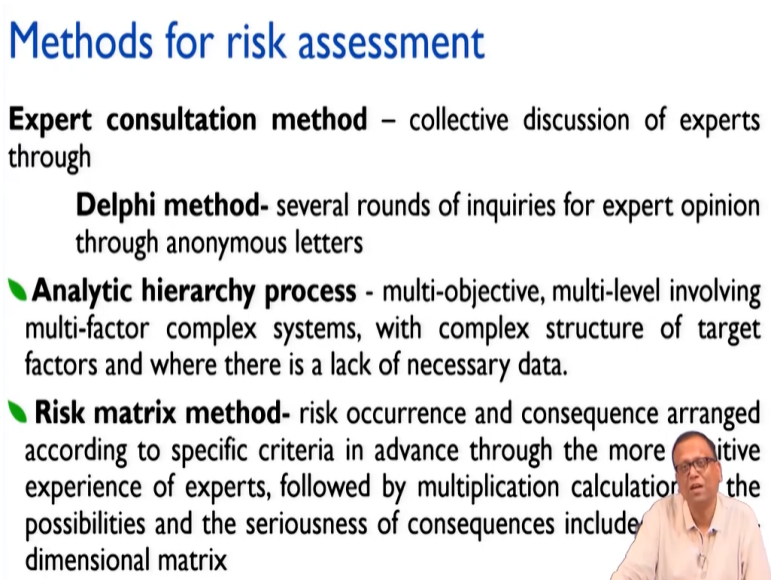

There are various methods for doing this risk assessment analysis; mostly it is run through the expert consultation method, where collective discussions of experts are done through the Delphi method where several rounds of inquiries for expert opinion are sought. Mostly through anonymous letters or with confidentiality and analytical hierarchy processes in which; it is done for multi objective multi-level, multifactorial complex systems.

And it is done with complex structure of target factors and where there is a lack of necessary data. So if the data is present then it becomes much easier. But when data is absent that time things become much more complex and this analytical hierarchical process needs to be carried out. In the risk matrix method risk occurrence and consequence are arranged according to specific criteria.

In advance through the more intuitive experience of the experts which is followed by a multiplication calculation of the possibilities and the seriousness of the consequences included in a 2 dimensional matrix. So this gives us a fair bit of idea about the risk assessment and how it has to be done.

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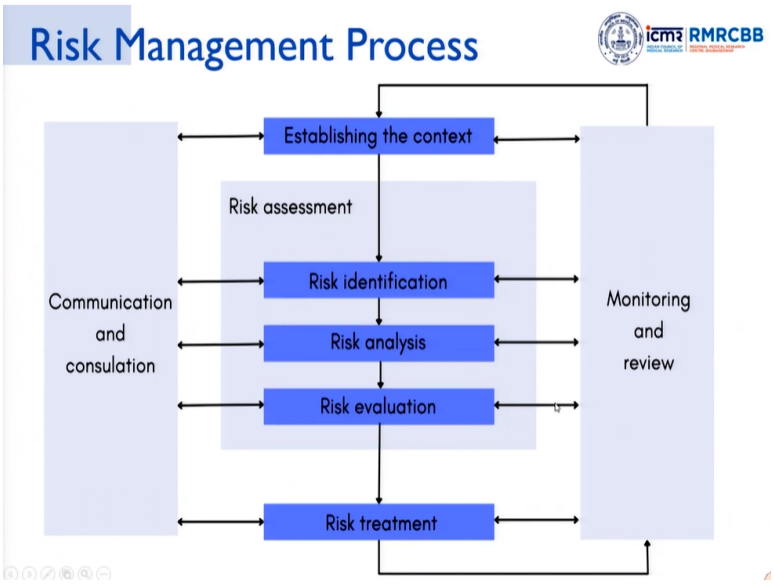

Now how risk is managed? So once the assessment is done, then there are few areas which I need to be looked into, say the risk assessment here taken in the center and on the left you have the communication and consultation and on the right you have the monitoring and review. So it is an interplay between these 3 processes that needs to be done. First is the establishment of the context of the disease.

And then communicating it to the stakeholders and consultations and then again monitoring it and then getting back to the risk assessment again. Similarly risk identification, risk analysis, risk evaluation and again risk treatment. So this cycle continues for each of this context risk identification analysis, evaluation and treatment.

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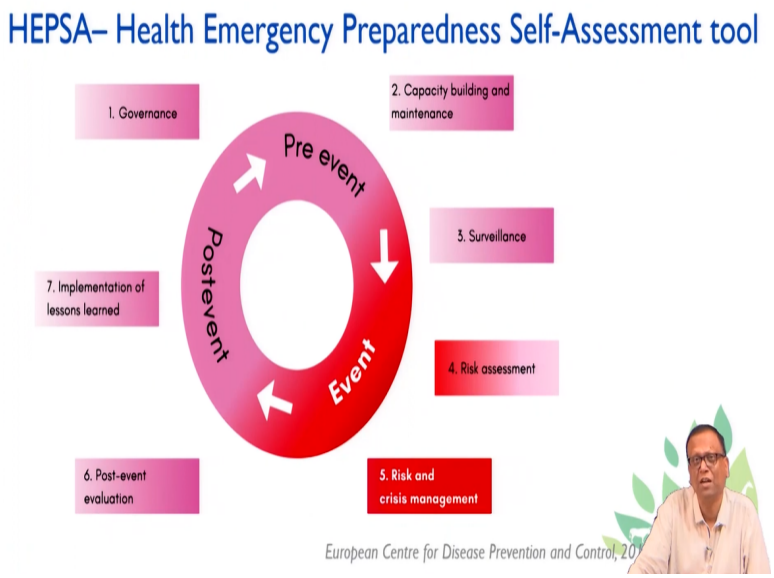

The health emergency preparedness self-assessment tools talks about the governance capacity building and maintenance, surveillance risk assessment, risk and crisis management. Post event evaluation, implementation of lessons learnt and then it cycles again. So there is a pre-event, event and post-event activity, so we always understand there might be an event and this even cannot be always controlled.

So when there is an event we must actually carry out some of the post event activities like the lessons learnt and the implementation of the lessons that we have learned from this event. And that helps us prepare for the next event also. I think we are at this stage when we are having a so-called post-event kind of situation, particularly with the SARS COVID 2, with the COVID 19.

Particularly in India, we have got several lessons which we have learnt and all of us including this particular program is been done to actually make us more prepared for even future events that may affect us. So that we all are prepared and we are able to act in accordance so that the risk is kept to the minimum as well as even if it occurs we are able to manage it in a much professional and much better way.

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Summary

- Crossing the animal human interface, ability of organism to infect, mode of transmission forms the key for emergence/ re-emergence of disease
- Factors contributing to disease emergence – evolution of microorganisms, antimicrobial resistance, urbanization, displacement, travel, climate change, agricultural practices
- Risk assessment should be scientific and comprehensive, avoiding over and underestimates
- Capacity building, surveillance, and monitoring should be a continuous process, along with risk assessment and management

So in summary, the crossing the animals human interface the ability of organisms to infect. Mode of transmission from the key for emergence and re-emergence of disease the factors contributing to the disease emergence like evolution of microorganisms, their antimicrobial resistance, urbanization, displacement, travel, climate change, agricultural practices all contribute as factors.

Then risk assessment of this factor should be scientific and comprehensive avoiding over and under estimates and it will also have an element of capacity building, surveillance and monitoring and this monitoring should be a continuous process along with the risk assessment and management.

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References

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- Wolfe, N.D., Dunavan, C.P., and Diamond, J. 2007. Origins of major human infectious diseases. Nature 447, 279–283
- Xinxing Han 2020 IOP Conf. Ser.: Earth Environ. Sci. 446 032023 doi:10.1088/1755-1315/446/3/032023
- European Centre for Disease Prevention and Control. HEPSA – health emergency preparedness self-assessment tool – user guide. Stockholm: ECDC; 2018.

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