Version

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PUBLIC HEALTH PREPAREDNESS (PHP)
TRAINING PROGRAM

Training Course Materials

The Foundations of Public Health Series:

The Epidemiology and Disease Surveillance Training Course

PUBLIC HEALTH PREPAREDNESS TRAINING COURSE MATERIALS

Handbook for the *Epidemiology and Disease Surveillance Training* Course

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    a. Handbook for the Epidemiology and Disease Surveillance Training Course

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Welcome to the Online *'Epidemiology & Disease Surveillance' Training* Course

This online accessible training course is intended to be done at the trainee's own pace. The intent of this course is to create a common foundation of knowledge to build off of during future trainings, exercises and real-world activations of the public health system.

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 trainings.

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 online training course should take about 15 minutes to complete.

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 class 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 what the audio recordings for each transition, we have provided a complete transcript of what those audio recordings cover.

Software Requirements: In addition to this internet connection requirement, we ask that your computer also have *Windows Player* installed. This will allow your personal computer (PC) to run the audio portions of the Prezi presentation.

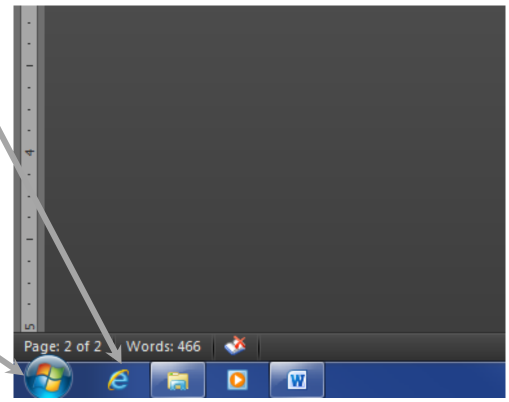
Sound Speaker(s): In order to listen to the presenter's recordings for each transition in today's course, please ensure that your PC has a speaker (or speakers) that are working, and as basic as this sounds: make sure the volume is turned on and up. If your system does not have a speaker, then you can 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 copy/paste this web address into your browser. Please ensure that <u>each</u> letter/digit/symbol is copied into your browser; otherwise the presentation <u>will not open</u> for you.

By clicking on this **hyperlinked** web address below, it should automatically open the *Prezi* presentation for you. If not, then please copy and paste this web address into your PC's internet browser.

http://prezi.com/1oxy03_y25xj/?utm_campaign=share&utm_medium=copy&rc=ex0share

Depending on your computer and the strength of its internet connection, it may take up to a minute for the online presentation to fully load; so <u>please be patient</u> while the website loads the online course.

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 the right-arrow at the bottom of the screen (circled above).

If you would rather watch and listen to this course like a movie, you can also click on this "Play" button in the bottom-left corner of the window, as indicated by this arrow.

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!

Chapter

1

Full-Transcript to the Epidemiology & Disease Surveillance Training Course

The U.S. Centers for Disease Control and Prevention (CDC) have created 10 essential public health services that public health systems throughout the country should be capable of. The eighth essential service is: "Assure a competent public and personal health workforce."

—Taken from the CDC website http://www.cdc.gov/nphpsp/essentialservices.html

In this next installment to the '*Foundations of Public Health Series*', we will look at a field within public health that helps direct a large percentage of our efforts: epidemiology and disease surveillance.

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

As with each of the courses within this series, here is the transcript of what was recorded for this course.

Path #1: Welcome back. I am sure you are quite used to this by now, but I ask that you please adjust your computer's volume control so you can hear the audio component of this training course. As with the previous courses, you can advance at your own pace by clicking that right-facing arrow at the bottom of your screen, or you can click that 'Play' button in the bottom-left corner of the screen.

Path #2: Hello, and welcome back to the next course in the series titled: *"The Foundations of Public Health Series: Epidemiology and Disease Surveillance."* My name is **Doctor Tracey Green** and I am the Chief Medical Officer for the State of Nevada. I will be presenting today's material for this online-accessible training course. This series is intended for both public health and its partner agencies, so that we may all be speaking the same language when it comes to large-scale responses to infectious disease.

Path #3: In this fourth course of the series, I would like to focus in on an aspect of public health that I suspect many of you have heard of, yet may not understand how it supports so many of the activities that public health takes part in. I am talking about a science called '*Epidemiology*', and a key component of that science: *Disease Surveillance*.

Path #4: So I will begin with epidemiology and a basic definition of what it is. As listed here; epidemiology is a science that looks for **patterns of disease within populations**. Although epidemiology is different from clinical medicine, epidemiologists work together with healthcare professionals to help identify and mitigate illness. Epidemiology is most often associated with diseases that can be passed from person-to-person (aka: communicable diseases); but this science also works on decreasing chronic diseases such as diabetes, and congenital diseases, such as certain forms of cancer, birth defects, etc.

Path #5: I use this metaphor to help explain this mutual relationship between clinicians and epidemiologists. Whereas a clinician (such as a nurse or doctor) will place his or her fingers on the pulse of an individual patient; epidemiologists place their '*fingers*' on the pulse of an entire population through the use of biostatistics. This more 'macro' view of illness that epidemiologists provide, can then be used to help unify the efforts of clinicians throughout a whole community, a state, a region, an entire country, or even our planet. Epidemiologists collect the mountains of information generated by clinicians, they then go through that data to find patterns. When such patterns of disease are identified, epidemiologists '*raise the alarm*' to help identify interventions that can decrease the disease.

Path #6: More than a decade before French doctor, Louis Pasteur, came up with his 'Germ Theory', the science if epidemiology was born through the detailed observation of disease outbreaks. For millennia, doctors had observed correlations between ailments they observed in the population with certain seasons of the year, or with certain migrations of insects and animals, and so on.

Path #7: The person credited with bringing all of those observations into focus was this English physician: Dr. John Snow. In the summer of 1854, the city of London, England, was in the grip of a deadly cholera outbreak. Through the detailed use of case investigation, Dr. Snow mapped out the location to each case he identified. Over the course of this investigation, an image began to develop that helped point to a source of the outbreak: the **Broad Street** water pump. In a bold move that was, at the time, considered unnecessary, Dr. Snow removed the handle to that water pump. This simple act helped to end London's cholera epidemic, and gave birth to epidemiology. If you are interested in watching an entertaining and educational video on this story, I have included that web address to the U.C.L.A. School of Public Health, down at the bottom of this image.

Path #8: For those of you who may be interested in hearing the details of how Dr. Snow conducted his cholera investigation, and how his observations came up with the controversial mitigation strategy of removing the pump handle; I would point you to this book by Steven Johnson: '*The Ghost Map*.'

Path #9: With the science of epidemiology acting as a framework, next we have 'Disease Surveillance', which fills in much of that framework. This quote from the U.S. Centers for Disease Control and Prevention (CDC) website explains what disease surveillance is. I've taken the liberty of highlighting some key components of that definition in yellow. The first term that I've highlighted for you is the word '*data*.' Without information to collect and analyze, epidemiology would be blind. I have also highlighted that idea about how results from this analysis must be given to "*those who need them for action*." This is where that interplay between clinicians and epidemiologists comes into the equation. And finally, I wanted to draw your attention to that phrase about surveillance being "*essential for planning, implementation, and evaluation*." This helps to capture the idea of how epidemiology cannot only be used retrospectively, to help figure out how outbreaks have occurred in the past; but this science can also be used prospectively to help inform the planning process of public health, along with its implementation and evaluation of those efforts.

Path #10: Disease surveillance comes in two forms, the first of which is something called 'Passive Surveillance.' This type of surveillance casts the widest net over a population, and therefore generates a large amount of data. I added that idea of passive surveillance being a 'quantity over quality' concept to help reinforce my point. This type of surveillance informs us that "something is going on", but it may not give us many details as to who/what/where/when/why and how. In the sub-bullets, I have provided some examples of how passive surveillance is collected here in Nevada. Although tracking of trends for over-the-counter (OTC) sales of anti-diarrheal mediations, fever reducing medications, etc., do NOT tell us who purchased what medication; they do raise an alarm if we begin to see spikes in sales like this within a certain area. For example: in the past we have seen a surge in OTC sales of anti-diarrheal medications in the days/weeks before a CDC announcement that something like salmonella was found to be in a certain batch of lettuce, from a certain farm, harvested at a certain time, etc. The next bullet lists school absenteeism; which we all know is how young children can be little 'germ factories' because when they are young, their immune system is still developing. We often see patterns of disease within our schools, before we see them in the rest of the population. That third bullet lists 9-1-1 calls for Emergency Medical Services (EMS). In situations when an agent is particularly difficult, we often observe a spike in 9-1-1 calls for certain symptoms (e.g. people who are severely dehydrated, or for people who have higher-than-expected body temperatures, etc.). And finally, that bottom bullet lists emergency department admissions as another source of passive surveillance.

Path #11: I have added this screen shot of one such system that our state and local epidemiologists use to track OTC sales. Those notes off to the left are there to point you toward particular parts of this system. The Real-time Outbreak and Disease Surveillance (**RODS**) system provides us with a system to monitor any patterns of OTC sales for various remedies. If you look closely at those tables to the right, you will see that antidiarrheal medications, anti-fever meds, bronchial meds, etc. are listed. Those tables are also broken down to provide community-wide totals, totals for adult medications only, and totals for pediatric meds only.

Path #12: With passive surveillance telling us that something is afoot, then we turn to active surveillance to figure the who/what/where/when/why and how aspects of an outbreak. Although the *quantity* of data generated by this form of surveillance is much lower; those data are of a much higher *quality*. If we observe a spike in OTC sales of anti-diarrheal medications, then we can begin warning healthcare providers to "*be on the lookout for symptoms X/Y and Z*" etc. When doctors and nurses run into patients who are ill with the types of symptoms we are looking for, then they can request samples for analysis at the public health laboratories. Results from those tests begin to paint a much more detailed image of what agent is loose within our population. That is when we can begin our case investigation and contact tracing. **Case investigation** is when we interview people who had lab results comes back for a specific pathogen. Those interviews can help to go back-in-time to see when and how the sick person was exposed to an agent. For agents passed between people, the interview can also create a list of '*contacts*' the ill person may have had (e.g. family, friends, co-workers, etc.). Our disease investigators can then use that list to conduct **Contact Tracing** to notify those people of their possible exposure, and to provide advice on actions they can take to protect themselves and their family, their friends, and so on.

Path #13: In some of the previous courses, I have referred to Threat Response Guides (aka: TRGs) to help demonstrate some of the tools that state health would employ during specific response scenarios. In this screen shot, I have chosen to use an example from the TRG for a 'Pandemic Influenza' scenario. In this example, we see that the Planning Section (highlighted in blue) has an "*Epidemiology and Disease Surveillance Unit*" assigned to it. In the three bullet points below that, we see that this unit will be providing the Command Section with three "key data points": Incidence Rate, Prevalence Rate, and Mortality Rate. I would like to zoom in on that image to the right, to help explain what each of those key data points are, and how they work in relation to each other.

Path #14: This faucet-and-bucket metaphor will be familiar to anyone who has gone through a public health degree program. The first data point is demonstrated by the amount of water flowing out of the faucet; this is called: the

Incidence Rate and represents the number of new cases entering the system. Next we have the level of water within the bucket, which is referred to as the: **Prevalence Rate**. This represents the number of existing cases within the system. And finally that third data point, represented by the amount of water leaking from the bucket, what we call the **Mortality Rate**. That's the number of cases that die from the disease in question. So with this image in mind, next I would now like to explain some epidemiological terms that are often used to better define these "key data points."

Path #15: I have chosen this term first, because it acts as a filter to help screen out background diseases from the one we are actually looking for. This is called **Case Definition**. Just because we may be in the middle of an influenza outbreak does NOT mean that other illnesses will stop doing their thing. So we use a working case definition to screen out those diseases we are NOT looking for, so we can try to only include the one we ARE looking for. This helps to make both our incidence rate and prevalence rate calculations more valid. We further divide those cases into three types, as listed here in the sub-bullets. A person who may have been exposed to an infected case would be considered a *person-under-investigation or PUI* for short. For people who were exposed and are beginning to show signs of illness, they would be a *probable case* (aka: as suspected case). And for those who have been exposed and have been confirmed to be ill with the agent in question (e.g. through a positive lab test), they are considered to be a *confirmed case*.

Path #16: In particularly large-scale outbreaks, you may hear epidemiologists using this phrase: Attack Rate. This phrase is often used when describing pandemic influenza scenarios, and as it says here: Attack Rate is the percentage of an exposed population that becomes ill with an agent. As scary as it sounds when we hear media say "this disease has a 20% fatality rate", from an epidemiological perspective, the first question we would ask is: "OK, but 20% of how many people?" This is why attack rate is so important; it establishes the denominator for us when we do rate calculations for other aspects of an outbreak. For those of you who took the Public Health 'Toolbox' course, you may remember that image of soldiers who were ill with influenza lined up in cots back in 1918. Most people are shocked to hear that 98% of those soldiers eventually recovered from their infection and walked out of there. What made the 1918 influenza so remarkable was its attack rate; it infected a quarter of the global population, which was just under 500 million people. Losing two percent of 500 million people gives us a much different number than 50% of 2,000 people. Based on these two examples, do you see why attack rate is so important?

Path #17: This term explains how we gauge the ability of an illness to jump from one infected person into another, and so on. **Reproduction Number** is the number of secondary infections that would be generated by an index case (aka: the first case) in the absence and presence of control interventions. That part about "absence and presence of control interventions" is important. This is saying: if we left an outbreak to do its thing and we took no actions to limit its spread, then this is how many people we should expect to see infected from the first case. Optimally we would want to see R-zero to be zero, but in emerging outbreaks we often see an R-zero of one and up. To help give you an idea, here are the R-zeros for disease you may be familiar with: The R-zero for seasonal influenza is about 1.3 (so for every person who has the flu, we can expect them to create 1.3 new cases of flu). The R-zero for measles before a vaccine against measles was developed was an incredible 17. For more exotic illnesses like Ebola, we see an R-zero of between 1.8 and 2.0. As interventions are implemented (remember the public health 'toolbox' and the V-M-A-I-Q-H-S model?), then this number should recede until it is nothing. At that point the outbreak will end. Here's a question we often receive about "*when do you declare an outbreak to over?*" An outbreak is over when we go through <u>two incubation periods</u> without seeing a new case.

<u>Path #18:</u> Although we often hear public health officials using these terms, I wanted to go through their definitions so we are all on the same sheet of paper. A **cluster** is when we see a group of cases in a certain place and time that exceed what we would normally expect to see. An **outbreak** is when we observe an illness in numbers we don't expect to see, in a time of year we normally don't expect to see it, and in a population we normally don't see it in. For seasonal illnesses like influenza, our records may tell us that for the month of February, we should expect to see 2,000 cases. But if we see that same number of cases for influenza in June, then something is wrong. For the more exotic infections: if we expect to see NO cases, and we see a single confirmed case; then by definition we are in an outbreak. An **epidemic** is an outbreak that is more wide spread and lasts for a longer amount of time. A **pandemic** is an epidemic that has spread across a large part of the planet.

<u>Path #19:</u> We track these clusters/outbreaks/epidemics and pandemics by using a visual depiction of the event called an epidemic curve (or '*Epi Curve*' for short). These charts are constructed by listing the number of cases by their date of onset. By tracking how many people became ill on what specific date, we begin to see a pattern. Over time these patterns take on shapes within the Epi Curve that can tell us if the agent is a virus or a bacteria, whether it's originating from one source or many, etc. There are three types of shapes we see within epi curves, and each tell us a different story.

<u>Path #20:</u> An *epi curve* representing a '**Point Source**' outbreak will have the following characteristics: they indicate a short period of exposure; all of the cases occurred within one incubation period; and; there is usually a sharp upward slope at the beginning and a gradual downward slope at the end. In this example to the right of a Point Source Outbreak epi curve, we see how the number of cases increase quickly and cluster after an initial case a few days before, then the number of cases taper off the further we get from that initial case. We often see this type

of epi curve in food poisoning outbreaks (e.g. Hepatitis A in food handlers, salmonella outbreaks at large banquets, etc.)

Path #21: An epi curve representing a '**Common Source**' outbreak can come in two forms: a '*continuous common source exposure*'; and, an '*intermittent common source exposure.*' In the situation of a *Common Source outbreak* there is often a long period of exposure; the number of new cases increases gradually; and, there is often a 'plateau' of cases. Since the exposure may occur over a long period of time, we may see cases stretch over many incubation periods at the beginning of an outbreak. If the source of the exposure is removed, then we often see a sharp decline in the number of new cases at the end of an outbreak. In this example to the right of an epi curve for a *continuous common source outbreak*, we see the gradual increase of cases at the beginning of the outbreak, that plateau of new cases in the middle, then the sharp decline at the end of the outbreak. This epi curve would be a classic example of a cholera outbreak from a contaminated water source. As more people drink from the common source, and the one to three incubation period begins, we start to see a gradual rise in new cases. Then once the source of contaminated water is identified and removed, then that sharp decline is reflected at the end of the outbreak. In the situation of an intermittent common source outbreak, there is usually a short and sporadic exposure period, followed by irregular peaks. In this example to the right of an epi curve for an intermittent common source outbreak, we see those irregular peaks with gaps between spikes in the numbers of new cases. We would often observe this type of epi curve in situations where a cook who is infected with Hepatitis A works only a few shifts per week. The incubation period begins after that cook's shift, but not for the other cooks. That's why the epi curve is so irregular in its shape.

Path #22: Finally we have the **Propagated Source** outbreak. In these sort of outbreaks, we often see the following characteristics: the illness spreads from person-to-person; the outbreak lasts much longer than a common source outbreak with multiple waves often apparent; and, as those waves in new cases progress, their peaks become taller. When we look at the time period between these progressively taller peaks, we see that there is often one incubation period between each peak. In this example of a *propagated common source outbreak* to the right, we see those telltale peaks becoming progressively taller. We often observe this type of epi curve in influenza outbreaks. That initial case at the beginning of this epi curve begins the outbreak, and then as more people are exposed and become sick, they in turn infect others, and so on. That process of creating second and third generation cases, is what makes those progressively larger peaks. As more and more people become sick and recover, they develop antibodies against the illness. The outbreak slows down and ends because the pathogen runs out of susceptible people to infect; which we see in this example to the far right. The shape of this epi curve is often observed in large-scale outbreaks involving influenza virus.

Path #23: In each of the examples that I just covered for epi curves, do you see how these tools help us to accurately gauge the size and magnitude of the outbreak over time? This simple tool gives us insight to details such as: when cases may have been exposed, the incubation period of the agent, and the life span of the outbreak itself. The shape of the curve can tell us if we are dealing with a virus or a bacterium; if we are dealing with something that's still making people sick, or something that has moved on. Epi curves are invaluable tools to help us identify and mitigate threats to public health.

Path #24: Well, that covers the basics of *epidemiology and disease surveillance*. If you have any questions or concerns on what I've covered thus far, please contact Dan Mackie at 775-443-7919, or at his e-mail address: dmackie@health.nv.gov . As always, we appreciate that you have taken the time to watch and listen to this online training course. We thank you for your willingness to learn about this key component to the *foundations of public health*!