

West Coast Transplant ID:  
Crossing Species

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**HPI:** ██████████ presented with fatigue and progressive non-productive cough and dyspnea. At admission, ██████████ was also diagnosed with AML in blast crises.

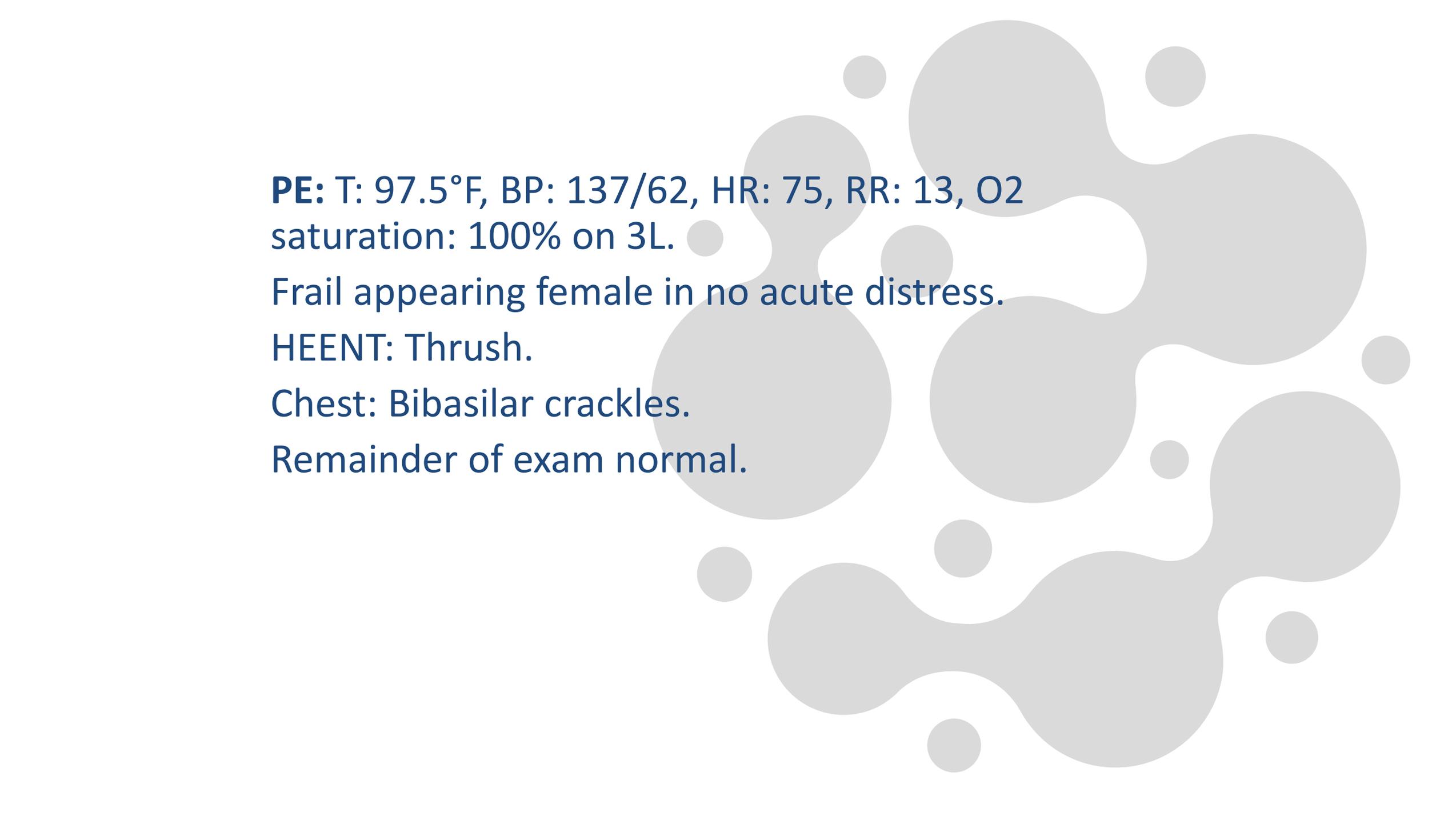
██████████ notes progressively worsening fatigue for 6 months, followed by cough and dyspnea on exertion for 4 months. Also, fevers, chills, and weight loss for the past few weeks.

No known sick contacts. No recent travel.

**PMH:** None

**Meds:** None

**SH:** Born in Illinois, now living in Southern California for several years. Exposed to tuberculosis as a child but was never treated for active or latent TB. Lives with ■ daughter and young grandchildren with a cat and a new 6-month-old dog that was adopted 4 months ago. Dog has had frequent vet visits for “worms.” The dog is up to date on its vaccinations.



**PE:** T: 97.5°F, BP: 137/62, HR: 75, RR: 13, O2 saturation: 100% on 3L.

Frail appearing female in no acute distress.

HEENT: Thrush.

Chest: Bibasilar crackles.

Remainder of exam normal.

**Studies:** WBC 61K (Blasts 65%, Mono 17%, Lymph 13%, Neutrophils 3%),  
Hb 7.6. Platelets 195.

LDH: 566

**Expectorated sputum culture:** WBC's seen. Normal upper respiratory  
flora

**AFB smear induced sputum:** negative, **TB NAAT:** negative

**(1,3)-Beta-D-glucan:** negative

**Aspergillus galactomannan sputum:** negative

**Coccidioides IgM/IgG:** negative

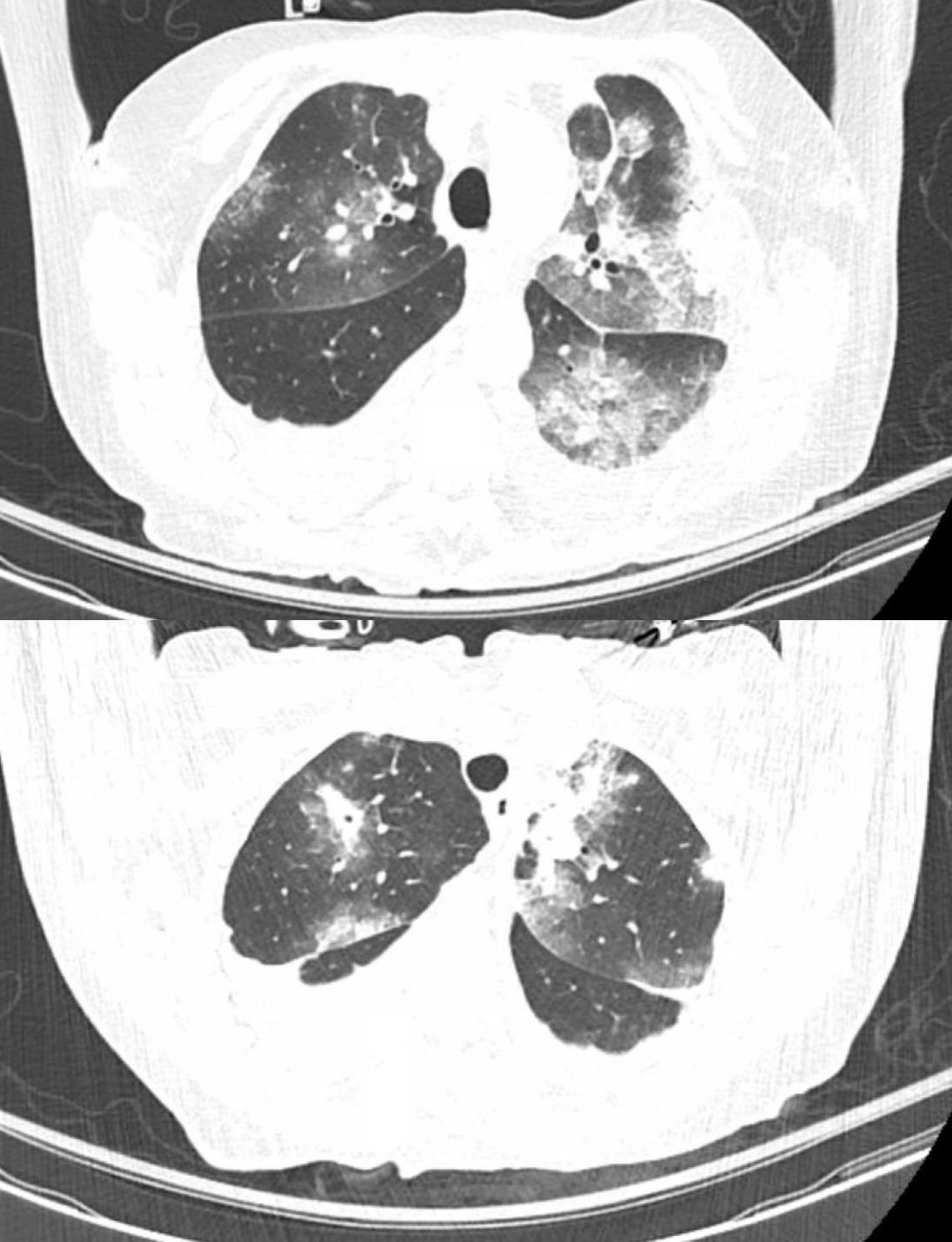
**Histoplasma antigen:** negative

**HIV antibody/antigen screen:** negative

**Quantiferon:** negative

**Blood cultures:** negative

**Respiratory pathogen multiplex PCR:** negative

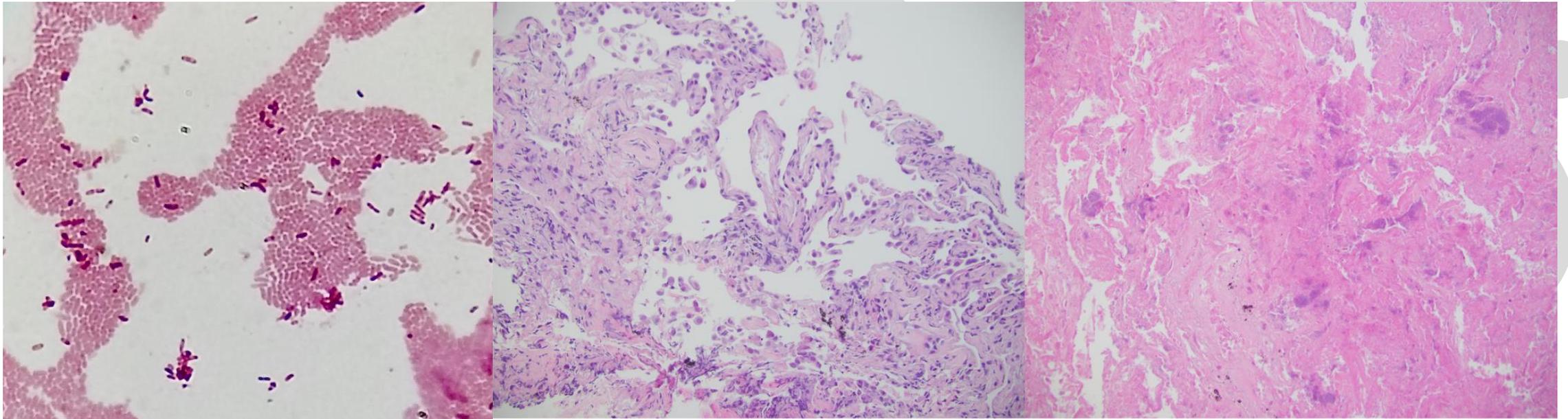


## Chest imaging

- Bilateral multifocal patchy groundglass and consolidative opacities in all lobes
- Bilateral moderate pleural effusions with associated lung atelectasis

# Diagnostic testing

Bronchoscopy with BAL and transbronchial biopsy was performed. Pathology performed with only necrotic debris and multiple bacterial colonies.



(From Left)

1. Gram stain with carbol fuchsin counter staining showing small gram-negative rod-shaped bacteria pathology from transbronchial biopsy.
2. H&E stain of alveoli
3. Necrosis with bacteria

## Diagnosis and Follow-up

- Culture from both BAL and transbronchial biopsy were identified on MALDI-TOF as *Bordetella bronchiseptica*.
- Patient was treated with levofloxacin with initial improvement in her cough and oxygenation.



Figure 5 – culture of isolate

# Poll Question

- What advice do you give to immunocompromised (or to be immunocompromised) patients with pets?

Pets	Keep It	Be Careful	Rehome It
Dogs			
Cats			
Birds			
Reptiles/Lizards			
Turtles			
Hamsters			
Rabbits			
Fish			
Horse			

# *Bordetella bronchiseptica*

## Microbiology

- Small, gram-negative coccobacillus with motility due to peritrichous flagella
- Closely related to *Bordetella pertussis* but can grow readily in culture media while *B. pertussis* is nutritionally fastidious and requires specialized media (Bordet-Gengou solid medium, Charcoal blood agar, etc.).
- Incubation of 3-4 days, but animals can shed for up to 3-4 months after recovery

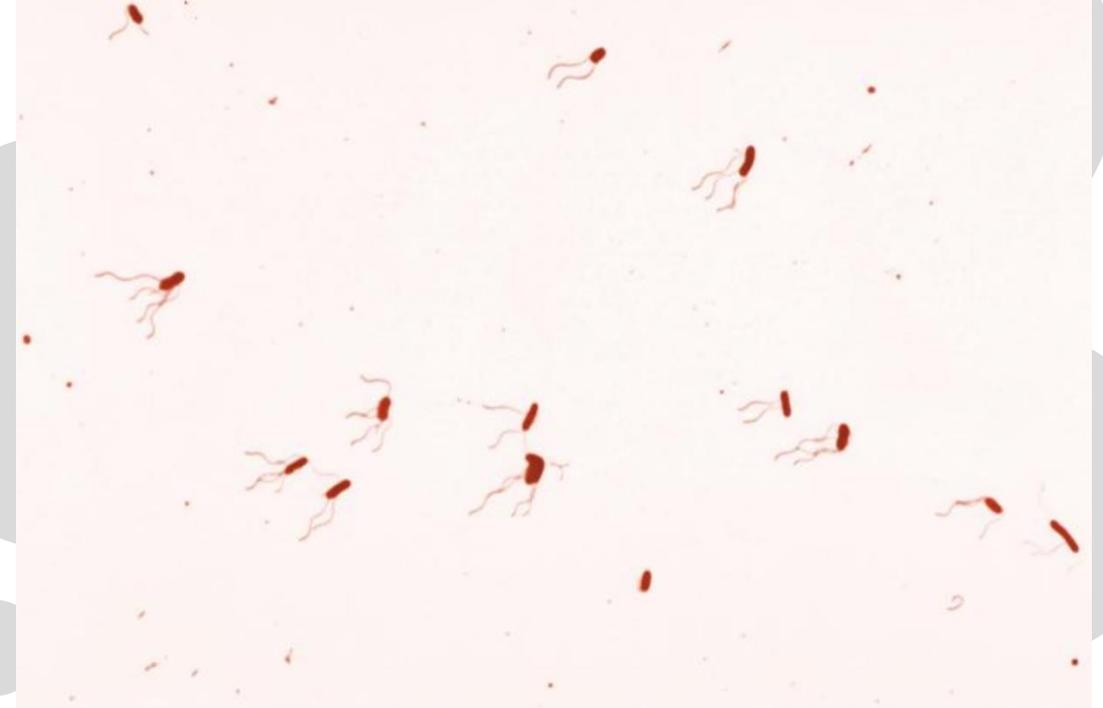


Figure 6 - Courtesy of CDC/Dr. William A. Clark

# *Bordetella bronchiseptica*

## Overview in Animals

- Typically seen in dogs as tracheobronchitis (“kennel cough”) but can also infect other animals (rabbits, pigs, cats, horses, and seals etc)
  - ~5% presumed asymptomatic carriage rate in dogs
  - Rabbits – Otitis media, tracheobronchitis
  - Swine – Turbinate atrophy
- Rarely infects humans (usually immunocompromised – HIV/AIDS, transplants, solid and hematologic malignancies)

# *Bordetella bronchiseptica*

## Transmission

- Droplet or Contact
- Capable of colonizing human respiratory tract by adhering to respiratory epithelial cells
- Nosocomial transmission from human to human has been reported in stem cell units and pulmonary wards [Huebner et al (2006). J Clin Microbiol 44(7): 2581-2583, Stevens-Krebberts et al (1999). J. Hosp. Infect 43: 323-324]
- Surge of cases reported in dogs in late 2022, together with H3N2 strain of canine influenza [<https://www.kttc.com/2023/05/04/veterinarians-raise-red-flags-over-highly-contagious-canine-flu/>]

## *Bordetella bronchiseptica*: Clinical Manifestations in Humans

- Usually immunocompromised host, but also reports in immunocompetent hosts with high inoculum exposures as well (i.e. breeders, farmers, etc)
- Typically reported as causing pneumonia or bronchitis
- Case reports of sinusitis, whooping cough, meningitis, endocarditis, peritonitis, bacteremia, and pancreatic abscess have been described

## *Bordetella bronchiseptica*: Diagnosis

- Bacterial culture
- PCR test (in animals)
- Cell-free DNA testing
- Broad range PCR



Figure 7 – culture from biopsy

# *Bordetella bronchiseptica*: Treatment

- In limited studies, susceptible to anti-pseudomonal penicillins, carbapenem, fluoroquinolones, aminoglycosides, but usually not macrolides
- Doxycycline frequently used in dogs but no CLSI interpretation
- Potent  $\beta$ -lactamase producer: may show initial response to  $\beta$ -lactam antibiotic, followed by deterioration in clinical status.
- Organism anchors to epithelial surface of the airway and may require prolonged antimicrobial administration for complete resolution of disease (range 2-6 weeks).

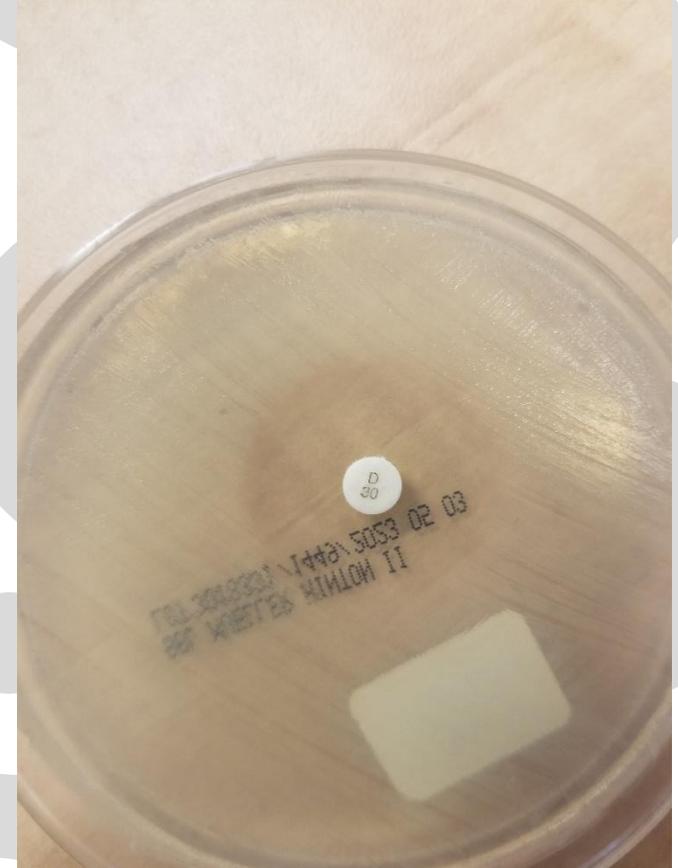


Figure 8- doxycycline zone size  
27mm

# Pet Ownership in the US

- As of 2023, 63% of homes own a pet.
- This number keeps increasing as 78% of adults surveyed by Forbes acquired pets during the COVID-19 pandemic.
- Significant increase of life satisfaction among pet owners without obvious increase in hospitalizations
  - 96% are obtained pre-transplant

## Pet Ownership by Generation and Pet Type



Source: Forbes Advisor 2022 Survey • [Get the data](#) • [Embed](#)

**Forbes** ADVISOR

# Poll Question Answer

- What advice do you give to immunocompromised (or to be immunocompromised) patients with pets?

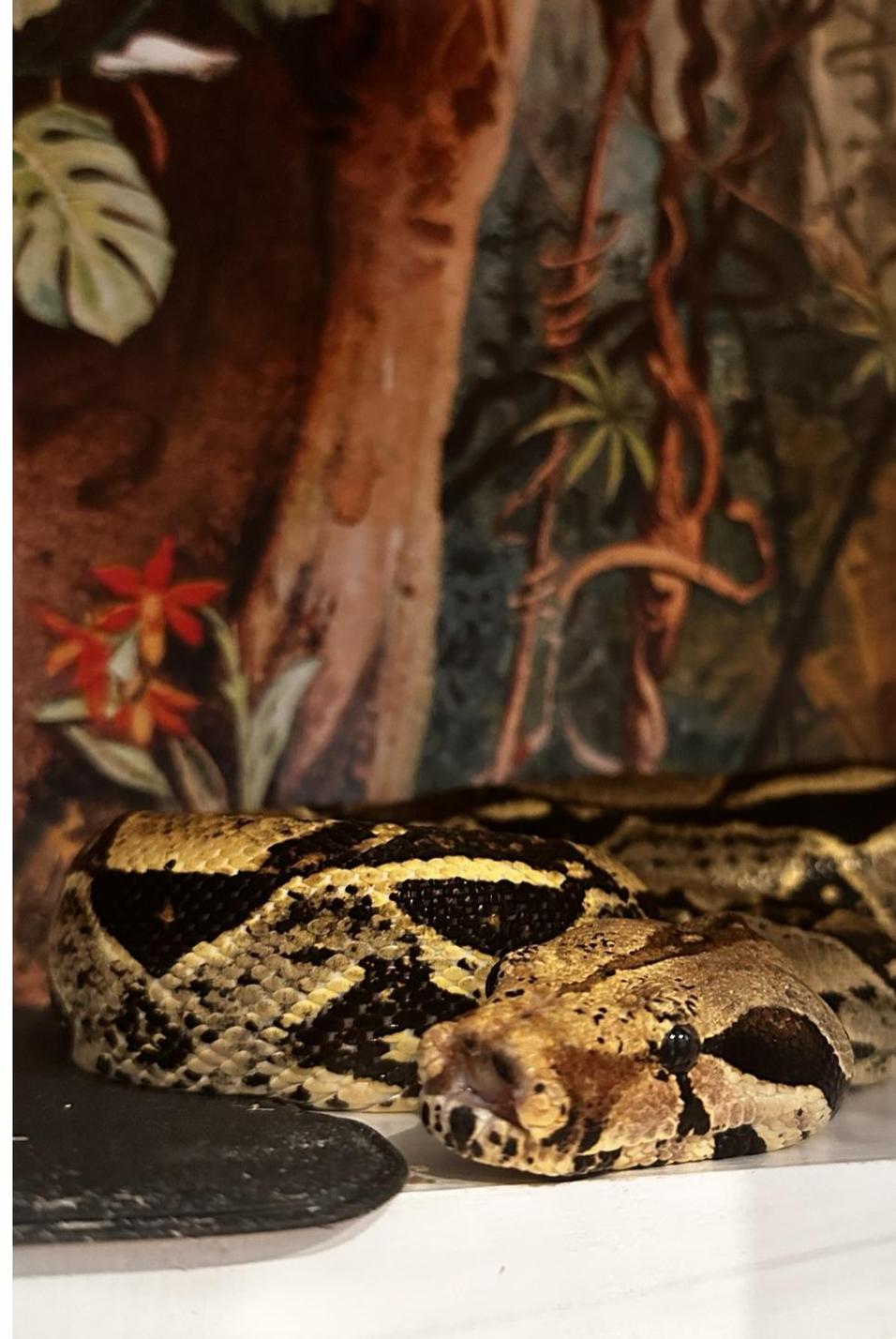
Pets	Keep It	Be Careful	Rehome It
Dogs	x	x	
Cats	x	x	
Birds	x	x	
Reptiles/Lizards		x	x
Turtles		x	
Hamsters		?	
Rabbits		?	
Fish		x	
Horse		?	

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# AST Guidelines 2019 on Pet Ownership

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- Those who work with animals (vets, pet shop employees, farmers, slaughterhouse, or lab workers) should avoid working during periods of maximal immunosuppression.
- Do not acquire a new pet immediately post-transplant.
- Pet health maintenance is important.
- Avoid contact with animals that have diarrhea.
- Avoid contact with bird cages, feeders, litter boxes, or feces. Use disposable gloves and surgical masks.
- Avoid contact with nonhuman primates.
- Avoid lizards (snakes, iguanas, turtles, etc), chicks/ducklings, stray animals (bites/scratches), racoons, exotic pets.
- Wear gloves for aquariums.



"When there is a cat in the history, it is always to blame"

# CLASSIC CAT-ASSOCIATED INFECTIONS

.\* My cat loves P Peanut B Bu T T Ter

PP = Plague (*Yersinia pestis*), *Pasteurella*

B = *Bartonella*, *Bordetella bronchiseptica*

TTT = Tularemia (*Francisella tularensis*), *Toxoplasma*,  
*Toxocara cati*

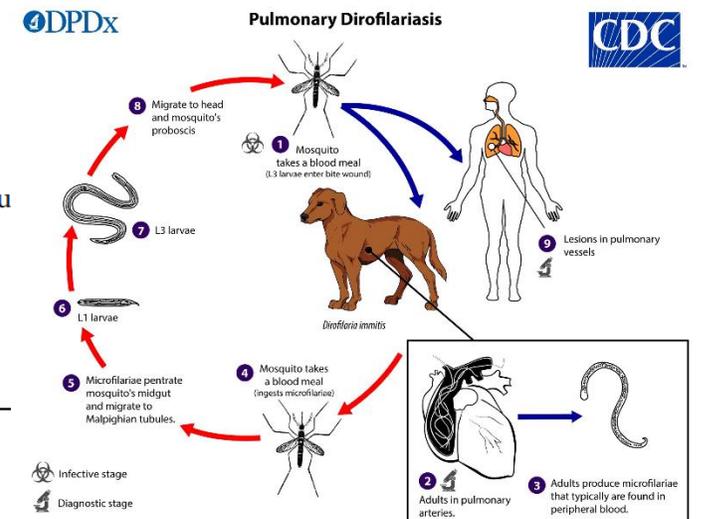
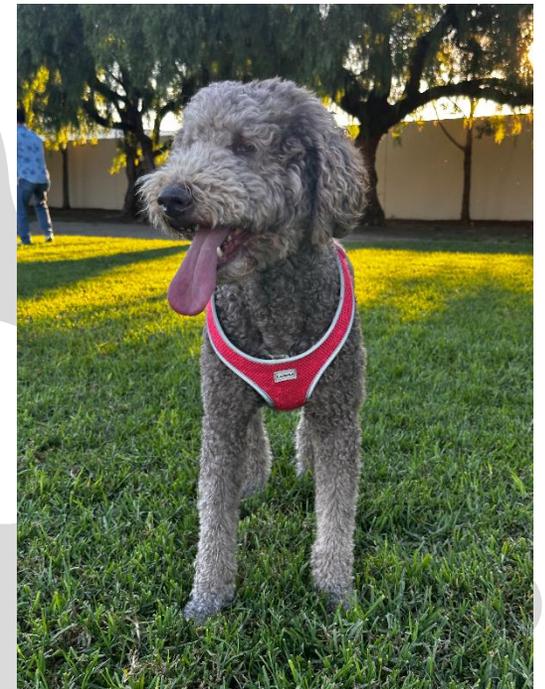
@MDDreamChaser  
Episode 2: Brains and lungs and eyes, oh my!  
febrilepodcast.com | @febrilepodcast | @swindong



# Dog Associated Infections

TABLE 1. Selected Diseases Transmitted by Dogs Stratified by Transmission Route

Transmission Route	Selected Diseases
Direct contact (bites)	Rabies (rabies virus) <i>Capnocytophaga canimorsus</i> infection Pasteurellosis ( <i>Pasteurella</i> spp.) <i>Staphylococcus aureus</i> , including methicillin-resistant strains <i>Streptococcus</i> spp. Infection
Direct or indirect contact	Flea bites, mites Fungal infection ( <i>Malassezia pachydermatis</i> , <i>Microsporum canis</i> , <i>Trichophyton mentagrophytes</i> ) <i>Staphylococcus aureus</i> infection Mites ( <i>Cheyletiellidae</i> , <i>Sarcoptidae</i> )
Fecal-oral	Campylobacteriosis ( <i>Campylobacter</i> spp.) Paratyphoid ( <i>Salmonella</i> spp.) Giardiasis ( <i>Giardia duodenalis</i> ) Salmonellosis ( <i>Salmonella enterica</i> subsp <i>enterica</i> serotypes)
Droplet	<i>Chlamydophila psittaci</i>
Vector-borne	Ticks (dogs passively carry ticks to humans; disease not transmitted directly from dog to hu <ul style="list-style-type: none"> <li>Rocky Mountain spotted fever (<i>Rickettsia rickettsii</i>)</li> <li>Ehrlichiosis (<i>Ehrlichia</i> spp.)</li> </ul> Fleas <ul style="list-style-type: none"> <li><i>Dipylidium caninum</i></li> <li><i>Bartonella henselae</i></li> </ul>



# Zoonotic Infections

## Rabbits



Cheyletiellosis  
Ectoparasites  
Pasteurellosis  
Ringworm  
Salmonellosis  
Tularemia  
Yersiniosis

## Ferrets



**Campylobacteriosis**  
Ectoparasites: fleas  
Influenza  
Rabies  
Ringworm  
Roundworms  
Salmonellosis  
Tuberculosis

## Mice and Rats



Leptospirosis  
Lymphocytic choriomeningitis  
Pasteurellosis  
Rat bite fever  
Ringworm  
Salmonellosis  
Yersiniosis

## Pocket Pets



### Gerbils

Ectoparasites  
Leptospirosis  
Salmonellosis  
Tularemia

### Guinea Pigs

Campylobacteriosis  
Chlamydiosis  
Ectoparasites  
Lymphocytic choriomeningitis  
Pasteurellosis  
Ringworm  
Salmonellosis  
Sarcoptic mange  
Tularemia

### Hamsters

Campylobacteriosis  
Ectoparasites  
Leptospirosis  
Lymphocytic choriomeningitis  
Mites/mange  
Pasteurellosis  
Ringworm  
Salmonellosis  
Tularemia

### Hedgehogs

**Lymphocytic choriomeningitis**  
Ringworm  
Salmonellosis  
Yersiniosis

## Pet Birds



**Campylobacteriosis**  
**Cryptococcosis**  
Newcastle disease  
Pasteurellosis  
**Psittacosis**  
Salmonellosis  
Tuberculosis

## Reptiles and Amphibians



Campylobacteriosis  
Mycobacteriosis  
**Salmonellosis**

## Aquarium Fish



Chlamydiosis  
Cryptosporidiosis  
Erysipeloid  
Mycobacteriosis  
Meloidosis  
Salmonellosis

# Pet Vaccines

- What specific guidance do you provide to your transplant patients regarding vaccinations for their pets?

# Mode of Transmission in our Case???

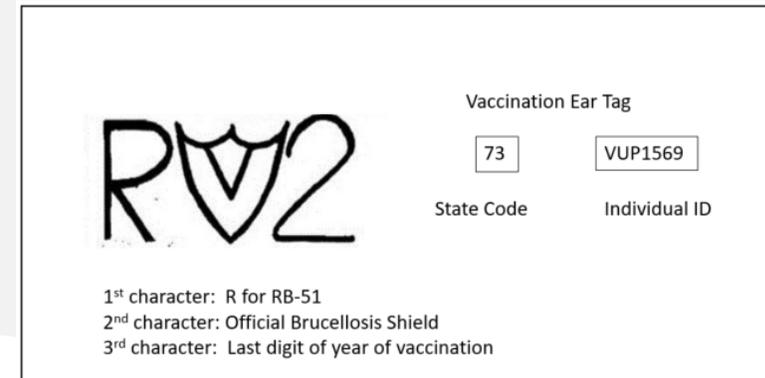
- Vet waiting room exposure
  - Asymptomatic carriage in patient's dog and/or cats
  - Canine *Bordetella* live vaccine exposure
- Report of infection from the live canine vaccine exposure in a solid organ transplant recipients [Kraai et al (2023). OFID 10(8):ofad421]

# Live Vaccine Zoonosis

- *Bordetella* is the most common live vaccine given routinely to dogs and cats with possible zoonosis
  - 14yo M with history of being “sprayed” in the face with vaccine w/ Pertussis-like symptoms for 3-4 months
  - 43yo F with spondyloarthritis (on TNF-alpha inhibitor) with proven *Bordetella* transmission from vaccine strain [Kraai et al (2023). OFID 10(8):ofad421]
- AST IDCOP specifies to avoid holding the animals for *Bordetella* vaccination and to avoid contact with the dog’s nose or face after vaccines.
  - Shedding period is up to 7 weeks though?
  - Consider requesting *Bordetella* as injection (non-live vaccine)?

# Live Vaccine Zoonosis

- *Brucella abortus* vaccine RB51, S19 (cattle), *B melitensis* Rev-1 (sheep, goats) from needlestick injury, lab exposure, eye and wound splashes, prolonged skin exposure, and stillborn calf exposure
  - Some vaccine types (*B melitensis* in Israel) persist in animal milk
  - PEP/PrEP with Doxycycline or TMP-SMX for 21 days
  - Regular symptom checks up to 24 weeks after exposure
- Rabies oral baits: Some live recombinant vaccinia vector vaccines, given in up to 16 states for raccoons and gray fox/coyotes
  - Sachet coated with fishmeal coating
  - Potential transmission noted, no cases reported including immunocompromised [MMWR 62(14): 267-269]



# Pet Therapy Question

- Do you allow pet therapy or animal assisted visits on your BMT/hematologic malignancy unit and/or in the rooms of your SOT recipients?

## SHEA EXPERT GUIDANCE

## Animals in Healthcare Facilities: Recommendations to Minimize Potential Risks

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TABLE 5. Summary of Policy Requirements for Personal Pet Visitation

Situation	Institutions (N = 23), No. (%)
Did not allow personal pets	4/23 (17)
No response or did not submit policy and procedure	6/23 (26)
Allowed personal pets	13/23 (54)
Allowed only dogs and cats	6/13 (46)
Allowed dogs only	2/13 (15)
Specified age (>1–2 y/o) and duration of ownership (>6–12 mo)	5/13 (38)
Did not specify type of pets	5/13 (38)
Excluded many types of animals	3/13 (23)
Visitation prohibited for patients in isolation, ICU, or immunocompromised	6/13 (46)
Case-by-case determination	8/13 (44)
Allowed pets for extenuating circumstances	6/13 (46)
Specified duration of visitation (1–2 hr)	5/13 (38)
Required certification of pet's immunization status and good health	5/13 (38)

NOTE. ICU, intensive care unit.

TABLE 7. Areas of Healthcare Facility In Which Animals Were Prohibited (Responses = 315)

Area in Healthcare Facility	Percent of Facilities Prohibiting Animals from Respective Areas, No. (%)
Intensive care unit	230 (73)
Operating room	293 (93)
Kitchen	211 (67)
Pharmacy	280 (89)
Step-down units	123 (39)
Recovery room	271 (86)
Central processing	290 (92)

# SHEA Guidance continued (2015)

- All visiting animals should be restricted from entering the following clinical area at all times,
  - Intensive care units
  - Isolation rooms
  - Neonatal and newborn nurseries
  - Areas of patient treatment where the nature of treatment (eg resulting in pain for the patient) can cause the animal distress
  - Other areas identified by the healthcare facility (eg. Rooms of immunocompromised patients)



Thank you!  
Comments/questions?