Design for Biosecurity

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Lecture 5

Bioterrorist Agents and Modes of Attack

Welcome to the fifth lecture, marking the conclusion of our first week. Last class, we delved into livestock and poultry biosecurity, discussing the essential pillars on which biosecurity protocols should be structured. We ended with a discussion of the Agricultural Biosecurity Bill of India, 2013, which is currently under consideration. This bill is both promising and challenging in its scope and implementation, and today, we will examine its details.

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To begin, the bill establishes the Agricultural Biosecurity Authority of India (ABAI). This central body is tasked with safeguarding plants, animals, and related products from pests

and diseases while ensuring overall agricultural biosecurity. It plays a critical role in regulating imports and exports, including quarantine measures, plant and animal protection, and interstate movement.

One of the most significant aspects of the bill is that ABAI will act as the central authority overseeing biosecurity across all states. Whether it concerns the import of plants or animals from abroad or the export to other regions, no such transfers can occur without permits issued by the relevant authorities in the country of origin or from ABAI itself. In practical terms, this means that even moving crop species from one geographical region to another within the country will fall under legal scrutiny. For example, transporting a species from Uttar Pradesh to Himachal Pradesh, or from Ladakh to Uttar Pradesh, would be subject to legal approval. Each region belongs to a distinct biogeographic zone, and the bill aims to control and regulate such movements to prevent ecological imbalances.

Additionally, ABAI will conduct surveillance on pests and diseases nationwide. It will undertake pest risk analysis, which involves predicting the potential impact of pests on specific crops and agricultural outputs. This proactive approach is crucial for minimizing damage and maintaining agricultural productivity. Furthermore, ABAI will collaborate with research institutes and state governments to bolster plant and animal protection measures. The authority may also issue notifications regarding quarantine pests and declare certain areas as "controlled zones" if a pest infestation is suspected. This will enable rapid response and containment strategies to be put in place.

ABAI’s interaction with state governments is an integral part of the bill's framework. If a state fails to take appropriate measures to control or eradicate a pest after being directed to do so by ABAI, the authority will step in. In such cases, ABAI will assume control, taking the necessary steps to contain the infestation. However, the state government would be required to reimburse ABAI for the costs incurred during these operations. Essentially, ABAI functions as a central biosecurity agency, similar to the Intelligence Bureau or the Central Bureau of Investigation, with nationwide authority to enforce agricultural biosecurity measures.

The central government can declare a biosecurity emergency, much like we witnessed during the COVID pandemic. This would happen on the recommendation of ABAI (Agricultural Biosecurity Authority of India) in response to pest or disease outbreaks. ABAI would also be responsible for fulfilling international obligations under various trade agreements and sanitary or phytosanitary standards. This forms the core of the Agriculture Biosecurity Bill of India, which was tabled in 2013, though it may have taken time, its necessity is clear.

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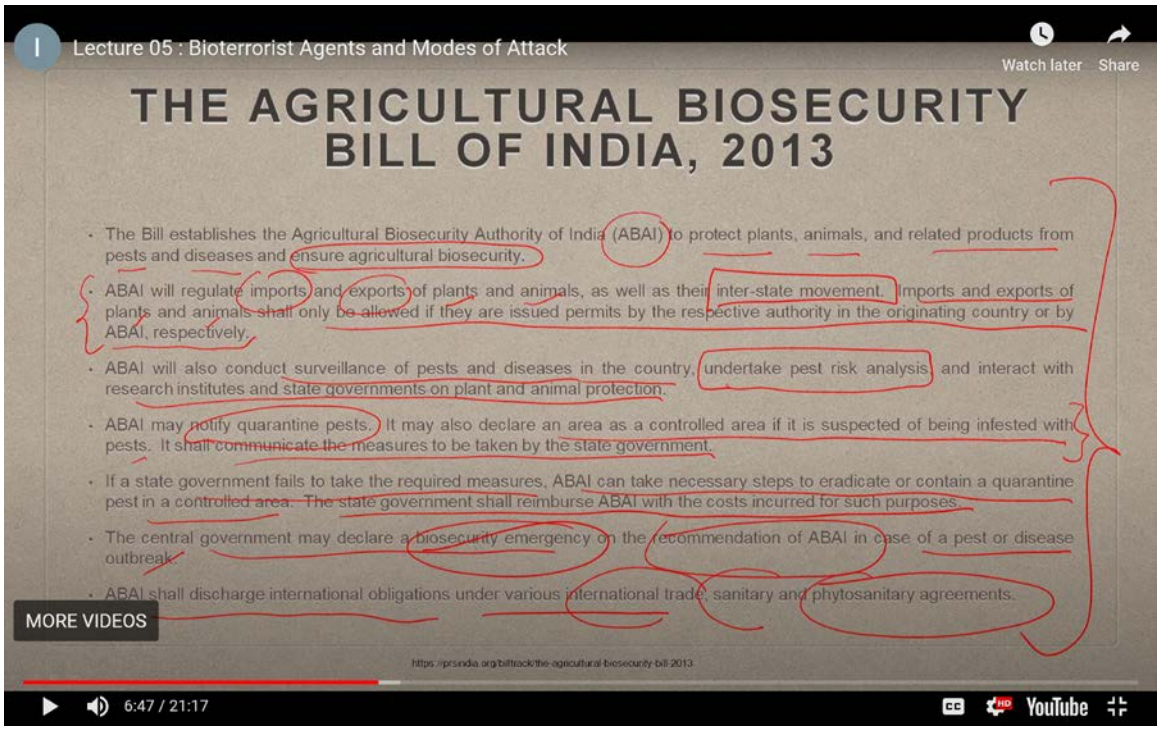

Without such a bill, India's biodiversity and biosecurity would be severely compromised, especially in critical sectors such as agriculture, livestock, fisheries, forests, and microbes. The importance of this legislation becomes even more pronounced when considering India's porous borders. We share borders with Pakistan, China, Myanmar, Nepal, Bhutan, and Sri Lanka, regions where the potential for biosecurity breaches is high. It is alarmingly easy for invasive species, like harmful weeds, to be introduced into our fields from outside sources. If such alien species invade, it could devastate our agricultural productivity. Tomorrow's conflicts may well be economic in nature, and one of the most effective ways

to cripple a nation is by undermining its agriculture and animal production systems. We've already seen the unimaginable economic losses that came with the COVID pandemic. This legislation, therefore, holds tremendous significance for safeguarding our future.

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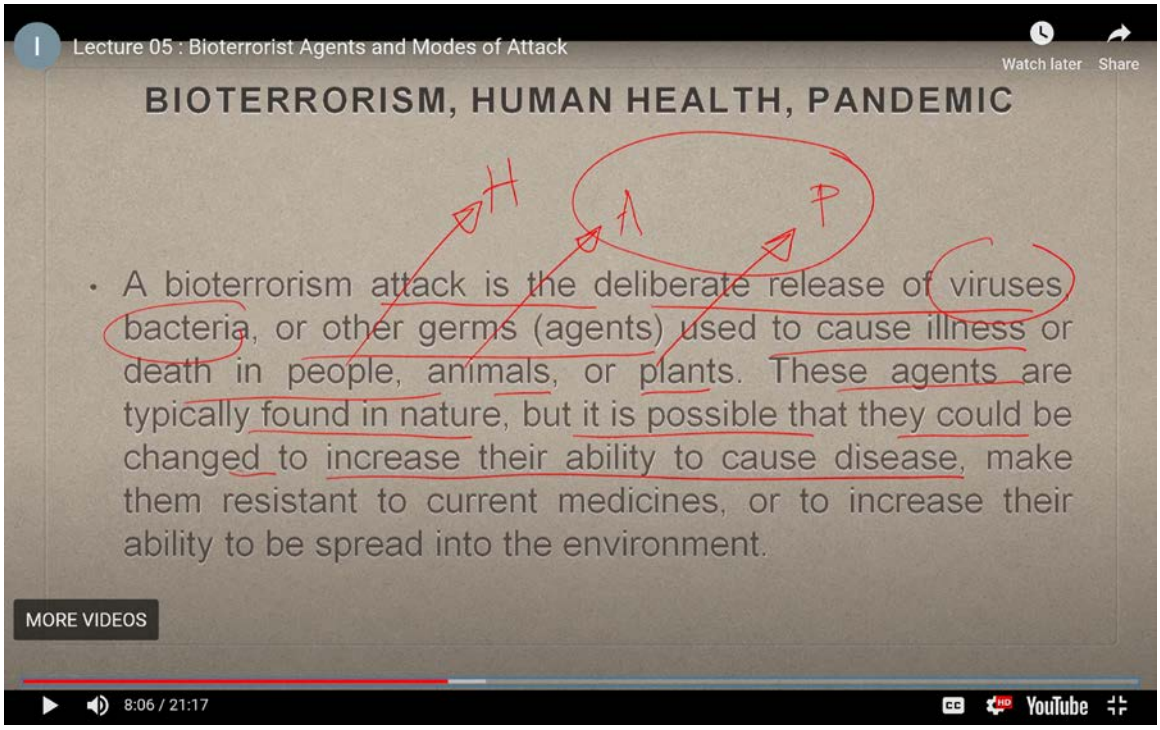

Now, moving on to bioterrorism, human health, and pandemic basics: A bioterrorism attack is defined as the deliberate release of viruses, bacteria, or other pathogens with the intent to cause illness or death in humans, animals, or plants, key pillars of any nation's economy. These agents, while often naturally occurring, can be modified to increase their potency or resistance to current treatments, making them more effective weapons in chemical or biological warfare. This comprehensive definition highlights the destructive potential of bioterrorism.

As we examine historical instances of bioterrorism, some of you may assume that we have not yet faced such attacks, but I would encourage you to review the reference by V.N. Pinto on bioterrorism and health sector alertness. India has long been aware of the potential threat

posed by biological warfare, as Indian defense and medical experts have carefully monitored this issue. There have been a few incidents that raised suspicions in the past.

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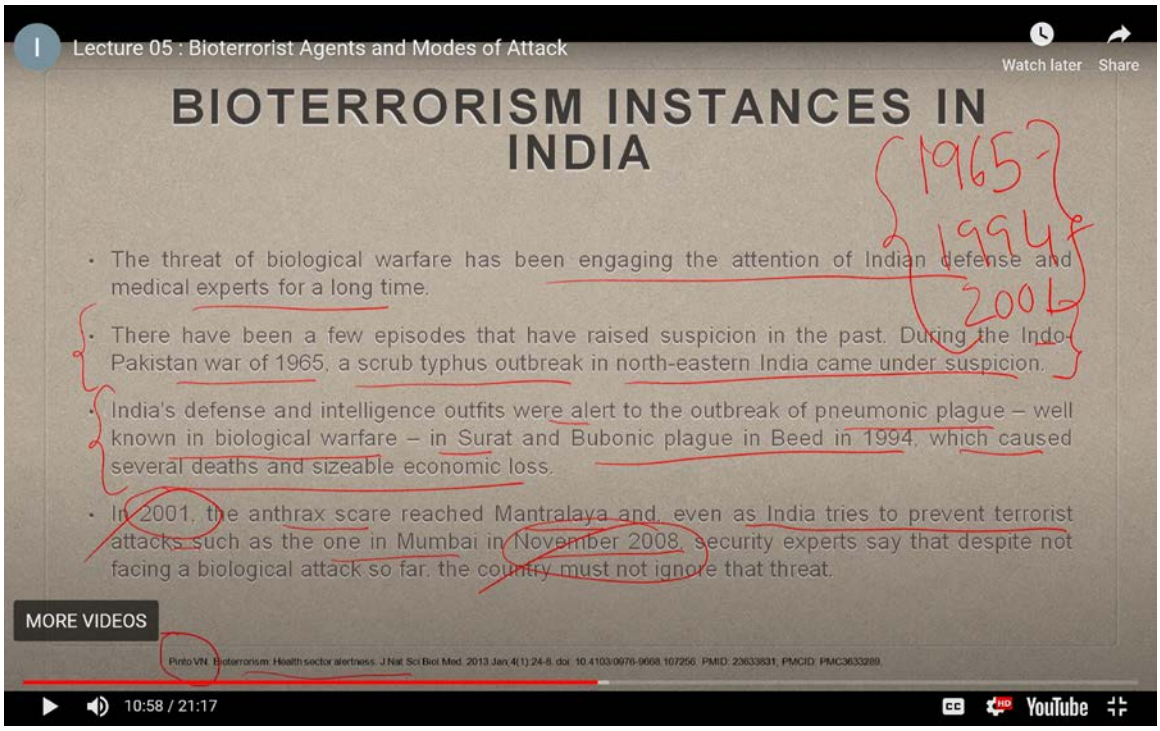

The first such incident occurred during the Indo-Pak war in 1965 when an outbreak of scrub typhus in northeastern India led to suspicions that bioterrorist agents had been deployed by a neighboring nation. This was a significant moment, as it was the first time a potential bioterrorist attack had been suspected. Remember, this was in 1965, almost six decades ago.

Another notable instance was in 1994, during the pneumonic plague outbreak in Surat, India. This event, believed to have been a biological warfare attack, caused considerable fatalities and significant economic damage. Then, in 2001, anthrax made its way to Mantralaya at a time when India was grappling with terrorist threats, including the 2008 Mumbai attacks. These bioterrorism-related incidents, spanning from 1965 to 2008, underscore the ongoing and significant risks faced by our nation. These earlier attacks were

potentially far more potent than what we have experienced in recent years, illustrating the evolving and dangerous landscape of bioterrorism.

This does not even account for the chemical intrusions occurring along our borders with China, from Uttarakhand to Arunachal Pradesh, where these agents are being introduced primarily to damage our crops. We haven't even begun addressing those incidents here. We're simply discussing the bioterrorism threats that have already directly affected human health, but make no mistake, the danger is very real. As we move forward, it’s essential to understand that biowarfare is not a modern invention, it dates as far back as the 12th century. Humanity has long been entangled with these dark arts. Now, let's delve into the classification of bioterrorism agents.

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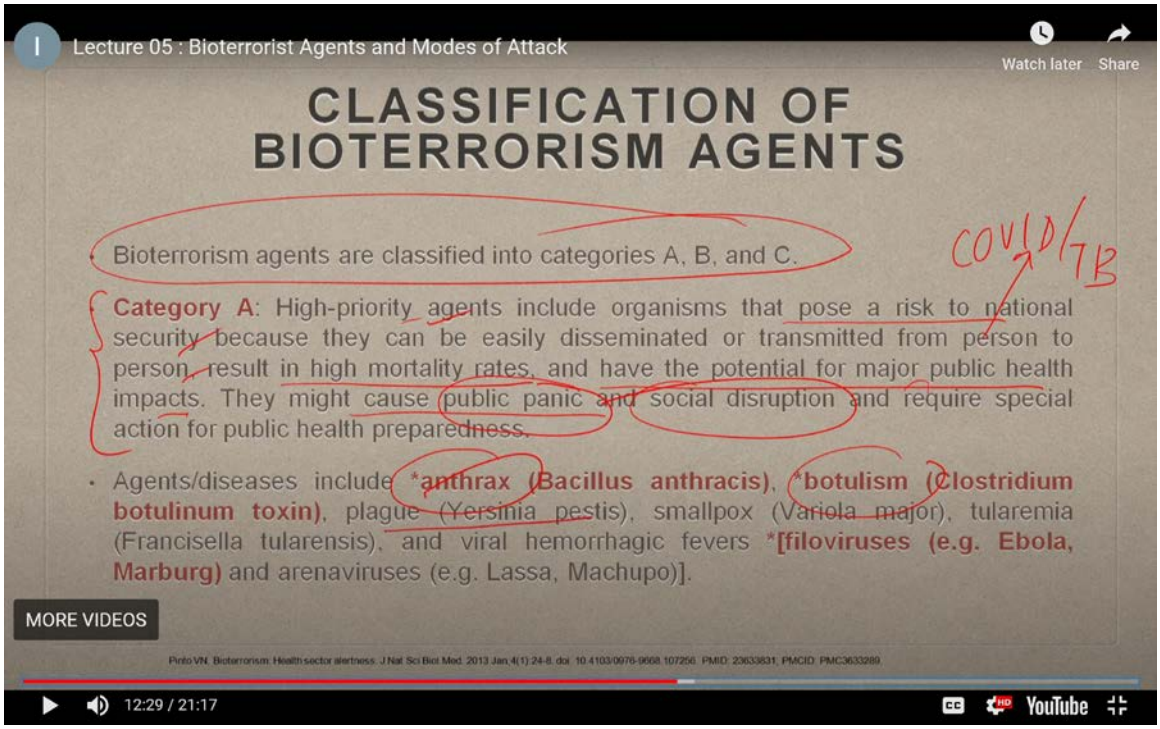

Bioterrorism agents are divided into three categories. You may recall, just as we classified allelochemicals into 14 groups, bioterrorism agents also require classification to manage and mitigate their impact. Category A agents are those that pose the highest risk to national security. These organisms can be easily disseminated or transmitted from person to person,

resulting in high mortality rates. Think back to COVID or tuberculosis, where the threat was transmitted through direct human contact. These agents can cause significant public health crises, potentially triggering widespread panic and societal disruption, as we saw during the pandemic. Public health systems must be especially prepared to counter these threats. Some Category A agents include anthrax (which we previously discussed with the 2001 anthrax scare), bacillus anthracis (which causes botulism via clostridium botulinum toxin), and the plague, one of the oldest known diseases. Other agents in this category include smallpox (variola major), tularemia, viral hemorrhagic fevers like Ebola and Marburg, and other dangerous viruses such as adenovirus, Lassa, and Machupo.

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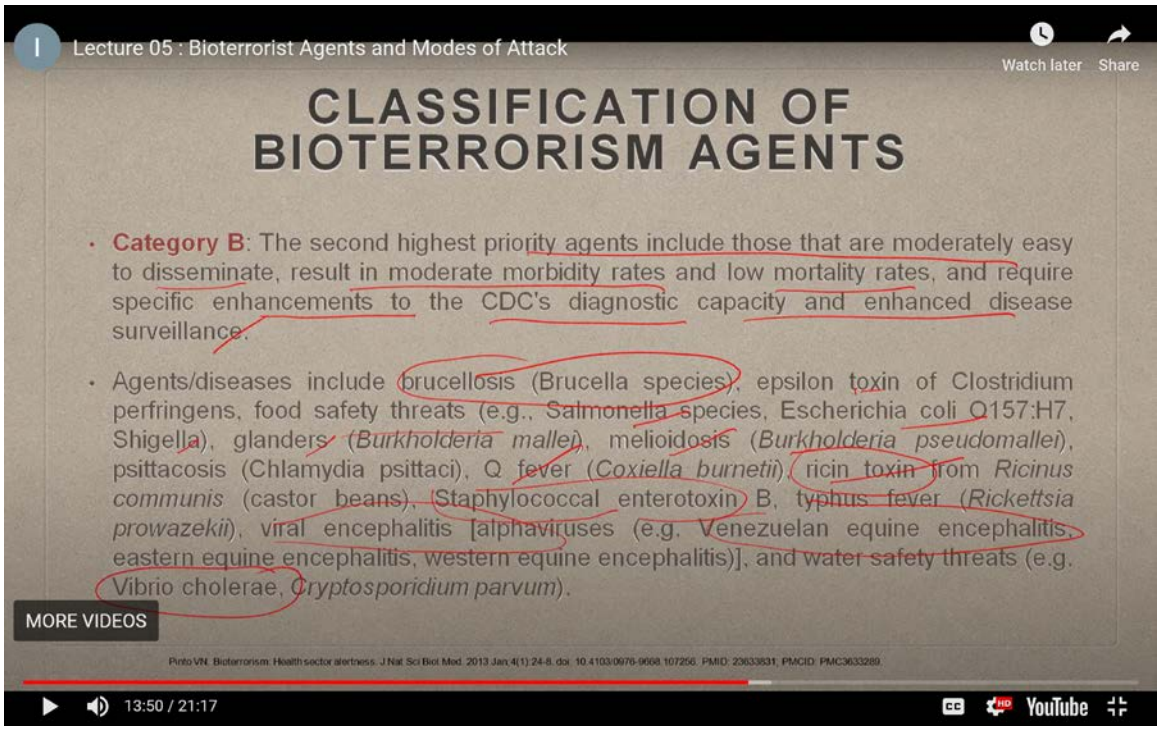

Next, we have Category B agents, which rank as the second-highest priority. These agents are moderately easy to disseminate, leading to moderate morbidity rates and low mortality rates. Nevertheless, they still require specific enhancements in diagnostic capabilities, particularly those provided by the CDC (Centers for Disease Control and Prevention), and bolstered disease surveillance efforts. Examples of Category B agents include brucellosis (which, you may recall, was mentioned in relation to livestock), epsilon toxin of

clostridium, salmonella, certain dangerous strains of E. coli, Shigella, Glanders, Melioidosis, Q fever, and the infamous ricin toxin. Ricin, as many of you may know, has been utilized as a bioterrorism agent in the past. Other notable agents include staphylococcal enterotoxin, viral encephalitis, particularly Venezuelan equine encephalitis, and water-safety threats such as Vibrio cholerae.

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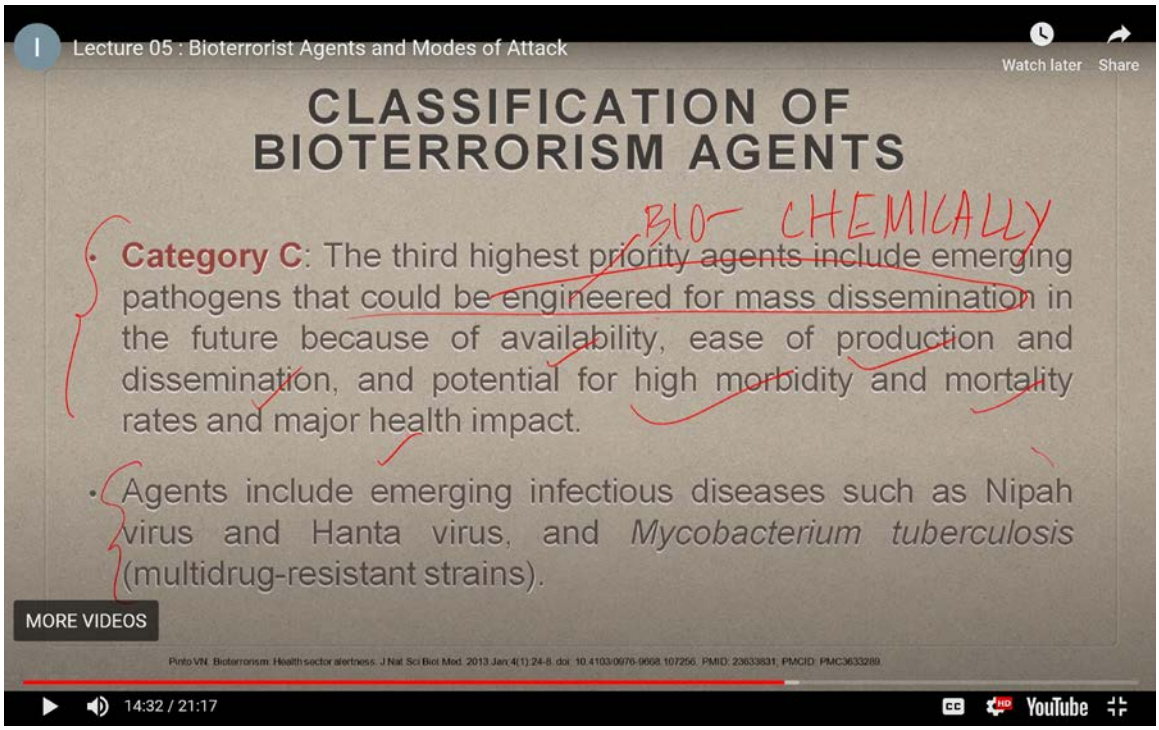

Finally, Category C agents are emerging pathogens that could be bioengineered or chemically enhanced for mass dissemination in the future. These agents are prioritized due to their ease of production, availability, and the potential for causing high morbidity and mortality rates, along with major health impacts. Examples include hantavirus, mycobacterium tuberculosis (especially multi-drug-resistant strains), and other infectious diseases that are proving increasingly difficult to treat. The implications of such pathogens, whether targeting humans, livestock, poultry, plants, or even aquatic life, are staggering. They could be weaponized at various levels, depending on how widely and intensely they are spread throughout the environment.

To effectively combat these threats, it's critical to understand their chemical signatures. Every pathogen, every agent, carries a unique chemical fingerprint, and once we decipher that chemistry, we can begin to develop antidotes and countermeasures. Without this understanding, we are left vulnerable, constantly living in fear. As new trends in bioterrorism emerge, including the creation of microbial products that can incapacitate or kill targeted hosts, the battlefront shifts. These agents, such as hormones, neuropeptides, and cytokines, are known as designer substances, crafted specifically for harm. Understanding and preparing for these threats is not just essential, it's a matter of national security.

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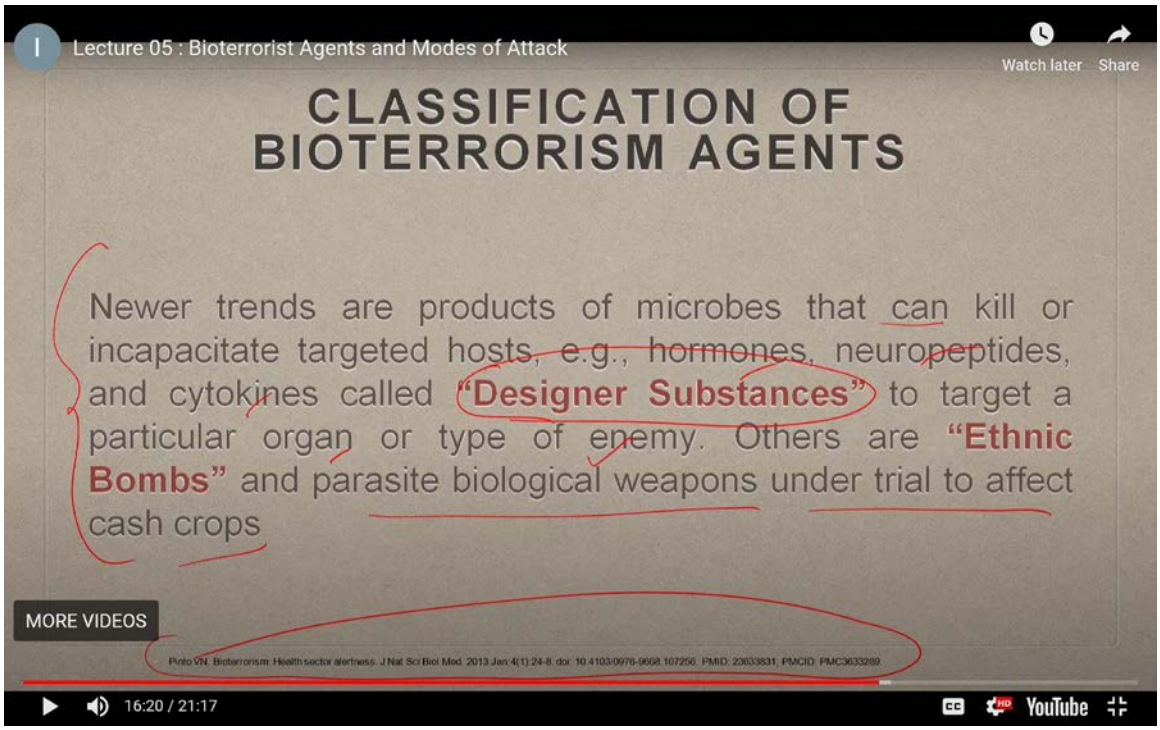

To target a specific organ or type of adversary, there are what we call ethnic bombs and parasitic biological weapons, which are under development to attack cash crops. These terms are becoming increasingly relevant in the modern era of biowarfare, and I recommend reviewing V.N. Pinto's reference on bioterrorism and health sector alertness for a more detailed understanding.

Now, let's compare this to conventional terrorist attacks. When dealing with traditional explosives like RDX or TNT, the logistical challenge is significant, you need kilograms of material to construct a bomb. However, in biological warfare, the scenario is entirely different. All you need is a small ampoule of the agent. You can divide it, spread it, and disperse it in many ways. It can be released into the water supply, introduced via animals, fish, birds, or even plants. So, whether one is vegetarian or non-vegetarian, it doesn't matter. The biological agent can reach its target through a variety of vectors. It could even be spread through aerosols. Do you understand the implications? Regardless of where we live, what we eat, or our religion, caste, creed, or color, none of that matters to a pathogen. The only thing that determines our vulnerability is whether or not we have immunity to it. It's that simple.

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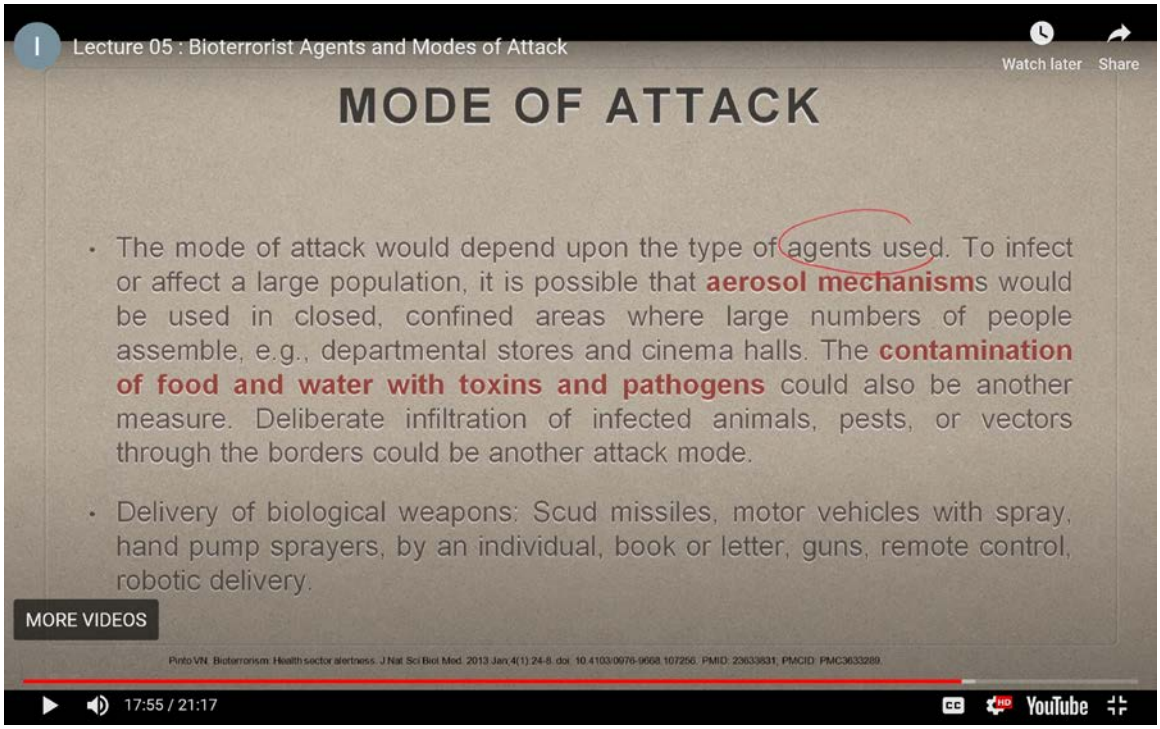

As we progress through this subject, it becomes increasingly clear that there's far more to understand. We urgently need to deepen our knowledge of the chemical nature of these pathogens, to develop antidotes, antibodies, and other means of countering or destroying them.

Now, as I mentioned before, the mode of attack depends on the type of biological agent being used. In a densely populated area, for instance, an aerosol mechanism could be devastating. Think about it, many of us live and work in environments with centrally controlled air conditioning and heating systems. A pathogen could be spread through these very systems, vented throughout entire buildings. Even places like department stores, movie theaters, or any location where large numbers of people gather could become targets, with food and water supplies contaminated by toxins and pathogens.

Another possibility is the deliberate introduction of infected animals, pests, or vectors across borders. We've already discussed how alien plants have been introduced along our borders to undermine agricultural productivity, but biological weapons could be introduced in similar ways.

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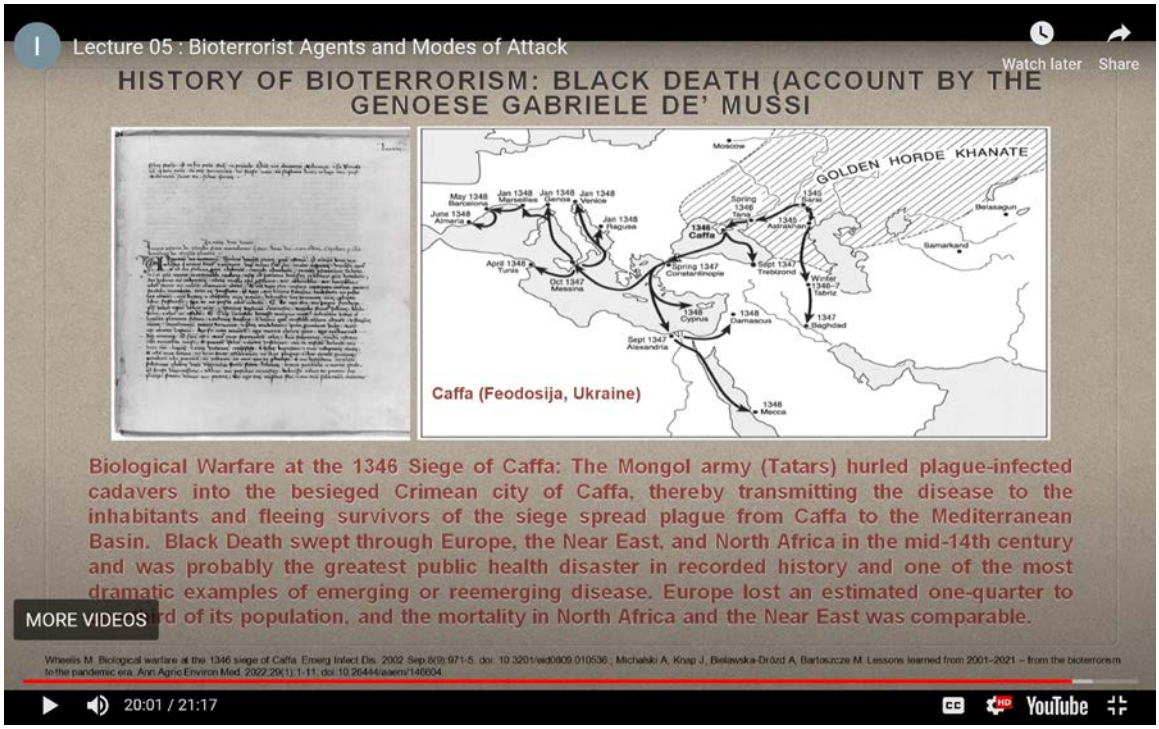

As for delivery methods, they range from the crude to the sophisticated. Biological weapons could be deployed via scud missiles, motor vehicles, or even simple hand-pump sprayers. We've seen in warfare that biological agents could even be packed into warheads

and dropped, or UAVs (unmanned aerial vehicles) could be used to disperse these agents over a wide area. UAVs are becoming increasingly accessible, and the technology to navigate and deploy them effectively is improving rapidly. These vehicles could be an integral part of future bioterrorism strategies.

With that in mind, I'll pause here before moving on to the historical perspective of bioterrorism. As I mentioned earlier, the history of biowarfare is ancient. In the next class, we will explore the roots of bioterrorism, examining how humanity unknowingly engaged in biological warfare long before the invention of nuclear missiles or advanced weaponry. The economic warfare of destroying crops, spreading disease, and wiping out populations through epidemics has been present for centuries, if not longer. Much of it was never officially recorded in history, but what we will focus on are the key events that were documented. This will provide insight into why studying these phenomena is so crucial. By understanding the chemical nature of these pathogens, we can finally begin to control them.

Thank you for your attention, and we will continue discussing the history of bioterrorism in our next class.