Bioenvironmental Engineering Site Assessment I

Unit 13: Biological Health Threats

Unit Description: In this unit, you will be working from a Turkish installation being used by the United States Air Force in support of operations in the area. During your assignment, you'll summarize principles associated with various biological health threats and learn about identifying and analyzing biological health threats. You'll also develop control options for biological health threats in a scenario.

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Lesson 1: Identifying and Analyzing Biological Health Threats

Lesson Description

In this lesson, you will assist Public Health with the investigation of an outbreak, and you'll respond to other biological health threats that may affect base personnel. Upon completion of this lesson, you will be able to summarize principles associated with biological health threats and explain how biological health threats are identified and analyzed.

Lesson Overview (Page 1 of 15)

Living organisms found in water, soil, plants, and animals may pose a risk to the health and well-being of humans or animals. These biological health threats are a potential danger in the environment as well as in a wide variety of occupational settings. Biological health threats include naturally occurring pathogens, engineered agents, amplified agents, or toxins that can threaten personnel. This unit focuses on non-weaponized biological health threats. It is important to be able to recognize these threats and understand the health effects they may cause.

As you consider the biological health threats that could be present at Camp Qahwa, you will:

- Compare categories, types, and characteristics of biological health threats.
- Explain how to stop the spread of disease by breaking the chain of infection.
- Determine why and when biological health threat identification and analysis should occur.
- Explain the steps for identifying and analyzing biological health threats.
- Describe the roles of entities involved in biological health threat identification, analysis, and control.
- Determine potential biological health threats for a given scenario.

Audio Script

OIC: I just got a call about some illness reports. Several people have been to the MTF with similar symptoms and histories over the last few days. I want you to work with SSgt Campbell from Public Health to figure out if there's a connection. Report back to me as soon as you find anything.

Camp Qahwa Scenario (Page 2 of 15)

Audio Script

BE Tech: It looks like we might have an outbreak on our hands. Any idea what it is?

PH Tech: Well, we've had six people come in complaining of diarrhea, nausea, and stomach cramps. We're pretty sure it's food related, because they all said they had eaten at the Sandwich Shop on base. I can't seem to narrow it down to a specific food though. Take a look at this list and see what you think.

BE Tech: Hmm . . . It looks like most of the people had sandwiches, but I don't see a common ingredient for all of them. And two people just ate soup and salad. You're right – there doesn't seem to be any particular food that's causing the problem.

PH Tech: I think the problem is most likely poor hygiene or work practices at the restaurant. We need to go down there and see how they're doing things.

BE Tech: Okay, let's go check it out.

Scenario Challenge Point (Page 3 of 15)

You and SSgt Campbell arrive at the restaurant and begin observing the workers to try to determine whether their work practices could be spreading disease.

Which two of the following are ways to attack a disease at the source?

A Coughing into one's sleeve.

B Eating fruits and vegetables.

C Keeping cold food refrigerated.

D Washing one's hands frequently

The Chain of Infection (Page 3a of 15)

Being exposed to a disease-producing agent does not necessarily mean an infection will occur. Infection results from an orderly progression of events in which the biological agent travels from a source to a host. More information about the factors essential to the transmission of disease is presented below.

Tab: Reservoir (Source)

The source of a biological agent capable of causing disease is called a reservoir. Some examples of reservoirs include:

- An infected person.
- Unrefrigerated food.
- Raw or undercooked food.
- Contaminated surfaces.
- Vectors such as mosquitoes

Tab: Means of Transmission

In order for infection to occur, the infectious agent must be able to get from the source to a susceptible host. The principle means of transmission for infectious microorganisms and other biological materials are:

- **Contact**
- **Ingestion**
- **Inhalation**
- **Vector-borne Transmission**

Contact

Infections can be transmitted through direct or indirect contact, including injection and absorption. Direct contact transmission can occur from person-to-person contact which allows an infectious material to enter a receptive site in the body. Indirect contact transmission, or person-to-fomite transmission, occurs from touching a contaminated surface.

For example, a person with a cold may spread the illness by coughing into his hand and then shaking another person's hand (person-to-person transmission) or touching a doorknob that is later used by someone else (person-to-fomite transmission).

Infections can be transmitted through direct or indirect contact, including injection and absorption. Direct contact transmission can occur from person-to-person contact which allows an infectious material to enter a receptive site in the body.

Ingestion

Infection can be caused by ingestion of biological agents in contaminated food or water supplies, or incidental ingestion of fecal matter or soil due to inadequate hand-washing habits. This type of transmission is also called common vehicle transmission.

Many food-borne illnesses are the result of cross-contamination of food preparation surfaces.

Inhalation

This type of transmission occurs when infectious particles are released into the air where they can be inhaled into the respiratory system of a host. Some ways that infectious particles can be released are when a person coughs or sneezes and when contaminated surfaces are disturbed.

Droplet transmission and airborne transmission are two sub-types of inhalation. Droplet transmission is carried out via relatively large respiratory droplets and travels short, local distances. Airborne transmission is carried out via smaller respiratory droplets (called droplet nuclei) or virus/bacteria attached to dust particles. Airborne transmission is capable of traveling longer distances than droplet transmission.

Vector-borne Transmission

Vector-borne illnesses are spread from a source to a host by a living vector, such as when a mosquito bites a person who is infected with malaria and then spreads the disease to others by biting them.

Breaking the Chain of Infection (Page 3b of 15)

If any one of the links in the chain of infection is broken, the disease cannot spread. Even if a part of the chain can merely be weakened, the spread of infection through a population will be reduced. Learn how methods of protection may be applied at each of the three areas by reading the information below.

Tab: Reservoir (Source)

Targeting the source of an infection destroys the biological agent before it can be transmitted to susceptible personnel. Some methods of attacking disease at the source include:

- Hand washing.
- Chlorinating water.
- Disinfecting surfaces.
- Thoroughly cooking food.
- Disposing of waste properly.
- Treating an illness with antibiotics.

Tab: Means of Transmission

Contagious diseases are difficult to stop immediately at the source. Attacking the disease at the point of transmission places a barrier between the source and the susceptible population. Breaking this link will keep the disease from spreading and cause it to “die off” naturally. Methods of protection directed at transmission include:

- Altering or stopping social behaviors such as hand-shaking.
- Coughing and sneezing into the sleeve of one’s garment.
- Refraining from meeting in large groups.
- Additionally, High-Efficiency Particulate Air (HEPA) filters and Ultra-Violet (UV) radiation may stop or kill some disease-causing particles during transmission.

Tab: Susceptible Person

Methods of protection directed at this link in the chain involve protecting people from being susceptible hosts. Personnel can improve their immune systems and decrease their risk of disease by adopting a healthy lifestyle and staying current on required immunizations. Some lifestyle choices that are known to improve an individual’s health and decrease the risk of disease include:

- Eating fruits and vegetables.
- Limiting fat and sugar intake.
- Receiving vaccinations.
- Exercising regularly.
- Quitting smoking.

Camp Qahwa Scenario (Page 4 of 15)

As you and SSgt Campbell observe the restaurant workers in the Sub Shop, you don't notice any worker habits that seem unsanitary. Employees follow proper hand-washing procedures and wear gloves while making sandwiches. SSgt Campbell points out that food preparation surfaces are kept clean, the refrigeration bin is at the correct temperature, and foods are stored properly.

You continue your assessment by collecting water and ice samples from the restaurant for bacteriological analysis. When you analyze the results, you find that one of the ice machines tested positive for coliform bacteria. You notify your OIC of the problem immediately so corrective action can be taken.

In response to the problem, you request that the ice machine be taken off line. You take another sample and further inspect the unit for any visual signs of contamination. When the ice is removed from the machine, you can see an opaque substance coating the interior of the unit. As an immediate action, the restaurant staff is told to thoroughly clean the machine. You will then follow up with Public Health to determine whether the gastrointestinal signs and symptoms on the base have ceased.

Categories of Biological Health Threats (Page 5 of 15)

Learn more about the categories of biological health threats in the information below.

Tab: Bacteria

The oldest and most abundant life forms on earth, bacteria are single-cell organisms that usually need moisture to survive. Although relatively few bacteria cause infectious disease in humans, the diseases they may cause can be very serious. Disease-producing bacteria are often found in fecal matter, and the diseases are transmitted by humans. Bacterial infections can often be successfully treated with antibiotics.

Rickettsia is a genus of non-motile, non-spore forming, and non-encapsulated bacteria which are carried as parasites by ticks, fleas, lice, and mites.

Tab: Parasites

Parasites are organisms (e.g., protozoa, worms, fleas) which live in and off of a host without providing any benefit. People can be exposed to parasitic health threats through eating poorly cooked food, drinking contaminated water, or handling animal blood or feces. Parasitic health threats may also be vector-borne. Parasites cause widely varying health effects.

Tab: Toxins

Toxins are poisonous substances which are produced naturally by living organisms such as animals, plants, or microbes. Once a toxin is introduced into the body, treatment of symptoms will depend on the particular toxin. In some cases, anti-toxins can be administered, but in other cases, the only treatment that can be offered is supportive care such as ensuring hydration is maintained while the body eliminates the toxin.

Tab: Fungi

Fungi are found in degrading organic matter and include mushrooms, molds, and yeast. It is important for you to be aware of the health threats related to fungi because many Air Force facilities are older and have the potential for leaks or other moisture problems which may promote the growth of mold. While removal of the mold by using bleach solutions or discarding moldy materials is a necessary part of the cleanup process, the most important action to take when mold is found in a building is to remediate the source of the moisture that enabled the mold to grow.

Tab: Viruses

Viruses are smaller than bacteria and multiply within living cells. It is important to remember that the illnesses caused by viruses cannot be treated with antibiotics.

Arthropod-borne viruses, commonly known as arboviruses, are maintained in nature through biological transmission between susceptible vertebrate hosts by blood-feeding arthropods such as mosquitoes and ticks. Arboviruses are particularly virulent. In other words, they generally produce disease with severe symptoms.

Scenario Challenge Point (Page 6 of 15)

After you wrap up your investigation of the food-borne illness outbreak, you learn that several cases of malaria have been reported in eastern Turkey, not far from the base.

Build a list of preventive actions that can stop the chain of infection for this disease.

Word Bank	List
Wear protective clothing.	_____
Use insecticides and insect repellant.	_____
Avoid close contact with others.	_____
Issue a “boil water” notice.	
Disinfect surfaces with bleach.	
Eliminate vector breeding areas.	

Audio Script

Narrator: After you wrap up your investigation of the food-borne illness outbreak, you learn that several cases of malaria have been reported in eastern Turkey, not far from the base. Build a list of preventive actions that can stop the chain of infection for this disease.

Types of Biological Health Threats (Page 6a of 15)

As you've learned, a biological agent is capable of producing infection when it escapes from its reservoir and is transmitted to a susceptible host. Read the information below to learn about some of the types of health threats in each category, the illnesses they can cause, and how they are transmitted.

Tab: Examples of Bacteria

Escherichia coli

Some strains of Escherichia coli (E. coli) bacteria can cause fatigue, stomach cramps, bloody diarrhea, or other symptoms if ingested. Ways to avoid E. coli contamination include proper hand-washing and ensuring that meats are cooked thoroughly.

The presence of coliform bacteria, including E. coli, in drinking water is of particular concern because it is an indicator of fecal matter contamination, which can cause many types of infectious diseases.

Legionella

Legionella bacteria cause Legionnaire's Disease, which is a type of pneumonia generally contracted by inhalation of mist from water that contains the bacteria. The mist may come from hot tubs, cooling towers, hot water tanks, and air-conditioning units for large buildings. Infected people can usually be successfully treated with antibiotics.

Mycobacterium tuberculosis

Mycobacterium tuberculosis bacteria cause Tuberculosis (TB), an often deadly disease transmitted through inhalation. Prevention of TB includes screening programs and administering the Bacillus Calmette-Guérin (BCG) vaccine.

Rickettsia australis

Rickettsia australis causes Queensland tick typhus, which is similar to Rocky Mountain spotted fever but less severe. Symptoms include a small ulcer at the site of the tick bite, swollen glands nearby, a red raised rash, and fever. Queensland tick typhus is generally a concern in Australia and Tasmania.

Rickettsia rickettsii

The bacterium *Rickettsia rickettsii*, which is carried by ticks, causes Rocky Mountain spotted fever (RMSF), the most severe tick-borne rickettsial illness in the United States. People can become infected from being bitten by a tick or from removing ticks (if the disease is passed from a crushed tick through a cut or scrape on the person's skin). Symptoms include fevers, nausea, rash, joint pain, and diarrhea.

Yersinia pestis

Yersinia pestis causes Plague, which may be highly communicable under certain climatic conditions and is transmitted through inhalation or contact. Early administration of antibiotics is critical in the treatment of Plague.

Tab: Examples of Parasites

Cryptosporidium

Cryptosporidiosis is a disease caused by microscopic parasites of the genus *Cryptosporidium*. *Cryptosporidium* are most commonly found in water but may be found in soil or food, or on surfaces contaminated with the feces of an infected person or animal. The most common symptom of cryptosporidiosis is diarrhea.

Giardia intestinalis

Giardiasis is an illness caused by a microscopic parasite known as *Giardia intestinalis*, also known as or *Giardia lamblia*. *Giardia* infection is one of the most common causes of waterborne disease in humans in the U.S. *Giardia* is found in soil, food, water, or surfaces that have been contaminated with the feces from infected humans or animals. The most common symptoms of giardiasis include diarrhea and nausea.

Plasmodium

Malaria is caused by the Plasmodium genus of protozoal parasites and is transmitted by the bite of infected *Anopheles* mosquitoes. Symptoms of the disease include high fevers, chills, other flu-like symptoms, and anemia. Malaria is a major health concern in some tropical and subtropical areas such as South America, Africa, India, and Asia. Anti-malarial chemoprophylaxis medications are typically prescribed to people traveling to areas where malaria is prevalent. Other methods to prevent infection include controlling the mosquito population with insecticides and avoiding mosquito bites by wearing protective clothing and using screens and insect repellant.

Toxoplasma gondii

The *Toxoplasma gondii* parasite causes a disease called toxoplasmosis which generally causes either no symptoms or flu-like symptoms such as swollen lymph glands or muscle aches. People can become infected by eating undercooked, contaminated meat or by accidentally ingesting something that has come into contact with contaminated cat feces or soil. Because infants can be infected while in the womb, pregnant women are cautioned to avoid handling litter boxes.

Trichinella

Trichinellosis, also known as trichinosis, is caused by eating raw or undercooked meat of animals infected with the larvae of a species of worm called *Trichinella*. Trichinellosis causes a number of symptoms, including diarrhea, vomiting, and fever. Infection is usually caused by eating undercooked pork and is relatively rare in the U.S.

Tab: Examples of Toxins

Botulinum Toxin

Botulinum toxins, the cause of botulism, are produced by the bacterium *Clostridium botulinum*. Botulism is a rare but serious paralytic illness that can be transmitted by wound infections, intestinal infections in infants, or ingestion of improperly prepared food. The most common sign of botulism is drooping eyelids. Botulism can be treated with antitoxins and supportive care.

Staphylococcal Enterotoxin B

Staphylococcal Enterotoxin B (SEB) is one of several toxins produced by the *Staphylococcus aureus* bacteria. SEB thrives in unrefrigerated meats, dairy, and bakery products and is generally transmitted by eating contaminated foods. In addition to commonly causing unintentional outbreaks of food poisoning, SEB can be aerosolized and thus used as a biological weapon as an incapacitating agent.

T-2 Mycotoxins

The trichothecene (T-2) mycotoxins are compounds produced by fungi of the genus Fusarium, a common grain mold. These toxins can be ingested if contaminated foods are eaten. They can also be weaponized and dispersed through the air or mixed with food or beverages.

Tab: Examples of Fungi

Aspergillus

Aspergillus, such as A. fumigatus and A. flavus, is a common mold found in soil, on plants, and in household dust. When inhaled by people with weakened immune systems, the mold can cause a disease called aspergillosis, which produces respiratory symptoms and can damage tissues in the body.

Histoplasma capsulatum

The fungus *Histoplasma capsulatum* grows in soil and material contaminated with bat or bird droppings. If disturbed, the soil or material releases airborne spores which can lead to an infection called histoplasmosis if inhaled. While most infected people suffer no apparent ill effects, the fungus can cause acute respiratory disease which, if left untreated, can be fatal. Antifungal medications are used to treat these severe cases.

Stachybotrys chartarum

Stachybotrys chartarum (S. chartarum) is a common greenish-black mold also known as Stachybotrys atra. It grows on materials such as fiberboard, gypsum board, and paper when constant moisture exists because of conditions like water leaks, excessive humidity, and condensation. People who are sensitive to molds may experience strong allergic symptoms when exposed. People with weakened immune systems may develop fungal infections in their lungs if exposed.

Tab: Examples of Viruses

Common Cold Viruses

More than 200 different viruses are known to cause the symptoms of the common cold. People can become infected by cold viruses through contact or inhalation and generally recover with supportive treatment after a week or two. Colds generally do not result in serious health problems, such as pneumonia, bacterial infections, or hospitalizations.

Ebola Virus

The Ebola virus is an arbovirus that can be spread through contact with blood and/or secretions of an infected person and causes a severe, often fatal disease called Ebola hemorrhagic fever (Ebola HF). No standard treatment for Ebola HF exists, and because the natural reservoir of the virus is unknown, there are few established prevention measures other than avoiding contact with infected people and observing universal precautions, such as wearing protective clothing and sterilizing equipment.

Influenza Virus

Influenza, commonly known as the flu, is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness and at time can lead to death. Some complications that can result from the flu include pneumonia, bronchitis, and sinus and ear infections. The best way people can avoid getting the flu is by receiving a flu vaccination each year.

Severe Acute Respiratory Syndrome Coronavirus

Severe Acute Respiratory Syndrome (SARS) is a respiratory illness caused by a coronavirus. SARS was first reported in Asia in February, 2003. Over the next few months, the illness spread to more than two dozen countries in North and South America, Europe, and Asia. Before the global SARS outbreak was contained, over 8,000 people became ill and 774 died. SARS seems to be spread mainly by close person-to-person contact and the virus is thought to be transmitted most readily by respiratory droplets produced when an infected person coughs or sneezes.

West Nile Virus

West Nile virus (WNV) is a potentially serious arbovirus most commonly transmitted by infected mosquitoes. Most infected people exhibit no symptoms, but some develop severe illness. Milder WNV illness improves on its own without treatment, and only supportive treatments such as intravenous fluids exist for more severe WNV infections. It is important to control the mosquito population through the use of insecticides and elimination of mosquito breeding grounds. People can avoid being bitten through the use of protective clothing, screens, and insect repellant.

Appraisal (Page 7 of 15)

Match each type of health threat to its description by marking the correct block in the table.

Description	Botulism	West Nile	Histoplasmosis	Toxoplasmosis
A rare but serious paralytic illness that can be treated with antitoxins.				
A parasitic disease spread by handling cat litter or eating undercooked meat.				
An infection caused by inhaling a fungus which grows in contaminated soil or bird droppings.				
A potentially serious arbovirus most commonly transmitted by mosquitoes.				

General Characteristics of Biological Health Threats (Page 8 of 15)

Infections do not necessarily occur simply because a person or population is exposed to a disease-producing agent. Biological agents exhibit a wide variety of characteristics that affect how the diseases they cause may spread through a population. These characteristics include the agent's:

- **Incubation period.**
- **Period of communicability.**
- **Sensitivity and resistance.**
- **Infectivity.**
- **Pathogenicity.**
- **Virulence.**

Incubation Period

The incubation period is the duration of time between when a person is exposed to a biological agent and when they begin to exhibit signs and symptoms of the disease. Incubation periods vary based on the type of agent and may be as short as a few hours or as long as a few weeks.

Period of Communicability

The time during which a contagious agent can be transmitted from person-to-person is known as the period of communicability. This period can last for days, weeks, or months depending on the type of agent.

Sensitivity and Resistance

Some biological agents are sensitive to treatment and can be eliminated with antibiotic or antiviral treatments. Other infectious diseases are impossible to prevent and/or treat with current medical interventions and treatments. In the case of biological agents that are highly resistant or have no available interventions and treatments, every attempt should be made to avoid exposure.

Infectivity

Infectivity refers to how easily the pathogen infects a host. For example, the chicken pox and measles viruses are very "infective," easily infecting a susceptible host. On the other hand, the bacteria causing tuberculosis is not very infective.

Some diseases, such as botulism, are non-contagious, meaning they are transmitted only from the source to a susceptible person. Other diseases, such as smallpox or influenza, are contagious and may spread rapidly from one person to another through populations and across geographic regions. A rapid spread of a contagious disease could have a significant impact on an installation's mission.

Pathogenicity

Pathogenicity is the ability to actually produce health effects. Some agents, such as the measles virus, produce disease in virtually all infected persons. Other diseases, such as the polio virus, produce disease in only a small percentage of infected individuals.

Virulence

Virulence relates to the severity of the disease caused by a biological agent. A highly virulent microbe usually produces disease with severe symptoms.

Classes of Biological Health Threats (Page 9 of 15)

To recognize biological health threats, you must understand the level of risk they may pose. More information about the four classes of biological health threats is listed below.

Class 1: Minimal or No Known Hazard

Class 1 agents are unlikely to cause human disease and thus can generally be handled safely without special apparatus or equipment.

Class 2: Low Risk

Class 2 agents may produce diseases of varying degrees of severity, but normally can be contained by good work practices. Some examples of Class 2 agents include the *Legionella* bacteria and the influenza virus.

Class 3: Moderate Risk

Class 3 agents require special handling and containment. Protective clothing, decontamination procedures, controlled access, and engineering controls are minimal conditions for containment of these agents. Some examples of Class 3 agents include bacteria such as *Yersinia pestis* and *Mycobacterium tuberculosis* and fungi such as *Histoplasma capsulatum*.

Class 4: Highly Infectious and/or Capable of Causing Debilitating or Life Threatening Disease

Class 4 agents may be handled only under conditions of total containment, and the most stringent precautions must be taken to prevent the spread of the agent outside the facility. The U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) is the only laboratory in the Department of Defense (DoD) equipped to safely study Class 4 agents. Examples of Class 4 agents are the Ebola virus, Lassa fever virus, Crimean/Congo hemorrhagic fever, and Variola major (smallpox).

Appraisal (Page 10 of 15)

You will see several questions to test your knowledge of the general characteristics of biological health threats. Select the correct answer for each question.

Botulism is transmitted only from the source to a susceptible person and does not spread from person to person. This disease has no _____.

A Infectivity

B Pathogenicity

C Virulence

D Resistance

The polio virus produces disease in only a small percentage of infected individuals, but the effects of the disease can be severe. Based on this information, which two of the following descriptions apply to this virus?

A Low virulence

B High virulence

C Low Pathogenicity

D High Pathogenicity

Choose the statement that best describes the incubation period of an illness.

A The average amount of time it generally takes for a disease-producing agent to infect a susceptible host.

B The period during which an illness is able to be successfully treated through the administration of antibiotics.

C The period of time during which a contagious agent is able to be transmitted through direct contact from person to person.

D The duration of time between a person's exposure to an agent and that person's exhibition of signs and symptoms of the disease.

Why and When to Identify and Analyze Biological Health Threats

(Page 11 of 15)

Any time there is a potential for personnel to be exposed to biological health threats, it is important to know what those threats are and what health effects may occur as a result of the exposure. Listed below are reasons for identifying and analyzing biological health threats, as well as when the identification and analysis should occur.

Why?	**When?**
▪ To protect the health of personnel on the base and in the community so the mission can be successfully accomplished. ▪ To assist in assessing the health threats and determining the exposure potential. ▪ To minimize the incidents of illness. ▪ To make control decisions or recommendations. ▪ To allow the Commander to make informed decisions, based on what the threats could be, in accordance with mission requirements. ▪ To assist in assessing the health threats and determining the exposure potential.	▪ During an initial, routine, or special occupational health risk assessment. ▪ When a new process is being introduced or a process changes in the workplace that may include biological health threats. ▪ When a worker expresses concern about exposure or effects. ▪ When an illness or injury report occurs related to a potential biological health threat, such as an illness outbreak. ▪ When work is performed that involves potential biological health threats to which personnel could be exposed. ▪ When community issues near the base may affect base personnel.

Appraisal (Page 12 of 15)

Which two of the following are examples of times in which identification and analysis of biological health threats are necessary?

A A few of the personnel in the medical treatment facility (MTF) have called in sick over the past week.

B A water main is being repaired and contaminants could be introduced into the water supply through the break.

C Several corrosion control shop workers have complained of illness after working with new paints and solvents.

D Biological wastes from a nearby chicken farm have reportedly been dumped into a river that runs through the base.

Scenario Challenge Point (Page 13 of 15)

You have been called to a large building on base in which several workers have recently become ill. You will need to answer a few questions to investigate the source of the illness.

Audio Script

Narrator: You have been called to a large building on base in which several workers have recently become ill. You will need to answer a few questions to investigate the source of the illness.

Several people who work in the building began experiencing respiratory symptoms, such as shortness of breath and wheezing, after a period of heavy rains. Which two of the following illnesses could cause these symptoms?

A An arbovirus such as the Ebola virus.

B A fungal infection such as aspergillosis.

C A parasitic infection such as trichinellosis.

D A bacterial infection such as Legionnaire's Disease.

What are *typically* the first two steps in identifying and analyzing biological health threats?

A Assess the health risk by considering factors that influence how a disease or infection may spread through a population.

B Gather critical information about the potential health threat and the duties of the population and sub-populations involved.

C Make recommendations for addressing the health risk, based on professional judgment and sampling results (if applicable).

D Collect samples, if necessary, to identify the biological health threat and analyze it to determine whether it is an actual health risk.

As you are investigating, you see mold growing on several walls near the baseboards. In this case, what are your next two courses of action?

A No action is required if the mold is not toxic.

B Conduct sampling to confirm the presence of mold.

C Recommend that the affected wallboards be replaced.

D Call CE to inspect the plumbing and repair any leaks.

Based on the presence of visible mold, which two of the following could likely be causing the workers' respiratory symptoms?

A *Stachybotrys chartarum* fungus.

B *Aspergillus* fungus.

C *Legionella* bacteria.

D *Toxoplasma gondii* parasite.

Steps for Identifying and Analyzing Biological Health Threats (Page 13a of 15)

Learn about the general steps for identifying and analyzing biological health threats by reading the information below.

Tab: Gather Information

The first step in determining whether a potential or existing exposure poses a health threat is to gather critical information about the potential health threat and the duties of the population and sub-populations involved. You can identify many potential biological health threats associated with the mission and the location by **reviewing intelligence, conducting interviews, making observations**, and collaborating with Public Health. When identifying a potential or actual health threat, you should not consider any countermeasures or controls necessary to reduce the threat. This is because, even if a control is in place to reduce the threat, the biological agent(s) present must still be identified

Reviewing Intelligence

For occupational exposures to biological health threats, you can use the intelligence gathered when performing baseline activities to determine likely biological agents that may be present. An infectious disease outbreak, on the other hand, typically requires a more reactive approach from BE and other medical professionals. For these types of threats, you must gather information about the disease to be able to respond appropriately.

Conducting Interviews

You will conduct interviews, in conjunction with Public Health and other medical personnel, to collect valuable data that may be difficult to collect through other methods. This data will help you to properly identify the biological health threats that are or may be present. Public Health will likely interview community members or other people who have become ill. These interviews can provide important clues as to common behaviors and activities which may have spread a disease, as well as locations where the illness could have been contracted. For occupational exposures, you can learn information about workers' experiences, any minor accidents that have occurred that haven't been reported, or any symptoms they may be feeling.

Making Observations

You can often identify biological health threats by making observations about how processes are conducted at a particular site. Even when good standard operating procedures are in place, the opportunity for human error remains – potentially opening a pathway for biological health threat exposures. For example, improper food handling or poor hand-washing practices in a restaurant kitchen could cause many people to become ill. In this particular case, these observations should be reported to Public Health for further investigation.

When making observations at a work site for occupational exposures, be sure to also look for any workers who are exhibiting signs or symptoms of a biological health threat exposure and may not realize it.

Many biological health threats can be identified through observations of the environment. For example, water spots on the ceiling indicate that favorable conditions for mold growth may be present.

Tab: Conduct Sampling

When appropriate, sampling can provide a great deal of information useful for identifying a biological health threat, as well as analyzing the threat to determine the extent to which it is an actual health risk. However, sampling is not always useful or necessary for the identification of biological health threats. For example, if visible mold is present in a home, observation of the problem is enough to identify it as a threat. Because mold is known to present health risks, you can proceed directly to making a recommendation to control the health threat by repairing the water problem and cleaning or replacing surfaces on which the mold is growing. In other situations, sampling is a vital aspect of the identification and analysis process. For example, in a large building equipped with water cooling towers, you may need to conduct sampling for the Legionella bacteria to determine whether the personnel who work in the building are at risk for Legionnaire's disease.

There is a wide variety of equipment you can use for sampling and detection of biological health threats. In addition, Public Health may be able to sample with their High Microbial Load Kit (HMLK). For guidance on assessing biological health threats by individual agent, consult Appendix P of the BE Field Manual (January 2008). When sending samples to be analyzed, keep in mind that you must have certification from the International Air Transport Association (IATA) in order to pack and ship biological samples through civilian means.

Sampling Equipment Examples

Department of Defense Biological Sampling Kit

The DoD biological sampling kit holds up to 8 Hand Held Assays (HHAs), used to test suspected surfaces for the presence of biological agents regardless of how the agent was released. The kit employs an antigen-antibody technology for the presence or absence of agents of interest. The assays are designed to collect samples from nonporous surfaces and are not designed for soil, skin, wood, food, or water sampling

Dry Filter Unit (DFU)

The DFU Sampling Collector is used to collect and capture bio particulates from ambient air. This is essentially a large air sampling device.

Equipment for Collecting Water and/or Liquid Samples

Water and liquid sampling equipment includes the following:

- Alpha sampler
- Kemmerer sampler
- Bacon bomb
- Pond (dip) sampler
- Automatic sampler
- COLIWASA
- Bailer

HazMat ID System

When used for biological health threat identification, the HazMat ID System provides qualitative results and is used to detect the presence of proteinaceous material. This piece of equipment is extremely useful for situations involving unknown powders because it uses infrared radiation to analyze the chemical bonds in the unknown compound, and it can provide specific identification.

Joint Biological Agent Identification and Diagnostic System (JBAIDS)

JBAIDS is used to provide rapid biological testing as part of both healthcare and the force protection structure of an installation. The system employs a polymerase chain reaction technology to determine the presence or absence of agents of interest. This equipment is used by medical laboratory personnel and it is often found with the deployable Biological Assessment Team.

M1M Analyzer

The M1M analyzer is also used by medical laboratory personnel and uses an electrochemiluminescence (ECL) technology to identify presence or absence of biological agents of interest. Compared to the HHA, the M1M has better sensitivity.

QuickSilver Kit

The QuickSilver Kit is used for collecting environmental and forensic evidence samples for later laboratory analysis.

Radiation Detection Company (RADeCO) Kit

The RADeCO kit is used for sampling airborne particulates or a combination or particulates and radionuclides.

XMX Bio-aerosol Sampler

The XMX bio-aerosol sampler is used for rapid collection of any aerosol. It operates at a flow rate of 800 L/min. This is essentially a large air sampling device.

Tab: Assess the Health Risk

Risks associated with biological health threats are different from other types of risk in that health effects are not typically associated with the dose. You must rely on the expertise of other medical personnel and professional judgment to assess biological health threats. As part of this assessment, you will consider what would happen to the affected population immediately and in the future as a result of controlling the health threat or choosing not to control it.

To **determine the risk of infections**, factors that influence how a disease or infection may spread through a population include: population density, weather conditions, available medical support, and perceptions regarding social, political, and ethical issues.

Determine the Risk of Infections

When determining the risk of infections, consider the following questions:

- Is the biological agent pathogenic?
- Is there enough of the organism to live and reproduce?
- Can the biological agent escape from the reservoir?
- Can the organism be transferred through the environment by various means?
- Is there a portal of entry into the new host?
- Is the new host susceptible to the biological agent?

Tab: Make Recommendations

Next, you will work with other medical personnel to recommend ways of addressing the health risk. If you collected samples, you may base your recommendations on the sampling results compared to standards, if they exist. However, because standards for exposure to biological health threats are rare, you will usually work with other medical personnel and rely on professional judgment to formulate recommendations.

An example of an infection control method you could recommend would be installing or improving ventilation systems to control positive and negative pressure between rooms in a hospital. Other controls include training, **quarantine**, isolation, and the use of PPE.

Quarantine

A decision to quarantine personnel must come from the Installation Commander, with advice from the Medical Group Commander and Public Health Emergency Officer (PHEO). Quarantine facilities are selected through a collaboration of BE, CE, and PH personnel.

Roles in Identification, Analysis, and Control of Biological Health Threats (Page 13b of 15)

The organizations and individuals that are involved in the identification, analysis, and control of biological health threats include:

- **Public Health (PH).**
- **Public Health Emergency Officer (PHEO).**
- **Infection Control Officer (ICO).**
- **Medical Laboratory.**
- **Civil Engineering (CE).**
- **Bioenvironmental Engineering (BE).**

Public Health (PH)

PH is responsible for disease surveillance and food safety surveillance.

Public Health Emergency Officer (PHEO)

The PHEO is responsible for determining whether a case suggesting a public health emergency exists and advises the Installation commander on medical aspects of declaring a public health emergency, as well as appropriate disease containment measures.

Infection Control Officer (ICO)

The ICO oversees infection control practices in a medical treatment facility (MTF) and runs the Infection Control Committee (ICC).

Medical Laboratory

The medical laboratory has the ability to analyze samples using JBAIDS and the M1M analyzer, and can recommend higher-level laboratory analysis, depending on the class of biological agent being analyzed.

Civil Engineering (CE)

CE plays an important part in biological health threat control related to vector-borne diseases by providing pest management services. CE also conducts repairs to facilities and utilities, and assists with identification of facilities for isolation and quarantine, when needed.

Bioenvironmental Engineering (BE)

BE works in conjunction with other organizations and individuals to conduct environmental/occupational sampling and health risk assessment, with the purposes of assisting in the identification and analysis of biological health threats and recommending appropriate controls.

Appraisal (Page 14 of 15)

Match each organization with the role it plays in the identification, analysis, and control of biological health threats. Mark the appropriate boxes in the table to make your selections.

Description of Role	Civil Engineering (CE)	Bioenvironmental Engineering (BE)	Medical Laboratory	Public Health (PH)
Provides pest management to control vector-borne diseases.				
Analyzes samples and recommends higher-level analysis as needed.				
Responsible for disease surveillance and food safety surveillance.				
Conducts environmental/occupational sampling and health risk assessment.				

Lesson Summary

You have learned that biological health threats are living organisms that may pose a risk to the health and well-being of humans or animals. Remember, the categories of biological health threats are bacteria, fungi, parasites, viruses, and toxins. You've also learned the types and characteristics of the health threats posed by each of these categories.

In this lesson, you:

- Compared categories, types and characteristics of biological health threats.
- Explained how to stop the spread of disease by breaking the chain of infection.
- Determined why and when biological health threat identification and analysis should occur.
- Explained the steps for identifying and analyzing biological health threats.
- Described the roles of entities involved in biological health threat identification, analysis, and control.
- Determined potential biological health threats for a given scenario.

Audio Script

OIC: You've done a good job helping Public Health with the outbreak issue, as well as identifying and analyzing the mold problem in one of the buildings on the base. Understanding the categories, types, and characteristics of biological health threats is essential for being able to anticipate the threats personnel may be exposed to on the new base and for responding to disease outbreaks.

Lesson 2: Biological Health Threat Controls

Lesson Description

In this lesson, you will determine appropriate controls for the hospital at Camp Qahwa. You'll also learn about the proper use and maintenance of PPE for biological health threats. Upon completion of this lesson, you will be able to develop biological health threat control options for the scenario. Public Health with the investigation of an outbreak, and you'll respond to other biological health threats that may affect base personnel. Upon completion of this lesson, you will be able to summarize principles associated with biological health threats and explain how biological health threats are identified and analyzed.

Lesson Overview (Page 1 of 7)

After a specific biological health threat has been identified and analyzed, it is important to recommend controls to prevent or minimize occupational exposures to biological infectious agents.

As you develop control options for the health risk posed by tuberculosis in the hospital, you will:

- Determine appropriate controls for biological health threats.
- Determine if biological PPE is used and maintained in accordance with established guidelines.

Audio Script

OIC: I just got a call from the hospital. They have a patient who they believe has a drug-resistant form of tuberculosis, and they want someone from BE to make sure their personnel are protected. Head over there and check things out.

Scenario Challenge Point (Page 2 of 7)

Match the methods you could recommend for controlling tuberculosis exposure with the correct category of control. Make your selections by marking the appropriate block in the table.

Control Options	Engineering Controls	Administrative Controls	Personal Protective Equipment PPE)
Establish a limited-access area to prevent unneeded exposure for other personnel.			
Have personnel wear respirators when potentially exposed to TB patients.			
Use ventilation to control pressure relationships between rooms.			

Determining Biological Health Threat Controls (Page 2a of 7)

The goal of an infection control program is to "contain" the hazardous organisms effectively to prevent unwanted exposures. Containment of biological health threats is generally described as being "primary" or "secondary."

Primary containment is the protection of workers and the immediate work environment by using good work practices and appropriate safety equipment. Secondary containment is attained by adequately designed, constructed, and maintained facilities and operational practices.

The methods of containing hazardous organisms to prevent unwanted exposures consist of:

- **Engineering controls.**
- **Administrative controls.**
- **Personal Protective Equipment (PPE).**

Engineering Controls

Engineering controls are methods of isolating or removing hazards from the workplace. These controls typically target the source, or the reservoir, of the health threat, although at times they target the means of transmission.

Examples of engineering controls that are appropriate to use with biological health threats include disinfection of drinking water and the use of ventilation.

Ventilation is often used in hospitals to control positive and negative pressure relationships. Maintaining negative pressure in an isolation room keeps air flowing into the room, thus helping to contain the contaminants and prevent their escape into surrounding rooms. BE is required to periodically check the positive and negative pressure relationships in rooms used for isolating highly contagious patients, as part of the hospital's infection control program.

Other uses of ventilation include specialized biological safety cabinets and specialized cleaning equipment to remove or inactive biological aerosols.

Administrative Controls

Administrative controls are practical techniques that reduce the likelihood of exposure or prevent health effects of the exposure. These controls typically attack the chain of infection at the means of transmission or susceptible host link, because they involve changing behaviors. Examples of administrative controls include:

- Establishing a quarantined area.
- Using isolation to separate people.
- Implementing biohazardous waste management, such as using sharps disposal containers.
- Changing the way a task is performed.
- Establishing controlled or limited-access areas.
- Implementing proper housekeeping techniques.
- Conducting medical surveillance.

- Observing universal precautions.
- Training personnel on proper procedures and uses of controls.
- Implementing emergency procedures such as a "boil water" notice.
- Administering immunizations as a preventive measure and prophylaxis as a reactive treatment.

Personal Protective Equipment (PPE)

The purpose of PPE is to prevent the biological agent from reaching the workers' skin, mucous membranes, personal clothing, or airways. It must create an effective barrier between the exposed worker and the agent, thereby breaking the pathway between source and receiver. PPE includes respiratory protection, gloves, lab coats, gowns, shoe covers, safety goggles, and face shields.

In medical treatment facilities, infection control personnel or the individual workplace is usually responsible for selecting the PPE. Note that surgical masks are meant to protect the patient and not the wearer, so they are not to be worn for respiratory protection.

PPE for Biological Health Threats (Page 3 of 7)

Determining the appropriate PPE for controlling exposures to biological health threats is not always a straightforward matter. There is not one particular guidance document you can consult to make a recommendation. Some resources you can use include:

- *Biosafety in Microbiological and Biomedical Laboratories,* 5th edition, published by the Department of Health and Human Services (DHHS).
- *Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets,* published by DHHS.
- DHHS (NIOSH) 2002-109, *Interim Recommendations for the Selection and Use of Protective Clothing and Respirators Against Biological Agents.*
- National Institute for Environmental Health Science (NIEHS) Worker Education and Training Program (WETP): *Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold*
- *Eye Protection for Infection Control,* published by NIOSH.

There are also many substance- and situation-specific resources available from the Centers for Disease Control (CDC). For example, in a situation involving tuberculosis exposure in a hospital, you could consult DHHS (NIOSH) Publication Number 99-143, *TB Respiratory Protection Program in Health Care Facilities.*

Scenario Challenge Point (Page 4 of 7)

The patient who is suspected of having drug-resistant tuberculosis is being examined in a negative pressure room in the hospital. While examining the patient, the doctor wears an N95 filtering facepiece respirator and disposable gloves. The technician who takes chest X-rays of the patient wears a surgical mask.

Which recommendation should you make based on this information?

A The doctor should be wearing a surgical mask.

B The surgical mask should be rated N90 or higher.

C The exam should be in a positive pressure room.

D The technician should be wearing an N95 respirator.

Scenario Challenge Point (Page 5 of 7)

After recommending PPE for the doctor and X-ray technician, which of the following is the *best* course of action to take for the situation in the hospital?

A Fit test all personnel who work in the hospital and issue N95 respirators.

B Issue an N95 respirator for the technician and do a fit test at a later time.

C Fit test the technician for an N95 respirator and then issue the respirator.

D Fit test anyone who may work with the TB patient and issue N95 respirators.

Use and Maintenance of Biological PPE (Page 5a of 7)

Most PPE used to protect personnel against biological health threats is disposable; therefore, maintenance is not generally an issue. Proper disposal of PPE is probably the biggest concern. Depending on the type of contamination, disposable PPE used for biological health threats may need to be incinerated, or it may be disinfected. Items such as surgical gowns that can be laundered are typically sent out to contracted laundry services.

One of the primary ways that BE is involved in ensuring the proper use of biological PPE is conducting fit tests for respirator use. Respirators that rely on a mask-to-face seal must be properly fitted to the wearer before being issued, and they need to be annually checked to determine whether the mask continues to provide an acceptable fit to the wearer. Fit testing is accomplished IAW OSHA standard Title 29 CFR 1910.134(f) and Appendix A of the same section.

Users are required to inspect respirators prior to each use to ensure the respirator is the correct size and free from defects. Proper storage of the respirators and PPE is also important.

Examples of Improper Storage of PPE

Respirators and other PPE should not be stored in areas where the equipment could be exposed to:

- Direct sunlight.
- Dust and dirt.
- Excessive moisture.
- Extreme temperatures.
- Damaging chemicals.

Examples of Proper Storage of PPE

Respirators and other PPE should be stored in areas where the equipment can remain clean and dry, away from direct sunlight and other damaging influences. Goggles should be hung properly, not from the elastic because this can cause stretching and improper fit.

Appraisal (Page 6 of 7)

Choose the two situations in which PPE is NOT being used or maintained properly.

Choices	**Answer**
A paramedic examines two different accident victims while wearing the same pair of latex gloves.	_____
A lab technician removes a contaminated apron and disposes of it into a biohazard container.	_____
A CE technician washes her hands after working on a broken sewer line without gloves.	
A hospital sends surgical gowns to a laundry service so the doctors can reuse them.	
A doctor wears a surgical mask without being fit tested by BE personnel.	

Lesson Summary

You have learned that it is important to recommend controls to prevent or minimize occupational exposures to biological infectious agents. The primary goal of an infection control program is to contain the hazardous organisms effectively to prevent unwanted exposures. This containment is achieved through use of the hierarchy of controls, which includes engineering controls, administrative controls, and PPE.

In this lesson, you:

- Determined appropriate controls for biological health threats.
- Determined if biological PPE is used and maintained in accordance with established guidelines.

Audio Script

OIC: I see from your report that you've completed your visit at the hospital. Looks like you recommended the use of N95 respirators and conducted fit testing for all personnel who may come into close contact with the patient who has tuberculosis. Good work. I'm also glad to know that the other controls already in place are working well to control the health threat, such as isolating the patient and using ventilation to create negative pressure in the room. Those controls will prevent the contaminants from spreading to surrounding areas.

Resources

- AFMAN 48-153, Health Risk Assessment
- Bioenvironmental Engineering Field Manual, 2008
- USACHPPM TG 273, Diagnoses and Treatment of Diseases of Tactical Importance to U.S. Central Command
- APHA's Control of Communicable Diseases Manual, 18th edition
- DHHS Biosafety in Microbiological and Biomedical Laboratories, 5th edition
- DHHS Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets
- DHHS 2002-109, Interim Recommendations for the Selection and Use of Protective Clothing and Respirators Against Biological Agents
- National Institute for Environmental Health Science (NIEHS) Worker Education and Training Program (WETP): Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold
- Eye Protection for Infection Control
- DHHS 99-143, TB Respiratory Protection Program in Health Care Facilities
- Title 29 CFR 1910 (f) and 1910 (Appendix A)
- USAMRIID's Medical Management of Biological Casualties Handbook
- Centers for Disease Control and Prevention
- Association for Professionals in Infection Control and Epidemiology
- Electronic Code of Federal Regulations

Answer Key: Appraisals / Scenario Challenge Points

Lesson 1: Identifying and Analyzing Biological Health Threats

Page 3 of 15

Which two of the following are ways to attack a disease at the source?

C Keeping cold food refrigerated.

D Washing one's hands frequently

Rationale: Targeting the source of an infection destroys the biological agent before it is transmitted to susceptible personnel. Some methods of attacking disease at the source include hand washing, disinfecting surfaces, keeping cold food refrigerated, thoroughly cooking food, and treating an illness with antibiotics. Coughing into one's sleeve is a method of attacking a disease's means of transmission. Eating fruits and vegetables is one way of maintaining a healthy lifestyle so you don't become a susceptible host.

Page 6 of 15

Build a list of preventive actions that can stop the chain of infection for this disease.

Wear protective clothing.

Use insecticides and insect repellant.

Eliminate vector breeding areas.

Rationale: Malaria is an illness caused by a microscopic parasite and transmitted by mosquito bites. It is not spread by contact or ingestion. The chain of infection can be broken by targeting the means of transmission and by helping to ensure that personnel are not susceptible hosts. The best precautionary measure is to control the mosquito population by using insecticides and eliminating breeding areas. Personnel can also avoid being bitten by using protective clothing, screens, and insect repellant. There is no vaccine against malaria, but personnel should take chemoprophylaxis pills to guard against infection.

Page 7 of 15

Match each type of health threat to its description by marking the correct box.

Descriptions	Botulism	West Nile	Histoplasmosis	Toxoplasmosis
A rare but serious paralytic illness that can be treated with antitoxins.	X			
A parasitic disease spread by handling cat litter or eating undercooked meat.				X
An infection caused by inhaling a fungus which grows in contaminated soil or bird droppings.			X	
A potentially serious arbovirus most commonly transmitted by mosquitoes.		X		

Rationale: Botulism is a rare but serious paralytic illness, caused by botulinum toxins, which can be treated with antitoxins. The West Nile arbovirus causes a potentially serious disease transmitted by mosquitoes. Histoplasmosis is caused by the fungus Histoplasma capsulatum, which is found in soil or material contaminated by bat or bird droppings. Toxoplasmosis is caused by a parasite called Toxoplasma gondii, which is often carried by cats, and can be transmitted by handling litter boxes or eating undercooked meat

Page 12 of 15

Which two of the following are examples of times in which identification and analysis of biological health threats are necessary?

B **A water main is being repaired and contaminants could be introduced into the water supply through the break.**

D **Biological wastes from a nearby chicken farm have reportedly been dumped into a river that runs through the base.**

Rationale: Biological health threats must be identified and analyzed when work is performed that involves potential biological health threats to which personnel could be exposed, as well as when community issues near the base may affect base personnel. Remember, the reason for collecting water samples when responding to a water main break is to assess the possibility of biological contamination. In addition, while it is important to respond to actual illness or injury reports that involve potential biological health threats, it is not necessary for BE to conduct an analysis every time a few workers call in sick. You will also respond to workers who complain of illness after working with paints and solvents, but these are chemical, not biological, health threats.

Page 13 of 15

Several people who work in the building began experiencing respiratory symptoms, such as shortness of breath and wheezing, after a period of heavy rains. Which two of the following illnesses could cause these symptoms?

B A fungal infection such as aspergillosis.

D A bacterial infection such as Legionnaire's Disease.

What are *typically* the first two steps in identifying and analyzing biological health threats?

B Gather critical information about the potential health threat and the duties of the population and subpopulations involved.

D Collect samples, if necessary, to identify the biological health threat and analyze it to determine whether it is an actual health risk.

As you are investigating, you see mold growing on several walls near the baseboards. In this case, what are your next two courses of action?

C Recommend that the affected wallboards be replaced.

D Call CE to inspect the plumbing and repair any leaks.

Based on the presence of visible mold, which two of the following could likely be causing the workers' respiratory symptoms?

A *Stachybotrys chartarum* fungus.

B *Aspergillus* fungus.

Rationale: Fungi can often cause respiratory symptoms, as can the bacteria legionella, which can be present in the air conditioning systems of large buildings. Because visible mold is present, it is likely that the workers' symptoms are a result of a fungal infection. Sampling is not required because the visual identification of mold is sufficient. The cause of the mold problem should be repaired and the surface on which the mold is growing should be cleaned up or replaced.

Page 14 of 15

Match each organization with the role it plays in the identification, analysis, and control of biological health threats. Mark the appropriate boxes in the table to make your selections.

Description of Role	Civil Engineering (CE)	Bioenvironmental Engineering (BE)	Medical Laboratory	Public Health (PH)
Provides pest management to control vector-borne diseases.	X			
Analyzes samples and recommends higher-level analysis as needed.			X	
Responsible for disease surveillance and food safety surveillance.				X
Conducts environmental/occupational sampling and health risk assessment.		X		

Rationale: CE provides pest management services, BE conducts environmental sampling and health risk assessment, the medical laboratory analyzes samples and can recommend higher-level lab analysis as needed, and PH is responsible for disease surveillance and food safety surveillance.

Lesson 2: Biological Health Threat Controls

Page 2 of 7

Match the methods you could recommend for controlling tuberculosis exposure with the correct category of control. Make your selections by marking the appropriate block in the table.

Control Options	Engineering Controls	Administrative Controls	Personal Protective Equipment (PPE)
Establish a limited-access area to prevent unneeded exposure for other personnel.		**X**	
Have personnel wear respirators when potentially exposed to TB patients.			**X**
Use ventilation to control pressure relationships between rooms.	**X**		

Rationale: Establishing a limited access area is considered an administrative control. Wearing respirators is an example of using personal protective equipment (PPE). Ventilation is an example of an engineering control.

Page 4 of 7

Which recommendation should you make based on this information?

D The technician should be wearing an N95 respirator.

Rationale: Personnel who are expected to come in close contact with patients who have communicable diseases such as TB should wear respirators. Surgical masks do not provide respiratory protection. Maintaining negative pressure in the room keeps air flowing into the room, thus helping to contain the contaminants and keeping them from escaping into surrounding rooms.

Page 5 of 7

After recommending PPE for the doctor and X-ray technician, which of the following is the *best* course of action to take for the situation in the hospital?

D Fit test anyone who may work with the TB patient and issue N95 respirators.

Rationale: All personnel who are expected to come in close contact with the TB patient should wear respirators, but not all personnel in the hospital can be expected to come in close contact with this patient. Before the respirators can be issued, the wearer must be fit tested IAW 29 CFR 1910(f).

Page 6 of 7

Choose the two situations in which PPE is NOT being used or maintained properly.

A paramedic examines two different accident victims while wearing the same pair of latex gloves.

A CE technician washes her hands after working on a broken sewer line without gloves.

Rationale: Biological waste should not be handled without gloves, even if followed by vigorous hand-washing. Latex gloves and other disposable PPE should not be reused, but most surgical gowns are meant to be washed and can be reused. Surgical masks do not serve as respiratory protection and are not designed to be fit tested. Contaminated PPE should be disposed of in biohazard containers.

Course Glossary

Acronyms

AAR
After Action Report

ACADA
Automatic Chemical Agent Detection Alarm

AFI
Air Force Instruction

AFMIC
Armed Forces Medical Intelligence Center

AFMS
Air Force Medical Service

AFMSA
Air Force Medical Support Agency

AFOSH
Air Force Occupational and Environmental Safety, Fire Prevention and Health

AFRRAD
Air Force Radiation and Radioactive Recycling and Disposal

ALARA
As Low As Reasonably Achievable

AMC
Aerospace Medicine Council

amu
Atomic Mass Unit

AO
Area of Operations

AOC
Area of Concern

AOR
Area of Responsibility

BE
Bioenvironmental Engineering Flight

CBRN
Chemical, Biological, Radiological, Nuclear

CE
Civil Engineering

COA
Course of Action

COC
Contaminant of Concern or Constituent of Concern

CONUS
Continental United States

CSM
Conceptual Site Model

CV
Coefficient of Variability

DIA
Defense Intelligence Agency

DF
Duty Factor

DOD
Department of Defense

DOE
Department of Energy

DOS
Department of State

DOT
Department of Transportation

D_{pel}
Estimated Hazard Distance

DRI
Direct Reading Instruments

EHF
Extremely High Frequency (Occurs between 30 and 300 GHz)

EMR
Electromagnetic Radiation

EPA
Environmental Protection Agency

EPD
Electronic Personal Dosimeters

FPWG
Force Protection Working Group

G_{abs}
Absolute Gain

HF
High Frequency (Occurs between 3 and 30 MHz)

HRA
Health Risk Assessment

HRE
Health Risk Estimate

HRM
Health Risk Management

IATA
International Air Transport Association

IPE
Individual Protection Equipment

LCL
Lower Confidence Limits

LET
Linear Energy Transfer

LF
Low Frequency (Occurs between 30 and 300 kHz)

MAJCOM
Major Command

MEDIC CD
Medical Environmental Disease Intelligence and Countermeasure CD

MIO
Medical Intelligence Officer

MF
Medium Frequency (Occurs between 300 and 3,000 kHz (3MHz))

MOPP
Mission Oriented Protection Posture

MPE
Maximum Permissible Exposure

MSP
Mission Support Plan

NFB
Near-Field Boundary

NGIC
National Ground Intelligence Center

NHZ
Nominal Hazard Zone

NIOSH
National Institute for Occupational Safety and Health

NOHD
Nominal Ocular Hazard Distance

NRC
Nuclear Regulatory Commission

OCONUS
Outside the Continental United States

OEH
Occupational and Environmental Health

OEHSA
Occupational and Environmental Health Site Assessment

OEL
Occupational Exposure Limits

OEL-C
Occupational Exposure Limits-Ceiling

OEL-STEL
Occupational Exposure Limits-Short Term Exposure Limit

OEL-TWA
Occupational Exposure Limits-Time Weighted Average

OH
Occupational Health

ORM
Operational Risk Management

OSHA
Occupational Safety and Health Administration

OSI
Office of Special Investigation

P_{avg}
Average Power

PEL
Permissible Exposure Limit

PH
Public Health

P_p
Peak Power

PPBS
Planning, Programming and Budgeting System

PPE
Personal Protective Equipment

PPM
Parts per million

PRF
Pulse Repetition Frequency

PW
Pulse Width

RFR
Radio Frequency Radiation

RSO
Radiation Safety Officer

S
Main-Beam Power Density

SAR
Specific Absorption Rate

S_{avg}
Power Density Average

SEG
Similar Exposure Group

SHF
Super High Frequency (Occurs between 3 and 30 GHz)

SLM
Sound Level Meter

S_{max}
Maximum Power Density

SPL
Sound Pressure Level

TLD
Thermoluminescent Dosimeters

TWG
Threat Working Group

UHF
Ultra High Frequency (Occurs between 300 and 3,000 MHz)

USACHPPM
United States Army Center for Health Promotion and Preventive Medicine

UTC
Unit Type Code

VA
Vulnerability Assessments

VHF
Very High Frequency (Occurs between 30 and 300 MHz)

VLF
Very Low Frequency (Occurs between 3 and 30 kHz)

Definitions

Absolute Gain (G_{abs})
The ratio of the power that would be required at the input of an ideal isotropic radiator to the power actually supplied to the given antenna, to produce the same radiant intensity in the far-field region.

Action Level
An airborne exposure level that dictates active air monitoring, medical monitoring, and employee training. The Action Level is one-half the Occupational Exposure Limit for time-weighted average (OEL-TWA) exposures, except where 29 CFR 1910 Subpart Z designates a different concentration or where the statistical variability of sample results indicates that a lower fraction of the OEL should be used as the Action Level.

Activity
The number of disintegrations or transformations of radioactive material per unit of time (usually expressed in seconds).

Antenna
The point on an RFR emitter where RFR energy radiates into free space.

Asbestos
A natural material that is made of tiny threads or fibers. The fibers can enter the lungs as a person breathes. Asbestos can cause many diseases, including cancer. Asbestos was used to insulate houses from heat and cold. It has also been used in car brakes and for other purposes. Some old houses still have asbestos in their walls or ceilings.

Asbestosis
A lung disease caused by breathing asbestos fibers over a period of time. The fibers eventually scar the lungs and make breathing difficult. Symptoms are similar to asthma.

Atomic Mass Unit (amu)
Approximately equal to the mass of a proton or a neutron and is used to describe the mass of an atom.

Becquerel (Bq)
The international standard for the unit of measurement for activity.

Breathing Zone
The location where exposure is measured in air sampling. The breathing zone is located forward of the shoulders within 9 inches of the nose and mouth. Breathing zone measurements are taken beneath a welder's helmet or face piece but outside of any respiratory protective devices.

Bremsstrahlung
An interaction that causes a form of x-ray production in which high-speed beta particles penetrate the electron cloud and interact with the nucleus.

Carcinogens
Hazardous materials that stimulate the formation of cancer.

Ceiling Limit (OEL-C)
The limit for an employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, the OEL-C will be evaluated during the worst-case 15-minute exposure period.

Chrysotile
The most common asbestos type. Chrysotile asbestos fibrils may appear crinkled, like permed or damaged hair, under plane-polarized light.

Coefficient of Variation (CV)
For an air sampling method, the CV is the standard deviation of the sampling and analytical error divided by the mean of the sample results. The CV is used to calculate the confidence limits for sampling. OSHA uses the term sampling and analytical error (SAE) to account for the total variation or error in the method.

Compton Scatter
A gamma/x-ray interaction which takes place between a photon and an outer electron where the photon has more energy than the electron can accept, so it imparts only a portion of its energy to the electron.

Conceptual Site Model (CSM)
Articulates the health threats and exposure pathways and begins when data or information is gathered during Predeployment and Baseline Activities.

Confidence Limits
The upper confidence limit (UCL) and lower confidence limit (LCL) are the boundaries for a single sample or a series of samples that have a specified probability (usually 95 percent) of including the true value of the level of exposure.

Controlled Environments
An area where personnel are aware of the potential for RFR exposures associated with their employment or duties.

Counts per minute (cpm)
The amount of radiation detected by an instrument each minute.

Diffuse Reflection
Situations where a laser beam is bounced off a dull or uneven surface that breaks the beam apart.

Disintegration per minute (dpm)
The number of atoms that decay or transform in a given amount of material per minute.

Disintegration per second (dps)
The number of atoms that decay or transform in a given amount of material per second.

Dose
The quantity of radiation absorbed.

Dose Rate
The quantity of radiation absorbed per unit of time.

Duty Factor (DF)
A unit-less number which only applies to pulsed wave systems that describes the ratio of time an RFR emitter is on to the total operating time.

Electromagnetic Radiation (EMR)
Waves of energy that can travel through space and matter.

Electromagnetic Spectrum
The entire frequency range of electromagnetic waves, or wave radiation.

Energy
The ability to do work.

Estimated Hazard Distance (D_{pel})
The distance from the antenna to the point where the power density equals the permissible exposure limit (PEL).

Excitation
Occurs when there is an addition of energy to an atomic system, changing the atom from a "ground" state to an excited state.

Exposure
Exposure occurs when an employee is subjected to a hazardous material through any of these routes: inhalation, ingestion, skin contact, or skin absorption. Airborne exposures are specified as the duration and concentration of hazardous materials measured in the breathing zone of an individual worker without regard for personal protective equipment used by the worker.

Exposure Assessment
An exposure assessment is a process of estimating or calculating potential exposure of a health threat for an individual or population at risk. The assessment includes professional judgment, calculations based on estimates or models, actual measurements, collection and analysis of samples, and statistical evaluation.

Exposure Pathway
Includes a threat and the opportunity for the population to come into contact with the threat.

f
Algebraic express that means, "a function of."

Fission
The splitting of the nucleus of an atom into nuclei of lighter atoms, accompanied by the release of energy.

Frequency
A value of how often a wavelength cycle occurs in a second.

Gain
The antenna's ability to concentrate its energy in a certain direction.

Hazardous materials
Materials that pose a hazard and require a Material Safety Data Sheet as defined in FED-STD 313, Federal Standard, Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Governmental Activities.

Health Risk
The health risk equals threat "combined with" vulnerability (health risk = (threat) + (vulnerability)). A health risk is an identified health threat and the vulnerability of the population at risk of coming into contact (i.e., completion of an exposure pathway) with the health threat.

Health Risk Assessment (HRA)
Health risk assessment is the process of identifying and analyzing or evaluating (exposure and toxicity assessments) OEH threats in populations or at locations over time (HRA = f [(health risk) "+" (HRE) "+" (COA)]). The HRA "product" is the validated health threat, qualified by the HRE, and the COA which includes overall mission impact, recommended control options, associated uncertainties, risk mitigation estimate(s), and a cost-benefit analysis if applicable.

Health Risk Communication
Health risk communication is the process of effectively communicating potential health effects, outcomes, and control measures to all stakeholders (i.e., commanders, supervisors, AF personnel, military, families, and the public). It provides detailed information about the HRA and should occur throughout the HRA process.

Health Risk Estimate (HRE)
Health Risk Estimate is the probability and severity of loss from exposure to the health threat. The HRE is a function of probability and severity when either or both increase the Health Risk Estimate increases. The HRE is also referred to as a health risk level.

Health Risk Management (HRM)
Health risk management is a decision-making process to evaluate and select COAs, minimize OEH risks, and maximize benefits for operations and missions. HRM is the health component of the ORM process and health risk management recommendations and decisions are integrated into the commander's ORM decision-making.

Health Threat
A health threat is a potential or actual condition that can cause short or long-term injury, illness, or death to personnel. A health threat can be occupational or environmental in origin; internal or external to the installation; or continuous, intermittent, or transient; and includes enemy capability and intent.

Ionization
Occurs when beta particles interact with nearby atoms causing an electron to be removed, creating an ion pair.

Ionizing Radiation
Radiation which has enough energy to change the atomic structure of matter.

Isotope
Elements with the same number of protons, but a different number of neutrons.

Kinetic Energy
Energy of motion.

Laser
Light amplification by stimulated emission of radiation.

Linear Energy Transfer (LET)
Energy lost by particles along the path through which they are traveling.

Mass
Description of how much matter there is present in an object.

Maximum Permissible Exposure (MPE)
The level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eyes or skin.

Mesothelioma
Cancer that generally occurs in the chest, abdominal region, and areas surrounding the heart. It is typically associated with exposure to asbestos.

n
Algebraic express that means, "Number of samples."

Nominal Hazard Zone (NHZ)
The area within a laser workplace in which the exposure from direct beam, specular reflection, and diffuse reflection could exceed the Maximum Permissible Exposure (MPE).

Nominal Ocular Hazard Distance (NOHD)
The distance along the laser beam beyond which the exposure is not expected to exceed the appropriate Maximum Permissible Exposure (MPE).

Non-aqueous Phase Liquids (NAPLs)
Non-aqueous phase liquids are liquids that are sparingly soluble in water. Because they do not mix with water, they form a separate phase. For example, oil is an NAPL because it does not mix with water, and oil and water in a glass will separate into two separate phases. NAPLs can be lighter than water (LNAPL) or denser than water (DNAPL). Hydrocarbons, such as oil and gasoline, and chlorinated solvents, such as trichloroethylene, are examples of NAPLs.

Non-ionizing Radiation
Radiation which does not have enough energy to change the atomic structure of matter.

Nuclear Stability
Describes the certain combinations of neutrons and protons within a nucleus of an atom which are required for that atom to be considered stable.

Occupational and Environmental Health Site Assessment (OEHSA)
The key operational health tool for producing data or information used for health risk assessments (HRA) and to satisfy Occupational and Environmental Health (OEH) surveillance requirements.

Occupational Exposure Limit (OEL)
The limit for the airborne concentrations of a specified substance for a specified time. Employees will not be exposed to concentrations greater than the OEL. The term OEL includes all OEL-TWAs, OEL-STELs, OEL-Cs, and acceptable ceiling concentrations, that apply to a specific substance. For each hazardous material, the OELs are the most stringent limits found in the latest edition of the TLV Booklet published annually by the American Conference of Government Industrial Hygienists, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances. OELs apply to occupational exposures for each individual worker for a single 8-hour work shift except where 29 CFR 1910 Subpart Z allows 40-hour averages. Exposure during work shifts that exceed 8 hours must be adjusted before applying an OEL.

Operational Risk Management (ORM)
A systematic process of identifying hazards, assessing risk, analyzing risk control options and measures, making control decisions, implementing control decisions, accepting residual risks, and supervising/reviewing the activity for effectiveness.

Optical Cavity
The component that houses the laser.

Pair Production
Occurs when a photon disappears in the vicinity of a nucleus, and an electron and positron appear in its place.

Particulate Radiation
Fast-moving atomic or subatomic particles that may be charged positively or negatively or not at all.

Peak Power (P_p)
The maximum power density during the on time for a pulsed wave system.

Permissible Environment
Operational environment in which host country military and law enforcement agencies have control as well as the intent and capability to assist operations that a unit intends to conduct.

Permissible Exposure Limit (PEL)
The value to which an individual may be exposed without exhibiting damaging biological effects and is based on the emitter's frequency.

Photochemical Reaction
A chemical reaction which is induced by the absorption of energy in the form of visible, infrared, or ultraviolet radiation.

Photoelectric Effect
An "all or none" energy loss where gamma rays impart all of their energy into an electron.

Pleural Effusion:
When too much fluid collects between the lining of the lung and the lining of the inside wall of the chest.

Positron
Created when a proton changes into a neutron and a positron because there are too many protons in the n:p ratio.

Potential Energy
Energy of position.

Pulse Repetition Frequency (PRF)
The number of times the signal is on per unit of time.

Pulse Width (PW)
The length of time the signal is on for a pulsed wave system.

Quality Factor (Q)
A dimensionless quantity assigned to each type of radiation that allows doses to be normalized in relation to each other.

Radiation
Energy in the form of waves or moving subatomic particles emitted by an atom or other body as it changes from a higher energy state to a lower energy state.

Radiation Absorbed Dose (RAD)
The amount of radiation absorbed by the tissue.

Radioactive Decay
The spontaneous disintegration or transformation of an atom in an attempt by that atom to reach a stable state.

Radioactive Material (RAM)
Material which contains unstable (radioactive) atoms that give off radiation as they decay or transform.

Radioactivity
The spontaneous emission of matter or energy from the nucleus of an unstable atom.

Radioisotopes
Unstable isotopes that, in an attempt to become a stable atom, emit energy in the form of radiation.

Regulated Area
An area under the supervisor's control where entry and exit are restricted and controlled to prevent exposure to hazards. An area shall be established when a requirement in 29 CFR 1910 or 29 CFR 1926 exists, or when BE determines that employees entering the area might be exposed to a hazard unless access is controlled.

Short Term Exposure Limit (OEL- STEL)
A time-weighted exposure for a 15 minute (or shorter) period which shall not be exceeded during the work day. The definition of STEL is different in 29 CFR 1910.1000 (a) (5) (ii) and in the TLV Booklet. The definition must correspond to the reference being cited. As with other OELs, OEL-STELs are the most stringent limits found in the latest TLV Booklet, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances.

Short-Term Public Emergency Exposure Guideline (SPEGL)
An acceptable peak concentration for unpredicted, single, short-term emergency exposures of the general public. These limits do not apply to occupational exposures.

Specific Absorption Rate (SAR)
An expression of how much RFR energy is imparted to each kilogram of biological body mass per second. SAR is expressed in units of watts per kilogram (W/kg).

Specular Reflection
Situations where a laser beam is reflected from shiny, mirror-like surfaces.

Spontaneous Fission
Spontaneous fission is a natural mode of decay in which nuclei disintegrate.

Stakeholders
Any individual who is affected by the content of the communication and/or will be making decisions based on the information provided.

Stratigraphy
The layering of rock or ice strata, from which information on succession, age relations, and origin can be deduced.

Threshold Limit Values—(TLVRs)
Exposure guidelines published annually by the American Conference of Governmental Industrial Hygienists (ACGIH) in Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. TLVRs are employed as OELs when they are more stringent than the OSHA PELs.

Time-Weighted Average (OEL-TWA)
Eight-hour average concentration for which the average is mathematically adjusted for the duration of exposure. The method for calculating OEL-TWAs is shown in 29 CFR 1910.1000 (d) and in the TLV Booklet.

Toxicology Assessment
Process of estimating the human toxicological impact of a specific material based on published and unpublished literature sources and taking into consideration: uptake, metabolism/biotransformation, transport and storage, and excretion including acute (short-term) and chronic (long-term) human health endpoints.

Transmission Line
Carries the RFR signal from the transmitter to the antenna.

Transmitter
The part of an RFR emitter that generates the RFR signal.

Uncontrolled Environments
An area where exposures may be incurred by people who have no knowledge or control of the hazard.

Wavelength
The distance from one peak of a wave to the next peak of a wave.