



CHARACTERIZATION OF TOXOPLASMOSIS REPORTING AND SURVEILLANCE IN THE UNITED STATES

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Infectious Diseases and Zoonoses

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Background

- Began MPH in Spring 2020
 - 3rd year veterinary student (Class of 2023)
 - PhD Candidate
- Veterinary Medical Officer (VMO) at USDA NBAF
 - Continue teaching at KSU CVM

Background

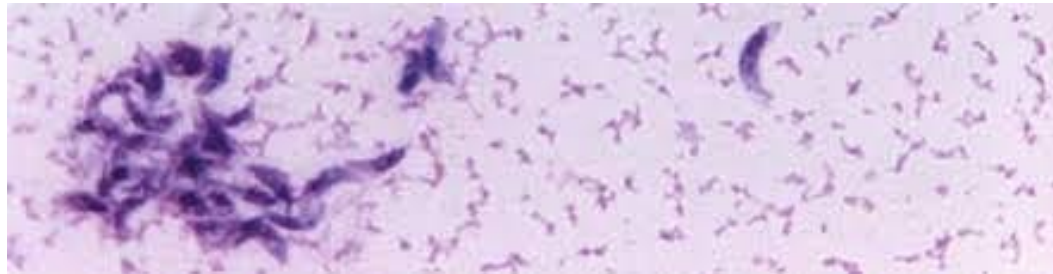
- Completed field experience Summer 2021
 - Completed remotely (due to COVID-19)
- CDC, Parasitic Diseases Branch
 - Mentor: Anne Straily, DVM, MPH, DACVPM

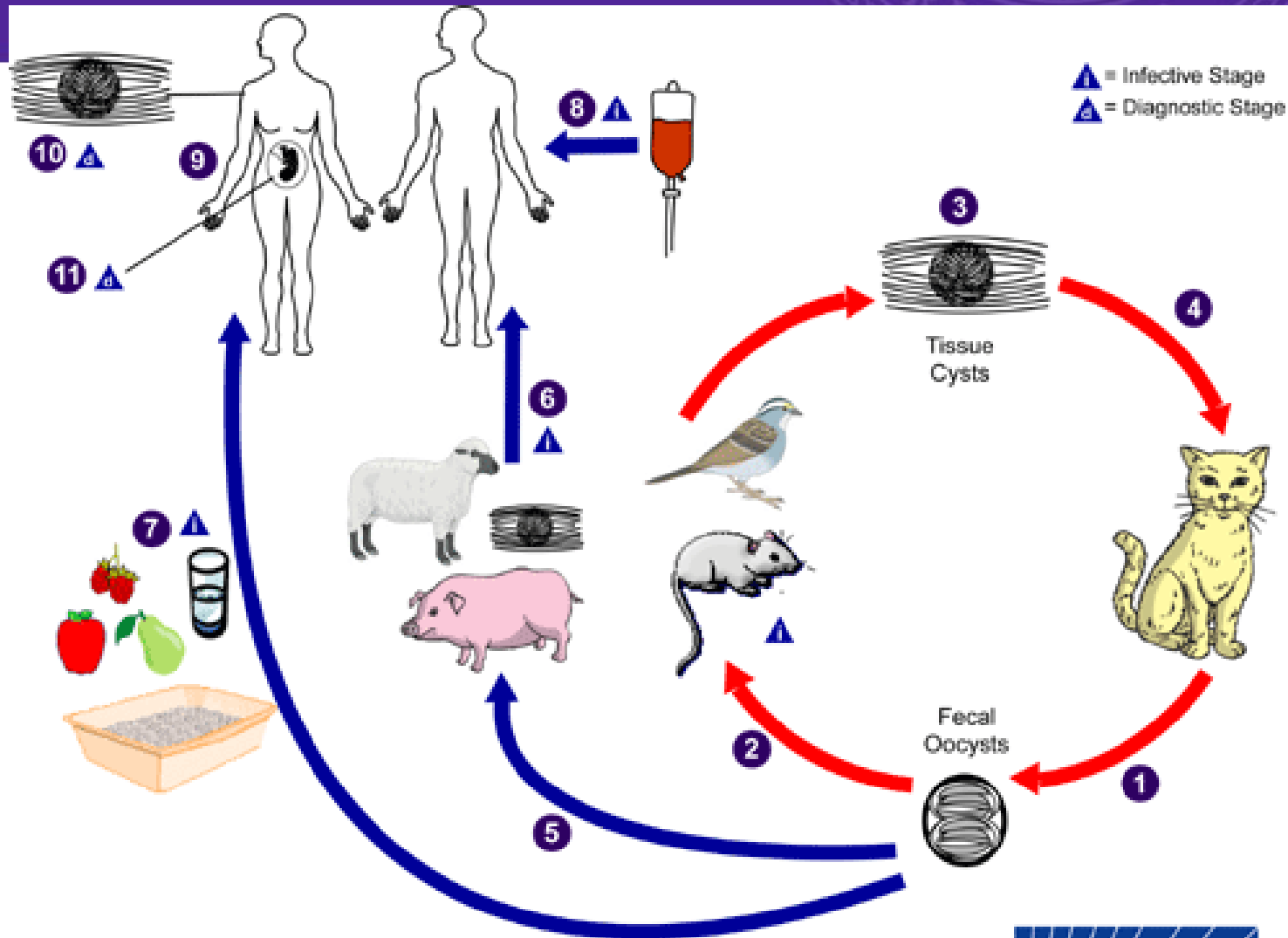


OVERVIEW

Toxoplasmosis

- *Toxoplasma gondii* is a zoonotic protozoan parasite
- Felids are primary host species
 - Humans infected via fecal-oral transmission/
improper food handling
 - Infection *in utero* and transplantation





Toxoplasmosis

- 10.4% seroprevalence in USA
- One of five “neglected parasitic diseases”
 - Toxoplasmosis, Chagas, Neurocysticercosis, Trichomoniasis, and Toxocariasis
 - Diseases with potentially greater than realized impact
 - High prevalence



Toxoplasmosis

- Clinical signs primarily in immunocompromised individuals and children
 - Neurological abnormalities (encephalitis) and chorioretinitis
- Absent to flu-like symptoms in immunocompetent individuals
- Diagnosis via matching clinical symptoms, serology, and/or PCR/histopathology

Reportable vs Nationally Notifiable

- Reportable: Participating states compile case data to monitor disease burden
- Nationally notifiable: States collecting case data voluntarily share data with federal agency (i.e. CDC)
- Toxoplasmosis: Currently reportable in 8 states (KY, AR, NE, MN, WI, PA, HI, DE)



LEARNING OBJECTIVES & PORTFOLIO PRODUCTS

Learning Objectives

1. To learn about surveillance systems and how they are used by states to monitor toxoplasmosis disease burden
2. To gain a better understanding and first-hand experience in how the CDC monitors diseases in the United States
3. To write a report summarizing the findings of the study and to share the results with personnel at the CDC

Portfolio Products

1. **Portfolio product no. 1A:** “Characterization of public health surveillance and reporting of human toxoplasmosis in the United States”
2. **Portfolio product no. 1B:** Slide deck developed for presentation of study results to CDC Parasitic Diseases Branch
3. **Portfolio product no. 2:** Slide deck and class lecture regarding toxoplasmosis
4. **Portfolio product no. 3:** CCDM article in the *One Health Newsletter*

Portfolio product no. 1A: “Characterization of public health surveillance and reporting of human toxoplasmosis in the United States”

- To determine if toxoplasmosis should become a nationally notifiable disease
- Interviewed officials from 6 of the 8 reportable states (PA, KY, AR, MN, WI, NE)

Portfolio product no. 1A: “Characterization of public health surveillance and reporting of human toxoplasmosis in the United States”

Table 3.1: The nine question-template used in all interviews of state officials to gather information on their respective toxoplasmosis surveillance systems.

1) When was toxoplasmosis made reportable in your state?
2) What are the reasons that toxoplasmosis was made reportable?
3) How was the case definition developed?
4) What, if any, public health actions do you take after a case is confirmed?
5) Who is responsible for reporting cases in your state / how are you typically notified of cases?
6) Do you currently collect non-human data for toxoplasmosis surveillance? If yes, please explain.
7) Do any programs in your state focus on screening pregnant women and/or infants born to infected mothers? If yes, please provide a brief description of the programs.
8) How are the collected data utilized? How are the results disseminated?
9) Have there been any changes to the surveillance for toxoplasmosis since it began in your state? If yes, please explain

Portfolio product no. 1A: “Characterization of public health surveillance and reporting of human toxoplasmosis in the United States”

Experiential Learning:

- How public health professionals operate/communicate in surveillance systems
- Priorities within surveillance systems (how data is collected and shared, etc.)
- How federal agencies (such as CDC) collect data with nationally notifiable diseases

Portfolio product no. 1B: Slide deck developed for presentation of study results to CDC Parasitic Diseases Branch

- Presented to Parasitic Diseases Branch on August 26, 2021
 - During biweekly branch meeting
- Summarized results of study

How was the case definition developed?

State	Clinical Case Definition	Laboratory Criteria
Arkansas	Cervical lymphadenopathy and/or flu-like illness and/or ocular infection with vision loss	<ul style="list-style-type: none"> Elevated <i>T. gondii</i>-specific IgG, IgM, IgA, and/or IgE titers (presumptive) Isolation of <i>T. gondii</i> in blood/fluids; detection of tachyzoites in tissue; and/or detection using PCR (confirmatory)
Kentucky	Fever, lymphadenopathy, and/or lymphocytosis. <u>Immunocompromised</u> : Above, plus myocarditis, pneumonia, and/or cerebral signs <u>Infection during pregnancy</u> : Congenital anomalies or infant mortality	<ul style="list-style-type: none"> Single antibody titer (suspect) Change in paired specimen antibody titer; demonstration of <i>T. gondii</i> in tissues/fluids; detection by PCR; and/or specific IgM or increasing titer in sera in congenital infection (confirmed)
Minnesota	<u>Immunocompetent</u> : Ranging from asymptomatic to flu-like symptoms, fever, lymphadenopathy, and/or chorioretinitis. <u>Immunocompromised</u> : Encephalitis and/or chorioretinitis <u>Latent</u> : No symptoms required.	<ul style="list-style-type: none"> Individual positive IgM test with/without positive IgG test from commercial laboratory (suspect) <i>T. gondii</i> in tissue; positive PCR; and/or confirmatory testing at reference lab (positive IgM and/or low IgG avidity test) (confirmed) Positive IgG or IgM from commercial laboratory with no symptoms OR reference lab results indicating past infection (negative IgM/positive IgG/high IgG avidity) (latent)
Nebraska	Fever, lymphadenopathy, malaise, lymphocytosis, and/or elevated liver enzymes. <u>Immunocompromised</u> : Chorioretinitis, myocarditis, pneumonia, and/or encephalitis. <u>Mothers infected during pregnancy</u> : Infant death or congenital abnormalities. <u>Neonatal</u> : Fever, rash, jaundice, and/or chorioretinitis	<ul style="list-style-type: none"> Detection of <i>T. gondii</i> in tissue or by PCR; and/or IgG/IgM change in paired serology (confirmed)
Pennsylvania	<u>Immunocompetent</u> : Lymphadenopathy and/or ocular infection (uveitis) <u>Immunodeficient</u> : Encephalitic symptoms with or without pulmonary/cardiac involvement <u>Newborn infants (1st trimester infection)</u> : Fever; lymphadenopathy; microcephaly; megaloccephaly; rash; and/or anemia <u>Newborn infants (3rd trimester infection)</u> : Ocular complications/developmental days in later life	<ul style="list-style-type: none"> Sequential sera displaying four-fold rise in <i>T. gondii</i> – specific IgG antibody titer (supportive) Demonstration of <i>T. gondii</i> organisms in tissue; demonstration of tachyzoites in tissue by histopathology; and/or positive PCR (confirmatory)
Wisconsin	Fever, lymphadenopathy, and/or lymphocytosis. <u>Immunocompromised</u> : Above, plus myocarditis, pneumonia, and/or cerebral signs <u>Infection during pregnancy</u> : Congenital anomalies or infant mortality	<ul style="list-style-type: none"> Change in paired specimen antibody titer; demonstration of <i>T. gondii</i> in tissues/fluids; detection by PCR; and/or specific IgM or increasing titer in sera in congenital infection (confirmed)

Who is responsible for reporting cases in your state / how are you typically notified of cases?

- All states: Physicians and laboratories responsible for reporting
 - **Laboratory results electronically sent to state agency for case follow-up**
 - **Laboratories are primary source of case reports**
 - **In MN, veterinarians/vet diagnostic labs may report in “certain circumstances”**
- Limitations:
 - **Physicians must think to include toxoplasmosis as differential**
 - **3/25 patients diagnosed correctly in Atlanta outbreak in 1977 (Dubey, 2021)**
 - **Serology**
 - **IgG and IgM tests cannot differentiate chronic vs acute cases**
 - **IgM also gives false positives (FDA has given warning on this!)**
 - **Cost of testing**

How are the collected data utilized? How are the results disseminated?

- 3/6 states produced public reports (results shared on website)
- 2/6 states produced "in-house" reports
 - **Kept within agency, not shared publicly**
- One state (Kentucky) updated toxoplasmosis in annual disease tables
 - **On state health department website**

Have there been any changes to the surveillance for toxoplasmosis since it began in your state?

- **Difficult to say as no states could identify when reporting began**

Conclusion

- Common trends between current reportable states
- Doesn't appear to be significant evidence to suggest making nationally notifiable
 - Some states considering dropping reporting programs
 - May be seen as unnecessary drain on resources
 - Public health action in response to a single case is limited
 - If chronic case, source is very difficult to identify
- Focus on providing education, especially for vulnerable individuals
 - Risks regarding toxoplasmosis
 - Once individuals are infected, education not as beneficial
 - Provide education to physicians to better detect toxoplasmosis



Portfolio product no. 2: Slide deck and class lecture regarding toxoplasmosis

- For Dr. Kastner's undergraduate *Environmental and Public Health* course (DMP 314)
- General background information on toxoplasmosis
- Additional focus on environmental causes of disease
 - Food safety
 - At-risk populations (pregnant women/immunocompromised individuals)

Portfolio product no. 2: Slide deck and class lecture regarding toxoplasmosis

Experiential Learning:

- Further experience teaching/lecturing
 - Gave ASFV lecture during Fall 2021 semester
- Developed quiz questions to hone learning for students

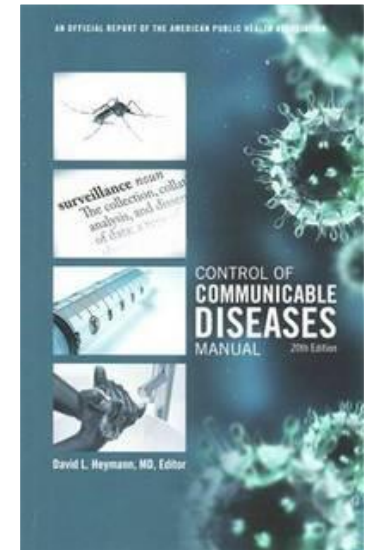


Portfolio product no. 3: CCDM article in the *One Health Newsletter*

- Discuss value of *Control of Communicable Diseases Manual* (CCDM) to public health professionals
 - Produced by American Public Health Association (APHA)
 - Required for Dr. Kastner's *Environmental and Public Health* course
 - Dr. Anne Straily is author for Toxoplasmosis chapter

Portfolio product no. 3: CCDM article in the *One Health Newsletter*

- Dr. Straily interviewed regarding her involvement in publication
 - Intended audience?
 - Value to public health professionals?
 - How will COVID-19 fit into future editions?
- CCDM was useful source in producing all other Portfolio products



Portfolio product no. 3: CCDM article in the *One Health Newsletter*

- CCDM: Information on hundreds of infectious diseases
 - Yellow Book: Traveler's health (focused on infectious disease) by CDC
 - Red Book: Pediatric health (focused on infectious disease) by AAP
 - Merck Veterinary Manual: Veterinary reference book containing information on infectious and non-infectious diseases in animals

ADDITIONAL REFLECTIONS

Observation of State-Federal Disease-Reporting

- Reportable: Participating states compile case data to monitor disease burden
- Nationally notifiable: States collecting case data voluntarily share data with federal agency (i.e. CDC)
- Different from reportable diseases for USDA



Observation of State-Federal Disease-Reporting

- States generally produce own case definitions
 - Inconsistencies in reporting/comparing between states
 - Nationally notifiable diseases generally receive definitions for all states to use
- States voluntarily send case data to federal system
 - Less useful if some states in a region don't send data



Observation of State-Federal Disease-Reporting

- In nationally notifiable system, may require more personnel to compile information
 - Additional resources/time committed
 - Resources not available for other diseases
 - COVID-19





Perception of Role of Veterinarian at CDC in Public Health

- Met weekly with Dr. Straily via Zoom
 - Parasitic diseases primarily in humans
 - Veterinary training provides additional value to human health programs, especially regarding zoonoses
- Biweekly Parasitic Diseases Branch meetings
- Zoonoses/One Health Updates (ZOHU) meeting in June
- Interviewed with several state public health professionals

MPH Coursework That Was Most Helpful

- *Principles of Veterinary Immunology* (DMP 705)
 - Diagnostic testing as part of case definitions
- *Introduction to One Health* (DMP 710)
 - Life cycles of parasitic diseases and associated risk factors for humans
 - Environmental risk factors (especially useful in preparing Portfolio product no. 2)



MPH FOUNDATIONAL CONCEPTS

MPH Foundational Competencies

Number and Competency	Portfolio Product/Activity Description
4: Interpret results of data analysis for public health research, policy or practice	Portfolio product no. 1A
12: Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence	Portfolio product no. 1A
18: Evaluate policies for their impact on public health and health equity	Portfolio product no. 1A
19: Communicate audience-appropriate public health content, both in writing and through oral presentation	Portfolio product no. 1A, 1B, and 2
21: Perform effectively on interprofessional teams	Portfolio product no. 1A and 3



MPH IDZ Competencies

1. Pathogens/Pathogenic mechanisms
2. Host response to pathogens/immunology
3. Environmental/ecological influences
4. Disease surveillance
5. Disease vectors

Details for all listed competencies for the IDZ
Emphasis can be seen in the ILE report

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- MPH Office
 - Dr. Ellyn Mulcahy
 - Barta Stevenson
- State Health Departments
 - KY, AR, PA, NE, WI, and MN
- Family and Friends

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Questions?

