Version

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PUBLIC HEALTH PREPAREDNESS (PHP)
TRAINING PROGRAM

Training Course Materials

Handbook for the '*Biological Threats to Homeland Security*' Course

PUBLIC HEALTH PREPAREDNESS TRAINING COURSE MATERIALS

Handbook for the Biological Threats to Homeland Security Course

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    a. Handbook for the *'Biological Threats to Homeland Security'* Course

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Introduction

I

Welcome to the Online *'Biological Threats to Homeland Security'* Course

This online accessible training course is intended to be done at the student's own pace. The intent of this course is to create a common foundation of knowledge to build off of, for future trainings and exercises. This course is approved for 4 CEU credits.

In this ongoing grant climate of '*do more with less*', we here at the Nevada Division of Public and Behavioral Health's (DPBH), Public Health Preparedness (PHP) training and exercise program, are working on ways to continue bringing you training opportunities, but with little to no travel expenses associated with those training sessions.

One of the strategies we have come up with is to provide training opportunities through an **online format** using a internet-accessible system called **Prezi**. For those of you who have never heard of Prezi, it is basically a more dynamic version of the old standby: *Microsoft (MS) Power Point*. Rather than transitioning from slide-to-slide like we have in the past on MS Power Point; with Prezi you 'fly' through the transitions seamlessly. You'll see what I mean in a few moments.

Today's training course is divided into ten modules, with each module averaging about 15 to 20 minutes in duration. As you will see in this course handbook, trainees are asked to work their way through each module in order, and to not skip ahead. As the modules progress, they build upon the principles discussed in previous modules, etc.

System Requirements to Run Today's Training Course

Basic Computers Will Work Fine: The technical support team at Prezi has posted the following on their Prezi Basics web page:

The Prezi editor runs well on most contemporary computers, even netbooks. You can easily determine if your computer meets system requirements to watch prezis by:

1. *Checking out any prezi from www.Prezi.com/explore to see if it plays back smoothly on your computer.*

2. *Checking if you can play back YouTube videos while in full screen mode when in any prezi.*

High End Usage: If you would like to play a very large prezi (with many videos, animations, high resolution images, etc.), Prezi uses Adobe Flash technology to render prezis in real time, therefore you can create very high resolution presentations, but your playback performance will rely on the hardware. Here are some hardware recommendations:

1. *Fast processors and lots of memory will help more than a strong graphics card.*

2. *It can help to play a prezi through once, it will play more smoothly the second time (do not restart the prezi).*

Website: The www.Prezi.com website supports all major modern browsers (Internet Explorer 9 and above, Mozilla Firefox 3 and above, Google Chrome, Safari) but for the best experience we recommend using the most standard compliant browsers available (Firefox 3.6+, Chrome 4+, Safari 4+). Flash version 11.1 is required.

Prezi for Windows / Mac: For users who would like to access Prezi through Microsoft Windows:

- *2.33GHz or faster x86-compatible processor, or Intel Atom™ 1.6GHz or faster processor for netbook dass devices*

- *Microsoft® Windows® XP, Windows Server 2003, Windows Server 2008, Windows Vista® Home Premium, Business, Ultimate, or Enterprise (including 64 bit editions) with Service Pack 2, Windows 7, or Windows 8 Classic*

- *512MB of RAM (1GB recommended)*

For users who would like to access Prezi through a Mac Operating System (OS):

- *Intel® Core™ Duo 1.83GHz of faster processor*

- *Mac OS X v10.6, v10.7, or v10.8*

- *512 MB of RAM (1GB recommended)*

High-Speed Internet Connection: In order to access today's training course, you will need access to a computer with a high-speed internet connection. We realize that for many of you in our rural counties, such a connection may be an issue. So in an effort to ensure that you can at least read along with the audio recordings for each transition, we have provided a complete transcript of what those audio recordings cover. Each

chapter within this course handbook correlates with a corresponding module in the Prezi presentation.

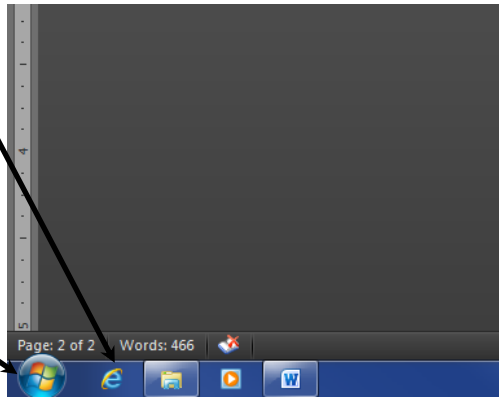
Sound Speaker(s): In order to hear the presenter's recordings for each transition in today's course, please ensure that your PC has a speaker (or speakers) that is/are working, and as basic as this sounds: make sure the volume is turned on and up. If your system does not have a speaker, then you can follow along in this course handbook and read through each recording's content.

How to Access, Open and Watch the Prezi Presentation: Open the internet browser for your PC by double clicking on that browser's icon in the bottom-left corner of your screen like this:

If your computer is setup with a shortcut to your browser, like this, then click here:

If your computer does not have that shortcut, then click here:

When that opens, look for the Internet browser and double click on that.



Once your internet browser opens, you will need to enter the web addresses listed below for each part. I realize that these are long addresses to type out, but please enter each letter/digit/symbol carefully; otherwise the presentation will not open for you.

1. For Part I of today's presentation, please use this web address:

   http://prezi.com/3vb7x5fupvrj/?utm_campaign=share&utm_medium=copy&rc=ex0share

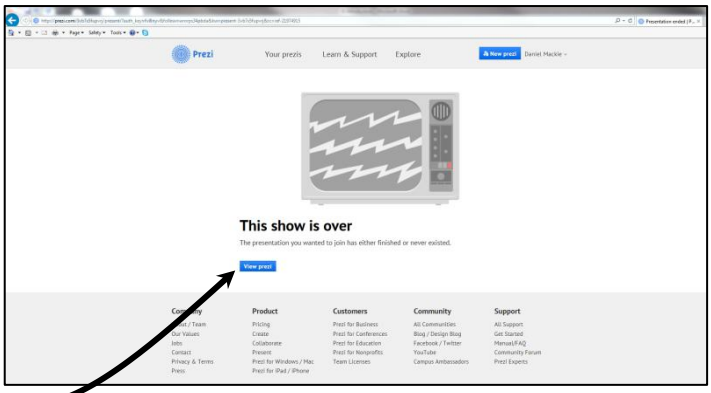
2. For Part II of today's presentation, please use this web address:

   http://prezi.com/npvb0h5tsths/?utm_campaign=share&utm_medium=copy&rc=ex0share

3. For Part III of the presentation, please use this web address:

   http://prezi.com/brzhbodiqudw/?utm_campaign=share&utm_medium=copy&rc=ex0share

When this web address opens, it may show this screen, which will most likely freak you out. Fear not! If you look down here in the bottom-left corner, there's a blue button that says View prezi , please double click on that.



Depending on your internet connection, this presentation may take a few seconds, to a few minutes, to load; so please be patient. Once the presentation does load, you can watch the course as it displays, on a portion of your PC's screen; or, you can expand it to fill your computer's entire screen by clicking on this symbol in the bottom-right corner of your screen:

Either way you choose to watch the Prezi presentation, in full screen mode or not, you will be advancing the presentation at your own pace, one transition at a time, by clicking this right-arrow at the bottom of the screen.

Note: If you opt to watch the course in the full-screen mode, the software will pop-up a question about "*Allow full screen with keyboard controls?*" Just click on the Allow button.

From that point on, you will watch and listen at your own pace. If you need to go back and redo a previous slide (or as Prezi calls them: Path), then simply click that left-facing arrow at the bottom of your screen. Adjust your PC's volume and enjoy the course.

To help you plan for how you will allot your time to go through this course, here is a breakdown of how long it should take to watch each module:

Part I: This portion of the course will take approximately one hour and 15 minutes.

Module 1: A Brief History of Biological Warfare and Bio-weapons	= 18 minutes
Module 2: A Brief Overview of Bio-terrorism	= 15 minutes
Module 3: The Threat Spectrum of Biological Agents	= 13 minutes
Module 4: The Public Health 'Toolbox'	= 28 minutes

Part II: This portion of the course will take approximately one hour and 15 minutes.

Module 5: Anthrax	= 40 minutes
Module 6: Botulism	= 15 minutes
Module 7: Plague	= 18 minutes

Part III: This portion of the course will take approximately one hour and 15 minutes.

Module 8: Smallpox	= 27 minutes
Module 9: Tularemia	= 18 minutes
Module 10: Viral Hemorrhagic Fevers (VHF)	= 28 minutes
Total amount of time needed to complete the entire course	**= 4 hours**

Continuing Education Units (CEUs)

For those of you who are taking today's training course for CEUs, please ensure that you complete Appendix A (Pre-Test) and Appendix B (Post-test). Once those are completed, we ask that you please fax them in to the state Public Health Preparedness (PHP) program's Training Officer at 775-684-5951. On your fax cover sheet please write the following: **ATTN -- State PHP Training Officer.**

Please note that this course is approved for four (4) CEU credits.

Module 1

A Brief History of Biological Warfare and Bio-weapons

[We are] determined for the sake of all mankind, to exclude completely the possibility of bacteriological agents and toxins being used as weapons;

[We are] convinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize the risk…"

—Preamble to the Biological and Toxin Weapons Convention, 1972

This module of today's presentation is intended to be general in nature and should not be construed as an exhaustive history of the topic. The expectation here is that students will gain a basic understanding of how we, as humanity, arrived to where we are today with biological weapons.

The transcript from my Prezi presentation follows along with what Prezi refers to as "Path numbers." For those of you who are familiar with Microsoft Power Point, think of each "Path" as a slide within MS Power Point, or as a bullet within one of those PowerPoint slides.

If you are taking this course at your own pace from your computer, then please allocate at least 18 minutes to complete this first module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.

Note 2: Make sure the volume on your computer is turned on, and turned up.

Here is the transcript, listed in order as 'paths', to module one of today's course.

Path #1: Welcome to the course, please adjust your computer's volume control at this time, and we'll begin as soon as you are ready. As per the course handbook's directions, you will advance the presentation at your own pace by clicking on that right-arrow along the bottom of your screen.

Path #2: Hello and welcome to today's presentation titled "*Shedding Light on Biological Threats to Homeland Security.*" I will serve as the person presenting today's material. My name is Dan Mackie, and I am an epidemiologist with the Nevada Division of Public and Behavioral Health's Public Health Preparedness program, or as it is more commonly known: the state PHP program. This presentation is intended as a training tool for federal, state and local partners that would be involved in joint operations following a biological event involving what the U.S. Centers for Disease Control and Prevention, the CDC, have designated a Category-A agents. These types of agents are those that the CDC has determined to pose the most threat to the security of our homeland.

Path #3: In Module One, I will begin by covering two core components of today's presentation: A brief history of biological warfare, and biological weapons. The intended outcome for this module is to establish a foundation of knowledge for these weapons, and a historical context of their use.

Path #4: As stated: this is class of weapons quite different from anything else we would associate with the war fighting mission. Contrary to our traditional view of weapons, Air, Sea, and Land; biological weapons are truly in a class all by themselves.

Path #5/#6/#7: None.

Path #8: We shall begin be examining the use of these weapons prior to the year 1900. In this portion of Module 1, I will predominantly discussing two historical cases of biological weapons being used to change the direction of a specific battle. However, please do not take this as the only cases of biological weapons being employed. History is rife with examples of retreating armies dumping the carcasses of animals, and in some cases, human cadavers, into drinking water sources, such as wells, along the route of march of advancing armies. We'll go into some detail on specific examples in this module.

Path #9: The first such example I will be citing is the Siege of Caffa in 1346, which is now in modern-day Ukraine. If you are interested in learning more about this event, there is a great article on the topic written by Mr. Mark Wheelis of the University of California, Davis. Mr. Wheelis' article for the CDC's Emerging Infectious Diseases, also referred to as the EID journal, was published in September of 2002, and is titled: *Biological Warfare at the 1346 Siege of Caffa*. In his article Mr. Wheelis explains how the memoirs of Gabriele De' Mussi were used as a description of how the Mongols employed trebuchets, which are catapult systems, to hurl the deceased bodies of plague victims over the defenders' walls at Caffa. As the city defenders tried to remove those bodies, they too came in contact with the fleas that carried the deadly plague bacterium. Once their host had died, these fleas then began to look for new hosts to feed upon, which due to the tactic used by the Mongols, became the defenders and citizens of Caffa.

Path #10: In this Arabic translation to De Mussi's narrative, we see a siege trebuchet depicted to the left, and the walls of Caffa with their by Genoan defenders to the right. Although no cadavers appear to be loaded into the trebuchet itself, the translation explains how that new tactic was employed.

Path #11: I apologize for the quality of this image, it's the only one I could find that helps give an idea of how this played out within the walls of Caffa. In that top-right corner of the image is a two-person team removing one of the bodies hurled into the city by the Mongols. It is at this moment when we suspect the

fleas departed the body of their deceased host, and began looking for that of a new host. This simple act is what some historians attribute the outbreak of plague amongst the populace of Caffa.

Path #12: I found this image in a old manuscript describing diseases of the middle ages. This husband and wife duo appear to be afflicted with the classic symptoms associated with bubonic plague. Those odd looking lumps spread over the couple's bodies are called buboes, hence the term: Bubonic Plague. A bubo is the severe swelling of the body's lymph nodes, which serve as a sort of filter for the body's immune system. As white blood cells trap invaders, they in turn are trapped from the blood stream within the lymphatic system. In cases like plague, the lymphatic system is overwhelmed and the nodes swell to dramatic levels as depicted here. Of special note in this image is that long haired guy in the top corner throwing what appear to me leaves into the air. Those are aromatic herbs that he is throwing around. In the time of this manuscript, the medical community attributed disease to something they called miasmas; or 'bad air.' By throwing those aromatic herbs in the room of an afflicted patient, the belief was that miasmas would be removed, thus curing the patient. If you have ever seen those images of plague doctors from this era wearing what appear to be masks with long beaks, the beak portion of the mask was hollow and stuffed with these herbs. It was thought by doing so, the person wearing the mask would be protected against the putrid air that caused infection.

Path #13: This is perhaps one of the more poignant examples of indigenous peoples suffering from the illnesses brought to them by western nations: the Siege of Fort Pitt in 1763 in what is now the Pittsburgh, PA, area. Besieged British General, Lord Jeffrey Amherst (the same person that Amherst College in Massachusetts is named after), was bottled up in Fort Pitt by many bands of the Delaware and Shawnee tribes. Lord Amherst sent a letter to the commander of his relief party with the following idea:
"Could it not be contrived to send the Small Pox among those disaffected tribes of Indians? We must, on this occasion, use every stratagem in our power to reduce them."
This 'stratagem' not only worked to bring the siege to a rapid end, but it also reduced the native American population within Pennsylvania to levels where they no longer posed any real threat to British interests in the region. Thus a tactical 'weapon' was used to have strategic impact on an entire region.

Path #14: I stumbled upon this photo of historical re-enactors portraying this tragic event in our nation's history. Little do the Native Americans realize what they are handling. The English soldiers and local citizens had long suffered bouts of smallpox infection, so they had acquired some immunity to its effects. For native peoples, this sort of infection was entirely new to them, so they had no immunity whatsoever to these new infections. If you are interested in learning more about this phenomenon, I would point you toward the Pulitzer Prize winning book by Jared Diamond called *Guns, Germs, and Steel*. He explains in great detail how this process has been repeated throughout both human history, and throughout the planet.

Path #15: This colorized image from a document of that era depicts the ongoing suffering endured by the Native American tribes around Fort Pitt long after the siege ended.

Path #16: In world history, the First World War serves as a break between what had come before, and what we see today. This war, often referred to as 'The Great War' was a conflict waged on a truly industrial and global scale. This was also humanity's first exposure to biological and chemical weapons used on a large-scale. From the Summer of 1914, until November eleventh of 1918, humanity watched as new and ghastly weapons (primarily chemical weapons) were used against large field forces on both fronts, and by all sides of the conflict.

Path #17: Perhaps one of the more infamous uses of biological weapons during that four-year conflict was by Germany. In an effort to limit the movements of their enemy, with horse-pulled equipment still being a primary means of transportation at the time, the German military leaders authorized a bio-weapons program to infect both horses (used to pull equipment) and cattle (used to feed large armies). In my research for this presentation I was surprised to learn of German efforts to also use these bio-weapons against marshalling yards here in the U.S. for horses and cattle being staged for overseas deployment to the Western Front. Of particular interest to the German High Command was the use of Glanders (also known as Burkholderia) and *Bacillus Anthracis* (also known as anthrax). I will go into more detail on each of those pathogens later in this presentation.
Germany's interest in biological weapons during this time period was not simply limited to impacting horse and cattle targets; the Germans were also interested in infecting human targets directly. One example of such interest was the plan to spread *Yersinia pestis* (also known as plague) amongst Russian troop formations staging in and around St. Petersburg on the eastern front.

Path #18: Although this image shows a horse and rider in full kit against a chemical attack, I offer this image as a means of showing to what lengths armies, of that time, would go through to protect their horses and mules. A biological

threat against these mainstays of military logistics (for that period) could, quite literally, hobble an entire army.

Path #19: Most of us would associate biological and chemical weapons primarily with the First World War, so the use of these weapons during the Second World War could come as somewhat of a surprise. Not only were these weapons employed, but the knowledge and expertise accumulated in their use became the seed for both our own bio-weapons program here in the U.S., as well as the Soviet Union's, following the Second World War.

Path #20: The best example of a fully fledged offensive bio-weapons program for this period would be that of Imperial Japan. In an effort to conceal this program's true purpose, the unit was officially called "Water Purification **Unit 731**." This unit served throughout the duration of the war, from the late 1930s after Japan invaded Manchuria and China, to the Summer of 1945. This unit was led by an ambitious doctor of microbiology, Dr. Shiro Ishii. Over the course of the war, Dr. Ishii and his team developed and refined a whole host of biological weapons, and the successful means to deliver those weapons upon an entire populace. An example of those efforts would be Unit 731's infamous porcelain bombs. Dr. Ishii and his team figured out a way to grow fleas with a particularly lethal strain of plague. When sufficient quantities of those fleas were grown, they were loaded into large porcelain bombs that would be dropped from low level over a major city. A drag parachute would slow the bomb's decent, and at a pre-determined altitude, a small charge would burst open the porcelain case of the bomb. The cloud of plague-infected fleas would fall harmlessly to the ground and begin their natural activity of seeking and feeding upon warm-blooded hosts such as humans and animals. The massive epidemics that these bombs initiated decimated the Chinese and Manchurian populations they targeted.

Path #21: Here is a war-time photo of Dr. Ishii in his uniform.

Path #22: Here is the only photo I could find of those infamous porcelain bombs that Unit 731 used to such dreaded effect over China and Manchuria. If you look closely at that bomb to the left you will notice a propeller fuse and latch near the top. That is the system that Unit 731 devised to release the fleas at a pre-determined altitude above a target city.

Path #23: This next example comes from the Soviet Union and their great struggle against the invading Nazis. In his book titled "*Biohazard*", Dr. Kantjan Alibekov (later called Ken Alibek after he defected to the U.S.) claims that as a military medical cadet, he was asked by a senior professor to research a strange outbreak of *Francisella tularensis* (aka: Tularemia) amongst German troops in and around Stalingrad in 1942. According to Dr. Alibek's research, he observed that there was a dramatic spike in tularemia cases amongst german troops initially, then soviet troops later on, in that sector of the war during 1942. He compares those

data from '42 with the data from years before and after. As you can see here, Dr. Alibek associates that spike, along with the fact that nearly 70% of those cases were of the most dangerous pulmonary form of the disease, with a suspicion that this event was caused by Russian bioweapons. That claim has been disputed, most notably, and surprisingly, from a German scientist, Dr. Erhard Geissler of the Max-Delbrück Center for Molecular Medicine in Berlin. Dr. Geissler attributes this outbreak to a collapse of infrastructure in the battle field setting, and the confluence of hundreds of thousands of troops in austere conditions, sleeping and eating amongst mice and rats that carry this disease.

Path #24: That is a great segue into the Cold War period, and how we witnessed a massive build-up of offensive biological weapons by both sides initially, then primarily by the Soviet Union by the end of that era.

Path #25: We will begin with the West and our development of offensive biological weapons. Based off of the data and plans we captured from Unit 731 at the end of the war, the U.S. used those materials as a *blue print* to help jump-start our own bioweapons program. Most notably, those efforts resulted in Fort Detrick, MD, which we will talk about later, Plum Island off the north-east branch of Long Island which is used exclusively for animal studies with biological agents; and Pine Bluff in Arkansas. These sites have been controversial since their inception and continue to be so right up to the current day.

Path #26: Here is press release photo of American bio-weapons scientists working within a research suite at Ft. Detrick sometime back in the 1950s/1960s. Those metal and glass boxes they are reaching into are called 'Hot Boxes" because they allow scientists to work with dangerous (aka: hot) agents without being exposed directly. Those boxes are also pressure negative, which means that if there's a crack or break, the air from outside will be pulled in, thus keeping the agent from escaping to the outside world. This same principle is used on a larger scale with patients who are ill with highly contagious and deadly diseases: they are placed in a pressure negative hospital room to help keep their illness from escaping to the hallways and other patient rooms throughout the hospital.

Path #27: Here is when we turn back to Dr. Alibek and his revelations to the world about the Soviet Union's bio-weapons program which he lead for a number of years, called ***Biopreparat***. I found this citation from his book to be an effective way in describing the difference in how the West and the Soviets viewed this class of weapons. What I find so amazing with Dr. Alibeks' statement is how blatant the Soviets were with their approach to using agents that had **no known cure**. The unrestricted research, development and deployment of these weapons is far different from anything the West considered at the time. Later in this presentation I will use photos of Soviet production facilities to help give each of you an idea as to how massive their bio-weapons production system truly was. If

you are interested in learning more about this topic, and Dr. Alibek's claims, I would encourage you to read his book *'Biohazard.'*

Path #28: With Nuclear, biological and chemical weapons each being stockpiled in large numbers, by both sides, during the Cold War, the specter of biological weapons being employed against populated cities become too great. Over the course of nearly a decade, the nations of the world came together to develop and sign something called the Biological Weapons Convention, or more commonly referred to as the *BWC*.

Path #29: The BWC is comprised of ten articles that were ratified and signed into international law in 1972. Both the BWC and its conventions remain in effect to this day. It is this law that you will often hear being referred to when Syria's embattled President, Bashar Al-Assad, uses biological weapons against his domestic enemies within Syria, or when Saddam Hussein used them against the Kurds in northern Iraq following Operation Desert Strom in the early 1990s. With so many nations contributing to the authorship of this convention, it is no wonder that complaints of weak verification have emerged. Nor would the argument that the convention leaves too much room for interpretation of *'offensive versus defensive'* biological weapons, come as any sort of surprise. If you have been following along in the course handbook for this presentation, you will notice that I opened module one with a quote from the BWC. A lofty as those aspirations within that quote appear, one must wonder if we have achieved that stated desire to "*exclude completely the possibility of biological agents and toxins being used as weapons*."

Path #30: Before moving on to the next module of this presentation, if you have any questions concerning what I have already covered up this point, please e-mail your questions to this address: PublicHealthDan@gmail.com, or feel free to call me at 775-247-3680.

A Brief Overview of Bio-terrorism

"Terrorists want a lot of people watching and a lot of people listening and not a lot of people dead."

—British Author Brian Jenkins

This module of today's presentation is intended to explore if terrorist organizations would even consider using biological agents in an attack. I will be citing various books and articles related to counter-terrorism that discuss this question in greater detail.

If you are taking this course at your own pace from your computer, then please allocate at least 15 minutes to complete this second module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.

Note 2: Make sure the volume on your computer is turned on, and turned up.

Here is the transcript, listed in order as 'paths', to module two of today's course.

Path #31: Now we will transition to the use of this class of weapons by non-nation state actors, or terrorists.

Path #32: As with the previous module, the intent here is to not go into an exhaustive history lesson. The examples cited in this module are only the latest in what history would tell us is a much longer timeline. In the post 9/11 world, there are many people who see biological weapons used in terrorist attacks as "low probability/high consequence events." These improbable events are known by a another term, as author Nassim Taleb calls them in his 2010 book with the same name: *Black Swan* events. In this module we will cover four such events.

Path #33: Early on in my studies at the Naval Postgraduate School (NPS), many of my classmates, as well as some faculty, would ask: do terrorists even consider using such a class of weapons in their attacks? If so, would a terrorist organization attract too much of a response from the targeted nation, once the proverbial '*genie is let out of the bottle*', as well as from the rest of the global community, because the use of such weapons is considered taboo?

Path #34: Based off of my studies at NPS, it appears to me that there are basically two camps of thought surrounding this question.

Path #35: The first of these would be by this well respected, and published gentleman: Dr. Bruce Hoffman. Dr. Hoffman was a professor at the University of St. Andrews in Edinburgh, Scotland, and later went on to research and write for the Rand Corporation. His writings were a major component of our studies at NPS.

Path #36: One such example of those writings by Dr. Hoffman is this book: *Inside Terrorism*. In this piece of his work, Dr. Hoffman wrestles with many of the key issues within the field of terrorism studies; such as: how do we even define the term 'terrorism' (you would be surprised to see how many different definitions there out there, and that's just within the various branches of our own government!).

Path #37: Dr. Hoffman makes great use of the work by British writer: Brian Jenkins. As the U.K. came to grips with an expanding and escalating counter-terrorism effort against the Irish Republican Army (IRA) in the 1970s and 1980s, Mr. Jenkins wrote some extraordinary work concerning the '*Hows and Whys*' behind terrorist organizations. This first quote from Jenkins that Dr. Hoffman uses in his book is one of my favorites because it is so simple. As we all watched the horrifying events of September 11th unfold before our eyes, one must admit that the wave attack-method used by Al-Qaida made maximum use of gaining and

holding, to quote Jenkins: the "*attention of the electronic media and the international press.*"

Path #38: This next quote helps to explain why Hoffman would not expect terrorists to use biological weapons: it's not about killing a lot of people, it's about killing enough people to get everyone else to tune into the TV and radio news. Biological agents have the uncanny ability to keep killing long after they have been released. So from a terrorists' perspective, it's rather difficult to negotiate terms when the weapon you used to force the government to the negotiating table…keeps killing people. It's this lack of control that in Hoffman's eyes make this class of weapon a poor choice for a terrorist attack.

Path #39: In opposition to Dr. Hoffman's perspective, we have another view, that in this new age of terrorism, when events like 9/11 have raised the bar to new heights; the use of such weapons is feasible, and some would say, even likely.

Path #40: This is Dr. Reza Aslan, and for those of you who watch *Fox News*; yes that is the same man who had the on-air argument with the interviewer back in 2013 when he was repeatedly asked why he, as a Muslim, would choose to write a book about Jesus of Nazareth.

Path #41: This is only one of many books that Dr. Aslan has authored, and I chose this cover because it introduces a core concept within his writings: the idea of a **Cosmic War**. This idea is rather basic: this new breed of fundamental religious terrorist groups subscribe to beliefs that are so hard core, that the only way those beliefs could be realized is by either destroying other races/religions/ethnic groups/etc., or by losing their lives in the process of seeking this perfect vision. This mindset is not limited to only one faith, if you look at the word "War" on the cover of this book, the symbols to Christianity, Islam and Judaism are depicted. From whatever faith they originated from, these are tough groups to negotiate with because they often seek no monetary, political, or social incentives. What they seek either does not exist on this earth, or could not exist on this earth without a lot of people being killed off.

Path #42: That idea took on so much interest that it resulted in this book: *Beyond Fundamentalism.* In our curriculum at NPS, this is one of the first books we are asked to read in depth prior to our first set of in-residence courses. It was then, and continues to be, one of my favorite books from the NPS program because it explains the underpinnings of this idea of a *Cosmic War.*

Path #43: In an effort to help provide you with a succinct quote that best illustrates this idea of a *Cosmic War,* I chose this quote. Notice how there is no middle ground with this very binary way of looking at the world: us versus them, etc. Pretty hard to negotiate and appeal to a group of people (be they Christian, Islamic or Jewish fundamentalists) who see our very existence as an aberration.

No a lot of wiggle room there. If you are interested in hearing or learning more about this concept, I am including the citation below for you.

Path #44: None.

Path #45: In an effort to balance these two contrary views on the use of biological weapons by terrorist groups, our class also read an article from the Washington Quarterly, by Mr. John Parachini. I chose this quote because the author struggles to put this threat in perspective amongst all the other things we, as Homeland Security enterprise practitioners, are being told to concern ourselves with. Within this broader context, Mr. Parachini describes examples of the bio-weapon related attacks what we have seen in the past 30+ years.

Path #46: For those of you who are not from public health, you may be surprised to learn that a successful bio-weapons attack has made on U.S. soil in the not-too-distant past: the 1984 attack using salmonella by a religious group called the Rajneeshees. Their attack was intended to sway local elections in Wasco County, Oregon. This group had been in conflict with the local county government over zoning laws, which they saw as infringing upon their rights. In the days leading up to the local elections, the Rajneeshees spread salmonella across buffets and salad bars at local restaurants. By the time that election day arrived, the idea was to have so many of the local people home, too sick to go out and vote, that the registered and un-infected voters from the Rajneeshees would be the only ones left to vote; thus changing their local political situation to their benefit. The attack was a success: the group managed to sicken 751 people, with 45 of them being hospitalized. This is a classic epidemiological study at most public health programs, and if you are interested in using the study guide from the program I attended, please contact me and I'll send you a photocopy. Notice how in this example, the attack does not fit with either Hoffman or Aslan's ideas: This attack was successful in effecting political change, yet it did not kill anyone (thank god), nor did it attract electronic media attention outside of the local news outlets. In fact, it was not until some years later, when a member of the Rajneeshees left the group and informed local law enforcement and public health of what had really happened on election day. If this person had not come forward, we may never have learned what happened. In the days after the attack, the CDC sent an outbreak investigation team to look into what was going on in Oregon. That team's investigation revealed no nefarious actions.

Path #47: This is a photo of the groups' spiritual leader, Bhagwan Shree Rajneesh, boarding his personal jet.

Path #48: I apologize for the grainy quality of this photo, I added it to show how the group converted their new found political power into real impacts on the ground. Following the elections, they created their own town within a town. You can also see their population listed below the sign. With a population number like

that showing up for local elections, it's no wonder that the Rajneeshees won any ballots they sought to gain in the election; especially when they removed 751 local voters from the vote.

Path #49: Although this example by Parachini is related to the use of a chemical weapon by a separatist/terrorist group, it does serve as an example of using a politically taboo weapon (such as bio-weapons). Prior to my studies at NPS, I had never heard of the Tamil Tigers, but now that I've completed the program, I see them as perhaps one the most innovative and audacious of modern terrorist groups, up there with Al-Qaida. In my humble opinion: if you are interested in studying modern terrorism, I would begin with an in-depth study of this group.

Path #50: This is their final leader, Velupillai Prabhakaran who was killed by the Sri Lankan Army in 2009, thus ending a long enduring conflict between the Tamils and the Sri Lankan government.

Path #51: This is the bio-attack that most of us remember: the 1995 Sarin attacks on the Tokyo subway system by the religious cult: Aum Shinrikyo. This is the event that accelerated any and all plans/preparations against biological attacks by the world's nations. Once this event went down, it was no longer 'if' but 'when.'

Path #52: I struggled with the decision to even use this image as part of today's presentation, for it shows a man literally taking his last breaths before he passes away. Although we cannot recognize him, I am sure there are people in Japan who still do, for he was someone's son, brother, friend, husband, or father. Although it has been nearly twenty years since this terrible day in Japan, I have no doubt that the families and friends of those we lost still ache. I included this image because it re-connects each of us to why we chose to serve within public health or Homeland Security: to protect the American people. What makes this photo so heart breaking for those of us who have studied this agent, is that Sarin is heavier than air, so it sinks to low ground. No one knew what they were being hit with at the time, so laying people down into a colorless and odorless cloud is an easy mistake to make. One must wonder: if these people were brought up to fresh air, would they have survived?

Path #53: This shocked me when I studied Aum Shinrikyo while at school. We hear and know so much about the subway attack, but few of us know that this was that cult's eleventh attempt at employing biological weapons in an attack. Not only did some of these previous attacks succeed, they used different biological agents as well. The fact that multiple attacks, using multiple agents, over multiple years, was this groups' reality, makes the study of how they did it even more important. In the end Aum spent a lot of time and effort on attacks that, thank goodness, were not as successful as they had envisioned. I have included the citation to Parachini's article in case you want/need to read more.

Path #54: This changed a lot of things across the U.S., and it did so separately, but in parallel to the tragic events of 9/11. The anthrax letter attacks impacted multiple states, multiple levels of government, and multiple families. Hot on the heels of the 9/11 attacks, this event made the simple act of going out to the mailbox and opening letters a dangerous endeavor. From my reading of the subject, the two facts that capture my attention are: 1) when law enforcement finally tracked down which drop-off mailbox the letters were sent from, it was still 'hot' for weaponized anthrax spores; and 2) the scientists who studied the anthrax spores used in these attacks identified a **single strain**, the Ames Strain which is often used by laboratories studying weaponized anthrax, but there were varying grades of spore used. I will discuss this in greater detail later in the Anthrax portion of this course.

Path #55: The Daschle letter was one of the letters that contained the higher grade of weaponized anthrax spores.

Path #56: This is the CDC's Morbidity and Mortality Weekly Report (aka: MMWR) that was published in the days/weeks following the 2001 anthrax attacks. That chart at the bottom is something that we in epidemiology call an '***Epi Curve.***' These are used to track how many people were ill, and when they were ill. If you look at those two spikes on the Epi Curve you will notice that many cases are bunched together. This is a classic indicator of what we call a **common-source exposure**. That is fancy way of describing an outbreak where people who were in the same area, at the same timeframe, all became ill within the same window of time. I snipped a copy of an image from a course presented by the University of Hartford, in Connecticut. This chart compares two classic epi curves superimposed over each other. That Common Source curve to the left shows a lot of people becoming ill all at once, but then the number of new cases wanes dramatically. That green curve is for a disease that can transmit Host-to-Host (e.g. influenza). Here is how the educators at University of Hartford explain this chart: *"Common source epidemics usually produce more new cases earlier and faster than host-to-host epidemics. Once the infected source is closed, sealed, or removed, the common source epidemic usually abates rapidly. Host-to-host epidemics are slower to grow and slower to diminish."*

Path #57: Before moving on to the next module of this presentation, if you have any questions concerning what I have already covered up this point, feel free to e-mail me your questions to this address: PublicHealthDan@gmail.com, or feel free to call me at 775-247-3680.

Module 3

The Threat Spectrum of Biological Agents

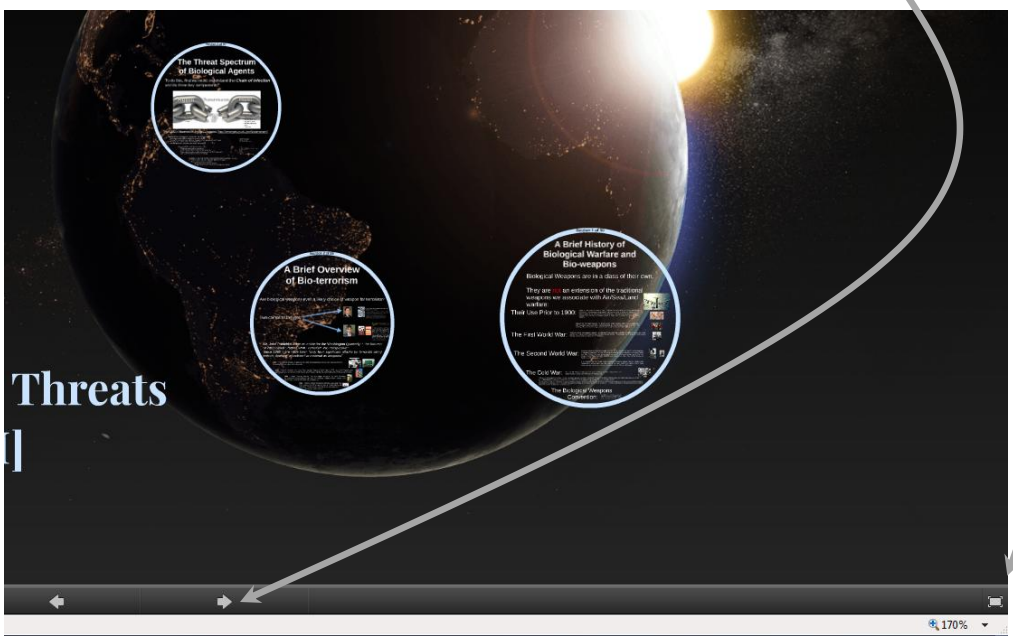
"Of the biological agents that may be used as weapons, the Working Group on Civilian Biodefense identified a limited number of organisms that, in worst case scenarios, could cause disease and deaths in sufficient numbers to gravely impact a city or region."

—Journal of the American Medical Association (JAMA), May 1, 2002, Vol. 287, No. 17, page 2236

In this module of today's presentation we will explore the process that infectious agents need to accomplish, to get from where they are, into our bodies; this is called the Chain-of-Infection. That will be followed up by a brief description of the agents that the U.S. Centers for Disease Control and Prevention (CDC) have labeled as the most threatening to our domestic security.

If you are taking this course at your own pace from your computer, then please allocate at least 13 minutes to complete this third module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.



Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #58: Now that we covered the history of some of these agents, now we'll delve into the actual threat spectrum agent these agents pose to both public health and Homeland Security.

Path #59: As it says; we first need to understand how people become infected with a biological agent. This process is often referred to as the '*Chain of Infection*' and is a core concept provided in both medical and public health degree programs. Once that is understood, then both public health and its sister agencies will use common vocabulary and grammar when addressing biological threats together.

Path #60: There are three components to the *chain-of-infection*, and in this field I will address them one at a time. The first is what we call an 'Agent', which is basically a fancy way of saying: something that can make a person or animal sick.

Path #61: There are basically five types of agents that we, in public health, and Homeland Security, need to concern ourselves with when it comes to biological threats to the homeland. The first are viruses which are thought to be one of the oldest life forms on our planet. When classified with other life forms, viruses are

literally in a class by themselves. They are unique in that they cannot do many of things other life forms do, on their own. The best example of that would be replication. In order for a virus to make more copies of itself, it requires a host cell to do so. These are also some of the smallest living things on our planet. To help give you an idea of how a virus' size measures up against that of a bacteria, or a cell; I will use this example from a book I once read:

Imagine you are flying above a soccer stadium: the stadium around the soccer field would be a good representation of a cell's size, the field would represent the scale of a bacterium, and the soccer ball in the middle of that field would represent the size of a virus.

Next we have toxins, which are natural compounds made by some organisms, that are extremely lethal to others. Later in this course I will go into more depth on one such toxin: *Clostridium botulinum* or botulism. The next example of an agent are parasites. These are the bugs you hear and see so much about on those television shows about people who went to developing countries on vacation and came back with a worm living in their intestines, etc. From a bioterrorism perspective, one would think this type of agent as irrelevant; but that's why I discussed Japan's **Unit 731** previously. In that example porcelain bombs loaded with plague-infected fleas were dropped on unsuspecting city centers throughout China and Manchuria during WWII. Finally we have fungi, which for any of you who have had bread go bad at home, you know what these little fuzzy guys look like. Although this would at first glance appear to be a poor class of agents for bioterrorism, their persistence is quite remarkable. We still hear of mold issues (another term for fungi) in New Orleans following the floods of Hurricane Katrina in September of 2005. For any of you that have had mold abatement issues in your own home, you already know how tough it is to remove both the mold/fungi, and the billions of tiny spores they release.

Path #62: The next link in the infection chain is 'Transmission', which is the process of getting an agent from where it was into an unsuspecting person and/or animal.

Path #63: This is public health 101 sort of stuff, but it is always wise to go back over it, just so everyone is using the same terminology. This information comes out of a CDC document called the *"2007 Guidelines for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings."* For those of you following along in the course handbook, I have added the web address to this document in case you want or need a copy for yourself. The mode of disease transmission we seem to hear the most about is contact, especially during cold and flu season's winter months. These are those dirty doorknobs, elevator buttons, handrails, and handshakes that our mothers always warned us about. Person A coughs and/or sneezes into their hands, then with those same hands, then goes on to touch all sorts of objects that the rest of us also touch. That transfer puts the agent of

Person A on the hands of Person B/C/D and so on. If any of those people touch their eyes, nose, mouth, open skin, etc., then Person A's agent is well on its way to infecting those other people, then the process repeats itself. You will notice the CDC has further divided this mode of transmission into two subtypes: direct and indirect. Here is how they define direct contact on page 16 of that document they published in 2007: *"Direct transmission occurs when microorganisms are transferred from one infected person to another person without a contaminated intermediate object or person."* The authors go on to define indirect contact transmission as well: *"this involves the transfer of an infectious agent through a contaminated intermediate object or person."* They go on to cite contaminated hands, patient care devices, and medical instruments as examples of these intermediate objects. Here's an image of those nasty door handles our mothers warned us about.

http://www.cdc.gov/hicpac/2007IP/2007isolationPrecautions.html

Path #64: None.

Path #65: Next we have droplet which are those tiny globules our body ejects when we cough and/or sneeze. Each of those tiny droplets act like a sort of life raft for agents looking to leave one host, with the intent of finding another. Each of those wet droplets provides a mini ecosystem for germs to survive in, but this is a race against time. Once that droplet dries out, so too do the germs they housed. For as small as they appear to the naked eye, these droplets are actually quite large when one considers the size of bacterium and viruses they house. When the droplets are ejected from the body, they do not hang in the air for much time. Gravity ends up pulling them down to the ground within three to six feet from where they started. Non-porous floors (e.g. tiles) and surfaces (e.g. countertops, smooth walls, etc.) generally end up being where these droplets reside. In this demonstration photo from the CDC, you can get a sense of the sheer volume of droplets ejected during an uncovered sneeze.

Path #66: None.

Path #67: Unlike droplets that are ejected from the body and immediately fall to the ground, airborne transmission involves agents that are so small they can remain suspended in the air for an appreciable amount of time. These pose a particular challenge to infection control specialists in hospital settings because an infectious person in one hospital room could infect other patients in neighboring rooms that they never even come in direct contact with, and so on. In cases like this, those pressure negative rooms I spoke of earlier would be called into use to help limit the possibility of the agent escaping.

Path #68: None.

Path #69: Vehicle transmission is when something inanimate carries an agent to the body; good examples of this would be food and water. Foodborne illnesses

gain a lot of national attention each time we hear about salmonella outbreaks amongst people who ate a certain vegetable from a certain farm, etc. We also seem to be hearing a lot about cruise ships that are battling large-scale Norwalk Virus (aka: Noro virus) outbreaks aboard ship, etc.

Path #70: None.

Path #71: Vector transmission is when something animate like a flea, a fly, a tick, or mosquito, carries an agent to the body, and delivers that agent usually through a bite. Classic examples of vector-borne transmission of disease would be Yellow Fever, malaria, West Nile Virus, etc. As a former Peace Corps Volunteer who spent many years living and working in public health clinics along the equatorial belt of Africa (Gabon, Kenya, Congo, etc.), I can attest to the unbelievable disease burden these types of illnesses bring down upon people in those areas of our planet.

Path #72: After spending so much time in that part of Africa, I am often asked by people back here in the states: what is the most dangerous animal over there, or what animal was I most concerned about 'running into?' These people are often shocked when I reply that the lowly mosquito, in my opinion, is the deadliest animal in all of Africa, if not the world.

Path #73: Finally we have the third and final link to this chain-of-infection, the Host (that's you and I, along with our pets).

Path #74: Rather than leave it at that, I thought this would be a good opportunity to go back over the Portals of Entry to a body that agents could use to gain access. The first is of course those skin and mucous membranes we know about such as the ears, eyes, and nose. Next we have the respiratory tract that includes the upper (nose, sinuses, throat), and the lower tracts such as the bronchial tubes and the lungs. The third portal of entry listed here is the digestive tract, followed by the genitals and urinary tract which of course would involve sexually transmitted diseases or STDs, and finally we have the placenta. That is when an agent is passed from a mother to her unborn fetus through the placenta in the womb.

Path #75: If you have any questions concerning the Chain-of-Infection, please pass them along to me via that e-mail address and/or cell phone number provided previously.

Path #76: So now that we have established a basic understanding of how an agent transmits itself from where it was to our bodies, now we will focus in on the biological threats themselves. There is a more detailed version of what I am about to cover on that CDC website listed here.

Path #77: The CDC has divided biological agents that it sees as potential weapons into three categories: Category A, Category B and Category C. The category A

agents are those thought to pose the highest risk to the publics' health and our national security. The list of six Category A agents represent some of the most deadly pathogens humanity has ever seen. Although one of the six agents was declared by the World Health Organization (WHO) as being eradicated worldwide in the early 1980s, the specter of that virus re-emerging as an intentionally released outbreak still looms. As the bullet points indicate, these are the agents that could move through a population with ease, and would kill many of the people they infect.

Path #78: This list is in alphabetical order, so please don't think one is any worse than the others. I am listing each agent by both its Latin name, and by its more common name. I am also listing the fact of whether an agent is a virus, a bacteria, or a toxin. I provide these identifiers as a means of correcting an issue we experienced here in Nevada during a large-scale exercise held in March of 2012. At that time, the Nevada state PHP program participated in a three-day (full-scale) exercise called '*Simple Truth*.' This capstone exercise was intended to build and expand upon previous exercises involving an anthrax release in one of Nevada's population hubs. In spite of having been the latest in a series of anthrax-related exercises, I was quite shocked to hear some of our partners referring to the agent as "anthrax *virus*." When I tried to make the necessary correction, I was even more surprised to hear: "*viruses and bacteria, they're all the same thing.*" Ugh! That is like telling a counter-terrorism person that Sunnis and Shia are the '*same thing*.' Later in this course I will cover each of these Category-A agents separately, and in detail.

Path #79: The Category B agents are obviously a step down from what we just covered. These agents pose a threat, but not to the same scale as the Category A agents. Some of the reasons as to why they do not pose as serious a threat have been listed in the bullet points provided below.

Path #80: You already heard about that fourth one down the list: Glanders. That was one of many agents that the German looked at using during the First World War. The others are an assortment of pathogens that can infect humans, animals, or both.

Path #81: The final category, known as the Category C agents, are those that could emerge to become large-scale problems in the future. One concern is that if existing strain of these viruses are re-engineered to become something far more lethal, then these could become more substantial threats than what they are already.

Path #82: None.

Path #83: OK, that's it for this module. Before I move on to the next, if you should have any questions concerning what I have already covered up this point, please e-mail them to at the following e-mail address: PublicHealthDan@gmail.com, or feel free to call me at 775-247-3680.

Module 4

The Public Health 'Toolbox'

Plan strategy, improvise tactics. Good planning is not the same thing as good management.

— E.L. Quarantelli

Thus far in today's presentation we have discussed the biological threats to Homeland Security, but we have not gone into what we, as public health and/or Homeland Security practitioners, plan to do about them if we were to be hit. In module four we will look at options public health would have during a response to help break that Chain-of-Infection discussed in module three.

If you are taking this course at your own pace from your computer, then please allocate at least 28 minutes to complete this fourth module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here

Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #84: Now that we have covered the biological agents, along with some of their history of use; we have a basic understanding of the processes these agents need to go through in order to gain access into a body. Now we can discuss what public health intends to do to prevent those processes from happening, or as you saw in the previous module's diagram: to break the Chain-of-Infection.

Path #85: Earlier in today's presentation I mentioned a full-scale exercise called '*Simple Truth*' that was conducted back in 2012. If you recall, I also mentioned that during this exercise, some of our partner agency's had difficulty understanding the differences between viruses and bacterium. In this module I will build upon the corrective actions that we, at state PHP, took to alleviate those problems; which at their core, are basically training issues. After working with our partners from '*Simple Truth*', the state PHP Training Officer and I came up with something that we call '*The Public Health Toolbox*.'

Path #86: The idea is rather basic: what interventions would public health '*bring to the fight*' in response to a biological attack? In addition to the issue we experienced during '*Simple Truth*' concerning virus versus bacterium, we also

learned that our partners were confused as to when certain public health interventions should be taken. For example: during '*Simple Truth*' we had people asking about when we should employ isolation and quarantine plans for people exposed to anthrax. As we will learn later on in this course, anthrax cannot be passed from person-to-person, so there's no need for isolation and/or quarantine plans and procedures to be activated. To help prevent these sort of misunderstandings in the future, the public health toolbox was designed as a quick reference guide to ensure responders are literally on the '*same-sheet-of-paper.*' The idea behind this 'toolbox' is something called the VMAIQHS Model…which you can probably tell, isn't an acronym that 'rolls off the tongue', hence the reason we instead call it the 'toolbox.' We list each of the seven components in an order of efficacy, which means: we put our most effective intervention first, and work our way down.

Path #87: The first tool in our toolbox would be vaccination. If we were to be hit with an agent that has been properly identified, the first question we as public health responders would ask is: "Do we have a vaccine against this agent?" Vaccinations are one of public health's greatest achievements, for when vaccinations are done properly, they impart a prolonged protection against specific threats to our body. While serving in Africa as a Peace Corps Volunteer in Gabon (1998 to 2000) and Kenya (2001), it was routine to see national vaccination drives on at least an annual basis. Vaccines in that part of our planet are considered so important, that I have seen presidents nearly lose elections if their electorate believed their leader to be weak on getting vaccines to the people. So you can imagine was surprise when I returned home to the U.S. to see this anti-vaccine campaign being led by people like model and actress: Jenny McCarthy. If you are interested in hearing or learning more about this national debate, I would point you toward a Frontline report done by PBS called "*The Vaccine War*" in 2010. For those of you following along in the course handbook, I have included the web address to the PBS website for that documentary: **http://www.pbs.org/wgbh/pages/frontline/vaccines/view/**

Path #88: We owe this triumph of public health to the founder of Immunology, an English physician named: Dr. Edward Jenner. Dr. Jenner noticed that milk maids (also known as dairymaids) did not appear to fall ill with smallpox at a rate he observed in the rest of the population. These milk maids would develop cowpox lesions on their hands, and upon closer inspection, he observed that milkmaids who had acquired cowpox in the course of their duties were now protected against infection by smallpox. Based off of these observations, he concluded that cowpox would not only protect against smallpox infection, but that if it was transmitted from one person to another as a "deliberate mechanism of protection", it would confer protection. Here is an excerpt on what happens next from an article in January 2005 by Dr. Stefan Riedel of Baylor University's Department of Pathology: "*In May 1796, Edward Jenner found a young dairymaid, Sarah*

Nelms, who had fresh cowpox lesions on her hands and arms. ON May 14, 1796, using matter from Nelms' lesions, he inoculated an eight-year-old boy, James Phipps. Subsequently, the boy developed mild fever and discomfort in the axillae. Nine days after the procedure he felt cold and had lost his appetite, but on the next day he was much better. In July 1796, Jenner inoculated the boy again, this time with matter from a fresh smallpox lesion. No disease developed, and Jenner concluded that protection was complete." This image depicts that fateful experiment with young James Phipps by Dr. Jenner. For those of you who are following along in the course handbook, I have included the web address to Dr. Riedel's article if you would like to learn more on this person: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200696/pdf/bumc0018-0021.pdf

Path #89: The next tool in our toolbox would be medications. If we were hit with a biological agent, we would next ask: "Are there any medications available that we can give to either prevent disease, or treat the disease?" That first point about preventing disease is what we refer to as a post exposure prophylaxis or PEP. Later when we discuss anthrax and plague, PEP will figure heavily into our response options. For people who were exposed to an agent and became ill, then we would want to know if there are any medications available to treat or cure the disease.

Path #90: Although there are a wide range of medications available, within the scope of today's discussion, we would be most interested in antibiotics. These life-saving medications literally changed how we viewed disease overnight. Prior to their discovery, age old illnesses caused by various bacteria plagued humanity. But due to some sloppy housekeeping in a research laboratory, all that changed by this man: Sir Alexander Fleming. While studying and researching influenza virus in a lab, Dr. Fleming let the culture plates he had used in previous experiments to pile up in the laboratory sink. He noticed that on one of them, a mold had developed on a plate with staphylococcus culture. Any place on that plate where the mold came in contact with the staph culture, the staph died. This inspired him to look into this phenomenon further. He would dilute the mold culture 800 times, and yet it would still kill off the staph culture. These efforts became his discovery of penicillin, and to a Nobel Peace Prize in 1945 for his work. In the nearly ninety years since their discovery, this class of medications has nearly lost its supremacy over bacterial infections. If you are interested in learning more about this threat to global health, I would recommend you watch the PBS Frontline documentary called "Hunting the Nightmare Bacteria." For those of you following along in the course handbook, I have included the web address to the PBS website for that report: http://www.pbs.org/wgbh/pages/frontline/hunting-the-nightmare-bacteria/

Path #91: Although antivirals are a type of medication, we split them apart because this class of medications serves such a unique role. It seems that every time we learn of a new pandemic-strain influenza virus, everyone starts asking about antivirals. Over time people have developed an inflated sense of what these medications can do. For all the attention this class of medications has received, people view them as some sort of silver bullet. They are not a silver bullet. These meds must be taken at very specific time frames within a viral infection, and do not confer any sort of permanent protection against a viral illness. This means that: if we started providing these to a person who was exposed to a virus, and that person kept being exposed to the virus, then we would need to keep providing them with antivirals until a permanent protection (such as a vaccine) could be given.

Path #92: Here is a mini-lesson in how antivirals work. Remember that portion of today's course when I discussed how viruses are incomplete life forms that require a host cell in order to replicate themselves? Here is where we will apply that lesson. To the left we have a square shaped object representing a host cell's outer layer. We also see an arrow penetrating through that outer layer, that is a virus trying to get inside the cell. That long word above the cell, pronounced hemagglutinin, is the name of surface proteins on the outside of a virus. There are 16 different types of hemagglutinin proteins, called H1 through H16 for short. If you can imagine these 16 different hemagglutinins as 16 different keys sticking up from a viruses outer layer, then you get an idea of how a host cell sees them. Antivirals are like stuffing a wad of bubble gum into some of the host cell's key holes. When the virus tries to insert its 'keys' into these key holes, they are blocked. Antivirals that block an invading virus from fitting any of its keys into a host cell's outer key holes are referred to as "hemagglutinin inhibitors." When these are administered correctly, they prevent the virus from propagating and making millions of copies of itself within our body. In that diagram to the right we have a virus depicted as an arrow trying to exit a host cell. That word above, pronounced neuraminidase, is what we call another type of surface protein on the outside of a virus. If an invading virus has penetrated a cell and made millions of copies of itself by hijacking the host cell's reproduction machinery, now those new viruses need to exit their host and begin the process anew. To achieve this they must insert their keys called neuraminidase which are labeled N1 through N9 for short, into the host cell's inner keyholes. If they cannot find a way out, the host cell dies, but the infection stops dead in its tracks because those new viruses can't get out and infect new cells. Some antivirals work as neuraminidase inhibitors: they block some of the keyholes that the newly minted viruses try to open to get out. With sixteen different Hs and nine different Ns, now you understand what we're talking about when we say: H7N9 (that the seventh key to get in, and the ninth to get out of a host cell).

Path #93: We often hear people use the term isolation and quarantine in unison as if they stand for one thing; but in reality, they are quite different from each other, both in what they're expected to do, and the logistics that

go along with each of them. Isolation is for people who are already sick with a contagious disease. This makes planning for isolation wards much easier from a logistical and planning point-of-view because we can co-locate isolation ward patients in what we call 'shared air.'

Path #94: Here is an example of what I mean by 'shared air' from the 1918 Spanish Influenza pandemic. This military isolation ward has co-located a large number of its patients who are already shows signs and symptoms of infection into one big room: hence the shared air phrase we use. Since they're already sick, they can cough and wheeze on each other without creating a new sick person. Before we move on, here is a little exercise about the 1918 Spanish Influenza. In this photo of people who are clearly ill with that life threatening influenza virus, what percentage of these men died of that infection? 5% 10%, 20%, 30%, 60? Take a moment to select what choice you would select. Here's the answer, and it may come as a shock to you: based off of the data from that pandemic, we estimate that somewhere between **2 and 5 percent** of the people who fell ill with that strain of virus died from it. What made this pandemic so deadly was that it infected 25 to 30 percent of the population. Losing 2% of one thousand people is a MUCH different number than losing 2% of a billion. This is what we in epidemiology refer to as an "Attack Rate." If you are interested in learning more, I have another Prezi presentation on that topic and pandemic strain viruses that I can send to you.

Path #95: Next we have quarantine, and as I stated previously: this is much different from isolation. Here is an interesting tidbit of information from the educators at the University of Hartford in Connecticut, on where this word originally came from: *Quarantine, from the Italian word* ***quarentina****, meaning forty days was the amount of time for isolation of any ships entering a harbor that were thought to be carrying some form of contagion. This number of days, is based on no scientific reason, but rather on the number of days the bible said Christ spent in the wilderness.* Quarantine is for people who may have been exposed to an illness but are not yet symptomatic with that illness. From a planning and logistics point-of-view, this requires a higher degree of complexity: each patient must be housed separately, and have their own air. To help give you an idea of how that would play out during a response, I will explain how we here in Nevada look at this planning and logistical challenge. If we needed to house a extraordinary number of quarantine ward patients, we could perhaps use existing infrastructure here in our state to help in those efforts. With Nevada's economy tied to gaming and tourism, we have an abundance of hotels. Those hotels are accessible to all types of people (e.g. ADA compliant), they're centrally located, and they have their own cooking/cleaning systems onsite. If we could work with hotels interested in becoming quarantine wards, we could assign patients to alternating rooms and alternating floors. By this I mean: we could house one patient per even-numbered rooms, and on even-numbered floors, etc.

Path #96: The concept of quarantine goes back hundreds of years. Our counterparts in the nautical world have long used the yellow flag, as seen here, as an easy way to wave off other ships because this ship contained crew or passengers who were ill with contagious disease. If you ever notice that the U.S. Surgeon General wears a naval officers' uniform, this is in recognition of the historical fact that the navy once controlled quarantine of offshore ships. Ships trying to enter port were required to host a U.S. Navy health inspector who would verify if there was any outbreak already onboard an arriving ship.

Path #97: Unfortunately Hollywood has taken this concept and overinflated what it actually is. For any of you who were around in the 1980s, this scene from Steven Spielberg's hit movie, E.T., is a great example of what I'm talking about.

Path #98: Here's what it actually ends up looking like if a person who was initially in quarantine becomes ill. They are moved them to a new space, and we disinfect the old space. This photo from Uganda's 2012 Ebola outbreak is a good example. When dealing with infectious disease, the idea is to not have porous surfaces for the virus to hide in while we clean and disinfect. So the walls and floor are covered with plastic that can be sprayed and soaked with a five percent or ten percent bleach solution that's spread through five gallon sprayers. We will talk more about this later on in this presentation when we discuss viral hemorrhagic fevers or VHF.

Path #99: Next we have the oldie but goodie: hygiene which would include decontamination. That is just another way of saying that we physically removed an agent from the environment, or from the surface of our body. You'll notice that in the parenthesis I also have an acronym: PPE. That stands for Personal Protective Equipment which are physical barriers that prevent an agent from entering our body. These are great ways of breaking that middle link in the Chain-of-Infection called *Transmission*.

Path #100: The makers of those fancy hand sanitizers hate when people such as I say this, but good old fashioned soap and water work really well in combating infectious diseases. Our mothers and our grandmothers were right when they ordered us as kids to "*wash up before dinner!*" That simple act removes all sorts of agents from our hands, the same hands that carry food to our mouths, which if you remember from that Chain-of-Infection discussion, the mouth is a portal-of-entry, as is the gastrointestinal tract.

Step #101: This is an example of a wet decontamination station, during an anthrax exercise. It's pretty basic: park two fire trucks side-by-side, spread a ladder across them, and hang a fire hose off the middle of that bridge. I don't know about you, but when we used to play under fire hydrant water as kids, that water was friggin' cold! This poor guy was not only hit with anthrax spores, but now he has to run around the back parking lot in his skivvies, and get hosed down by freezing cold water! Yikes! Over the course

of many exercises like this, we have learned to use warm water and shower stalls; we have also learned to capture that run-off water down on the concrete. The good folks over at environmental protection refer to this as 'grey water.' Just because a spore was washed off does not necessary mean that same spore is dead. If left to flow down into the sewer system, it could come back later to haunt us.

Path #102: So now when we pull the trigger on exercises like this, we provide warm water, privacy screens, and if you notice, tubs to capture all that grey water I mentioned.

Path #103: Here's an image of some various forms of PPE that I mentioned earlier in this module. It looks pretty basic, but for any of you who have had a friend or loved one in a hospital under what are called 'contact precautions', you know that we are required to put on a new set of these scrubs upon entering the patient's room, and removing that as we leave. From a planning and logistics point-of-view, we need to plan for one person to consume at least a case of this PPE per day. Based off of our previous discussion about portals of entry, do you see any exposed portals if we were dealing with a Category-A agent? I'll give you a moment to look. The best I can come up with would be: she is wearing a porous top that needs to be covered with a non-porous smock; and the skin of her neck is exposed.

Path #104: Last but not least, we have Social Distancing. For those of you in public health, you may also know this by another term: Non-pharmaceutical interventions or NPI. This is often one of the most controversial interventions that public health can recommend because it cuts into people's business earnings. If we had an outbreak of a communicable disease here in Reno during the Hot August Nights event, and we told the city to cancel all public gatherings, that would go over like a lead balloon. Businesses rely on the earnings from that event to keep their businesses going. The best we can do is make an informed recommendation to our leadership, and let them make the decision.

Path #105: Here's a real-world example of a recommendation like that being made, and it not being carried through. In the Fall of 1918 as the full impact of that dreadful pandemic's second wave was being felt (particularly on the East coast), the City of Philadelphia opted to not cancel its Liberty Loan Parade scheduled for Saturday, September 28, 1918. In spite of reports that the virus was considered to be wide spread throughout Philadelphia's naval stations and army cantonments (aka: camps), as they saying goes: the show must go on; so the parade was not cancelled.

Path #106: Some of the best descriptions of what happened next come from this book by John Barry: *The Great Influenza*. In his exhaustive research, Mr. Barry's narrative on this little known chapter in humanity's story is replete with tragic stories about federal/state and local government not making the hard but right decision in the face of highly pathogenic influenza

virus. One such story is that of the City of Philadelphia and its director of their health department. In spite of warning his leaders to cancel the Liberty Loan Parade, it appears he didn't make those recommendations with enough vigor, for as we just saw in that photo; the show certainly did go on.

Path #107: I will use this quote from John Barry's book to help capture and describe what happened next. I'll give you a moment to read the quote. That part about the epidemic "*assuming the type found in naval stations and cantonments*" is truly frightening because it is telling us: this thing is loose within our city, and it's on a scale we cannot even come close to handling. The experience of Philadelphia in 1918 is now a case-study in how to not handle an epidemic or pandemic involving a highly pathogenic virus. As you can see at the bottom, most cities at that time had enough morgue capacity city-wide to store a few hundred bodies at once; Philly was losing five to eight thousand per day within two weeks of that photo of the Liberty Loan Parade being taken. A classmate of mine as NPS, Officer Dave Bonk with the Philadelphia Police Department, told me that they still dig up bodies from 1918 in all sorts of crazy places. People ran out of room to bury their dead, or were too weak themselves from the illness to move their dead out of town and bury them. The bodies were interred wherever survivors could find the space, or the energy.

Path #108: OK, so how we doing with this 'toolbox' concept? Does it make sense? This tiered system is how we at state and local public health departments would approach a large-scale biological event, such as a biological attack involving a Category-A agent.

Path #109: As great as all that 'toolbox' stuff sounds, how would it fit together with the Category-A agents that I discussed previously? Good question, and for that I will refer to another tool we came up with at state PHP to help both public health, and non-public health responders to 'connect-the-dots.'

Path #110: We took each component of that VMAIQHS Model (aka: the 'toolbox'), and listed those as column headers across the top of this table. From left-to-right you will see each of those interventions I just covered being listed as column headers. Next we took the Category-A agents and listed them to the left as row headers. As you make your way through the table, we have provided a succinct description on whether that intervention would work or not, and if it does, we give a basic idea of what we're talking about. Under the column for Hygiene, which you will remember also includes decontamination and PPE, we list which protective measures we are specifically recommending. For those details, look at the bottom of the page and each type of precaution is listed: standard precautions, contact precautions, etc. Remember my comments about people asking if we were going to isolate and/or quarantine patients following an aerosolized anthrax release scenario? The idea behind this was to preclude those strange encounters we experienced during the 'Simple Truth' exercise. This little

table would literally get us all on the same sheet of paper. Do you notice how each intervention works in concert with the other as applicable. It's not one intervention by itself, by a combination of interventions.

Path #111: As great as that table looks, for any of us who have conducted real-world response operations: a table does not equal a plan. So in an effort to keep our own leadership within public health organized and focused, we borrowed an idea by our friends over at the New York City Department of Health (NYC DOH). In 2012 while attending a national public health preparedness summit in Anaheim, CA, I had the pleasure of attending a wonderful session by NYC DOH's Mitchell Stripling. In that session Mr. Stripling presented a topic that he and his team came up with called **Threat Response Guides** or TRGs for short. These are not plans in the classic sense, as the title goes: they're guides. The idea is to get public health leaders to follow a guide, who I regret to admit, are the same people least likely to follow plans of any sort. The guide allows our leadership to make key decisions in collaboration with key partners at key times in the first 48 to 72 hours of a large-scale response. I took what Mitch and his team had done, and applied Nevada-specific details to create our own set of TRGs. At the time of this presentation, we currently have a library of 22 separate scenarios that involve everything from each of the Category A agents, to earthquakes, floods, wild fires, industrial accidents, etc. For those of you who are following along in the course handbook, I have included TRGs for each of the Category A agents, and one of the Category B agents. The one shown here is included in your course handbook. If you want to see the table we just discussed, turn to page 6 of 22. If you want to see the specific medical protocols and regimens, turn to pages 16 to 19.

Path #112: As is this one for aerosolized plague. There are medical protocols and regimens listed in this TRG as well, as are other useful guides, such public messaging templates, etc.

Path #113: Here's an example of a Category-B agent: Glanders. We hope to add a TRG for Sarin, and a TRG for Ricin by Summer of 2014. With these TRGs, we took an incredible idea that our counterparts over at the New York City Department of Health came up with and re-worked it to meet our own Nevada-specific realities. This give-and-take between public health colleagues is a great example of best practices being openly shared and improved upon.

Path #114: OK folks, that was a lot of information, from this point on we'll be covering each of the Category-A agents one-at-a-time. If you have any questions concerning what I've covered thus far, just contact me at that e-mail address and number I've been using.

Module 5

Anthrax

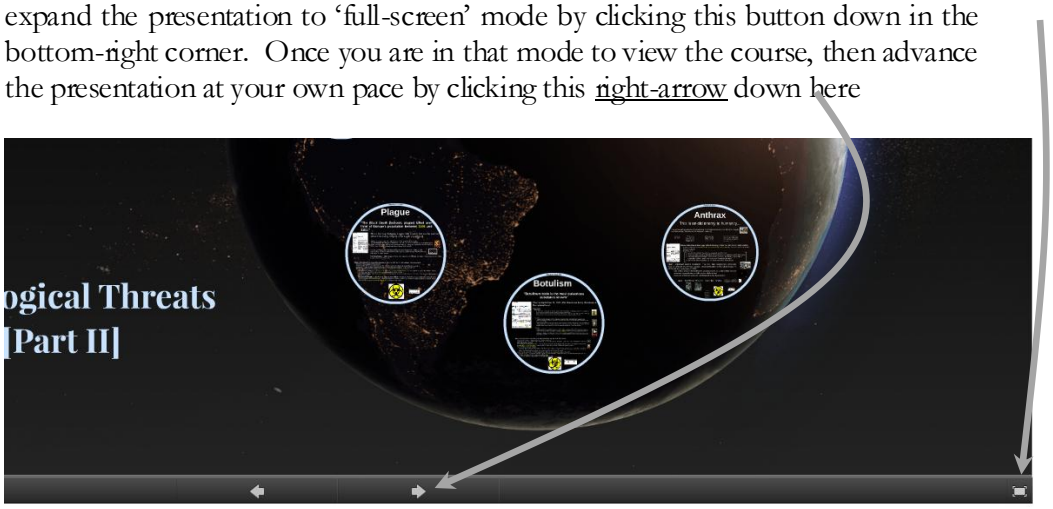
Soon after the terrorist attacks of 9/11, letters laced with anthrax began appearing in the U.S. mail. Five Americans were killed and 17 were sickened in what became the worst biological attacks in U.S. history. The ensuing investigation by the FBI and its partners—code-named "Amerithrax"—has been one of the largest and most complex in the history of law enforcement.

— From the FBI website's "Famous Cases & Criminals"

Thus far in today's presentation we have discussed the biological threats to Homeland Security, but we have not gone into what we, as public health and/or Homeland Security practitioners, plan to do about them if we were to be hit. In module four we will look at options public health would have during a response to help break that Chain-of-Infection discussed in module three.

If you are taking this course at your own pace from your computer, then please allocate at least 40 minutes to complete this fifth module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here



Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #1: Welcome back to the course, please adjust your computer's volume control at this time, and we'll begin as soon as you are ready. As with the previous modules, you will advance the presentation at your own pace by clicking on that right-arrow along the bottom of your screen.

Path #2: In Part II of today's course, we will begin by focusing on the first three agents listed by the CDC as Category-A agents: Anthrax, Botulism, and Plague.

Path #3: From this point on, I will be covering each Category-A agent separately. We'll work our way through each of these agents in alphabetical order. The first will be *Bacillus anthracis*, or **anthrax**.

Path #4: When federal grant funding began flowing from the federal level of government down to the state and local levels of government, a sizeable portion of those grants were aimed at countering an anthrax attack.

Path #5: As new as those federal grants were at the time, they were only the most recent attempt at taking on an age old enemy of humanity.

Path #6: If we turn to the historical record, we find numerous narratives of our ancient forefathers wrestling with this same threat to our health. Even our most holy scriptures, be they the holy scriptures of Judaism, Christianity, or Islam (just to name a few), we find descriptions of anthrax. Within Christianity's Holy Bible, in the Book of Genesis, we hear of Moses warning Pharaoh of the Ten Plagues that will descend upon Egypt if he refuses to let the Jewish slaves leave Egypt in peace. When Pharaoh refused, the fifth of those plagues is believed to have been anthrax as we hear of Egypt's cattle succumbing to this infection.

Path #7 In this colorized version of an old manuscript, we see the scene of that fifth plague playing itself out in ancient Egypt's cattle markets to dramatic effect.

Path #8: We also have historical accounts from the Hindus, the Greeks, and the Romans who also suffered from this bacterial agent in their own times.

Path #9: Although not as dramatic as the great plague, or "Black Death, epidemic that rocked Europe from 1348 to 1350, this epidemic of anthrax in the 17th century carved its own swath through that continent. If you remember that lesson about Dr. Edward Jenner and his discovery of immunization by using cowpox to protect against smallpox, then you see how that last part of this paragraph about making an '*association*' between human and animal disease worked out.

Path #10: When compared to other bacterium, the anthrax bacteria itself is rather large, so many scientists have used it for their studies. One of the pillars of such researchers is none other than Louis Pasteur who established Germ Theory in the mid 1860s. If you remember my discussion earlier about those long beak-like masks that were stuffed with aromatic herbs to help ward off what were then called *miasmas;* Pasteur's *Germ Theory* ended centuries of miasma theory and replaced it with what we now understand on how infection actually occurs. As if that wasn't enough, Germany's Robert Koch used *B anthracis* as one of the microbes he studied when he wrote his ground breaking "*Koch's Postulates*." His four criteria were created to establish a causal relationship between a microbe and a disease. For those of you following along in the course handbook, I have listed each of the four postulates in case you're interested:

1) The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms.
2) The microorganism must be isolated from a diseased organism and grown in pure culture.
3) The cultured microorganism should cause disease when introduced into a healthy organism.
4) The microorganism must be re-isolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent.

Path #11: As England became industrialized; it suffered through large epidemics of anthrax amongst it wool sorters and rag pickers as a result of the milling and tanning processes. Those issues became so pervasive that the U.K. finally mandated that all raw wool material heading into the British milling industry be dunked in massive pools of formaldehyde first. That simple intervention almost eliminated the illness from the British Isles. Keep formaldehyde in mind, for I'll be discussing it again later in this module.

Path #12: For those of you interested in seeing, and reading, more on where I found this material, I am listing my citations for the first part of this anthrax lesson here for you. This information was taken from the writings of my favorite professor at graduate school: Dr. Phil Brachman, whose class called "*Public Health Preparedness and Bioterrorism*" served as a segue to my career path in this branch of public health.

Path #13: Some of the best minds in our field have contributed to the body of knowledge that we in public health, as well as Homeland Security, have benefitted from. These science-based articles were great contributors to those Threat Response Guides (TRGs) discussed previously.

Path #14: As you can see from this publication date of May 12, 1999, these issues related to biological weapons were attracting those minds well before

the terrible attacks on September eleventh. As I mentioned during the Aum Shinrikyo portion of today's course: the Tokyo subway attacks changed everything.

Path #15: Here's an excerpt from that 1999 JAMA article. I provide this for those of you who come from the law enforcement and/or intelligence community (IC). Just as we study foreign and domestic terrorist groups in an effort to understand the "*Nature of the Threat*", so too must we study these microscopic agents and the nature of the threat they pose.

Path #16: The JAMA article does a thorough job of explaining what anthrax is, but in a scientific way. So please allow me to translate. Aerobic, as you see, means that anthrax needs to be exposed to air in order to live. Next we have something about anthrax being "gram-positive" which describes if its outer membrane can absorb crystal violet stain. That tells us something about its outer surface.

Path #17: Here is what they're talking about in that article; when viewed under a microscope, those long bamboo-rod anthrax bacteria have absorbed the violet stain, so much so that they easily stand out from the white blood cells around them.

Path #18: Next we see that anthrax is a spore forming organism, which is bad news for those of us who seek to counter its effects. For bacteria capable of becoming spores, this means that when they cannot find the right conditions to germinate and begin replication, they go into a sort of dormant phase, where they surround themselves with tough outer shell. Once that occurs, an anthrax spore can wait decades, if not centuries if you read some of the theories surrounding King Tut's burial chamber, before they re-emerge as anthrax bacteria.

Path #19: Here is a close up shot from an electron microscope showing what anthrax bacteria look like. They are long rods, and if you look closely at that rod to the right, they cleave in the middle of their body, thus creating a new bacteria. In this image we can already see that rod to the right beginning to cleave itself, right where I added that arrow.

Path #20: Here is our enemy: anthrax spores by the hundreds. In this close up of the spores we can see that hearty little football-shape they take on when they go into this mode. This electron microscope image also provides a measuring scale, in what are called microns, down to the bottom-right corner of the image. Based off of that scale, we can estimate that anthrax spores are about one micron long, and half a micron wide. At that size, they are more than capable of slipping past our body's barriers and penetrating deep within the human lung. Once in those warm, dark, and moist conditions, they can re-emerge as anthrax bacteria and cause an infection known as inhalational anthrax.

Path #21: This is the first of two scientific case studies on truly weaponized anthrax being let loose. The first of these occurred in 1942 when the British War Department used a small island off the north-east corner of Scotland, called Gruinard Island, to conduct airborne trials of weaponized anthrax. Although those tests proved quite successful as we'll watch in a moment, they also convinced England of the futility in using such persistent agents under wartime conditions. The anthrax spores that were released during those trials not only persisted, they propagated. In the decades following those trials, when wind conditions were right, it is rumored that some of the spores were carried to the mainland where they killed off local animals grazing nearby. This led to a group of environmentalists to conduct what they called "*Operation Dark Harvest*" to raise awareness about the continuing effects of these trials. Those two bullets give you an idea of how much effort and time it took to decontaminate Gruinard Island. There's that reference again to formaldehyde that I asked you to keep in mind.

Path #22: Here's an image of some people who look to be involved with that Dark Harvest project. From what I observe, they do not appear to be wearing any sort of fitted masks, other than pulling their hoods down tight. In this next clip, we see video footage from those trials in 1942 on Gruinard Island. Pay attention to the part of the video when they detonate an anthrax containing round from atop a telephone pole out in a paddock. If your computer's screen resolution allows, look closely at the color of the cloud after the burst is released. From what I can tell, it's not a white cloud, but more of a mustard color cloud.

Path #23: [Video Footage]

Path #24: When it comes to studying a real-world release of weaponized anthrax upon an un-suspecting population, this next case study is the Grand Daddy of them all: **Sverdlovsk**, 1979, in what is now Russia. The good folks over at PBS did a great documentary on Frontline covering this event that many experts now refer to as: the "*Biological Chernobyl*." Here is an excerpt from that Frontline documentary.

Path #25: At the time of the accident, a man who would go on to become the first democratically-elected leader of the new Russia, Boris Yeltsin, was the leader of the communist party in this part of the old Soviet Union. Yeltsin was born and raised in this area east of the Ural Mountains. Nearly thirteen years later, when Yeltsin was President, he mentioned to a western journalist that there had been an "anthrax outbreak" that was caused by "military activity at the facility" in Sverdlovsk. This was the first sort of confirmation we in the West had had since the accident took place. Even with so much attention on **if** this had even happened; during those 13 years the Russians were hard at work producing high-grade weaponized biological weapons on an industrial scale that not even the most ardent war hawks in the West would estimate.

Path #26: That all began to change when Harvard University's, Dr. Matthew Meselson, brought a team of U.S. and Russian researchers to Sverdlovsk to conduct a full investigation of the accident, albeit some years after the event. Those efforts resulted in this classic epidemiological study, published in Science journal in November of 1994.

Path #27: In this image from the Meselson article, we see the classic plume model emanating south-east from what we now know to be Compound 19 at the Sverdlovsk biological weapons plant. Based off of what we have learned, an air filter that was supposed to be replaced by the day shift on Friday, March 30, 1979, failed to record that properly in their shift report. When the oncoming night shift reviewed the report, no deficiencies were noted, so the Shift Leader ordered the production plant to re-start operations. Throughout the long night of March 30th, 1979, that plant spewed weapons grade anthrax into the atmosphere un-filtered. If you look closely at this image of the plume model, you will see small numbers in red: each of those numbers correlates to a specific case, or person, who Meselson and his team identified as having died of their exposure to anthrax. Those two numbers to the right were truck drivers whose duties required that they drive east-to-west through the plume cloud at the time of the release. That big group of numbers half way down the plume belongs to the night shift of a nearby ceramics factory.

Path #28: I added this more current satellite image of Sverdlovsk's Compound 19 to illustrate an issue concerning the ability of anthrax spores to persist in the environment. In this current satellite image, I have recreated that yellow frame used in the Meselson article to help give you a reference. You will also note that since the fall of the Soviet Union, they now call this city *Yekaterinburg*. During that 'Simple Truth' exercise you've heard me talk about so much, we ran into a disagreement, with a key public health partner, over the susceptibility of anthrax spores to sunlight's UV rays, etc. That partner agency firmly believed that the anthrax spores depicted in the exercise scenario would be dead from the sunlight, so they should advise the public to break from the *Shelter-in-place* order issued earlier in the exercise. When we, at state PHP, asked what data that recommendation was based off of, we received nothing in response. So I scanned a copy of that satellite image of Compound 19 from the Meselson article, and then jumped onto Google Earth to see if I could find what it looks like now. Being a former Field Artillery officer in the U.S. Army, I knew that certain landmarks from the Meselson image could lead me to the site. That oval running track and intersection in the top-right corner of this image is what I used, and as you can see, I succeeded in finding the site. What amazed me is that as I zoomed in, I could still see the old soviet army trucks parked outside of the Compound 19 building where the anthrax emanated from during that 1979 disaster. Not only are their trucks abandoned in situ, but I could make out trees and grass growing through them. When I placed the Meselson image next to this image, the issue of sunlight killing all anthrax spores was put to rest for the remainder of that exercise. Thank you Google Earth!

Path #29: Thanks to reports and updates from the Cooperative Threat Reduction program, we now have photographic evidence of what the Soviets were actually doing in the years following the Biological Weapons Convention, or the BWC, that I covered at the beginning of today's presentation. Not only were they still producing offensive biological weapons, they were doing so on a massive scale as this 20,000 liter fermentor illustrates. How big is a fermentor of this size you may ask….

Path #30: Well here's an image of a fermentor of that size as seen from the outside, and with a full-sized man standing there to help give a sense of scale to the image. What blows my mind is that these fermentors go up four floors, and that in this specific factory, there were ten such fermentors.

Path #31: If we could climb up those four floors, this is an image that gives us an idea of what we would see: whole rows of fermentors with only their tops showing. As you can see, from what I can make out in this photo, I'm guessing there are seven such fermentors to the right, and I'm assuming the same number in parallel to the left. The dismantling of production infrastructure such as this has obviously been an aim of the Cooperative Threat Reduction program; but so too is the tracking of those scientists who had the expertise to come up with these sort of facilities and agents. Yikes!

Path #32: With production facilities on such a massive scale spread throughout he Soviet Union, what was their plan to get those agents from where they were to our bodies over here in the West. Enter this Big Bad Boy: The soviet SS-18 intercontinental ballistic missile, or ICBM for short. Just one of these multi-stage rockets reach any western city within minutes, and once it arrived over that target city at a certain altitude, it would release hundreds of these melon-sized bomblets upwind.

Path #33: I know, this all sounds absolutely crazy, and it is, but that's what makes Ken Alibek's book, *Biohazard*, so frightening. The guy who worked his way up through their bioweapons program to the point where he was its director, tells us about how the Soviets perfected the refinement, production, and delivery of high quality weaponized biological agents.

Path #34: Here's the cover to Dr. Alibek's book. If you are interested, I would recommend you read this book.

Path #35: Here is a more current photo of Dr. Alibek, who now works with both western and eastern governments to help rid the world of this terrible class of weapons. I once had Dr. Alibek as a guest lecturer in grad school, and I literally blanched at some of the things he described to us during his seminar. Truly scary stuff.

Path #36: And speaking of scary stuff, here's a quote from his book. For those of you in the law enforcement and/or intelligence community (IC), I've

highlighted some key points in yellow for you. This quote gives you a glimpse into the minds of *bioweaponeers* and how they approach challenges with the delivery of their weapons. They study air currents and inversion; they study weather patterns and precipitation. They also understand that it's better to hit a target by aiming upwind, rather that aiming directory at it. So let's look at an attack using anthrax from this perspective.

Path #37: Considering what Dr. Alibek tells of us of how *bioweaponeers* conduct their craft, what are the implications for the law enforcement and the IC?

Path #38: The first thing everyone will be clamoring for is laboratory confirmation and/or lab results. Here's yet another example of Hollywood creating false expectations. Listen folks, when we go out and collect samples, we pick up what we're look for, plus all sorts of background stuff. Separating all of that out takes some time. Once we get that done, we can only grow the stuff back in a lab at the speed it grows naturally. Yes we can provide the ideal conditions in a Petri-dish, but the stuff only grows at fast as it will grow. So just when everyone is going to be screaming the most for lab data…is most likely when we'll have the least amount of those data. Sorry, it's just a reality of how this works in the real world.

Path #39: Yet as we await those data, we can still make informed decisions based off of what we observe. These are my own notes from working with various public health laboratories throughout my career. In essence, we would need these labs to do three things for us. The first of those is also the most basic: confirmation. Is it the bad stuff or not? From my experience that initial question can be answered at the county or state level labs within a few hours (24 to 36 hours max). Here in Nevada, for us to pull the alarm that we've been hit, we would need two separate PCRs, which stands for Polymerase Chain Reaction, tests to come up positive for anthrax. But keep in mind, PCR just tells us it's anthrax, and NOT if that anthrax is still alive, so factor that into your intelligence flow. Next we have identification which discerns if its background anthrax, yes here in Nevada we have naturally occurring anthrax blowing all over the place, or weaponized anthrax. This would also tell us if those bacteria/spore are still viable, meaning they're still alive and kicking and can get people sick. That's a job for a CDC-level lab, and there are labs like that between here and Atlanta, so that may take a few days to a week before we receive results back. Finally we have the most detailed picture of the agent: characterization. This is what tells us how the agent performs, a great piece of data for all those decontamination folks we'll have running around. For this level of testing, I can think of only one lab here in the U.S. capable of handling something like that: the good folks at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) back at Fort Detrick, Maryland. For those data, we'll need to wait probably a week or more.

Path #40: In the 2001 attacks, the person who sent those letters notified the recipient of each letter that they had just been exposed to anthrax. In future attacks, we may not be so fortunate. By notifying us of their attack, a person or persons using biological weapons has helped us, because their notification alerts us and gets our response cranked up early after the release (e.g., disease surveillance, environmental sampling, PEP, etc.). In an attack involving a biological agent, we as responders are racing a 48-hour clock to get life-saving medications and/or vaccines into those people who may have been exposed; it also allows us to focus our decontamination efforts early on as well. From a law enforcement and intelligence perspective, this notification of an attack may narrow the field of potential suspects down to a person or group that do not have end-of-world Armageddon agendas (remember Reza Aslan's *Cosmic Warrior* discussion earlier?). They may want lots of people scared (not necessarily dead) and national/international media attention to bring their agenda to a world or regional stage, etc.

Path #41: Keep that quote by Dr. Alibek in mind, for it helps explain how the "*pros would do it.*" Based off of the accumulated knowledge of *bioweaponeers*, they would pick their target(s) carefully, and match the release of their weapons upon that target to maximize its effects. If a release was indoors, then that may be a sign that they didn't have a lot of agent to work with, so they maximized the effects of what they had by focusing it indoors. This may lead to a terrorist or group that made the material themselves. If it was released outside, then that may point to a group that has gotten its hands on a nation's stockpiles. I've also listed some basic criminal investigation leads these sorts of attacks could create: CCTV footage of target reconnaissance, strange requests for building blueprints, etc. I highlighted in yellow those hints that Alibek provided: Upwind of a target versus on a target. Upwind points toward a pro, on a target points toward something less than that perhaps? If released outdoors, a pro would likely have detailed records on weather patterns in the target area, and those may still reside on his/her computer which could surface in an investigation?

Path #42: A lot has been said and written about the "White Powder Incidents" that we have all witnessed on the national news. When we watched that video from 1942 about Gruinard Island, for those of you who have computers with high resolution, the agent released in those trials was mustard in color. As much as we hear about white powder incidents, anthrax is most often brownish and granular in color and appearance. This is not to say that we shouldn't treat white powder incidents as serious threats, they are. But if weaponized anthrax as a white powder is involved, it doesn't act like anything we would normally associate with white powders. To create a batch of high quality weaponized anthrax that is white, this points toward a highly skilled and trained bioweaponeer. In the 2001 anthrax letter attacks, the first batch of letters to media were of lower quality; but later, when the letters were sent to political targets, the agent was of a much higher quality, and was white in color. Whomever created those spores know how to make them

electrostatically charged, so they would literally 'jump' into the air once released from their letter envelope.

Path #43: The best way I could describe to you how a white powder of this quality would perform once it was released, is the vapor from one of those vaporizers we so often use here in Nevada's dry climate. When that vapor is first released, we can see it with the naked eye, but as it moves further away from its source, it just disappears. This is how I've heard the high quality material used in those second batches of anthrax letters being described: "*the stuff just wafts away the moment you take it out and try to weigh it.*"

Path #44: Once again, the good folks over at PBS Frontline have provided us with an in-depth investigation, and documentary, about a national event such as this. I tried to splice a portion of that video into this presentation from the Frontline video report titled, *"The Anthrax Files."* Unfortunately Prezi would not allow me to insert only a portion of that one-hour report. If you would rather watch the video interviews of the quotes I am about to use, just open this web address and scroll the video to the two minute mark and let it play to the six minute mark.

Path #45: PBS Frontline provides transcripts of their reports, so I clipped these two sets of quotes from the PBS transcript for this documentary. In this quote by Grant Leslie, an intern working at the office of a U.S. Senator, she describes what the second batch of anthrax letters looked like: white powder.

Path #46: Once that material was brought to USAMRIID, the nation's best experts were shocked by what they found. In this set of quotes from the Frontline transcript, we learn of how USAMRIID's top anthrax expert, Dr. Bruce Ivins, described the agent as he tried to examine it in the lab. I have taken the liberty of bold some key points of these quotes for you: "*it was so light, you couldn't weigh it*", the "*powder was dry*", "*describe it as 'energetic'*, and how it would "*migrate towards the hand.*" This is what I meant earlier when I discussed how a 'white powder' of this sort doesn't act like other white powders we're accustomed to. The material used in the second batch of letters aimed at political targets was "*highly floatable*", and as Dr. Ivins went on to state in his report: "*these are not 'garage spores'*." Whomever produced this agent used "*professional manufacturing techniques*." For those of you who choose to watch the Frontline documentary, you will see how Dr. Ivins ended up being the FBI's top suspect in their investigation of this crime. Dr. Ivins took his own life, so we may never know who was behind these attacks.

Path #47: Ok, that is the nature of the threat we may be facing, now we will go into some of the key interventions we as responders would need to implement to counter this biohazard called anthrax.

Path #48: With anthrax not being a disease that can be passed from person-to-person, one of our first strategies in limiting the exposure of additional people would be decontamination. As listed here, the timeframe when those spores are at their most lethal effect would be that period called '*primary aerosolization.'* That is when the agent is first released upon an unsuspecting person or group of people. Once those anthrax spores float away, they will fall upon and generally remain on surfaces in what most of us refer to as a '*Hotzone*.' People and equipment moving through that zone can kick those spores back up into the air, and this is called '*secondary aerosolization*.' Here are some bullets listing what decontamination efforts would need to address: people, buildings, and environment. If you remember from the "Public Health Toolbox" discussion we had earlier, there at the bottom are those grey water considerations.

Path #49: The incredible minds over at the National Research Council of the National Academies have produced an incredibly useful tool to help federal/state and local partners responding to a biological attack answer that core question: '*how clean is clean enough*?' In my meager opinion, this '**decision making framework**' should be required reading for anyone who thinks they may have a leadership role to fill in a response to biological agents.

Path #50: Back in President George H.W. Bush's first term, he announced during a State of the Union Address the creation of what is called Bio-Watch. This three-part system was intended to help alert us to a biological attack. The first part of that system is run by the U.S. EPA and is comprised of air sensors pre-positioned in public areas that are considered as potential targets of a biological attack (e.g. key NYC subway stations, national monuments, etc.). Those samples are then sent to the second arm of the Bio-Watch system: analysis. This is the domain of the good folks over at the CDC. Finally we have the third and final component of Bio-Watch: response. That' s us here at the state and local health departments who would go out and mass dispense those life-saving medications provided by the federal government's Strategic National Stockpile (SNS). Medications, such as antibiotics, would be dispensed to the public within 48 hours. The bullets listed here are an overview of the medical protocols we would use in such a response as PEP, or as treatment. If you want to see the specific details for each of these protocols, they are included in the Threat Response Guide (TRG) examples listed as appendices in the back of the course handbook.

Path #51: For those of you who remember that VMAIQHS Model (the public health toolbox), you probably noticed that I skipped vaccination; even though the table I provided earlier indicates that there is an anthrax vaccine. Here's the deal on the anthrax vaccine: it takes 18 months to complete the regimen. In a response that needs to protect people in hours to days, an 18-month vaccination regimen will take too long. That's not say we would renege on these vaccines completely, just that they would slide them down the priority list.

Path #52: Public Health tracks disease within a population by something we call disease surveillance. In an attempt to provide real-world examples of how other states handled disease surveillance following the 2001 anthrax letter attacks, I used this article from the State of New Jersey by Bresnitz and DiFerdinando. Anthrax can make us ill through various portals of entry, and result in three separate presentations of the disease: cutaneous (in the skin), gastrointestinal (in the gut), and the most dangerous of all: inhalational. To find people who may be ill, with these types of anthrax infection, public health would use passive surveillance to search for patterns in things like: over-the-counter (OTC) sales of certain medications, school absenteeism rates, EMS requests, Emergency Room admissions, etc. Although passive surveillance provides a great quantity of data, those data may not be of good quality. But *passive* surveillance may lead to what we call *active* surveillance, which provides a lower quantity of data, but at a higher quality. Here's a synopsis of what I mean: passive surveillance tells us that something is afoot, active surveillance tells us the who/what/where/ and when. To help us count only those cases that are ill with the illness we are looking for, epidemiologists create what is called a **Case Definition**.

Path #53: I have included what the CDC's website uses as its definition of a Case Definition, followed by my own in layman's terms. When we create a good case definition and publish that to healthcare providers, this helps get everyone looking for the same thing. This helps us filter out people who are no doubt ill, but with a illnesses other than the one we are looking for. When used, a case definition gives us a more accurate view of just how spread an illness is within our population. To help give you an idea of what a case definition could possibly look like for an anthrax event, I added that little example down there at the bottom. Now we'll look at the symptoms for all three forms of anthrax infection.

Path #54: As you can read here, if we are going to see any anthrax cases, this is probably the form of the disease we would expect to see first. It hits exposed skin, as listed, and develops through a progression of lesions: e.g. macule, to papuale, to vesicle. That classic symptom, the *black eschar* is a dead giveaway of cutaneous anthrax infection.

Path #55: Here's a photo of what cutaneous anthrax looks like with those black eshars. What has always amazed me is that these are described as being *painless*, and often the patient '*feels fine*.'

Path #56: Next we have the gastrointestinal form of the disease. In the aftermath of the Sverdlovsk accident, the Soviets saw a lot of cases with this form of the disease. They used that to help cover their tracks by claiming the outbreak was caused by tainted meat products. In this type of anthrax infection, it appears in two stages: it hits the upper oral-pharyngeal tract (aka: the mouth and throat) first; then moves its way down to the lower GI tract where things get really uncomfortable for the patient.

Path #57: Finally we have the most serious form of this disease: inhalational anthrax. As you can see, even a single confirmed case is reason to sound the alarms.

Path #58: I snipped this screen shot from page 2242 of that May 2002 JAMA article. To the left we see what is called a '*widened mediastinum*' which shows how deep the infection to the lungs can go. In the image to the right, we have a cross-cut CT scan of the lungs where we can see the infection and the buildup of fluids in the lungs of a patient infected with inhalational anthrax. As the patient lies down, those two black arrows at the bottom show the pooling of this excess fluid.

Path #59: For those of you who already looked through the Threat Response Guides (TRGS) that are included as appendices to the course handbook, you may recognize this diagram. Way back when I was a new graduate student in public health, I had a professor explain three key data points of epidemiology with a metaphor like this. Over twelve years later and I still remember that professor's lesson, so I went and created this little image based off of what he instructed us on. As disease is tracked through a population, it will generate three basic data points; the first is listed in the top-left corner and is called *Incidence Rate*. That is the number of new cases entering the system. The next data point is listed in the far right of this image and is called *Prevalence Rate,* which is the number of existing cases within the system. Finally we have that last data point down in the lower left corner, called *Mortality Rate*. That's the one that gets all the attention, the number of people who died from their infection. Together these three data points give you an idea of what your epidemiologists should be reporting to the incident command staff at each of the daily updates.

Path #60: Ok, as I mentioned earlier, just follow along with the basic guidelines listed in the Threat Response Guides, or TRGs. If you start hearing partner agencies discussing isolation and quarantine, just point them toward this and it will help get them on the same sheet of paper.

Path #61: That is today's discussion on *Bacillus anthracis*, if you have any questions concerning what was presented here, please contact me at PublicHealthDan@gmail.com, or at 775-247-3680.

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Botulism

Botulism toxin is the most poisonous substance known.

— from page 1059 of the February 28, 2001, Vol. 285, No. 8 JAMA article

This next agent is unique amongst the Category-A agents in that it is a toxin. As you can see from the quote provided above, this is no common toxin, in fact, it's the most poisonous toxin know to humans. Although less persistent in the environment, as compared to anthrax, the *Clostridium botulinum* toxin still poses a lethal threat to both public health and Homeland Security.

If you are taking this course at your own pace from your computer, then please allocate at least 15 minutes to complete this sixth module of today's presentation. Each of the modules within this presentation are designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.

Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #62: In this next installment of today's course, I will be discussing *Clostridium botulinum*, or botulism for short.

Path #63: Although this is caused by a bacteria, it's not the bacteria we are concerning ourselves with; it's the toxin those bacteria produce once they enter our body through a contaminated food, through contaminated air we breathe to our lungs, or through a wound into our bloodstream.

Path #64: I chose this quote from an article I am about to present because it puts in context the nature of the threat this toxin poses to human health. That's quite a statement when one considers other top-tier toxins to the human body; for example: ricin which is as you may recall, is a Category-B agent.

Path #65: Here's that article from the Journal of the American Medical Association (JAMA) that I just mentioned. Once more, we in public health, and Homeland Security, have benefitted from the knowledge and experience that some of this nation's brightest minds have contributed to in the authorship of this article.

Path #66: I have highlighted in yellow where I found that quote listed in the opening to this module. I have also highlighted the date and volume of this article for those of you who may want to print your own copy.

Path #67: By highlighting that date, I wanted to also show you how these issues were being discussed, at the national level, prior to 9/11. This is yet another example of the dramatic effect the Tokyo subway attacks had on those of us who plan, train and prepare for biological attacks within the U.S.

Path #68: Let's begin by looking at some recent examples of botulinum toxin being used as a biological weapon. In this first example, we turn once more to Dr. Shiro Ishii, and Imperial Japan's infamous '**Unit 731**.' In the years following that war, we have admissions by Ishii and his team of their use of an experimental form of weaponized botulinum toxin upon POWs. Some of these POWs were from our own military, as well as those of our closest allies. Back in the European Theater of Operations, also known as the ETO, Allied concerns over Nazi Germany's stockpile of weaponized botulinum toxin were so great, that Supreme Allied Commander, General Dwight D. Eisenhower, had a million doses of toxoid vaccine prepared for troops that were readying themselves for the D-Day invasion.

Path #69: Evidence of those fears are evident in this photo of a D-Day re-enactor. I have taken the liberty of adding this blue arrow to point you toward a rather odd looking black rubber bag strapped to this man's upper chest: that is a chemical and biological warfare mask. As familiar as the

photos are of our soldiers storming Normandy's beaches, have you ever noticed that our men on Omaha and Utah are all wearing these on their chests? In addition to stockpiling anti-toxin, it would appear from these masks that the Allied leadership also feared the use of those weapons early on during the liberation of France.

Path #70: I like this quote from that JAMA article, for it shows yet another country taking advantage of the BWC's limits: Iraq. Once other signatories of the BWC eliminated their stockpiles, some countries, like Iraq and the U.S.S.R. went on to greatly expand theirs. This led to some frightening revelations by United Nations (UN) inspection teams following the successful conclusion of *Operation Desert Storm* in the early 1990s. Not only had Iraq stockpiled 19,000 liters of this stuff, they even loaded some of into medium range missiles, and deployed those to the field.

Path #71: Here's an example of one such missile hidden beneath what appears to be a soccer stadium's stands. Delivery systems, such as these, for biological weapons with a 600 Km range (which equates to about 375 miles) were a regional threat to Iraq's neighbors.

Path #72: Here we return to **Aum Shinrikyo** and that religious cult's various attempts at producing, and disseminating, weapons-grade biological agents in their terrorist attacks. That group's leader, Shoko Asahara, directed his bioweaponeers to release aerosols containing *botulinum toxin* in downtown Tokyo, as well as on U.S. military bases in Japan. As you can see, this was not a single attempt, but rather three separate attempts that we know of. Although these attacks failed, it was not for lack of effort. As Ken Alibek states on page 20 of his book, *Biohazard*: "*One of the problems has always been to find a reliable means of delivery, one that prevents biological agents from losing virulence when they are dispersed.*" Based off of what we learned in the investigations of Aum Shinrikyo, following their subway attacks, it appears that they too had issues with finding a *reliable means of delivery*.

Path #73: Here is an image of the Time magazine cover following the subway attacks; that's Shoko Asahara, the leader of Aum Sinrikyo.

Path #74: Just as we did with the previous agent, we will look at the nature of the threat posed botulinum toxin. Much of the information used here was taken from the JAMA article that I cited earlier in this module. That first bullet is intended to once again show you the relationship between the bacteria, and the toxin those bacteria create. It's that toxin we are concerning ourselves with. Next we have that bullet that talks about how *C botulinum* is spore forming, and I added that translation on what spores are, etc.

Path #75: Here is a close-up of what the *C botulinum* bacteria looks like.

Path #76: Next we see that *C botulinu*m is an "*obligate anaerobe*" which means it can only survive in environments that have no oxygen, or very little. I also

added that fact that this bacteria is easily found in soils and aquatic habitats throughout our planet. For anyone looking to find some, and convert that to a weapon (just like Aum Shinrikyo did), it's easy to go out and collect this bacteria from those samples.

Path #77: Here is a classic example of what C botulinum looks like in most of the cases the CDC studies: a swollen can of preserved food. In the very rare cases when this happens, it's usually tracked back to a lapse in food preparation and/or the canning process. Within the oxygen-free environment of a sealed can, any residual spores of C botulinum can germinate in a process that causes the can to swell like this.

Path #78: The CDC reports that it sees a few hundred cases of C botulinum poisoning each year from what is called 'home canning.' Based off of some of their investigations of these outbreaks, this practice of home canning appears to be common up in Alaska, where people grow food in the few warm months, then prepare and can those foods for the long winter. In the air-tight conditions of these mason jars, a single surviving spore of *C botulinum* could survive and spawn.

Path #79: Although that JAMA article does a really thorough job of explaining how botulinum toxin interrupts some of our body's nerves, I couldn't figure it out in a way that I could then explain to each of you. So I went looking for a more basic explanation to this question: *How does Botulinum Toxin work?* Fortunately the good folks over at MedicineNet.com are way more intelligent than I, so I've inserted their answer here for you. It stops our body from being able to control its muscles, which as you will see later becomes a major problem because the act of breathing is controlled by muscles. What makes this infection so cruel is that patients can still feel everything, they just can't say or do anything about it. I also included that bullet about *C botulinum* coming in seven types; described as letters A through G. The three most common types seen by the CDC in the course of its outbreak investigations are type A/B and E; so for obvious reasons those are the types aimed at in the CDC's trivalent anti toxin that they derive from equine, or horses. I'll talk more about that in a moment. My former employer, the U.S. Army, has an experimental heptavalet (meaning seven) antitoxin that covers the whole range of known *C botulinum* types.

Path #80: OK, that should help give you an idea of what we could be facing, now we'll look at some options on what should do about it.

Path #81: As we saw with Anthrax, *C botulinum* is not something that can be passed from person-to-person. So if we can identify where it was released, keep people from going in or near that area, and decontaminate the area; then we should be able to limit the number of new cases coming into the system (which as may recall from that image, with the faucet and bucket, that I discussed earlier is called *Incidence Rate*). Fortunately for us, C botulinum is not nearly as hardy as the anthrax spores I spoke about in the previous

module. As potent as this stuff is, it doesn't stand up to the elements very well (perhaps this is what that partner agency had in mind during 'Simple Truth' when we discussed that lifting of the Shelter-in-Place order?). The decontamination issues for people, buildings and environment are similar to what we've seen. I added that last bullet in there about the "Decay Rate" for C botulinum to help give an idea of what the experts are telling us.

Path #82: I cannot stress enough how useful this book is. My old and beat-up copy is stuffed full of references and notes in the margins, plus mine is tabbed out for quick reference. If you should ever see me at the ESF-8 desk in the State Emergency Operations Center (SEOC), I always have my copy right there with me.

Path #83: You would think that since this stuff comes from a bacterium, we would be handing out antibiotics in mass dispensing operations like we do with anthrax at Points of Dispensing (PODs). That is not the case with this agent: the CDC's antitoxin we would need to provide does not lend itself to these sort of mass dispensing ops. When the CDC developed this anti toxin, it was derived from horses, so there is a possibility of some recipients having an allergic reaction and going into anaphylactic shock. The fact that these anti toxins are given as an intra venous infusion doesn't help either for mass dispensing.

Path #84: The epi folks will no doubt be quite busy trying to track down where this stuff is coming from. With so few cases of C botulinum per year (as per the CDC's data), if we were to suddenly see a bunch of people coming into local ERs with "flaccid paralysis" symptoms, then that's a pretty strong indicator that we've been hit with an agent like *C botulinum*. The JAMA article does a good job listing the incubation periods for each type of C botulinum poisoning, as well as basic morbidity and mortality facts. That term morbidity is our way of saying: the temporary or permanent effects of an illness upon a person who is ill. At the bottom I included those Lethal Dose/50 estimates (described by Bioweaponeers as LD_{50}). When LD_{50} estimates are listed being below 100 micrograms, we are talking about some truly lethal stuff that doesn't require a high expose to create and sustain dramatic illness in a person.

Path #85: I snipped this image from page 1064 in that JAMA article because I thought it to be so succinct and useful. That second line about "*unusual botulinum toxin types C/D/F or G*" was interesting to me. That next bullet about a "*common geographic factor*" is a classic epidemiological indicator of a point source exposure. That fourth bullet about "no common source" is our worst nightmare from a decontamination and infection point-of-view. Finally that note there at the bottom about travel history, dietary history, etc. Those would be our marching orders to the outbreak investigators we would bring onboard to help track down what are called case histories.

Path #86: As I have said before when it comes to this sort of response: don't 'wing it' and stick to your Threat Response Guides (TRGs). The basics are already in there for you, so follow along and approach the response issues using the TRGs to help guide your efforts.

Path #87: OK, we've got two Category-A agents down, and four more to go. If you have any questions or concerns on what I've covered thus far, just e-mail them to me at PublicHealthDan@gmail.com , or call me at 775-247-3680.

Module 7

Plague

When the Lamb opened the fourth seal, I heard the voice of the fourth living creature say, "Come!" I looked, and there before me was a pale horse! Its rider was named Death, and Hades was following close behind him. They were given power over a fourth of the earth to kill by sword, famine and plague, and by the wild beasts of the earth.

—Holy Bible, New International Version, Book of Revelation, Chapter 6, verses 7 and 8.

Of the six Category-A agents we will cover in this course, the word 'plague' is the only one that can be used as a noun, or as a verb. Prior to the 1918 Spanish Influenza, bubonic plague was the great scourge of humanity. This pathogen emptied Europe of a third of its population within a few short years. Although the invention of antibiotics in 1928 by Alexander Fleming put a severe dent in the ability of *Yersinia pestis* to impact humans, a weaponized version of this agent is still a threat, especially one that has been grown with resistance to our armamentarium of existing antibiotics.

If you are taking this course at your own pace from your computer, then please allocate at least 18 minutes to complete this seventh module of today's presentation. Each module in this presentation is designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.

Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #88: In this next installment of today's course, I will be discussing one of the more infamous agents listed by the CDC as a Category-A agent: ***Yersinia pestis,*** or as it is more commonly known, plague.

Path #89: Plague is caused by a bacterium that comes to us through various portals of entry: remember we discussed those back in Module three's topic on "*Chain of Infection*" (remember: Agent → Transmission → Host?). I'll go into more detail on those portals later in this module.

Path #90: This quote from another of those JAMA articles on Category-A agents says it all. I have highlighted that year '1346' in yellow for you as a means of re-connecting you with that Siege of Caffa topic I covered back in Module 1. As you may recall, in 1346 the Mongols catapulted cadavers over the defenders' walls, and created an epidemic of plague amongst the Italian occupants of that besieged city. There are some who believe the return Caffa's displaced survivors to southern Europe touched off this '*Second Plague*' epidemic that is forever seared into humanity's collective memory as the "*Black Death.*"

Path #91: Once again, we have yet another example of the collective efforts of our nation's brightest minds, to help public health and Homeland Security practitioners with guidance and recommendations that are based off of the best science we have available.

Path #92: As with the previous articles for anthrax and botulism, I highlight this publication date because it demonstrates the national focus of biological threats

to our security prior to 9/11. This JAMA article from May 3, 2000 (Volume 283, Number 17, pages 2281 to 2290) will be cited and used throughout this module. I provide this reference for any of you who may want a copy of this article. For those of you who work at the state Fusion Center and/or the State Emergency Operations Center (aka: the SEOC), a copy of this article with all my field notes and references is loaded into the ESF-8 Coordinator Manual that resides permanently at the ESF-8 desk in the SEOC. Just look for Annex I, turn to the tab for "Biological" and flip to "Aerosolized Plague." Behind that TRG is a scanned copy of my working version of this JAMA article. Please note that this applies for each of the Category-A agents as well. FYI.

Path #93: As I said earlier, this is the only Category-A agent with this claim to fame, if we should call it that at all.

Path #94: The referenced JAMA article does a good job of covering the three major plague epidemics within recorded history. One of ancient Rome's emperors, Justinian the First, has the dubious honor of having this first plague named after him. Much of what we know of this epidemic comes from Byzantine historian: Procopius. In his work "History of Wars" Procopius explains to us how "*This disease always began from the coast and then moved up to the country inland.*" Returning roman legions from Constantinople are believed to have carried the both disease and its vector (rats and fleas) back to southern Europe/Italy with them. You can see the attributable losses in population in that last sentence.

Path #95: Here is a mosaic of Justinian the First, dated from the year 546 AD. In spite of having the misfortune of not only having this first plague named after him, he also fell severely ill with this disease. Fortunately for him, Justinian managed to survive his run in with this deadly disease.

Path #96: This image is of one of that particular plague epidemic's most horrifying characteristics: necrosis of the hand. I will go into this form of plague, something called *septicemic plague*, later in this module. As you can see from this telltale sign of plague, now we get an idea of where that term '*Black Death*' is derived from.

Path #97: Of the three separate plague epidemics, this is the one we are most familiar with: The Black Death (aka: The Great Pestilence) that gutted Europe in the Middle Ages. I raise that issue of Caffa's returning refugees just to re-connect that discussion we had earlier in Module 1.

Path #98: I stumbled onto this image while reading through the British Broadcasting Corporation (aka: the BBC) website, and its section on the 'history of the Middle Ages.' For those of you who are following along in the course handbook, I have included the specific BBC website in case you are interested in learning more.
http://www.bbc.co.uk/history/british/middle_ages/black_01.shtml

Path #99: Here are the carriers of bubonic plague's vector: stowaway rats onboard merchant, and military, ships of that era. Once these rats, and the fleas that hitchhiked rides upon them, entered a European seaport, it was just a matter of days before the first cases of plague made their dramatic appearance. Once the contagion established itself within these seaports, then it was just a matter of time before, as Procopius described: "*This disease always began from the coast and then moved up to the country inland.*" One of the epidemiological indicators that a bubonic plague epidemic is underway is described in the JAMA article: the "*prelude to human epidemics, rats frequently die in large numbers, precipitating the movement of the flea population from its natural rat reservoir to humans.*" This quote came from page 2282 of that JAMA article.

Path #100: This backlit image of a flea, that has just fed upon an unsuspecting host, demonstrates how their blood meal can fill such a small vector. As these small insects feed upon their victim, they regurgitate the *Yersinia pestis* bacteria into the host's skin and capillaries. Once they are delivered into that system, they end up in the regional lymph nodes, where they "rapidly multiply, causing destruction and necrosis of lymph node architecture", etc. Without the rapid initiation of life-saving antibiotics, the patient descends into shock, coma, and death.

Path #101: This third plague began in China, and then travelled the globe within months. I listed those death tolls from China and India to give you an idea of how virulent this form of the disease was.

Path #102: Now we will cover the basic facts concerning the nature of this threat to public health, and Homeland Security. *Yersinia pestis* is non-motile, which as you may remember means, it is not capable of moving itself. Next we see that it is gram negative, which again, tells us something about its outer layer. It is described as something called a coccobacillus because it can take on the shape of either a rod or a sphere.

Path #103: Here is an artist rendering of plague as a single link of that rod form I just spoke about.

Path #104: And here is an electron microscope image, that I found online, of plague in that spherical form I just mentioned.

Path #105: There are three types of plague infection, we'll begin with the form of the disease we would most expect to see following a biological attack: pneumonic plague. This form of the disease is so rare naturally, that a single case would alert us to a possible attack. If plague bacilli were released upon an unsuspecting population, then we would see both animals and humans succumbing to its infection. Once this form of the disease establishes itself, then it could be passed from person-to-person, etc. This ongoing effect of droplet infection would make this appealing to a bioweaponeer. On page eight of his book '*Biohazard*', Dr. Ken Alibek tells us of the Soviet Union's interest in this biological agent: *"The plague weapon we had created in our laboratories was more virulent*

then the bubonic plague, which killed one quarter of the population of Europe in the Middle Ages."

Path #106: Once this form of the disease takes hold of a person, its most immediate effects are seen and felt within the lungs. In this image of an x-ray from that JAMA article we see what the authors describe in their article as: "*extensive lobar consolidation in left lower and middle lung fields.*" This basically means "really bad infection in the lower and middle left-lung."

Path #107: The bubonic form of the disease is the most common form of the disease we see each year across the globe. As I have listed: this form of the illness does not transmit from person-to-person, so from a bioweaponeer's perspective, this form of plague may not be as appealing to develop and release as pneumonic plague.

Path #108: Way back in Module 1, I used a color painting from the Middle Ages that depicted a husband and wife who were afflicted with bubonic plague. Remember that long-haired guy throwing aromatic herbs into the air to ward off harmful miasmas? As helpful as that image was, it was actually wrong. It shows the buboes of bubonic plague spread evenly over the whole body. In reality, these buboes are generally located in these three areas of the lymphatic system: the neck, the axilla (aka: armpits), and the groin.

Path #109: Finally we have the most infrequent form of the disease: septicemic plague. What makes this form of the disease so dangerous is that it can occur on its own, or in concert with any/all of the other two versions of the illness. Once the bacteria infect the bloodstream, they are carried throughout the entire body. When this happens, then the illness takes on those classis 'Black Death' symptoms we have heard so much about.

Path #110: This case photo is of a 61 year old man from Bend, Oregon, named Paul Gaylord, who contracted bubonic, and septicemic plague, from a bite by his pet cat in 2012. Mr. Gaylord spent 27 days in a coma, lost all his fingers, all his toes, and most of his right foot. For those of you following along in the course handbook, I have included the web address to the *New York Daily News* article about this story:

http://www.nydailynews.com/life-style/health/bubonic-plague-survivor-speaks-recovery-article-1.1600598

Path #111: As we did with previous agents, now we will look at interventions we can introduce to help limit the impact of this biological agent amongst our population here in Nevada.

Path #112: Although I will begin with decontamination, plague is somewhat tricky because it could enter our bodies through two portals of entry (remember those from the 'Chain-of-Infection' discussion?). As strange as this may sound, initiating a bubonic plague epidemic, if you recall from that discussion about

World War Two, and Japan's **Unit 731**, such an attack has been successfully done in the past. That second bullet down includes a sub-bullet about the timelines we should expect before exposed people begin their first symptoms. That 2 to 4 day incubation periods can complicate things. As with anthrax, that amount of time would give the perpetrator plenty of time to clear the area and make their escape. For that third bullet down, I added all those quotes from the JAMA article to help give you an idea of whether plague bacilli would persist in the environment, and the working group's recommendations for decontamination.

Path #113: This bacterial infection is normally treated or prevented with an aggressive antibiotics plan. As with any biological agent that has been weaponized, we always worry about agents that have been modified to be resistant to antibiotics. Once again we turn to Dr. Ken Alibek who describes to us how Soviet bioweaponeers created genetically engineered versions of these pathogens that were resistant to treatment, particularly antibiotics. From page 160 of his book: *"The only worthwhile genetically altered weapon, for military strategists, was on that could resist all possible treatments."*

Path #114: This slide incorporates many of the issues raised in previous modules to this course. Way back in the Module 2 (*Brief Overview of Bio-terrorism*) I discussed something called *Epi Curves* (remember that graph by University of Hartford, CT, 'Common Source' versus 'Host-to-Host', etc.?). Later in the Anthrax portion of the course, I went on to discuss realistic timeframes for laboratory testing and results: Confirmation, Identification, and Characterization. Here is where we will connect those two concepts for plague. If an attack using plague was un-announced, then we are most likely to see an epi curve that initially resembles that Common Source exposure (remember that steep curve that goes straight up, but then drops off precipitously?). By the time we realize something is going on, the agent itself may be gone from the environment, so the only data we may have early in an epidemic are these Epi Curve data points. If those initial cases pop up all within a day or two of each other, and plague cases normally being so rare, then this would tell us something. The trick with pneumonic plague is that once it establishes itself within a population, it could then transmit person-to-person via droplets. The epi curve would then resemble that long and drawn out epi curve we would associated with a 'Host-to-Host' epidemic later on. For the healthcare providers who will be tending to patients stricken with plague infection, there is yet another challenge; something called a **differential diagnosis**. This is when the symptoms of one illness closely resemble those of another. In the case of plague, its initial symptoms are nearly identical to those of anthrax infection. As we await lab test results, we may not know if we've been hit with plague, or anthrax, so keep that in your intelligence assessments early on into a response.

Path #115: All this talk about droplet transmission, person-to-person, etc., tells me that I should cover *Infection Control* methods that the authors to that JAMA article have pre-identified for us to use. These bullets come from page 2289 of that article, in case you are interested in reading more. That first quote about plague "*not spread widely or rapidly in a community*" is good news for us. Once those

initial cases that were exposed to the original release become ill, we hope to not see too many secondary infections. The standard and droplet precautions recommended by the Working Group on Civilian Biodefense are within our current capabilities for the short term (a week or two), anything longer and we would need a re-supply from the Strategic National Stockpile (SNS). I included those recommendations for something called **Biosafety Level** or ***BSL*** for short, so you get an idea of what our counterparts at the state laboratories would concern themselves with.

Path #116: Although weaponized plague bacilli will probably not persist too long in the environment, this biological threat is tricky because the infection comes in three different presentations: bubonic, pneumonic, and septicemic. The baseline recommendations listed within this table from the TRG for Plague are conservative, so they may be changed later on in a response as those lab data come in, and we get a better idea of what we're dealing with. I also highlighted in yellow the standard and droplet precautions that I mentioned a few moments ago. These more detailed explanations of those precautions are there to help the Logistics Section, Operations and Planning Section in their duties during a response.

Path #117: OK, that was the last installment for part II of today's training course. In the third and final part of the course, we'll go on to cover Tularemia, Smallpox and Viral Hemorrhagic Fevers (VHFs). As with all the previous modules, if you have any questions please don't hesitate to contact me at PublicHealthDan@gmail.com, or at 775-247-3680.

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Module 8

Smallpox

"Future nations will know by history only that the loathsome smallpox has existed, and by you, has been extirpated."

—Thomas Jefferson in a letter to Edward Jenner, in 1806.

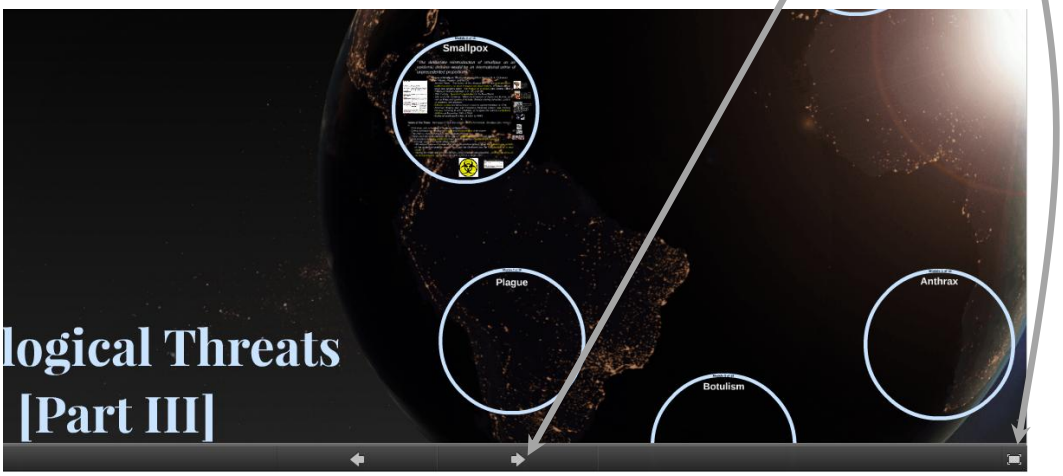
The virus that causes Smallpox infection, variola, had been the scourge of humanity from ancient times, all the way until its eradication was declared by the World Health Organization (WHO) in May of 1980. This triumph of public health has provided the blueprint for the eradication of other diseases that use humans at their sole reservoir; most notably: polio.

Yet this victory is seen by some as tenuous, for the smallpox virus itself still exists in two secure locations: at the CDC in Atlanta, Georgia; and, at the State Research Centre of Virology and Biotechnology, in Koltsovo, in Russia. Within public health, there is a great debate on whether these remaining stocks of variola virus should be maintained, or destroyed. If you are interested in reading more about this debate, I would point you toward Richard Preston's book titled "*The Demon in the Freezer.*" Try this website too:

http://abcnews.go.com/Health/debates-fate-smallpox-vials-us-russia/story?id=23568217

If you are taking this course at your own pace from your computer, then please allocate at least 27 minutes to complete this eighth module of today's presentation. Each module in this presentation is designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.



Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #1: Welcome back for the final installment of today's course. Before we get started please adjust your computer's volume control.

Path #2: This is Part III of today's course titled "*Shedding Light on Biological Threats to Homeland Security.*" In Part III, I will be covering the remaining Category-A agents: Smallpox, Tularemia, and Viral Hemorrhagic Fevers or VHFs.

Path #3: I will begin with one of the more dangerous Category-A agents: a virus called Smallpox.

Path #4: Smallpox is a virus that is also known as variola. Scientists and microbiologists suspect that the variola virus mutated many thousands of years ago in north-eastern Africa, where its reservoir, (aka: the place where it resided) became the human body. As we will see later, there are other versions of this type of virus that infect other species (e.g. cows, monkeys, etc.), but this specific virus, variola, inhabited only one species: homo sapiens, better known as humans.

Path #5: I am using this quote from another one of those JAMA articles to make the point of how serious a threat this is to our species. I am also using this quote as a means of reinforcing that discussion we had way back in Module 2 about Bruce Hoffman and Reza Aslan. If a terrorist group were to get its hands on this agent, and release that agent, then we're probably talking about a group that has an end-of-world or Doomsday vision. If this Jeanie were to be once again 'let out of the bottle', then

whoever was responsible would have the entire world body of governments coming down upon them; not exactly a tactic to get a seat at the negotiation table.

Path #6: OK, you're getting the hang of this now. Yet another one of those useful JAMA articles that I plan on using throughout this module.

Path #7: For those of you so inclined, I have once again highlighted the reference to this article, in case you want (or need) to print your own copy.

Path #8: This is one of humanity's oldest foes, as described to us in this book by Mr. Michael Oldstone: *Viruses, Plagues , and History*. Smallpox has been around for so long that we have plenty of records of its effects through ancient texts from various civilizations. Throughout these texts we read over-and-over how this virus would respect no borders, nor would it exclusively infect only certain classes within a society. As I listed in that first bullet: Smallpox afflicted kings and paupers alike! One such example is the **Plague of Antonius** in ancient Rome (aka: the Plague of Galen who was a roman doctor that wrote detailed histories of this epidemic). These sort of historical records do not come to us solely from the roman records, for we hear of this illness in ancient Egypt as well.

Path #9: Once such example is literally written on the face of a mummy from 1145 BC: ancient Egypt's Pharaoh, Ramses the 5th. The pock marks left over from smallpox infection can still be seen on his face, neck, and chest. I added that arrow to help point you to where those marks are most easily seen.

Path #10: Next we have the *Spanish Conquistadors* and their expansion into the New World (aka: North and South America). Europeans had long suffered epidemics of this deadly disease, and over many centuries had developed some antibodies to the disease. Although they would still fall ill from the illness, for those who survived, they had life-long immunity to re-infection from smallpox. When the Spanish arrived in the New World, the indigenous populations had no such antibodies.

Path #11: So in this image, we get an idea of what happened next: the conquistadors marched unopposed into the Aztec capital. Once again, I would point you toward Jared Diamond's book *Germs, Guns, and Steel* if you would like to learn more. For the purpose of today's course, I added these quotes from page 210 of Mr. Diamond's book to help make my point. Even more dangerous than the western weapons and tactics that the Spanish conquistadors carried into the New World, were the microbes they carried in their lungs. I highlighted in yellow that "decisive advantage" statement by the author.

Path #12: Back in Europe and Asia smallpox was by no means slowing itself down. In fact, it was changing the very fabric of those societies by "*altering dynasties, control of countries, and alliances.*" That all began to change in the late 1700s when English physician Edward Jenner made his discovery of using cowpox lesions to inoculate people against smallpox. Remember that discussion we had in the Public Health 'Toolbox' portion of today's course: Jenner and his observation of the milkmaids and cowpox? Here in the U.S., one of our most famous and universally known events, the Gettysburg Address,

almost did not happen at all. In the days leading up to President Lincoln's famous address in November of 1863, he fell ill with smallpox that had taken on epidemic proportions in our nation's capital. For those of you following along in the course handbook, there a web address with an article about all of this.

http://www.civilwarprofiles.com/abraham-lincoln-smallpox-and-the-gettysburg-address/

Path #13: In this photo, taken just 11 days before the Gettysburg Address, we see Lincoln just before he begins to feel ill. One of that address' most notable characteristics was its brevity. Was Lincoln's short speech caused of his failing health at the time he both wrote, and presented his famous address?

Path #14: That sixth bullet down lists three outbreaks: New York in 1962, Germany in 1970, and Yugoslavia in 1972. In a 1998 article for the CDC's Emerging Infectious Diseases (EID) journal, Dr. D.A. Henderson describes how each of these three separate outbreaks amongst immunized populations created incredible havoc. His question is: if the single cases identified as the cause behind each these outbreaks could create so much chaos, then what would a single case do today amongst a global population that is barely immunized against Smallpox? Dr. Henderson goes on to discuss how Soviet bioweapons experts saw that situation as the reason behind why they view Smallpox as the most likely agent to be used in a biological attack. In that last bullet at the bottom, we see that this virus has been eradicated since 1980. A weakness of smallpox is that its natural reservoir is the human body. That made it a top candidate for eradication in the 1950s/60s and 70s. The World Health Organization (WHO) set out to completely rid humanity of this scourge with its global smallpox eradication program (to which Dr. Henderson served as Director for some time). In this triumph of public health and global cooperation, those efforts came to a successful end in May of 1980.

Path #15: This photo from the WHO's magazine reflects that incredible achievement. Overnight we went from posters like this to the right (from Lagos, Nigeria) to the removal of an ancient scourge of humanity. Here's a side note about another virus up for eradication: Polio. That virus' reservoir is also humans, and ongoing immunization efforts had that scourge on the ropes. But unforeseen obstacles in northern Nigeria, in Afghanistan and in Pakistan have allowed this virus to hold on. Here is an example of one such obstacle. As incredible as the raid, and killing of Osama Bin Ladin was for all nations of the world, there have been far reaching public health consequences to that mission. Confirmatory DNA samples of his presence in Abbottabad, Pakistan, were gleaned from a fake immunization drive that used needles to collect DNA from his children. Since that raid, and the announcement of how those DNA samples were collected, Pakistani and Afghan mobile immunization teams have been killed, for they are now seen as puppets of the west. I'm not saying we shouldn't have killed Bin Ladin, I'm just saying we should not have told the world **how** we confirmed his location.

Path #16: You're getting the hang of this by now, so we'll go into the '*Nature of the Threat*.' Variola virus is a DNA virus, which are more complex than their simple RNA cousins on the 'virus family tree.' If we plotted out where variola virus would reside on

the family tree of all viruses, it would end up on the branch called orthopoxviruses. As I have highlighted in yellow for you, these are some of the largest and most complex of all viruses. An individual smallpox virus, also called a 'virion' in that third bullet down, is described as being 'brick shaped.'

Path #17: Here is a close-up of an electron microscope's image of the smallpox virus. Pay attention to that 'dumb-bell' shaped area in the middle. That's where all the genetic code for this rather large and complex virion resides.

Path #18: I added this image because it's an amazing piece of glass sculpture by British artist Luke Jerram. As often as we see images of virus and bacteria in color, they are so small that they actually don't have any color pigment. In their natural state, they look like this. Mr. Jerram's "Glass Microbiology" are sold for thousands of Euros, and have developed quite a following. In this image we get a much better understanding of variola's outer layer, and that dumb-bell shaped bundle of genetic code within it. So you see: ESF-8 people (aka: public health geeks) appreciate the arts too! For those of you who are following along in the course handbook, I have included the web address to Mr. Jerram's gallery and website. Check out his work when you can, it will blow your mind! http://www.lukejerram.com/glass/

Path #19: That fourth bullet down talks about other orthopoxviruses. I have highlighted in yellow that first one on the list, Monkeypox, because I have first-hand experience with this cousin of smallpox. Back in 2004, within a few months of completing my MPH, I was hired by the University of North Carolina at Chapel Hill's school of public health, to serve as their in-country program manager for their monkeypox research program in the Democratic Republic of the Congo, or the DRC. As a newly minted epidemiologist (who is also fluent in French, which comes in wicked handy in the DRC), my two-year assignment was to establish the "Incidence Rate" of Monkeypox amongst the population within the DRC's central district called the Sankuru. If you remember from that faucet and bucket diagram I used earlier in the course: incidence rate is represented by the amount of water pouring into the bucket (aka: number of new cases entering the system). Once that was done, I was to turn over my data to the good folks at USAMRIID (remember those guys/gals from Fort Detrick, MD, we spoke about earlier?) who were going to run drug trials in the DRC of *Cidofovir* as a post exposure prophylaxis (aka: PEP) for all orthopoxviruses.

Path #20: In my first foray to the DRC's Sankuru District, I met this young lady. We had passed through her village the previous day to look at another outbreak five kilometers further down the road. The cases we found there were at the tail-end of their illness, and were almost done with shedding their scabs. The next morning as we re-traced our route, the people of this girl's village blocked the road. As I jumped off the back of our dirt bike, the throng of people opened before me. At the end of that was a woman dressed in a bright orange robe that you can see in these photos. That was this girl's mother, who had her back to me and was carrying something. As a chair was brought forward for the lady to sit upon, she turned and this is what I saw. There are few times I have blanched in front of a client/patient, etc., but I must admit I did on this occasion. This was my very first case of monkeypox in the full-effect of its clinical presentation. Unlike measles which is predominately on the trunk of a body, this virus

(and smallpox) gravitates to the extremities (a classic symptom that helps with any differential diagnosis issues between smallpox and chickenpox – FYI). This girl's palms and soles of her feet were covered with rock-hard and painful pox. She could no longer walk, so that's why her mother carried her everywhere. I heard later that she survived her encounter with this illness, but lost her left eye from secondary infections (that as you may recall is called a *morbidity* of illness). If you would like to see more, I have included the article on this research project in the course handbook.

http://www.pnas.org/content/107/37/16262.full.pdf+html

Path #21: That fifth bullet down is really bad news for those of us in the prevention and response business. Once this *Jeanie is let out of the bottle*, it is transmitted between people via **droplets** and **contact** (remember those nasty images at the beginning of this course with the woman sneezing, and the dirty door knob?). I also added that sixth bullet that talks about how smallpox could be used as a biological weapon. The sub-bullets say it all. The virus could be aerosolized, the agent could persist long enough to infect untold numbers of people, and a few weeks later when those people fall ill, they can infect many others, and so on. Yup, this would be a really bad and prolonged response for ALL of us.

Path #22: OK, so what the heck are we going to do about all of this?

Path #23: I'll start with decon again, but to be honest, by the time we figure out that something has happened, the agent would be long gone.

Path #24: Rather than explain what I mean, I snipped this screen shot from page 2132 of the JAMA article. I realize that there's a lot there, so I have highlighted in yellow the key points I am trying to make. If a terrorist was smart enough to get their hands on this stuff, then they're probably not going to tell us they released it. If that planning assumption is true, then the first we'll see/hear of anything is as long as two weeks later, and by that time, the agent would be gone from the environment.

Path #25: If we were lucky enough to know of a release, right after it happened, then the authors of that JAMA article provide us with estimates from data using a surrogate to variola virus, a similar virus called vaccinia. Note: This virus is so close to smallpox, that it is what we use in the vaccination for smallpox. I'll talk more about that in a moment. Based off of all sorts of tests with vaccinia, scientists have a pretty good idea of how variola would persist in the environment following an aerosol release. I listed some temperature and humidity calculations, in a moment I'll provide a detailed table of the results to those experiments. In that fourth bullet down I also list the disinfectants recommended to counter smallpox virus. That last bullet about scabs is discussed throughout the literature, so I mention it here. Remember our discussion about Fort Pitt and British General Amherst providing blankets to the Native Americans? With all the data, it sounds like the scabs are a threat, but not to the same degree as other phases of this infection, which I will talk about in a moment.

Path #26: For the data geeks listening to this course, I re-created table 2 from the JAMA article for you. In the original version, the authors uses Celsius for those

temperatures listed in the left column. In my re-created version of their table, I converted their temperatures into Fahrenheit for you, to help make this easier to read.

Path #27: With smallpox being a viral infection, there's not much in the way of a treatment we can provide (or as it's listed here: Tx). As we'll see with other viral infections, such as Ebola, the only treatment we can provide is something called *palliative* in nature (e.g., keep their fluids and electrolytes up, try to lower their fever, provide antibiotics for secondary infections, which would have come in handy for that girl in the Congo and her left eye). The JAMA authors inform us that if a vaccine against smallpox is provided within four days of exposure, then that can provide some immunity, or lessen the severity of the illness should the person fall sick. That third bullet down talks about how this type of vaccination is administered, with something called a bifurcated needle.

Path #28: Unlike those intramuscular (IM) injections we remember so well from our youth, or from our annual seasonal influenza immunization (we interrupt this slide for a message from my wife. Hey folks, my wife used to be the state immunization program manager for Nevada, and wanted me to remind you all: get your dang flu shot every year!), the smallpox vaccine is given with one of these. They swirl the needle in a little dish of vaccine, get this little droplet between the needle's forks, the push that against your left deltoid fifteen times in an area the size of a small button.

Path #29: Here's a close-up of what I'm talking about. You can get a sense of how small the head of that bifurcated needle truly is. Those two metal forks only penetrate about a millimeter into the cutaneous layer of skin, so there's little pain. It feels like you're getting little pinches.

Path #30: For those of you looking at the appendices to the course handbook, you may recognize this image from the Threat Response Guide (TRG) for Smallpox. This is a training aid we would use for our healthcare providers and immunization providers. I have also snipped a screen shot of *Ring Vaccination Model* diagram that I made for the TRG for smallpox. While in grad school, I had the privilege of studying under Dr. Stan Foster, and while in his courses, we would sometimes have Dr. Bill Foege as a guest lecturer. Those two gentlemen were a big part of the WHO's Smallpox Eradication Program, and this tactic of *Ring Vaccination* figured heavily into their operations. For any of you taking this online training who are clinicians and/or immunization providers, I have included a web address to a *How-To* video done by the CDC on how to properly administer this type of vaccination. In addition to that video, I have also included some other web addresses from the CDC that those of you who are clinicians may find useful.

http://emergency.cdc.gov/agent/smallpox/vaccination/administration-video/

http://emergency.cdc.gov/agent/smallpox/overview/disease-facts.asp

http://emergency.cdc.gov/agent/smallpox/clinicians.asp

Path #31: This set of images from the JAMA article should help give you an idea of how long that vaccine-caused scab takes to fully form. From my own experience, after I received my smallpox vaccine at Chapel Hill in September of 2004, this was the time frame I experienced. However, in my case, what these images do not show is how swollen the lymph nodes in my left armpit (aka: axilla) became. That was one tough vaccine for me to handle.

Path #32: Finally down there with the last three bullets I have listed some medications. I mentioned Cidofovir from my time in the Congo chasing down Monkeypox cases. I don't know much about that experimental drug called ST-246, but it was discussed in much of the literature involving the case of two year old boy from Indiana who contracted vaccinia virus infection from his dad's smallpox vaccination.

Path #33: OK, now we'll get into the nitty-gritty of what our epidemiology folks will be doing, and as you will see: they have their work cut out for them! To begin, there are two forms of smallpox infection and disease. The first, which is something called Variola Major is the most common form of the disease, and the deadliest. When this form of the disease enters an unvaccinated population, we estimate that we'll lose about 30% of those people to their illness. What makes this version of the illness so difficult is that it can come in four distinct sub-types, as listed here. That first one called Ordinary Smallpox is the form of the disease we'll most likely see. For people like me, who have be re-vaccinated within the past ten years, that second form of, called Modified Smallpox, is what we may see. Although those last two are certainly rare, they are basically guaranteed death sentences for anyone so unfortunate as to fall ill with these forms of the disease. Down there at the bottom we have Variola Minor which is rare and not nearly as deadly as its counterpart. For those of you following along in the course handbook, I have a useful web address to the CDC on the case definition for this disease.

http://emergency.cdc.gov/agent/smallpox/diagnosis/casedefinition.asp

Path #34: I know, this is a busy table, and I'm sorry, but it's the best way for me to help give you an idea of how long this whole process of smallpox infection, and disease would be. I also highlighted in yellow the various windows of how contagious this virus would be through that progression. For clinicians and public health people, we worry most about that "Early Rash" timeframe, so that's why I put that big honkin' arrow right there for everyone else. In that next field called "Pustular Rash" I also highlighted that sentence about how the "*bumps feel like BBs embedded in the skin.*" Yup, I witnessed that first-hand with all the monkeypox cases we found in the Congo; that's a classic indicator of infection with an orthopoxvirus.

Path #35: This figure comes from page 2130 of that JAMA article and does a good job of conveying how the rash caused by the smallpox virus progresses and develops in a child. Every 48 hours of this photo series, we see significant amplification of those lesions. Notice how the lesions are generally uniform in size and appearance? That too is a classic indicator of smallpox. Notice how there are more lesions on this child's face, versus his/her torso? That is yet another classic symptom of infection from an orthopoxvirus versus a chickenpox infection.

Path #36: A biological attack using this agent would force us to use nearly all the tools in our public health 'toolbox.' Two of those 'tools' would be Isolation & Quarantine (aka: I&Q). The JAMA article does a good job of informing us what the differences would be between confirmed cases, suspected cases, and contacts. Those last three sub-bullets come from page 2133 of the JAMA article. What makes this so difficult is the long incubation period between first exposure and onset of symptoms.

Path #37: If a terrorist organization was smart enough, and dedicated enough, to get its hands on this agent, then we can guess that they're not interested in any sort of negotiations following their attack, etc. If they were smart enough to do all that, then we should plan for them to NOT announce the release of their agent. In that case, we will be playing catch-up from the outset, and we will be using nearly all the tools in our public health 'Toolbox' simultaneously. To hammer that point home, I've highlighted in yellow all the interventions that we would be using.

Path #38: Alright everyone, that's it for Smallpox. As with all the previous modules, if you have any questions on what I've covered up to this point, feel free to e-mail them to me at PublicHealthDan@gmail.com, or call me at 775-247-3680.

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Module 9

Tularemia

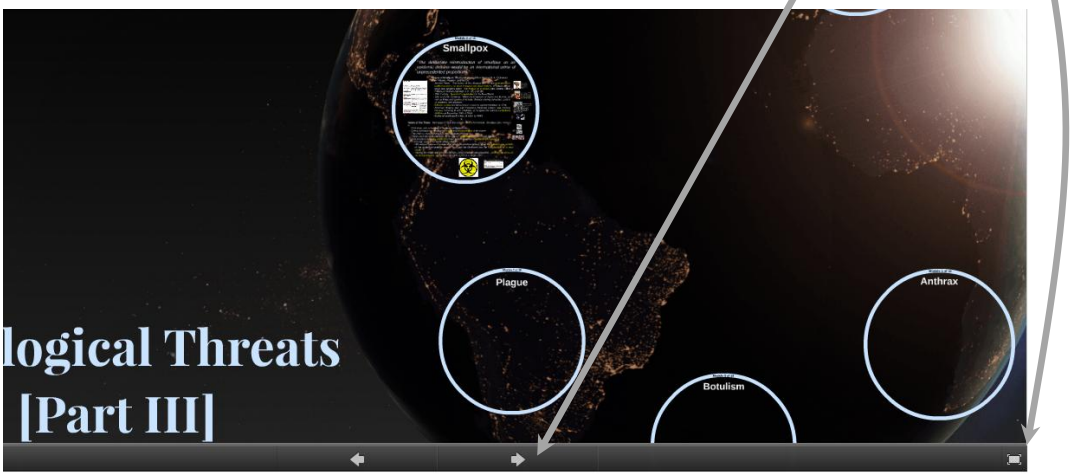
F. tularensis subspecies tularensis (type A) is one of the most infectious pathogens known in human medicine.

—World Health Organization (WHO) 'Guidelines on Tularemia', 2007

Tularemia is a bacterial zoonotic disease that is only found in the Northern Hemisphere of our planet. This bacterium is incredibly virulent to humans, as well as a whole range of animals (e.g. rodents, hares, rabbits). It is transmitted to both humans and animals through insect bites (e.g. ticks, flies), by direct contact with infected animals (e.g. their tissues or fluids), by consuming contaminated food or water, and as an aerosol of wet droplets or dry powder.

If you are taking this course at your own pace from your computer, then please allocate at least 18 minutes to complete this ninth module of today's presentation. Each module in this presentation is designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.



Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #39: Now we shall transition to module nine of today's training course.

Path #40: *Francisella tularensis*, also known as **tularemia**, is a bacterial disease that can be spread by infected animals through their tissues and fluids (hence the reason it is also referred to as '*Rabbit Fever*' amongst hunters), by ingesting it (e.g. through eating it or by drinking it), through the bites of ticks and/or flies, or as an aerosol spray of a wet or dry agent.

Path #41: This quote comes directly out of another JAMA article that I will be citing in a moment. I have highlighted in yellow that word 'infectivity' to help explain two common words that we often hear used when describing an illness, but words that are also misunderstood. When a disease is described as being 'contagious', this term describes how it can spread from person-to-person. Although infectiousness (or as it is used here: infectivity) is thought of as being synonymous with contagious, in reality this word means something different. When we talk about a pathogen being infectious, that is describing the amount of an agent needed to cause an infection and illness. These terms will come up again in the tenth and final module about viral hemorrhagic fevers or VHFs.

Path #42: Here is that JAMA article I mentioned a few moments ago, this is the one I'll be using for most of this module.

Path #43: I have highlighted in yellow that quote that I just used in the opening to this module, and for those of you who are interested in printing your own copy, I have also highlighted the citation for you. As I mentioned in previous modules, if you want or need to see ESF-8's working copy of this article, it can be found in Annex I of the ESF-8 Coordinator Manual at the ESF-8 desk, in the State Emergency Ops Center or SEOC.

Path #44: As you are accustomed to, we shall begin with the history of use for this agent. Unlike previous agents we have covered in this course, tularemia is a relatively new agent to science. We have only known about this bacterium since the early 1900s. A series of scientists explored the bacteria, but Dr. Edward Francis is credited with identifying it and naming it; as we can see by his last name and the Latin term for the bacteria Francisella tularensis.

Path #45: Here is an image of Dr. Francis who lent his name to this newly identified bacterium back in the 1920s.

Path #46: In module one, I discussed those rumors about the Soviets using tularemia against the Germans around Stalingrad in 1942. Dr. Ken Alibek asserts in his book '*Biohazard*' that as a military medical cadet a senior professor asked him to look into the epidemiological reports from that era, etc. Well that's not all we hear about tularemia from Dr. Alibek. In chapter six of his book he describes in great detail how the

Russians had yet another large-scale accident involving a weapons-grade biological agent: this time the agent was the "*highest possible concentration*" of liquid tularemia in what he describes as being '*milky brown*' in appearance. In this accident at a biological weapons production plant, and research facility in *Omutninsk*, Dr. Alibek ends up walking into a puddle of this agent. He describes how he began to feel ill and took three times the prescribed prophylaxis of Tetracycline in the weeks following his exposure. In that fourth bullet down, I have listed an interesting fact from the JAMA article; that the more dangerous type of the bacteria (aka: Type A) resides here in North America, and has been reported in every state except Hawaii. I add those fifth and sixth bullets to give you an idea of how common this illness once was, here in the U.S. In that last bullet, way down at the bottom, I use an epidemiological term called '*seasonality*.' As you know from your own experience, certain illnesses become more apparent at certain times of the year (e.g. although influenza is technically a year-round illness, we see most of our cases during the winter months, etc.). It appears that if we were to see naturally occurring tularemia here in Nevada, then we would most likely see that from late spring to early fall.

Path #47: And as the trees in the background of this photo appear, we could see cases in the winter months as well in populations of rabbit hunters, etc. This image gives you an idea of why tularemia is also called *Rabbit Fever*. This hunter appears to have been made aware of the hazards posed to his health by contact with "*infected animals through their tissues and fluids*" that we covered at the start of this module. If you look closely, this man is wearing surgical gloves, which you may remember from our "*Public Health 'Toolbox'*" discussion is a form of PPE, or Personal Protective Equipment.

Path #48: In the Nature of the Threat portion of this module, we will look at the details of this bacterium. We begin with the basics: tularemia is a bacterial zoonosis, which basically means that it comes to us through animals (e.g. rabbits, voles, hares, etc.). The second bullet hammers home that issue of infectivity I covered a few moments ago: look at how small an amount of this agent we would need to be exposed to. To put that in perspective; if you look at page 2239 of that May 1, 2002, JAMA article on anthrax, the authors tell us that they estimate the number of inhaled spores to infect and kill a person would be anywhere from 2,500 to 55,000. When we look at this number of ten organisms of tularemia that is an incredibly low number and gives you an idea of why this agent is included amongst the CDC's other Category-A agents. The third bullet lists this agent as being non-motile (aka: it cannot move by itself) aerobic (it needs to be exposed to air to live), gram negative (tells us if it absorbs that stain, which tells us about its outer layer) and that it's a coccobacillus which means its shape can be somewhere between a rod and a sphere.

Path #49: I snipped this figure from page 2769 of the JAMA article on tularemia because it provides a side-by-side comparison of how three of the Category-A agents we have covered look under the microscope. To help you identify each agent, I have added those "Anthrax Gram +" inserts to the image. In the anthrax image, there are those classic bamboo rods that we covered in Module 5. In the middle image, we have plague which is gram negative. If you recall from Module 7, these bacteria are also a coccobacillus like tularemia. All the way to the right we see tularemia as those little football shaped spheres. That insert image of what these look like under what lab

techs call *immunofluoresænæ* shows how they glow when viewed under this light source. If you look in the parenthesis for each agent, the authors also provide the size in microns so we get an idea of how they stack up against each other: anthrax is the largest (.5 to 1.2 microns wide, by 2.5 to 10 microns long), then plague (.5 to .8 microns wide, by 1 to 3 microns long), then tularemia (.2 microns wide, by .2 to .7 microns long).

Path #50: I included that fourth bullet down that discusses how this organism can survive for weeks at low temperatures because that fact will feed into our estimates on how we will decontaminate people, places and the environment following an attack. I have italicized that point about decaying animal carcasses because it feeds into the cause of an outbreak back where I am from: New England. If you are interested in learning about a deadly outbreak of tularemia from the year 2000 in Martha's Vineyard, just Google it, it's a pretty crazy story. In that last bullet I repeat how this bacterium is not spread person-to-person, and I go on to list what vectors would bring this disease to us (remember, those are the animals or insects that bring an illness to us, usually through their bites, etc.). According to a 2007 document with guidelines for tularemia from the WHO, if we were to see a naturally occurring case of tularemia here in Nevada, then the vector that delivered that bacterium into an ill person would most likely be flies.

Path #51: Alright, that's all fine and good, but what the heck are we going to do about this threat to our community? As the authors to the JAMA article tell us; if we are going to be hit with this as a weapon, then we'll most likely be hit with an aerosol release.

Path #52: If that ends up being true, then decontamination will figure heavily into our response plans. What this bacterium gains in infectiousness, it loses in its ability to persist long-term in the environment. Unlike those tough little anthrax spores we covered in Module 5 (remember Gruinard Island and Sverdlovsk?), this bacterium will not last nearly as long. In that first bullet I copied a quote from page 2771 of the JAMA article about environmental degradation of the agent. That's good news for those of us in the response and mitigation business! Next I list in bullet two and bullet three the decontamination solutions that JAMA article authors recommend we use. Those last three bullets explain washing procedures, etc., nothing too fancy there. As we remember from that public health 'Toolbox' discussion, wet decontamination must also account for run-off water (remember we call it Grey Water), so I included that statement by the JAMA article authors about municipal water systems and chlorine.

Path #53: Yup, yet another plug for this incredibly useful *decision making framework* by the National Academies.

Path #54: Treatment recommendations are covered in great detail by the JAMA article authors, so I will not go into too much detail there. For those of you who would like to see the treatment recommendations, look to Annex I of the ESF-8 Coordinator Manual for the Threat Response Guide (TRG) for aerosolized tularemia and turn to pages 17 and 18. All the treatment protocols are listed there from the JAMA article. As you can see in the sub-bullets, the treatment recommendations

cover what the authors calls "*Contained Casualty Settings*" and "*Mass Casualty Settings for Post Exposure Prophylaxis*" or PEP. I added that last bullet at the bottom about the Food and Drug Administration (FDA) having a possible tularemia vaccine in the works under what is called an Investigational New Drug or IND for short.

Path #55: OK, there are two types of tularemia, the more dangerous one is Type A and is found throughout most of North America. That Type B is wide spread throughout most of Europe and Asia with outbreaks in Scandinavia occurring with some regularity. Back here in the U.S. and Nevada, if we were to see cases of tularemia, we could see any combination of these six presentations of the disease. That first one, ulceroglandular, usually comes from handling an infected animal carcass, or from an insect bite. Because the initial symptoms are so general in nature, an un-suspecting clinician may make the wrong diagnosis early in an epidemic. That second form of the disease, oculoglandular, is when a person touches their eye with hands/fingers that have the bacterium on them. The oropharyngeal presentation occurs in the mouth and throat and is transmitted by eating contaminated food, or drinking contaminated water. The fourth one is one of the more serious presentations of this disease, and would be the form of the illness we would most likely see after a biological attack using tularemia. Those last two sub-bullets are the rarest forms of the disease, but also the deadliest.

Path #56: I snipped this table from 2766 of the JAMA article because it shows you what clues epidemiologists may need to work off of in the early phases of a response following an attack. I highlighted in yellow that part about a "*point source outbreak pattern*" to re-connect you with those epi-curves we covered earlier. This term 'point source' is synonymous with that Common Source term I used in that earlier module to this course. I have also highlighted that part about characterization being performed at "*specialized laboratories*" because it too re-connects us with a topic we covered earlier. Remember those timeframes for lab results (e.g. identification, confirmation, characterization) that we covered? Here is a reference to USAMRIID and its "*specialized laboratories*" in the JAMA article.

Path #57: A big part of an epidemiological investigation would be a *case definition*, a topic we have covered in previous modules. A big part of writing a good case definition is to provide specific symptomology; this helps filter out people who are no doubt ill, but with a agent different from the one we are looking for. Here are the symptoms provided to us by the authors of the JAMA article. Unlike Smallpox which make take weeks before we begin seeing ill patients in our Emergency Rooms (ERs); following a tularemia release we could begin seeing ill patients at the ERs in a day or so. The problem with these symptoms is how the look like influenza's initial symptoms; but here is where seasonality may help us: lots of sick people with influenza like illness (aka: ILI) showing up in clinics/ERs in February is one thing, but in July is something else. Do you see how one may point to a natural outbreak and the other to an attack? Does this make sense?

Path #58: OK, you know the deal: don't "Wing It" when it comes to dealing with biological agents. Follow this framework in the TRG and know what interventions (or tools in the *'Toolbox'*) we should, and should not concern ourselves with. I have

highlighted in yellow the *Standard Precautions* we would be recommending to caregivers and the public.

Path #59: Alright, we can just about see the finish line! After this we'll head into the tenth and final module to this training course. As you no doubt know by now; should you have any questions on what I've covered thus far, please don't hesitate to contact me at PublicHealtDan@gmail.com, or simply call me at 775-247-3680.

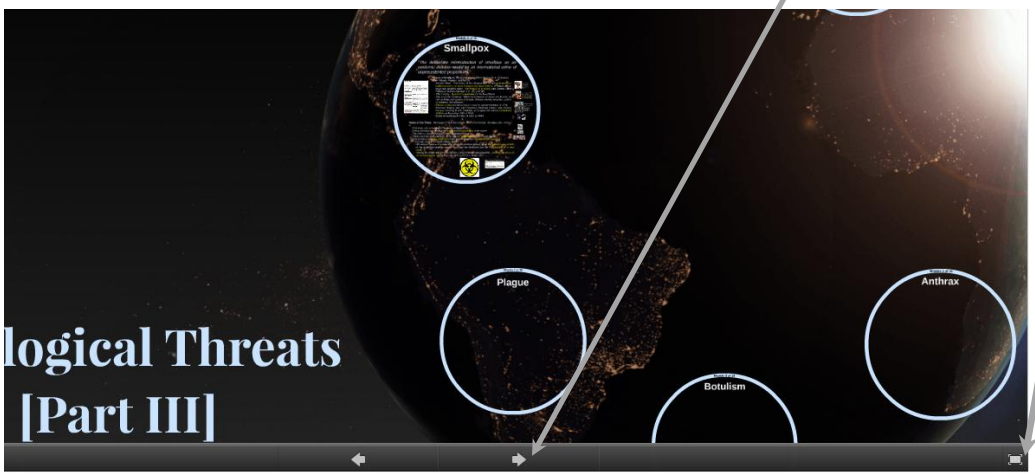
Viral Hemorrhagic Fevers (VHFs)

Thou shall not be afraid for the terror by night; nor for the arrow that flieth by day; nor for the pestilence that walketh in darkness; nor for the destruction that wasteth at noonday.
—King James Bible, Psalm 91:5-6

During today's course we have covered individual agents that pose a biological threat to both public health and the security of our homeland. In this module, we will be covering a set of agents referred to as viral hemorrhagic fevers or VHFs for short. These types of viruses come from a set of four distinct families of viruses: Filoviridae, Arenaviridae, Bunyaviridae, and Flaviviridae.

If you are taking this course at your own pace from your computer, then please allocate at least 28 minutes to complete this tenth and final module of today's presentation. Each module in this presentation is designed to build upon the knowledge gained in previous modules, so please do not jump from module to module out-of-sequence.

Note 1: Remember that when you open the web address for this course, you can expand the presentation to 'full-screen' mode by clicking this button down in the bottom-right corner. Once you are in that mode to view the course, then advance the presentation at your own pace by clicking this right-arrow down here.



Note 2: Make sure the volume on your computer is turned on, and turned up.

As with the previous modules, here is the transcript of what was recorded for this module.

Path #60: Alright folks, this is the tenth and final module for today's training course.

Path #61: Unlike the previous Category-A agents that we have covered today, this module will cover a whole group of viruses referred to simply as Viral Hemorrhagic Fevers, or VHFs for short.

Path #62: I promise, this is the last JAMA article I'll be using today. This article is the final installment of the Working Group on Civilian Biodefense and their efforts to provide science-based recommendations and explanations on each of the Category-A agents identified by the CDC as a threat to both global, and domestic, public health.

Path #63: For those of you interested in knowing where my information is coming from, here is the citation highlighted in yellow for you.

Path #64: We will begin by looking at the *history of use* for this group of viruses as biological agents. Fortunately, we do not have any indicators of these viruses being used on purpose. Since Ebola virus was first identified in 1976, all outbreaks we have identified appear to have been caused by natural means. However, we do know that some countries were interested in weaponizing some of these viruses, as listed in that first bullet. We also know from Dr. Ken Alibek's book that the Soviets routinely sent KGB agents to remote areas to collect "*new or unusual diseases*." That third bullet down references a wake-up-call article by a public health hero of mine: Dr. D.A. Henderson of the Johns Hopkins University. In his article titled ***"Bioterrorism as a Public Health Threat"*** that he authored in the CDC's quarterly Emerging Infectious Diseases (EID) journal for July to September of 1998, Dr. Henderson not only discusses the Soviet interest in VHFs, he goes on to tell us of how *Aum Shinrikyo* sent some of its members to Zaire in 1992 to collect Ebola virus specimens.

Path #65: Although history cannot provide us with examples of VHFs being used on purpose, Hollywood and writers of fiction have filled that void with their own interpretation of what an intentional release of a VHF would look like. Over the years, the publics' knowledge about this class of viruses has been heavily influenced by how Hollywood portrays these threats. Those misunderstandings and myths about VHFs continue to this day, as we see with the Ebola epidemic in the west African countries of Guinea and Liberia. In an effort to counter those myths, the Minister of Health for Guinea has been using a messaging campaign about *"Ebola Myths"*, and he has received some help in getting that message out through global news outlets such as CNN. Here is a list of the myths concerning Ebola as presented by CNN's Dr. Sanjay Gupta. For those of you following along in the course handbook, I have provided the web address to this video with Dr. Gupta.

http://www.cnn.com/video/data/2.0/video/health/2014/04/17/orig-jag-ebola-myths-gupta.cnn.html

Path #66: I read this book by Richard Preston years ago while on active duty in the Army, and it scared the hell out of me (which I suspect was the author's intent). At the time, if someone had told me that I would be living and working one district over from the cave in western Kenya where this book begins, I would have thought they were crazy. If they went on to tell me that I would also live for two and half years in Gabon, where a sizeable number of Ebola outbreaks have taken place, I would think they're twice as crazy! Although I have not yet had the opportunity to work an Ebola outbreak, I have had the pleasure of working with locals in equatorial Africa who have; most notably that Monkeypox team I worked with in the Democratic Republic of the Congo (DRC) back in 2004.

Path #67: Mr. Preston's book spawned this Hollywood movie starring Dustin Hoffman, Rene Russo, and Morgan Freeman: the film called *Outbreak*.

Path #68: I had to include this image because it's just so funny how Hollywood tries to portray the down and dirty work of public health. I do not know where these crazy looking space suits come from, but I sure as hell have never seen them down range in Africa. I guess actors and actresses cannot do their thing and 'act' while wearing the layers of PPE that the real professionals actually wear when working a hot agent like Ebola.

Path #69: With that being said, here is how the pros actually do it: PPE burkas! This recent image from the Spring of 2014 Ebola outbreak in Guinea is a great way of showing the difference behind what Hollywood portrays, versus how things like this are done in the real world. At the end when we look at the public health toolbox for VHFs, you will see that I have highlighted in yellow the highest level of PPE we can wear: **Full Barrier Precautions**. This is an image of what those look like under real-world conditions.

Path #70: OK, I will go through the nature of the threat as you are no doubt accustomed to; but, in order to do this for an entire group of viruses, I'll need a lot of help from the authors to that May 2002 JAMA article. I have highlighted in yellow the specific pages to that article where I pulled the content to re-create these tables.

Path #71: I will begin with this re-created version of Table 1 from that article. Here the authors list the four distinct families of VHFs in that column to the far left: Filoviridae, Arenaviridae, Bunyaviridae, and Flaviviridae. I have taken the liberty of highlighting in red those families that have subtypes of VHFs that the JAMA authors inform us as having *"key features that characterize biological agents that pose particularly serious risks if used as biological weapons against civilian populations."* I will go through each of these, in order, from top to bottom.

Path #72: We'll begin with the most dangerous family of VHFs: Filoviruses. This family has the two types of VHFs most familiar to the public: Ebola virus and Marburg virus. Since this article originally came out in 2002, I took the liberty of updating the original table with that vector of fruit bats highlighted in yellow to the right. Since 2002, scientists now believe that they have finally identified the natural reservoir where this

virus resides. To the left of that I have also highlighted a notation made by the JAMA authors.

Path #73: If we look down here at the bottom of the re-created table, the original authors note that there are four sub-types of the Ebola virus: Zaire, Sudan, Ivory Coast, and Reston. The most lethal of these would be Zaire and Sudan, followed by Ivory Coast. The Reston strain only kills primates and is named after an outbreak in Reston, Virginia, back in 1989. This outbreak occurred in Hazelton Laboratories amongst imported monkeys used for research. This close-call forms the foundation of that book by Richard Preston titled: *The Hot Zone*.

Path #74: Here is an electron microscope image of the Ebola virus and its infamous "Shepherd's Crook" shape. By this we can also get a sense why these are referred to as filoviruses; after that long filament-like shape they take on. The outbreak in Guinea is with the Ebola Zaire strain, the most dangerous and lethal of all VHFs.

Path #75: Next we have Arenaviruses, and as you can see, there are two subtypes that are believed to pose a significant threat as biological weapons: Lassa virus and New World Arenaviruses. The original authors included that notation that I have highlighted in yellow for you here.

Path #76: When we look down at what that notation means, we see that the authors noted that the New World Arenaviruses have four subtypes as well (which I have also highlighted in yellow for you): Machupo, Junin, Guanarito, and Sabia. They also list a fifth that was yet-to-be-named (at the time of the article's publication) from an outbreak in California during 1999 and 2000.

Path #77: Here is a close-up (and colorized) image of an electron microscope scan of Lassa virus. Obviously from what you can see here, this type of virus has a shape much different than that of Ebola.

Path #78: The next family of VHF viruses is Bunyaviruses. The only sub-type identified by the working group as a potential bioweapons threat is that middle one called Rift Valley Fever.

Path #79: These spherical virions are different as well than that shepherd's crook that we saw for Ebola.

Path #80: Finally we have the Flaviviruses down here at the bottom of the table. I had the misfortune of seeing Yellow Fever during my first tour of service with the Peace Corps in Gabon during the late 1990s. We had a small outbreak of this vector borne disease in a nearby village. A fellow Peace Corps Volunteer evacuated a woman from that village to our clinic with his truck, where she literally dropped dead as she walked through our front doors. Although the type of Yellow fever she suffered from was by no means the hemorrhagic form of the disease, it was still an imposing threat.

Path #81: Here is a close-up image of the yellow fever virion.

Path #82: As useful as that first table may have been, it does not go into any detail on how these viruses threaten us. So to fill that gap, I took the content used by the original authors in Table 3 of the JAMA article (page 2396), and re-created it here. I also added that column to the far left to help you keep track of each family of VHF. In this table I will go through each specific virus in order from top to bottom.

Path #83: We will begin once again with the filoviruses Ebola and Marburg. The Ebola virus is named after a river in north-central Congo that was first identified in 1976. While working in the Democratic Republic of the Congo (DRC), I had the pleasure of working with **Dr. Jean-Jacques Muyembe** who was one of the outbreak investigators to that outbreak back in 1976. Dr. Muyembe is director to the DRC's national biomedical research institute in Kinshasa. After my team and I would return to Kinshasa from our trips to the field, we were required to turnover our monkeypox virus samples to Dr. Muyembe's team at the research institute. As we filled out the paperwork and forms, Dr. Muyembe would tell us of how he, and his teammates, tried to come to grips with the new Ebola virus in 1976. Many of the protocols that we were using to collect Monkeypox virus samples were identical to those that Dr. Muyemebe had come up with for Ebola. OK, back to this table. As useful as the JAMA article is, there are A LOT of medical terms and phrases, so I have highlighted in yellow some words and terms that may be difficult to understand. For those of you following along in the course handbook, there is a Threat Response Guide (TRG) for VHFs. At the back of that TRG is a table with **each** of these words and their meaning; that table may come in handy for you. For Ebola we have the term *maculopapular rash* which is a type of rash characterized by a flat, red area on the skin that is covered with small bumps that touch each other. *Disseminated intravascular coagulation (aka: DIC)* is a condition when blood clots form throughout the body's small blood vessels, thus blocking, or reducing, blood flow which damages organs, etc. Under Marburg virus the term *nonpruritic maculopapular rash* means: a combination of flat and raised bumps. *Nonpruritic* means they're not itchy. The columns to the right list how these viruses can transmit between people, as well as their incubation periods. That 21 day incubation is what makes quarantine so difficult. There are those infamous mortality rates we have heard so much about with the Guinea outbreak. All the way to the right we see that each of these viruses has nothing but supportive Treatment, which I will talk about more in the next section of this module.

Path #84: Next we have the Arenaviruses of Lassa fever and New World Arenavirus. In that row for Lassa, the term *bucal mucosa* is used and means the lining of the cheeks and back of the lips within the mouth. *Exudative pharyngitis* means a sore throat that produces pus and/or postnasal drip. *Cervical lymphadenopathy* is a swelling of the lymph nodes in the neck. *Pleural and pericardial effusions* are an over accumulation of fluid in the sac that surrounds the heart (aka: the pericardium). This term *hemorrhagic complications* is used throughout this table and means consequences of an infection with a hemorrhagic virus, such as: shock, organ failure, and death. For the New World Arenaviruses, the term *myalgias* is used and means muscle pain and aches. *Generalized lymphadenopathy* is the enlargement of more than two lymph node groups that are not direct neighbors with each other. *Petechia* are small red or purple spots caused by bleeding into the skin from within. *Myodonic movements* are the sudden jerk of muscles on both sides of the body at

once. *Dysarthria* means to have difficulty with speech. The transmission, incubation, mortality and treatment data are listed in the columns to the right.

Path #85: For the Bunyaviruses, the table lists Rift Valley Fever. That word *jaundiæ* describes a medical condition with yellowing of the skin and eyes, which indicates liver disease. The word *encephalitis* means swelling of the brain. Retinitis is an inflammation of the retina which is the part of the eye where the hole is located. An *acute febrile illness* refers to a sickness with sudden high fever caused by an unknown agent. The transmission, incubation, mortality and treatment data are listed in the columns to the right.

Path #86: Finally we have the Flaviviruses that include Yellow Fever, Omsk Hemorrhagic Fever, and Kyasanur Forest Disease. The term *conjunctival injection* means when the white part of the eye becomes inflamed and turns red. *Bradyaardia* is an abnormally slow heart action. *Papulovesicular eruption* is the sudden onset of papules (aka: firm bumps on the skin) and macules (aka: flat discolored spots on the skin). The *soft palate* is the back of the mouth and the top of the throat. *Hyperemia* is an engorgement caused by an excess of blood. *Splenomegaly* is an enlargement of the spleen. Down at the bottom we have *biphasic illness* which you can figure out means an illness that hits a person in two phases. *Afebrile* simply means to be without fever, and *meningoencephalitis* is an inflammation of the brain and *meninges*, which are the three types of membranes that cover the brain and the spinal cord.

Path #87: With such a broad range of VHF threats to public health, as well as to Homeland Security, here is where we'll go over what we plan to do about them?

Path #88: The JAMA article goes into detail on something called *Infection Control Practices*. The first component of these practices they discuss are isolation precautions, which you may recall were depicted in that photo I shared of how the pros are doing this in Guinea. Although airborne transmission is rare, the data do indicate a potential for small-droplet airborne nuclei to transmit from one patient to another over some distance. In the previous table there was a column that listed the incubation periods for each VHF; that third sub-bullet down under Isolation Precautions is where we will apply those incubation estimates. All contacts to confirmed cases will need to be observed and have their temperature taken for days to weeks (depending on which virus we're dealing with) following their last unprotected exposure. That second bullet about Personal Protective Equipment or PPE discusses something called Powered Air-Purifying Respirators or PAPRs. As safe as these systems are, they do come with some limitations. They are difficult to work in, and to speak in, and there is data showing that something called 'needle sticks' is more likely to happen to healthcare workers while they are working in these systems. In the 1976 Ebola outbreak, those cases that received the virus *percutaneously* (injected by a contaminated needle) had a 100% fatality rate. Lab testing for VHF requires the highest Bio-safety Level: BSL-4. The post mortem exposure that have been identified as sustaining many Ebola outbreaks in Africa (e.g. where female family members wash and prepare the deceased for burial, thus expose themselves and fall ill too) are addressed under that fourth bullet. In that last bullet I added a quote from page 2403 about how these types of viruses persist in the environment, so as you can see: that's good news for us in the response business.

Path #89: I snipped this box insert from page 2398 of that JAMA article. It's useful in listing the details behind some of those infection control practices discussed previously. I highlighted that term *nosocomial* to let you know that it too in listed in the vocabulary table of the TRG for VHF; this word means hospital acquired infection.

Path #90: As you recall from that table that listed each virus, its incubation period, etc., that table also included treatment recommendations for each specific virus. There's not much we can offer patients other than what the table listed as *supportive care*. That first bullet lists what we mean by supportive care: maintain their fluids and electrolytes, maintain their circulatory volume of their blood, and maintain their blood pressure. That second bullet is a quote from the JAMA article and explains how we do not have any vaccine and/or antiviral against VHFs in our public health 'toolbox.' But therein lies a problem, because as you see in the next bullets, the authors briefly discuss an **antiviral called Ribavirin**, a medication that has some effect against two of the families of VHFs. The last bullet briefly covers some medical therapies we could possibly employ on a case-by-case basis. That last sub-bullet tells us about thing to avoid (aka: contraindicated) with VHF patients.

Path #91: Any outbreak involving a VHF is an epidemiologists worst nightmare. The prolonged incubation periods, the high mortality rates, etc., all require epidemiology to be at its best. That first bullet is somewhat of a relief because it somewhat limits the number of second generation cases spawned by an initial case. One thing about VHFs is that once a person falls ill, they're pretty much down for the count. They are not running around hacking and wheezing all over family, friends or the general public. That's why these diseases are particularly deadly amongst family members of an ill person, and healthcare workers (aka: close contacts). As with any communicable disease outbreak, we will relying upon detailed case definitions to help us screen out those who are ill with the agent we are looking for, versus those who are sick with some other illness. The remaining bullets cover key points raised earlier: isolation and quarantine, direct contact with blood/secretions/tissues of infected patients, and that concern over a rare, but possible, airborne transmission of the virus that cannot be ruled out.

Path #92: As per the Threat Response Guide (TRG) for VHFs, here is a synopsis of the tools we would have in our public health 'toolbox' following an attack with a VHF. As you can see, those first three options are pretty much out of the equation, so we would be relying on interventions that humanity has relied upon since antiquity: isolation, quarantine, hygiene, and social distancing.

Path #93: OK, before I wrap up this module, and today's course, I wanted to take a moment to tell you a brief story that serves as a warning from my friends in central Africa where Ebola made its dramatic debut. That photo to the left is of a mobile vaccination drive that my Gabonese counterpart, Madame Elizabeth Dindzona, and I put on in 1999 in a Massango village called Diyanga. Just as the sun was setting after a long and arduous six hour shift of immunizing the entire population of that village, Elizabeth and I were surprised to see nomadic pygmies emerge from the forest's tree line at dusk. So as we reset our immunization supplies and autoclaved our needles, I had the opportunity to sit down with some of the older pygmy men to give my

standard HIV/AIDS Peace Corps pitch (e.g. the ABCs: Abstinence, Be Faithful, Condom). As we spoke, the old men began telling me of HIV, but in timeframes that were unknown to me. Although we in the industrialized world have known about HIV since the summer of 1981, these men were talking about it in terms of the 1920s and 1930s. What has always amazed me was that about a decade later, the scientific forensic have revealed where HIV came from, and how long it's been around, thus confirming what these old men told me. As interesting as their information was, that's not where the story ends. After telling me about HIV and how long it has plagued their people, the men went one to discuss two other diseases, none of which I recognized then, nor now. A few years later when I went to graduate school at Emory University in Atlanta, I sat down with some CDC faculty members who are specialists in emerging infectious diseases to recount my conversation with the pygmy men in Diyanga. None of my professors had ever heard of a disease with the symptoms these men described in such vivid detail to me. We did not discover Ebola virus until the mid 1970s, we didn't discover HIV until the 1980s, so if what these men tell me was true, then what else is in the pipeline for us to *'discover?* It is that question that has guided me toward epidemiology and public health preparedness. If you ever see me in a bar, let's grab a beer and I'll tell you all about those two yet-to-be discovered diseases that the old men described to me way back in 1999.

Path #94: Alright folks, that's it, congratulations on completing today's training course. I realize that this took a lot of time out of your schedule, and I trust that the material presented helps to demystify a lot of what we in public health and ESF-8 may be preparing for, and doing, in response to a biological attack involving a Category-A agent. This course is the *beginning of the conversation, not the end;* so if you have any questions or concerns please do not hesitate to contact me at 775-247-3680, or at PublicHealthDan@gmail.com. For those of you who took this course for Continuing Education Unit credits (aka: CEUs), please do not forget to fax your pre- **and** post-test results to the state PHP program's fax machine at 775-684-5951. To ensure your fax goes to the correct person, please make sure that you write **ATTN: State PHP Training Officer** on the cover page to your fax. Thank you and stay healthy!

Pre-Test to the *'Biological Threats to Homeland Security'* Course

Prior to viewing today's online training course, please take a few moments to fill out this pre-test of 20 equally weighted questions. At the completion of today's training course you will be taking a post-test. Once the Pre- and Post-Tests are completed, we ask that you please fax them to the State PHP program's Training Officer at 775-684-5951. Please write **ATTN: State PHP Program Training Officer** on the fax cover page.

Please fill out this information so we know who completed this test:

First Name:	
Last Name:	
Telephone Number:	( )
E-mail Address:	

Question 1: Smallpox is a type of:

A) Virus
B) Bacteria
C) Toxin
D) Parasite

Question 2: During World War II, which country successfully used porcelain bombs filled with plague infected fleas to create large-scale epidemics of that disease?

A) Great Britain
B) United States
C) Soviet Union

C) Imperial Japan
D) Nazi Germany

Question 3: True or False: there is a readily available vaccine against Ebola.

True
False

Question 4: Which of these is NOT a Category-A agent?

A) Botulism
B) Smallpox
C) Tularemia
D) Influenza
E) Anthrax

Question 5: There are four sub-types of the Ebola virus: Zaire, Sudan, Ivory Coast and Reston. Which of these strains is not dangerous to humans?

A) Zaire strain
B) Sudan strain
C) Ivory Coast strain
D) Reston strain

Question 6: In 1346, during the siege of Caffa, human cadavers were catapulted over the city walls to create an epidemic of which disease?

A) Anthrax
B) Botulism
C) Plague
D) Smallpox

Question 7: In 1995 the Japanese religious cult, Aum Shinrikyo, used which agent in its successful attack upon the Tokyo subway system?

A) Influenza
B) Herpes
C) Sarin
D) Anthrax

Question 8: The 'Chain of Infection' is comprised of three components:

A) Agent / Infectiousness / Host
B) Pathogen / Transmission / Human
C) Agent / Transmission / Host

D) Host / Agent / Contagiousness

Question 9: Which of these is the only Category-A agent to be declared as 'eradicated' by the World Health Organization (W.H.O.)?

A) Anthrax
B) Botulism
C) Plague
D) Smallpox

Question 10: Here in Nevada, the first tool in the public health "Toolbox" is:

A) Social Distancing
B) Hygiene
C) Vaccination
D) Anti-virals
E) Isolation

Question 11: Tularemia is also known as:

A) Camel Cooties
B) Hunters' Scourge
C) Rabbit Fever
D) The Black Death

Question 12: Epidemiologists use a graph to plot out the number of cases, as well as the date when those cases fell ill. These graphs are referred to as what?

A) Disease Outbreak Charts
B) Epi Curves
C) Epi Tracking Reports
D) Outbreak Investigation Charts

Question 13: The acronym VHF stands for:

A) Viral Heptacemic Fluid
B) Viral Herpes Foundation
C) Viral Hemorrhagic Fever
D) Virus Hemorrhagic Fluid

Question 14: When an agent is referred to as being "spore forming" that means that it:

A) Needs oxygen to survive
B) Absorbs crystal violet stain into its outer layer
C) Goes into a hardy shell and waits for the right conditions to re-emerge
D) Cannot move by itself

Question 15: When it comes to case studies of weaponized anthrax being used on an un-suspecting and un-protected population, the '*grand daddy of them all*' is:

A) Gruinard Island – 1942
B) The Anthrax Letter Attacks – 2001
C) Sverdlovsk, U.S.S.R – 1979
D) Operation Desert Storm – 1991

Question 16: Please fill in the blank with the correct answer:

_____ *toxin is the most poisonous substance known.*

A) Anthrax
B) Botulism
C) Smallpox
D) Ebola

Question 17: In 1972 an international agreement called the BWC was ratified and signed by most of the world's countries. This acronym stands for what?

A) Bio Warfare Compact
B) Biological Weapons Committee
C) Bio Weapons Cancellation
D) Biological Weapons Convention

Question 18: Dr. Ken Alibek is the former director of what Russian bioweapons program?

A) Unit 731
B) USAMRIID
C) Biopreparat
D) Infectious Diseases Branch

Question 19: True or False: A good *case definition* helps epidemiologists to differentiate those people who are ill with the disease they're looking for, versus those who are ill with some other disease that they are not looking for.

A) True
B) False

Question 20: The person credited with discovering immunizations is:

A) Dr. Edward Jenner
B) Dr. Shiro Ishii
C) Dr. D.A. Henderson
D) Dr. James Phipps

Appendix B

Post-Test to the *'Biological Threats to Homeland Security'* Course

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First Name:	
Last Name:	
Telephone Number:	( )
E-mail Address:	
License Type and License Number	

Note: Each of these questions are weighted equally and are each worth five points each. In order to receive the four CEU credits for completing this course, you can score no less than a minimum of 70% on this Post-test. To meet this minimum score, you can miss no more than six questions.

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