

Animal Bites and Zoonosis

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Disclosures

- Views are my own opinion, and not those of the US Army or WRAIR
- I have no financial relationships with any of the products / companies discussed

Outline

- Dogs
- Cats
- Other pets
- Exotics
- Most dangerous animal in the jungle
- Review

A few cases along the way...

- **Bite Infections**

- mix of anaerobes and aerobes from patient's skin and animals oral cavity

- **Zoonosis**

- Animal disease that is transmissible to humans (humans are usually an accidental host)
- Spread by aerosols, feces, urine, insects, and direct skin contact

Bites

- 1% of all ER visits
- 60% related to dogs, 10% -20% cats
- Dog bites account for \$1 Billion/year in USA
- Age and gender
 - Age <20 and males more frequent victims for all bites
 - Females and elderly more common in cat bites
- Exotic animals



Envenomations

TABLE 2. TYPES OF MICROORGANISMS ISOLATED FROM 50 DOG BITES AND 57 CAT BITES, ACCORDING TO THE TYPE OF INFECTION.*

TYPE OF MICROORGANISMS	ABSCESS		PURULENT WOUND		NONPURULENT WOUND	
	DOG BITE (N=6)	CAT BITE (N=11)	DOG BITE (N=29)	CAT BITE (N=22)	DOG BITE (N=15)	CAT BITE (N=24)
	number of bites (percent)					
Aerobes only	1 (17)	3 (27)	10 (34)	7 (32)	10 (67)	8 (33)
Anaerobes only	1 (17)	0	0	0	0	0
Aerobes and anaerobes	4 (67)	8 (73)	18 (62)	14 (64)	2 (13)	14 (58)
No growth on culture	0	0	1 (3)	1 (5)	3 (20)	2 (8)

*Because of rounding, not all percentages total 100.

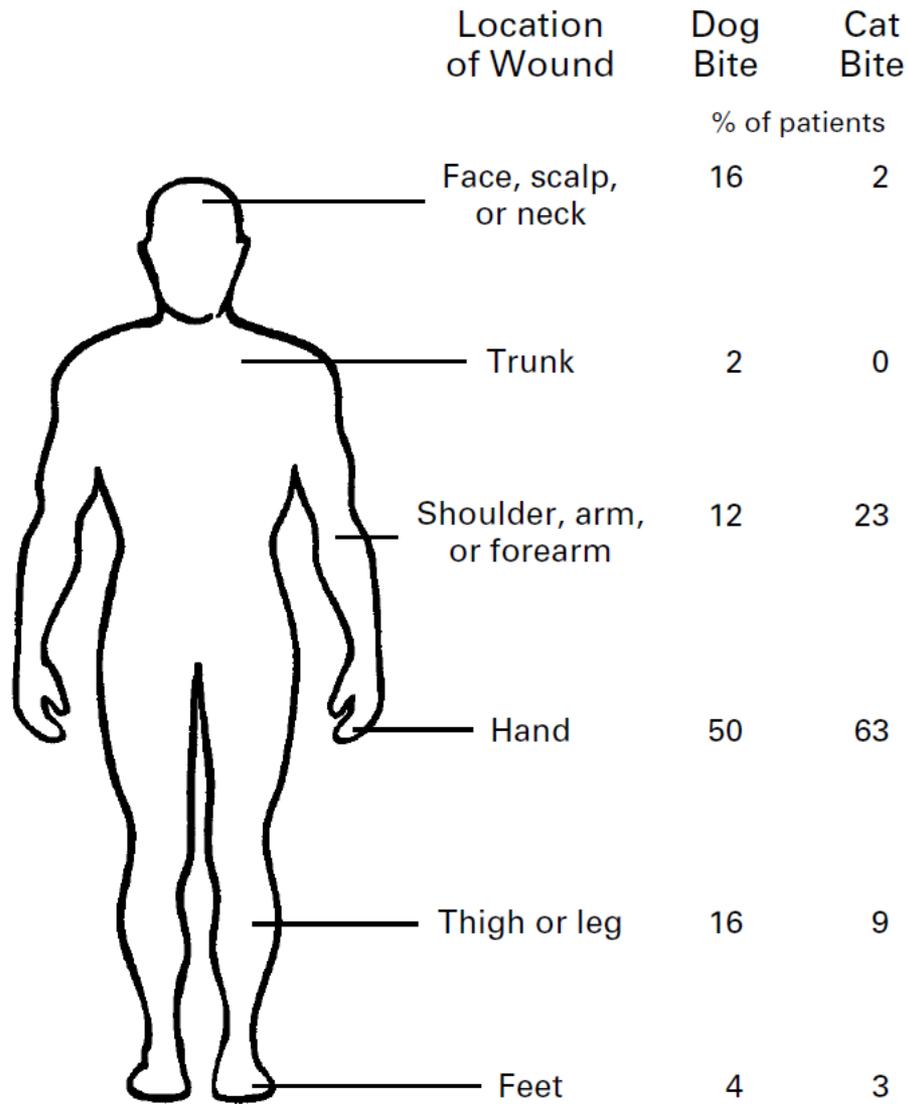


Figure 1. Location of Wound Infections in 50 Patients Bitten by Dogs and 57 Patients Bitten by Cats.

Dogs



Dogs

- Risk of Bite injury
- Type of dog
 - Working dogs and aggressive breeds at higher risk
 - Pit bull terrier, rottweiler, german shepherd, akita
- Age of victim
 - Young boys (age 5 – 9)
- Area of bite
 - Children: face, head and neck
 - Adults: hand, face, scalp, neck, thigh, leg
- Type of bite
 - Severe crushing injury can cause depressed skull frx, severe scalp and intracranial bleed, facial disfigurement, damage to the great vessels and nerves



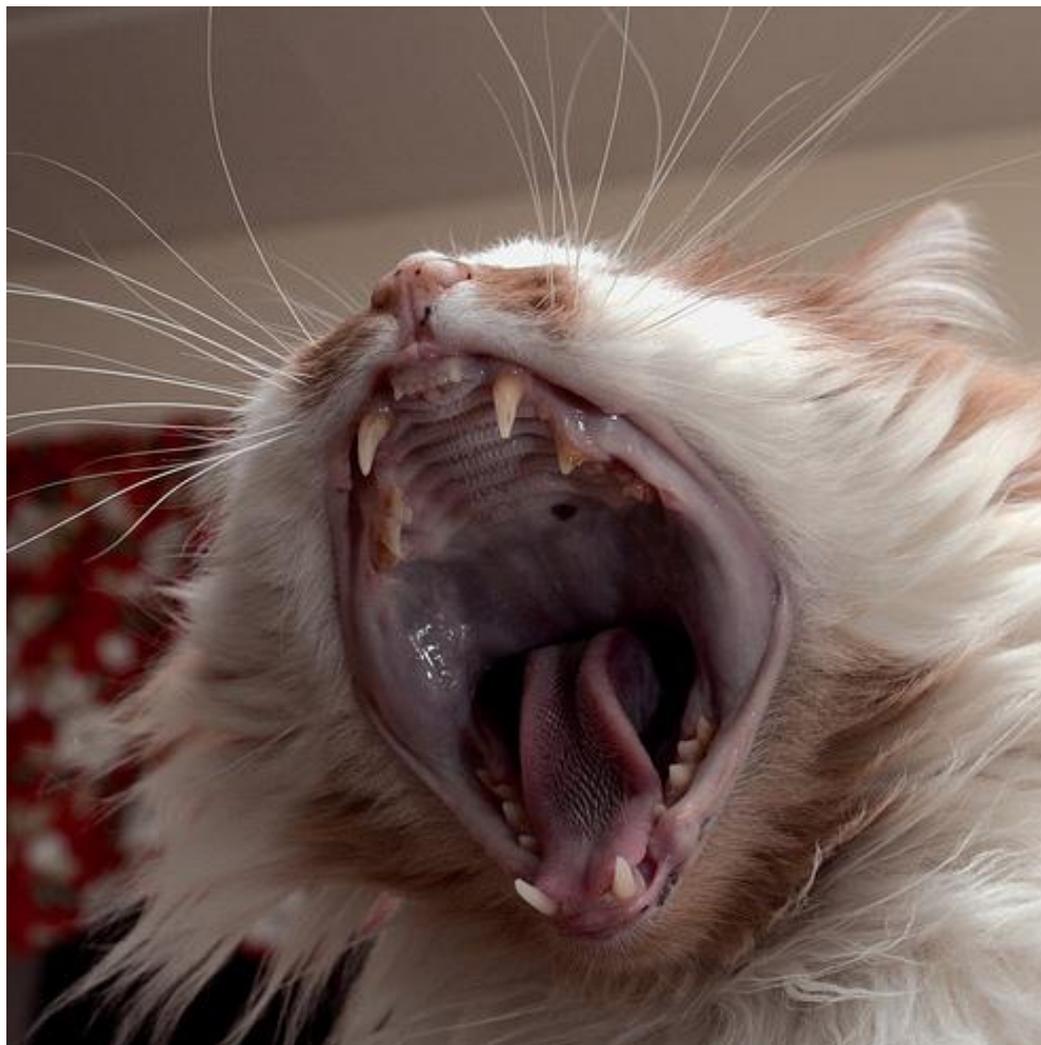
Dog Bites - organisms

- Aerobic
 - Pastuerela spp,
 - Streptococcus spp
 - Staphylococcus spp
 - Neisseria
- Anaerobic
 - Fusobaterium
 - Bacteriodes
 - Porphyromonas
 - Prevotella
 - Capnocytophaga canimorsus

Dog Bites

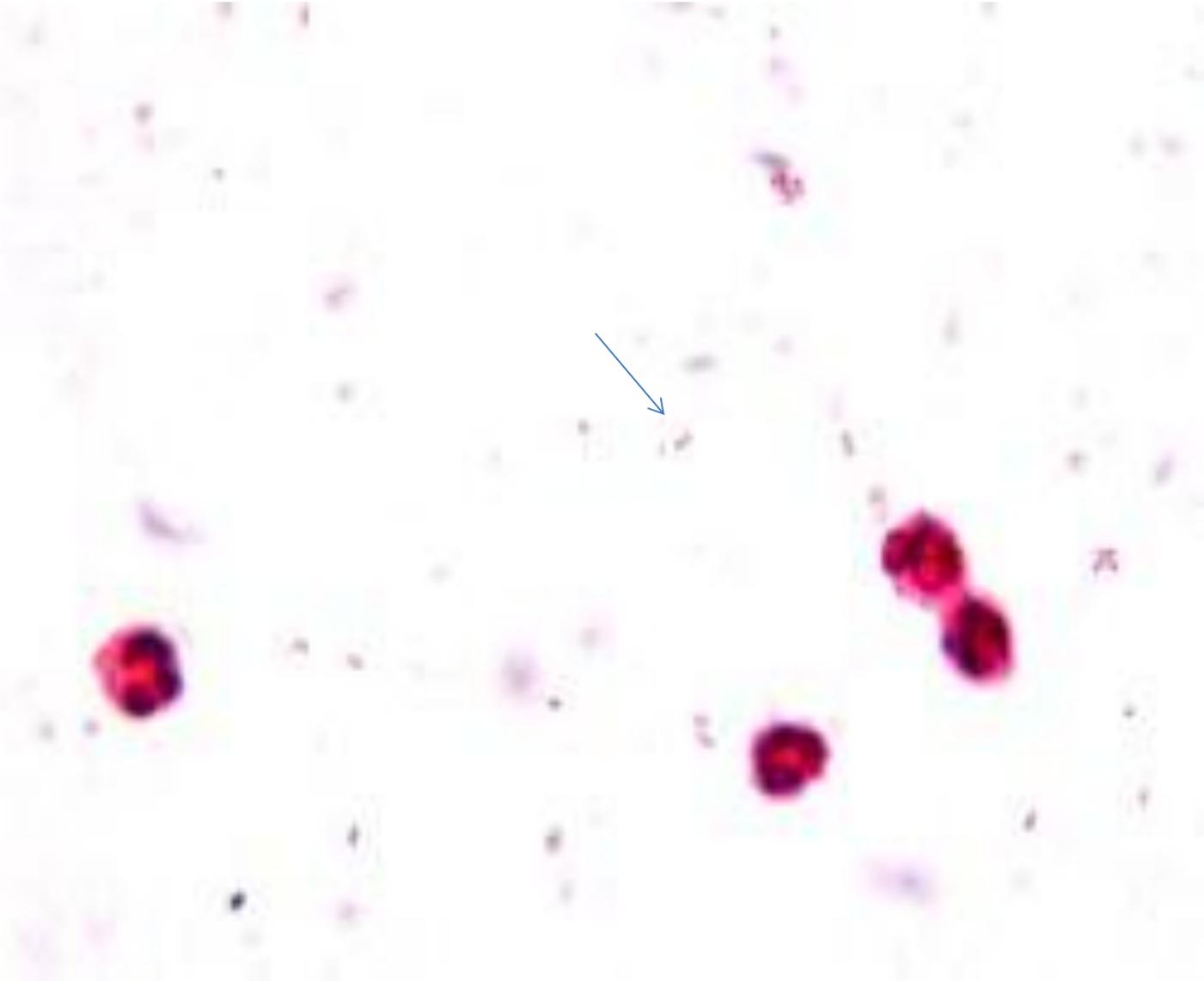
- Only 2 – 10% get infected
- *Pastuerella* spp
 - Resistant to: cephalexin, clinda, diclox, emycin
 - Suscept to: PCNs, FQs, Doxy, TMP/SMX, ESC
- *Capnocytophaga* spp
 - Resist to: TMP/SMX, ?Vanco
 - Suscept to: Amox/Clav, PCN G, Clinda

Cat Bites



Cat Bites - organisms

- Aerobic
 - Pastuerella spp,
 - Streptococcus spp
 - Staphylococcus spp
 - Bartonella henselae
 - Neisseria
- Anaerobic
 - Fusobacterium
 - Bacteriodes
 - Porphyromonas
 - Prevotella



**Gram-negative, non-spore-forming bacilli consistent with
*Pasteurella multocida***

Pasteurella multocida

- In saliva of >90% of cats, over 80% of wounds get infected
- Different species, *Pasteurella canis*, in saliva of 50% dogs, only 2 – 8% get infected
- Small aerobic GN bacilli
- Amoxicillin sensitive

Pasteurella multocida

- Cause serious infections
 - Necrotising fasciitis
 - Septic arthritis
 - Osteomyelitis
 - Less commonly, sepsis, septic shock, and meningitis.
- Severe infection (ie, sepsis and septic shock) can be seen in:
 - Infants
 - Pregnant women
 - Patients on chronic steroids,
 - HIV-positive individuals
 - Organ-transplant recipients
 - Other immunocompromised patients

Pasteurella multocida

- Bacteremia
 - occurs in 25–50% of patients with pneumonia, meningitis, and septic arthritis due to *P multocida*.
 - *many patients with* bacteremia have evidence of notable liver disease.
 - rare cases of bacteremia have also in previously healthy individuals. In such cases, **Mortality remains substantial at 25%**.

Cats



Septic arthritis of left first proximal interphalangeal joint

Girl vs Cat

- 15 yo female with wound from cat on forearm
- Seen in ED, wound cleaned, treated with amox/sulbact orally
- Wound slowly became worse, somewhat ulcerative. Patient now back in ED for further evaluation.
- Upon further questioning, she had a hx of recurrent infections



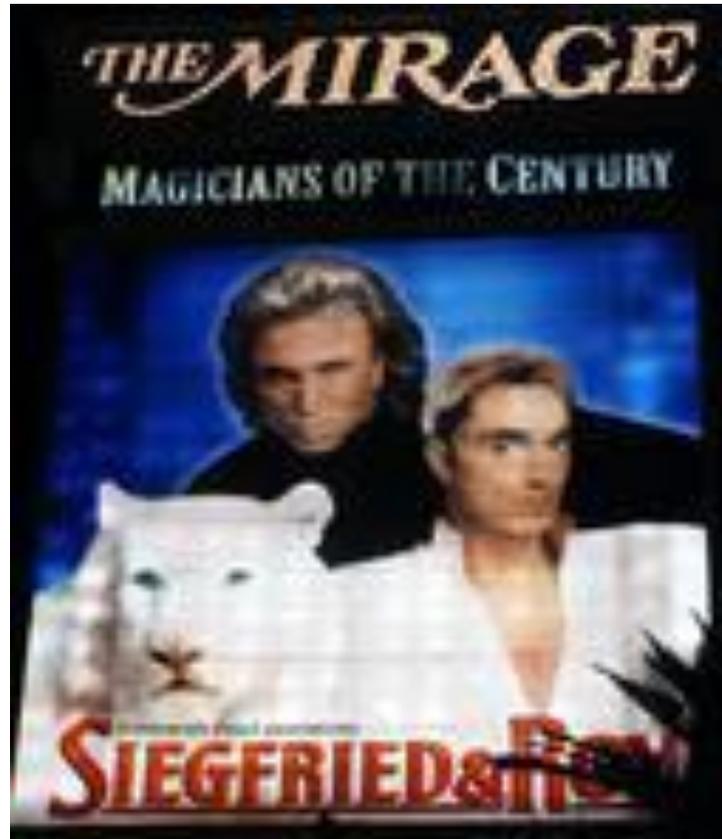


MRSA infection of the left forearm of a 15-year-old



cat had developed recurrent MRSA culture-positive skin lesions of the perineal area

Roy Horn of Siegfried and Roy attacked by tiger



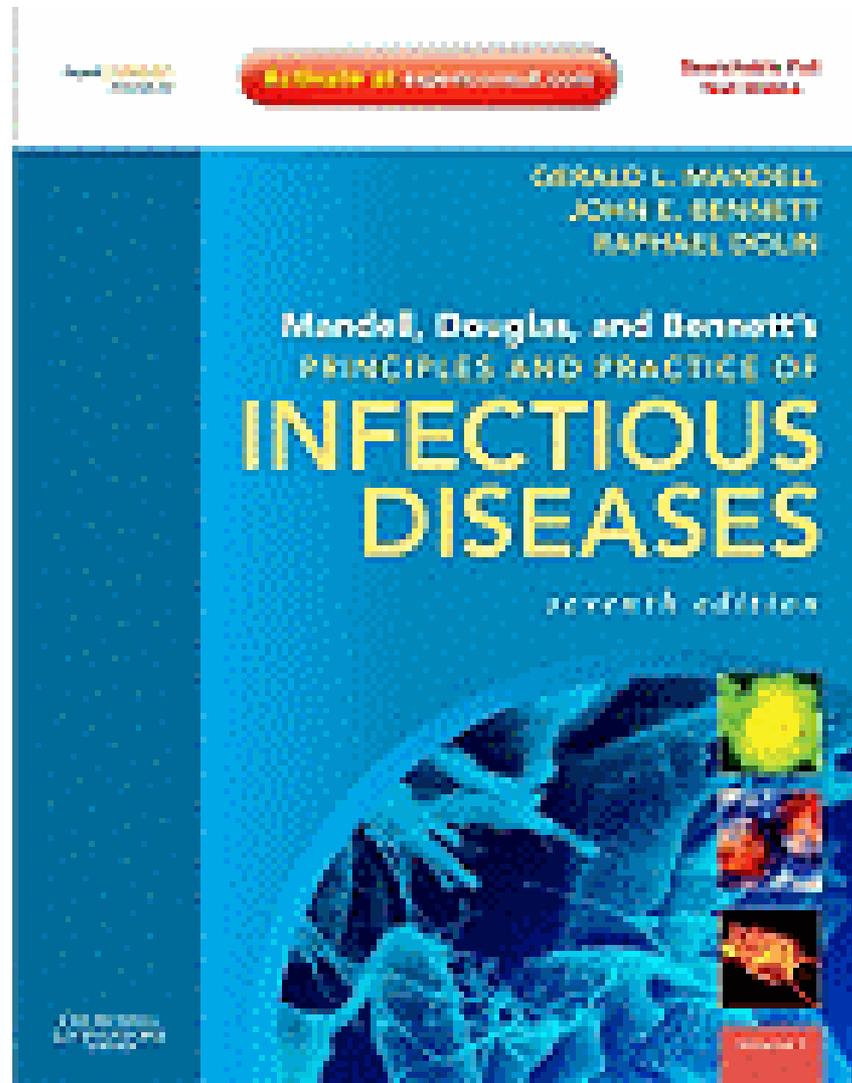
Don't try this at home...or abroad

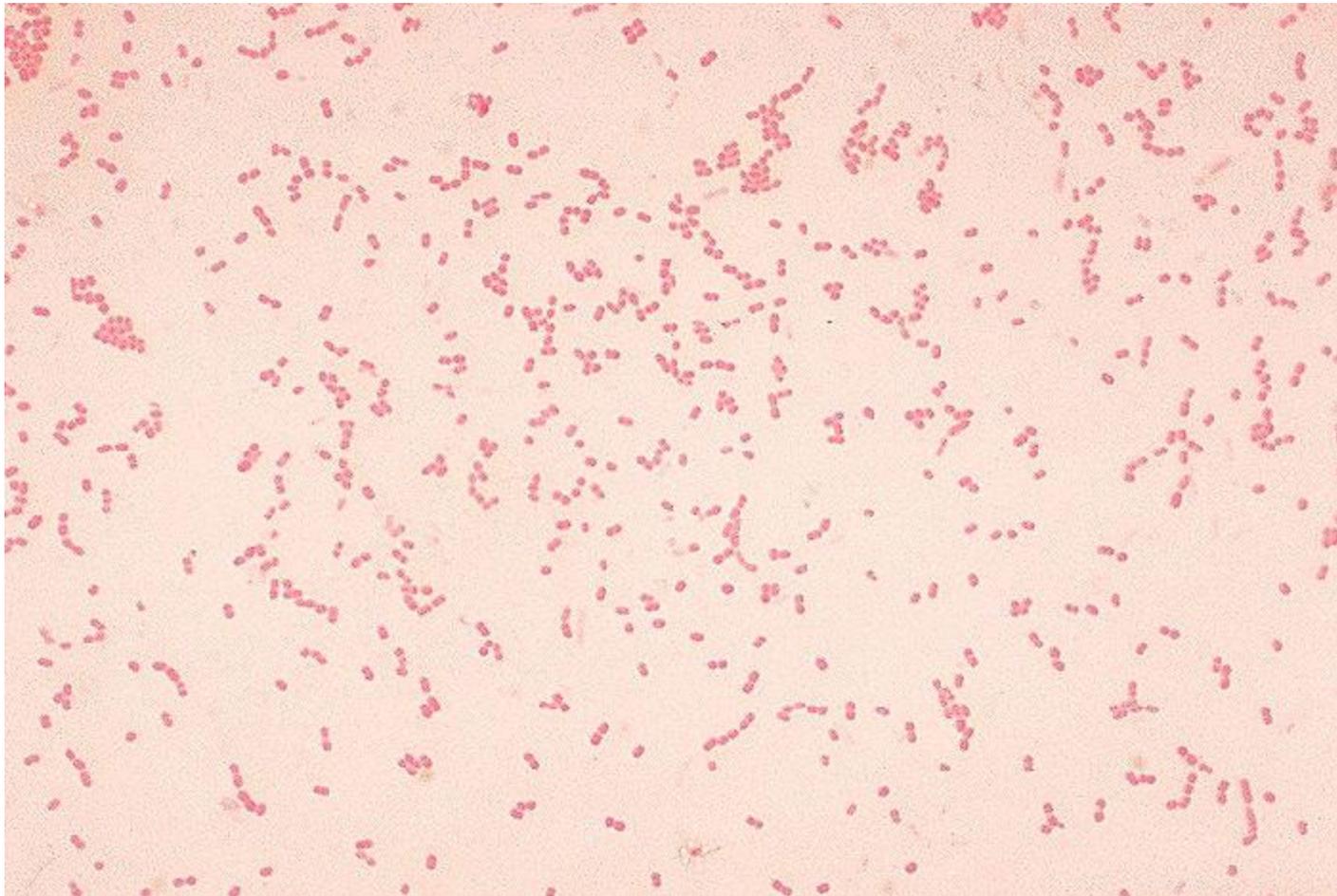


Tiger Bite

- September 18, 2003, a group of U.S. Army Reserve soldiers and Iraqi police were patrolling in the zoo after it had closed.
- A soldier had his right arm severely mauled by a male Bengal tiger; he had reportedly attempted to feed the tiger a chicken kabob
- Bystanders, seeing the attack, shot and killed the animal
- Bleeding was stopped, wound debrided, placed on broad spectrum ABX and patient medi-vaced to WRAMC for further debridement and therapy.

PPID; Ellie J.C. Goldstein MD





fastidious gram negative bacillus

Acinetobacter baumannii

- Environmentally present
- Occurs in many of the wounded coming in from theater
- Treated with further wound revision, broad spectrum ABX to include Amox/Sulbact and Colistin, wound eventually healed.
- Sustained a substantial amputation of arm in sequential surgical revisions.

Horses

- Fecal transmission. Unlikely, but considered in those with close equine contacts
 - Salmonella
 - Usually mild, self limited disease
 - Severe cases (septicemia, meningitis) in immunocompromised
 - Campylobacter
 - Incubation 1 – 7 days
 - Abd pain and bloody diarrhea
 - Cryptosporidium
 - Rarely from healthy horses
 - Intracellular protozoan parasite
 - C parvum and C hominis are the likely human pathogens
 - Giardia lamblia-
 - directly or thru contaminated **H₂O**
 - Clostridium difficile-
 - no horse to man transmission

Horses

- Aerosol
 - Rhodococcus equi
 - GP pleomorph: coccoid on solid, rods/filaments in liquid
 - Found in the soil contaminated with herbivore manure
 - Horses have lung disease, UC and mesenteric adenitis
 - Humans – pulmonary infection most common occurs in immunocompromised
 - Brucella suis and abortus
 - Unlikely, but occurs with exposure to Blood and Body Fluids
 - Coxiella burnetti
 - Q fever
 - Generally flulike illness, pneumonia, hepatitis
 - Chronic infxn results in endocarditis

Horses

- Mosquito-borne disease
 - EEE: low/undetected viremia
 - WEE: low/undetected viremia
 - West Nile: low/undetected viremia
 - VEE horse is primary amplification host
 - Prevent by immunizing horses
 - Found in FLA to South America
 - Incubate 1-6 days in man
 - 0.5% adults on 4% children develop encephalitis
- Infected saliva
 - Rabies unlikely but possible

Rabbits

Video Available at <http://www.youtube.com/watch?v=XcxKIJTb3Hg>

Rabbits

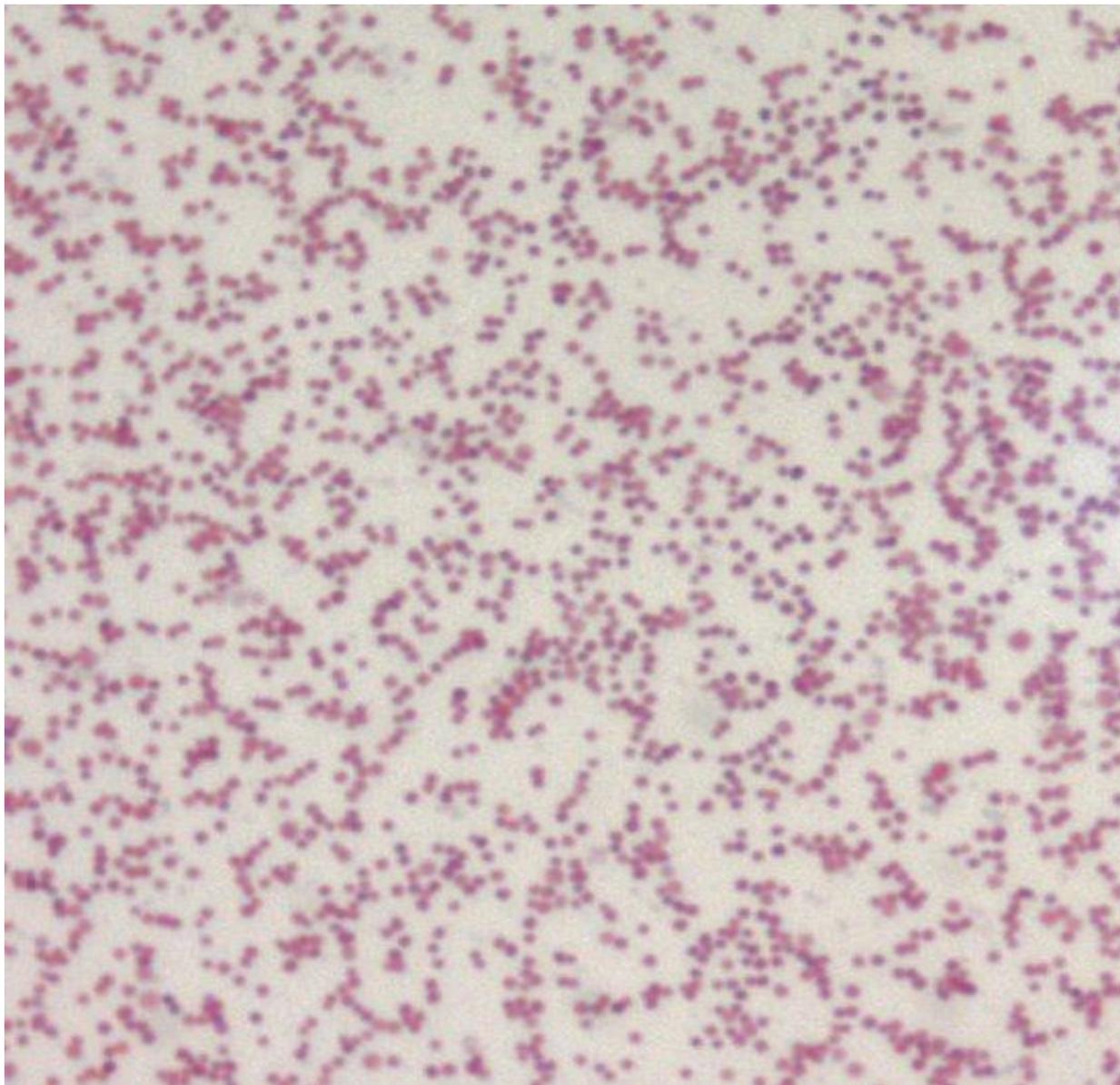
- GI
 - Salmonella, Yersinia pseudoTB, Crypto
- Respiratory
 - Pasturella multocida (no bunny to man trans) causes eye infections and snuffles in rabbits
 - Bordetella bronchseptica respiratory infxn that can trans to man
- Neurologic
 - Rabies reported in 7 rabbits
- Cutaneous
 - Dermatophytes transmitted by direct skin contact
- Zoonoses
 - Tularemia
 - Babesiosis

Rabbits?

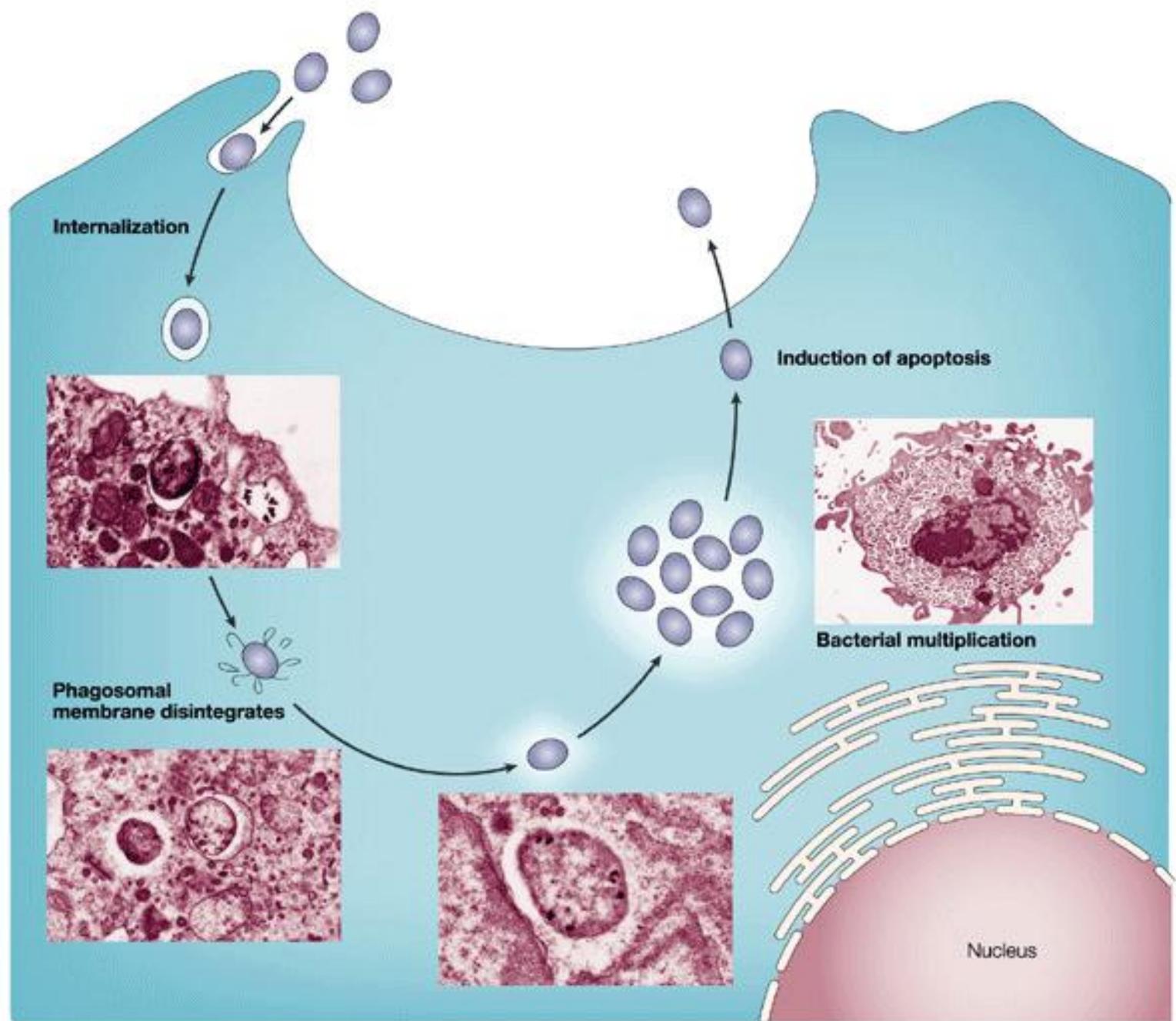
- 22 yo male acute fever, lymphadenopathy, malaise, and dry, non-productive cough in Martha's Vineyard.
- 5 pack-year smoker, mows lawns at the Golf club. No reports of running over any animals nor handling animal carcasses
- CXR showed RLL pneumonia, with some findings on LLL (Bilat?)

Differential

- Typhoidal syndromes such as salmonellosis or rickettsial infections should be included in the differential diagnosis.
- Other causes of pneumonia such as infection with *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Legionella pneumophila*, and *Coxiella burnetii*, or *Chlamydia psittaci*, as well as exposure to *staphylococcal* enterotoxin B
- In fulminant pneumonias, plague and inhalational anthrax



Tiny, pleomorphic, poorly staining gram-negative coccobacillus (0.2 to 0.5 by 0.7 to 1.0 microns). In clinical specimens, these forms can be found intracellularly.



AN OUTBREAK OF PRIMARY PNEUMONIC TULAREMIA ON MARTHA'S VINEYARD

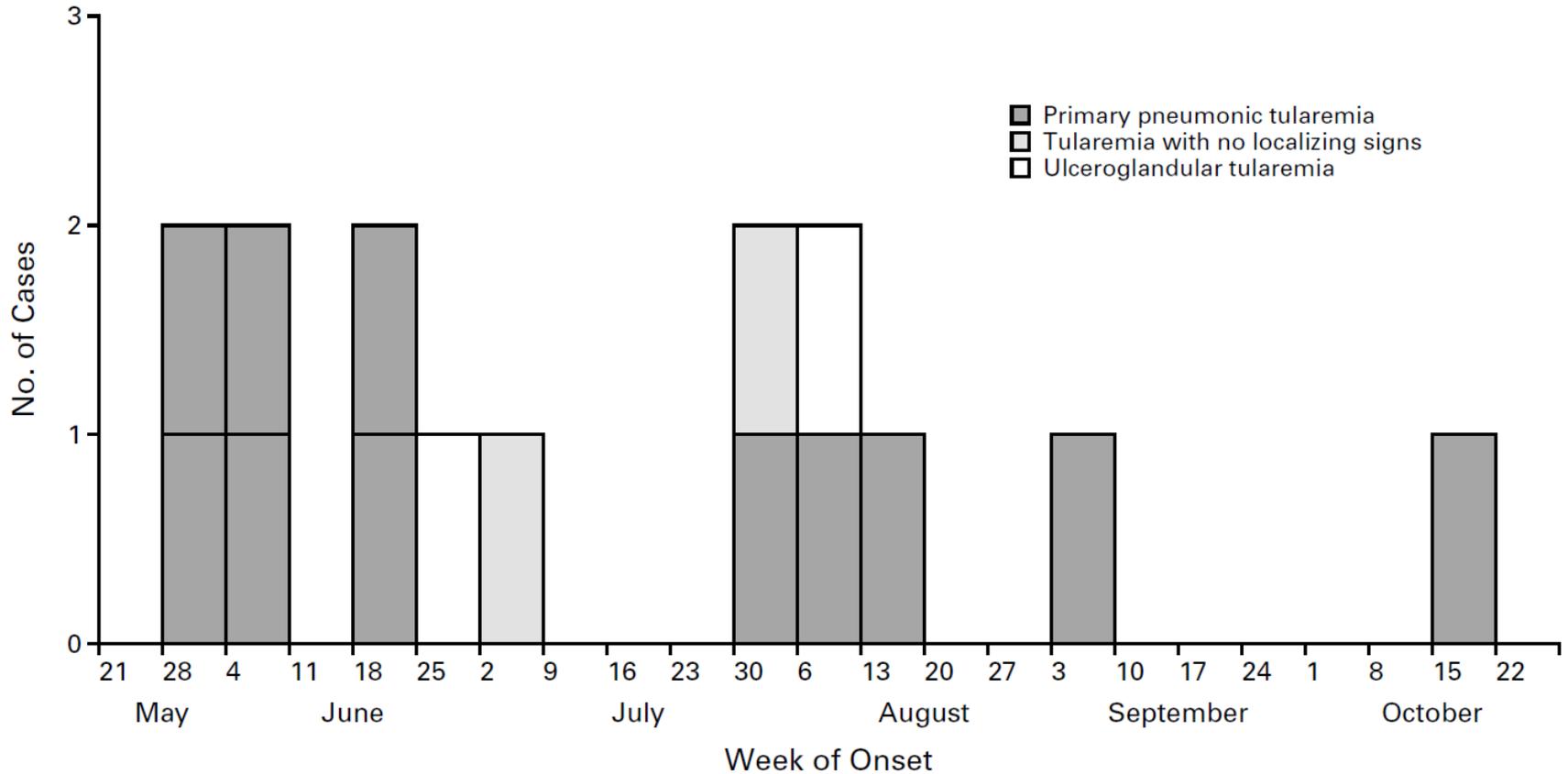


Figure 1. Cases of Primary Pneumonic Tularemia, Tularemia with No Localizing Signs, and Ulceroglandular Tularemia on Martha's Vineyard, May 21 through October 28, 2000, According to the Week of Onset of Illness.

Tularemia

- Although *F. tularensis* does not form spores, it can survive in water, soil, and decaying animal carcasses
- The organism persists in water and mud for as long as 14 weeks, in straw for 6 months, and in oats for 4 months
- *F. tularensis* was shed in animal excreta, persisted in the environment, and infected people after being mechanically aerosolized and inhaled

Tularemia: 6 Presentations

- *Typhoidal*
 - Bacteremia with fever, chills, headache, myalgias, malaise, sore throat, and anorexia.
 - Abdominal pain, nausea, vomiting, and diarrhea may be present
- *Pneumonic*
 - Dry, non-productive cough, dyspnea, pleuritic chest pain, and fever.
 - Physical examination may reveal rales, consolidation, and a friction rub or signs of effusion
- *Oculoglandular*
 - painful, often purulent, conjunctivitis with lymphadenopathy especially in the periauricular, submandibular, and cervical areas

Tularemia: 6 Presentations (cont'd)

- *Oropharyngeal*
 - painful sore throat; there may also be abdominal pain, nausea and vomiting
- *Ulceroglandular*
 - Regional lymphadenopathy with a papule that develops into an ulcer at the site of entry. Fever, chills, headache, malaise, anorexia, and fatigue usually are the first symptoms
- *Glandular*
 - similar to the ulceroglandular form, but without skin or mucous membrane lesions

Diagnosis

- *F. tularensis* is difficult to culture on standard media
- Definitive diagnosis is usually made retrospectively by serology
- Titers are usually negative during the first week of infection
- Titers pos 50-70% of cases in the second week, and reach a maximum in 4-8 weeks. Cross-agglutination can occur with *Brucella* and *Proteus* species
- Early post-exposure (0-24 hours) nasal swabs, sputum and induced respiratory secretions may be collected for culture, and for fluorescent antibody (FA) assay

Tularemia

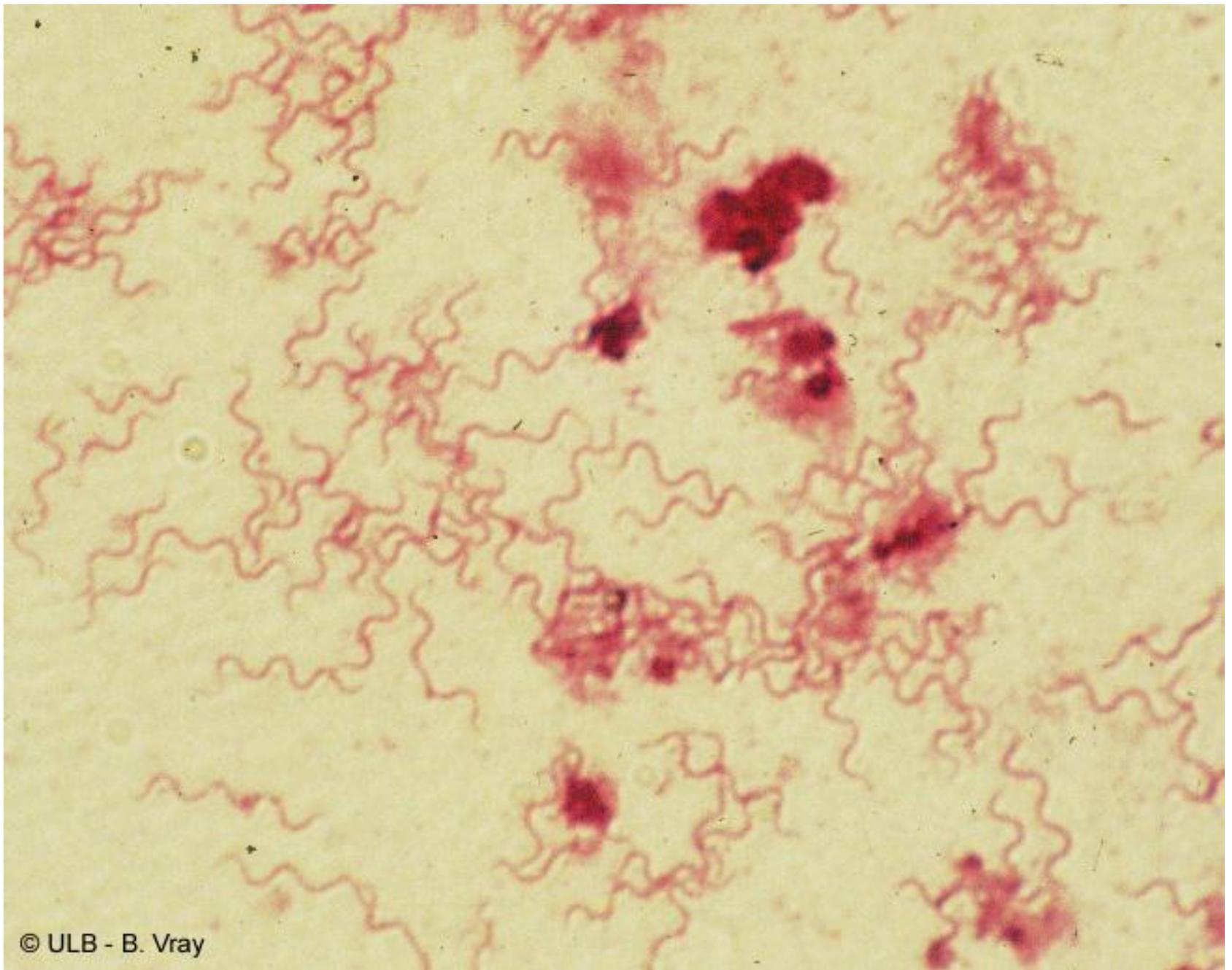
- Treatment:
 - Streptomycin 30 mg/kg qd IM for 10-14 days, or gentamicin 3-5 mg/kg qd IV for 10-14 days.
- Prophylaxis:
 - A live, attenuated vaccine available as an investigational new drug is administered once by scarification.
 - Doxycycline 100 mg q12h po for 14 days, or
 - Tetracycline 500 mg qid po for 14 days.

Rodents

- Infected saliva
 - Tularemia
 - Rat bite fever
 - Rabies (VERY rare) 2005 case report of rabies in guinea pig in NY
- Direct contact or aerosol
 - LCMV (lymphocytic choriomeningitis virus)
 - Trans to man thru direct contact with fomites
 - LCV
 - asymp donor to organ recipients
 - Monkeypox
 - Prairie dogs in the flea market
 - Cowpox
 - Ringworm
 - Hantavirus

Clubbing with the rat pack

- 48 yo male, in Asia, comes to the clinic with fevers and severe polymyalgia
- He had been slipped a ruffi while at a club, bushwacked when exiting, roughed up, robbed and left in a back alley, awakening in his own filth, shoes, valuables and ID all stolen
- No evidence of sexual assault
- On PE, animal bite marks around R ankle
- Faint rash on extremities
- Within 24hrs, blood cultures positive for pleomorphic GNR



Rat Bite fever

- *Spirillum minus* in Asia
- *Streptobacillus moniliformis* in USA
- Bites or contaminated food/water
 - Haverhill Fever
- Sxs:
 - Fever
 - Ext rash (mac/pap, pustular, petechial, purpuric)
 - Polyarthralgia
- Treatment:
 - PCN, Doxy

Birds

- Pet birds
- *Chlamydophila psittaci*:
 - found in almost all pet birds, shed in feces and nasal discharge
 - 1988-2003, 935 human cases in USA
- *Cryptococcus*
 - Found in soil, from bird feces
 - Inhalation of basidiospores or poorly encapsulated yeast
 - Generally in the immunocompromised
- Wild birds
 - Avian influenza
 - West Nile virus

- Psittacosis
 - Fever HA and dry cough with recent bird exposure
 - Pharyngitis, diarrhea and rarely encephalitis
 - DX by serology, DFA, MIF, Monoclonal AB, PCR
 - Do NOT culture: grade 3 pathogen
 - Tx with tetracycline. Erythromycin as alternative.
- Cryptococcus
 - Cough, chest pain, fever, wt loss, hemoptysis
 - Uncommon: dyspnea, rash, night sweats
 - DX by histo, fungal cult, serum crypto ag, xray
 - Tx with fluconazole, itra, posi, vori in immunocompetent pt

Exotics

- Ferrets
 - Influenza: aerosols from infected ferrets
 - Giardia
 - Mycobacterium microte (vole TB)
 - No rabies trans documented (vaccinate!)
- Hedgehogs
 - Dermatophytes
- Flying squirrels
 - Toxo, Staph and *R. prowazeckii* (epidemic typhus)
- Chinchillas
 - Dermatophytes
 - Kleb pneumo and Pseudomonas (no known trans)

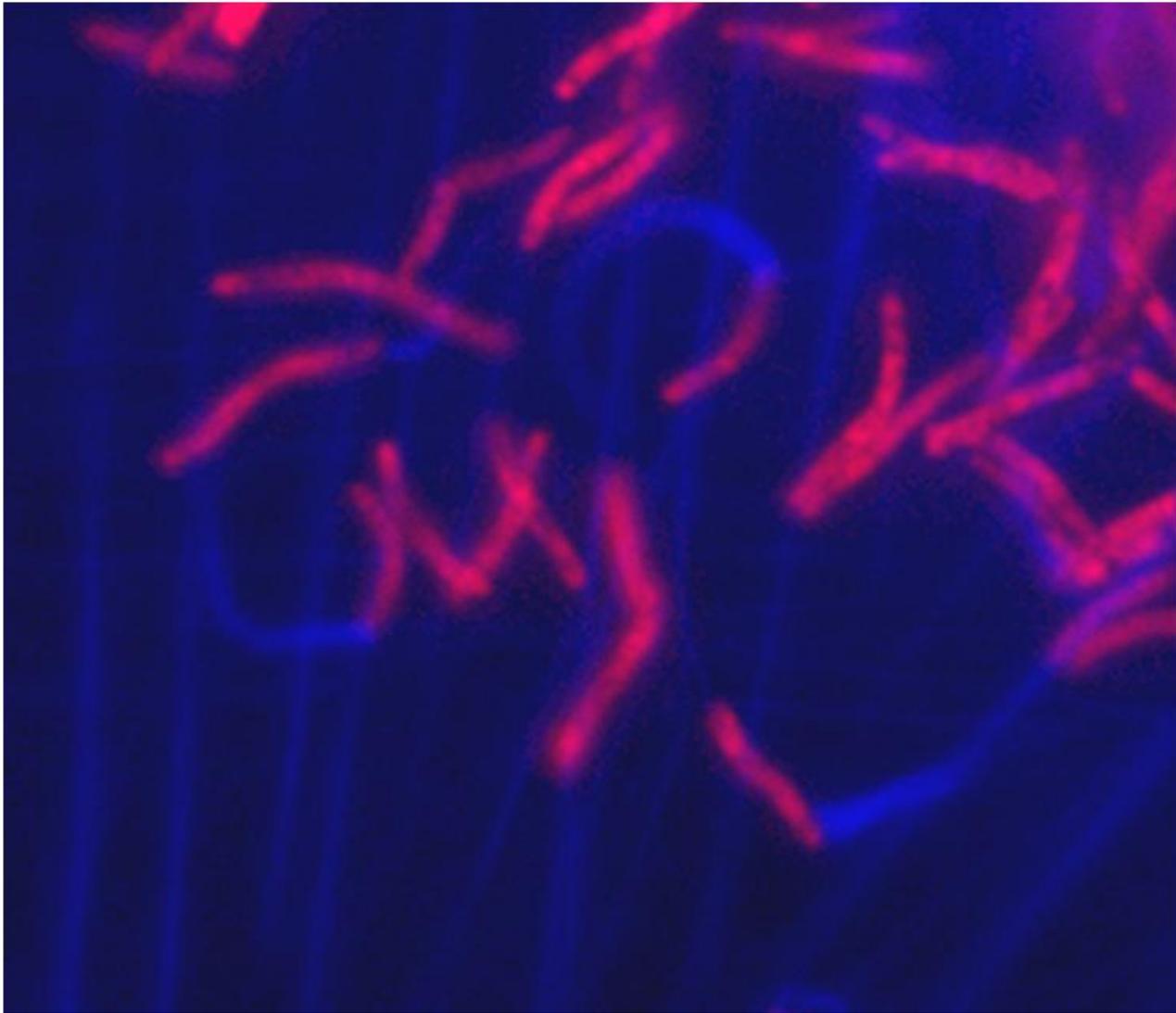
Fish

- Water exposures:
 - *Mycobacterium marinum*
 - *Aeromonas hydrophilia*
 - *Edwardsiella tarda*
 - *Erysipelothrix rhusiopathiae*
- Shell fish insult
- Parasites

Tanks a lot...

- 22 year old grad student had afterwork job at pet shop (fired 3 weeks ago)
- Sustained minor abrasion on underside of tank/plastic branch, while cleaning aquarium
- Now with lesion on dorsum of hand, limited healing, not responsive to topical abx ointment and cephalexin





Acid fast stain

Mycobacterium marinum

- Causes fish TB and contaminates aquarium water
- “Fish tank granuloma” caused while sustaining minor injury or abrasion while cleaning fish tank
- Infections in humans present as cutaneous lesions (soft skin papules, pustules and ulcers developing weeks after an injury/exposure)
- Treatment of infection by *M. marinum* is oral antibiotics. Medication options include rifampin plus ethambutol, tetracyclines, TMP-SMX , clarithromycin and fluoroquinolones

fishy case of shellfish?

- 53 yo gulf bay fisherman, alcoholic with cirrhosis, has abrasions on arm/leg while harvesting oysters
- Few hours later, red, painful skin, hemorrhagic bullae begin to develop on legs and hands/arms
- Comes into the clinic not well 36 hrs later, in pain



Vibrio vulnificus

- Leading cause of shellfish associated deaths in USA
- 50 confirmed cases, 45 serious illnesses, and 16 deaths are reported each year from the Gulf Coast states.
- Liver disease, hemochromatosis, and exposure to estuaries are major risk factors
- Infected wounds manifest as bullae in 75% of cases. Primary bacteremia also occurs
- Treatment : doxy + ceftriaxone or ESC (or FQ)
generally resistant to aminoglycosides

Vibrio vulnificus

- Do not expose open wounds or cuts to warm seawater. When swimming or wading, the wound should be covered with a watertight wrap.
- Wear gloves when handling raw shellfish and avoid cross-contamination of raw shellfish with other foods.
- Cook shellfish thoroughly. Individuals in the high risk category should not consume raw oysters or other shellfish.
- Illness caused by *V. vulnificus* is relatively rare and most healthy persons do not become ill when the organism is ingested.



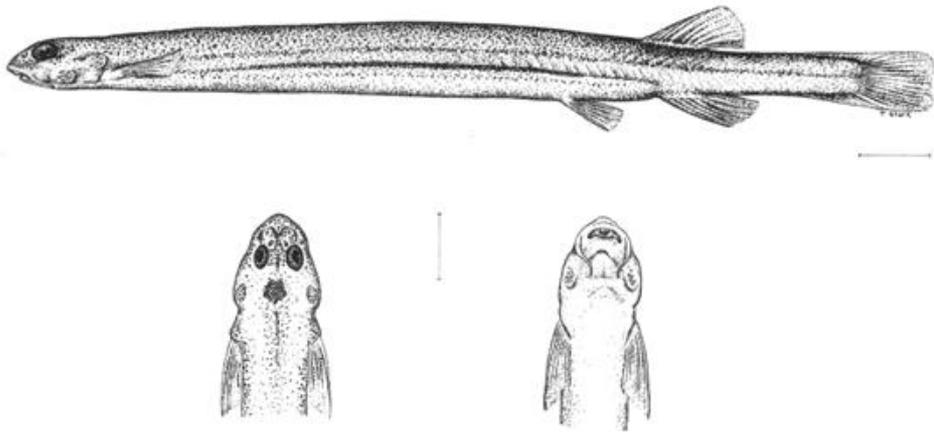


FIG.51 Illustration of a candiru (*Vandellia cf. plazai*) from the Rio Jauaperi. *Top*: Lateral view. *Bottom left*: Dorsal view of head and upper body. *Bottom right*: Ventral view of head and upper body. Scale bar = 5 millimeters. Illustrations by Tamara L. Clark. Source: Stephen Spotte.



Fear the Turtle



Reptiles

- 74-90% colonized with Salmonella
- Intermittently shed in feces
- Responsible for 6% (74,000 cases) of salmonella in US
- Yersinia, Campylobacter, Aeromonas
- Sale of turtles < 4" banned in 1975 resulted in decrease of Salmonella cases in children by 100k





Monkeys

- Few reports of disease transmission from pet monkeys
- Shigella and Salmonella have been transmitted from asx spider monkeys
- Herpes B
 - Cercopethicine herpes virus 1
 - Transmitted directly from rhesus macaques through bites or scratches or from tissues or fluids
 - 80 – 90% of adult macaques infected. Asx.

B virus

- In monkeys, either no lesions or oral/genital lesions (HSV for monkeys)
- Viral shed is lifelong in oral and genital secretions and from conjunctiva
- In humans, leads to encephalitis, fatal in 80% without treatment
- Majority of cases are in those who work with non-human primates

B Virus – Who is at risk?

- Monkey handlers
- Travelers exposure to free ranging monkeys
 - India, Indonesia and Nepal
 - Puerto Rico and the Carribean
- Those with monkeys kept as pets

B Virus – 3 clinical manifestations

- 1
 - Vesicular or ulcerative lesions
 - Tingling, pain or itching at site
 - Local lymphadenopathy
- 2
 - Influenza like illness (fever and myalgias)
 - Numbness, paresthesias, fever, conjunctivitis, abd pain, hepatitis, pneumonitis, CNS sx
- 3
 - Nausea and vomiting
 - CNS sx including HA, CN deficits, dysarthria dysphagia, seizures, paralysis, respiratory failure and coma

B Virus: Post exposure Indications

- Skin or mucosal exposures to animals that are at high risk of shedding B virus (ill or immunocompromised macaques, animals with oral or genital lesions, or animals known to be shedding virus)
- Inadequately cleaned skin or mucosal exposures
- Lacerations of the head, neck, or torso
- Deep puncture bites
- Needlestick injuries in which the needle was exposed to macaque tissue or fluid from the central nervous system (CNS), mucosa, or eyes
- Lacerations or puncture wounds with objects contaminated with macaque fluid from oral or genital lesions, CNS tissues, or known to contain B virus
- Exposures in which **post-cleansing cultures** are positive for B virus

B Virus: Post exposure

- Wash wound for 15 minutes
 - Skin with detergent or bleach 1:20, then detergent
 - Eyes, mucous membranes: flush with water
- Post wash cultures of wound
- Treatment / prophylaxis (based on rabbit studies)
 - Acyclovir 800 mg po qid x2 weeks if 1 day post exp (PREGNANCY)
 - Valacyclovir 1g po tid x2 weeks (preferred for all others)
 - Suppressing tx lifelong : valacyclovir 500 mg po qd or acyclovir mg 400 po tid
- Treatment/disease
 - If no CNS or PNS findings: IV Acyclovir
 - If CNS or PNS findings: IV Gancyclovir

Postexposure Prophylaxis for Non-immunized Individuals

Treatment	Regimen
Wound cleansing	All postexposure prophylaxis should begin with immediate thorough cleansing of all wounds with soap and water. If available, a virucidal agent such as povidine-iodine solution should be used to irrigate the wounds.
RIG	If possible, the full dose should be infiltrated around any wound(s) and any remaining volume should be administered IM at an anatomical site distant from vaccine administration. Also, RIG should not be administered in the same syringe as vaccine. Because RIG might partially suppress active production of antibody, no more than the recommended dose should be given.
Vaccine	HDCV or PCECV 1.0 mL, IM (deltoid area), one each on days 0 , 3, 7, and 14.

Postexposure Prophylaxis for Previously Immunized Individuals

Treatment	Regimen
Wound cleansing	All postexposure prophylaxis should begin with immediate thorough cleansing of all wounds with soap and water. If available, a virucidal agent such as povidine-iodine solution should be used to irrigate the wounds.
RIG	RIG should not be administered.
Vaccine	HDCV or PCECV 1.0 mL, IM (deltoid area), one each on days 0 and 3.



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*"We'll have to clean that out immediately...
there's nothing dirtier than a lawyer bite."*

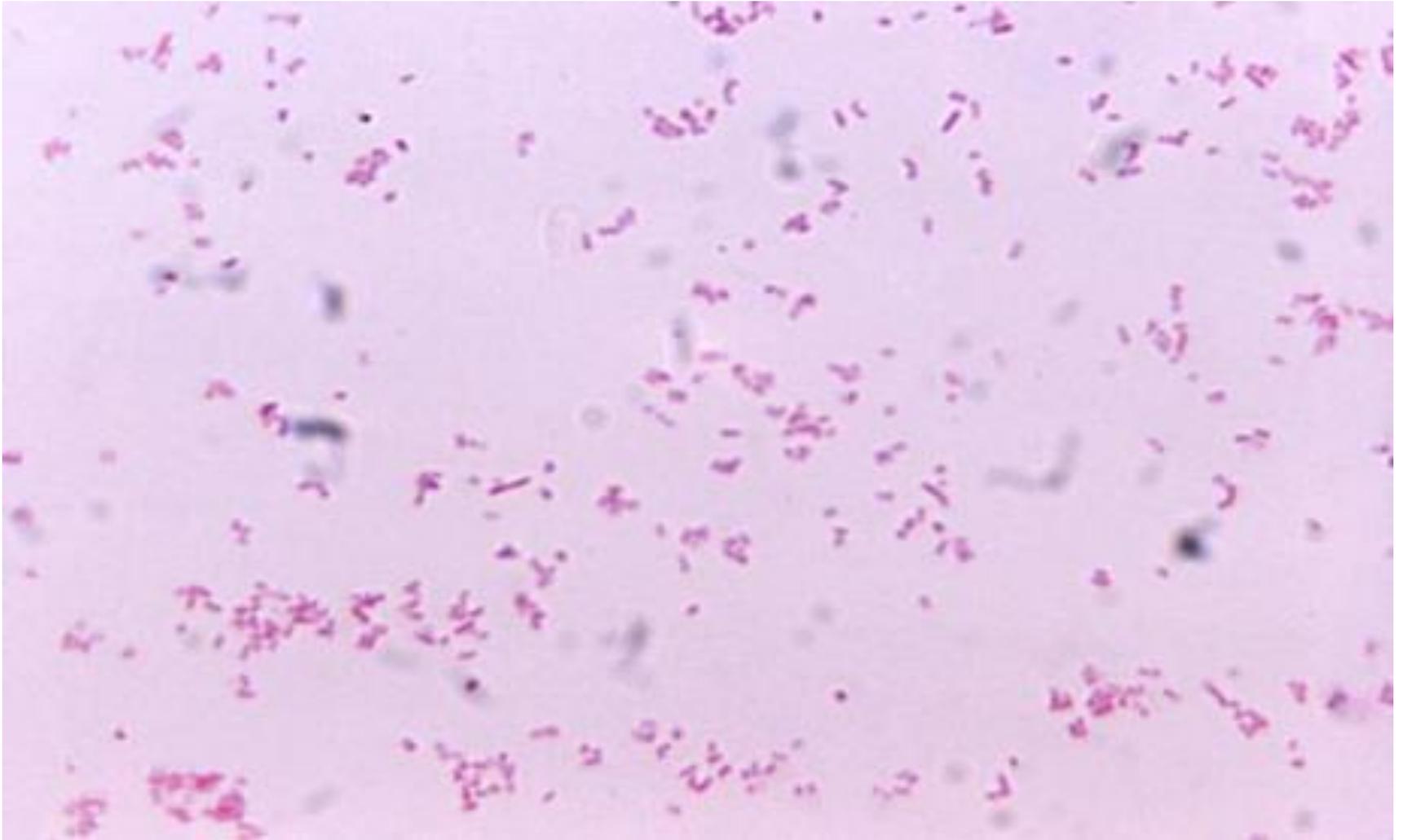
Human Bites

- 52 yo male suffers a hand injury in brawl at tailgate party in Baltimore
- Presents 12 hrs later with a swollen, red, painful fist. Seen in a medi clinic. Xray indicated boney frags. Wound cleaned and given cephalixin, ice, rest.
- Returns to ER 5 days later tachycardia, hypotension, fever, confuse (Glasgow scale 13/15). At ED, clinical observation
 - secretion through a small injury on the dorsal aspect of the proximal phalanx of 3 finger in left hand
 - increase of local temperature
 - slow capillary reflux
 - edema on the forearm
 - flictenas on dorsum of hand and forearm
 - exacerbated pain at finger mobilization
 - decrease in distal sensibility (median nerve territory)
 - no crepitation was detected.



- As soon as clinical evaluation was finished, anti-tetanic immunization was performed, and patient transferred to surgery room
- Pressure in dorsal compartment was (20mm Hg) and in palmar compartment (42 mm Hg)
- Purulent material (about 120 ml) drained from pre-retinacular space
- 1 g amox–sulbact IV q 6 hours





Anaerobic Small GNR

Eikenella corrodens

- Anaerobic small GN bacilli
- Common in human oral flora
- Resist to:
 - Cephalexin, Clinda, Erythro, Flagyl
- Suscept to:
 - PCN, FQs, TMP/SMX, Doxy, ESC



Review

- Cat and Dog Bites
- Exotic animal Bites
- Zoonosis

Management and Treatment of Animal Bites

Cultures

Gram stain, aerobic, and anaerobic cultures are indicated if abscess, severe cellulitis, devitalised tissue, or sepsis present

Irrigation

Normal saline irrigation copiously with high-pressure jet from syringe

Debridement

Debride necrotic tissue and remove any foreign bodies

Imaging

Plain radiographs, MRI, or CT if fracture or bone penetration, to rule out osteomyelitis

Wound closure

Primary wound closure is not usually indicated

Management and Treatment of Animal Bites

Antimicrobial therapy

Prophylactic antibiotics in selected cases. Coverage based on patient type and specific animal involved

Hospitalization

Indications include fever, sepsis, spreading cellulitis, substantial edema or crush injury, loss of function, immunocompromised status, or noncompliance

Immunizations

Tetanus booster if original three-dose series has been given but none in the past year. Give primary series and tetanus immunoglobulin if the patient was never vaccinated

Human diploid rabies vaccine (days 0, 3, 7 and 14) with rabies immunoglobulin may be required (assess exposure risk)

Empiric oral antibiotic therapy for animal bites

Antibiotic agents	Adults
Agent of choice	
Amoxicillin-clavulanate	875/125 mg twice daily
Alternate empiric regimens include:	
One of the following agents with activity against <i>P. multocida</i>:	
Doxycycline*	100 mg twice daily
TMP-SMX*	1 double strength tablet twice daily
Penicillin VK	500 mg four times daily
Cefuroxime	500 mg twice daily
Moxifloxacin	400 mg once daily
PLUS	
One of the following agents with anaerobic activity:	
Metronidazole	500 mg three times daily
Clindamycin*	450 mg three times daily

Empiric intravenous antibiotic therapy for animal bites

Adults

Options for empiric gram-negative and anaerobic coverage include:

Monotherapy with a beta-lactam/beta-lactamase inhibitor, such as one of the following:

Ampicillin-sulbactam 3 g every six hours

Piperacillin-tazobactam 4.5 g every eight hours

Ticarcillin-clavulanate 3.1 g every four hours

A third generation cephalosporin such as ceftriaxone 1 g IV every 24 hours

PLUS

Metronidazole 500 mg IV every eight hours

Alternative empiric regimens include:

A fluoroquinolone (eg, ciprofloxacin 400 mg IV every 12 hours or levofloxacin 500 mg IV daily) **PLUS** metronidazole 500 mg IV every eight hours

Monotherapy with a carbapenem•, such as one of the following:

Imipenem-cilastatin 500 mg every six hours

Meropenem 1 g every eight hours

Ertapenem 1 g daily

References

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- 15th Annual Comprehensive Review of Infectious Diseases Syllabus
- Images from online sources and personal library

This Lecture...Bites?

- Feedback appreciated

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