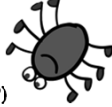


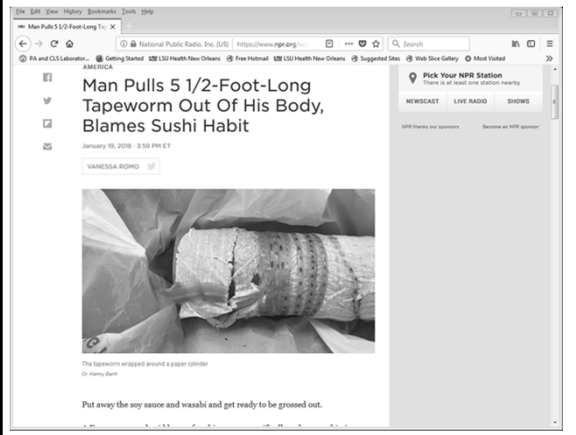
## ***Parasites & Fungi in Recent News***



**Michele B. Zitzmann, MHS, MLS(ASCP)**  
Associate Professor, LSUHSC, New Orleans  
Spring 2018 CLPC

## Objectives

- Discuss case studies involving various parasites and fungi reported in recent news articles.
- Describe the epidemiology and lab diagnosis for each organism.



The screenshot shows a news article on the USA Today website. The headline is "Man Pulls 5 1/2-Foot-Long Tapeworm Out Of His Body, Blames Sushi Habit". The article is dated January 16, 2018, at 3:59 PM ET. The author is Vanessa Romo. There is a photo of a long, segmented tapeworm wrapped in a paper towel. The article is categorized under "AMERICA".

## USA Today January 20, 2018

- Young man enters ER in Fresno, California
- Complains of bloody diarrhea & abdominal cramping
- Asks to be treated for worms
- Man hands doctor a plastic grocery bag containing a toilet paper roll



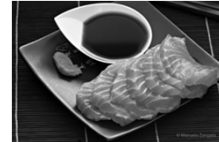
## USA Today January 20, 2018

- Patient explains the worm wriggled its way out of him as he sat on the toilet
- He "thought he was dying" & his "guts were coming out"
- He began pulling on the worm until it came out
- Was "relieved" it was a worm
- Measured 5 feet 6 inches (longest on record was 40 feet long)



### USA Today January 20, 2018

- Patient reported no trips abroad or drinking any questionable water
- Confessed his deep love of salmon sashimi
- Eats raw salmon almost everyday

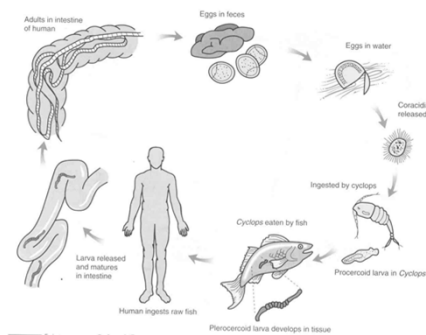


### Japanese Tapeworm

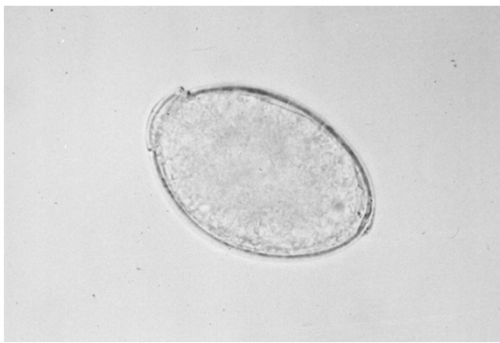
- *Diphyllobothrium* sp.
- Broad tapeworm
- Prevalent in Alaska
  - CDC study in 2017 found salmon infected with Japanese tapeworm
- Requires 2 intermediate hosts
  - Copepod (water flea)
  - Fish



### *Diphyllobothrium* Life Cycle

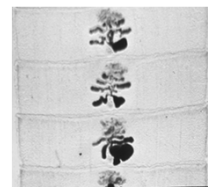
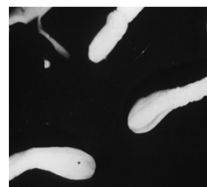


### Egg Morphology



### Adult Morphology

- May measure up to 10 meters long
- Scolex is elongate & spoon-shaped; contains two sucking grooves
- Proglottids (segments) are broad



## Clinical Disease & Diagnosis

- Usually minor symptoms: abdominal discomfort, weight loss, weakness
- Vitamin B<sub>12</sub> deficiency
- Eggs &/or proglottids found in stool
- Proglottids are passed in chains of a few inches to several feet long

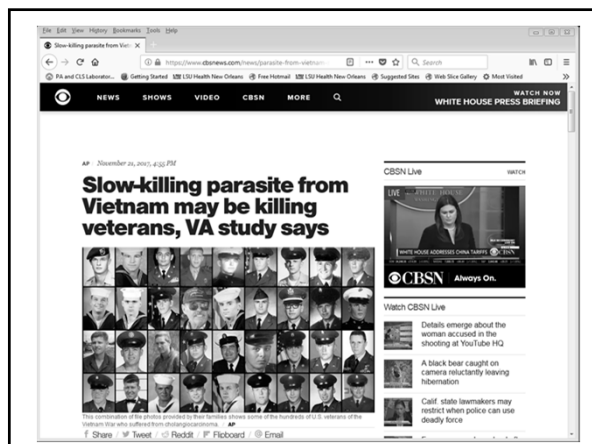
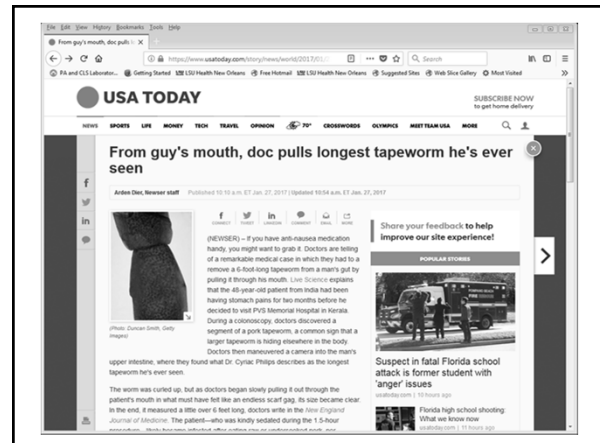
## Treatment



- Praziquantel
- Albendazole
- Medication depends on species of tapeworm
- Drugs target the adult, not the eggs
- Important not to be reinfected
- Handwashing very important

## Japanese Tapeworm

- Only about 2,000 cases reported in humans (mostly in northeastern Asia)
- Pork & beef tapeworms more common in U.S.
  - Caused by *Taenia* species
  - Estimated less than 1,000 cases/year



## CBS News November 21, 2017

- Dept. of Veterans Affairs
- Conducting study to determine if there is a link between liver flukes & bile duct cancer
- 700 veterans with cholangiocarcinoma have been seen by the VA in past 15 years
- At least 20% of blood samples submitted were + for liver fluke antibodies
  - Performed at Seoul National University in South Korea

### CBS News November 21, 2017

- 69 year old male in New York
- Participated in study
- No symptoms, wanted to help save lives
- Discovered 2 cysts on his bile duct
  - Potential to develop into cancer
- Cysts removed; doing well
- Most likely acquired from uncooked fish he ate in Vietnam when his unit ran out of rations in the jungle

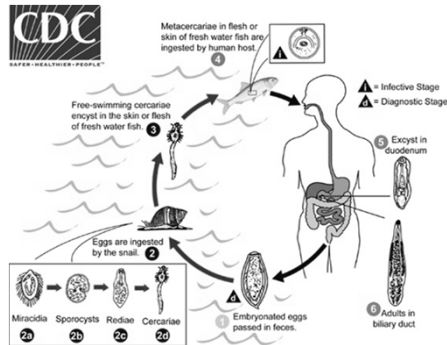


### Liver Fluke

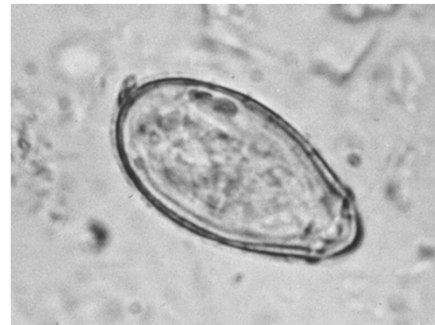
- *Clonorchis sinensis*
- Rarely found in Americans
- Infects about 25 million people worldwide
- Endemic in rivers of Vietnam
- Intermediate hosts:
  - Snail
  - Fish



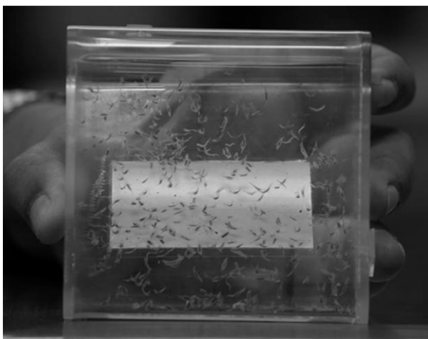
### *C. sinensis*: Life Cycle



### *Clonorchis sinensis*: Egg Morphology

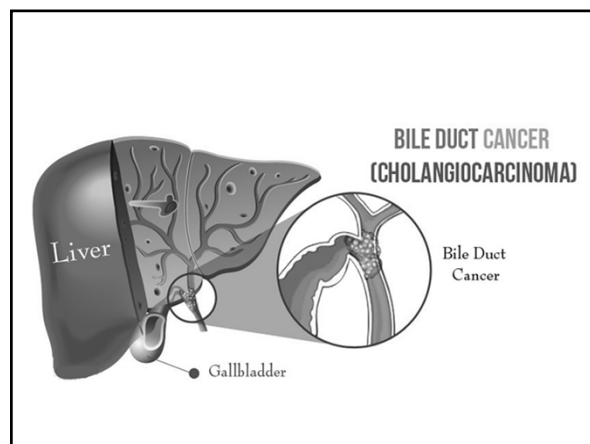
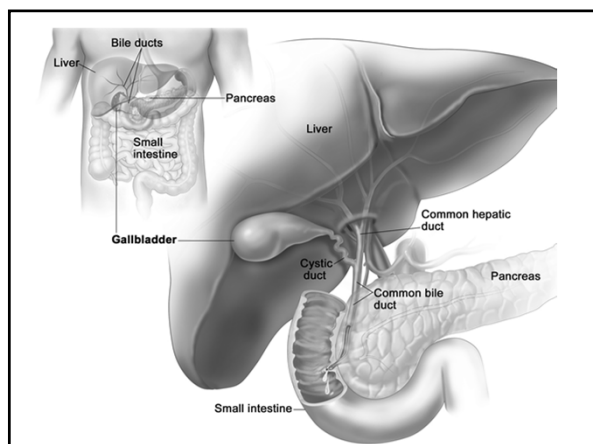


### Preserved liver flukes Siriraj Hospital in Bangkok, Thailand



### *C. sinensis*: Clinical Disease

- Symptoms:
  - Indigestion, abdominal pain
  - Malnutrition
  - Swelling, inflammation &/or obstruction of bile ducts
  - Cirrhosis of liver
- Linked to neoplasms of bile duct (cholangiocarcinoma)
  - Jaundice, abdominal pain, dark urine, fever, itchy skin, vomiting & unexplained weight loss



### *C. sinensis*: Diagnosis

- Patient history
- Recovery of eggs in stool or biliary contents
  - Unlikely in persons whose only exposure took place more than 25-30 years ago
  - Liver fluke must be alive to produce eggs
- Cysts can be detected by ultrasound, CT, or MRI
- No test to link liver fluke infection to cholangiocarcinoma

### Treatment

- Praziquantel
- Albendazole
- If left untreated, flukes can live for decades without making host sick



### VA Study

- 700 veterans with cholangiocarcinoma seen by VA in past 15 years
- Less than half submitted claims for service-related benefits
  - Not aware of possible connection to Vietnam
- VA rejected 80% of requests
  - Decisions made haphazardly
  - Depended on what desk it landed on



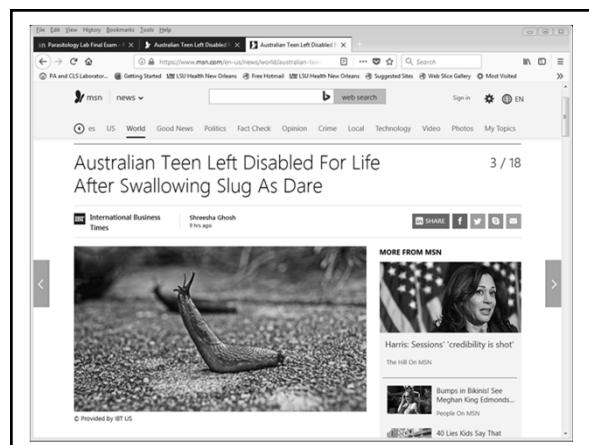
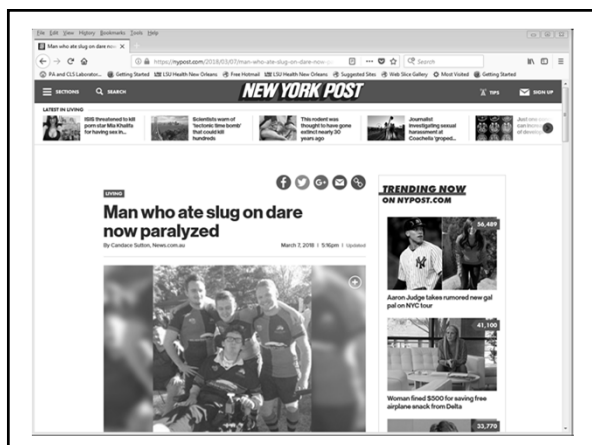
### VA Study

- Congress is researching the study & raising more awareness about liver flukes
- Vietnam veterans encouraged to have an ultrasound to detect inflammation of the bile duct
- Government recently posted a warning on its website
  - "Veterans who ate raw or undercooked freshwater fish while in Vietnam might have been infected."



## VA Study

- 65 year old veteran
- Claim was granted after being denied 3 times
- Doctor had to write letter
  - Bile duct cancer "more likely than not" caused by liver flukes
- "Those affected by Agent Orange automatically receive benefits"
- "We have to fight to receive help due to lack of awareness"



## New York Post March 7, 2018

- 19 year old male rugby player
- Sydney, Australia
- At birthday party with friends
- Sitting around table drinking red wine
- Garden slug noticed; was dared to eat it; he did
- Began feeling ill; taken to hospital



## New York Post March 7, 2018

- Diagnosed with eosinophilic meningo-encephalitis
- Lapsed into coma for 420 days
- Paralyzed below the neck
- Released from hospital 3 years later in motorized wheelchair

### New York Post March 7, 2018

- 8 years later:
  - Requires 24 hour care
  - Lives with tracheostomy tube
  - Experiences consistent seizures
  - Cannot control his body temperature
- Recently told that his benefits package was cut significantly

### New York Post March 7, 2018

- Australia's National Disability Insurance Scheme (NDIS)
  - Government run office
  - Deals with patients who are incapacitated & require monetary assistance for therapeutic/psychological well-being & care
- Family is facing huge debts & could lose many services
- Fighting to keep his benefits

### *Angiostrongylus cantonensis*

- Cause of patient's meningoencephalitis
  - Rat lungworm
  - Parasite typically infects rats
  - Can infect people who consume infected snails/slugs not properly cooked
  - Slugs become infected after ingesting feces of infected rats
  - May also be found in frogs, freshwater shrimp & land crabs
  - "Barber pole" appearance

### *Angiostrongylus cantonensis*



### *Angiostrongylus cantonensis*



### *Angiostrongylus cantonensis*

- Life Cycle:
  - Host is common Norway rat
  - Parasite found in lungs of rat, which excretes larvae in its feces
  - Snail & slugs are intermediate hosts, picking up larvae & excreting them in slime trails
  - Often crawl across vegetables, infecting human food sources



### Clinical Disease

- Incubation period
  - Usually 1-3 weeks
  - Can range from 1 day to greater than 6 weeks
- Symptoms
  - Throbbing headache
  - Stiff neck
  - Fever
  - Nausea/vomiting
  - Abnormal sensations of the arms & legs

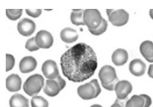
### Clinical Disease

- Severity of disease depends on number of larvae ingested & age of patient
  - Illness usually lasts 2-8 weeks
- Some people exhibit very mild symptoms



### Diagnosis

- Can be difficult
  - No available blood tests
- Patient history very important
  - Travel
  - Ingestion of raw/undercooked snails/slugs
- Eosinophilic meningitis
  - High levels of eosinophils in blood or CSF
    - Usually >10%
  - Lack of neutrophils (rules out bacterial meningitis)



### Treatment

- No specific treatment
- Anthelmintic agents & corticosteroids
  - Remains controversial
  - Many studies found that prednisone helped relieve headaches & shortened the duration of the illness



### *The Advocate*, March 22, 2000



- ANIMAL HEALTH:
- "Pacific area parasite creeping across state"
  - Microscopic parasite carried by rats & snails
  - Invaded south Louisiana
  - Killed zoo animals in N.O. & Lafayette
  - Infected horses, and one human

### *Angiostrongylus cantonensis*

- Endemic in the United States
- Believed to arrive in LA through rats on ships docked along Miss. River
- First discovered in LA by Tulane Medical Center researchers who often survey wharf rats, looking for tropical diseases



### *Angiostrongylus cantonensis*

- 1993: First documented case of human infection in LA
  - Occurred in New Orleans
  - 11 year old boy infected after eating a snail on a dare
  - Treated at Children's Hospital
  - CSF revealed 215 WBC's (16% eosinophils)
  - Recovered completely



### *Angiostrongylus cantonensis*

- 1998: Zoo of Acadiana, Lafayette
  - Red lemur found dead
  - Had displayed signs of neurological trouble
  - Cage in shady, damp area (environment snails & slugs like)
  - Parasite found in lemur's spinal cord



### Survey Conducted

- September, 1997 - September, 1998:
  - East BR Parish Rodent Abatement District
  - 113 rats trapped behind area grocery stores
  - 48% tested positive for *A. cantonensis*



### Audubon Zoo New Orleans



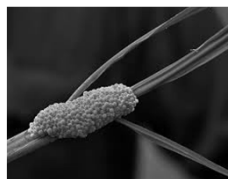
- After 6 animals were infected & some died, officials decided to have occasional "slugathons" by volunteers
  - One year, top collector gathered over 400 slugs & snails
- Since program began, no other cases of infection have been recorded

### Apple Snails

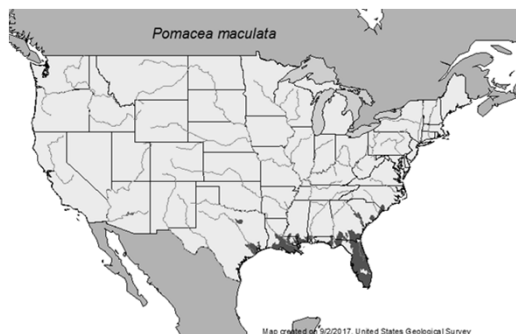


- Native to South America
- Introduced to SE United States through aquarium trade
- Found in lakes, rivers, streams, ponds & ditches
- Have negative impact on wetlands, agricultural crops & human health
- Can produce thousands of eggs/month in bright pink masses

### Apple Snails



## Geographical Map



## Apple Snail "Roundup" Mobile Bay, Alabama



## Apple Snail Eggs



## *Angiostrongylus cantonensis*

- March, 2006
- 22 year old in Lafourche Parish
- Hospitalized with neck pain, back aches & hypersensitivity to touch
- CSF revealed 304 WBC's/uL with 36% eosinophils
- Diagnosed with eosinophilic meningitis
- 9 days prior to onset of symptoms, he had eaten (on a dare) 2 raw legs from a green tree frog



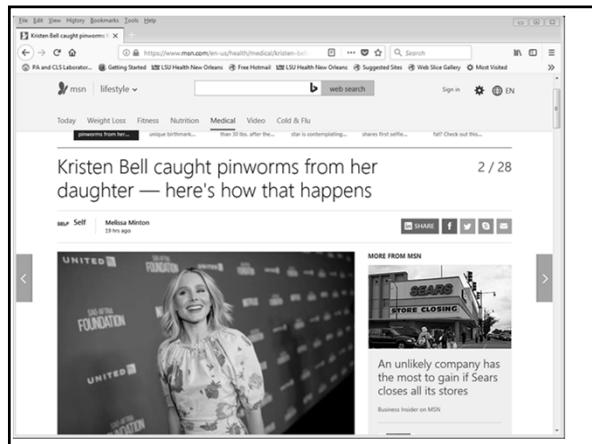
## Outbreak News Today September 28, 2017

- Infant in Hawaii
- Hospitalized after accidentally consuming a slug/snail
- 17<sup>th</sup> case of Angiostrongyliasis
  - Hawaii State Dept. of Health (DOH)



## Outbreak News Today September 28, 2017

- Hawaii Island Health Officer
  - Reminds parents to watch infants & toddlers when playing on ground
  - Help children properly wash hands
  - Inspect & wash all fruits & vegetables
  - Control snail/slug population in home gardens
  - Farmers should control snail/slugs & rats on farms



## Kristen Bell

- Revealed she caught pinworms from her 3 year old daughter
- Noticed that all carpeting at the preschool was gone
- Asked about it & was told that there was a case of pinworms
- Soon after, noticed her daughter was scratching her anal area - knew there was a problem!

## Kristen Bell



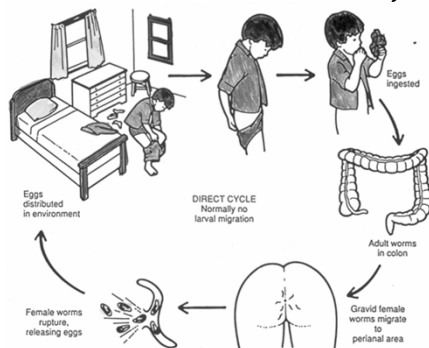
- Later that day, she felt "the itch"
- She wiped and saw a little white worm
- Then came a family round of "chalky nonsense from the drugstore"
- Eventually an end to the worms' reign of terror in their household!

## Pinworm infection

- Caused by *Enterobius vermicularis*
- Most common nematode infection in the world
- Very common in children
  - School classrooms & cafeteria
  - Daycare facilities



## *E. vermicularis*: Life Cycle



## *E. vermicularis*: Egg Morphology



### *E. vermicularis*: Adult Morphology



### *E. vermicularis*: Clinical Disease

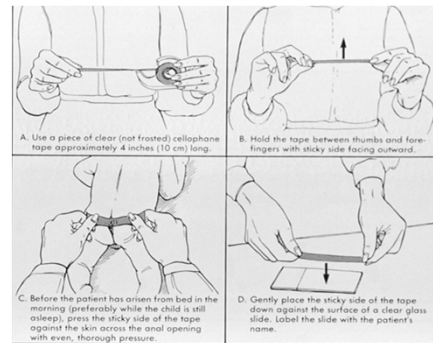
- Non-invasive organism
- Most common symptom - Perianal itching (pruritis)
- Transmitted by:
  - Direct anus to mouth contamination
  - Sleeping in same bed as carrier
  - Airborne eggs inhaled or swallowed

### *E. vermicularis*: Diagnosis

- Eggs in stool, perianal scrapings, or scotch tape prep
- Adult worm in stool



### Scotch (Cellulose) Tape Prep

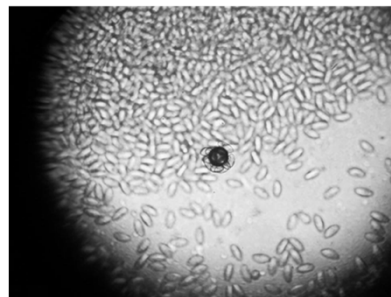


### Scotch (Cellulose) Tape Prep

- Best method for diagnosis
- Series of 4-6 preps may be necessary to receive a positive result
- Optimal sample taken after patient has been sleeping for several hours or immediately upon waking



### Pinworm infection - 15 month old (Lafayette hospital)



## *Enterobius vermicularis* Prevention & Treatment

- Total prevention not realistic
  - Short, clean fingernails
  - Closed sleeping garments
- Treatment
  - Mebendazole, Albendazole
  - Over the counter treatments



## CNN Health February 13, 2018

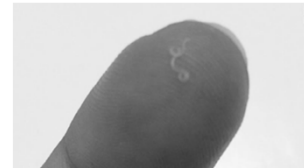
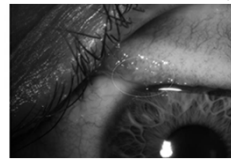


## CNN Health February 13, 2018

- 26 year old college student
- Lives on a cattle ranch in Oregon
- Salmon fishing in Alaska
- Began feeling a sensation of something in her eye
- Persisted for about 5 days
- Went to mirror & pulled out a clear thread from her eye
- It was squiggling around on her finger!



## CNN Health February 13, 2018



## CNN Health February 13, 2018

- Initially thought it was from the salmon
- Removed 4 more worms before she could see an eye doctor
- They didn't believe her; couldn't see any worms
- An hour later, they finally saw one; started screaming!

## CNN Health February 13, 2018

- Returned to Oregon to see her ophthalmologist
- He sent some of the worms to CDC
- Parasitologist ruled out all other "eye worms"
- Finally diagnosed as *Thelazia gulosa*, the cattle eye worm
- Never reported in people before
  - Had to refer to a 1928 reference written in German
- Case recently published in *American Journal of Tropical Medicine and Hygiene*

### *Thelazia gulosa* Life cycle

- Worms live on surface of a cow's eye
- Mate & produce larvae
- Causes pus to pour out of cow's eye
- A fly lands on pus & ingests larvae
- Larvae develops in fly then are released back into another cow's eye (or human eye in this case)
- Unable to survive without fly



### *Thelazia gulosa*



### *Thelazia gulosa*

- Over a few weeks, collected 14 worms from her eye
- Patient made full recover
- No permanent scarring in eye
- No lingering psychological scars
- Prognosis not very good for cattle
  - Worms stay in eye much longer & cause permanent scarring & blindness



### Fox News January 28, 2018



- Couple from Canada
  - 22 year old female; 25 year old male
- Vacationing in the Dominican Republic
- Experienced "incredibly itchy" feet after strolling on the beach
- Assumed it was due to sand fleas
- Worsened each day

### Fox News January 28, 2018

- Returned home to Canada
- Developed painful swelling & blisters
- Could not tolerate shoes or socks & used crutches to walk
- Multiple visits to hospital; misdiagnosed twice
- Third doctor identified the problem as cutaneous larva migrans caused by hookworm larvae

### Cutaneous Larva Migrans

- Caused by a hookworm of dogs & cats
- *Ancylostoma braziliense/caninum*
- Also referred to as "creeping eruption"
- Method of Infection:
  - Larvae in soil or sand penetrate skin
  - Papule forms & develops into linear tracts as larvae migrates through tissues

### Initial infection



### Linear tracts



### *Ancylostoma braziliense/caninum*

- Lives in the intestines of dogs & cats
- Larvae burrow through human skin when in contact with sand/soil contaminates with animal feces
- Diagnosis
  - Patient history
  - Characteristic linear tracts
  - No serological tests

## Treatment



- Couple prescribed Ivermectin
  - Anti-parasitic drug
- Canada's public health dept. denied medication request
  - Not licensed in Canada
- The male's mother drove over the Canadian-US border to Detroit to pick up the Ivermectin

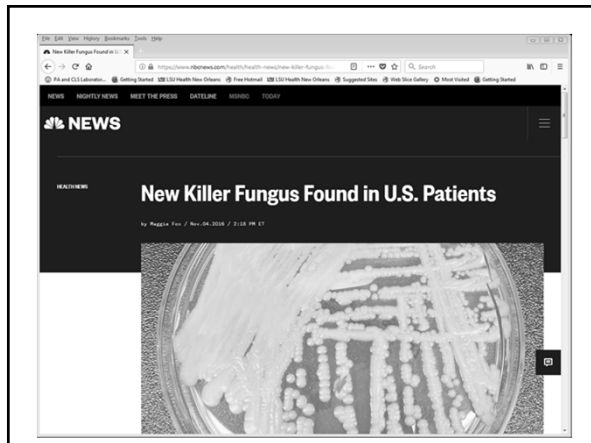
## Prevention



- Wear shoes when walking in sand
- Don't assume glamorous beach resorts are not at risk
  - Ask if private beach with no dogs allowed
- If symptoms occur (itchy feet), seek medical attention immediately



shutterstock 311287314



## NBC News November 4, 2016

- Newly identified fungus found in U.S hospitals
- *Candida auris*
- Yeast
- Can kill very sick patients
- First identified in 2009 in a Japanese patient with an ear infection

## *Candida auris*

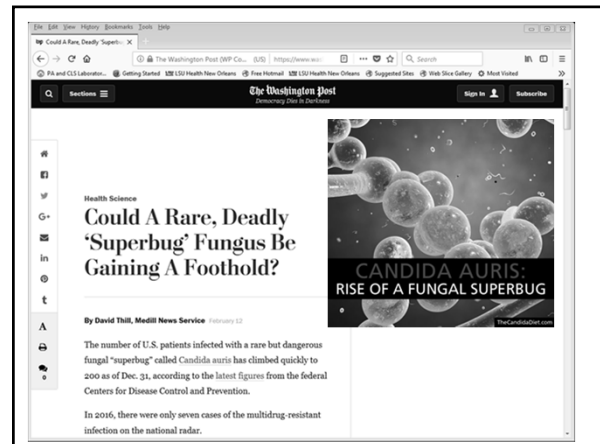
- June 2016
  - CDC asked doctors to begin looking for it
  - Found 13 cases over the summer
  - 4 patients died
    - 1 brain tumor; 2 blood cancer; 1 respiratory failure
  - Some strains were resistant to all antifungal drugs
  - Difficult to identify
    - Often mis-diagnosed as other yeasts

## *Candida auris*

- Appears to have arrived in U.S. in past few years
- CDC trying to understand how it spreads
- Organism found throughout the body and on the skin
  - Enters bloodstream through wounds, ventilators, or catheters
- Considered an emerging threat by CDC

## *Candida auris*

- At least 30% of infected persons in the U.S. have died
- Acts more like a nosocomial bacteria
- Mainly a hospital-acquired infection
- Healthy persons not usually at risk



## Washington Post February 12, 2018

- CDC reports:
  - "Number of U.S. patients infected with rare, but dangerous fungal "superbug" climbs to 200 as of Dec. 31"
  - Most cases (123) reported in New York; followed by New Jersey (48)



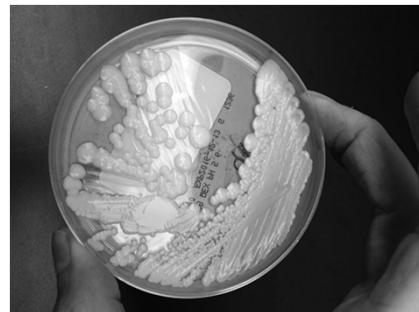
## Washington Post February 12, 2018

- Wide variety of organisms in the yeast family
  - Athlete's foot
  - Nail infections
  - Oral thrush
  - Vaginal yeast infections
- *Candida auris* can attack organs & is resistant to many medications

## *Candida auris*

- Transmitted easily between patients
  - Contact with contaminated surfaces
  - Person to person contact
- CDC recommends thoroughly cleaning hospital rooms with bleach and UV light
- Important to protect vulnerable patients
- Symptoms: fever & chills that don't improve with antibiotics

## *Candida auris* culture



## Diagnosis

- U.S. FDA recently authorized first test to identify *Candida auris*
  - MALDI-TOF
    - Technology known as matrix-assisted laser desorption/ionization time of flight
    - Mass spectrometry
    - Molecular identification
    - Reference organism database



## Treatment

- CDC recommends concurrent treatment with 3 antifungal drugs:
  - Anidulafungin
  - Caspofungin
  - Micafungin
- Infections in the U.S. have been successful with this protocol



## *Candida auris*

- Recommendations to medical facilities & laboratories
  - Continue to report cases
  - Forward isolates not identified using common methods to state/local health authorities & CDC
- CDC continues to study risk factors, transmission, & infection control



Questions  
are  
guaranteed in  
life;  
Answers  
aren't.