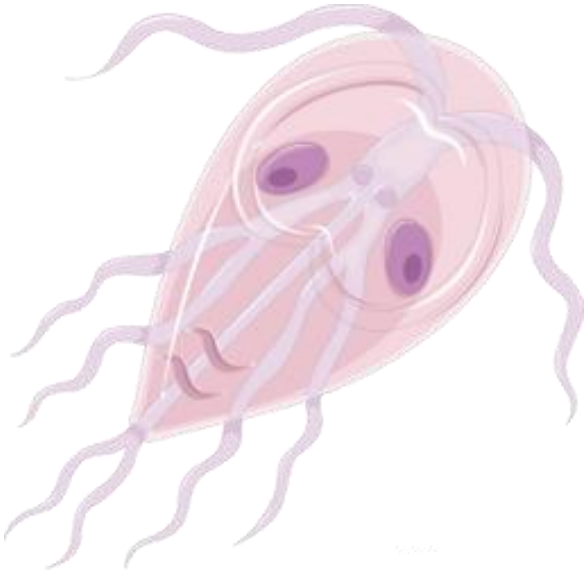
Veterinarian Perceptions of Canine Giardiasis and Communication on Zoonotic Potential in the U.S.

Megan Eppler, MPH Candidate

Emphasis: Infectious Diseases/Zoonoses

Game Plan

- Background: Who? When? Where? Why? What?
- Project: How Did We Do It?
- Results: The Good Stuff
- Discussion: Why This Data Matters
- Products: Look What I Made
- Competencies
- Thank You
- References
- Question and Answer



https://commons.wikimedia.org/wiki/File:Giardia_intestinalis_trophozoite.png

Who was Involved in the Project?

Dr. Jeba Jesudoss Chelladurai

- Bachelor of Veterinary Science and Animal Husbandary (BVSc & AH) from Madras Veterinary College in Chennai, India
- Masters in Microbiology from North Dakota State University in Fargo, North Dakota
- Ph.D. in Parasitology from Iowa State University in Ames, Iowa
- American College of Veterinary Microbiologists (ACVM) diplomate
- Co-instructor of Veterinary Parasitology for second year vet students and the Parasitology instructor for fourth year veterinary students at K-State
- Other research interests in novel or repurposed anti-parasitic drugs

Megan Eppler

- Bachelors in Biology and English minor from Kansas State University in Manhattan, Kansas
- Graduate Student in Master of Public Health Program, emphasis in infectious diseases/zoonoses
- OHNL Student Editor
- Graduate Teaching Assistant for MPH 802 and DMP 314

When? Where?

- The project took place at K-State as part of a veterinary parasite outreach.
- Dr. Chelladurai and I began working in January 2021 and the majority of our work will be completed by August 2021.
    - Another product, a paper, will be written by Dr. Chelladurai with editing assistance from myself after I have graduated.

Why *Giardia*? Purpose of Project

- Certain *Giardia* assemblages are capable of infecting both canines and humans, especially children. ***A disease that can spread from animals to humans is call a zoonotic disease or a zoonoses.***

- Canines receive ***extra-label*** treatments of metronidazole, fenbendazole, and febantel in the U.S.

- Impossible to know if a canine or human is carrying a zoonotic assemblage because molecular characterization is not routinely carried out and, to our knowledge, no data has been collected on how vets treat pets/communicate the zoonotic risk to owners.

- Thus, it is important to understand the veterinarian perception and practices of treating *Giardia* within the context of One Health.

Tangtrongsup & Scorza, 2010. *Topics in companion animal medicine*, 25(3), 155-162.

Patton, 2013. https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/overview-of-giardiasis

Why *Giardia*? Purpose of Project

- Goal of study was to determine:
  - **types of treatments** veterinarians are using
  - whether vets are **educating pet owners on zoonotic potential** from different assemblages of *Giardia*
  - and whether they are **advising control measures to prevent environmental contamination** by *Giardia* (e.g., washing bedding and bathing pets)

…But What is *Giardia*?

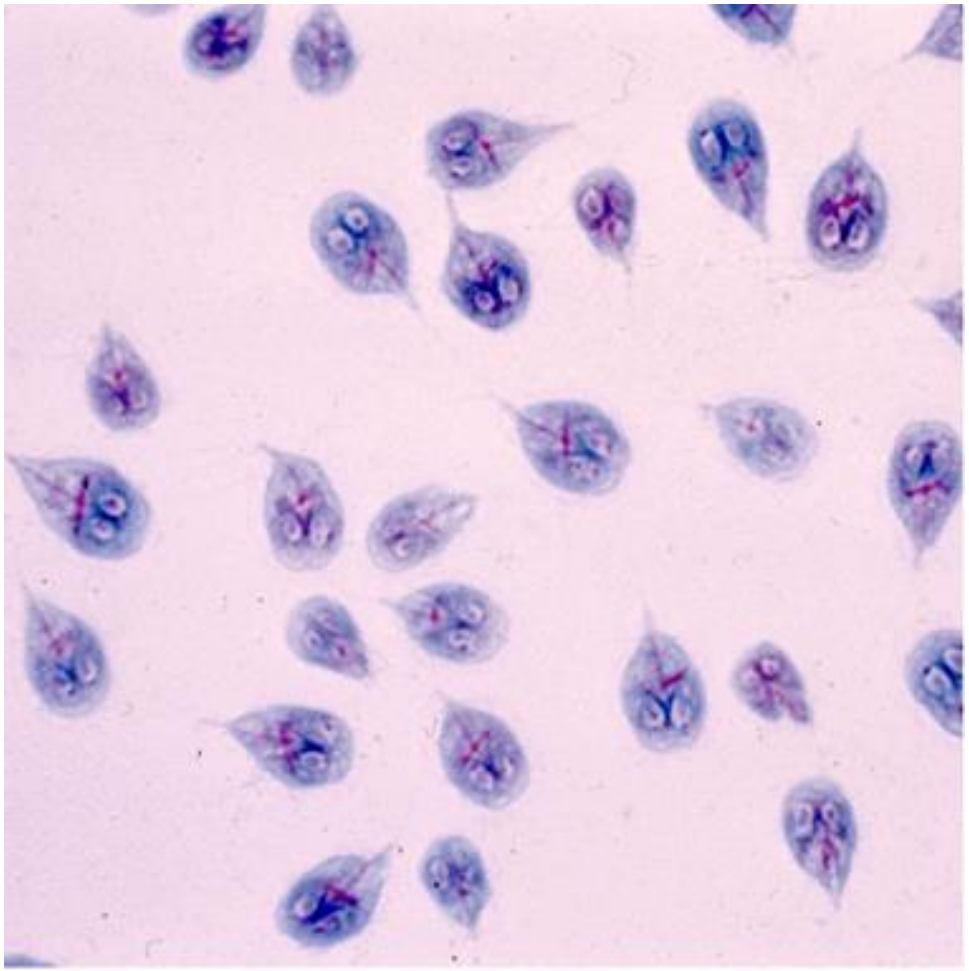


Figure 1: *Giardia* Trophozoites Stained with Trichrome.
https://www.cdc.gov/parasites/giardia/illness.html

- Protozoal gastrointestinal parasite spread through the fecal-oral route (ingesting feces, ew!)
- Known for causing diarrheal disease, but many ***asymptomatic*** carriers of *Giardia* exist for humans and animals.

Accidental Feces Feasting: Lifecycle & Symptoms

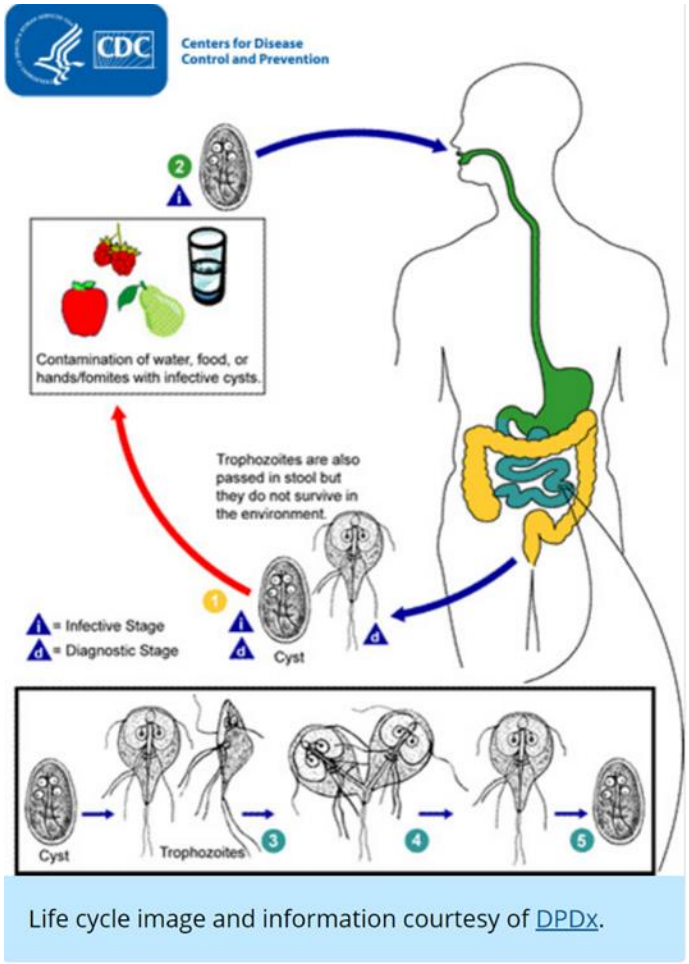


Figure 2: *Giardia* Lifecycle.
https://www.cdc.gov/parasites/giardia/pathogen.html

Dogs (symptomatic):

- Pungent, pale, loose feces
- Dehydration
- Weight loss
- Rarely vomiting or watery diarrhea
- Blood not typically found in feces

Humans (symptomatic):

- Violent, watery diarrhea or fatty stools
- Flatulence
- Nausea/vomiting
- Abdominal cramping, gurgling, or distension
- Dehydration/Weight loss
- Blood not typically found in feces
- Rarely: hives, itchy skin, fever, or swelling of the eyes and joints

Patton, 2013. https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/overview-of-giardiasis
Wolfe, M. S. (1992). Giardiasis. *Clinical microbiology reviews*, 5(1), 93-100.
Adam, R. D. (1991). The biology of Giardia spp. *Microbiological reviews*, 55(4), 706-732.
CDC, 2021a. https://www.cdc.gov/parasites/giardia/general-info.html#anchor_1614258835081

I’m a Survivor: Handling an Environmental Contaminant

https://commons.wikimedia.org/wiki/File:Giardia_intestinalis_trophozoite.png
https://commons.wikimedia.org/wiki/File:Explosion-417894_icon.svg

Weaknesses:

- Quaternary ammonium compounds
- Steam
- Heat
- Desiccation

Choose Your Weapon:

- Scalding toys/bowls in boiling water or dishwasher
- “Pooper Scooping”
- Steam cleaning carpets
- Quaternary ammonium for hard floors
- Washing all soft toys, dog beds, pillows, blankets, etc.
- Bathe the dog!

CDC, 2015. https://www.cdc.gov/parasites/giardia/prevention-control-pets.html#:~:text=If feces are on a,upholstered furniture to fully dry.

Paw Patch Place Animal Hospital, 2015. https://pawpatchplace.com/files/2015/12/Amy-Giardia.pdf

You Mentioned Assemblages?

Table 1: *Giardia duodenalis* assemblages and corresponding hosts.

Assemblage	Host(s)
A	Humans [5], dog [5, 8, 29, 58], cat [27, 51], cattle [15, 24], alpaca [19], deer [45, 48], ferret [39], pig [3], beaver [40], chinchilla [39], jaguar [47], horse [56], marsupials [38, 52], sheep [17, 27, 30, 62], goat [17], muskox [9], non-human primates [60, 61], cetacean(s) [41, 42], seals [26], Australian sea lion [10], moose [27, 43], reindeer [43], chicken [5], gull [26]
B	Humans [5, 15], cattle [15, 38], dog [8], gazelle [48], deer [38], horse [56], beaver [40, 50], muskrat [50], chinchilla [39, 47], ferret [39], rabbit [30, 39], Desmarest's hutia [39], marsupials [38, 52], guinea pig [27], rock hyrax [4], non-human primates [47, 60, 61], chicken [5], sheep [62], seals [26], pig [13], Australian sea lion [10], ostrich [47], dolphin [25, 41], porpoise [25], gull [26]
C	Dog [8, 29], kangaroo [38], cattle [33], pig [33] cetacean(s) [42]
D	Dog [8], chinchilla [39], kangaroo [38], cattle [33], cetacean(s) [42], fox [38]
E	Cattle [24, 30, 38], sheep [15, 17, 27, 30], pig [3, 13, 15], alpaca [19], goat [17, 62], horse [56], yak [27], fox [38], deer [27], cat [27]
F	Cat [27, 51], cetacean(s) [42], pig [3, 33]
G	Rat [27, 63], mouse [63]
H	Grey seal [26], gull [26]

https://www.parasite-journal.org/articles/parasite/full_html/2016/01/parasite150104/T1.html

CAPC *Giardia* Map July 22, 2021

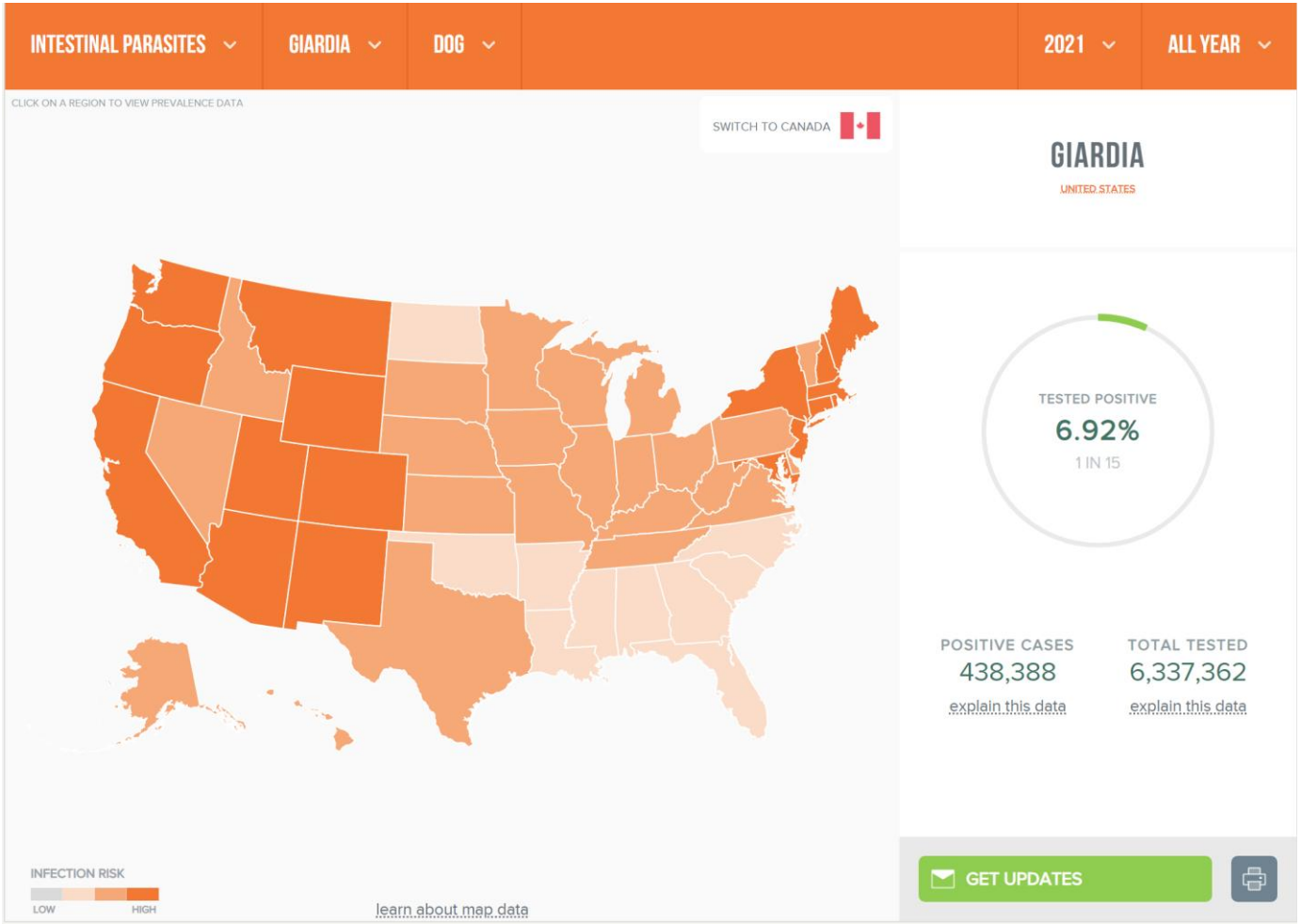


Figure 3: Map of *Giardia* Prevalence in the United States of America in 2021.
https://capcvet.org/maps/#/2021/all-year/giardia/dog/united-states

Project: How Did We Do It?

- As part of a public health study, a questionnaire-based Qualtrics survey was distributed among U.S. small and mixed animal veterinarians. Approved by the Ethical Review Board (URCO) at Kansas State University.

- Distributed by KS-VDL online newsletter.

- 14 questions (Q1-Q14, including the project summary and consent) were designed to minimize the time constraints associated with longer surveys for ease of participant use.

Results: The Good Stuff

- The initial release of the survey occurred on February 25, 2021. The survey was sent a second time on March 4, 2021.

- Sent to 17,443 email addresses, was opened by 2,862 people, and 218 clicks were recorded for the survey link embedded in the email.
  - The survey bounced 575 times.

- Data was collected for this project between February and April 2021.

- Total 134 respondents, 133 provided consent to take the survey in Q1, of which 123 completed the survey, while 10 respondents did not finish all questions on the survey.

Results: The Good Stuff

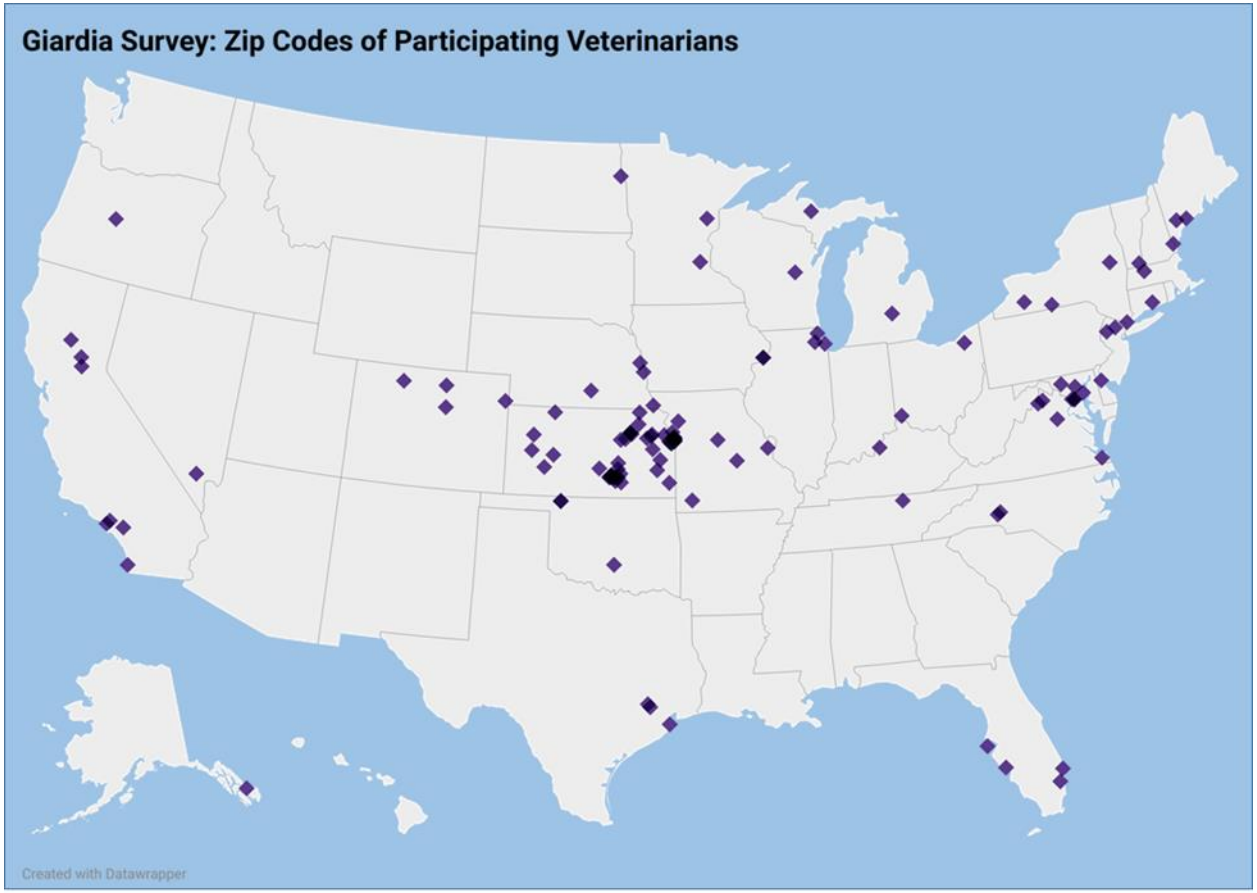


Figure 4: (Q2) Map of Participating Veterinarian Responses to the *Giardia* Survey from February 2021- April 2021. Created on Datawrapper.

- A total of 123 U.S. small and mixed animal veterinarians responded to the survey from 31 U.S. states.
- At least one veterinarian response from each of the six zip code sectors across the U.S.

Results: The Good Stuff

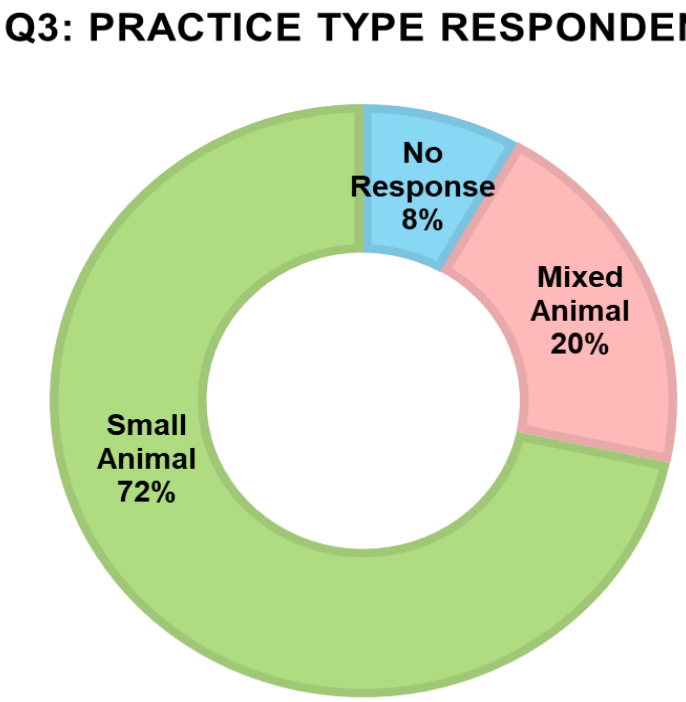


Figure 5: (Q3) Percentages of Small or Mixed Animal Veterinary Participants. Created on Excel and PowerPoint.

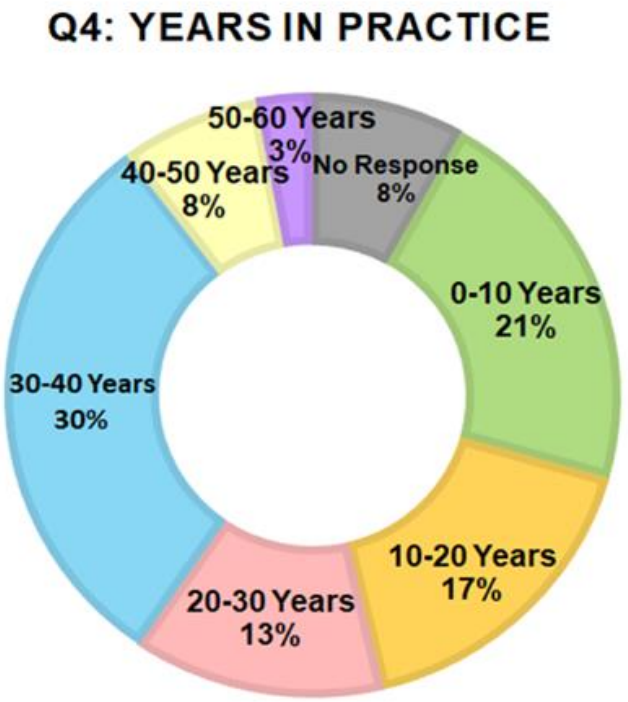


Figure 6: (Q4) Number of Years Participants have Worked in the Veterinary Field. Created on Excel and PowerPoint.

Results: The Good Stuff

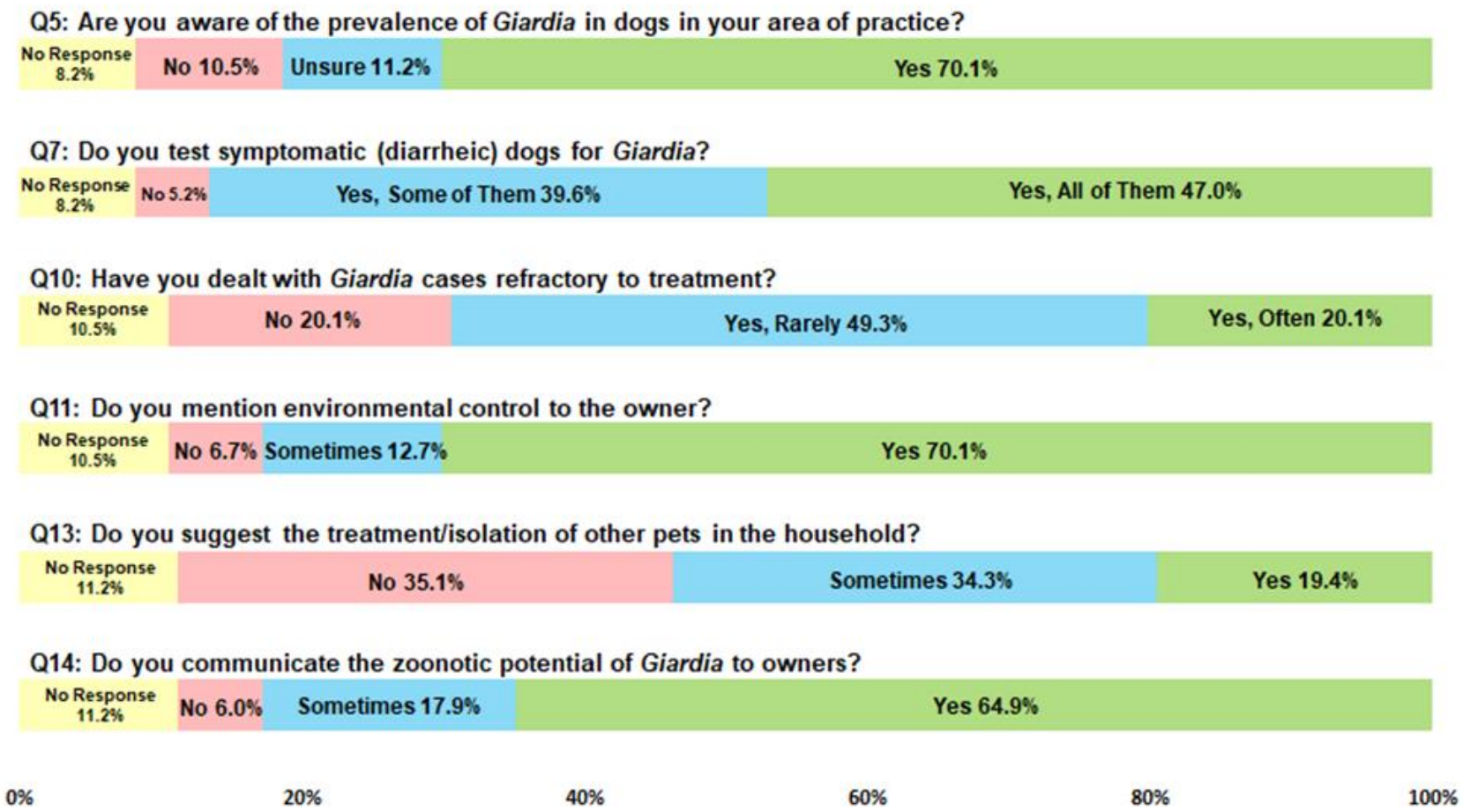


Figure 7: Bar Graphs Compiling Information on Veterinarian Perceptions and Communication Concerning *Giardia*. Created on PowerPoint.

Results: The Good Stuff

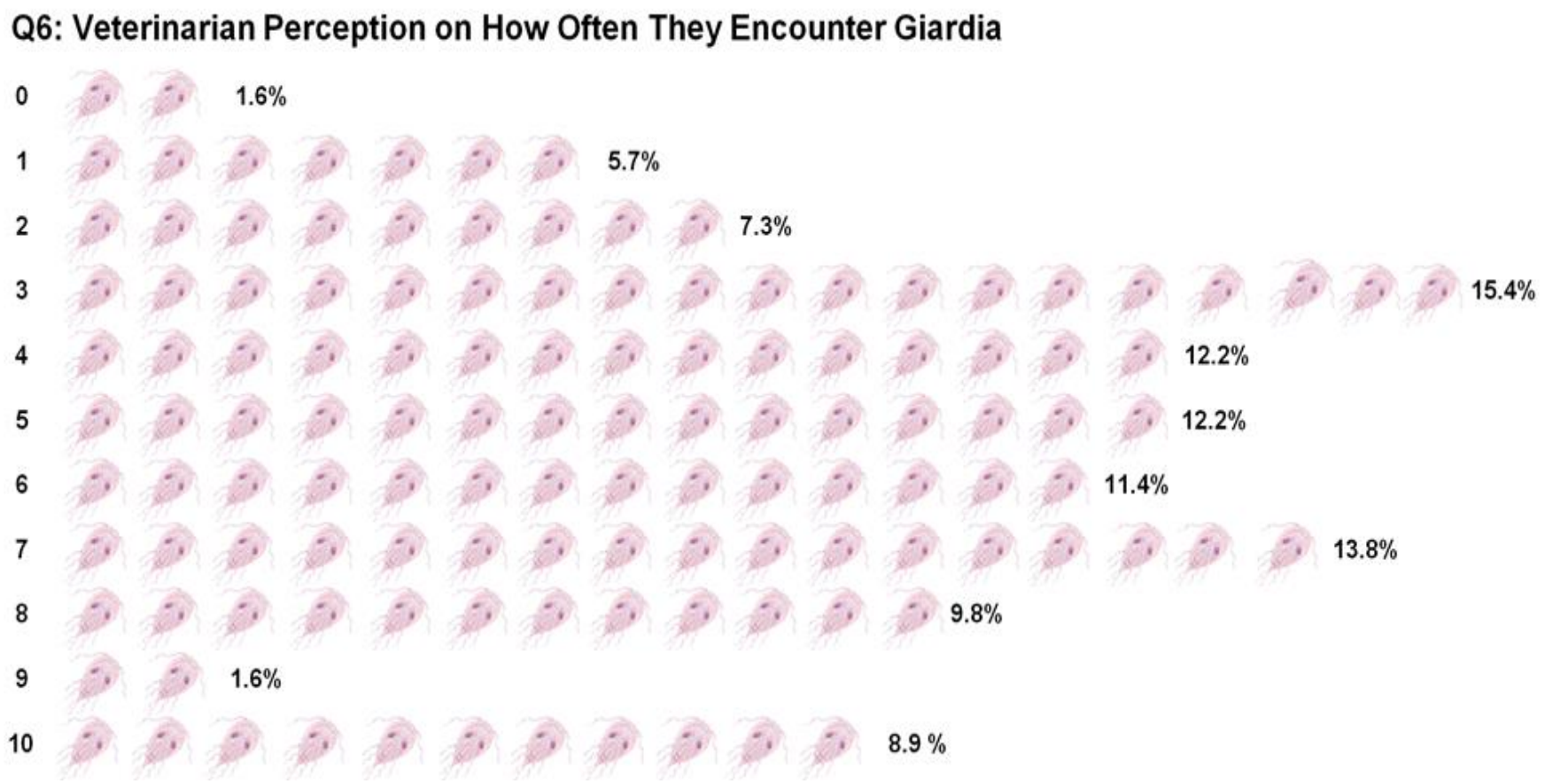
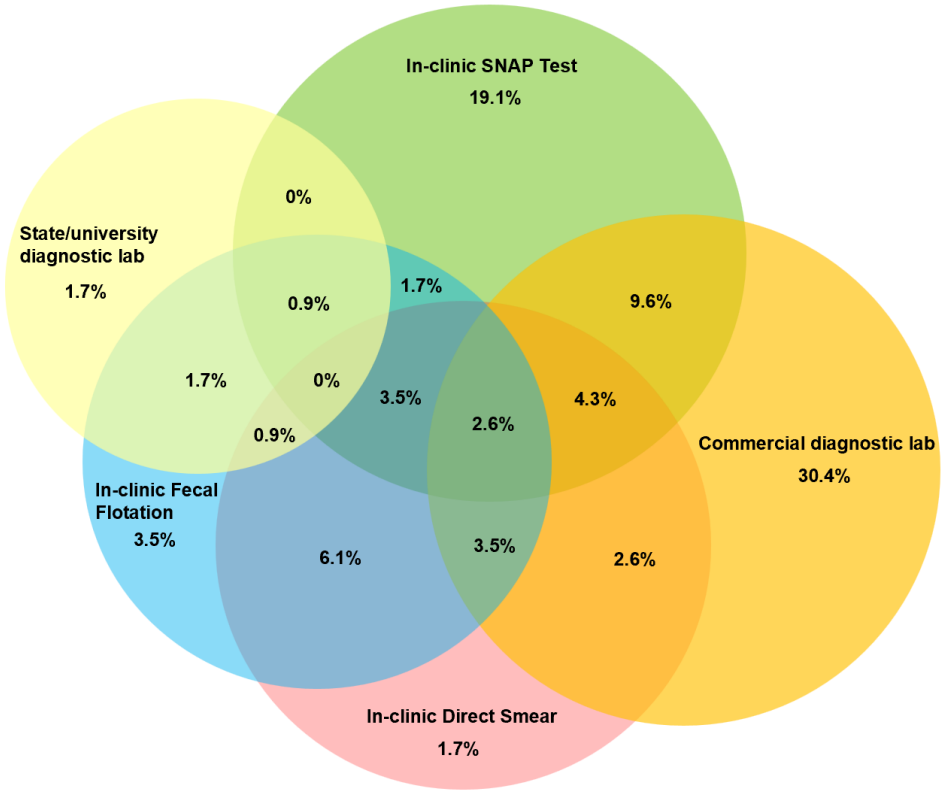


Figure 8: (Q6) Pictogram on Veterinarian Perceptions of *Giardia* Frequency In-Clinic. Created on PowerPoint. *This does not include the number of no responses recorded to avoid confusion with the perception of 0 on the scale.

Results: The Good Stuff



Testing Methods Used*	Percentages
In-clinic Direct Smear, State/university diagnostic lab	1.7%
In-clinic Fecal Flotation, Commercial diagnostic lab	1.7%
In-clinic Direct Smear, In-clinic SNAP Test	0.9%
In-Clinic SNAP, State/university diagnostic lab, Commercial diagnostic lab	0.9%
In-clinic Direct Smear, In-clinic Fecal Flotation, State/university diagnostic lab, Commercial diagnostic lab	0.9%

Figure 9: (Q8) Venn Diagram of Testing Methods Used to Diagnose *Giardia*. Created on PowerPoint. *Missing 7% from Venn Diagram in table.

Results: The Good Stuff

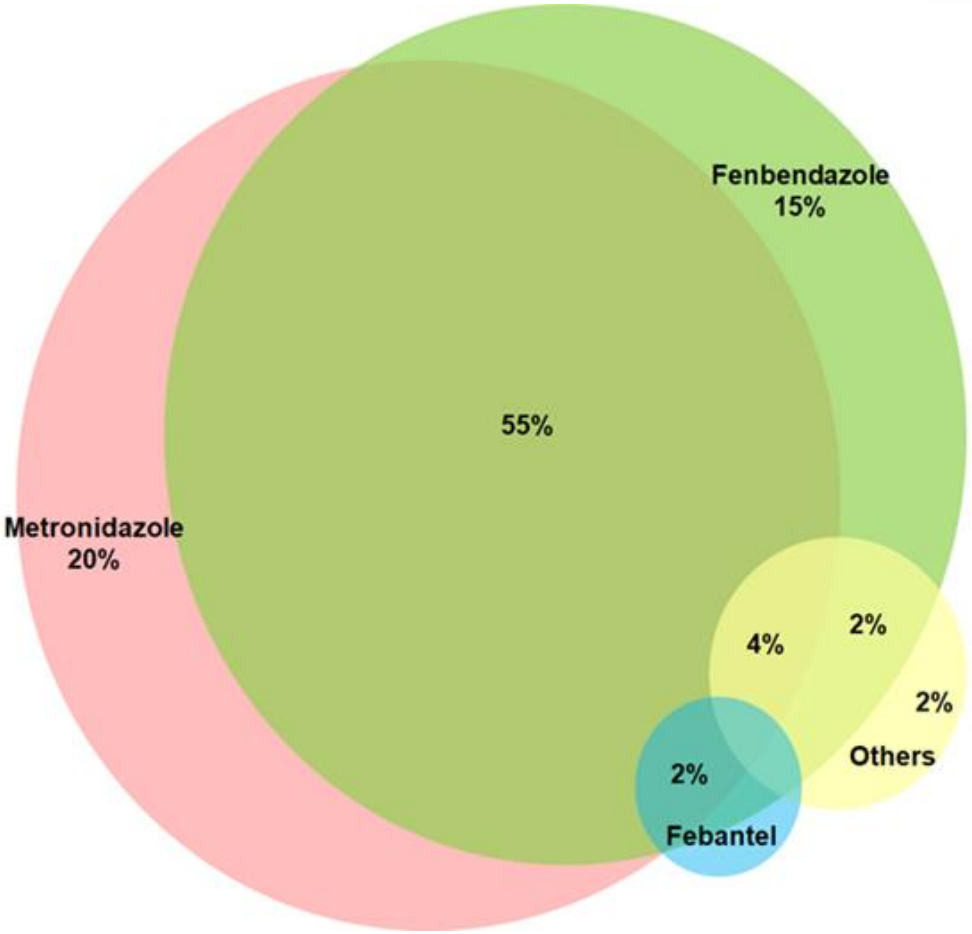


Figure 10: (Q9) Venn Diagram of Extra-label *Giardia* Treatments Used in the U.S. Created on PowerPoint.

Results: The Good Stuff

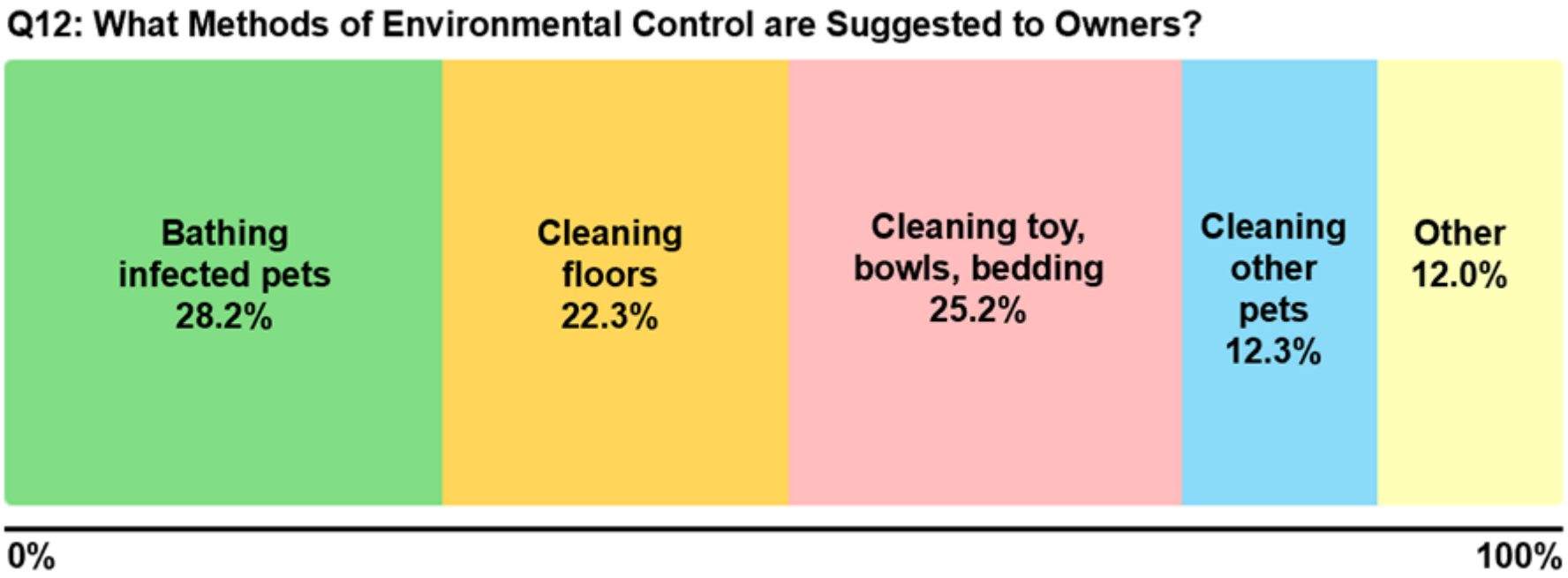


Figure 11: (Q12) Bar Graph of Methods of Environmental Control Suggested by Veterinarian to Client. Created on Qualtrics and PowerPoint. *This graph does not include the percentage of the vets who did not respond to the question.

Discussion: Why This Data Matters

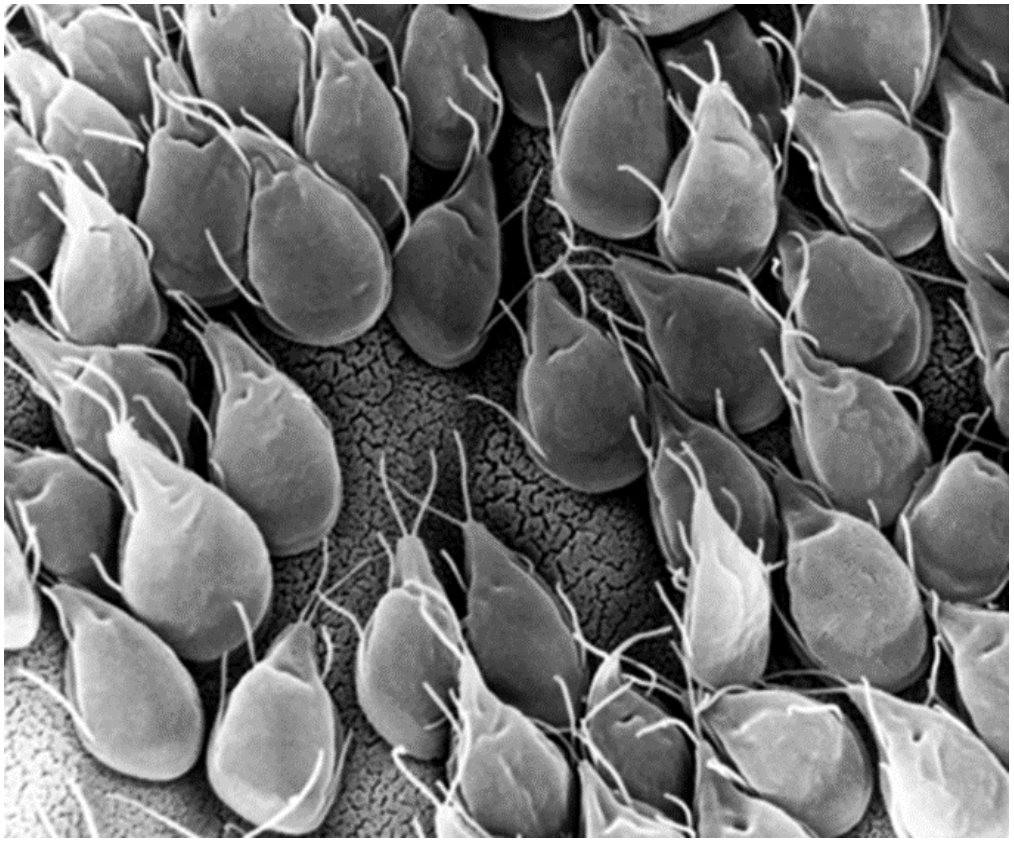


Figure 12: SEM image of small intestine mucosal surface from a gerbil, infested with *Giardia* sp. protozoa.
https://phil.cdc.gov/Details.aspx?pid=11632

- To the best of our knowledge, this is the first survey to assess knowledge of the practices, perceptions, and communication of zoonotic potential from veterinarians when treating canine giardiasis in the United States.
- Some interesting points from our data include…

Discussion: Why This Data Matters

- Our results revealed that **70.1% of veterinarians were aware of the prevalence of canine *Giardia*** in their areas of practice. Ideally, 100% of responding vets should be aware of the local prevalence of *Giardia* because **it is an extremely transmissible parasite, especially if the dog is asymptomatic.**

- Prevalence information is publicly available on the capcvet.com website, which is updated monthly at state and county levels. Promotion of sites like these would increase awareness among veterinarians, ensuring they can access current data on *Giardia* prevalence rates.

- **The most common veterinarian perception of *Giardia* occurrence was a 3 on a 0-10 scale**, which seems low considering the frequency of medium-high risk states (slide 11). Perceived occurrence could be low:
  - if vet does not see *Giardia* often
  - if vet unconsciously compared *Giardia* occurrence to another parasite
  - if it is due to the geographical distribution of the practicing veterinarians

Discussion: Why This Data Matters

- Due to the complex differentials associated with canine diarrhea, veterinarians must use good clinical judgement to decide whether to perform a diagnostic test for *Giardia* while remaining within the financial ability of the owner.
  - **Surprisingly, 47% of veterinarians tested all symptomatic dogs for *Giardia*.**

- **30.4% of vets chose to use a commercial diagnostic lab to diagnose *Giardia,* followed by 19.1% of vets using an in-clinic SNAP test.**

- **The most popular combination of tests at 9.6% was the in-clinic SNAP test and the commercial diagnostic lab.**
  - It can be difficult to identify cysts/trophozoites (and their antigen) in feces because they shed intermittently, so it is common to use a combination of tests when screening for *Giardia*.

Discussion: Why This Data Matters

- The most popular *Giardia* treatment at 55% was a combination of metronidazole and fenbendazole, followed by 20% of vets treating with only metronidazole.

- **This is surprising because metronidazole is an antibiotic/antiprotozoal approved for treating canine infections with Trichomonads, Amebeas, and anaerobic bacterial infections…*not Giardia!***

- ***Prescribing metronidazole alone would only treat the symptoms of a Giardia-infected dog instead of treating the Giardia infection itself.***
  - More research would be needed to investigate the veterinarians' reasoning behind prescribing metronidazole only.

Boothe, 2015. https://www.merckvetmanual.com/pharmacology/antibacterial-agents/nitroimidazoles

Discussion: Why This Data Matters

- **49.3% of vets rarely encountered refractory cases of *Giardia* and 20.1% of vets often encountered refractory cases of *Giardia*.**

- It would be interesting to pinpoint the exact quantities of the biological causes for refractory cases of *Giardia* in practice. Refractory cases could be due to:
  - lack of treatment compliance
  - contact with an asymptomatic carrier
  - initial treatment failure
  - or a truly drug resistant case of *Giardia*

- To date, I have been unable to find any literature supporting the existence of drug resistant cases of canine giardiasis.

Discussion: Why This Data Matters

- 70.1% of veterinarians suggested environmental control as a means of reducing the spread of *Giardia*, ***but*** the majority of vets ***did not suggest or sometimes suggested the isolation*** of other pets from the environment shared with a *Giardia*-infected pet.

- This is interesting because ***Giardia*** **is known to be a difficult environmental contaminate to remove and is highly transmissible between animals sharing the same environment.**

- ***Not separating another pet from the Giardia-infected dog is counterintuitive!***

Patton, 2013. https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/overview-of-giardiasis
CDC, 2021b. https://www.cdc.gov/parasites/giardia/prevention-control-pets.html

Discussion: Why This Data Matters

- Almost 30% of respondents suggested bathing the infected pet, ***but*** that number is low considering that **bathing a pet after treatment is a common addition to most treatment plans** prescribed by veterinarian parasitologists because **dogs can accidentally re-infect themselves during grooming** if cysts are lodged in the fur.

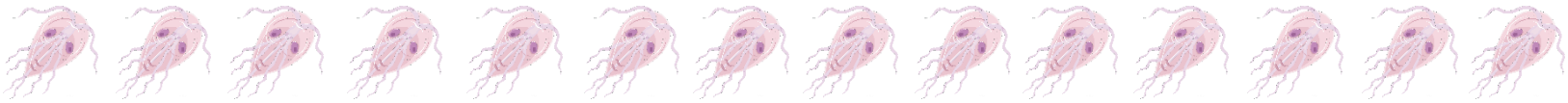
- We thought an option for “cleaning up feces in the environment” was created; however, after the release of the survey we found it was missing.

- This is probably why many “other” responses were recorded, the most popular being the removal of feces from the environment (18-22 of 36).

Patton, 2013. https://www.merckvetmanual.com/digestive-system/giardiasis-giardia/overview-of-giardiasis
CDC, 2021b. https://www.cdc.gov/parasites/giardia/prevention-control-pets.html

Discussion: Why This Data Matters

- Though we expected all vets to communicate the risk of zoonotic potential, **it is promising that 64.9% of veterinarians confirmed they communicated the zoonotic potential of *Giardia* to their clients.**



- Ideally, if One Health beliefs were upheld by all American health practitioners, ***all*** veterinarians would communicate the zoonotic potential of *Giardia* to ***all*** owners ***all*** the time.

Products: Look What I Made

KANSAS STATE UNIVERSITY | Master of Public Health Interdisciplinary Program

Veterinarian Perceptions of Canine Giardiasis and Communication on Zoonotic Potential in the U.S.

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2 Kansas State Veterinary Diagnostic Laboratory, College of Veterinary Medicine, Kansas State University
3 Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University
4 Vector Biology Laboratory, Department of Entomology, Kansas State University
5 jebaj@vet.k-state.edu

Introduction

- Certain *Giardia* assemblages are capable of infecting both canines and humans, especially children. *Giardia* infections are treated differently in veterinary and human medical perspectives:
  - Humans receive metronidazole, tinidazole, and nitazoxanide.
  - Canines receive extra-label treatments of metronidazole, fenbendazole, and febantel.
- It is impossible to know if a canine or human is carrying a zoonotic assemblage because molecular characterization is not routinely carried out.
- Thus, it is important to understand the veterinarian perception and practices of treating *Giardia* within the context of One Health.

Methods

- As part of a public health study, a questionnaire-based Qualtrics survey was distributed among U.S. small and mixed animal veterinarians to assess:
  - perceived prevalence, preferred testing and treatment methods, recommended control measures, and relevant information communicated about the zoonotic potential of canine Giardiasis.
- Approved by the Ethical Review Board (URCO) at Kansas State University.
- Distributed by KS-VDL online newsletter.

Discussion

- Knowledge on the zoonotic aspect of *Giardia* is limited in the scientific community because few clinical cases of zoonotic transmission between canines and humans have been recorded.
- Given that children have a higher risk of developing *Giardia* infections, it is important for veterinarians to preserve the health of canine companions to protect their human owners.
- Thus, the contributions of veterinarians in managing canine Giardiasis within One Health initiatives should not be overlooked.

Acknowledgements

The authors thank KS-VDL Client Services for distributing the survey, Dr. Mulcahy of the Master of Public Health Program, and the Master of Public Health Program for funding the registration for the AAVP 2021 Annual Meeting.

Results

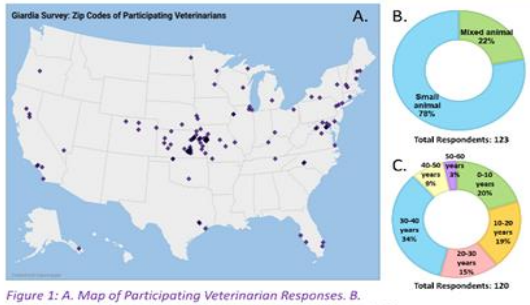

Figure 1: A. Map of Participating Veterinarian Responses. B. Practice Type of Respondents. C. Years in Practice by Respondents.

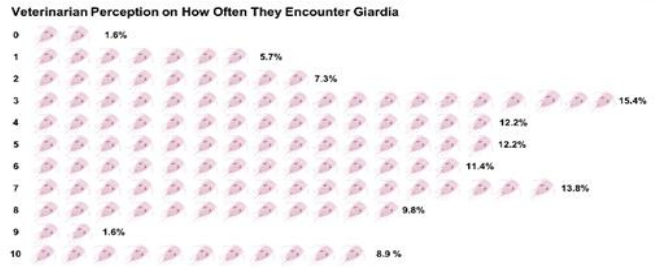

Figure 2: Pictogram on Veterinarian Perception of Giardia Frequency in clinic.

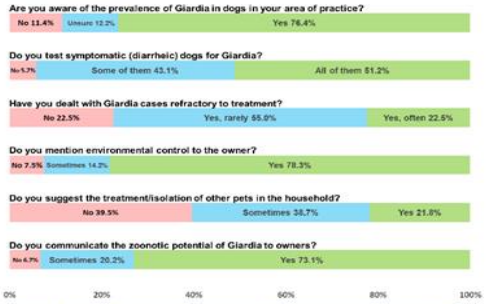

Figure 3: Bar Chart Compiling Information on Veterinarian Perceptions and Communication Concerning Giardia .

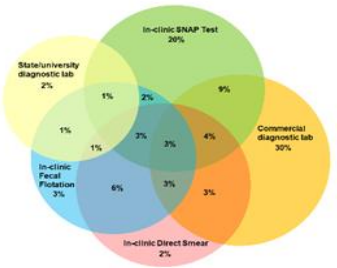

Figure 4: Venn Diagram of Testing Methods Used to Diagnose Giardia.

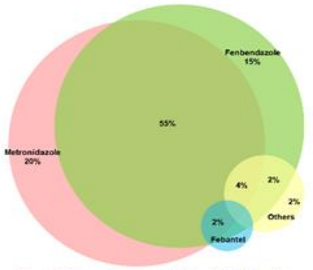

Figure 5: Venn Diagram of Extra-label Giardia Treatments Used in the U.S.

Figure 6: Bar Graph of Veterinarian Recommended Methods of Environmental Control.

Interested in participating? Follow the QR code to the survey.

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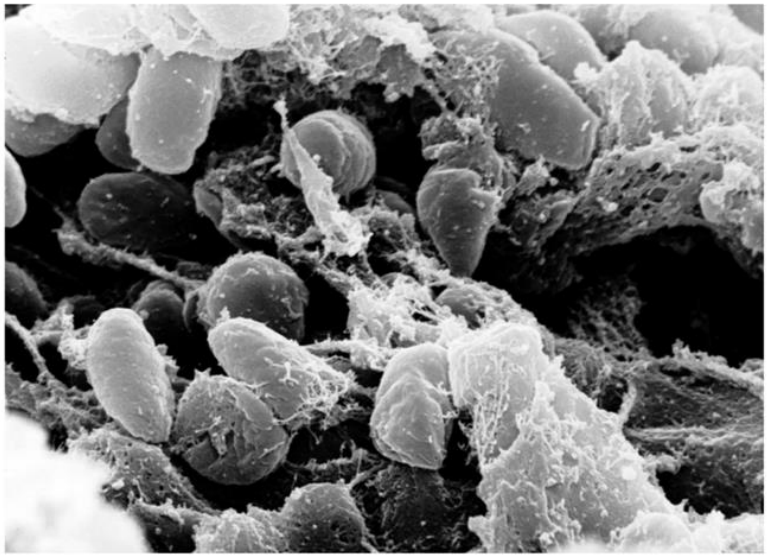
Products: Look What I Made

Fighting the Spread of Disease With…Words?

by Justin Kastner, Megan Eppler, Valerie Jojola-Mount, Ellyn Mulcahy, Phutsadee Sanwisate and Kate Schoenberg

While we need to be wary of the transmission of the novel coronavirus in our communities, perhaps we ought to be equally concerned about the transmission of information *about it*.



https://www.vet.k-state.edu/about/news-events-publications/OneHealth/Previous_Issues/Vol12-Iss2/

Summary of MPH Foundational Competencies

Table 5.1 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.	I analyzed survey responses using Excel and Qualtrics data processing tools to develop graphs/tables which appropriately communicated the statistical relevance of the data.
4	Interpret results of data analysis for public health research, policy, or practice.	I used this competency when determining the statistical significance of the results from the graphs/tables I created.
18	Select communication strategies for different audiences and sectors.	I created a Qualtrics survey as well as graphs/tables of the data that were quick and easy to interpret for participants and individuals interested in interpreting the data.
19	Communicate audience-appropriate public health content, both in writing and through oral presentation.	Dr. Chelladurai, Dr. Londono, and I collaborated to create a poster for the AAVP summer conference. Additionally, Dr. Chelladurai and I will be publishing a paper on our findings.
21	Perform effectively on interprofessional teams.	I worked with Dr. Chelladurai from the Diagnostic Medicine and Pathobiology department when working on the *Giardia* project.

Summary of MPH Emphasis Area Competencies

Table 5.3 Summary of MPH Emphasis Area Competencies

MPH Emphasis Area: Infectious Diseases/ Zoonoses		
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 immune 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.

Finally, Thank You!

- Thank you to Dr. Mulcahy and Barta Stevenson.
- Thank you to my preceptor, Dr. Chelladurai.
- Thank you to the vets who responded to the survey.
- Thank you to the KS-VDL Client Services for sending out the survey and to the MPH program for covering my registration fee to attend the AAVP Summer 2021 Annual Meeting.
- Thank you to Dr. Adams, Dr. Kastner, and Dr. Chapman.
- Thank you to my committee members, Dr. Londono, Dr. Herrin, and Dr. Reif.
- Thank you to my friends.
- Thank you to my MPH family.
- Thank you to my family.

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Any Questions?