



Rat Lungworm Disease in Hawaii

Control and Prevention Legislative Report

Hawaii State Department of Health
March 2018

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Director's Note

Rat lungworm disease is not new to Hawaii. It has been around for decades and is likely to continue to be a challenge in our islands. As a result of timely support from Hawaii's legislators, the Hawaii Department of Health has been able to launch an aggressive educational campaign so that Hawaii residents and visitors can take proper precautions to prevent the disease from becoming more prevalent in Hawaii.

Eighteen cases of rat lungworm disease were confirmed in Hawaii in 2017. This is a relatively low number compared to other foodborne illnesses such as *Salmonella*, *E. coli*, or hepatitis A. However, the disease has had long-term disabling outcomes for individuals. The health department is charged with protecting the health of Hawaii and we are taking this disease seriously to prevent it from impacting the lives of Hawaii's people.

For more than a decade, the department has worked closely with local, national and international experts to combat this disease, and we are continuing this important work. From conducting widespread disease investigations to developing effective testing protocols, the department is committed to protecting the public's health.

In the 2017 regular session, the legislature appropriated $1 million over a two-year period to provide additional support to its education and response efforts to better control and reduce the risk of rat lungworm disease statewide.

The collaborative efforts and commitment of our staff and our partners over the last several months have rapidly moved a number of initiatives forward in the most cost-effective manner to provide the greatest return on public funds. Most notably, teams from the neighbor islands stepped forward to take charge and protect their communities in ways that were both innovative and efficient. Experts from a cross-section of the community—academia, agriculture, tourism, education and public health—are working hand-in-hand to problem solve, using evidence-based guidelines to drive their work. It is encouraging to see these subject-matter experts from diverse fields throughout the state come together to make a difference in the lives of both our residents and visitors alike.

I am encouraged by the direction our statewide efforts have taken to this point and look forward to the remaining initiatives and partnerships to come. I am confident that the spirit of collaboration and dedication of all involved in leading this statewide charge will result in a better-informed public armed with the tools they need to protect themselves, their families and their communities from the threat of rat lungworm disease, now and in the future.

Virginia Pressler

Dr. Virginia Pressler, Director
Hawaii State Department of Health

Introduction to Rat Lungworm Disease

Background

Rat lungworm disease, or angiostrongyliasis, is caused by a parasitic roundworm called *Angiostrongylus cantonensis* (*A. cantonensis*) and can have devastating effects on an infected person's brain and nervous system. The adult form of the *A. cantonensis* worm can only be found in rodents. However, the disease is spread when infected rodents pass larvae of the worm in their feces, which is then consumed by snails and slugs. Slugs and snails are intermediate hosts and harbor the infectious larvae in their bodies.

Transmission

Humans become infected with the *A. cantonensis* parasite if they eat a raw or undercooked infected intermediate host. Since angiostrongyliasis cannot be passed from person-to-person, humans are dead-end hosts for the parasite.

Symptoms

This infection can cause an uncommon type of meningitis (eosinophilic meningitis). Some infected people do not have symptoms or only have mild symptoms; in some infected people the symptoms may be much more severe. Diagnosis can be difficult because not everyone will present with symptoms in the same way. When symptoms are present in adults, they can include severe headache and stiffness of the neck, tingling or painful feelings in the skin or extremities, low-grade fever, nausea, and vomiting. Sometimes, a temporary paralysis of the face may also be present, as well as light sensitivity. Young children may have similar symptoms, but they may also show different signs, such as increasing lethargy, irritability, or unusual behavioral changes. Symptoms and course of infection of angiostrongyliasis may be dependent on the number of infectious larvae ingested.

The symptoms usually start one to three weeks after ingestion of the parasite but have been known to range anywhere from one day to as long as six weeks after exposure. Although they vary from case to case, symptoms usually last between two to eight weeks; in some cases, symptoms have been reported to last for longer periods of time. While the disease is rare, it can be very serious for people and may cause long-term neurological problems, pain, and severe disability.

Individuals may be infected more than once in a life time.

Treatment

Treatment protocols are not fully defined and are typically supported by using steroids to reduce inflammation, which causes the symptoms infected people may experience. The use of anti-parasitic drugs, such as albendazole, are debated. There is limited evidence of how the drug will affect a patient's illness or the parasite.

Rat Lungworm Disease Presence Worldwide

Angiostrongyliasis is not a new disease. The parasite, *A. cantonensis*, was discovered in southern China in 1945. Since then, the parasite has been widely reported in southern and eastern Asia, Australia, South America, Africa, the Canary Islands, southeastern United States and islands in the Pacific, Caribbean, and Indian Ocean.

Cases of angiostrongyliasis have been documented in most of these places, with almost 3,000 cases recorded worldwide.[1]

On the continental United States, the parasite has been found in snails and rats in Texas, Florida and Louisiana. Cases of the disease have also been documented in various mammal and bird hosts in Florida, Alabama, Louisiana, Mississippi, Oklahoma and California.[1]

Angiostrongyliasis Cases Reported in Regions Worldwide

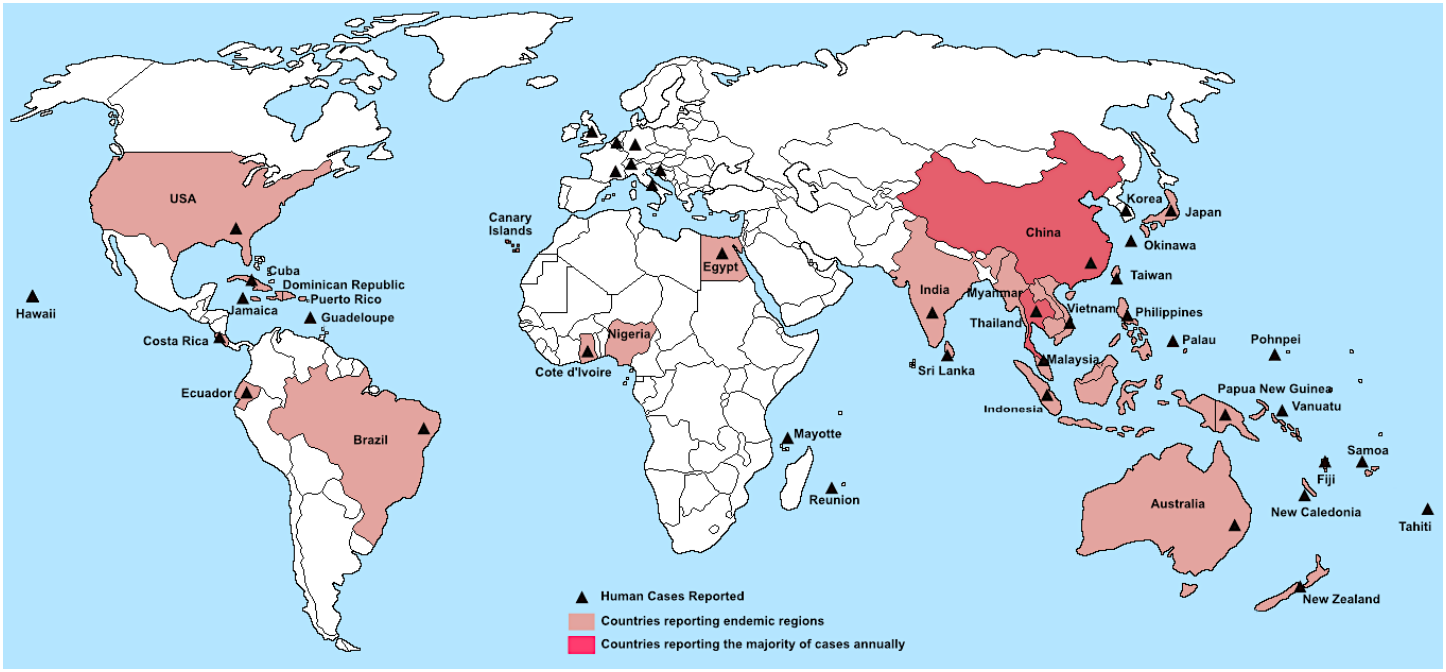


Figure 1. Adapted from Wang, QP, et al. 2008. Lancet Infect Dis 8:621-630.

Hawaii's Rat Lungworm Disease History

In 1961, Hawaii reported its first case of angiostrongyliasis. Parasitic worms were found in the brain of a patient who became ill in 1959 and died in 1960. Almost simultaneously, the disease manifested itself in another patient who had eaten raw slugs and also died in 1960. Between 1959 and 1965, there were 19 cases reported. There are no available records on cases from 1966–2000 since it was not a reportable health condition during that time.[1]

Since late 2004, when five cases were reported from Hawaii Island over a three-month period, the Hawaii Department of Health (DOH) has been working with partners, including the U.S. Centers for Disease Control and Prevention (CDC), along with malacologists (experts in slugs and snails) and other colleagues at the University of Hawaii (UH) at Manoa and Hilo and the John A. Burns School of Medicine (JABSOM) among others, to prevent and combat the disease. Before then, the parasite that causes this disease had been known to be endemic and capable of causing infection throughout Hawaii since the 1960s.

In 2005, DOH invited a team from CDC to provide technical assistance to the state. Together, DOH and CDC staff reviewed all available laboratory data collected over the previous five years. Subsequently, snails and slugs were collected for testing, and findings were published in a peer-reviewed journal.[2]

As part of an ongoing collaborative effort with CDC, DOH worked alongside federal experts to develop a molecular (polymerase chain reaction or PCR) test for *A. cantonensis* DNA in cerebrospinal fluid, and since 2016, has been able to utilize this reliable laboratory testing method to accurately confirm the disease in patients. Hawaii is the only state in the nation with the ability to conduct confirmatory testing for angiostrongyliasis, aside from CDC's laboratories.

Angiostrongyliasis became reportable to DOH in 2007. Clinicians are required to report patients with eosinophilic meningitis, and laboratories are required to provide cerebrospinal fluid results for such patients. Over the years, DOH's State Laboratories Division has worked with all clinical laboratories in the state to assure reports and specimens for suspect cases are submitted for investigation and follow up. When suspected cases are reported, disease investigators work closely with the patients to carefully examine where they live, work, recreate, or may have traveled in order to identify how they may have become infected.

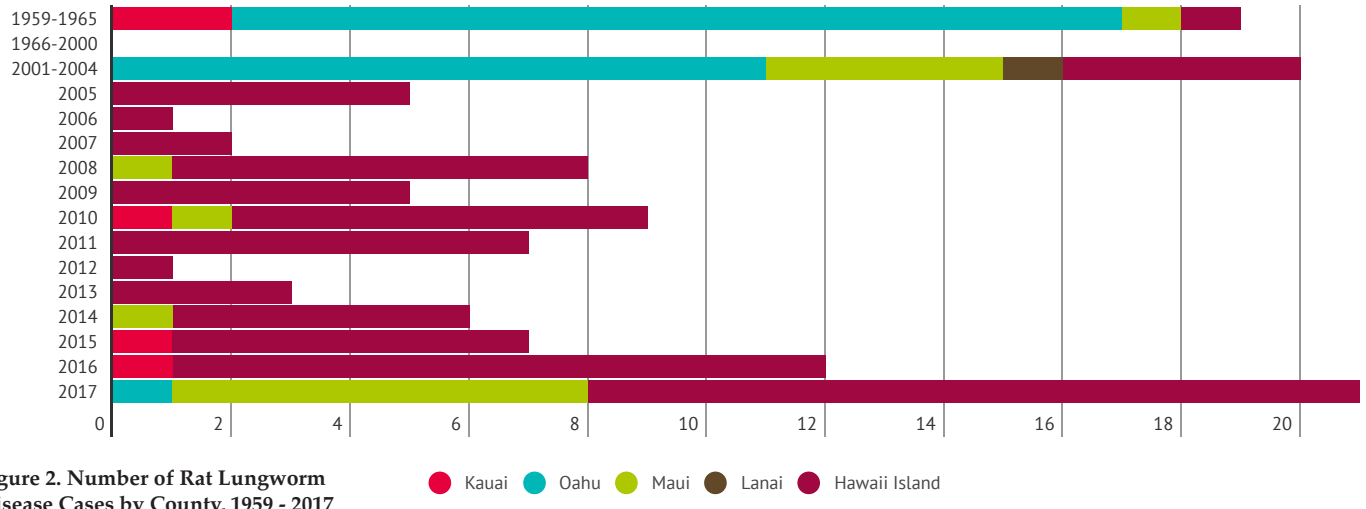


Figure 2. Number of Rat Lungworm Disease Cases by County, 1959 - 2017
Modified from Cowie, R. ACS Chemical Neuroscience 2017.

There have been 46 laboratory-confirmed cases and 37 probable cases, resulting in a total of 83 cases statewide reported to the health department since tracking of angiostrongyliasis began in 2007. Two adult deaths related to the disease have been reported, one in 2012 and another in 2015.

"Confirmed" cases refer to laboratory-confirmed cases where a lumbar puncture sample was provided for testing or the actual parasite was visualized (rare occurrence).

"Probable" cases refer to cases that were not laboratory-confirmed, but persons had symptoms, laboratory findings (specifically in cerebrospinal fluid), and background history all consistent with likely having been infected.

Between 2006 and 2016, DOH recorded between one and 11 cases of angiostrongyliasis per year. In 2017, there was a total of 18 laboratory-confirmed cases of angiostrongyliasis and three probable cases.

The breakdown of the 2017 cases by island is as follows:

Hawaii Island		Maui		Oahu		Kauai	
Confirmed	Probable	Confirmed	Probable	Confirmed	Probable	Confirmed	Probable
11	2	6	1	1	0	0	0

Note: Of the six laboratory-confirmed cases on Maui, two of the cases included non-residents who contracted the disease during their visit to Hawaii.

Historically, a majority of the cases occurred on Oahu. This was true until about 2004, and since then, most cases have appeared on Hawaii Island. The exact reason for this is not known at this time. Some have speculated a relationship with the increased prevalence of the invasive *Parmarion martensi*, more commonly known as the semi-slug. It has been present on Oahu since at least 1996, and it was first recognized on Hawaii Island in 1996. The semi-slug is an extremely effective carrier of *A. cantonensis* and may pose a greater risk since it is especially quick-moving and often hard to see.[1]

Photo courtesy of L. Castro, Hawaii Department of Agriculture

Photo courtesy of L. Castro, Hawaii Department of Agriculture

Studies have shown that when compared with other slug and snail species found locally in Hawaii, the semi-slug had the highest prevalence of infection of *A. cantonensis*, with 68 percent of all specimens collected testing positive for the parasite.[3] Regardless, all mollusks (including slugs and snails) in Hawaii pose a risk and should be treated as potentially infectious regardless of what species they are.

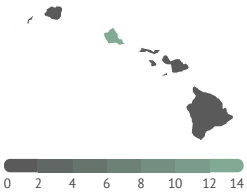
While there have been a few isolated cases of people getting infected by purposefully consuming slugs and snails, the majority of cases are assumed to have been infected by accidentally ingesting slugs and snails hidden on contaminated, unwashed produce. There are also growing food safety concerns around raw vegetable juices and smoothies. Another potential source of infection includes people drinking from their garden watering hoses, and inadvertently swallowing a snail or slug in the process.

In mid-2017, a cluster of cases on Hawaii Island was exposed to the disease from drinking homemade kava that was left out overnight in an uncovered container. Six adults drank the kava and found a slug at the bottom of the bowl. All six adults were hospitalized—three individuals had confirmed positive laboratory tests, and three individuals were considered probable cases based on their shared exposure as well as consistent clinical and laboratory findings.

Timeline of Significant Dates: Rat Lungworm Disease in Hawaii

1961

Hawaii documents its first definitive case of rat lungworm disease.



1959-1965

Nineteen cases of angiostrongyliasis documented across the state.

1996

Invasive semi-slug detected in Hawaii.

2004

Five cases of angiostrongyliasis confirmed on Hawaii Island over a three-month period. DOH collaborates with CDC and UH experts to better control the disease.

2005

CDC experts visit Hawaii to work with DOH and provide technical assistance.

2007

Rat lungworm disease becomes reportable to DOH.

2016

DOH and CDC develop a reliable laboratory test to detect *A. cantonensis* in cerebrospinal fluid. Hawaii is the only state in the nation with the ability to conduct this test, aside from CDC's laboratories.

2016

Governor's Joint Task Force on Rat Lungworm Disease established to to assess threat of angiostrongyliasis in Hawaii.

2017

Hawaii State Legislature appropriates $1 million to DOH to enhance control and prevention efforts related to rat lungworm disease.

Governor's Joint Task Force on Rat Lungworm Disease

In May 2016, DOH and the East Hawaii Liaison to the Office of the Governor announced the establishment of a Joint Task Force to assess the threat of angiostrongyliasis in Hawaii. Experts from medical, scientific, environmental and public health fields from across the state were brought together to share scientific knowledge in the application of diagnostics, treatment, mitigation and public education related to rat lungworm disease.

Members include specialists from the University of Hawaii John A. Burns School of Medicine, Pacific Biosciences Research Center; Daniel K. Inouye College of Pharmacy at the University of Hawaii at Hilo; Hawaii Department of Agriculture's Plant Industry and Quality Assurance Divisions; U.S. Department of Agriculture's Agriculture Research Service; Kaiser Permanente Hawaii; Hilo Medical Center; Kapiolani Medical Center for Women and Children; Hawaii County; and DOH's State Laboratories Division, District Health Offices of Hawaii Island, Maui, and Kauai, Vector Control Branch, Safe Drinking Water Branch, Disease Outbreak Control Division, and Sanitation Branch.

One of the major undertakings by the Joint Task Force's subcommittee on clinical management is to develop detailed, evidence-based guidelines, including diagnosis and treatment protocols, to help local physicians better recognize symptoms and take prompt action. To learn more about the disease and its current understanding, subcommittee members have attended the American Society of Tropical Medicine and Hygiene Annual Meeting in Baltimore, MD, and a subsequent convention in Thailand, where experts on angiostrongyliasis from around the world gathered to share the latest developments in disease management. The subcommittee's preliminary practice guidelines are expected to be complete and available for use by local clinicians in 2018.

Members of the Joint Task Force have also been instrumental in guiding collaborative public education efforts. In mid-2017, members provided a comprehensive narrative with recommendations on how to best approach different target audiences and address critical misinformation circulating about angiostrongyliasis. They have also taken it upon themselves to dialogue with local farmers and grocers, attend community support group meetings, and interface with the public during farmer's markets and provide attendees with their expertise.

Approach Introduced

As the number of confirmed cases in the state appeared to increase in 2017 with greater public awareness and highly-publicized events, including a group of cases on Hawaii Island of people who drank homemade kava contaminated with an infected semi-slug, DOH continued its public education and response efforts. That same year, during its current session, the Hawaii State Legislature appropriated $1 million over fiscal years 2018-2019 to enhance DOH's response and outreach activities to further control the spread of angiostrongyliasis. The department's action plan encompasses public information and outreach, epidemiological, and vector control efforts.

Communications

Objectives

- Raise awareness about the rare, yet debilitating angiostrongyliasis, and ensure people understand its presence and risks statewide.
- Target populations such as farmers, gardeners, food establishment service workers, and visitor industry establishments to better protect consumers from risks; and also, medical and health care providers to ensure proper diagnosis and care are provided for those who may have been infected.
- Encourage people to be more cautious while washing and preparing the foods they eat, especially raw produce, and promote safe food handling and preparation practices.
- Motivate the public to do what they can to safely eliminate rat and slug/snail populations, especially around their homes, to reduce the risks of angiostrongyliasis spreading in their neighborhoods.

Target Audiences

- Consumers shopping for produce
- Home gardeners and gardening organizations
- School-age children
- Parents with young children & caregivers
- Daycare and preschool operators
- Landscapers & groundskeepers
- Farmer's and open market operators
- Healthcare providers
- Visitor industry service providers and accommodations
- Visitors to Hawaii
- Non-English-speaking groups
- Agritourism businesses
- Senior and adult day care operators
- Religious and faith-based organizations
- Food establishment staff and managers
- Roadside food vendors
- Natural and organic food establishments

Key Messages

Primary prevention campaign messages:

- Practice safe eating habits by washing produce thoroughly regardless of where it came and/or cooking it to kill harmful parasites.
- Eliminate snails, slugs, and rats—all of which are potential vectors for the disease—both around residential home gardens and agricultural operations of all scales.
- Prevent the consumption of snails and slugs by covering all containers, from water catchment tanks to drink and food dishes, and supervising small children outdoors.

Secondary Messages

Angiostrongyliasis poses a unique issue in that diverse stakeholders are affected by the threat of the disease. Targeted sample messages are below:

- ***Messages for Farmers*** (from Department of Agriculture [HDOA]): Take extra precautions to reduce rodent, snail, and slug populations in and around your crops. Inspect your produce carefully before transferring it to retailers to prevent the spread of snails and slugs that may accidentally be on, for example, fruits, vegetables, decorative plants, and flowers.
- ***Messages to Consumers*** (from Department of Agriculture [HDOA]): Local produce is safe to eat. Just make sure to follow safe food handling and preparation practices as recommended by DOH to reduce the risk of angiostrongyliasis in addition to other food-borne illnesses.
- ***Messages to Retailers and Restaurants***: If your business receives a shipment from any farmer or vendor (local or mainland) with an infestation of slugs or snails, contact the DOH District Health Office in your area (main DOH Sanitation Branch on Oahu) to schedule a visit from an inspector. DOH will work collaboratively with local representatives from HDOA to visit the farm (if local) where the produce was grown or the local distributor (if from the mainland) to ensure proper pest reduction measures are being implemented. All Hawaii food establishments are required to wash produce thoroughly before preparing and serving in compliance with state food safety regulations.

Earned Media: Press Conference & Campaign Kick-Off

To showcase the state's coordinated and active steps to prevent angiostrongyliasis by building awareness in the community, DOH coordinated with the Governor's Office to reintroduce the Governor's Joint Task Force on angiostrongyliasis, announce its expansion from a Hawaii Island-centered group to a group with broader, statewide representation, and share its statewide goals for the coming months in a joint press conference in early August 2017. In addition to Governor Ige, the Joint Task Force, and DOH leadership were joined by leadership from the Department of Agriculture, Hawaii Tourism Authority, and legislative partners.

The Pulse of Paradise
Star Advertiser

State plans awareness efforts to fight rat lungworm disease

A8 >> HONOLULU STAR-ADVERTISER >> THURSDAY 8/3/17

JAMM AQUINO / JAQUINO@STARADVERTISER.COM

Gov. David Ige played a public service video announcement about rat lungworm disease prevention and awareness during a news conference Wednesday at the state Capitol.

Paid Media: Hawaii Association of Broadcasters Partnership

DOH's Communication Office established a partnership with the Hawaii Association of Broadcasters, Inc. (HAB) via its Public Education Program to develop and implement a statewide media broadcast education campaign about angiostrongyliasis. HAB guarantees sponsors a minimum three-to-one rate of return on their investments in paid broadcast airtime.

HAB has leveraged its partnership with a local video production company to develop three 30-second television commercial spots and three 30-second radio commercial spots. They also contracted with participating television and radio stations to air the commercials with a scheduled run on a minimum of 40 radio and seven television stations statewide. The campaign started in November 2017 and is scheduled to end in June 2018.

Paid Media: Advertising

Movie Theatres: DOH worked with both major movie theater chains in Hawaii, Consolidated Theatres and Regal Theatres, to show commercials developed as part of the broadcast component of the campaign. Commercials were displayed prior to movies. The campaign started at the end of November 2017 and ended in early January 2018, and was shown at the following movie theaters on Oahu, Maui and Hawaii Island:

- Hawaii Island: Makalapua Center, Keauhou Shopping Center and Prince Kuhio Plaza
- Maui: Queen Kaahumanu Center, Maui Mall and Wharf Cinemas
- Oahu: Kahala Mall, Victoria Ward Center, Pearlridge Center, Mililani Town Center, Consolidated Theatres Kapolei, Kapolei Commons, Koolau Center, Windward Mall and Dole Cannery

Mall Advertisements: DOH has partnered with Hawaii Malls to display large scale graphic advertisements in malls and shopping centers across the state. The campaign started in December 2017 and will run through the first quarter of 2018, with some placements remaining for an additional and complimentary three months (through May 2018) as space allows. Malls and shopping centers included by island are as follows:

- Hawaii Island: Keauhou Shopping Village and Prince Kuhio Plaza
- Maui: Queen Kaahumanu Center and Maui Mall
- Oahu: Ala Moana Center, Kahala Mall, Manoa Marketplace, Mililani Shopping Center, Pearl Highlands Center, Pearlridge Shopping Center, and Windward Mall
- Kauai: Kukui Grove Center

Local Stations and Publications: To reach more niche audiences across the state, DOH engaged local radio stations and print publications. We worked with local (non-HAB member) radio stations to purchase discounted airtime and also developed small print advertisements placed in publications alongside editorial features.

Examples include:

- Maui Family Magazine
- Generations Magazine
- Hawaii Parent Magazine
- H-Hawaii Media (Kauai radio)
- Kauai FM 97 Radio
- Mahalo Media (Hawaii Island)

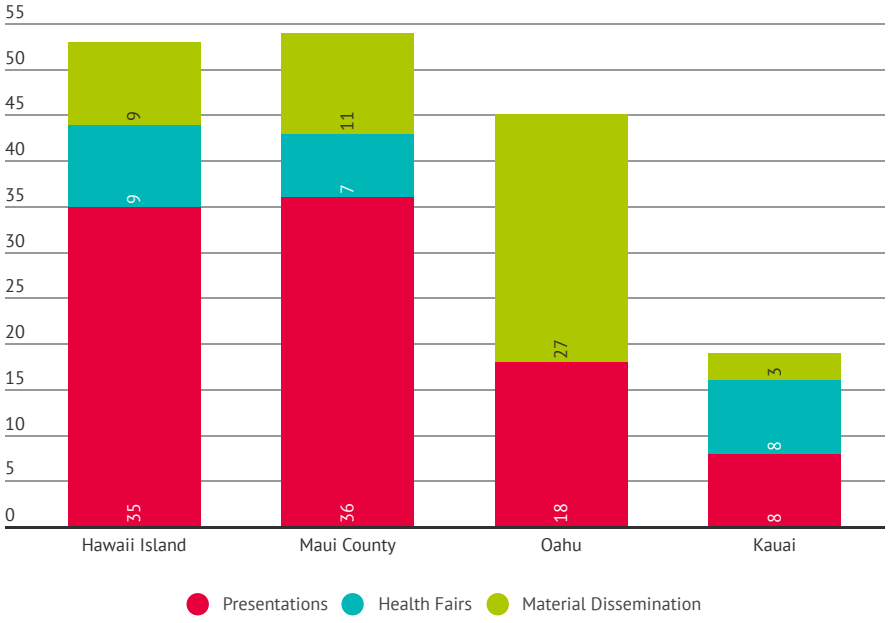
Community Relations: Educational Material Development and Dissemination

Educational materials:
DOH has been collaborating with its partners at the University of Hawaii (mainly at the John A. Burns School of Medicine [JABSOM] and College of Tropical Agriculture and Human Resources [CTAHR]) to develop a series of print educational materials people can use as resources to learn more about the disease and how to prevent it. Resources include an informational card, door hanger, and flyer. The informational card has been translated into Japanese, Spanish, Illocano, and German. DOH is currently evaluating the need for translation into other languages and formats.

Community meetings and presentations:
Since early 2017, the District Health Offices on Big Island, Maui, and Kauai have led the charge in hosting community meetings for the public, providing direct access to the department and an opportunity to learn more about how to prevent this disease. Oahu also completed a series of meetings, which took place in October and November 2017. Community meetings leveraged partnerships to bring experts to the community. In addition to DOH, participants included presentations by the Hawaii Department of Agriculture, UH's College of Tropical Agriculture and Human Resources, and survivors of angiostrongyliasis. Additional informational presentations and briefings by DOH are provided to groups that request them through the department.

Targeted outreach: DOH has worked collaboratively with its partners to provide targeted outreach to specific population groups. For example, to reach home gardeners and small famers, DOH provided materials to CTAHR, who in turn disseminated those resources during small community workshops specifically for those involved with home gardening. As another example, to reach young families, public health nurses on Hawaii Island distributed resources to be posted or handed out in pediatrician offices island-wide. DOH also worked with its partners to develop a food safety banner that can be displayed at farmer's markets, health fairs, and other outdoor event venues.

Outreach Summary: Below is a summary of community outreach participation from the department related to angiostrongyliasis education in 2017.



Physician Outreach

DOH experts present regularly on multiple conditions, including angiostrongyliasis, during Medical Grand Rounds and other medical forums and meetings across the state.

The department's Disease Outbreak Control Division has a special section on its website specifically for medical providers, where it posts medical advisories and other materials related to disease diagnosis and treatment. For example, one of the Hawaii Epi Bulletin articles earlier this year focused on rat lungworm disease.

DOH also participates in a statewide Public Health/Medical Advisory Forum that works to assure healthcare provider awareness of current topics of concern. This group acts as a liaison for messaging to the healthcare provider community as it includes representatives of the various hospital systems, medical professional societies, and other healthcare partners.

Angiostrongyliasis has been one of many topics of discussion in the past, but most importantly, this group serves as a resource and direct link to healthcare providers across the state.

The department's District Health Offices on Hawaii Island, Kauai, and Maui have also been working to distribute angiostrongyliasis materials (i.e. informational cards, door hangers, and posters) to physicians' offices in every county throughout the state.

It should also be noted that at the John A. Burns School of Medicine, curricula cover infectious meningitis, specifically including angiostrongyliasis, twice in the first two years. Physicians also receive information in their residency programs, often through efforts offered by DOH for Continuing Medical Education (CME) credits.

Visitor Industry

DOH works directly with the Hawaii Tourism Authority to provide critical updates to Hawaii visitors. Through a partnership with the Hawaii Department of Transportation Airports Division, the U.S. Centers for Disease Control and Prevention (CDC) donated two monitors, which are stationed in the interisland terminal in Honolulu's Daniel K. Inouye International Airport. The monitors display a rotating slide deck to increase awareness of potential health risks, such as angiostrongyliasis, to visitors to Hawaii, and to provide education on healthy practices during their stay in Hawaii. Additional exposure in airports and other points-of-entry into the state are currently being explored as potential opportunities for education.

Visitors are a crucial target audience for this education campaign. Work is continuing to develop to implement creative and cost-effective ways to engage travelers both before they reach Hawaii and during their stay in the islands to ensure they are well-equipped to protect themselves during their visit.

Social Media

In 2018, DOH will launch a series of social media advertisements via Facebook to remind the public of important prevention information. Infographics will be posted on DOH's Disease Outbreak Control Division's web pages for consistency, as it provides a one-stop shop for infectious disease related information in the social space. Social media is an efficient and effective means of message delivery, and DOH plans to expand efforts in this media format during the second fiscal year of funding.

Translated Materials

Through relationships built with government partners, non-profit community groups and faith-based organizations, DOH will bridge the communications gap that may exist with foreign language-speaking and low-literacy populations. The original angiostrongyliasis rack card has been translated into four different languages so far, including Japanese, Ilocano, Spanish, and German. DOH will assess further translation needs going forward and is also considering airing educational messages in various languages on local foreign language stations in the future.

Market Research: Focus Groups

As the first year of the campaign runs through June 2018, it will be crucial for DOH to learn from its target audiences how to refresh and update messaging for the second year of the campaign. In mid-2018, DOH is planning to commission/conduct a series of focus groups to determine if the messages have been effective and to learn where there may be gaps in messaging and how to best communicate key messages to the public.

Vector Control

The use of multidisciplinary teams to stop angiostrongyliasis from spreading at its source was an important effort recently initiated by DOH. Whenever local grocery stores or restaurants receive a shipment of produce that may have been infested with slugs or snails, they have been instructed to notify DOH. From there, members of DOH's vector control and/or food safety programs along with a representative from the Hawaii Department of Agriculture visit the farm where the produce was grown or production site where it was assembled and packaged. They work hand-in-hand with the grower to conduct an inspection (vector control), provide education, and ensure proper measures are in place to control snails, slugs, and rats. Farmers and retailers have been very cooperative with this new system, and we look forward to their continued partnership to better protect the public's health.

In 2018, DOH's Vector Control Program will contract with malacology experts from UH Manoa to undergo training in slug and snail identification, entrapment, and eradication. Mollusks collected will be catalogued and tested for A. cantonensis by UH Manoa malacologists. During the slug and snail trapping, Vector Control staff will also conduct training activities around rodent trapping. Rodents collected during these activities will be sent to the Hawaii Department of Agriculture's Veterinary Laboratory for processing. Costs associated with this particular project are being absorbed by DOH's Vector Control Program and are separate from those being covered by the legislative appropriation.

Photo courtesy of L. Castro, Hawaii Department of Agriculture

Epidemiology

Angiostrongyliasis presents many unknowns. Prevention, control, and disease investigation efforts, while thorough, are often hindered by an incomplete understanding of the risk factors relating to contracting the illness.

Through the Disease Outbreak Control Division, DOH plans to conduct a statewide population survey to better understand local demographics related to potential risk factors for angiostrongyliasis. Obtaining a more complete picture of the general food consumption habits, preferences, and practices of Hawaii residents will be beneficial in potentially identifying and describing additional risk factors, which will help direct the public health response and resources to prevent additional cases.

The survey instrument will consist of a questionnaire, which will be translated into six languages. DOH anticipates bringing a contractor onboard to support this effort in mid-2018.

Additional Partnerships

Hilo Medical Center's Rat Lungworm Disease Support Group

In November 2017, Hilo Medical Center (HMC) formed a Rat Lungworm Disease Support Group after survivors and their caregivers voiced a need for education, guidance, and support in the aftermath of contracting the disease. The group first met in December 2017 in Keaau and has been meeting on a monthly basis. Attendees include survivors, caregivers, healthcare providers, researchers from the University of Hawaii Daniel K. Inouye College of Pharmacy and John A. Burns School of Medicine, advocates, legislators and staff from DOH.

HMC is responsible for managing the support group, securing a meeting space, and informing and reminding the community about the meeting. DOH will be providing funding support going forward to help offset costs HMC incurs to host these vital meetings.

DOH will also help to support another HMC initiative, which will focus on assessing long term prognosis and rehabilitation of survivors through a comprehensive assessment. This assessment will include an MRI to assess for permanent structural damage as well as a comprehensive cognitive, psychological, and functional assessment. HMC has assembled the necessary assessment tools and a resource pool which includes a case manager, speech pathologist, and occupational therapist.

Hawaii Tribune Herald

Hawaii rat lungworm cases differ from others around globe

By JEFF HANSEL Hawaii Tribune-Herald | Thursday, January 11, 2018, 10:05 am

Members of the Governor's Task Force on Rat Lungworm Disease discuss with journalists what they learned shortly after speaking with health professionals.

Governor's Joint Task Force on Rat Lungworm Disease

The Governor's Joint Task Force has taken a leading role in prevention and education efforts. From attending local farmer's markets and setting up information tables, to attending HMC's aforementioned Support Group meetings, the Task Force is willing to leverage the expertise of its members and partners to move prevention initiatives forward.

In addition to developing clinical management guidelines (as discussed in the previous section), the Task Force is also looking for opportunities to partner with experts in the medical community to bring resources to victims of angiostrongyliasis. DOH plans to support these initiatives as they are developed in the near future.

Budget

Detailed below is the working budget for DOH's prevention and control efforts related to rat lungworm disease. The budget below is subject to change as efforts progress.

Items	Description	Cost
Communications	**FY 2017-2018 Public Outreach & Education**	
HAB Media Campaign	Partnership with Hawaii Association of Broadcasters (HAB) to produce television and radio public education announcements to air on 49 stations statewide from fall 2017 to summer 2018.	$125,000
Staff Position	Communications project coordinator for risk communication	$67,200
Pre/Post Campaign Research	Measure public perception to guide messaging strategies; evaluate campaign efficacy	$30,000
Movie Theater	Run advertisements in movie theaters operated locally by Consolidated & Regal (6-week statewide run)	$20,000
Printing/Collateral/Promo	Designing, printing and production of educational materials for statewide distribution	$15,000
County Initiatives	Support additional island-specific public information projects	$15,000
Internet/Social Ad Campaign	Graphic ads on local news websites and social media channels	$8,000
Ethnic Media Ads	Translate radio spots and air on ethnic media stations	$9,000
Community Meetings	Host community meetings to educate the public	$1,000
Equipment	Computers, camera, printer	$5,600
Visitor Industry	Provide support for initiatives focused at targeting and educating the visitor industry.	$5,000
	Public Information Campaign Total for FY 2017-18	**$300,800**

Epidemiology	**April 2018 - Sept. 2019**	
Statewide Survey	RFP for contracted services with a marketing/research firm to conduct a statewide population survey among 3,772 households on potential risk factors for rat lungworm disease, including information on types of food and consumption habits.	**$250,000**

Other State Initiatives	2018 - 2019	
RLWD Task Force Initiatives	Provide funding and support for initiatives of the Governor's Joint Task Force on Rat Lungworm Disease, such as updating medical guidance and increasing medical training opportunities and events for the health care community (estimated figure).	**$70,000**
RLWD Support Group and Hilo Medical Center Initiatives	Provide funding for the Rat Lungworm Disease Support Group, which convenes regularly on Hawaii Island under the facilitation of Hilo Medical Center staff. Funds will also be used to support costs of providing MRI assessments as well as staffing resources to provide long-term prognosis and rehabilitation to survivors of the disease in need.	**$29,294**

Communications	FY 2018-2019 Public Outreach & Education	
HAB Media Campaign	Continue partnership with Hawaii Association of Broadcasters to produce television and radio public service announcements to air on 49 stations statewide from Fall 2018 to Summer 2019.	$125,000
Staff Position	Continue communications project coordinator for risk communication through 2019.	$67,200
Pre/Post Campaign Research	Measure public perception to guide messaging strategies; evaluate campaign efficacy	$30,000
Movie Theater	Run advertisements in movie theaters operated locally by Consolidated & Regal (6-week statewide run)	$20,000
Printing/Collateral/Promo	Update design, printing and production of educational materials for statewide distribution	$10,000
County Initiatives	Support additional island-specific public information projects	$50,000
Internet/Social Ad Campaign	Graphic ads on local news websites and social media channels	$8,000
Ethnic Media Ads	Translate radio spots and air on ethnic media stations	$5,000
Community Meetings	Host community meetings to educate the public	$1,000
Visitor Industry	Provide support for initiatives focused at targeting and educating the visitor industry.	$5,000

Public Information Campaign Total for FY 2018-19	**$321,200**

Total Budget Plan for 2017-2019 Rat Lungworm Disease Control and Prevention Efforts (Estimated)	**$971,294**

Sources

1. Cowie, R. H. (2017). *Angiostrongylus cantonensis*: Agent of a Sometimes Fatal Globally Emerging Infectious Disease (Rat Lungworm Disease). ACS Chemical Neuroscience, 8(10), 2102-2104. doi:10.1021/acschemneuro.7b00335.
2. Hochberg NS, Park SY, Blackburn BG, et al, 2007. Distribution of Eosinophilic Meningitis Cases Attributable to Angiostrongylus cantonensis, Hawaii. Emerg Infect Dis. 13(11): 1675–80.
3. Kim, J. R., Hayes, K. A., Yeung, N. W., & Cowie, R. H. (2014). Diverse Gastropod Hosts of *Angiostrongylus cantonensis*, the Rat Lungworm, Globally and with a Focus on the Hawaiian Islands. PLoS ONE, 9(5). doi:10.1371/journal.pone.0094969.