Counter Terrorism

Tracking the identity and Origin of Biological Threats

In cases of bioterrorist attack, such as the anthrax cases in several cities in late 2001, decision makers and law enforcement need to know quickly what kind of attack they are facing. Are there any clues hidden in the materials the attackers used? Is the attacking substance resistant to vaccines or antibiotics, or does it harbor information leading to the source of the materials?

Our Solutions

Researchers at Los Alamos National Laboratory, Northern Arizona University and Lawrence Livermore National Laboratory developed sophisticated tools to analyze and identify the DNA of biological threat agents, including those that cause anthrax and plague.

DNA analysis of *Bacillus anthracis* and *Yersinia pestis* offers clues to:

- The exact genetic identity, such as virulent or vaccine strain
- Its geographic origin, in some cases
- The presence of genetic modification to enhance the organism's antibiotic or vaccine resistance.

These Department of Energy National Nuclear Security Administration laboratories are providing critical information and tools to decision makers, and they are prepared to provide continuing support.

Years of Research Enable Quick Response

Multiple years of intensive research by the laboratories into B. anthracis, Y. pestis and many other threat agents has led to a wealth of genetic information and unique technologies to detect and identify the genetic strains of these organisms down to their precise DNA "fingerprints." The laboratories have focused on tracking selected, highly variable or very specific DNA signatures in the microbial genome. This offers faster and less expensive identification than full DNA sequencing.

In its recent work on the ongoing anthrax cases, Los Alamos researchers have analyzed B. *anthracis* DNA samples and compared them against a library of more than 1,200 different strains of the bacteria.

Technologies in Use

A full range of technologies has been developed by the laboratories to meet the challenges presented by biological agents.

Unique reagents identify fragments of the genome using polymerase chain reaction. These reagents have been made available to federal agencies and can be used for rapid detection of biological agents in times of concern.

Amplified fragment length polymorphism analysis (AFLP) uses small DNA fragments to establish a "fingerprint" that is added to a database where it can be read and interpreted by comparison to others in the database.

Multiple locus variable number of tandem repeat analysis (MLVA) gives a very high-resolution DNA fingerprint through the recognition of the presence of repeated DNA sequences in the genome.

Single nucleotide polymorphism analysis (SNP) uses a flexible microsphere array that is analyzed on a flow cytometer platform. It can target potential antibiotic-resistant genes, toxin genes and sites in the genome that may have undergone deliberate genetic modification or engineering. SNP detection is also being used for strain identification and it may eventually supplant MLVA when enough sequences are available.

Since 1943, Los Alamos has created and applied advanced science and technology to solve critical challenges in national defense and civilian research.

Preparing for DNA studies of *Bacillus anthracis*

Past Uses of the Technology

These technologies have been used as follows:

- AFLP was used to identify an anthrax outbreak in cattle in Australia in the mid-1990s. The disease was due to a strain that first arrived in Australia from cattle imported from India in the 1950s.
- Reagents were used to identify the causative strains of *B. anthracis* that, in 1979, led to the death of many people in the former Soviet Union. The attack was eventually attributed to a biological weapons release.
- Technology used to study *Y. pestis* has been used to develop a method to detect *Salmonella enteritidis*, a source of life-threatening gastrointestinal infections. Salmonella bacteria was used in 1984 when followers of Baghwan Shree Rajneesh poisoned several salad bars in Oregon.

Bacterial biological threat agents cause:

- Anthrax *(Bacillus anthracis)*
- Bubonic and pneumonic plague *(Yersinia pestis)*
- Botulism *(Clostridium botulinum)*
- Tularemia *(Francisella tularensis)*
- Glanders *(Burkholderia mallei)*
- Melioidosis *(Burkholderia pseudomallei)*

Los Alamos NATIONAL LABORATORY

Los Alamos National Laboratory is operated by the University of California for the U.S. Department of Energy's National Nuclear Security Administration

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