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Module 4: Biological Safety, Biological Security, and Biological Weapons
Part 2: Acquiring a Biological Weapon Capability

Similar to chemical weapons, biological weapons are multi-component systems. A biological weapon contains a weaponized *pathogen* that is the active ingredient or payload of the system. The payload is mixed with a chemical formulation that stabilizes the pathogen and improves its dissemination characteristics. It is contained in a *munition* that protects the formulated agent in storage and transport. A *dispersal device* disseminates the agent from the munition. Dispersal devices can range from technically complex sprayers or atomizers to simple mechanisms such as a spray bottle or syringe.

The acquisition of a biological weapons capability has three main requirements. First, it is necessary to have skilled people to work with and weaponize biological agents. These skilled personnel can include microbiologists, biochemists, engineers, and others. Next, obviously, a dangerous pathogen or toxin is needed. Select agents such as those causing anthrax, botulism, plague, smallpox, tularemia, and Ebola fever are ideal biological weapons agents and subject to biosecurity measures. Finally, special equipment is needed to disperse biological weapons agents over a targeted population. Such equipment is dual use, being widely employed in industry and science, and is therefore difficult to regulate and control. Biosecurity measures are successful if they prevent a proliferant nation or terrorist group from acquiring any one or more of these three requirements.

There are five elements of capability needed to develop biological weapons:

1. Expertise in applied microbiology,
2. Facility for housing persons and equipment,
3. Threat agent(s) for BWpurpose,
4. Equipment and supplies,
5. Expertise relevant to effective dispersal.

The effects of a bioweapon can take many forms, usually dependent on the skill level of the scientists involved. At the low end of the spectrum is Ma Anand Puja, a nurse who was a member of a cult known as the Rajneeshees, who developed a biological weapon that dispersed a foodborne pathogen over salad bars. At the highest end is Gennady Lepeshkin, who directed a BW-production plant for the Soviet Union. In the middle is Abdur Rauf, a microbiologist who proposed to weaponize *Bacillus anthracis* for al Qaeda.

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Here we see pages from Abdur Rauf's notebook, where he outlined how he would establish and organize a BW program, including the agent he proposed to weaponize. Although Rauf probably had the skills to grow Bacillus anthracis and process its spores so they would be useful for biological weapons purposes, the al Qaeda leadership for unknown reasons did not appear to have trusted him and therefore never provided him with the funding and other support required to institute a BW program.

Several biological agents have been weaponized by state biological weapons programs. The main threat agents include those that cause the diseases anthrax, plague, tularemia, smallpox, Marburg hemorrhagic fever, and botulism. All of these are select agents, making them potentially difficult for terrorists to acquire.

Terrorists could potentially acquire common foodborne pathogens such as E. coli with relative ease. It would be difficult to acquire more dangerous pathogens such as those that cause anthrax, plague, and tularemia, unless the perpetrators had help from a state sponsor. Acquiring dangerous viral pathogens like the hemorrhagic fever viruses would be extremely difficult because, not only are they difficult to come by, they are very dangerous to handle. It would be practically impossible to acquire smallpox virus because it has been eradicated, and there are only two stocks of the virus in the world, which are kept under very high security.

Terrorists could hypothetically acquire select agents through a multitude of pathways; fortunately, most are improbable. We should assume, then, that criminals and terrorists will reach for "low-hanging fruit" that is easy to pick. It is unlikely that they will genetically engineer or synthesize an agent or successfully steal smallpox virus or other select agents from government facilities. They could, however, burglarize less secure laboratories or acquire some select agents from natural sources, such as Bacillus anthracis, which inhabits soil.

Most biological equipment and supplies needed to produce BW agents are readily available to terrorists because they are dual use and widely used in civilian microbiology laboratories. Agar and growth media required to propagate bacteria are easy to acquire. Equipment to grow and process pathogens for dispersal can be purchased from legitimate suppliers, second-hand sellers, and from sellers on the Internet. Gas masks and other personal protective equipment are widely available. Some dispersal devices such as sprayers are easy to obtain, but more complex munitions and delivery systems that disperse agents by explosion are much more difficult to construct or acquire.

One example of an agent that would be easy for a terrorist or criminal to acquire and use is ricin toxin. Ricin, a natural protein toxin, is a byproduct of castor oil production. Ricin is very easy to obtain, with an estimated 50,000 tons available in the world today. Castor beans grow wild in most temperate and tropical regions, and not much expertise is required to purify them. Anyone can find information on the Internet about ricin production. In fact, for terrorist purposes, the beans might not need to be purified. In the hands of a perpetrator, mashed up castor beans can be dried and thus become a crude powder that contains the toxin in a stable state. Ricin can be used to contaminate food, water, or air and in high enough levels is fatal when ingested or inhaled. Because it is easy to acquire, easy to work with, and highly toxic, ricin is a very worrisome potential

bioweapon. It is quite different from an agent like *Bacillus anthracis*, whose weaponization requires substantial scientific expertise.

Shown here are castor beans, the raw material for ricin production, and the castor plant *Ricinus communis*.

This home-made biosafety cabinet was designed for producing ricin toxin from castor beans.

In this cabinet, castor beans were mashed into a paste, which was then dried.

After the ricin paste had dried, it was milled into a fine powder ideal for airborne dissemination. All of these materials and equipment are easily obtainable.

Some methods for dispersing biological weapons agents are easier than others. The easiest method would be contaminating food or beverages with pathogens or toxins, for example in a salad bar as was done by the Rajneeshees. Somewhat more difficult would be sabotaging the food industry by introducing a pathogen or toxin at some point in the cultivation, processing, or distribution of food. It would be difficult to successfully disperse an aerosolized bacteria or toxin, and even more difficult to achieve successful aerosol dispersal of viruses. Because of their level of sophistication, the latter two methods would be more reflective of the capabilities of large state biological weapons programs.

In the next part of this module, we'll look at two case studies of terrorist use of biological agents.