

Master of Public Health
Integrative Learning Experience Report

***THE DEVELOPMENT OF PUBLIC HEALTH CONTENT FOR
MICHIGAN RESIDENTS: HARMFUL ALGAL BLOOMS,
CANINE BRUCELLOSIS, AND RABIES***

by

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submitted in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

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Summary

This report presents a comprehensive overview of my: 1) applied practice experience, which took place at the Michigan Department of Health and Human Services, 2) the projects I completed during my applied practice experience, and 3) the integration of the knowledge and skills I gained throughout my coursework at Kansas State University. I applied the knowledge and skills gained during my coursework at Kansas State University to four different projects that will improve public health in the state of Michigan. I created three documents on harmful algal blooms to provide the public with important information and data on harmful algal blooms in Michigan. I produced a brochure on canine brucellosis to provide dog owners with necessary information about *Brucella canis* infections. I created a standard of procedures document for handling suspect rabid animals in animal care facilities, which will help to prevent rabies exposure and minimize the risk of infection among animal care personnel. Through the projects that I completed and the activities that I participated in during my applied practice experience, I was able to further develop the knowledge and skills I gained during my coursework. These developed knowledge and skills will help me in future career opportunities as a public health veterinarian. Additionally, the projects that I completed at the Michigan Department of Health and Human Services will provide Michigan residents with important information on significant public health concerns involving environmental toxins and zoonotic pathogens

Subject Keywords: Harmful Algal Blooms, Canine Brucellosis, Rabies, One Health

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Chapter 1 - Literature Review

Overview

I completed my Applied Practice Experience (APE) at the Michigan Department of Health and Human Services (MDHHS), Bureau of Infectious Disease Prevention, Emerging and Zoonotic Disease Section. The Michigan Department of Health and Human Services is a principal department of the state of Michigan. The department provides numerous programs to improve the health, safety, and wellness of Michigan residents. The Michigan Department of Health and Human Services works with many partners at the local, regional, and national levels to provide needed services. The Emerging and Zoonotic Disease Section (EZID) of MDHHS includes many infectious disease epidemiologists who focus on zoonotic, vector-borne, and emerging infectious diseases. The EZID Section has many responsibilities including reportable disease surveillance, outbreak response, educational outreach, interagency collaborations, and response planning. The EZID Section works with 1) local public health departments; 2) state partners, such as the Michigan Department of Agriculture and Rural Development (MDARD) and the Michigan Department of Natural Resources (MDNR); and 3) federal partners, including the Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture (USDA), and the Food and Drug Administration (FDA).

The Michigan Department of Health and Human Services is located in Lansing, Michigan; however, my APE was mostly virtual, with in-person field experiences that were located in East Lansing, Lansing, Grand Rapids, and southwest Michigan. My preceptor was Dr. Susan Peters, who has her Doctor of Veterinary Medicine degree from Michigan State University (MSU) and her Master of Public Health (MPH) degree from the University of Minnesota. Dr. Peters is an experienced public health veterinarian and epidemiologist who has had seventeen years of experience working in state and local public health agencies. Additionally, Dr. Peters has been an assistant professor at MSU teaching MPH courses since 2015. Currently, Dr. Peters is the Waterborne Disease Epidemiologist at MDHHS EZID. Dr. Peters' professional interests include infectious diseases and One Health.

Dr. Peters created a unique and individualized internship opportunity for me at MDHHS EZID. She allowed me to work on projects that interested me and produce products that helped me develop numerous skills needed for working at a state public health agency. The projects I worked on encompassed the primary public health focus areas of harmful algal blooms (HABs), canine brucellosis, and the rabies virus. I completed three products based on HABs, one product on canine brucellosis, and one product on the rabies virus.

Products based on harmful algal blooms (HABs)

The three products that I produced about HABs focus on providing the public with information and data on HABs in Michigan. These products provide awareness to the public about HABs as a public health concern. Harmful algal blooms are a public health concern because they can cause illness and even death in humans and animals. Harmful algal blooms are associated with the rapid growth of cyanobacteria, also known as blue-green algae. Cyanobacteria are naturally present in lakes, rivers, and ponds. However, HABs can form when cyanobacteria grow rapidly and produce toxins, called cyanotoxins, that are harmful to humans and animals (Centers for Disease Control and Prevention [CDC], 2023). Harmful algal blooms can be many colors and textures and can look like scum, spilled paint, foam, or discoloration of the water. Many are bright green with a “pea soup” appearance, and some HABs will turn light blue as they die off. Harmful algal blooms can last for days or sometimes weeks, and they can change in size, location, and toxicity. Harmful algal blooms can also disappear on a waterbody, but then form again (CDC, 2023).

Harmful algal blooms are a public health concern because breathing in or swallowing water with HAB toxins may cause illness, such as runny eyes or nose, asthma-like symptoms, difficulty breathing, stomach pain, vomiting, diarrhea, weakness, numbness, headaches, or dizziness. Additionally, skin contact with HABs may cause rashes, blisters, or hives (Trevino-Garrison et al., 2015). Animals, especially dogs, can become ill or die after contact with HABs. Signs of illness can include vomiting, diarrhea, staggering, and seizures (Roberts et al., 2020).

Harmful algal blooms are becoming more of a threat to human and animal health due to the fact that they are increasing in frequency, duration, and geographic distribution across the globe, including in Michigan (Al-Ghelani et al., 2005). The occurrence of cyanobacteria and their toxins typically takes place in the summer and fall in Michigan (Michigan Department of Health and Human Services [MDHHS], 2023). However, in 2022, confirmed HABs were present during nine months of the year. Additionally, in 2022, 80 harmful algal blooms in 38 Michigan counties were reported to the Michigan Department of Environment, Great Lakes, and Energy (EGLE), which is an increase from previous years (MDHHS, 2023).

Because of the potential illness with HABs exposure and the increase in HABs frequency and geographic distribution, creating HAB products, which included two data summaries and an annual summary of HABs information, was an important public health project. These products helped to spread awareness of this public health concern to the public. The data about HABs in Michigan will help the public track HAB trends over the years, see how

many HAB-related illnesses were reported, and see if there were any confirmed HAB reports in their county. The annual summary of HABs information allows the public to learn about HABs and learn about what actions they can take to keep themselves, their family, and their pets safe. Additionally, the summary provides information to public health professionals such as health providers, veterinarians, and public health agencies on how to report HAB-related illnesses and how to educate patients and clients on HABs. This information is extremely useful in Michigan, where recreational water activities such as swimming, boating, jet skiing, and tubing are very common. It is also useful because many people allow their pets to swim in bodies of water.

Products based on canine brucellosis

I created a brochure on canine brucellosis entitled, "Canine Brucellosis: Next Steps for Positive Dogs". This brochure is meant for people who have a dog that recently tested positive for canine brucellosis. Canine brucellosis is a contagious bacterial disease in dogs. Canine brucellosis is a public health concern because it is a zoonotic disease. It can be transmitted to other dogs very easily and can sometimes be transmitted to people. Globally, it was found that 1% of human brucellosis cases are caused by *Brucella canis*. There are about half a million human brucellosis cases per year, so that would mean that there are about 5,000 people each year diagnosed with canine brucellosis (Santos et al., 2021). However, due to difficulty in diagnosis, underreporting, and self-limiting infections, the incidence of human *Brucella canis* infections may be underestimated (MDHHS, 2018).

Canine brucellosis can cause mild to severe illness in humans and animals. Canine brucellosis can be both an acute and chronic disease. In humans, canine brucellosis normally causes a fever, chills, lethargy, headache, weakness, muscle aches, and swollen lymph nodes. In more severe infections, joints, bones, or heart valves may be affected. Additionally, brucellosis during pregnancy carries the risk of causing spontaneous abortion. However, some people may not have any symptoms (National Association of State Public Health Veterinarians, 2012). Most dogs won't show any clinical signs when infected with canine brucellosis. However, some dogs may have a history of infertility, abortions, or giving birth to dead or weak puppies, back pain, lack of energy, enlarged lymph nodes, and cloudy or red painful eyes (Kauffman & Peterson, 2016).

Additionally, *Brucella canis* organisms are passed in many bodily fluids including urine, vaginal discharge, semen, aborted material, milk, nasal secretions, and saliva. Transmission of *Brucella canis* organisms may occur through accidental contact between these infectious materials and a person's or other animal's mucous membranes or break in the skin (Center for

Food Security and Public Health, 2011). These routes of transmission are the foundation of an extensive list of quarantine requirements, and following these requirements is imperative for public health safety.

Canine brucellosis is more notably a public health concern because there are no canine or human vaccines available for brucellosis, and there is no known cure for canine brucellosis. Positive dogs remain infected for life and stay a risk to humans and other dogs. Since canine brucellosis is an incurable, life-long disease that can be spread to humans and other animals, humane euthanasia is often recommended for dogs that test positive (Hollett, 2006). However, according to a veterinarian at MDARD, in Michigan, there is currently an increase in people who do not want to euthanize their canine brucellosis positive dogs. Life-long quarantine is considered another option for dogs that test positive for canine brucellosis, but lifelong quarantine is often cumbersome and expensive, and there is not always complete owner compliance (Hollett, 2006). Therefore, canine brucellosis is an increasing concern for public health.

My brochure on canine brucellosis provides information to the public on what the next steps are if a dog tests positive for canine brucellosis. The brochure includes information such as what canine brucellosis is, if it can be prevented, what the treatment options are, what the health risks are to humans and animals, what the requirements are for life-long quarantine, how to minimize risk of transmission, and what to do if a human is exposed to *Brucella canis*. This is important public health information due to the incurable nature of the disease, the zoonotic risk of the disease, and the increase in people choosing life-long quarantine as a treatment option.

Products based on rabies

I created a standard precautions procedural document entitled, "Rabies Exposure and Control Plan for Animal Care Facilities". The document is meant for animal care professionals that may handle suspect rabid animals or their laboratory specimens. Rabies is a public health concern due to it being a fatal viral infection of the central nervous system and a serious zoonotic disease. Rabies is a neurotropic virus in the genus *Lyssavirus*, family *Rhabdoviridae*. All mammals are susceptible to the disease. In Michigan, most rabies cases are found in bats, raccoons, skunks, and foxes, but cats and dogs are also a threat for human exposure (Michigan Department of Health and Human Services, Rabies).

In Michigan, about sixty animal rabies cases are reported per year (MDHHS, Rabies). However, only 1-2 human rabies deaths occur per year in the United States (CDC, 2020), and the last death in Michigan was in 2009 (District Health Department 10, Prevent Rabies!). People

who work with mammals, such as veterinarians, veterinary staff, animal shelter caretakers, animal control officers, and wildlife rehabilitators, are at an increased risk of contracting the rabies virus. Other groups that are at an increased risk of contracting rabies are hunters, forest rangers, travelers who stay in high-risk regions, and people who are in regular contact with nature such as hikers, cyclists, and campers (Ma et al., 2023).

The highest concentrations of rabies virus are found in saliva, nervous tissue, cerebrospinal fluid, and salivary glands. Rabies transmission to humans usually occurs through bites or scratches from infected animals. However, rabies can also be transmitted by saliva or neural tissue from a rabid animal coming into contact with mucous membranes (through the eyes, nose, or mouth) or cuts, wounds, and abrasions in skin (Hankens & Rosekrans, 2004). Petting a rabid animal does not usually constitute as a rabies exposure. Only personnel who handle suspect rabid animals or their laboratory specimens are at risk of exposure/infection. This is because the rabies virus does not survive for long outside of its host and is rapidly inactivated by ultraviolet light and desiccation (Center for Food Security and Public Health, 2021). Additionally, personnel who handle suspect rabid animals or their laboratory specimens are not a risk to their families or community (Centers for Disease Control and Prevention, 2021).

Animal care professionals, such as veterinarians, veterinary staff, animal shelter caretakers, animal control officers, and wildlife rehabilitators, are at an increased risk of contracting the rabies virus due to their profession, which includes working with numerous mammals. The Rabies Exposure and Control Plan document was created to provide these professionals with a guide of control measures that can be used to prevent exposure to the rabies virus and minimize the risk of infection.

The idea for the creation of this document came from a veterinary clinic that called MDARD because it did not know what precautions to take when evaluating a suspect rabid animal. The veterinary clinic did not know what Personal Protective Equipment (PPE) to wear, how they should transport the animal through the clinic, or what disinfectant agents to use to inactivate the virus. The veterinary clinic wanted to decline their current patient an examination, which would ultimately leave the patient with no veterinary care. This would have increased the public health risk of this animal because if the animal had rabies, it could have transmitted it to humans and other animals. The Michigan Department of Health and Human Services and MDARD wanted to prevent situations like this from occurring in the future. Therefore, the Rabies Exposure and Control Plan for Animal Care Facilities document was created so that veterinarians and other animal care professionals can feel more confident in providing animal

care to suspect rabid animals. Ultimately, the document will increase public health safety by minimizing the risk of rabies transmission.

Summary

My integrated learning experience allowed me to develop the knowledge and skills I gained during my coursework and apply them to my applied practice experience at the MDHHS EZID Section. This allowed for the completion of projects that will improve Michigan residents' access to important public health content. The projects I worked on encompassed the primary public health focus areas of harmful algal blooms, canine brucellosis, and the rabies virus. All of these public health concerns are similar in that they are a risk for both humans and animals and that animals may serve as a sentinel species, meaning that the condition may be identified in an animal population before they might otherwise be detected through human epidemiologic studies. Harmful algal blooms, canine brucellosis, and rabies are important public health topics in Michigan and around the globe. Understanding these topics and why they are a public health concern is important in mitigating their negative effects. The products that I completed will help reduce the negative effects of these public health concerns in the state of Michigan, which will ultimately improve public health across the state.

Chapter 2 - Learning Objectives and Activities Performed

My Applied Practice Experience (APE) was completed through an internship at the Michigan Department of Health and Human Services with the Emerging and Zoonotic Infectious Disease (EZID) Section. My internship began in July 2023 and ended in August 2023. My site preceptor, Dr. Susan Peters, created an individualized internship opportunity for me. The internship was mostly virtual, with a few opportunities for in-person field experiences. During my internship with the MDHHS EZID Section, I performed various activities and completed multiple products that helped me achieve my learning objectives for my APE.

2.1 Learning Objectives

- Evaluate the role of a public health veterinarian within state government
 - The Michigan Department of Health and Human Services is a state governmental agency, and my preceptor is a veterinarian employed through MDHHS. Therefore, I was able to learn the various responsibilities of a public health veterinarian working for a state governmental agency. I learned that public health work is multifaceted, with numerous diverse roles and responsibilities.
- Assess comprehensive knowledge about the various emerging and zoonotic diseases that are monitored in Michigan
 - While creating my products, I researched the zoonotic diseases of concern for MDHHS, specifically the emerging and zoonotic infectious diseases documented in this report. By doing this, I was able to gain a comprehensive knowledge of the public health and One Health impacts of infectious diseases.
- Select public health content for diverse audiences
 - During my internship, I produced numerous products that communicated public health content for various audiences including the general public and health professionals. Through this, I developed skills in public health communication and content creation for diverse groups of people.
- Develop skills in data analysis, interpretation, and presentation
 - While creating a few of my products, I had to analyze and interpret data, and then find a clear and concise way to present it to the public. I analyzed the data using Excel, and then created public-friendly graphs, tables, and maps that were included in my products. Through this, I was able to develop and enhance my skills in data analysis, interpretation, and presentation.

2.2 Activities Performed

- Attended a training on mosquito identification for local health department staff
 - At this training, local health department staff and I were taught mosquito anatomy, mosquito life cycles, how to use a dichotomous key, how to identify different species of mosquitos under a microscope, and why mosquito surveillance is important across Michigan. This activity helped me gain knowledge about running a vector-borne disease surveillance-training program for local health department staff.
- Participated in a field excursion to multiple mosquito collection sites for active surveillance of Eastern Equine Encephalitis (EEE)
 - During this activity, I spent the day traveling to many mosquito collection sites in southwest Michigan. I learned about different methods of mosquito control, why mosquito control is important, how to collect mosquitos for surveillance, what habitats are conducive to *Culiseta melanura*, which is the mosquito that transmits EEE virus, and how mosquito control and surveillance is truly an interagency collaboration.
- Participated in a site visit and collection of mosquito larvae at a location where the invasive mosquito, *Aedes albopictus*, had been found
 - During this activity, I went to a small tire service company, where the invasive mosquito, *Aedes albopictus*, had been found during routine mosquito surveillance by a local health department. At the site visit, I collected mosquito larvae, talked to other agencies about the situation, took pictures of the site, and talked to the company owner about ways to control this mosquito population from spreading. I learned about the habitat, lifecycle, and importance of the invasive mosquito *Aedes albopictus*, why it is important to control the spread of this invasive mosquito species, how to speak with company owners about mosquito control, and how to work with multiple agencies to resolve a problem.
- Attended the MDHHS Preparedness and Response Workshop for MDHHS employees
 - This was a virtual, six-hour workshop where multiple department heads at MDHHS gave presentations on preparedness and response to public health emergencies in their respective areas. I learned about what the other bureaus, departments, and divisions at MDHHS do, how they plan, prepare, and respond

to public health emergencies, and why it is important for public health agencies to have preparedness and response workshops for their employees.

- Attended a Rabies Working Group meeting
 - This was a virtual, two-hour meeting where multiple different stakeholders concerned with the rabies virus met to give updates on national and statewide rabies virus management, surveillance, and unusual cases. Stakeholders included agencies such as MDARD, MDHHS EZID, MDNR, USDA, and CDC, laboratories in Michigan, general practice veterinarians, epidemiologists with local health departments and the Michigan State University College of Veterinary Medicine, and local police officers and animal control. During this workshop, I learned about the importance of interprofessional collaboration in the surveillance and management of the rabies virus.
- Attended daily EZID team meeting calls
 - These daily hour-long meetings were used to give updates on the various projects that employees were working on and on the various infectious disease outbreaks that were currently happening in the state of Michigan. I learned many things during these calls, but most importantly, I learned how a public health team operates and about the multiple different responsibilities that they have.
- Attended the Michigan Harmful Algal Blooms Interagency Workgroup Meeting
 - This was a virtual meeting between the following agencies: EGLE, MDHHS, MDHHS Lab, MDARD, MDNR, and local health departments. Each agency provided updates on Michigan harmful algal blooms that pertained to their specific agency. During this meeting, I learned about the importance of interagency collaboration in surveying and responding to Michigan harmful algal blooms.
- Attended a CDC-State Waterborne Disease Prevention Partner Call
 - This meeting provided a forum for CDC and state health departments to exchange information and expertise related to waterborne disease prevention. Participants in the call shared information related to ongoing and emerging waterborne disease prevention, detection, investigation, and preparedness. This call taught me about the importance of providing updates on a public health topic across the nation.
- Attended a One Health Workgroup call

- This was a multiagency call with various state and other agencies in Michigan including MDARD, MDHHS, MDNR, USDA, and Michigan State University. Participants in the call discussed various One Health topics and provided agency specific updates. From this call, I learned about current infectious disease outbreaks and how each agency played a role in managing them.
- Attended a webinar on Harmful Algal Blooms in Michigan's Recreational Waters
 - The Michigan Department of Environment, Great Lakes, and Energy and MDHHS worked together to create this webinar for the public. The webinar covered what HABs were, how EGLE responds to HAB reports, health concerns of HABs, risk assessment of HABs, how to keep pets safe from HABs, and public health response issues to HABs. By participating in this webinar, I gained information on HABs that I later used in my products, and I learned how to communicate scientific information to the public.
- Attended two One Health HAB Community of Practice calls
 - The Centers for Disease Control and Prevention coordinated the One Health HAB community of practice calls to increase communication and collaboration among state and federal partners with interest in public health activities related to HABs. The One Health HAB community of practice meets to share knowledge and activities related to surveillance, response, and mitigation of HAB-associated illnesses. Through listening to these calls, I learned about HABs-related news across the nation, and I learned how state and federal partners work together to share expertise to address ongoing or new challenges related to HABs.
- Attended CDC Zoonoses & One Health Updates (ZOHU) Calls
 - The Centers for Disease Control and Prevention ZOHU calls are one-hour monthly webinars that provide education on zoonotic and infectious diseases, One Health, food safety, vector-borne diseases, recent outbreaks, and other public-health topics. I attended two live webinars and also listened to a few of the previous webinars. Each webinar covered different topics, and I learned about many areas of public health while participating in these webinars.
- Created the first draft of the August 2023 Michigan HAB press release
 - I wrote the first draft of the August 2023 Michigan harmful algal bloom press release. I used previous press releases, recent presentations on Michigan HABs, and information gained from various HAB meetings to write the press release draft. The Michigan Department of Health and Human Services used my draft as

a starting point for creating their final draft. I was not included in updates of the draft, but I was sent the final press release before it was released. This activity helped me develop skills in communicating public health content to the general public in a way that holds their attention while getting important information across.

- Performed a literature review on airborne cyanotoxins spread through the air and their associated health risks
 - I completed a literature review on airborne cyanotoxins spread through the air and their associated health risks. I focused my search on the following cyanotoxins: microcystin, anatoxin-a, saxitoxin, cylindrospermopsin, and nodularin. I then summarized the findings of twelve different journal articles covering this topic. This activity was performed due to a question that the MDHHS HAB team got from the public about airborne cyanotoxins, spread through the air, and their health risk. From this activity, I learned how to complete a literature review about a topic that I previously knew nothing about. I also gained in-depth knowledge of airborne cyanotoxins associated with HABs.
- Completed sewer project status reports for eighteen laboratories in Michigan
 - The Michigan Department of Health and Human Services has a COVID-19 wastewater monitoring project that is carried out by nineteen local projects, which are served by eighteen laboratories across the state of Michigan. To help keep these laboratories on track and provide feedback on their efforts, MDHHS sends them progress reports a couple of times per year. These progress reports contain information on several metrics that MDHHS tracks to make sure the laboratories are fulfilling their responsibilities including completing weekly surveys and reporting their data. I was asked to assess data and summary statistics from an Excel spreadsheet and enter the data into PowerPoint templates. These templates with the data I filled in were the formal reports that were sent to the laboratories.
- Provided feedback on updates to the Michigan Rabies Flow Chart
 - The Michigan Rabies Flow Chart is an algorithm flow chart for assessing animals that have been exposed to rabies and animals that have bitten people. It is mostly used by veterinarians to determine how to move forward during these situations. The Michigan Department of Agriculture and Rural Development and MDHHS work together to create and update this flow chart. The current Michigan

Rabies Flow Chart is being updated, and I was asked to give my opinion on the potential draft update. I looked at the current rabies flow chart and the potential draft update from the perspective of a veterinarian who in the future might be evaluating these animals and utilizing this flowchart. I then provided multiple recommendations about areas that needed clarification and language used that was unclear.

- Analyzed and interpreted HAB data in Michigan
 - While creating a few of my products, I had to analyze and interpret HAB data in Michigan. I analyzed and interpreted the data using Excel, and then created public-friendly graphs, tables, and maps that were included in my products. Through this, I was able to develop and enhance my skills in data analysis, interpretation, and presentation.
- Performed research on the various emerging and zoonotic diseases covered by MDHHS
 - While creating my products, I thoroughly researched the zoonotic diseases they were based on. Additionally, I read about the multiple emerging and zoonotic infectious diseases that the MDHHS EZID Section works with. By doing this, I was able to gain a comprehensive knowledge of many infectious diseases.
- Created public health content for the general public
 - During this internship, I produced numerous products that communicated public health content for various audiences including the general public and health professionals. These products include the Harmful Algal Bloom 2021 Data Summary, the Harmful Algal Bloom 2022 Data Summary, the Harmful Algal Bloom Annual Section Summary for 2022, and the Canine Brucellosis: Next Steps for Positive Dogs brochure. These products are explained in more detail in the following section. Through creating these products, I developed skills in public health communication and content creation for diverse groups of people.
- Created an infectious disease control plan for animal care facilities
 - I created a rabies exposure and control plan for animal care facilities that may have to examine or handle suspect rabid animals. This document is an eight-page in-depth document that provides information about proper PPE to wear, proper disinfectant agents to use, and various other important considerations when handling suspect rabid animals or their laboratory specimens. Through creating this product, I learned about how to create an infectious disease control plan and about the multiple areas that need to be addressed while doing so.

Chapter 3 - Methods

3.1 Harmful Algal Bloom 2021 Data Summary and Harmful Algal Bloom 2022 Data Summary Methods

Summary of Products

I created a new two-page data summary template that will be used annually to summarize the year's harmful algal bloom data in Michigan. From the template I created, I produced the 2021 and 2022 Harmful Algal Bloom Data Summary documents. These summaries were created for the general public using HAB data collected from various groups including, but not limited to, EGLE, MDARD, and MDHHS. The documents include information about HABs, information about HABs monitoring and data collection in Michigan, information on public health actions taken, a bar-graph of the number of HABs per month in Michigan, a table portraying the number of different HAB events, a line graph of trends in Michigan HAB events from 2017-2022, a table of reported HAB-related illnesses in people and animals, and a map of the Michigan counties with confirmed HAB reports.

1. The first step in this project was to determine what the purpose of the document was, who the audience was, and how the document should be formatted. I achieved this through having a meeting with my preceptor and emailing my preceptor for clarification.
2. Once step one was completed, I reviewed MDHHS's Publication Style Guide to determine their rules for publication.
3. Next, I reviewed documents to determine how I should present data to the public. I reviewed documents created by MDHHS, the CDC, and other state public health agencies.
4. Then, I analyzed and interpreted the data given to me through Excel and an annual harmful algal bloom summary letter that MDHHS sent to the local health departments.
5. I created tables, graphs, and maps to accurately and concisely present my data.
6. I created a template for the data summary by referencing other data summaries on various topics from multiple public health agencies.
7. I sent my first draft to my preceptor, and we edited multiple drafts until a quality draft was produced. Other HAB colleagues and health educators at MDHHS and EGLE offered feedback, and from this, a final draft was produced. This draft was then sent to the MDHHS EZID manager & state public health veterinarian. This is the stage when I finished my internship.

8. The next steps would be to update the draft with any feedback from the MDHHS EZID manager, and then determine the publication reading level with Microsoft Word 14.0 software.
9. When a final draft was complete, a Publication Approval Request would be sent to the Office of Communications at MDHHS.
10. The final step would be to post the document onto the Michigan HABs website, michigan.gov/habs.

3.2 Harmful Algal Bloom Annual Section Summary for 2022 Methods

Summary of Product

I updated the Harmful Algal Bloom Section Summary for the 2022 annual Michigan Emerging and Zoonotic Disease Surveillance Summary. This summary is intended for the general public, health providers, and veterinarians and is posted on the MDHHS EZID's website. The harmful algal bloom section that I updated includes information about HABs, HAB data presented in graphs, tables and maps, and a page about what people can do to help keep themselves and their community safe from HABs. I updated the data, changed the HAB picture, added a graph that I created, and reworded some of the information.

1. The template was already made for this project, and my responsibility was to update the information with the new data for 2022 and possibly update the template if I thought it would enhance the summary. Therefore, the first step in this project was to review the previous HAB annual section summary from 2021.
2. Next, I updated the data in the tables and changed the picture in the summary to a more recent one.
3. I compared the document to the Harmful Algal Bloom Data Summary documents that I created and decided to add another graph from that document, add a new statistic, and change the arrangement and format of the section summary.
4. I sent my first draft to my preceptor, and we edited multiple drafts until a quality draft was produced.
5. We then talked about the updates with the rest of the MDHHS EZID team during an EZID team meeting. No changes were required, and the HAB annual section summary was added to the main document, the 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary. This is the stage when I finished my internship.

6. After all of the section summaries were finished, the team sent a Publication Approval Request for the 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary to the Office of Communications at MDHHS.
7. The 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary was published onto the MDHHS EZID website, michigan.gov/emergingdiseases, in October 2023.

3.3 Canine Brucellosis: Next Steps for Positive Dogs brochure Methods

Summary of Product

This product that I created is a brochure that provides information to the general public on what the next steps are if their dog tests positive for canine brucellosis. This is a two-page brochure that is intended for the general public and includes information such as what canine brucellosis is, if it can be prevented, what the treatment options are, what the health risks are to humans and animals, what the requirements are for life-long quarantine, how to minimize risk of transmission, and what to do if a human is exposed to *Brucella canis*. Additionally, the brochure includes references and contact information for someone who wishes to read more about the topic or contact employees at MDHHS or MDARD for questions. This is the first brochure created to cover these topics, and it was created due to the increase in people who do not want to euthanize their dogs that test positive for canine brucellosis.

1. The first step in this project was to determine what the purpose of the document was, who the audience was, and how the document should be formatted. I achieved this through having a meeting with my preceptor and a veterinarian at MDARD and through emailing them both with clarifying questions.
2. Next, I gained information about canine brucellosis by reviewing recent literature and researching other documents from universities and federal and state public health agencies about canine brucellosis.
3. I reviewed MDARD's Canine Brucellosis: What You Need to Know brochure to get an idea for how to format my new brochure.
4. Next, I produced my brochure by creating my own format and providing my own pictures.

5. I sent my first draft to my preceptor, and we edited multiple drafts until a quality draft was produced. We then emailed this draft to the veterinarian at MDARD. This is the stage when I finished my internship.
6. The next step would be to update the draft with any feedback from the MDARD veterinarian. That draft would then be sent to other stakeholders until a finalized draft was produced.
7. The publication reading level would then be determined using Microsoft Word 14.0 software.
8. A Publication Approval Request would then be sent to the Office of Communications at MDHHS.
9. The final step would be to post the document on the MDHHS EZID website, michigan.gov/emergingdiseases, and the MDARD website.

3.4 Rabies Exposure and Control Plan for Animal Care Facilities Methods

Summary of Product

This document is intended to provide control measures that can be used to prevent exposure and minimize the risk of infection of the rabies virus to personnel who examine suspect rabid animals or their laboratory specimens in animal care facilities such as veterinary clinics, animal shelters, animal control facilities, and wildlife laboratories. This is an eight-page in-depth document that is intended for animal care professionals. The idea for its creation came from a veterinary clinic that called MDARD because it did not know what precautions to take when evaluating a suspect rabid animal. This document includes information on the rabies virus, various exposure control methods, the rabies pre-exposure vaccination series, appropriate personal protective equipment, hand hygiene, animal handling and injury prevention, first aid treatment, transport of the animal through a facility, examination, isolation and euthanasia of the animal, collection and submission of samples, decontamination of equipment and surfaces, and other housekeeping procedures.

1. The first step of this project was discovering the necessity for the project during a Rabies Working Group meeting I attended when it was brought up that a veterinary office had called MDARD because it did not know what steps to take to examine a suspect rabid animal. The veterinary clinic did not know what personal protective equipment to wear,

how they should transport the animal through the clinic, or what disinfectant agents to use to inactivate the virus.

2. My preceptor and I then talked during a separate meeting about creating this document to guide veterinarians that may face a similar situation in the future.
3. My preceptor and I then had another meeting with a veterinarian at MDARD to determine the exact purpose of the document, the audience of the document, and how to format the document.
4. I reviewed information on the rabies virus, what personal protective equipment should be worn when handling a suspect rabid animal, what disinfect agents inactivate the rabies virus, how to write an infectious disease control plan, and various other topic areas.
5. I summarized all of the relevant information I found into a 14-page document.
6. Next, I edited and organized the document into my first draft.
7. I sent my first draft to my preceptor, and we edited multiple drafts until a quality draft was produced. We then emailed this draft to the veterinarian at MDARD. This is the stage when I finished my internship.
8. The next step would be to update the draft with any feedback from the MDARD veterinarian. That draft would then be sent to other stakeholders for input until a finalized draft was produced.
9. A Publication Approval Request would then be sent to the Office of Communications at MDHHS.
10. The final step would be to publish the document.

Chapter 4 - Results

Harmful Algal Bloom 2021 Data Summary and Harmful Algal Bloom 2022 Data Summary

The Harmful Algal Bloom 2021 Data Summary and the Harmful Algal Bloom 2022 Data Summary are documents that summarize the associated year's HAB data in Michigan. I produced these documents by creating a new two-page data summary template. These summaries were created for the general public using HAB data collected from various groups including MDHHS, EGLE, MDARD, MDNR, local health departments, local lake/watershed/conservation associations, lake management companies, and academic and research institutions. The documents include information about HABs, information about HABs monitoring and data collection in Michigan, information on public health actions taken, a bar-graph of the number of HABs per month in Michigan, a table portraying the number of different HAB events, a line graph of trends in Michigan HAB events from 2017-2022, a table of reported HAB-related illnesses in people and animals, and a map of the Michigan counties with confirmed HAB reports.

Currently, the final drafts are waiting on approval to the Office of Communications at MDHHS and they will be later published on the Michigan HABs website, michigan.gov/habs. The current drafts are included in Appendix 1.1 and 1.2.

The template that I created will continue to be used annually to summarize the year's harmful algal bloom data in Michigan. These data summaries will be published on the Michigan HABs website for any member of the public interested in this information. The template and documents I created allow the public to assess Michigan HAB data, see if there were any confirmed HAB reports in their county, and track HAB trends over the years.

Harmful Algal Bloom Annual Section Summary for 2022

The Harmful Algal Bloom Section Summary for 2022 is a document that I updated for the 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary. The HAB summary that I updated provides an annual summary of information and data related to HABs in Michigan for the associated year. The document is intended for the general public, health providers, and veterinarians. It is ultimately posted onto the MDHHS EZID's website.

The HAB section summary includes information about HABs, information about HABs monitoring and data collection in Michigan, a bar-graph of the number of HABs per month in Michigan, a table portraying the number of different 2022 Michigan HAB events, a line graph of

trends in Michigan HAB events from 2017-2022, a table of reported HAB-related illnesses in people and animals, and a map of the Michigan counties with confirmed HAB reports. Additionally, the HAB section summary includes a page about what health providers, veterinarians, public health agencies, and everyone can do to help keep themselves and their community safe from HABs. To produce this document, I updated the data, changed the HAB picture, added a graph that I created, added a new statistic, reworded some of the information, and changed the arrangement of the document.

By the end of my internship, my draft had been sent to all appropriate stakeholders, was finalized, and was added to the main document, the 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary. However, it was not yet published. Since then, the MDHHS EZID Department has gotten publication approval from the MDHHS Office of Communications. As of October 2023, the 2022 Michigan Emerging and Zoonotic Disease Surveillance Summary, which includes my Harmful Algal Bloom Annual Section Summary for 2022, has been published to the MDHHS EZID website, michigan.gov/emergingdiseases. The Harmful Algal Bloom Annual Section Summary for 2022 is located in Appendix 2.

This summary is used annually to summarize the year's harmful algal bloom data in Michigan and to provide HAB information to health professionals, veterinarians, public health agencies, and the public. The summary allows the public to learn about HABs, assess Michigan HAB data, see if there were any confirmed HAB reports in their county, and track HAB trends over the years. Additionally, the summary provides information to public health professionals on how to report HAB-related illnesses and how to educate patients and clients on HABs.

Canine Brucellosis: Next Steps for Positive Dogs brochure

The "Canine Brucellosis: Next Steps for Positive Dogs" document that I created is a brochure that provides information to the general public on what the next steps are if their dog tests positive for canine brucellosis. This is a two-page brochure that includes information such as what canine brucellosis is, if it can be cured, what the treatment options are, what the health risks are to humans and animals, what the requirements are for life-long quarantine, how to minimize risk of transmission, and what to do if a human is exposed to *Brucella canis*. Additionally, the brochure includes references and contact information for someone who wishes to read more about the topic or contact employees at MDHHS or MDARD for questions.

Currently, this draft is waiting for input from our original collaborator, the MDARD veterinarian, and other stakeholders. When the feedback is received and a final draft is finalized, it will then be sent to the Office of Communications at MDHHS for approval for

publication. The document will then be published onto the MDHHS EZID website, michigan.gov/emergingdiseases, and the MDARD website. The current draft is included in Appendix 3.

This brochure was created due to the apparent increase in people who do not want to euthanize their dogs that test positive for canine brucellosis. Canine brucellosis is a public health threat due to it being a zoonotic disease that can be passed from dogs to their owners. Originally, when veterinarians recommended euthanasia for *Brucella canis* positive dogs, most people complied. However, currently, more people are less willing to euthanize their pets. Therefore, more resources are needed to provide owners with information about what declining euthanasia and treating canine brucellosis means for them, their dogs, and their family. This brochure serves as an informative resource for owners of dogs with canine brucellosis.

Rabies Exposure and Control Plan for Animal Care Facilities

The Rabies Exposure and Control Plan for Animal Care Facilities is a document that is intended to provide control measures that can be used to prevent exposure and minimize the risk of infection of the rabies virus to personnel who examine suspect rabid animals or their laboratory specimens. This document can be used by animal care facilities such as veterinary clinics, animal shelters, animal control facilities, and wildlife laboratories. This is an eight-page in-depth document that is intended for animal care professionals. This document includes information on the rabies virus, various exposure control methods, the rabies pre-exposure vaccination series, appropriate personal protective equipment, hand hygiene, animal handling and injury prevention, first aid treatment, transport of the animal through a facility, examination, isolation and euthanasia of the animal, collection and submission of diagnostic samples, decontamination of equipment and surfaces, and other housekeeping procedures.

By the end of my internship, I completed the first draft of the Rabies Exposure and Control Plan. The draft is now waiting for feedback from our original collaborator, the MDARD veterinarian, and other stakeholders. When the feedback is received and a final draft is finalized, it will then be sent to the Office of Communications at MDHHS for approval for publication. The document will then be published onto the MDHHS EZID and MDARD websites as a reference for animal care professionals who may handle suspect rabid animals. The current draft is included in Appendix 4.

Chapter 5 - Discussion

My integrated learning experience allowed me to develop the knowledge and skills I gained during my coursework and apply them to my applied practice experience at the MDHHS EZID Section. This allowed for the completion of projects that will improve Michigan residents' access to important public health content. Harmful algal blooms (HABs) are increasing in frequency, duration, and geographic distribution in Michigan (MDHHS, 2023). However, this is not only a public health concern for Michigan residents; HABs are also increasing in frequency and geographic distribution in the United States and globally (Al-Ghelani et al., 2005). Potential causes of this include climate change, nutrient pollution, impacts from invasive species, and improved surveillance/reporting (MDHHS Emerging & Zoonotic Infectious Disease, 2022). Because climate change is likely a major cause of the increase in HABs and because a solution to climate change is complex, HABs will likely continue to increase globally and in Michigan. Therefore, it is important to keep collecting data and presenting this data to the public so that they can remain informed about the health risks associated with HABs.

The HAB data summary documents that I created provide a concise informative document about HABs for the public. These documents are a new resource to provide HAB data to Michigan residents and will increase their knowledge on HABs. This will help move the understanding of HABs as a public health concern forward in the state of Michigan. The Michigan Department of Health and Human Services will continue to release my data summary document every year. In the future, this template could be reexamined to determine if more data on HABs needs to be included. Because of the Great Lakes and numerous other lakes in Michigan, Michigan is well known for providing many recreational water sports/activities. Therefore, the products I created on HABs data and information is important in keeping Michigan residents and tourists safe.

Canine brucellosis is an important public health concern in the state of Michigan. However, *Brucella canis* is thought to be less virulent than other *Brucella* strains, and only a few human cases of canine brucellosis have been reported in Michigan (MDHHS, 2018). Globally, it was found that 1% of human brucellosis cases are caused by *Brucella canis*. There are about half a million human brucellosis cases per year, so that would mean that there are about 5,000 people each year diagnosed with canine brucellosis (Santos et al., 2021). However, due to difficulty in diagnosis, underreporting, and self-limiting infections, the incidence of human *Brucella canis* infections may be underestimated (MDHHS, 2018). This means that we are unsure of the prevalence of human *Brucella canis* infections, often making canine brucellosis a

neglected zoonotic disease. However, canine brucellosis is an important public health concern due to the close contact between dogs and humans.

In Michigan, a veterinarian at MDARD has reported that more people are selecting to decline euthanasia and choose life-long quarantine for dogs that are infected with *Brucella canis*. Because of this and because of the importance of canine brucellosis as a public health issue, creating my brochure called Canine Brucellosis: Next Steps for Positive Dogs was extremely important in controlling the spread of canine brucellosis. The brochure provides information to owners about the advantages and disadvantages of life-long quarantine, the requirements of quarantine, and how to reduce *B. canis* transmission. Ultimately, this will help move the understanding of canine brucellosis as a public health concern forward in the state of Michigan. In the future, a more detailed informative packet on canine brucellosis should be made for people who desire more information. However, the brochure I created is a great start for providing Michigan residents with necessary information on canine brucellosis infections.

Rabies is a serious zoonotic disease and major public health concern around the globe. In Michigan, about sixty animal rabies cases are reported per year (MDHHS, Rabies). However, only 1-2 human rabies deaths occur per year in the United States (CDC, 2020), and the last death in Michigan was in 2009 (District Health Department 10, Prevent Rabies!). This low number is likely due to animal control programs, pet vaccinations, public health testing and surveillance, and the development of effective post-exposure prophylaxis treatments. Despite the low prevalence of human rabies cases throughout the United States, rabies is still considered a major public health concern due to the fatality of an infection.

Therefore, creating the Rabies Exposure and Control Plan for Animal Care Facilities was extremely important. Animal care professionals are at an increased risk of rabies infections due to the nature of their work, where they often handle mammals with an unknown rabies vaccination status. Having a standard of procedures for working with suspect rabid animals will help to prevent exposure to the rabies virus and minimize the risk of infection. The document that I created is the first document to provide an in-depth standard of procedures for working with suspect rabid animals. This has provided new insights on what preventative measures should be taken when working with suspect rabid animals. Additionally, this document will help move the understanding of the importance of rabies as a public health concern in animal care facilities forward across the state of Michigan. In the future, this document should be reviewed and edited to add any new information about the rabies virus that may have been discovered during new research initiatives.

There were some limitations during the creation of each of my products. I was limited in my HAB documents because I was unable to choose which data was collected. I would have chosen to collect data on the number of HAB-related deaths separate from the number of HAB-related illnesses. Instead, the data was collected/presented as HAB-related illnesses/deaths. Additionally, I would have liked to have data/information about what the most common clinical signs were in people and pets with HAB-related illnesses. I believe that this information could provide the public with a better understanding of the significance of HABs and human/animal health.

I was limited in data availability for the canine brucellosis brochure because I was unable to retrieve data on the percentage of people in Michigan and nationwide who choose to decline euthanasia and select life-long quarantine instead. Having these percentages and having the data over multiple years to track the trend towards an increase in selecting life-long quarantine would have been able to provide me with more information about the significance of the situation. I was limited in my rabies exposure and control plan in that I was unable to find specific information about a standard of procedures for working with suspect rabid animals. Therefore, I had to use information on a standard of procedures for working with animals that had general zoonotic infectious diseases and apply it to the rabies virus using information I retrieved from numerous journal articles. While the limitations of my projects are important to note, they do not diminish the importance of my products in informing Michigan residents on significant public health concerns.

This report provided a comprehensive overview of my applied practice experience at MDHHS EZID, the projects I completed, and the integration of the knowledge and skills I gained throughout my coursework and during my APE. Through the projects I created and the activities I participated in during my APE, I was able to further develop the knowledge and skills I gained during my MPH coursework at Kansas State University. These developed knowledge and skills will help me in my future career opportunities as a public health veterinarian. Additionally, the projects that I completed at MDHHS EZID will provide Michigan residents with important information on significant public health concerns, and it will provide the EZID Section at MDHHS with new informative resources to build upon.

Chapter 6 - Competencies

Student Attainment of MPH Foundational Competencies

Five MPH Foundational Competencies that were attained and utilized during my culminating experience are 3, 4, 18, 20, and 21. Three of these were best utilized during my Applied Practice Experience in the creation of my products, and two of the competencies were best utilized during my coursework. Below, there is a table summarizing the competencies, and below the table is a written detailed explanation of each competency.

Table 6.1 Summary of MPH Foundational Competencies

Number and Competency		Description
3.	Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	This competency was best applied in my Biostatistics for Public Health (HM 802) course. I analyzed numerous quantitative and qualitative data sets using biostatistics and computer-based programming and software such as Excel and SPSS Statistics.
4.	Interpret results of data analysis for public health research, policy, or practice	For the creation of my Harmful Algal Bloom Data Summary documents, harmful algal bloom data was analyzed, interpreted, and presented in the form of graphs, tables, and maps for public health practice.
18.	Select communication strategies for different audiences and sectors	Some of the products I made during my APE were for the general public, some were for health professionals, and some were for both. Therefore, I selected different communication strategies for each of my products based on who the audiences were.
20.	Describe the importance of cultural competence in communicating public health content	This competency was attained in two of my courses: MPH 818 Social and Behavioral Bases of Public Health and LEAD 801 Foundations of Leadership. During my coursework in these classes, there were readings, discussions, and assignments about cultural competency and its importance in communicating public health content.
21.	Integrate perspectives from other sectors and/or professionals to promote and advance population health	All of the products I produced during my APE required me to perform effectively on interprofessional teams. I worked closely with the MDHHS' EZID team. Additionally, most of my products were made in collaboration with other state departments, and I took meetings and corresponded with members of those departments.

Competency #3: Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate

During my coursework, I often analyzed data. However, the skill was best applied in my Biostatistics for Public Health (HM 802) course taken through Michigan State University. During this course, I analyzed numerous quantitative and qualitative data sets using biostatistics and computer-based programming and software such as Excel and SPSS Statistics. The course focused on commonly used statistical methods in public health practice and practical application of these methods. Each week, new data sets from real public health projects were required to be analyzed and interpreted. There were also two major products that required analyzation and interpretation of public health data. This course helped me become familiar with statistical programming and software, as well as become better equipped to interpret public health data and statistical results.

Competency #4: Interpret results of data analysis for public health research, policy or practice

For the creation of my Harmful Algal Bloom Data Summary documents, Michigan's harmful algal bloom data was analyzed, interpreted, and presented in the form of graphs, tables, and maps for health professionals and the public. The presentation of the data through these graphs, tables, and maps was intended to be public-friendly and easy to read for any member of the public. Currently, the data analysis is used to track trends, educate, and guide public health practices. The data helps health professionals stay informed about harmful algal blooms, which helps them better diagnose and treat their patients. Additionally, the data analysis helped us determine that harmful algal blooms are increasing in frequency, duration, and geographic distribution across the state of Michigan. With this data, the MDHHS EZID Section was able to get funding for a project to expand HAB surveillance through recruiting help from local county health departments. This data analysis is currently being used for public health practice, but in the future, it could also be used for public health policy and research.

Competency #18: Select communication strategies for different audiences and sectors

I selected different communication strategies for each of my products based on who the audiences were. Some of the products I made were for the general public, some were for health professionals, and some were for both. My products for the general public needed to be

able to easily communicate data and information to any member of the public. I had to take scientific information and make it clear, concise, and relevant for members of the public that may not have a scientific background. My document for animal care professionals needed to be explicit and detailed. I often used scientific language; however, medical jargon could not be used because many animal care professionals do not have a medical background. However, some topics within the document were solely for veterinarians, and in those instances, some medical jargon was used. The document that was written for health professionals and the public was mostly written in a public-friendly, easy-to-read language. However, there were headers within the document where certain health professionals could go to for information, and in those areas, language specific to those health professions was used. Therefore, for all of my products, I had to select communication strategies that were appropriate for different audiences.

Competency #20: Describe the importance of cultural competence in communicating public health content

This competency was attained in two of my courses: MPH 818 (Social and Behavioral Bases of Public Health) and LEAD 801 (Foundations of Leadership). During my coursework in these classes, there were readings, discussions, and assignments about cultural competency and its importance in communicating public health content. I was first introduced to the concept of cultural competence in MPH 818 (Social and Behavioral Bases of Public Health) in one of the assigned readings. I was then asked to describe the concept in an assignment. In Lead 801 (Foundations of Leadership), I was reintroduced to the concept. I read two different journal articles on the topic and then discussed cultural competence in a class discussion. Learning about cultural competence in two different classes helped to strengthen my understanding of the importance of it in communicating public health content.

Competency #21: Integrate perspectives from other sectors and/or professionals to promote and advance population health

All of the products I produced during my Applied Practice Experience required me to perform effectively on interprofessional teams. I worked closely with the MDHHS' EZID team. Additionally, most of my products were made in collaboration with other state departments, and I took meetings and corresponded with members of those departments. My harmful algal bloom products required collaboration from EGLE and from the Division of Environmental Health at MDHHS. Drafts of my products were sent back and forth to members of these departments until

a final draft was created. My Canine Brucellosis brochure and Rabies Exposure and Control Plan were both created in collaboration with MDARD. I had meetings with a veterinarian at MDARD about the focus and scope of these documents. I also emailed with the MDARD veterinarian about edits to these products. Within the EZID Section at MDHHS, I worked with the whole team. My preceptor worked closely with me on all of my projects. Additionally, I helped other members of the team with some smaller projects.

Table 6.1 MPH Foundational Competencies and Course Taught In

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
Evidence-based Approaches to Public Health					
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	x		x		
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	x	x	x		
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	x	x	x		
4. Interpret results of data analysis for public health research, policy or practice	x		x		
Public Health and Health Care Systems					
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings		x			
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels					x
Planning and Management to Promote Health					
7. Assess population needs, assets and capacities that affect communities' health		x		x	
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs					x
9. Design a population-based policy, program, project or intervention			x		
10. Explain basic principles and tools of budget and resource management		x	x		
11. Select methods to evaluate public health programs	x	x	x		
Policy in Public Health					
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence		x	x	x	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes		x		x	
14. Advocate for political, social or economic policies and programs that will improve health in diverse populations		x			x
15. Evaluate policies for their impact on public health and health equity		x		x	
Leadership					

22 Public Health Foundational Competencies Course Mapping		MPH 701	MPH 720	MPH 754	MPH 802	MPH 818
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making			x			x
17. Apply negotiation and mediation skills to address organizational or community challenges			x			
Communication						
18. Select communication strategies for different audiences and sectors	DMP 815, FNDH 880 or KIN 796					
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	DMP 815, FNDH 880 or KIN 796					
20. Describe the importance of cultural competence in communicating public health content			x			x
Interprofessional and/or Intersectional Practice						
21. Integrate perspectives from other sectors and/or professionals to promote and advance population health			x			x
Systems Thinking						
22. Apply systems thinking tools to a public health issue				x	x	

Student Attainment of MPH Emphasis Area Competencies

Table 6.2 Summary of MPH Emphasis Area Competencies

MPH Emphasis Area:		
Number and Competency		Description
1	Pathogens/pathogenic mechanisms	Evaluate modes of disease causation of infectious agents.
2	Host response to pathogens/immunology	Investigate the host response to infection.
3	Environmental/ecological influences	Examine the influence of environmental and ecological forces on infectious diseases.
4	Disease surveillance	Analyze disease risk factors and select appropriate surveillance.
5	Disease vectors	Investigate the role of vectors, toxic plants and other toxins in infectious diseases

Competency #1: Pathogens/pathogenic mechanisms

I attained this competency throughout my coursework and then utilized it during my Applied Practice Experience. I evaluated modes of disease causation of infectious agents in courses such as DMP 812 (Veterinary Bacteriology and Mycology) and DMP 718 (Veterinary

Parasitology). During these courses, I gained a comprehensive understanding of many different pathogens and their pathogenic mechanisms. I learned about major characteristics of different organisms, their virulence factors, and their pathogenesis of infection. I was then able to apply this knowledge during my Applied Practice Experience through the creation of my products: Canine Brucellosis: Next Steps for Positive Dogs and the Rabies Exposure and Control Plan for Animal Care Facilities. I had to first understand *Brucella canis* and *Rabies lyssavirus* as pathogens to then understand the pathogenesis of canine brucellosis and rabies. Understanding the pathogenesis of these diseases was imperative to completing my products. For the Canine Brucellosis: Next Steps for Positive Dogs brochure, I had to understand the pathogenesis of canine brucellosis in order to effectively inform the public on how to minimize the risk of transmission. For the Rabies Exposure and Control Plan for Animal Care Facilities document, I had to understand the pathogenesis of the rabies virus to be able to inform animal care professionals about how best to minimize the risk of infection when examining a suspect rabid animal.

Competency #2: Host response to pathogens/immunology

I attained this competency throughout my coursework and then utilized it during my Applied Practice Experience. I investigated the host response to infection in the course DMP 705 (Principles of Veterinary Immunology). In this course, I learned the functions of the immune system and its role in combating diseases. I then applied this knowledge to the creation of my products during my Applied Practice Experience. While creating the Canine Brucellosis: Next Steps for Positive Dogs brochure, I used my knowledge of immunology to inform the public on how canine brucellosis is diagnosed, if it can be treated, and what the health risks are to humans and animals. For the Rabies Exposure and Control Plan for Animal Care Facilities document, I used my knowledge of immunology to inform animal care professionals about the rabies pre-exposure vaccination series and rabies post-exposure prophylaxis. Understanding the host response to *Brucella canis* and *Rabies lyssavirus* was critical in the creation of these products.

Competency #3: Environmental/ecological influences

This competency was attained in my coursework and then utilized during my Applied Practice Experience. During the courses MPH 802 (Environmental Health) and DMP 710 (Introduction to One Health), I examined the influence of environmental and ecological forces on

infectious diseases. In these courses, I learned about the impacts of air pollution, water quality, waste management, deforestation, climate change, and other environmental influences on the transmission, spread, and emergence of infectious diseases. This knowledge was then applied during my Applied Practice Experience. Harmful algal blooms are increasing in frequency, duration, and distribution in Michigan and across the nation. Potential causes of this include climate change, invasive species and nutrient pollution, which are all environmental and ecological forces. With the increases in harmful algal blooms, there are also increases in cyanotoxicities in both people and animals. Understanding the influence of environmental and ecological forces on harmful algal blooms was useful in understanding the effect this environmental hazard may have on communities' public health.

Competency #4: Disease Surveillance

I attained this competency throughout my coursework and then utilized it during my Applied Practice Experience. During the courses MPH 754 (Introduction to Epidemiology) and DMP 710 (Introduction to One Health), I learned about analyzing disease risk factors and selecting appropriate surveillance. Additionally, I learned about the importance of surveillance, the required data for surveillance, types of surveillance such as active and passive, uses of surveillance, and obstacles to surveillance. This knowledge was utilized during my APE through my data analysis of harmful algal blooms and field activities where I learned about mosquito and eastern equine encephalitis (EEE) surveillance. Clinical symptoms and illness associated with exposure to harmful algal blooms is reportable in Michigan; this is a form of passive surveillance. I used the data from these reported cases to identify trends in the frequency of HAB-related illnesses over the years. In some counties in Michigan, active mosquito surveillance is conducted for EEE. I went on a field activity where I went to many mosquito collection sites and was able to see the mosquito collection process. Those mosquitos are later identified and tested for EEE virus as part of active surveillance of EEE virus in the mosquito population.

Competency #5: Disease vectors

This competency was attained in my coursework and then utilized during my Applied Practice Experience. I investigated the role of vectors, toxic plants, and other toxins in infectious diseases in courses such as DMP 710 (Introduction to One Health) and DMP 718 (Veterinary Parasitology). Through these courses, I gained an understanding of toxins, toxic plants, and

different types of vectors such as mosquitos, ticks, flies, fleas, and lice. This knowledge and understanding of disease vectors was applied in my field activities during my Applied Practice Experience. All of my field activities during my APE involved mosquitos and mosquito-borne diseases, such as EEE. In these activities, I identified mosquito species, collected adult mosquitos and mosquito larvae for identification and surveillance, and visited a site where the invasive mosquito species *Aedes albopictus* had been collected. Together, these experiences have improved my understanding of disease vectors, their associated diseases, and their importance in the public health field.

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Appendix 1 – Harmful Algal Bloom Data Summaries

Appendix 1.1 Harmful Algal Bloom 2021 Data Summary



Harmful Algal Bloom 2021 Data Summary

Harmful algal blooms (HABs) are the rapid growth of cyanobacteria (also known as blue-green algae). Cyanobacteria are a natural part of lakes, rivers, and ponds. However, HABs can form when cyanobacteria grow rapidly and produce toxins, called cyanotoxins. HABs can cause illness in people and animals.

The Michigan Department of Health and Human Services and the Michigan Department of Environment, Great Lakes, and Energy collect data about HAB events and associated human and animal illnesses in Michigan. This report summarizes HABs reported to these agencies in Michigan during 2021.

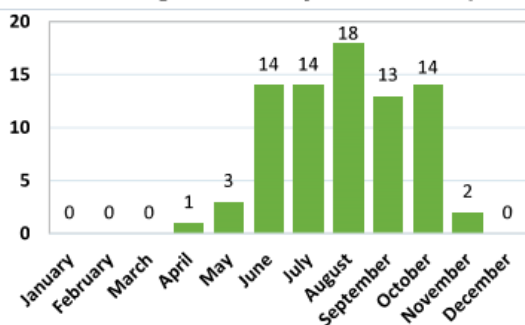
Michigan HABs monitoring is a collaboration between many groups:

- Michigan Department of Health and Human Services
- Michigan Department of Environment, Great Lakes, and Energy
- Michigan Department of Agriculture and Rural Development
- Michigan Department of Natural Resources
- Local health departments
- Local lake/watershed/conservation associations
- Lake management companies
- Academic and research institutions



Photo credit: Michigan Department of Environment, Great Lakes, and Energy

2021 Michigan HABs, by Month of Report



2021 Michigan
Harmful Algal Bloom Events

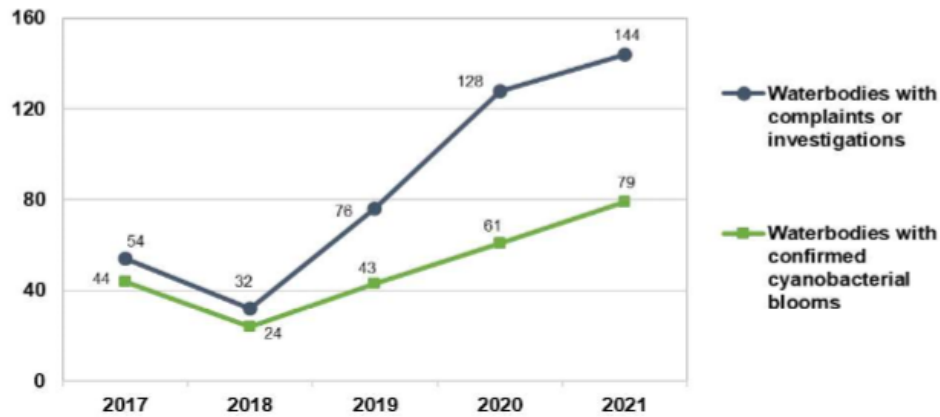
# of waterbodies with complaints and/or investigations	144
# of waterbodies with confirmed cyanobacterial blooms (HABs)	79
Public health actions taken*	31

* Examples include posting of signage, issuing an advisory or closure, press releases, and stakeholder or public communications.

Some blooms are tested for cyanotoxins. **68.7%** of blooms that were tested had cyanotoxins. Of the blooms with cyanotoxins, **63.0%** had levels that were above recommended recreational levels.



Trends in Michigan Harmful Algal Bloom Events, 2017-2021



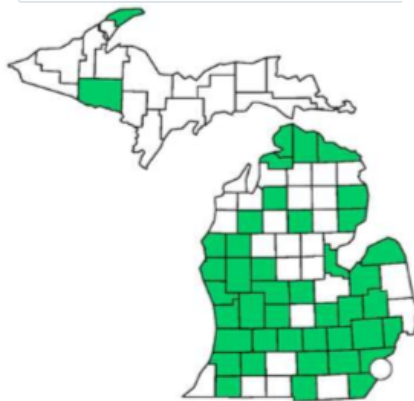
Reported HAB-related Illnesses	2021	2017-2021
 Human	5	12
 Animal	2	14

Public health actions were taken on **39.2%** of waterbodies with HABs:

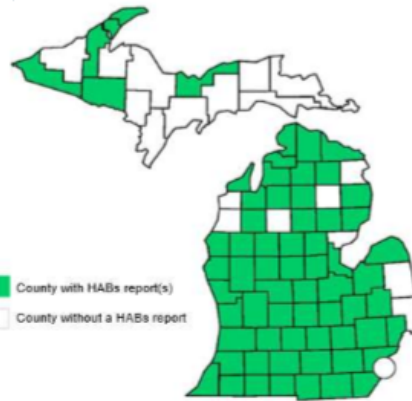
- Actions may include providing educational outreach, awareness, advisories, or closures of waterbodies.
- Actions are based on toxin concentrations, history of toxins, duration of the HAB, extent around the lake, proximity to recreational areas, and reported illnesses.

Michigan Counties with Confirmed Harmful Algal Bloom Reports, 2017-2021

Counties with Blooms, 2021 (n=43)



Counties with Blooms, 2017-2021 (n=65)



 County with HABs report(s)
 County without a HABs report



For more information: michigan.gov/habs

Appendix 1.2 Harmful Algal Bloom 2022 Data Summary



Harmful Algal Bloom 2022 Data Summary

Harmful algal blooms (HABs) are the rapid growth of cyanobacteria (also known as blue-green algae). Cyanobacteria are a natural part of lakes, rivers, and ponds. However, HABs can form when cyanobacteria grow rapidly and produce toxins, called cyanotoxins. HABs can cause illness in people and animals.

The Michigan Department of Health and Human Services and the Michigan Department of Environment, Great Lakes, and Energy collect data about HAB events and associated human and animal illnesses in Michigan. This report summarizes HABs reported to these agencies in Michigan during 2022.

Michigan HABs monitoring is a collaboration between many groups:

- Michigan Department of Health and Human Services
- Michigan Department of Environment, Great Lakes, and Energy
- Michigan Department of Agriculture and Rural Development
- Michigan Department of Natural Resources
- Local health departments
- Local lake/watershed/conservation associations
- Lake management companies
- Academic and research institutions

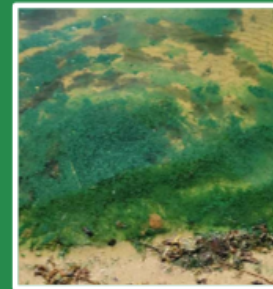
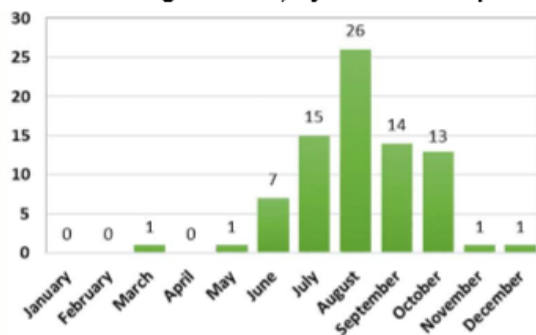


Photo credit: Mid-Michigan District Health Department

2022 Michigan HABs, by Month of Report



**2022 Michigan
Harmful Algal Bloom Events**

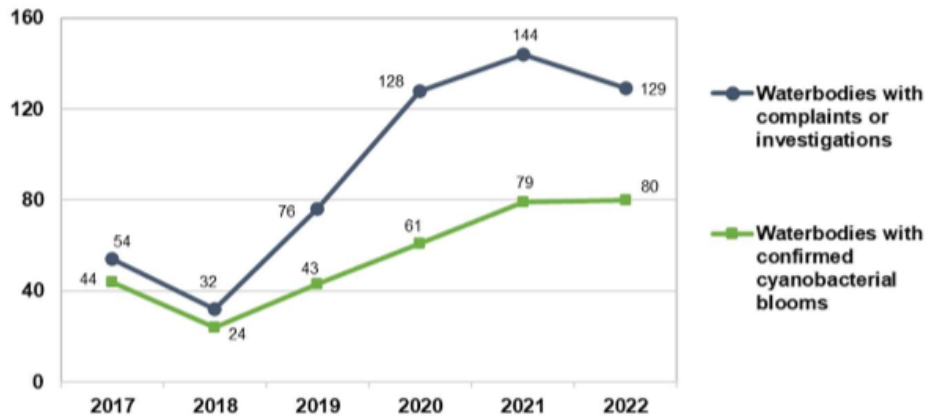
# of waterbodies with complaints and/or investigations	129
# of waterbodies with confirmed cyanobacterial blooms (HABs)	80
Public health actions taken*	42

* Examples include posting of signage, issuing an advisory or closure, press releases, and stakeholder or public communications.

Some blooms are tested for cyanotoxins. **48.8%** of blooms that were tested had cyanotoxins. Of the blooms with cyanotoxins, **66.7%** had levels that were above recommended recreational levels.



Trends in Michigan Harmful Algal Bloom Events, 2017-2022



Reported HAB-related Illnesses

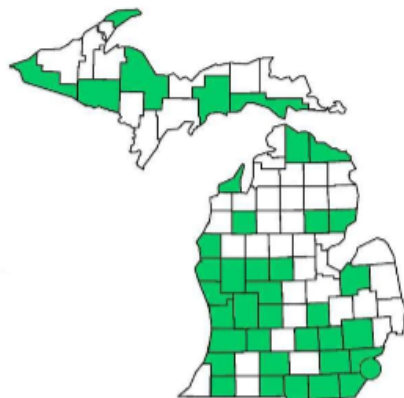
	2022	2017-2022
Human	0	12
Animal	0	14

Public health actions were taken on **52.5%** of waterbodies with HABs:

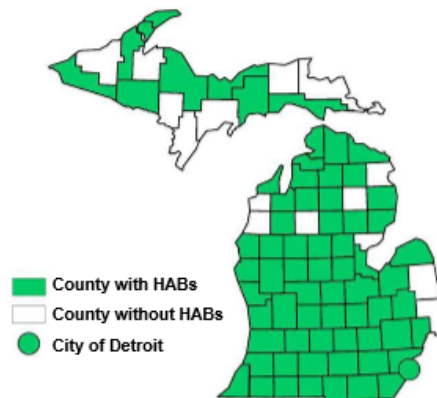
- Actions may include providing educational outreach, awareness, advisories, or closures of waterbodies.
- Actions are based on toxin concentrations, history of toxins, duration of the HAB, extent around the lake, proximity to recreational areas, and reported illnesses.

Michigan Counties with Confirmed Harmful Algal Bloom Reports, 2017-2022

Counties with Blooms, 2022 (n=38)



Counties with Blooms, 2017-2022 (n=68)



For more information: michigan.gov/habs

Appendix 2 – Harmful Algal Bloom Annual Section Summary for 2022

Harmful Algal Blooms

Cyanobacteria (also known as blue-green algae) can form blooms on water surfaces that are not visually pleasing, smell, and can interfere with recreational activities. Some blooms produce cyanotoxins that can cause illness and even death in humans and animals; these are known as harmful algal blooms (HABs).

HABs in Michigan are increasing in frequency and geographic distribution; potential causes include climate change, nutrient pollution, improved reporting, and impacts from invasive species. HABs can be many colors and textures and can look like scum, spilled paint, foam, or discoloration of the water. Many are bright green with a “pea soup” appearance.



Harmful algal bloom in a lake in Allegan County. Photo credit: Nicole Taubner, Allegan County Health Department

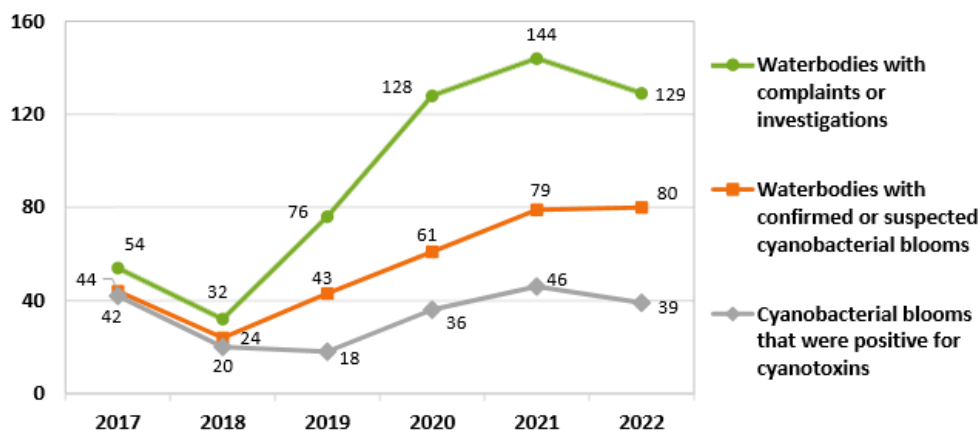
Summary of 2022 Michigan Harmful Algal Bloom Events

# of waterbodies with complaints and/or investigations	129
# of these waterbodies with confirmed/suspected cyanobacterial blooms (HABs)	80
Suspected HABs ¹	36
Confirmed HABs ²	44

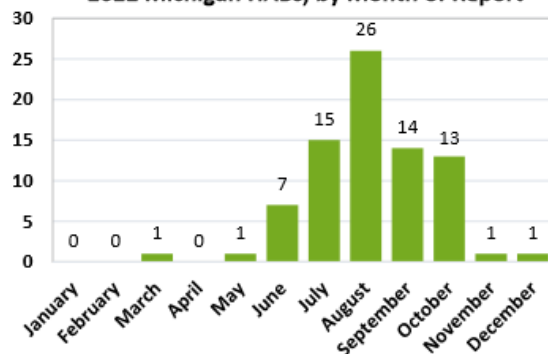
¹Suspected: Images or site visit findings/measurements are consistent with cyanobacterial bloom and cyanotoxins not measured/detected.

²Confirmed: Laboratory detection of cyanotoxins/toxin-producing genes/cyanobacterial species known to produce toxins.

Trends in Michigan Harmful Algal Bloom Events, 2017-2022



2022 Michigan HABs, by Month of Report



Cyanobacteria can “bloom” when water temperatures are warm, the water surface is calm, and sunlight and excess nutrients are available. In Michigan, HABs usually occur in June through October and can last for hours up to months.

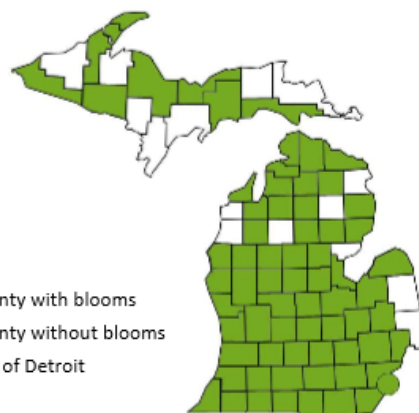
HABs monitoring requires collaboration between many Michigan organizations:

- Department of Health and Human Services
- Department of Environment, Great Lakes, and Energy
- Department of Agriculture and Rural Development
- Department of Natural Resources
- Local health departments
- Local lake/watershed/conservation associations
- Lake management companies

Counties with Blooms in 2022 (n=38)



Counties with Blooms in 2017-2022 (n=68)



 County with blooms
 County without blooms
 City of Detroit

Reported HAB-related illnesses	2022	2017-2022
Human	0	12
Animal	0	14

In 2022, cyanotoxins were detected in 48.8% of tested blooms.

Of the blooms with cyanotoxins, 66.7% were above levels recommended for recreation.





What can be done?

Everyone can....

- » **Know** what HABs do and do not look like (visit the HAB Picture Guide at www.michigan.gov/habs).
- » **Know** where HABs have been reported by looking at the Michigan Harmful Algal Bloom Reports Map at www.michigan.gov/habsmap.
- » **Report** suspect algae blooms or bloom-related illnesses to EGLE by calling 1-800-662-9278 or e-mailing AlgaeBloom@Michigan.gov. If available, pictures of suspected blooms are very helpful.
- » **Seek** medical care if you, your family, or your pet become sick after swimming or contact with algae.

Health Providers can....

- » **Learn** about symptoms (www.cdc.gov/habs/pdf/habsphysician_card.pdf) and ask patients about potential water exposures.
- » **Educate** patients about the risk of HABs.
- » **Report** any suspected HAB-related illnesses to your local health department and consult with state/local public health on uncertain cases.

Veterinarians can....

- » **Educate** yourself about clinical presentations of HABs (www.avma.org/resources-tools/animal-health-and-welfare/animal-health/harmful-algal-blooms-habs).
- » **Ask** clients about potential animal exposures and educate them on the risk of HABs for both them and their pets.
- » **Collect** clinical specimens and conduct necropsies on suspect HAB cases.
- » **Report** HAB illness in pets or livestock to MDARD by submitting a Reportable Disease Form (found at www.michigan.gov/dvmresources under 'Reportable Diseases') or calling 800-292-3939.

Public Health Agencies can....

- » **Report** suspected algae blooms or bloom-related illnesses to EGLE by calling 1-800-662-9278 or emailing AlgaeBloom@Michigan.gov.
- » **Respond** to HABs by posting signage, issuing appropriate advisories, and providing information to community stakeholders.

RESOURCES

- » State of Michigan Harmful Algal Bloom website: www.michigan.gov/habs
- » Michigan Harmful Algal Bloom Reports Map: www.michigan.gov/habsmap
- » Centers for Disease Control and Prevention's Harmful Algal Bloom-Associated Illness website: www.cdc.gov/habs/

Appendix 3 – Canine Brucellosis: Next Steps for Positive Dogs Brochure

CANINE BRUCELLOSIS: NEXT STEPS FOR POSITIVE DOGS

WHAT IS CANINE BRUCELLOSIS AND CAN IT BE CURED?

Canine brucellosis is a contagious bacterial disease in dogs. The disease can be transmitted to other dogs very easily, and sometimes to people. There are no vaccines available for brucellosis.

Unfortunately, there is no known cure for canine brucellosis. Positive dogs remain infected for life and will be a risk to other dogs and people.



WHAT ARE THE OPTIONS FOR DOGS THAT HAVE TESTED POSITIVE?

Since canine brucellosis is an incurable, life-long disease that can be spread to humans and other animals, humane euthanasia is often recommended for dogs that test positive. However, another option that can be considered is life-long quarantine. Both options have advantages and disadvantages:

EUTHANASIA	LIFE-LONG QUARENINE
Euthanasia eliminates the risk of transmission to people and other animals.	A life-long risk of infecting people and other animals.
The situation is resolved quickly.	Quarantine requirements are life-long and often cumbersome.
Euthanasia is less expensive.	Antibiotic treatments and periodic testing can be expensive.
Euthanasia means the loss of a dog and possible grief for family members.	Life-long quarantine means that the dog remains alive.

WHAT ARE THE HEALTH RISKS TO HUMANS?

In humans, brucellosis normally causes a fever, chills, lethargy, headache, weakness, muscle aches, and swollen lymph nodes. In more severe infections, joints, bones, or heart valves may be affected. Some people may not have any symptoms. Brucellosis during pregnancy carries the risk of causing spontaneous abortion.

WHAT ARE THE HEALTH RISKS TO ANIMALS?

Most dogs won't show any signs. However, some dogs may have a history of infertility, abortions, or giving birth to dead or weak puppies, back pain, lack of energy, enlarged lymph nodes, and cloudy or red eyes that may have a small pupil and seem painful.

CANINE BRUCELLOSIS: NEXT STEPS FOR POSITIVE DOGS

WHAT ARE THE REQUIREMENTS FOR LIFE-LONG QUARENTINE?

- Spay/neuter intact dogs
- Start appropriate long-term antibiotic therapy
- Lifetime periodic laboratory testing for *Brucella canis*
- Lifetime periodic visits by personnel from the Michigan Department of Agriculture and Rural Development
- Strict adherence to not taking the dog to public areas such as parks, beaches, pet stores, jogging paths, playgrounds, boarding facilities, etc.

WHAT TO DO IF SOMEONE IS EXPOSED TO *B. canis*:

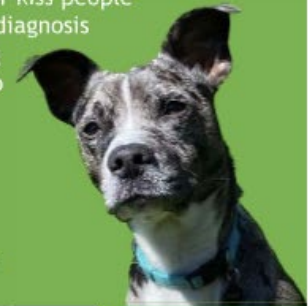
Persons who believe they may have been exposed should be aware of the signs and symptoms of brucellosis and consult with a medical provider if they become ill.

HOW TO MINIMIZE RISK OF TRANSMISSION:

Brucella canis organisms are passed in urine, vaginal discharge, semen, aborted material, milk, nasal secretions, and saliva. Transmission may occur through accidental contact between these infectious materials and a person's or other animal's mucous membranes, or a break in the skin.

Below are ways to minimize the risk of transmission:

- Spay/neuter the dog to decrease shedding of the organism via reproductive secretions
- NEVER breed infected dogs
- Treat the dog with appropriate antibiotics, often for as long as 12 weeks
- Periodically test the dog to monitor its disease
- Keep the dog away from other dogs and visitors
- Do not take the dog to public areas such as parks, beaches, playgrounds, boarding facilities, pet stores, etc.
- Do not let the dog have contact with children, pregnant women, and immunocompromised people
- Do not allow the dog to mouth or kiss people
- Warn veterinarians of the dog's diagnosis
- Practice good hygiene, including wearing gloves when cleaning up pet waste and washing hands thoroughly after contact with infectious materials
- Launder contaminated clothing and dog bedding frequently
- Disinfect contaminated surfaces



FOR MORE INFORMATION:

- CDC, "Brucellosis"
<https://www.cdc.gov/brucellosis/veterinarians/dogs.html>
- CDC, "Brucellosis Reference Guide"
<https://www.cdc.gov/brucellosis/resources/articles.html>
- The Center for Food Security and Public Health, "Brucellosis: *Brucella canis*"
https://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis_canis.pdf

Michigan Department of
Agriculture and Rural
Development
Phone: 800-292-3939
www.michigan.gov/mdard



Michigan Department of
Health and Human Services
Phone: 517-335-8165
www.michigan.gov/mdhhs

Appendix 4 – Rabies Exposure and Control Plan for Animal Care Facilities

Rabies Exposure Control Plan for Animal Care Facilities

Animal Care Facility:

Any facility that may come into contact with a suspect rabid animal such as veterinary clinics, animal shelters, animal control, and wildlife laboratories.

Purpose:

To provide control measures that can be used to prevent exposure to the rabies virus and minimize the risk of infection of personnel who examine suspect rabid animals or their laboratory specimens.

Suspect Rabid Animal:

- Any mammal being euthanized for rabies testing
- Any mammal with history of potential exposure AND clinical signs of rabies
- Potential exposure: any bite, scratch or other situation in which saliva or nervous tissue from a potentially rabid animal enters an open or fresh wound, abrasion or break in the skin, or comes in contact with a mucous membrane by entering the eye, nose or mouth. Direct contact between an animal and a bat is also considered an exposure.
 - *Fights between dogs and cats are not usually considered rabies exposures unless one of the animals has clinical signs of rabies or past exposure to a rabid animal.*
 - *To help assess exposure, assessment flowcharts can be found at www.michigan.gov/rabies*
- Clinical signs: lethargy, fever, vomiting, anorexia, cerebral dysfunction, cranial nerve dysfunction, ataxia, weakness, paralysis, seizures, difficulty breathing, difficulty swallowing, excessive salivation, abnormal behavior, aggression, and/or self-mutilation

Rabies Facts:

- Rabies is a neurotropic virus in the genus *Lyssavirus*, family *Rhabdoviridae*. It is a fatal viral infection of the central nervous system and a serious zoonotic disease and public health problem.
- All mammals are susceptible to the disease. In Michigan, most rabies cases are found in bats, raccoons, skunks, and foxes, but cats and dogs are also a threat for human exposure. However, rabies is rare in vaccinated animals.
- The highest concentrations of rabies virus are found in saliva, nervous tissue, cerebrospinal fluid, and salivary glands. However, limited amounts of rabies virus have been found in ocular secretions and respiratory tract fluids.
- Rabies transmission to humans usually occurs through bites or scratches from infected animals. However, rabies can also be transmitted by saliva or neural tissue from a rabid animal coming into contact with mucous membranes (through the eyes, nose, or mouth) or cuts, wounds, and abrasions in skin.
- In rare cases, rabies virus has been found to spread through air in enclosed spaces such as laboratories. Direct human-to-human transmission has only been reported in cases of organ transplants.

- Saliva or neural tissue coming into contact with intact skin rarely constitutes a risk for rabies virus transmission. Petting a rabid animal does not usually constitute as a rabies exposure.
- Because rabies virus does not survive well outside of its host, rabies is not usually transmitted through contaminated objects or materials such as clothes or bedding.
- Rabies virus is not shed in blood, urine, or feces. Therefore, blood, urine, and feces are not infectious and contact with them is not considered an exposure.
- Only personnel who handle suspect rabid animals or their laboratory specimens are at risk of exposure/infection. This is because the rabies virus does not survive for long outside of its host and is rapidly inactivated by ultraviolet light and desiccation. Additionally, personnel who handle suspect rabid animals or their laboratory specimens are not a risk to their families or community.
- Rabies is a reportable disease. Therefore, all suspect rabid animals should be reported to the local health department or MDARD ??, and all animal bites to humans should be reported to the local health department.

Rabies Exposure Control Measures:

- There is a range of control measures that can be taken to reduce possible rabies exposure. These include elimination, substitution, engineering, administrative procedures, and the use of personal protective equipment (PPE).
 - Elimination or substitution of the hazard is the most effective measure, but it is not always ethical. Elimination would mean refusing to see a suspect rabid animal. This may be appropriate for veterinary offices who want to exclude native wildlife such as raccoons and skunks from the clinic. However, if the animal is a current patient, refusing care may be unethical and different control measures should be used.
 - Engineering controls are designing a building to facilitate infection prevention practices. Examples are putting sinks for handwashing in convenient locations, putting laundry bins and biohazard bags right by isolation rooms, and using restraint devices.
 - Administrative controls are policies that a facility has mandated to provide infection prevention guidelines. Examples include handwashing practices and rabies pre-exposure vaccination of staff.
 - PPE is usually considered the least effective control measure because it requires the most compliance by staff. However, for suspect rabid animal examination, engineering and administrative control options are limited, and PPE is important for prevention of exposure. Examples of PPE are a mask, gloves, and gown. Appropriate PPE to wear when handling a suspect rabid animal or its specimens is provided in more detail below.

Vaccination as an Administrative Control Measure:

- Requiring vaccination of personnel is considered an administrative control measure.
- Personnel at high risk for exposure such as veterinarians, animal handlers, and laboratory workers should receive the rabies pre-exposure vaccination series.
- Only personnel who have completed the pre-exposure rabies vaccination series should handle suspect rabid animals and their specimens.

Personal Protective Equipment:

- All personnel handling a suspect rabid animal should wear the following personal protective equipment (PPE):

- Protective outerwear- laboratory coats, smocks, aprons, coveralls, nonsterile gowns, or other protective clothing that covers arms and legs to prevent exposure to open wounds on skin
- Eye protection- protective eyewear such as goggles or a face shield to prevent exposure of the mucous membranes of the eyes
 - *Personal eyeglasses are not considered adequate eye protection*
- Face mask- surgical mask to prevent exposure of the mucous membranes of the mouth
- Gloves- disposable gloves such as latex, nitrile, or vinyl gloves to protect hands from exposure
 - For puncture resistance, nitrile are the best, followed by latex, and then vinyl
 - If possible, gloves should extend over sleeves to cover wrist
 - If the animal is aggressive, wear bite resistant gloves over disposable gloves
 - Bite resistant gloves are gloves made from materials resistant to punctures, such as Kevlar® and stainlesssteel mesh
- Hair covering and shoe coverings can also be considered but are not required
 - Hair covering includes a Bouffant cap or surgical cap
 - Shoe coverings are stretch booties, usually made of paper or plastic, worn over shoes
- Rings and other jewelry should be taken off before putting on PPE.
- Hand hygiene should be performed immediately after removal of PPE.

Hand Hygiene:

- Hand hygiene is extremely important in reducing the risk of rabies exposure/infection. Hand hygiene consists of traditional handwashing, the use of alcohol-based hand rubs, and the use of gloves.
- Gloves should always be worn when handling the animal, specimens from the animal, materials/equipment the animal touched, articles contaminated by the animal, and animal waste and when touching environmental surfaces in the animal's isolation/examination room or when cleaning/disinfecting.
- Hand hygiene should be performed immediately following the removal of gloves and other PPE and before eating, drinking, handling contact lenses, or applying makeup.
- Handwashing should be done with a non-abrasive antimicrobial soap and warm running water. Hands should be scrubbed thoroughly with a soapy lather for at least 20 seconds.
- Alcohol-based hand rubs can be used, but removal of organic material prior to application is necessary.
 - Organic matter such as dirt, blood, or feces must be removed before application because their presence on hands decreases the efficacy of alcohol-based hand rubs.
 - The hand rub should contain 60% to 95% ethanol or isopropanol.
 - Hand rubs should be applied for 30 seconds to all surfaces of the hands. Rub hands together until they are dry.

Animal Handling and Injury Prevention:

- Suspect rabid animals should only be handled by experienced personnel who have received the rabies pre-exposure vaccination series.

- All personnel handling the animal should be trained on the proper methods of animal restraint and in the use of restraint devices.
 - Clients should not be allowed to participate in restraint of the animal.
- All personnel handling a suspect rabid animal should wear the appropriate PPE as described above.
- Suspect rabid animals should be handled as little as possible and with extreme caution.
- All personnel handling the animal must pay attention to behavioral changes in the animal and remain alert.
- All aggressive suspect rabid animals should be handled humanely and with caution. The following restraint devices may be used if deemed necessary by personnel:
 - Muzzles
 - Restraint/control poles
 - Catch poles
 - Kennel squeeze panels
 - Net/restraint bags
 - Bite resistant gloves
 - Sedation or anesthesia may be necessary depending on the situation.
- Preplanning, adequate equipment, and proper handling and restraint of the animal will decrease the possibility of bites, scratches, and other injuries and ultimately exposure to the virus.

First Aid Treatment:

- Possible exposure via bites, scratches, or saliva/neural tissue coming into contact with an open wound or mucous membranes should be addressed immediately.
- Wounds and mucous membranes that have come into contact with possible infectious materials should be washed and lavaged thoroughly with soap and water for at least 15 minutes. Wounds can be further disinfected with 70% ethanol or an iodine-containing solution.
- If saliva or neural tissue enters the eye, the eye should be rinsed for at least 15 minutes in eyewash.
- The individual should then report to a physician (ER?) immediately for follow-up wound care and to determine whether postexposure prophylaxis is required.
- If a physician recommends PEP, then it must be received immediately.
- Pre-exposure vaccination does not eliminate the need for postexposure prophylaxis (PEP), but fewer treatments will be required.
- All animal bites and other possible exposures should be reported to the local health department.

Transport through Facility:

- If a known suspect rabid animal is coming to the facility, ask the client to call the front desk when they arrive prior to bringing the animal inside the facility. The animal and client should not enter the facility alone.
- Two people should meet the client and animal outside. Both should be dressed in appropriate PPE as described above. However, one person should not touch the animal. That person should remain clean and uncontaminated and should open all of the doors for the person who is handling the animal.

- Animals should not be allowed to walk through the main areas of the facility. If there is an examination room with an outside entrance, this would be ideal. If this does not exist, use a private entrance such as a side or back entrance to bring the animal inside.
- Small animals should be transported in a cat carrier.
- Suspect rabid animals should be transported directly into a designated isolation or examination room. The designated isolation or examination room should be prepared for the arrival of the animal.
- Try to have all hallways used during transportation cleared of all people and other animals. Do not let the animal come into contact with other animals or people.
- Anywhere the animal has been, including the floors, counters, walls, chairs, and tables, must be immediately disinfected with an appropriate disinfectant agent as listed below. If a transport carrier was used for transportation, this must be disinfected.
- If the client/owner needs to enter the building, they should be escorted by personnel. Once they have entered the facility, the client should not leave the designated isolation or examination room until it is time for their departure.

Examination:

- The suspect rabid animal should be examined in an isolation room or in a designated exam room. The animal should remain in this room for all diagnostics and treatments.
- Only essential personnel should be allowed in the room, and everyone entering the room should wear the appropriate PPE, as mentioned above.
- The room used should remain out of service until it is clean and disinfected following the decontamination guidelines below. Signs should be put on the doors of the room that it is not to be accessed by unauthorized personnel until decontamination is complete.
- Everything in the room should be put away and only the supplies needed for diagnostics and treatments of the animal should be left out/brought in.
- All supplies must be disinfected or discarded at the end of use. All trash should go into a biohazard trash bag.
- Laundry bins and biohazard trash bags should be placed outside of the room door for easy access.

Isolation:

- If a suspect rabid animal is staying for observation, isolate the animal in a designated isolation room and limit the number of personnel with access to the room.
- Signs should be put on the doors of the room that it is not to be accessed by unauthorized personnel until the animal is gone and decontamination is complete.
- Personnel entering the room should wear the appropriate PPE as mentioned above. All PPE used should be donned prior to entry and doffed immediately following care of the animal.
- Laundry bins and biohazard trash bags should be placed outside of the room door for easy access.
- Only the supplies needed for the care, diagnostics, or treatment of the animal should be allowed in the room.
- Keep the items and equipment needed inside the room and do not remove them until the patient is gone and items are cleaned and disinfected.
- Use disposable items whenever possible (bowls, litterpans, gowns, thermometers, etc).

- When the room is no longer in use, it should be cleaned and disinfected based on the decontamination guidelines below.
- All supplies must be disinfected, laundered, or discarded at the end of the animal's stay. All trash should go into a biohazard trash bag.

Euthanasia:

- The gold standard for rabies diagnosis is the direct fluorescent antibody test. This test will be performed by the state laboratory using the brain of the animal. Therefore, animals should not be euthanized in a way that causes damage to the head.
- Additionally, the use of strychnine or other chemical poison should be avoided.
- Please wear all PPE mentioned above (protective outerwear, eye protection, surgical mask, and gloves) when euthanizing the animal.
- Euthanize the animal in an isolated room. The client may be present, but they must wear all of the same PPE.
- After the animal is removed, disinfect all surfaces of the room and any equipment used following the instructions under decontamination below.
- A guideline for the humane euthanasia of bats can be found at <https://www.michigan.gov/emergingdiseases/home/rabies>

Collection and Submission of Samples:

- Please see form DCH-1053, RABIES TEST REQUISITION for collection and submission instructions. This form can be found at www.michigan.gov/mdhhs/0,4570,7-253_7-254_7-255_7-256_7-257_7-258_7-259_7-260_7-261_7-262_7-263_7-264_7-265_7-266_7-267_7-268_7-269_7-270_7-271_7-272_7-273_7-274_7-275_7-276_7-277_7-278_7-279_7-280_7-281_7-282_7-283_7-284_7-285_7-286_7-287_7-288_7-289_7-290_7-291_7-292_7-293_7-294_7-295_7-296_7-297_7-298_7-299_7-300_7-301_7-302_7-303_7-304_7-305_7-306_7-307_7-308_7-309_7-310_7-311_7-312_7-313_7-314_7-315_7-316_7-317_7-318_7-319_7-320_7-321_7-322_7-323_7-324_7-325_7-326_7-327_7-328_7-329_7-330_7-331_7-332_7-333_7-334_7-335_7-336_7-337_7-338_7-339_7-340_7-341_7-342_7-343_7-344_7-345_7-346_7-347_7-348_7-349_7-350_7-351_7-352_7-353_7-354_7-355_7-356_7-357_7-358_7-359_7-360_7-361_7-362_7-363_7-364_7-365_7-366_7-367_7-368_7-369_7-370_7-371_7-372_7-373_7-374_7-375_7-376_7-377_7-378_7-379_7-380_7-381_7-382_7-383_7-384_7-385_7-386_7-387_7-388_7-389_7-390_7-391_7-392_7-393_7-394_7-395_7-396_7-397_7-398_7-399_7-400_7-401_7-402_7-403_7-404_7-405_7-406_7-407_7-408_7-409_7-410_7-411_7-412_7-413_7-414_7-415_7-416_7-417_7-418_7-419_7-420_7-421_7-422_7-423_7-424_7-425_7-426_7-427_7-428_7-429_7-430_7-431_7-432_7-433_7-434_7-435_7-436_7-437_7-438_7-439_7-440_7-441_7-442_7-443_7-444_7-445_7-446_7-447_7-448_7-449_7-450_7-451_7-452_7-453_7-454_7-455_7-456_7-457_7-458_7-459_7-460_7-461_7-462_7-463_7-464_7-465_7-466_7-467_7-468_7-469_7-470_7-471_7-472_7-473_7-474_7-475_7-476_7-477_7-478_7-479_7-480_7-481_7-482_7-483_7-484_7-485_7-486_7-487_7-488_7-489_7-490_7-491_7-492_7-493_7-494_7-495_7-496_7-497_7-498_7-499_7-500_7-501_7-502_7-503_7-504_7-505_7-506_7-507_7-508_7-509_7-510_7-511_7-512_7-513_7-514_7-515_7-516_7-517_7-518_7-519_7-520_7-521_7-522_7-523_7-524_7-525_7-526_7-527_7-528_7-529_7-530_7-531_7-532_7-533_7-534_7-535_7-536_7-537_7-538_7-539_7-540_7-541_7-542_7-543_7-544_7-545_7-546_7-547_7-548_7-549_7-550_7-551_7-552_7-553_7-554_7-555_7-556_7-557_7-558_7-559_7-560_7-561_7-562_7-563_7-564_7-565_7-566_7-567_7-568_7-569_7-570_7-571_7-572_7-573_7-574_7-575_7-576_7-577_7-578_7-579_7-580_7-581_7-582_7-583_7-584_7-585_7-586_7-587_7-588_7-589_7-590_7-591_7-592_7-593_7-594_7-595_7-596_7-597_7-598_7-599_7-600_7-601_7-602_7-603_7-604_7-605_7-606_7-607_7-608_7-609_7-610_7-611_7-612_7-613_7-614_7-615_7-616_7-617_7-618_7-619_7-620_7-621_7-622_7-623_7-624_7-625_7-626_7-627_7-628_7-629_7-630_7-631_7-632_7-633_7-634_7-635_7-636_7-637_7-638_7-639_7-640_7-641_7-642_7-643_7-644_7-645_7-646_7-647_7-648_7-649_7-650_7-651_7-652_7-653_7-654_7-655_7-656_7-657_7-658_7-659_7-660_7-661_7-662_7-663_7-664_7-665_7-666_7-667_7-668_7-669_7-670_7-671_7-672_7-673_7-674_7-675_7-676_7-677_7-678_7-679_7-680_7-681_7-682_7-683_7-684_7-685_7-686_7-687_7-688_7-689_7-690_7-691_7-692_7-693_7-694_7-695_7-696_7-697_7-698_7-699_7-700_7-701_7-702_7-703_7-704_7-705_7-706_7-707_7-708_7-709_7-710_7-711_7-712_7-713_7-714_7-715_7-716_7-717_7-718_7-719_7-720_7-721_7-722_7-723_7-724_7-725_7-726_7-727_7-728_7-729_7-730_7-731_7-732_7-733_7-734_7-735_7-736_7-737_7-738_7-739_7-740_7-741_7-742_7-743_7-744_7-745_7-746_7-747_7-748_7-749_7-750_7-751_7-752_7-753_7-754_7-755_7-756_7-757_7-758_7-759_7-760_7-761_7-762_7-763_7-764_7-765_7-766_7-767_7-768_7-769_7-770_7-771_7-772_7-773_7-774_7-775_7-776_7-777_7-778_7-779_7-780_7-781_7-782_7-783_7-784_7-785_7-786_7-787_7-788_7-789_7-790_7-791_7-792_7-793_7-794_7-795_7-796_7-797_7-798_7-799_7-800_7-801_7-802_7-803_7-804_7-805_7-806_7-807_7-808_7-809_7-810_7-811_7-812_7-813_7-814_7-815_7-816_7-817_7-818_7-819_7-820_7-821_7-822_7-823_7-824_7-825_7-826_7-827_7-828_7-829_7-830_7-831_7-832_7-833_7-834_7-835_7-836_7-837_7-838_7-839_7-840_7-841_7-842_7-843_7-844_7-845_7-846_7-847_7-848_7-849_7-850_7-851_7-852_7-853_7-854_7-855_7-856_7-857_7-858_7-859_7-860_7-861_7-862_7-863_7-864_7-865_7-866_7-867_7-868_7-869_7-870_7-871_7-872_7-873_7-874_7-875_7-876_7-877_7-878_7-879_7-880_7-881_7-882_7-883_7-884_7-885_7-886_7-887_7-888_7-889_7-890_7-891_7-892_7-893_7-894_7-895_7-896_7-897_7-898_7-899_7-900_7-901_7-902_7-903_7-904_7-905_7-906_7-907_7-908_7-909_7-910_7-911_7-912_7-913_7-914_7-915_7-916_7-917_7-918_7-919_7-920_7-921_7-922_7-923_7-924_7-925_7-926_7-927_7-928_7-929_7-930_7-931_7-932_7-933_7-934_7-935_7-936_7-937_7-938_7-939_7-940_7-941_7-942_7-943_7-944_7-945_7-946_7-947_7-948_7-949_7-950_7-951_7-952_7-953_7-954_7-955_7-956_7-957_7-958_7-959_7-960_7-961_7-962_7-963_7-964_7-965_7-966_7-967_7-968_7-969_7-970_7-971_7-972_7-973_7-974_7-975_7-976_7-977_7-978_7-979_7-980_7-981_7-982_7-983_7-984_7-985_7-986_7-987_7-988_7-989_7-990_7-991_7-992_7-993_7-994_7-995_7-996_7-997_7-998_7-999_8000
- Impermeable protective outerwear, eye protection, masks, and disposable gloves should be worn when collecting and handling specimens.
- A fresh, unfixed brain sample is critical to a rapid and accurate diagnosis of rabies.
- Whole animals should not be shipped, unless it is a bat carcass. Only intact heads or dissected brain tissue that includes a complete cross section of the cerebellum and brainstem should be submitted to the laboratory.
- Specimens must be refrigerated until they are ready to ship. Do not freeze specimens, as this will delay results.

Decontamination of Equipment and Surfaces:

- Rabies is an enveloped virus, so it is fragile and can be killed by desiccation, ultra-violet light, and common detergents and disinfectants.
- Disinfectants that can inactivate rabies virus include sodium hypochlorite (bleach), 70% isopropyl alcohol, 70% ethanol, 5-7% iodine solutions, quaternary ammonium compounds, hydrogen peroxide, glutaraldehyde, formaldehyde (formalin), phenol, VirkonS™ and some other agents.
- An EPA-registered disinfectant of one of the chemicals listed above should be used for decontamination of all reusable items/equipment and surfaces. It is important to read the label instructions for directions, such as proper dilution and contact time.
- A very effective disinfectant against rabies virus is a fresh (made that day) 1:10 sodium hypochlorite (bleach) solution.
 - To make this solution, you dilute 1 part bleach to 9 parts tap water.
 - There should be a 15-minute contact time.
- Rescue Disinfectants have become popular in many veterinary offices. Rescue is made of accelerated hydrogen peroxide. This is expected to be effective against rabies virus.

- When using it for rabies virus, a 1:64 (2 oz/gallon of water) to 1:16 (8 oz/gallon of water) dilution is recommended.
 - The recommended contact time is 5 minutes.
- You can also autoclave some items for 1 hour at 121°C or 250°F (15 lbs psi of steam pressure).
- Highpressure sprayers and similar devices should not be used as they can spread infectious particles.
- Appropriate PPE, such as protective outerwear, eye protection, a facemask, and disposable gloves, should be worn when cleaning/disinfecting to protect the skin, eyes, and mucous membranes from splashes.
- Surfaces and equipment must be cleaned with soap/detergent and water before they are disinfected. This is because organic material decreases the effectiveness of most disinfectants.
- Personnel should perform hand hygiene immediately after they have finished cleaning.
- Recommended procedures for cleaning and disinfection of animal care equipment:
 - Animal care equipment includes stethoscopes, thermometers, blood pressure cuffs, food and water bowls, toys, litter boxes, muzzels, etc.
 - Use soap and water to remove organic material such as blood, dirt, urine, etc. from used items.
 - Apply an EPA-registered disinfectant (consisting of one of the chemicals listed above) evenly over all surfaces, ensuring that all surfaces are wet. Small items that can be immersed can be put into a container of a disinfectant solution.
 - Read and follow the directions on the disinfectant label to ensure effective use of the product.
 - Make sure items remain in contact with the disinfectant for the appropriate contact time determined by the label of the disinfectant being used.
 - The surface should remain wet during the entire contact time.
 - After contact time has been achieved, remove the remaining solution with a paper towel, sponge, or clean cloth.
 - Immersed items should be removed from the disinfectant solution after the appropriate contact time. Then it should be rinsed with water and either allowed to air dry or dried off with a paper towel or clean cloth.
- Once the animal has left the examination room, isolation room, or other rooms they were in, a complete decontamination is required.
- Recommended procedures for cleaning and disinfection of animal housing facilities such as examination/isolation rooms, kennels, cages, stalls, etc.:
 - Remove all animals and feed from the area.
 - Remove all litter, bedding, and fecal material from floors, walls, and surfaces of kennels, cages, stalls, or other animal handling areas.
 - Empty or cover all feeding and water appliances.
 - Clean all surfaces (walls, windows, counters, tables, benches/chairs, and cupboards) with a soap or a detergent and wash with water.
 - It is recommended to work in a top-down manner, meaning starting with higher surfaces and cleaning lower surfaces last.
 - Apply an EPA-registered disinfectant (consisting of one of the chemicals listed above) to floors, walls, and other surfaces of the kennels, cages, stalls, or other animal handling areas.
 - Walls and floors should be foamed or mopped with a disinfectant solution.
 - Read and follow the directions on the disinfectant label to ensure effective use of the product.

- Make sure all surfaces remain wet for the appropriate contact time as listed on the disinfectant label.
- Allow the surfaces to thoroughly dry before reintroducing animals, equipment, or other items back into the area.
 - Surfaces can air-dry, be mopped, or be wiped with a clean cloth or paper towel
- Clean and disinfect all equipment used to remove litter, bedding, and fecal material/manure such as forks, shovels, and scrapers.
- After cleaning, remove all PPE and discard in either biohazard garbage bag or in a laundry basket outside of the room.
- Used towels should be placed in the laundry outside of the room. Paper towels and other disposable products should be thrown away in a biohazard bag.
- Seal trash and laundry bags closed with tape and take them to their appropriate places.
- Any signage that was on the door can be removed after complete decontamination and drying of the area.

Housekeeping Procedures:

- Disposable items such as gloves, gowns, and surgical masks must be discarded into a biohazard bag after a single use. All waste should go into a biohazard bag at the exit location of the room.
- Reusable items such as towels, bedding, gowns, laboratory coats, coveralls, or other clothing should be laundered after a single use.
- Laundered items should be removed before exit of the room and should be placed into the laundry bin at the exit location.
- Laundry and bedding should be machine washed with standard laundry detergent and machine dried at the highest temperature.
- Face shields and eye protection must be decontaminated after each use following the guidelines under decontamination above.
- Bite-resistant gloves should be decontaminated either by using an appropriate disinfectant above or by washing the gloves with soap, water, and bleach (1:10 dilution). Make sure the disinfectant is compatible with the glove material.
- Gloves and protective outerwear should be worn when handling laundry and waste.

Infection Control Plans:

- Animal care facilities should have written infection control plans tailored to the individual facility. Veterinarians can go to www.nasphv.org for a model infection control plan for their practice.
- Effective infection control plans should provide guidance specific to the animal care facility.

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