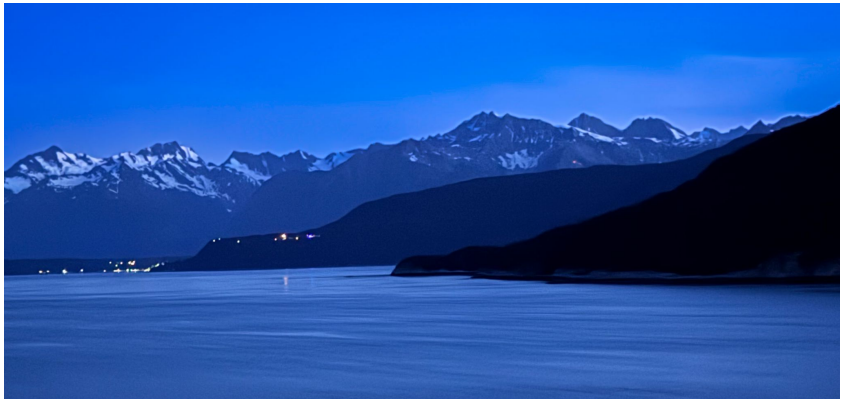
Travel History

CLINID conference
Hunter Ratliff
08/28/2025

Ages, dates, and other identifying information may have been changed
I have no conflict of interest in relation to this presentation

Exhibit #1


N1038U



Case #1

Case 1: HPI

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

Case 1: HPI

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

Review of symptoms

- Gait instability
- Dizziness
- Headache (occipital)
- General malaise

Case 1: HPI

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

- **No fevers**, but **sweating** a fair amount x **1-2 weeks**
  - As farmers do (in the summertime)
  - But these episodes do **happen indoors too**...
- Mild upper back pain
- No vision changes, face droop, confusion
- No ENT/pulm/GI symptoms

Review of symptoms

- Gait instability
- Dizziness
- Headache (occipital)
- General malaise

Case 1: HPI

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

- Had a fall while trying to **dump a bucket** of manure
- Couldn't get up after the fall
  - **Very atypical** of him
  - Walks >4 miles a day

Review of symptoms

- Gait instability
- Dizziness
- Headache (occipital)
- General malaise
- ?**Diaphoresis**

Case 1: HPI

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

Medications

- Metformin
- Monjaro
- Imdur (ISMB)
- Aspirin + atorva
- Amlodipine, lisinopril
- Flomax

Review of symptoms

- Gait instability
- Dizziness
- Headache (occipital)
- General malaise
- ?**Diaphoresis**

No drug allergies

Case 1: Social history, exposures, & risk factors

Geographic & Travel	• Lives with wife in **southern rural Pennsylvania** (close to WV border) on his **farm** • **No travel**
Occupational	• Works part time at a hardware store plus the work around the farm
Substance & needles	• No EtOH, tobabbo, or drugs • No needle exposures
Animals	• Multiple indoor **cats & dogs** (no bites/scratches) • **Horses** & **chickens** on the farm
Exposures	• No known tick bites, but has seen **ticks on his farm** before; no mosquitos • Contact with **manure & hay**, but no other contact with soil or organic material • No TB risk factors • Water from the city

Case 1: Physical exam

BP	**110/54**	**Pulse**	89	**SpO2**	94 %
Temp	**38.5** °C (**101.3** °F)	**BMI**	25 kg/m^2	**O2 source**	Room air
General	Alert and oriented, **diaphoretic**, vitals reviewed as above				
HEENT	NCAT; trachea appears midline, no gross LAD; EOMI				
Resp	Normal respiratory effort, CTAB				
CV	**Afib**; extremities perfused				
GI	Non-distended; no TTP				
Skin	No rash				
MSK	Moves extremities; no joint swelling				
Neuro	Neurology's exam was normal (MSE, CN, strength, sensory), except gait (below)				
Gait	short stride with slow pace & decreased step height with wanting to look down at the feet while walking				

Case 1: Labs

CBC	Result
WBC	10.1
Hgb	13.3
Platelets	188
Neut %	85%
Lymph #	**400 (L)**
Eos %	0%

Chem7	Result
Na	**130**
K	4.1
Cl	97
HCO3	23
Cr	1.11

LFTs	Result
AST	**44**
ALT	23
Alk Phos	49
Bili	1.3
Albumin	3.4

Case 1: Summary

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

Review of symptoms

- Gait instability & dizziness
  - A few days
- Occipital headache
- **Diaphoresis** x 1-2 weeks

Temp 38.5 **Pulse** 89
BP 110/54

- **Sweating**
- Otherwise well appearing
- Gait issues

Exposures

- Farmer in south central PA
- Cats, dogs, chickens, horses
- No clear tick bites

CBC	Result
WBC	10.1
Platelets	188
Neut %	85%
Lymph #	**400 (L)**

CMP	Result
Na	**130**
K	4.1
Cr	1.11
AST	**44**
ALT	23
AlkPhos	49
Bili	1.3

Case 1: Stroke work up

A **74 y/o M** with PMH including DM (A1c 6.5), CAD, macular degeneration p/w **gait instability x 2 days**

Initially worked up for stroke

- Normal CT head & CTA
- MRI brain W/WO normal
- TTE normal

Case 1: Lumbar puncture

Lumbar punct	Result
Opening Pr (cm H2O)	
WBC	
Neut (%)	
Lymph (%)	
RBC	
Protein	
Glucose	

CSF	Result
CrAg	
HSV PCR	
VZV PCR	
LDH	
Cultures	

Others	Result
Blood Cx	
HIV	
Syphillis	
uStrep/Legionella	
Lyme	
Tick panel	

Case 1: Lumbar puncture

Lumbar punct	Result
Opening Pr (cm H2O)	Unk
WBC	2
Neut (%)	2%
Lymph (%)	60%
RBC	1
Protein	47
Glucose	127

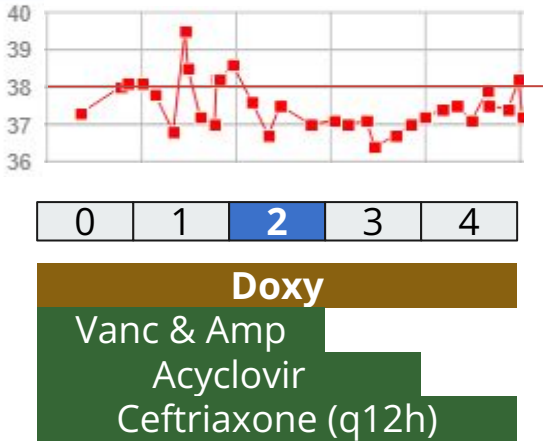
CSF	Result
CrAg	Neg
HSV PCR	Neg
VZV PCR	Neg
LDH	<30
Cultures	NGTD

Others	Result
Blood Cx	NGTD
HIV	Neg
Syphilis	Neg
uStrep/Legionella	Neg
Lyme	**Pend**
Tick panel	**Pend**

Case 1: Hospital course

Initially started on

- **Doxycycline** (doxy-deficient state)
- **CNS dosed abx** (until **LP results** back)



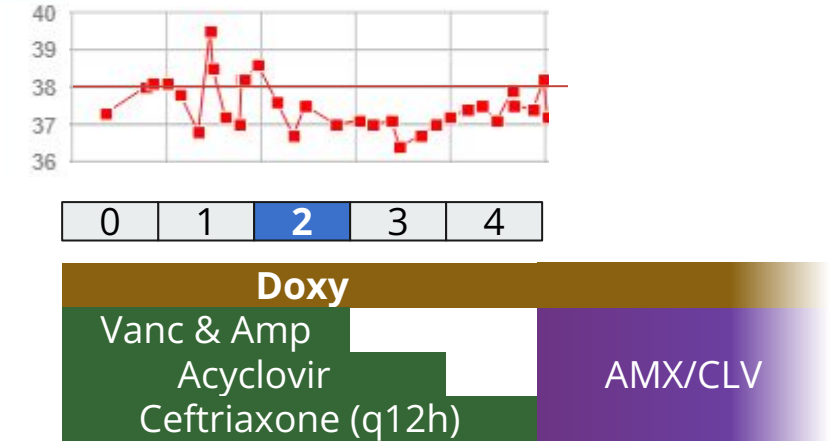
Case 1: Hospital course

Initially started on

- **Doxycycline** (doxy-deficient state)
- **CNS dosed abx** (until **LP results** back)

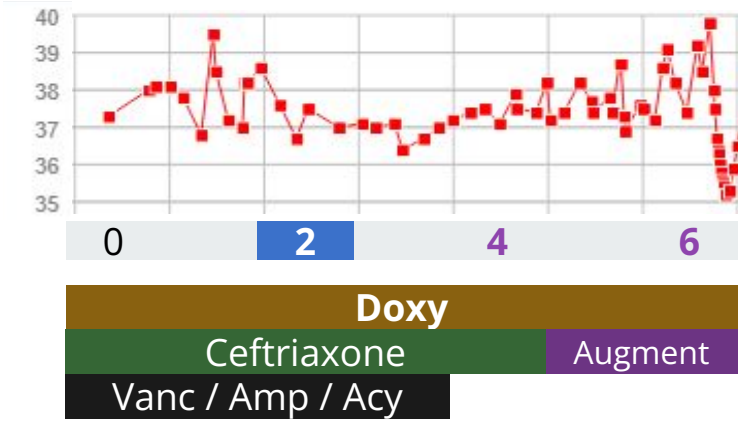
Signed off on **day 4**

- With good response to doxy (and pending tick panel) → **14 days of doxy**
- CT A/P was maybe suggestive of gallbladder issues → **Asked for HIDA**
- Said to do **Augmentin** (but can stop if negative HIDA)



Case 1: Hospital course

After signing off on **day 4**, started fevering again, so reconsulted on **day 6**



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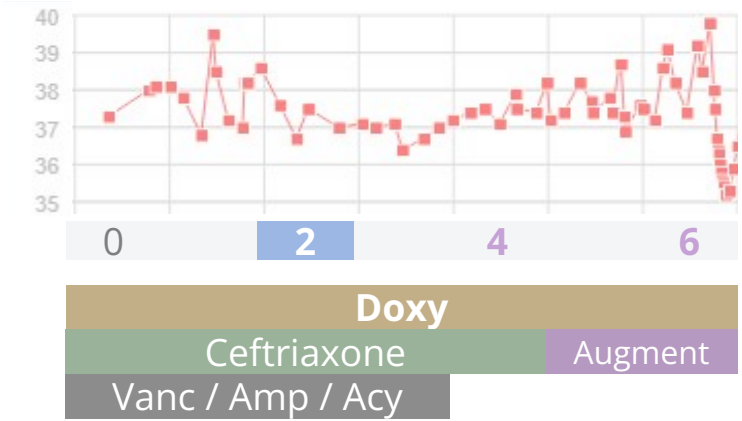


Additional exposure Hx

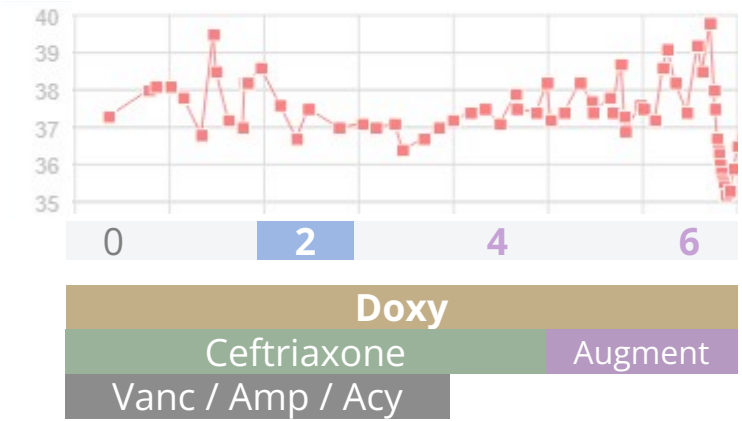
- Dead birds
- Dead racoons

HPI

- Feeling better than admission
- Aside from rigors, no localizing symptoms

Case 1: Hospital course

After signing off on **day 4**, started fevering again, so reconsulted on **day 6**

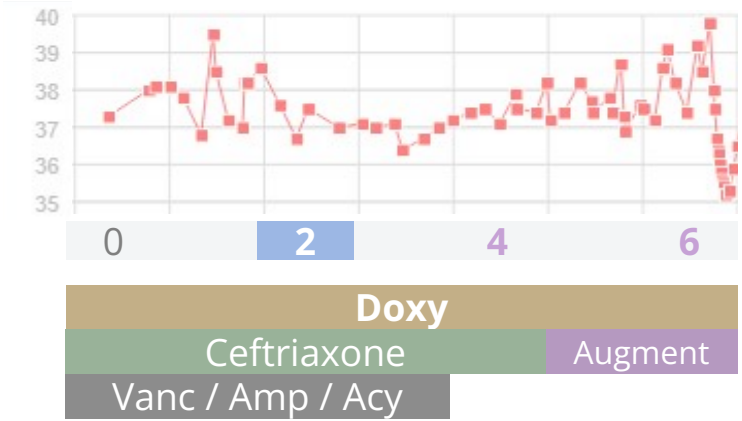


Labs	Day 0	Day 4	Day 6
Na	130	130	132
Cr	1.11	1.03	0.92
AST	44	78	234
ALT	23	33	121
AlkPhos	49	48	54
Bili	1.3	0.6	0.8
CRP	140	61	31

HIDA - Normal

Case 1: Hospital course

After signing off on **day 4**, started fevering again, so reconsulted on **day 6**



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CRP	140	61	31
LDH	---	---	509
Ferritin	---	---	1182

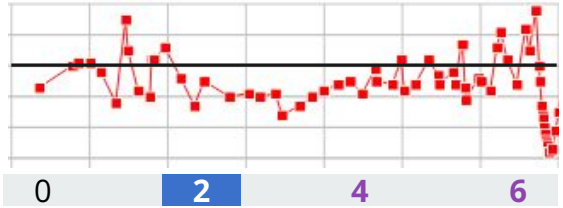
Case 1: What now??

Immunocompetent **74M** w/ DM, CAD p/w **gait instability & headaches** x 2 days (i/s/o 1-2 weeks of fevers?)

Thoughts now?
- Resume prior antibiotics?
- Additional workup?

Exposures
- Farmer in south central PA
- Cats, dogs, chickens, horses
- Dead birds & raccoons
- No known tick bites

CNS workup
Normal LP (2 WBC; protein 47)
MRI brain normal



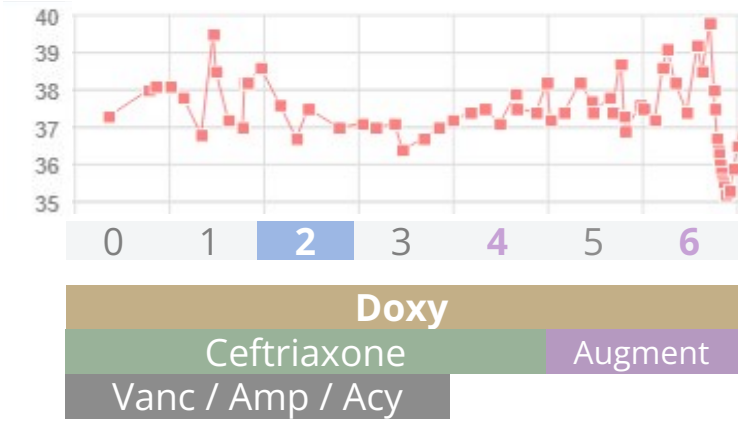
	Day 6
WBC	10.9
Platelets	193
Neut %	86%
Lymph #	510 (L)
Tick panel	Pend
LDH	509
Ferritin	1182

	Day 0	Day 4	Day 6
Na	130	130	132
Cr	1.11	1.03	0.92
AST	44	78	234
ALT	23	33	121
AlkPhos	49	48	54
Bili	1.3	0.6	0.8
CRP	140	61	31

Case 1: Hospital course

Picture unclear, so we:

- Obtain workup → → →



We ask for

- Q fever serologies
- Bartonella (serologies & PCR)
- CMV PCR
- Rheum & heme/onc consults

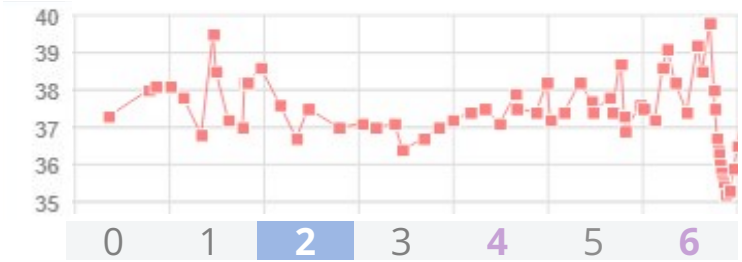
Case 1: Hospital course

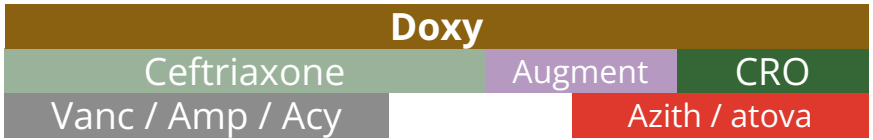
Picture unclear, so we:

- Obtain workup → → →
- Resume **ceftriaxone**
- Consider **azithro** & **atovaquone**

We ask for

- Q fever serologies
- Bartonella (serologies & PCR)
- CMV PCR
- Rheum & heme/onc consults





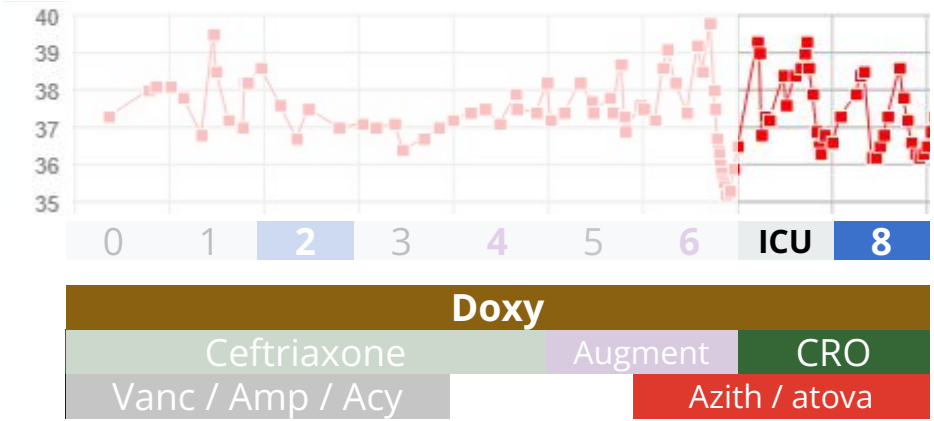
Case 1: Hospital course

Mental status declines → **ICU transfer**

Utility of repeat CSF sampling is debated but eventually decide to **repeat LP**

Negative labs now

- Parasite smear negative
- Tick panel PCR negative (anaplasmosis, babesia, ehrlichiosis) as was lyme screen



Case 1: Lumbar puncture, take 2

LP	Day 2	Day 8
Opening Pr	Unk	
WBC	2	
Neut (%)	2%	
Lymph (%)	60%	
RBC	1	
Protein	47	
Glucose	127	
CrAg	Neg	
HSV/VZV PCR	Neg	
Cultures	NGTD	

Serum	Day 8
Brucella	
Leptospirosis	
Q fever	

Case 1: Lumbar puncture, take 2

LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
Glucose	127	**64**
CrAg	Neg	---
HSV/VZV PCR	Neg	
Cultures	NGTD	*TBD*

CSF	Day 8
Biofire	Neg
Strep pneumo	Neg

Serum	Day 8
Brucella	
Leptospirosis	
Q fever	

Serum glucose:
163 (40%)

Case 1: Lumbar puncture, take 2

LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
CSF/Serum glu	127	**0.4**
CrAg	Neg	---
HSV/VZV PCR	Neg	
Cultures	NGTD	*TBD*

CSF	Day 8
Biofire	Neg
Strep pneumo	Neg

Serum	Day 8
Brucella	
Leptospirosis	
Q fever	

What else to send?

Case 1: Lumbar puncture, take 2

LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
CSF/Serum glu	127	**0.4**
CrAg	Neg	---
HSV/VZV PCR	Neg	
Cultures	NGTD	NGTD

CSF	Day 8
Biofire	Neg
Strep pneumo	Neg
Enterovirus PCR	
Arbovirus	
West nile	

Serum	Day 8
Brucella	
Leptospirosis	
Q fever	
West nile	

Case 1: Lumbar puncture, take 2

LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
CSF/Serum glu	127	**0.4**
CrAg	Neg	---
HSV/VZV PCR	Neg	Neg
Cultures	NGTD	NGTD

CSF	Day 8
Biofire	Neg
Strep pneumo	Neg
Enterovirus PCR	Neg
Arbovirus	Neg
West nile	???

Serum	Day 8
Brucella	Neg
Leptospirosis	Neg
Q fever	Neg
West nile	**IgM (+)**

Case 1: Lumbar puncture, take 2

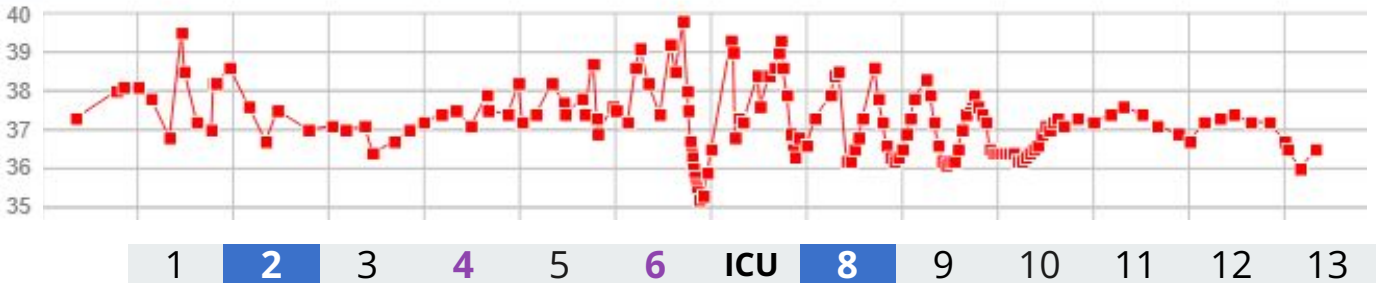
LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
CSF/Serum glu	127	**0.4**
CrAg	Neg	---
HSV/VZV PCR	Neg	Neg
Cultures	NGTD	NGTD

CSF	Day 8
Biofire	Neg
Strep pneumo	Neg
Enterovirus PCR	Neg
Arbovirus	Neg
West nile	**IgM (+)**

Serum	Day 8
Brucella	Neg
Leptospirosis	Neg
Q fever	Neg
West nile	**IgM (+)**

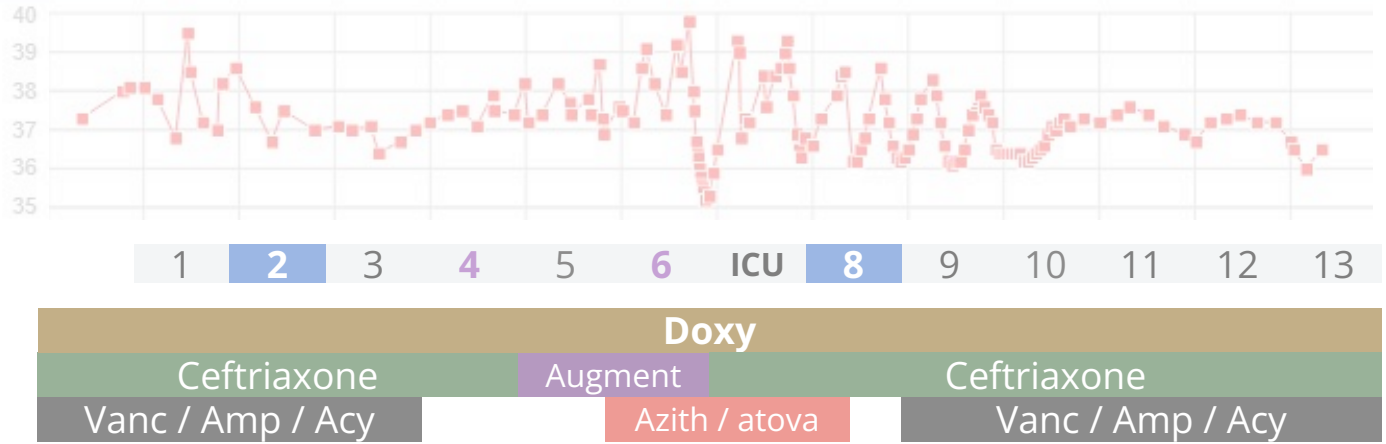
Case 1: Hospital course

- Prior to WNV serologies being positive, family mentions many cases of WVN around where they live



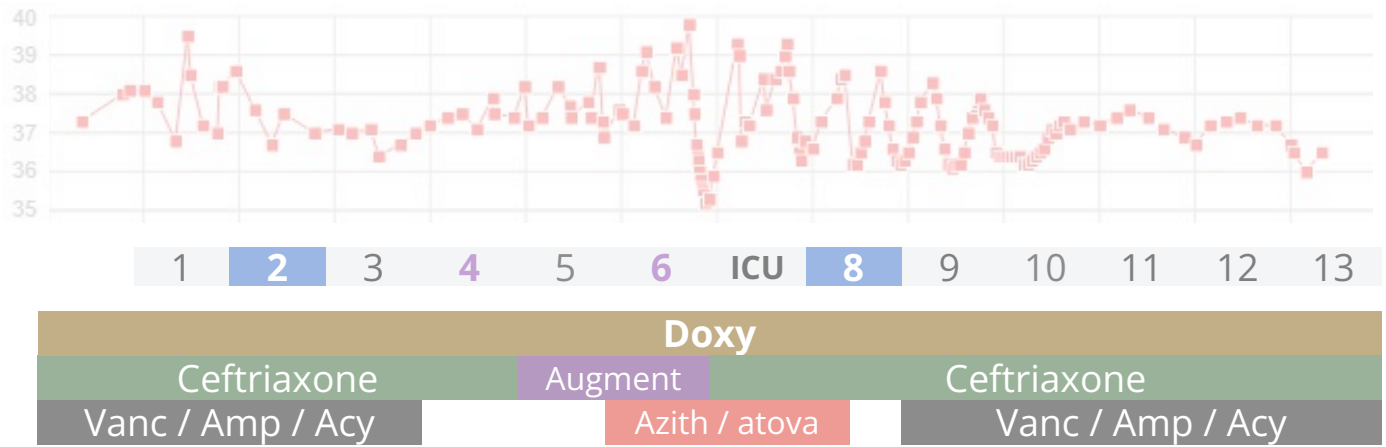
Case 1: Hospital course

- Prior to WNV serologies being positive, family mentions many cases of WVN around where they live
- **Fever curve** somewhat **improves** with empiric antimicrobials
  - **Encephalopathy does not**



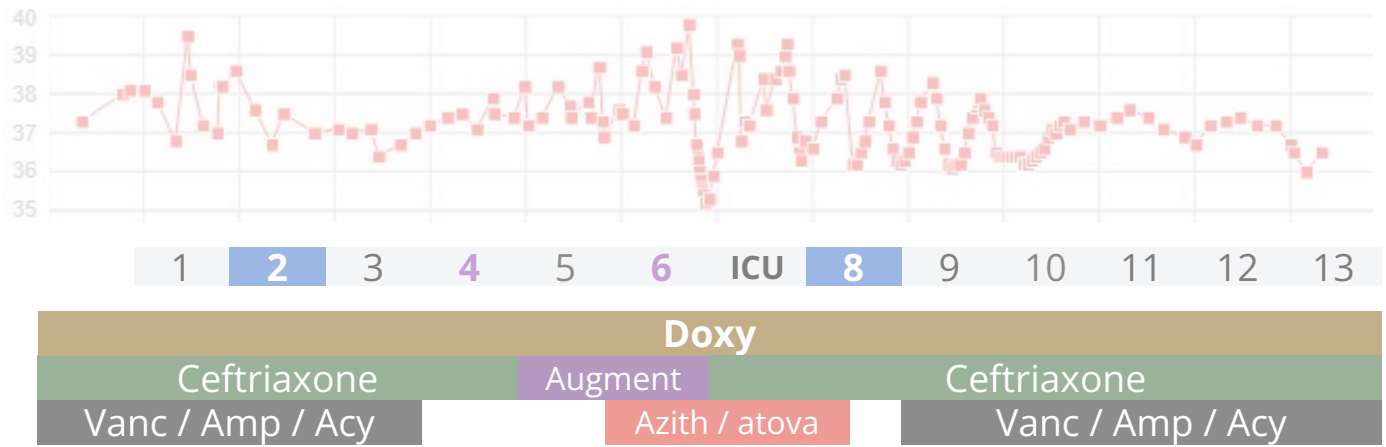
Case 1: Hospital course

- Ongoing encephalopathy → family decides **DNR/DNI**



Case 1: Hospital course

- Ongoing encephalopathy → family decides **DNR/DNI**
- **Periods of apnea** & non-sustained V-tach → **hypercapnic resp failure**



Case 1: Hospital course

- Ongoing encephalopathy → family decides **DNR/DNI**
- **Periods of apnea** & non-sustained V-tach → **hypercapnic resp failure**
- Started on BiPap → **comfort measures only**

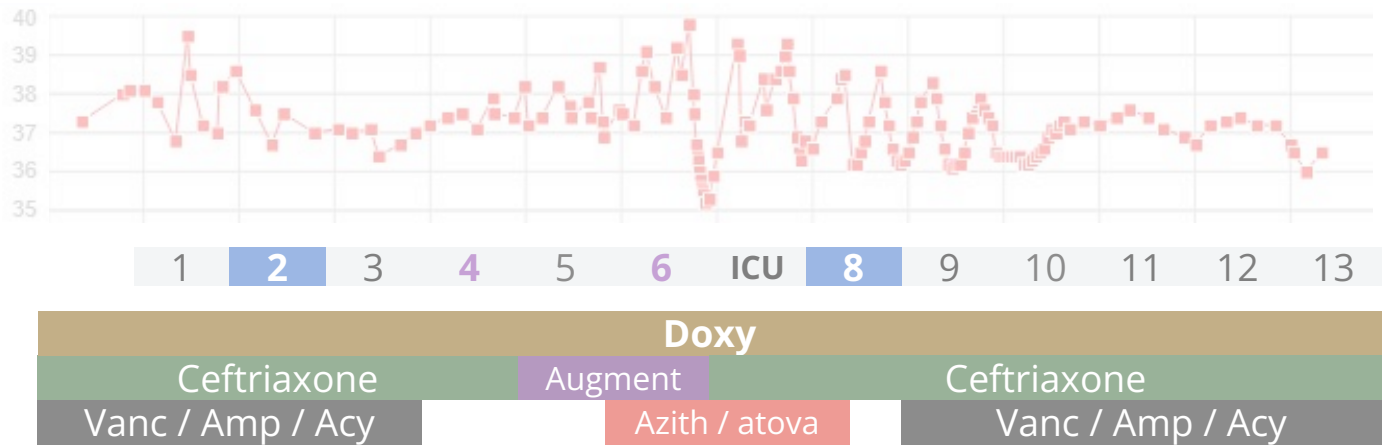


Exhibit #2

Humpback whales

Orca

Zoonosis

Brucella *(B ceti & B pinnipedialis)*
[MMWR 2012 / PMID 22739776]

- Main cause of Brucella in cetaceans (dolphins & porpoises, whales, orca)
- Brucella behaves very similar in them as it does in humans
- Mostly occupational hazard for vets

Seal finger (Mycoplasma)
[PMID 21119845]

- Causes cellulitis → osteo / septic arthritis
- Identified as *Mycoplasma phocicerebrale* in 1991 [PMID 9827264]
  - Before that they just amputated it
- Treat with tetracyclines

Case #2

Case 2: HPI

A **85 y/o M** with PMH including remote hx colon cancer (s/p colectomy, in remission) p/w **dizziness & weakness** for 10 days

Case 2: HPI

A **85 y/o M** with PMH including remote hx colon cancer (s/p colectomy, in remission) p/w **dizziness & weakness** for 10 days

- **Dizziness** a/w some blurred vision and frontal headache
- A little **short of breath**, but only with walking
- **Urinary complaints**: Change in color of urine, ?dysuria
- No fevers, chills, abdominal pain, rash

Review of symptoms

- Dizziness (assoc w/)
  - Frontal headache
  - Blurry vision
- Mild DOE
- Urine darker

Case 2: HPI

A **85 y/o M** with PMH including remote hx colon cancer (s/p colectomy, in remission) p/w **dizziness & weakness** for 10 days

Past Medical Hx
Remote history of colon cancer

Medications
- Vitamin C
- Claritin (PRN)
- Senna (PRN)
- No drug allergies

Review of symptoms
- Dizziness (assoc w/)
  - Frontal headache
  - Blurry vision
- Mild DOE
- Urine darker

Case 2: Social history, exposures, & risk factors

Geographic & Travel	• Lorem i • Duis bib
Occupational	• Lorem i
Substance & needles	• Lorem i urna ve quam, v
Animals	• Lorem i • Duis bib
Exposures	• Lorem i • Duis bib • Pellente • Pellentesque urna quam, vehicula sed.

ntesque
que urna

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Case 1: Admission physical exam

BP	102/60	**Pulse**	97	**SpO2**	93 %
Temp	38.4 °C (101.1 °F)	**RR**	20	**BMI**	24 kg/m^2
General	Alert and oriented, NAD, talkative				
HEENT	NCAT; trachea appears midline, no gross LAD; has dentures				
Resp	Normal respiratory effort, symmetric chest rise				
CV	RRR; extremities perfused				
GI	Non-distended; no TTP, **s/p ileostomy**				
Extremities	No clubbing, cyanosis, or edema				
Neuro/MSK	Intact CNs				
Psych	Normal mood; appropriate affect				

Case 2: Labs

CBC	Result
WBC	10.8
Hgb	16.2
Platelets	111
Neut %	78%
Eos %	0%

Chem7	Result
Na	134
K	4.5
HCO3	21
BUN	17
Cr	0.99

LFTs	Result
AST	55
ALT	24
Alk Phos	24
Bili	**3.2**

Case 2: Labs

Chem7	Day 0
K	4.5
HCO3	21
BUN	17
Cr	0.90
LFTs	**0**
AST	55
ALT	24
AlkPhos	24
Bili total	3.2
Bili direct	1.1
CBC	**0**
WBC	10.8
Hgb	16.2
Plts	111
Neut %	78%

Case 2: Labs

Chem7	Day 0	D1	D2
K	4.5	4.3	4.3
HCO3	21	22	20
BUN	17	24	28
Cr	0.90	0.87	0.88
LFTs	**0**	**1**	**2**
AST	55	60	**87**
ALT	24	20	23
AlkPhos	24	20	23
Bili total	**3.2**	**3.2**	**5.9**
Bili direct	1.1	1.0	
CBC	**0**	**1**	**2**
WBC	10.8	8.7	6.9
Hgb	16.2	15.0	13.3
Plts	111	98	**66**
Neut %	78%	75%	83%

Case 2: Labs

	Outside hospital					
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**	**Chem7**
K	4.5	4.3	4.3	4.4	4.5	K
HCO3	21	22	20	18	**14**	HCO3
BUN	17	24	28	44	55	BUN
Cr	0.90	0.87	0.88	0.88	**1.11**	Cr
LFTs	**0**	**1**	**2**	**3**	**4**	**LFTs**
AST	55	60	**87**	**133**	**199**	AST
ALT	24	20	23	32	43	ALT
AlkPhos	24	20	23	32	74	AlkPhos
Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**	Bili (total)
Bili direct	1.1	1.0		6.1	9.8	Direct B
CBC	**0**	**1**	**2**	**3**	**4**	**CBC**
WBC	10.8	8.7	6.9	9.5	11.7	WBC
Hgb	16.2	15.0	13.3	12.7	11.6	Hgb
Plts	111	98	66	**58**	**55**	Plt
Neut %	78%	75%	83%	76%	83%	Neut %

Case 2: Outside hospital course

- Blood cultures: negative
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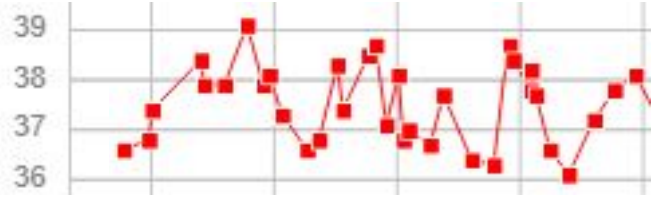


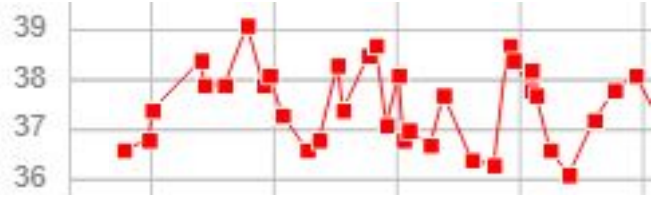
Case 2: Outside hospital course

	Outside hospital					
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**	**Chem7**
K	4.5	4.3	4.3	4.4	4.5	K
HCO3	21	22	20	18	**14**	HCO3
BUN	17	24	28	44	55	BUN
Cr	0.90	0.87	0.88	0.88	**1.11**	Cr
LFTs	**0**	**1**	**2**	**3**	**4**	**LFTs**
AST	55	60	**87**	**133**	**199**	AST
ALT	24	20	23	32	43	ALT
AlkPhos	24	20	23	32	74	AlkPhos
Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**	Bili (total)
Bili direct	1.1	1.0		6.1	9.8	Direct B
CBC	**0**	**1**	**2**	**3**	**4**	**CBC**
WBC	10.8	8.7	6.9	9.5	11.7	WBC
Hgb	16.2	15.0	13.3	12.7	11.6	Hgb
Plts	111	98	66	**58**	**55**	Plt
Neut %	78%	75%	83%	76%	83%	Neut %

LDH	**1570**
CRP	**247**
ANA	**1:640**
HIV	Neg
Hep screen	Neg

Case 2: Outside hospital course

- Blood cultures: negative
- CT A/P: No acute inflammatory findings in the abdomen or pelvis
- MRCP: Also normal
- Continues to fever
    - Was **not started** on antibiotics until just before transfer



Developed hypoxia when labs took a turn for the worse

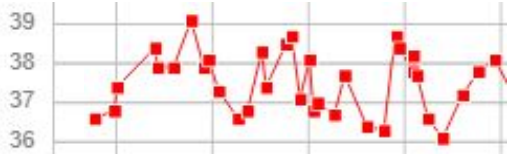
- No repeat BCx, but started Zosyn
- Transfer to Ruby for HLOC

Case 2: Summary

A generally healthy **85 y/o M** with PMH remote hx colon cancer p/w 10 days of **dizziness** and admitted to OSH with **fevers & ↑↑ bili**

 # Ongoing fevers
 # Hyperbilirubinemia
 # Thrombocytopenia, ?TTP
 # Hypoxic respiratory failure

Blood cultures: NGTD
CT A/P: normal liver
MRCP: Normal



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	Outside hospital				
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**
K	4.5	4.3	4.3	4.4	4.5
HCO3	21	22	20	18	**14**
BUN	17	24	28	44	55
Cr	0.90	0.87	0.88	0.88	**1.11**
LFTs	**0**	**1**	**2**	**3**	**4**
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Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**
Bili direct	1.1	1.0		6.1	9.8
CBC	**0**	**1**	**2**	**3**	**4**
WBC	10.8	8.7	6.9	9.5	11.7
Hgb	**16.2**	15.0	13.3	12.7	**11.6**
Plts	111	98	66	**58**	**55**
Neut %	78%	75%	83%	76%	83%

Case 2: Labs at Ruby

	Outside hospital					D4	
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**	10PM	**Chem7**
K	4.5	4.3	4.3	4.4	4.5	**5.6**	K
HCO3	21	22	20	18	14	8	HCO3
BUN	17	24	28	44	55	51	BUN
Cr	0.90	0.87	0.88	0.88	**1.11**	**1.7**	Cr
LFTs	**0**	**1**	**2**	**3**	**4**	10PM	**LFTs**
AST	55	60	**87**	**133**	**199**	**348**	AST
ALT	24	20	23	32	43	58	ALT
AlkPhos	24	20	23	32	74	98	AlkPhos
Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**	**26**	Bili (total)
Bili direct	1.1	1.0		6.1	9.8		Direct B
CBC	**0**	**1**	**2**	**3**	**4**	10PM	**CBC**
WBC	10.8	8.7	6.9	9.5	11.7	**26**	WBC
Hgb	**16.2**	15.0	13.3	12.7	11.6	**10.8**	Hgb
Plts	111	98	66	**58**	**55**	**85**	Plt
Neut %	78%	75%	83%	76%	83%		Neut %

Case 2: Labs at Ruby

	Outside hospital					D4	D5	
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**	10PM	5am	**Chem7**
K	4.5	4.3	4.3	4.4	4.5	**5.6**	**4.6**	K
HCO3	21	22	20	**18**	**14**	**8**	**10**	HCO3
BUN	17	24	28	44	55	51	50	BUN
Cr	0.90	0.87	0.88	0.88	**1.11**	**1.7**	**2.0**	Cr
LFTs	**0**	**1**	**2**	**3**	**4**	10PM	5am	**LFTs**
AST	55	60	**87**	**133**	**199**	**348**	**1200**	AST
ALT	24	20	23	32	43	**58**	**410**	ALT
AlkPhos	24	20	23	32	74	98	79	AlkPhos
Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**	**26**	**21**	Bili (total)
Bili direct	1.1	1.0		6.1	9.8			Direct B
CBC	**0**	**1**	**2**	**3**	**4**	10PM	5am	**CBC**
WBC	10.8	8.7	6.9	9.5	11.7	**26**	**28**	WBC
Hgb	16.2	15.0	13.3	12.7	11.6	10.8	**7.3**	Hgb
Plts	111	98	66	**58**	**55**	**85**	**70**	Plt
Neut %	78%	75%	83%	76%	83%			Neut %

LDH	**3088**
Lactate	**10.3**
Direct Coombs	Positive

Case 2: Labs at Ruby

This set of labs prompts ID consult

	Outside hospital					D4	D5	
Chem7	**Day 0**	**D1**	**D2**	**D3**	**D4**	10PM	5am	**Chem7**
K	4.5	4.3	4.3	4.4	4.5	**5.6**	**4.6**	K
HCO3	21	22	20	**18**	**14**	**8**	**10**	HCO3
BUN	17	24	28	44	55	51	50	BUN
Cr	0.90	0.87	0.88	0.88	**1.11**	**1.7**	**2.0**	Cr
LFTs	**0**	**1**	**2**	**3**	**4**	10PM	5am	**LFTs**
AST	55	60	**87**	**133**	**199**	**348**	**1200**	AST
ALT	24	20	23	32	43	**58**	**410**	ALT
AlkPhos	24	20	23	32	74	98	79	AlkPhos
Bili total	**3.2**	**3.2**	**5.9**	**10.9**	**17.5**	**26**	**21**	Bili (total)
Bili direct	1.1	1.0		6.1	9.8			Direct B
CBC	**0**	**1**	**2**	**3**	**4**	10PM	5am	**CBC**
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Hgb	16.2	15.0	13.3	12.7	11.6	10.8	**7.3**	Hgb
Plts	111	98	66	**58**	**55**	**85**	**70**	Plt
Neut %	78%	75%	83%	76%	83%			Neut %

LDH	**3088**
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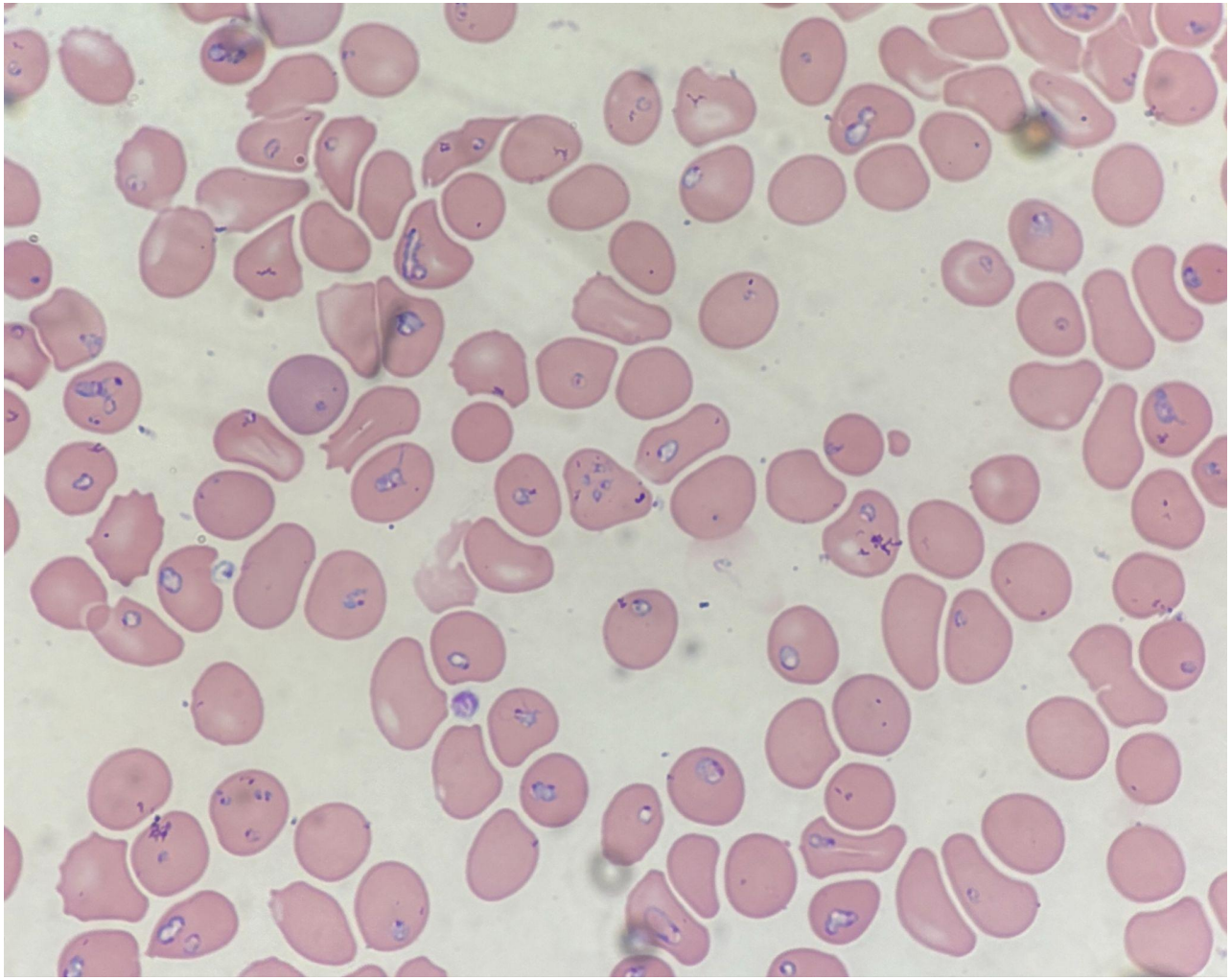
Direct Coombs	Positive

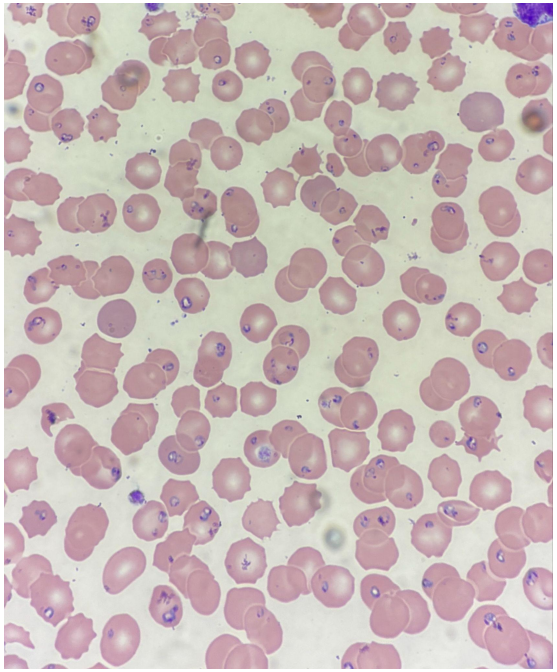
Case 2: Early hours page

Paged in early AM for abnormal peripheral blood smear

At this point, patient is in multi-organ failure and has been

- Started on two vasopressors for shock
- Intubated for rapidly progressive hypoxia
- CRRT for renal failure and profound acidosis
- Receiving numerous blood products



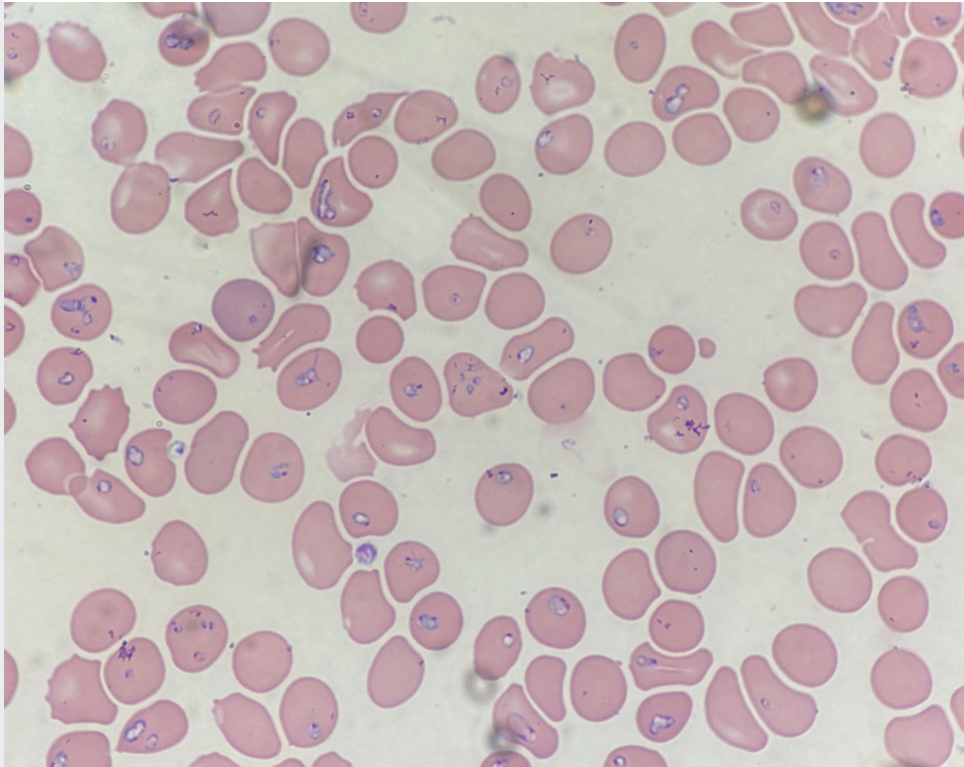


Case 2: Summary

A generally healthy **85 y/o M** with PMH remote hx colon cancer p/w 10 days of **dizziness** and admitted to OSH with **fevers & ↑↑ bili**

- Additional questions?
- Want to review the CT A/P again?
- Empiric treatment?

 # Ongoing fevers
 # Hemolytic anemia w/ hyperbili
 # Shock
 # Acute renal failure
 # Thrombocytopenia
 # Hypoxic respiratory failure



Case 2: Social history, exposures, & risk factors

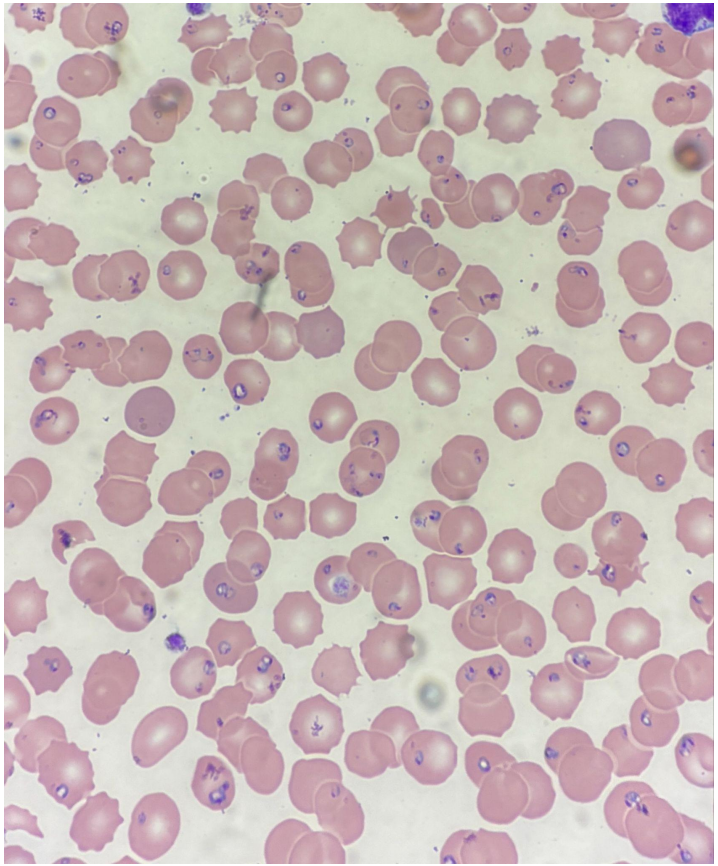
Geographic	• Lives with wife in **western WV** (between Wheeling and Parkersburg)
Travel	• **Never international travel** • No recent travel (farthest he has gone from his house in past 6 months was to his local church)
Exposures	• Spends **much of his time outdoors**, including mowing the lawn • Wife is unaware of any tick bites
Animals	• No animal exposures, but does **feed the deer** near his property • Wife has also noticed **snakes** on the property
Misc	• Never blood transfusions (prior to admission)

Case 2: Review of imaging

FINDINGS (CT A/P)
There is no confluent airspace disease in the imaged lung bases. Calcified lymph nodes are visible in the right hilum and a calcified granuloma is seen in the right middle lobe.

A few scattered presumed cysts are noted in the liver. Liver is otherwise unremarkable. The gallbladder, pancreas, adrenal glands, and kidneys reveal no acute abnormalities. A punctate nonobstructing stone is visible in the mid left kidney. Small presumed bilateral renal cortical cysts are noted. **Spleen is absent with splenules in the left upper quadrant**. The stomach and the small bowel are normal in caliber and wall thickness. There are extensive postsurgical changes of the bowel with a right abdominal ileostomy. Colon appears surgically absent. The urinary bladder and the prostate gland are grossly unremarkable. The abdominal aorta is normal in caliber. There is no abdominal or pelvic free fluid or free intraperitoneal air. There are no enlarged abdominal or pelvic lymph nodes.

Bone windows reveal no destructive bone lesions or evidence of acute bony abnormality.

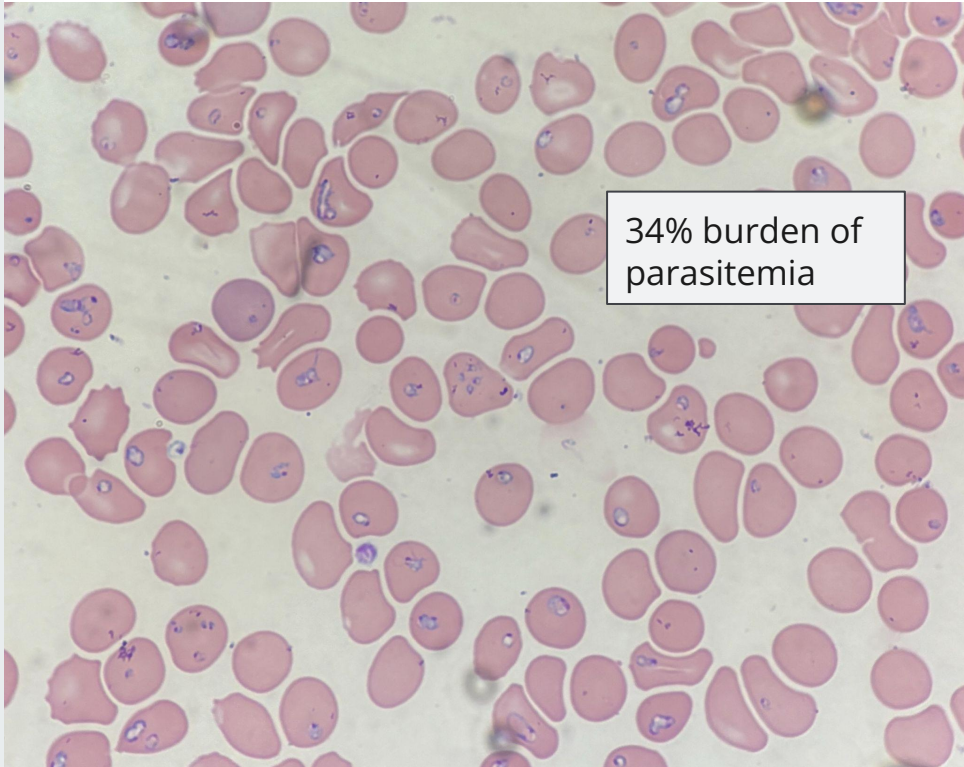


Case 2: Summary

A **85 y/o M** with PMH asplenia, remote hx colon cancer p/w 10 days of **dizziness** and admitted to OSH with **fevers &** ↑↑ **bili**

- Empiric treatment?
- Anything besides antibiotics?

 # Ongoing fevers
 # Hemolytic anemia w/ hyperbili
 # Shock
 # Acute renal failure
 # Thrombocytopenia
 # Hypoxic respiratory failure



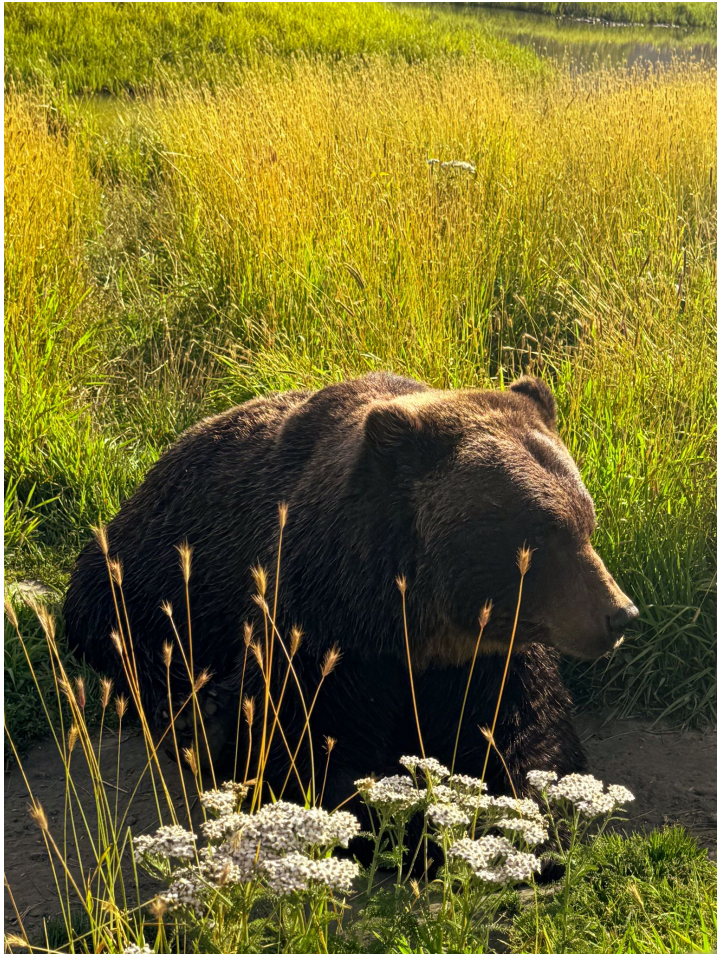
Case 2: Hospital course

- MICU team started Coartem, **atovaquone**, & **azithro**
  - We said to **stop Coartem**
- Renal consulted for **exchange transfusion**

Case 2: Hospital course

- MICU team started Coartem, **atovaquone**, & **azithro**
  - We said to **stop Coartem**
- Renal consulted for **exchange transfusion**
- Patient died within 8 hours of blood smear
  - Hgb dropped by 4.5g in last 24 hours of life
- PCR would eventually confirm **severe babesiosis infection**

Exhibit #3



Black bear (even though it looks brown)

Porcupine (they climb trees!)

Tularemia *(Francisella tularensis)*

[PMID 37916743]

- Has been isolated from porcupines
  - Porcupines = Rabbits + spikes
- However, main disease in humans is probably bacterial from puncture injury

Tularemia, brucellosis, toxoplasmosis

[PMID 31828973]

- Let's be honest, zoonotic diseases are the least of your concerns here
- If you survive the trauma of a bear attack, you may need antibiotics for superimposed infection

Discussion

West Nile Virus

First isolated in **1937** in the **West Nile region** **of** **Uganda**

West Nile Virus

First isolated in **1937** in the **West Nile region** **of** **Uganda**

No neurologic disease was seen clinically (at first)

- But did notice **cross reactivity** with **other neurotropic viruses**, like St Louis encephalitis)
- First case of **encephalitis** noticed in Israeli patients in **1950s**

West Nile Virus

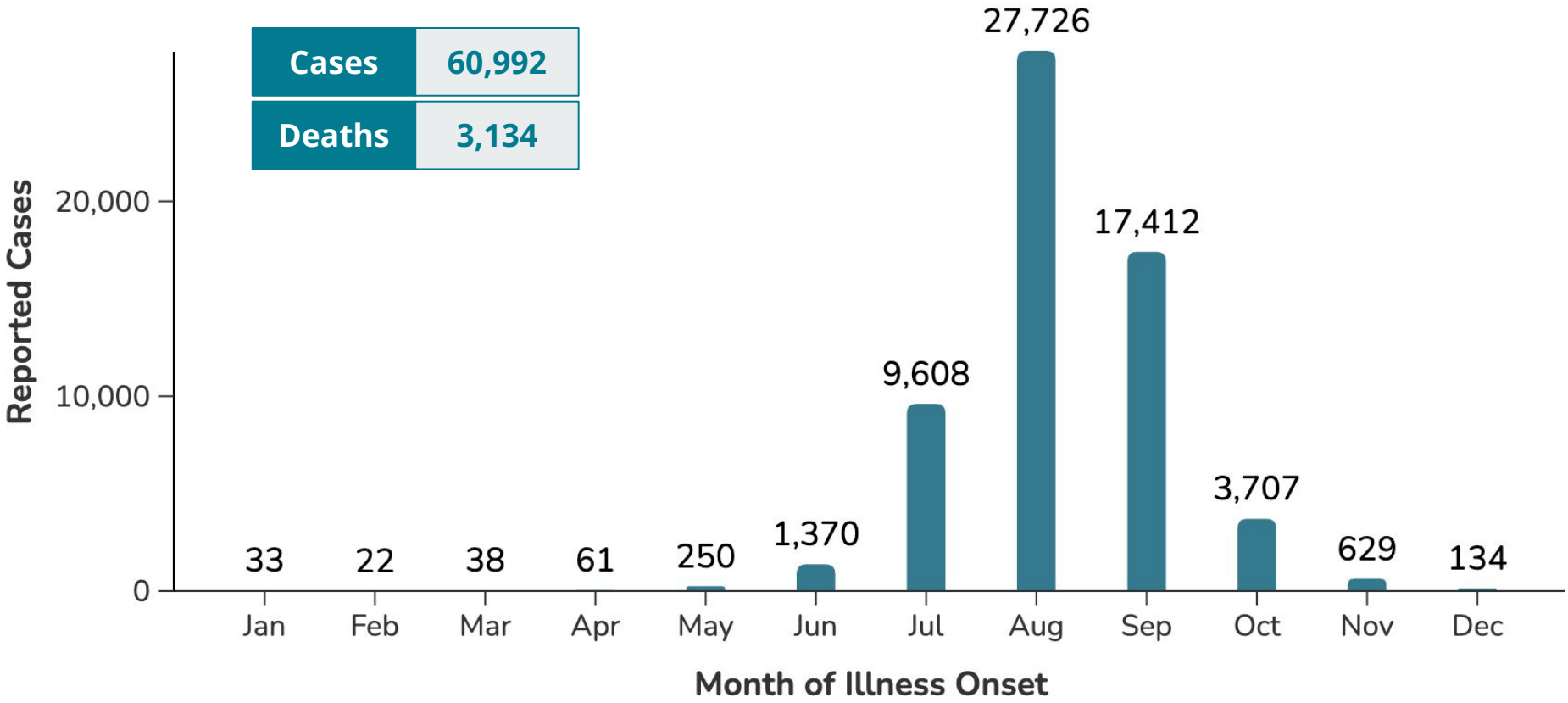
First isolated in **1937** in the **West Nile region of Uganda**

- First case of **encephalitis** noticed in Israeli patients in **1950s**

Epidemiology of **WNV shifted in 1990s** → world wide spread

- First outbreak in **western hemisphere** in Northeast United States (**1999**)
- Now, WNV is one of the most distributed arboviruses worldwide

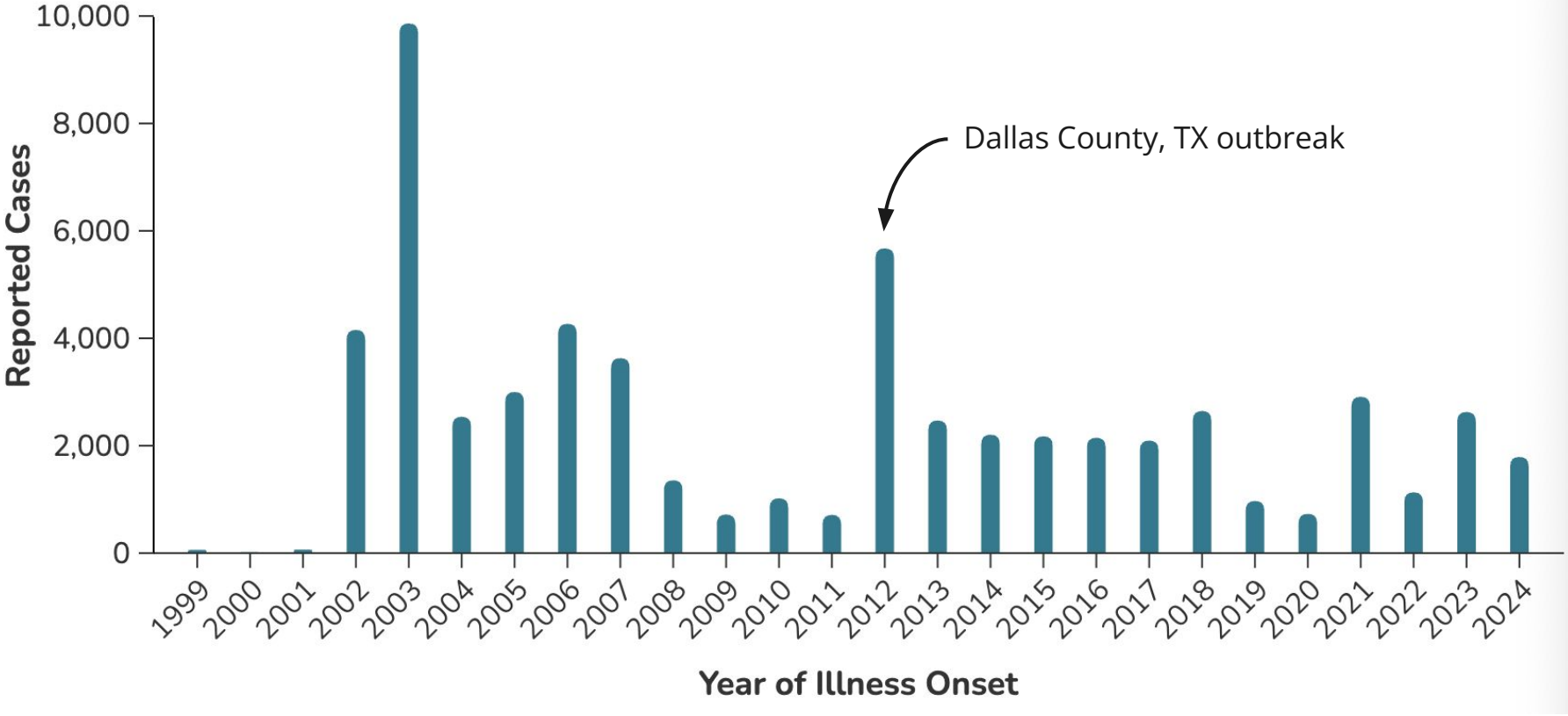
Geographic distribution of West Nile virus (Mandell 9e)



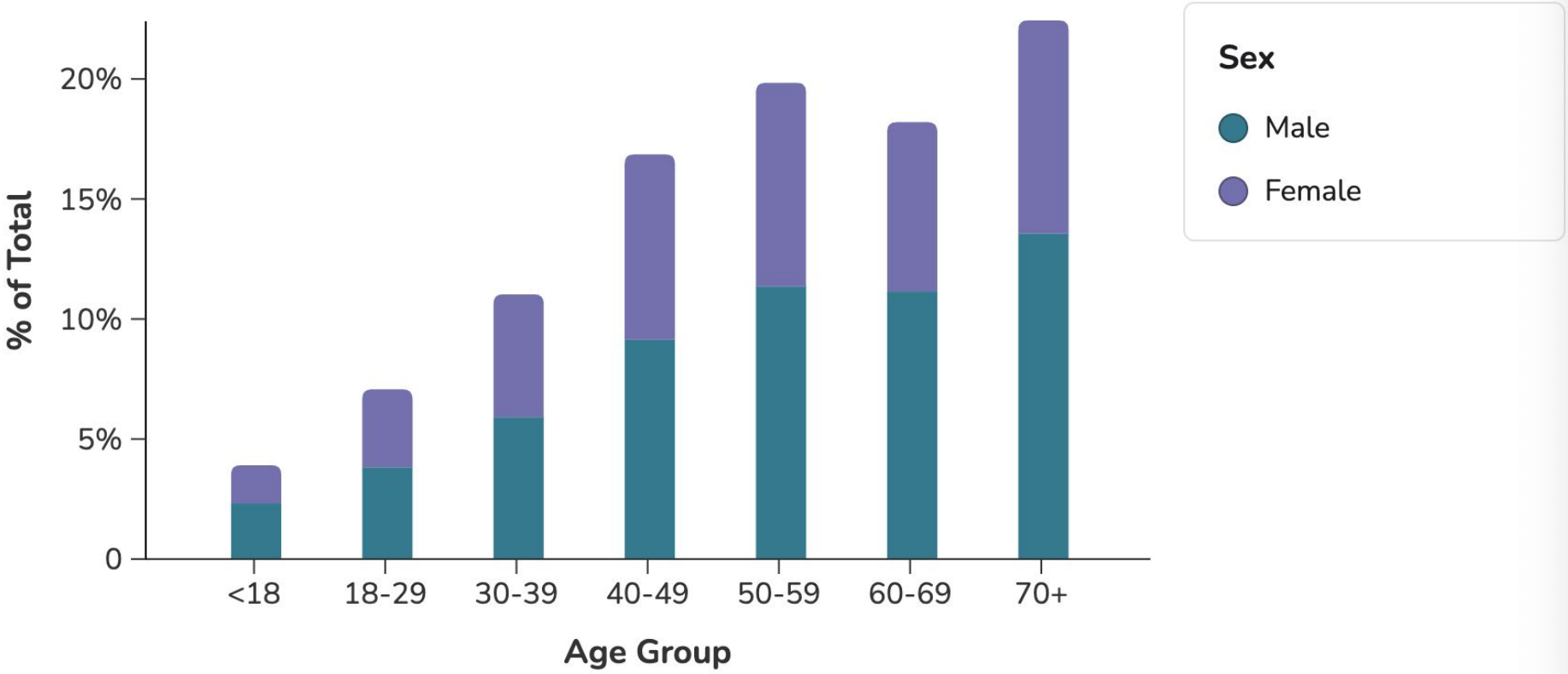
Data from 1999 - 2024

Source: CDC ArboNET

West Nile virus human disease cases by year of illness onset, 1999-2024

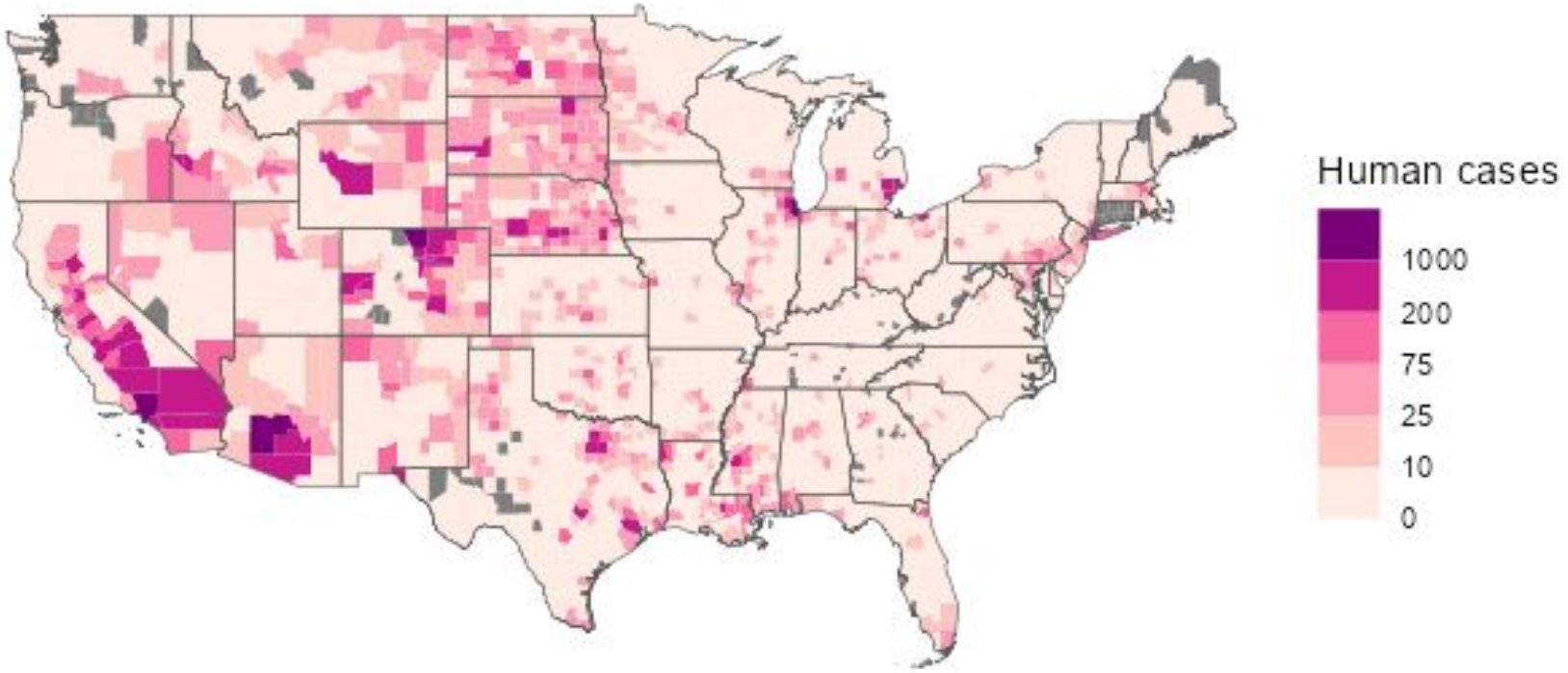


West Nile virus human disease cases by age and sex, 1999-2024



Total cases of West Nile Virus

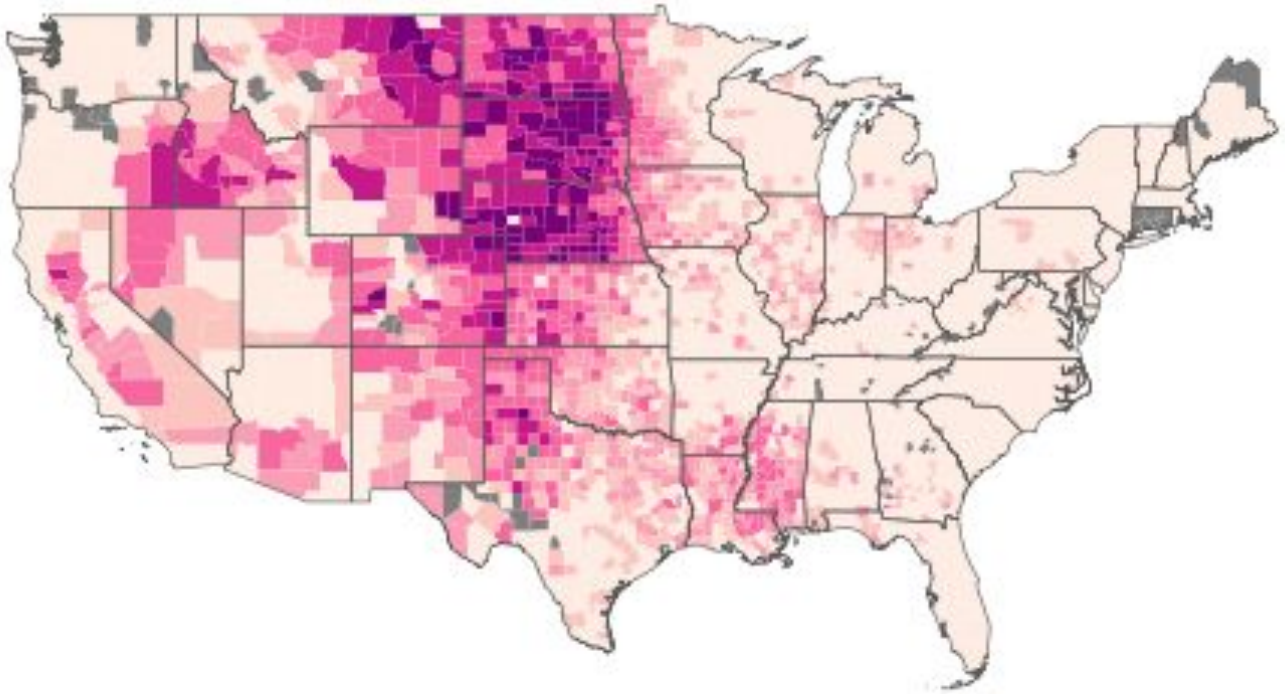
1999-2024



Source: CDC ArboNET data

Per capita cases of West Nile Virus

Average annual number of cases (1999-2024)



Source: CDC, 2020 Census

Per capita cases of West Nile Virus

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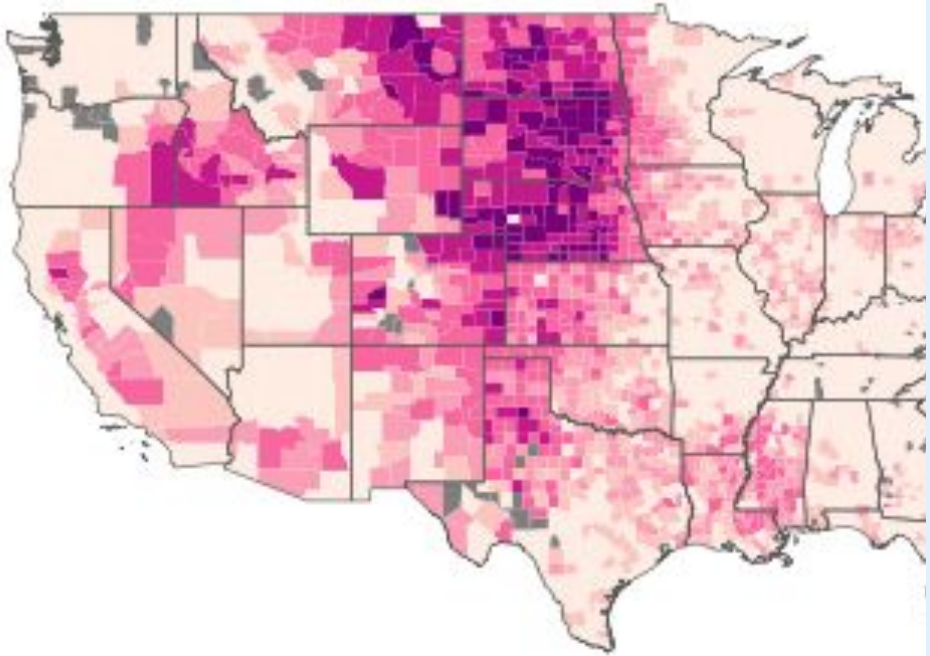
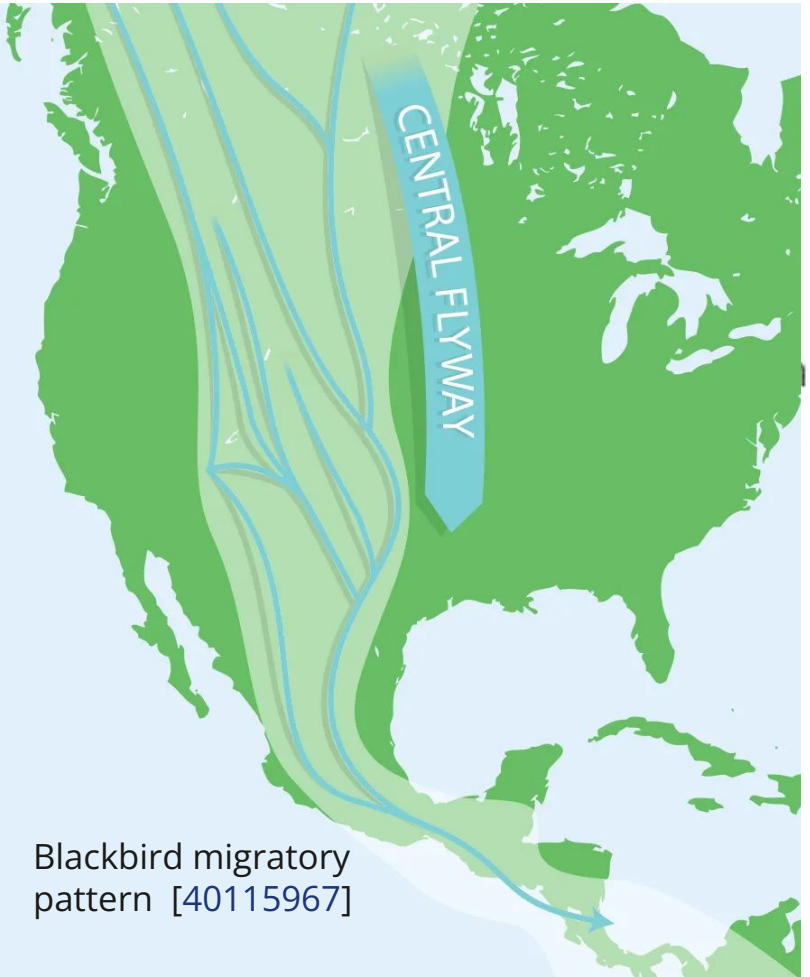
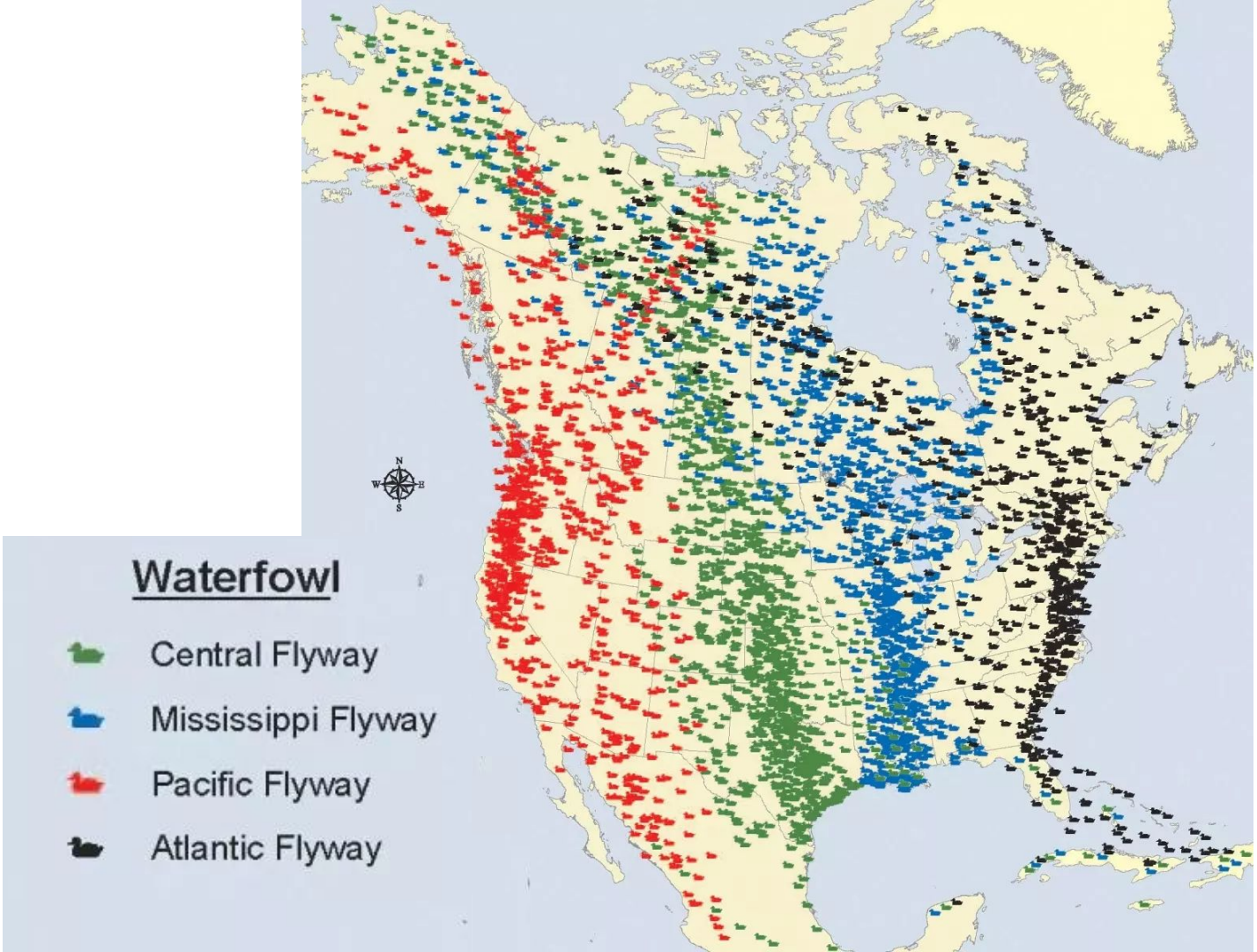


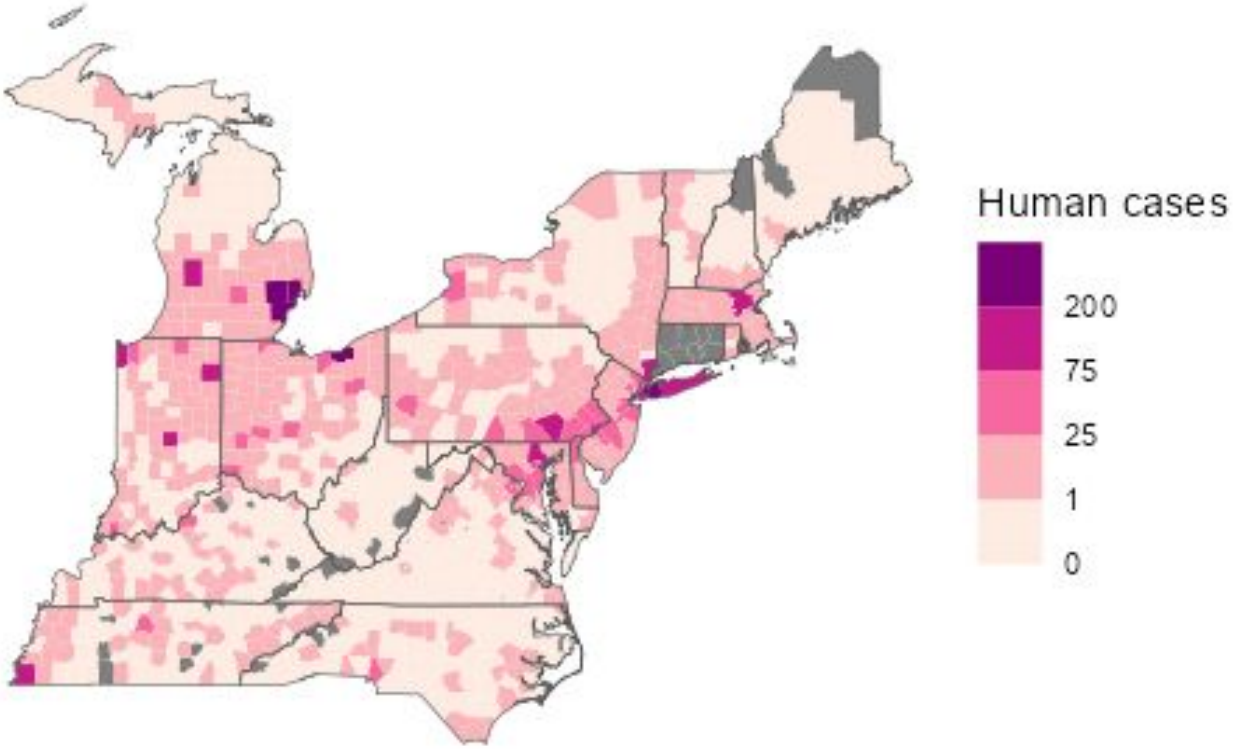


Blackbird migratory pattern [40115967]


Waterfowl
Central Flyway
Mississippi Flyway
Pacific Flyway
Atlantic Flyway

Total cases of West Nile Virus

1999-2024



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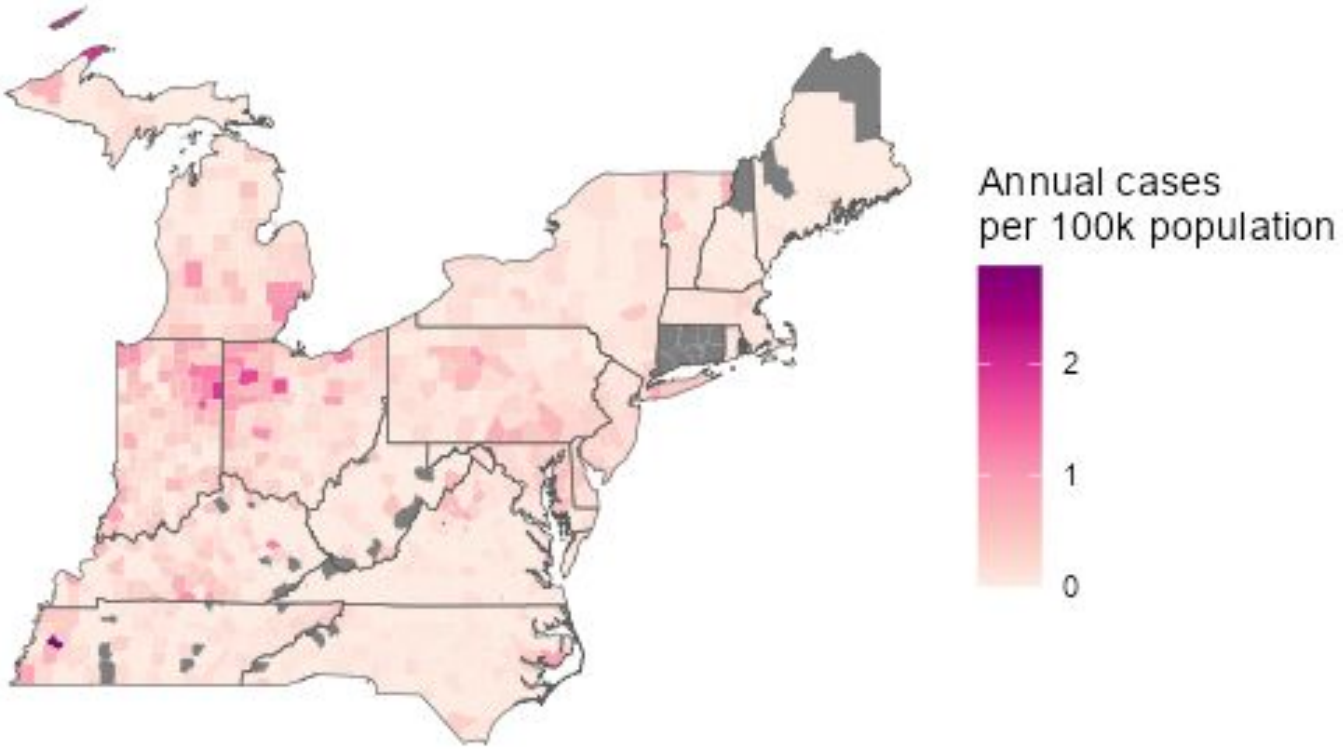

Source: CDC, 2020 Census

West Nile Virus

Why wide spread distribution? Because it can infect...

- **>62 species** of **mosquitoes**
- **>300 species** of **birds** (jays, blackbirds, finches, warblers, sparrows, crows)
    - **Crows** and **blue jays** are the most susceptible

West Nile Virus

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- **>62 species** of **mosquitoes**
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What happened when it came to the US?

- Was **devastating to the North American avian population**. Unlike the birds in Africa, these birds had no immunity
  - Arrival of the virus in America literally had **dying birds falling from the sky**
- Molecular analysis suggests it came from a **single viral strain** (perhaps from **Egypt**)

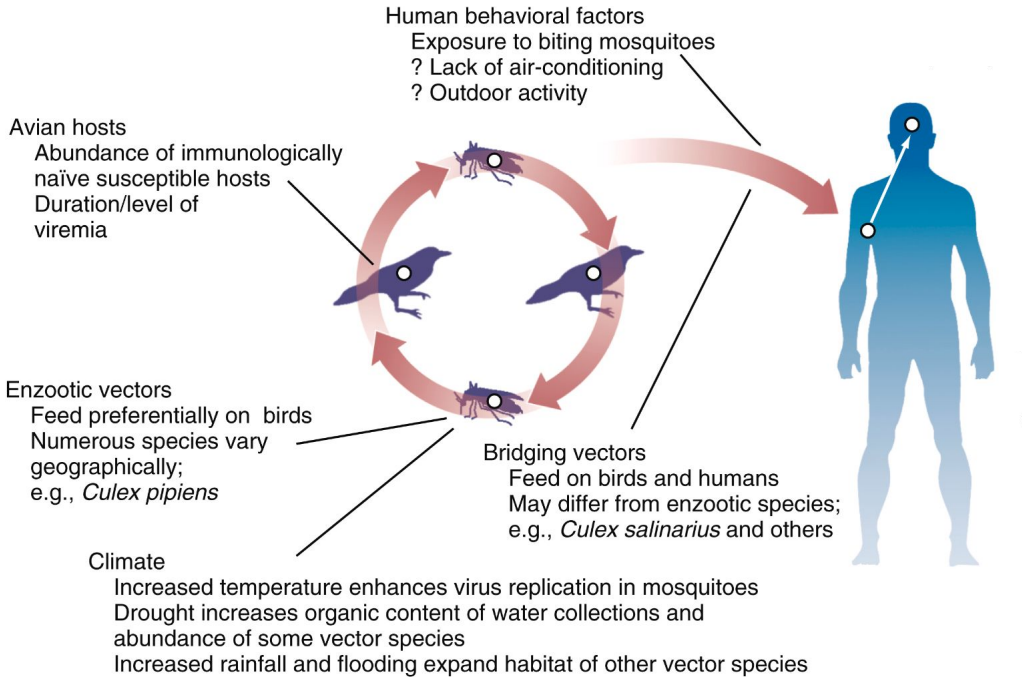
Both ravens & eagles are amplifying hosts for WNV

West Nile Virus: Transmission

Enzootic cycle between birds and mosquitos

Additional exposure Hx

- Dead birds
- Dead racoons

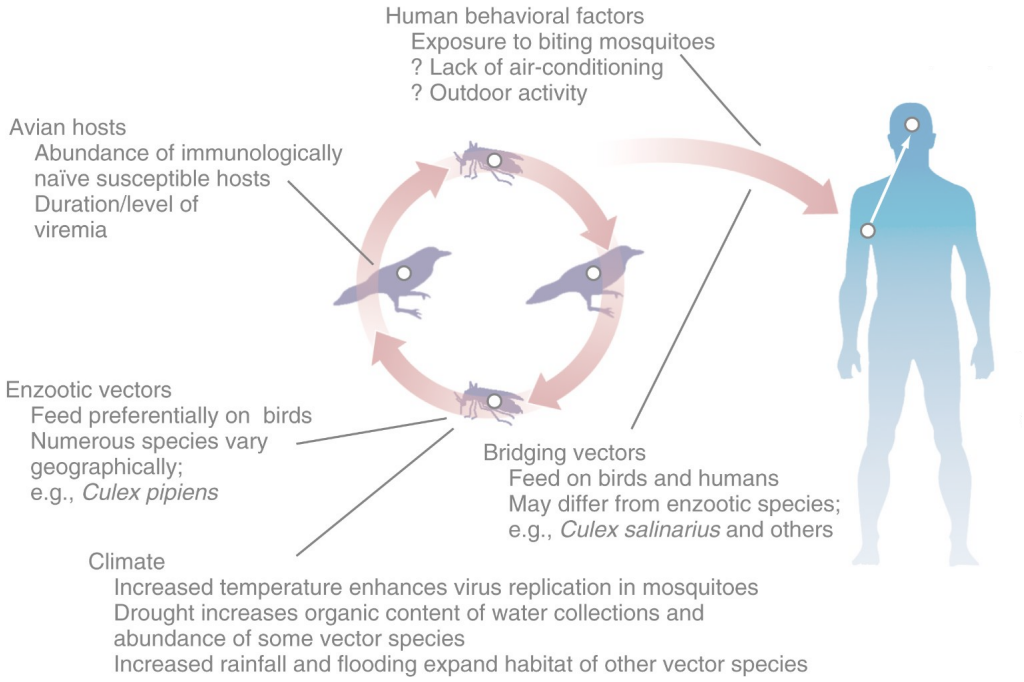


Adapted from figure 160.3 (Mandell 9e)

West Nile Virus: Transmission

Enzootic cycle between birds and mosquitos

- Other animals (including us) can be infected
- We have insufficient viremia to spread to mosquitos → dead-end hosts



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West Nile Virus: Transmission

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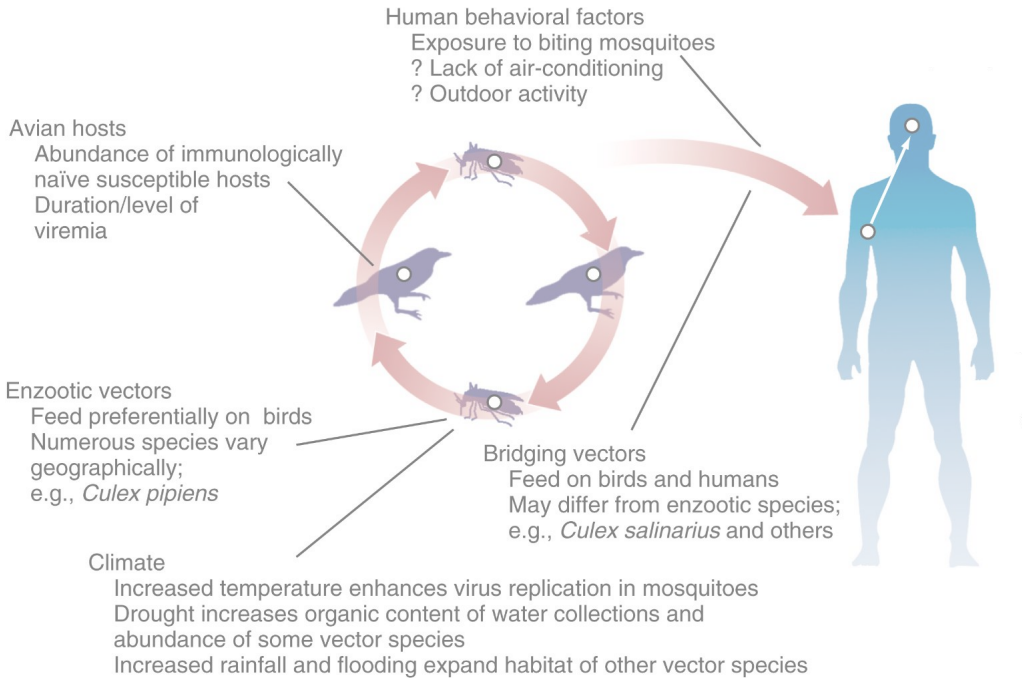
Prior spread from blood transfusions, but ↓↓↓ with screening PCRs



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Spectrum of disease

Asymptomatic (~80%)
Only **one in 4-5** of those who are infected develop any symptoms

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West Nile Fever
Sudden onset of an acute, **flu-like illness** (e.g. f/c, headache, mayagia, retro-orbital pain)

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No neurologic symptoms

West Nile Fever
Sudden onset of an acute, **flu-like illness** (e.g. f/c, headache, mayagia, retro-orbital pain)

- Last 3-6 days
- Not everyone has a fever
- 25-50% may develop rash
  - Perhaps lower risk of CNS disease if rash?

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CNS involvement (1 in 150)
Fever –and– (any of)

- Meningitis
- **Encephalitis** (WNE, most common)
- Flaccid paralysis

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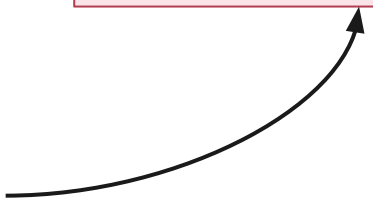
Age-dependent risk of death (especially WNE)

- Under age 50: <4% mortality
- Over age 70: >20% mortality

Unclear exact mechanism of spread



Risk factors for CNS disease

- **Age**

We already talked about this...

Risk factors for CNS disease

- Age
- **Hematologic abnormalities / malignancy**

Chemotherapy for cancer increases risk of CNS disease **six-fold**

Defective B-cells
Series of patients receiving Rituxan found 86% developed CNS disease & 79% died

Risk factors for CNS disease

- Age
- Hematologic abnormalities / malignancy
- **Transplant**

Very limited data, but one case series of **SOT** had **40% with neuroinvasive disease** [PMID 39599892]

Also, WNV can be transmitted via transplant

Risk factors for CNS disease

- Age
- Hematologic abnormalities / malignancy
- Transplant
- **Defective CCR5**

While this might be helpful for HIV, those with **CCR5 mutations** had higher rates of symptomatic WNV infection and **increased the odds of death 13-fold** (PMID 16418398)

Risk factors for CNS disease

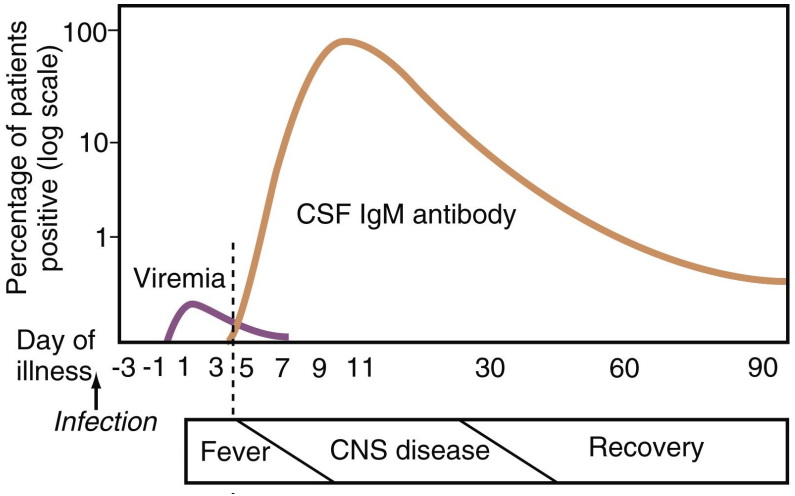
- Age
- Hematologic abnormalities / malignancy
- Transplant
- Defective CCR5
- **Lack of prior immunity**
  - This is technically a *protective factor*, not a risk factor *per se*

In a large South African outbreak (**18,000 cases**) only had **one case** of **West Nile encephalitis**

Thought to be because those at highest risk (elderly) had immunity from prior infections (e.g. during childhood)

Diagnosis

Incubation period of **2-6 days** (may be longer in immunocompromise)



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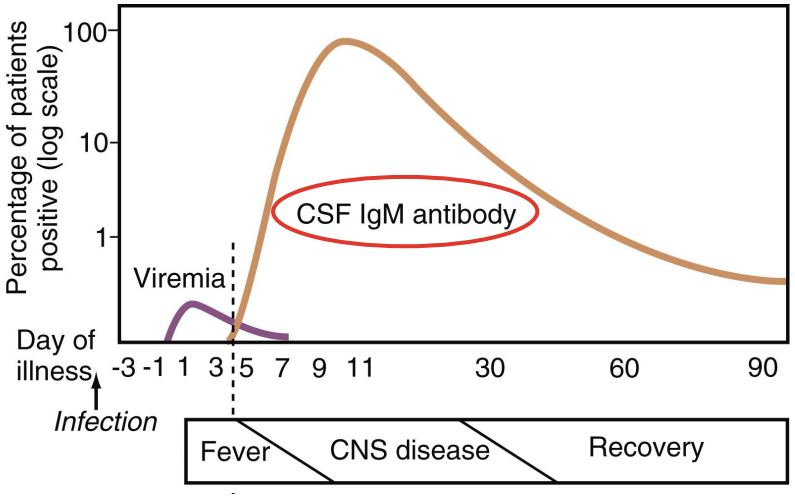
Mainstay of diagnosis is **serology**

- Test for **IgM** (serum +/- CNS)

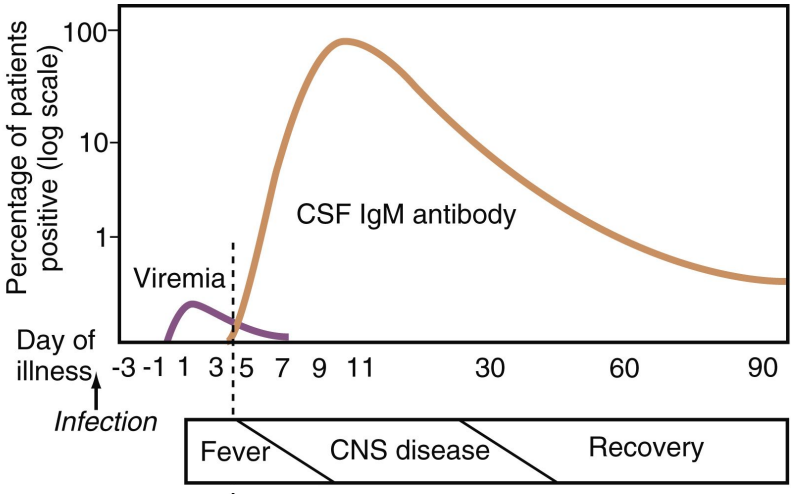


Diagnosis

Incubation period of **2-6 days** (may be longer in immunocompromise)

Mainstay of diagnosis is **serology**

- Test for **IgM** (serum +/- CNS)
- If *immunocompromise*, IgM + PCR is helpful
  - In the study on Rituxan, zero patients mounted an IgM response
- Otherwise PCR is of little use
  - Viremia is usually cleared by time of symptom onset



Diagnosis

Incubation period of **2-6 days** (may be longer in immunocompromise)

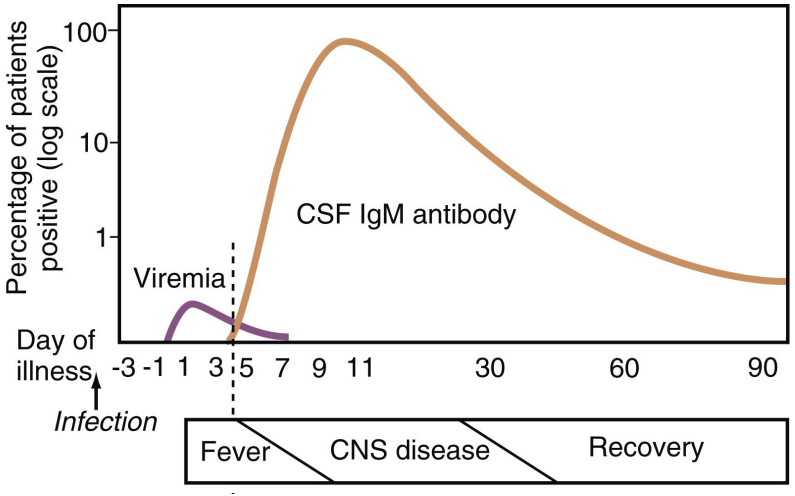
- 50% have peripheral leukocytosis
- CSF: Moderate (<500) lymphocytic pleocytosis
  - Can **neutrophilic** (~40% of cases)
  - Moderate protein elevation w/ normal glucose

LP	Day 2	Day 8
Opening Pr	Unk	34
WBC	2	**215**
Neut (%)	2%	86%
Lymph (%)	60%	8%
RBC	1	71
Protein	47	**117**
Glucose	127	**64**
CrAg	Neg	---
HSV/VZV PCR	Neg	
Cultures	NGTD	*TBD*

Diagnosis

Incubation period of **2-6 days** (may be longer in immunocompromise)

- 50% have peripheral leukocytosis
- CSF: Moderate (<500) lymphocytic pleocytosis
  - Can neutrophilic (~40% of cases)
  - Moderate protein elevation w/ normal glucose
- MRI: Nonspecific (early on)
  - Late in disease can get T2 & DWI enhancement in thalamus
  - This is a bad sign



Persistent symptoms

- Longitudinal cohort studies show many do not return to baseline health
  - Generally, just under **2/3rds** have lingering symptoms at 1 year
  - These have **included objective measures** (25% Dx with depression, 70% with abnormal motor function)
  - That said, one cohort did show recovery by one year

Common long WNV symptoms

- Fatigue
- Memory problems
- Language issues
- Muscle weakness
- Numbness/tingling
- Headaches

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  - In one longitudinal study, **60%** of patients **still had symptoms** at **1 year**
  - At **8 years**, **40%** still had persistent symptoms
- More common with those who had **CNS involvement**
  - **Older age** is associated with decreased likelihood of returning to baseline

Common long WNV symptoms

- Fatigue
- Memory problems
- Language issues
- Muscle weakness
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- Headaches

Babesiosis

Babesiosis

First **identified in 1888** by **Dr Victor Babeș**, a Romanian microbiologist (after which Babesia is named)

- Identified as a cause a hemolytic anemia in cattle
- He likely identified *B. divergens* (not B. microti, which causes disease in the US)

First human case reported in 1957

Babesiosis

First **identified in 1888** by **Dr Victor Babeș**, a Romanian microbiologist (after which Babesia is named)

	B. divergens	***B. microti***
Geography	UK, Europe, Russia	Northeast USA
Vector	*Ixodes ricinus*	*Ixodes scapularis*
Reservoir	Cattle, reindeer	White-footed mouse
Clinical presentation	Fulminant course with multiorgan failure	Often asymptomatic, may be severe in immunocompromise

Babesia microti

Transmitted by ***Ixodes scapularis*** (blacklegged tick)

Same vector as:

- Lyme
- Anaplasmosis
- Ehrlichiosis

Babesia microti

Transmitted by ***Ixodes scapularis*** (blacklegged tick)

Same vector as:

- Lyme
- Anaplasmosis
- Ehrlichiosis

Primary **zoonotic reservoirs** for the parasite are **white-footed mice** and **rabbits**

Tick table

	Pathogen	Vector	Reservoir
Lyme	*Borrelia burgdorferi*	*Ixodes scapularis* (blacklegged tick)	Deer (including white-tailed deer), rodents
Anaplasmosis	*Anaplasma phagocytophilum*	*Ixodes scapularis* *Ixodes persulcatus* (deer tick) *I. ricinus, I. pacificus*	Rodents (including white-footed mouse) deer, ruminants, horses
Ehrlichiosis	*Ehrlichia chaffeensis* *Ehrlichia ewingii*	*A. americanum* (lone star tick)	White-tailed deer, dogs
	E. muris eauclairensis	*Ixodes scapularis*	
Babesiosis	*Babesia microti*	*Ixodes scapularis*	White-footed mouse

Tick table

	Pathogen	Vector	Reservoir
Lyme	*Borrelia burgdorferi*	***Ixodes scapularis*** (**blacklegged tick**)	Deer (including white-tailed deer), rodents
Anaplasmosis	*Anaplasma phagocytophilum*	***Ixodes scapularis*** *Ixodes persulcatus* (deer tick) *I. ricinus, I. pacificus*	Rodents (including white-footed mouse) deer, ruminants, horses
Ehrlichiosis	*Ehrlichia chaffeensis* *Ehrlichia ewingii*	*A. americanum* (lone star tick)	White-tailed deer, dogs
	E. muris eauclairensis	***Ixodes scapularis***	
Babesiosis	*Babesia microti*	***Ixodes scapularis***	White-footed mouse

Babesiosis vs anaplasmosis

	Pathogen	Vector	Reservoir
Lyme	*Borrelia burgdorferi*	***Ixodes scapularis*** (blacklegged tick)	Deer (including white-tailed deer), **rodents**
Anaplasmosis	*Anaplasma phagocytophilum*	***Ixodes scapularis*** *Ixodes persulcatus* (deer tick) *I. ricinus, I. pacificus*	**Rodents** (including **white-footed mouse**) deer, ruminants, horses
Ehrlichiosis	*Ehrlichia chaffeensis* *Ehrlichia ewingii*	*A. americanum* (lone star tick)	White-tailed deer, dogs
	E. muris eauclairensis	*Ixodes scapularis*	
Babesiosis	*Babesia microti*	***Ixodes scapularis***	**White-footed mouse**

Babesiosis vs anaplasmosis

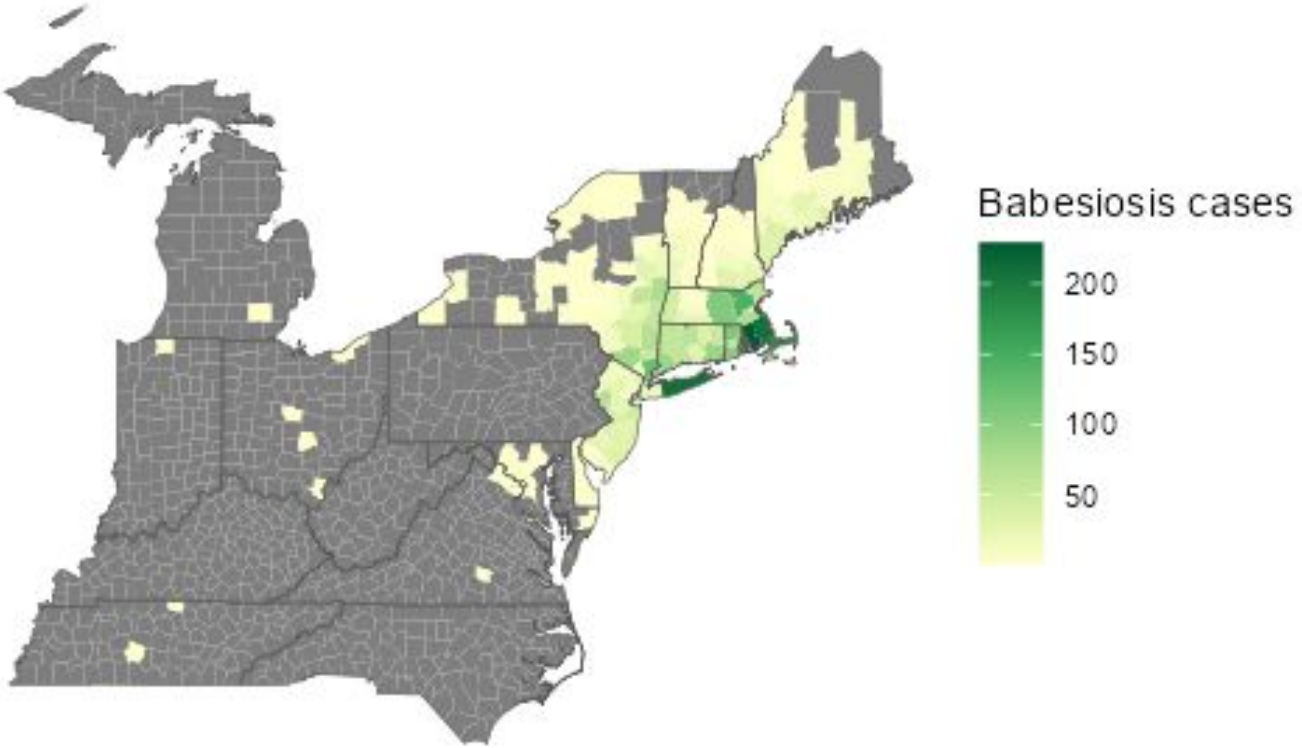
	Pathogen	Vector	Reservoir
Lyme	*Borrelia burgdorferi*	***Ixodes scapularis*** (blacklegged tick)	Deer (including white-tailed deer), **rodents**
Anaplasmosis	*Prefers* rodents, but not as picky	***Ixodes scapularis*** *Ixodes persulcatus* (deer tick) *I. ricinus, I. pacificus*	**Rodents** (including **white-footed mouse**) deer, ruminants, horses
Ehrlichiosis	*Ehrlichia chaffeensis* *Ehrlichia ewingii*	*A. americanum* (lone star tick)	White-tailed deer, dogs
	E. muris eauclairensis	*Ixodes scapularis*	
Babesiosis	More *selective* reservoir	***Ixodes scapularis***	**White-footed mouse**

Babesiosis vs anaplasmosis

	Reservoir	Deer	Rodents
Lyme	Deer (including white-tailed deer), **rodents**		  
Anaplasmosis	**Rodents** (including **white-footed mouse**), deer, ruminants, horses		  
Ehrlichiosis	White-tailed deer, dogs		
Babesiosis	**White-footed mouse**		

Total cases of Babesiosis

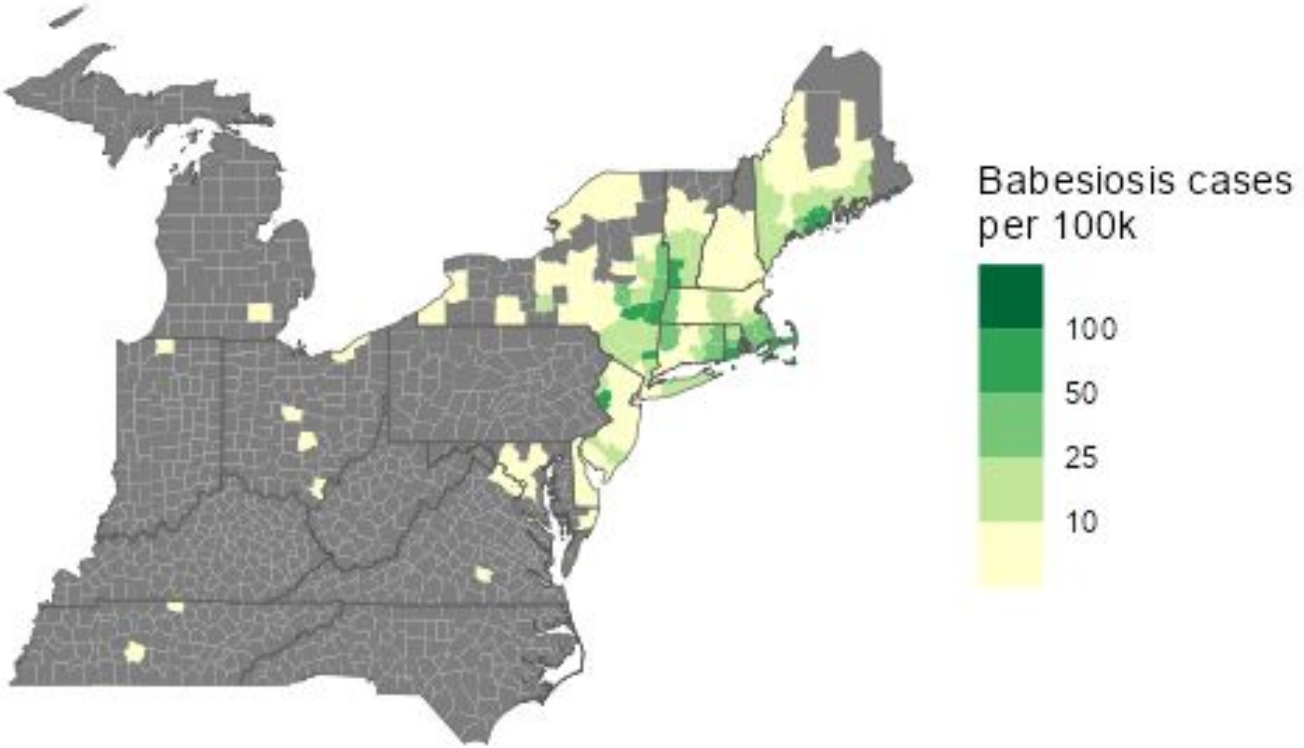
2019-2022



Source: CDC Tickborne Disease Surveillance

Per capita Babesiosis

2019-2022



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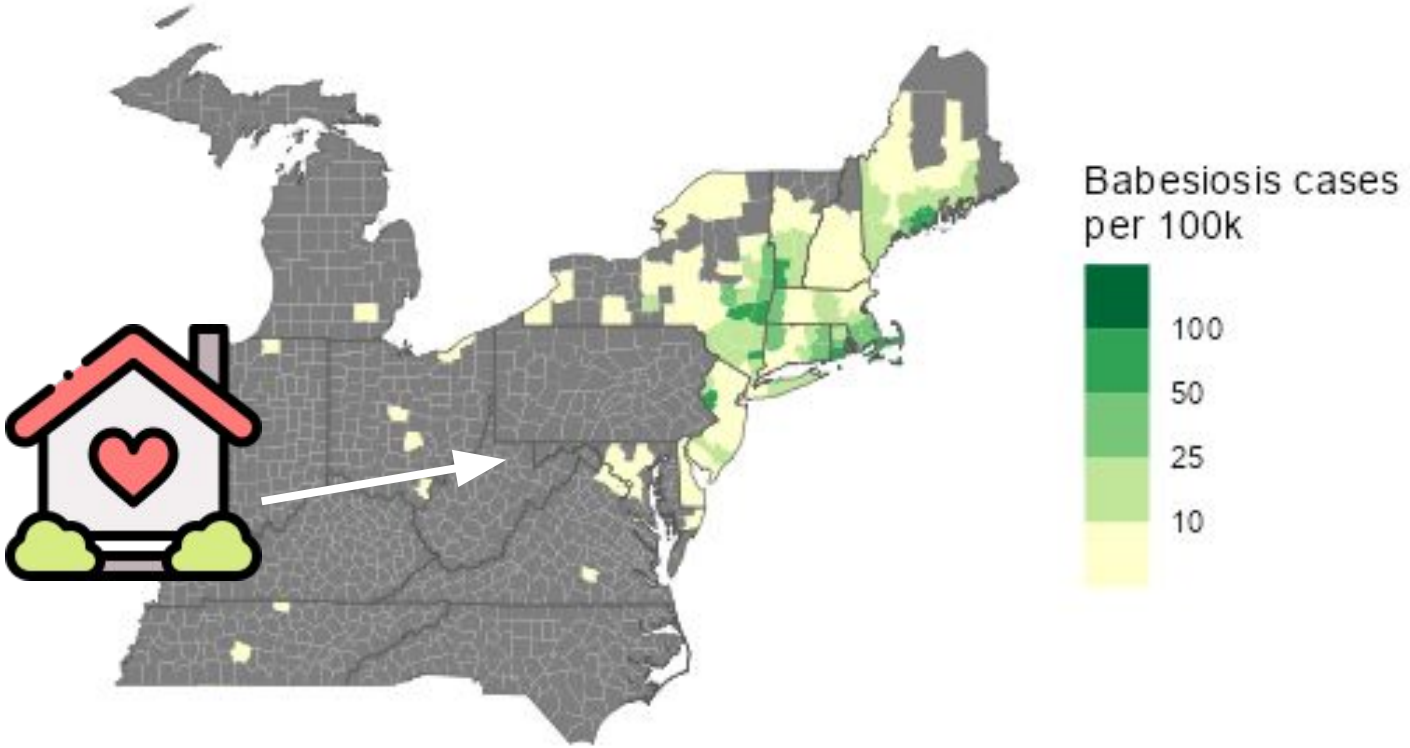
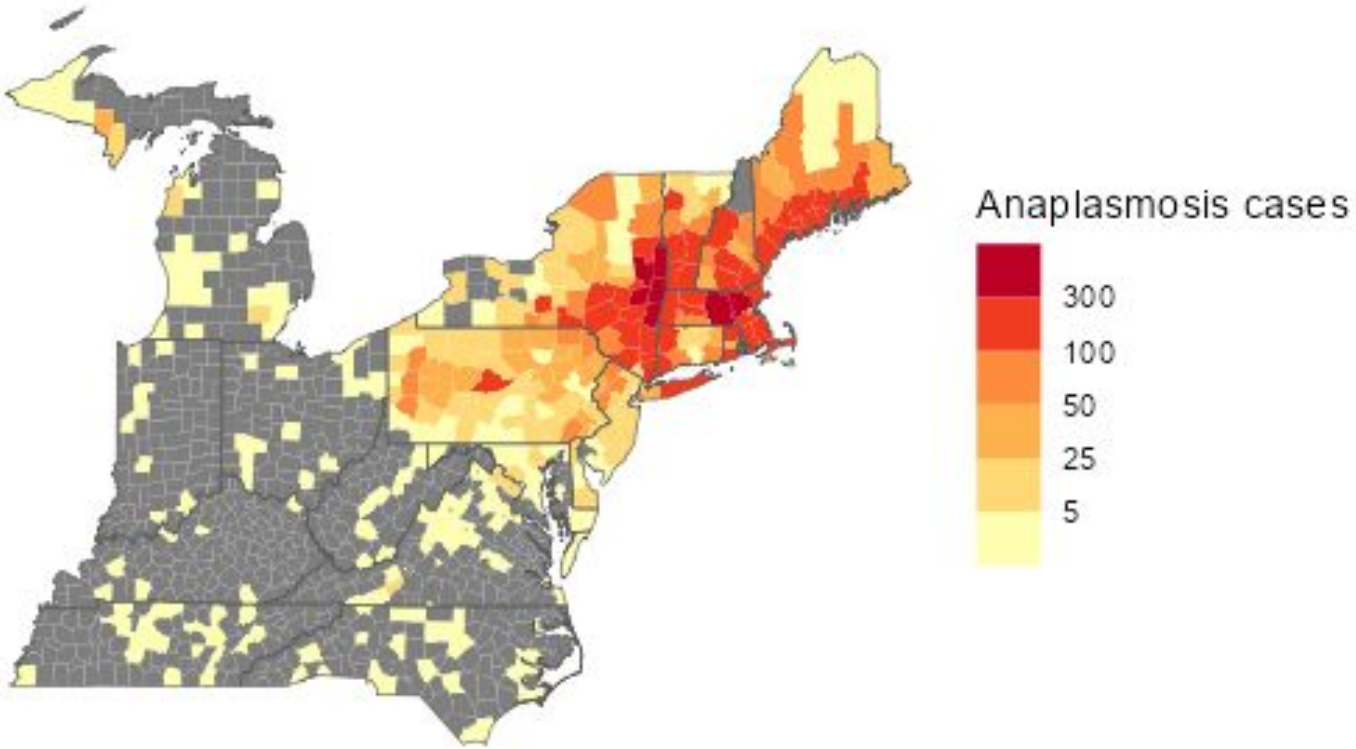


Source: CDC Tickborne Disease Surveillance

Total cases of Anaplasmosis

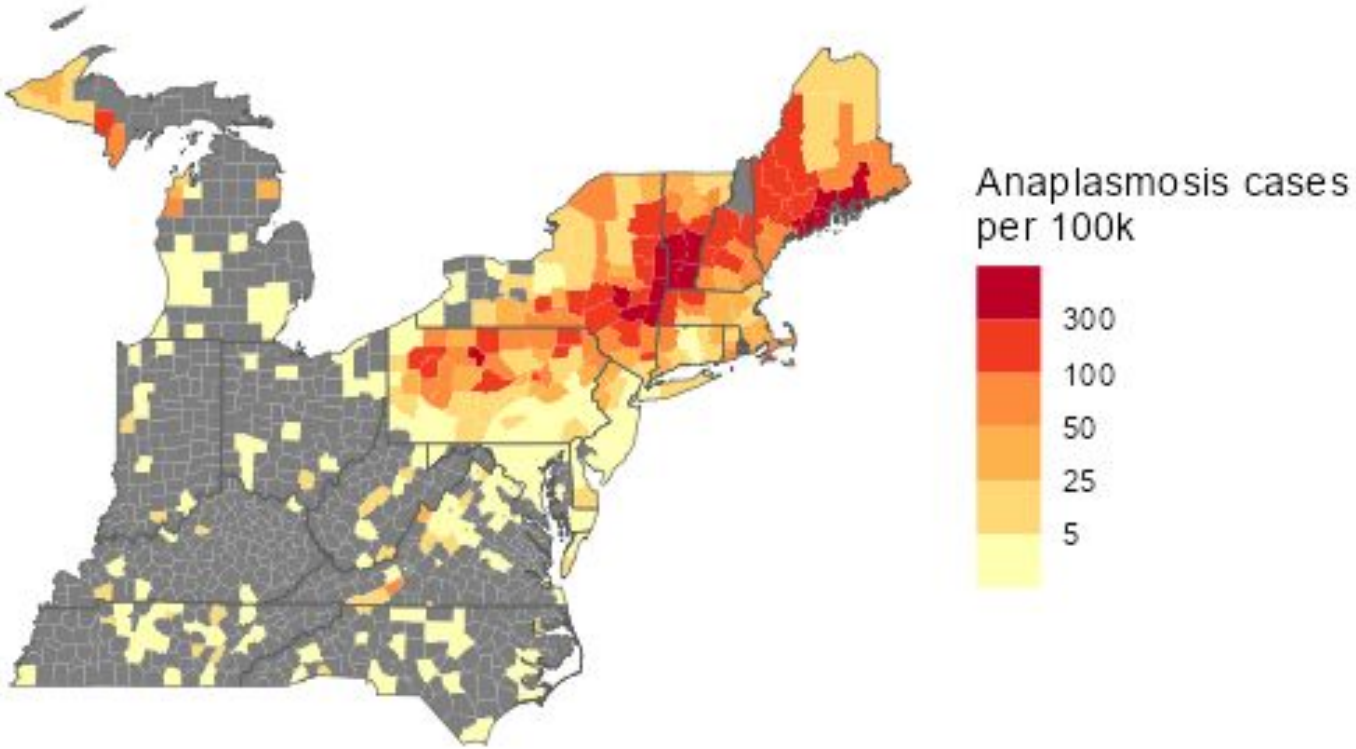
2019-2022



Source: CDC Tickborne Disease Surveillance

Per capita Anaplasmosis

2019-2022



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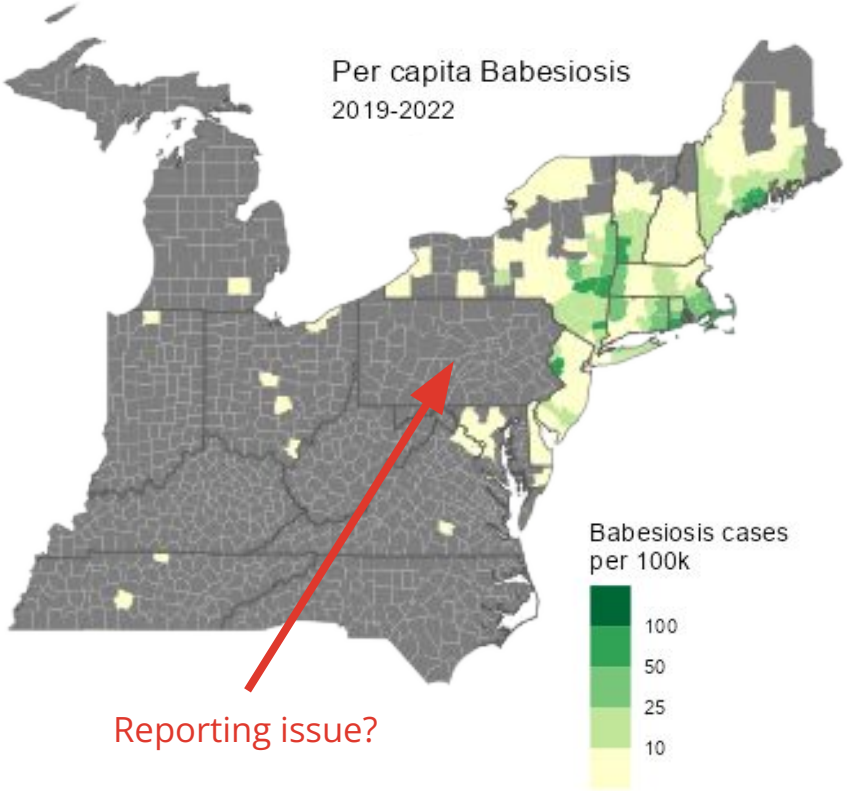
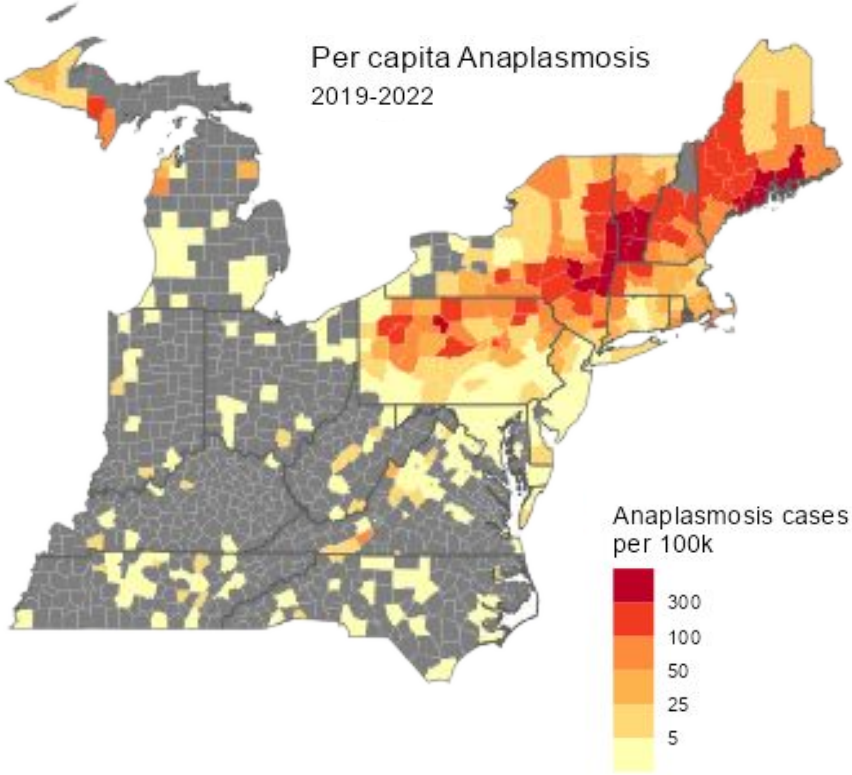
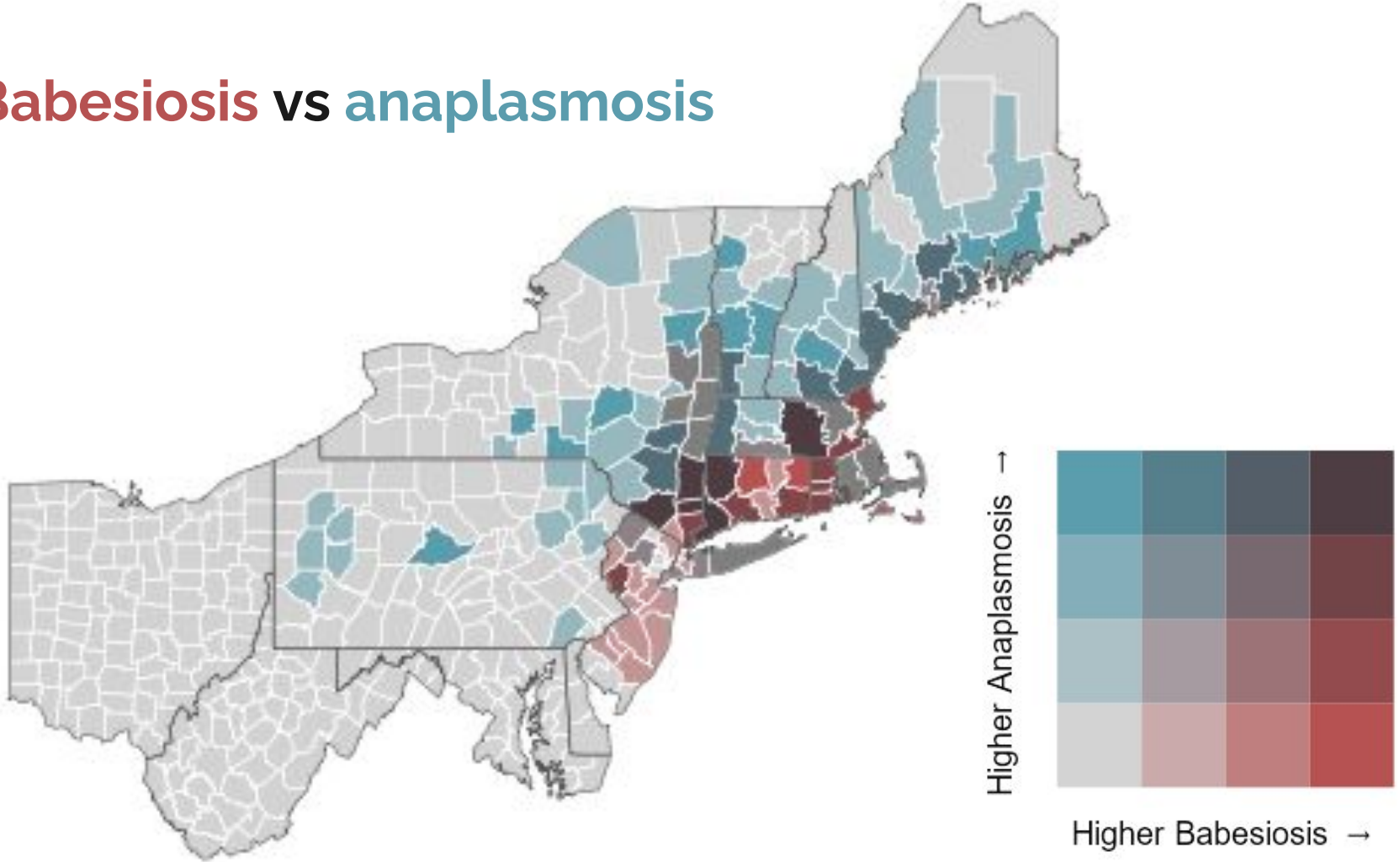
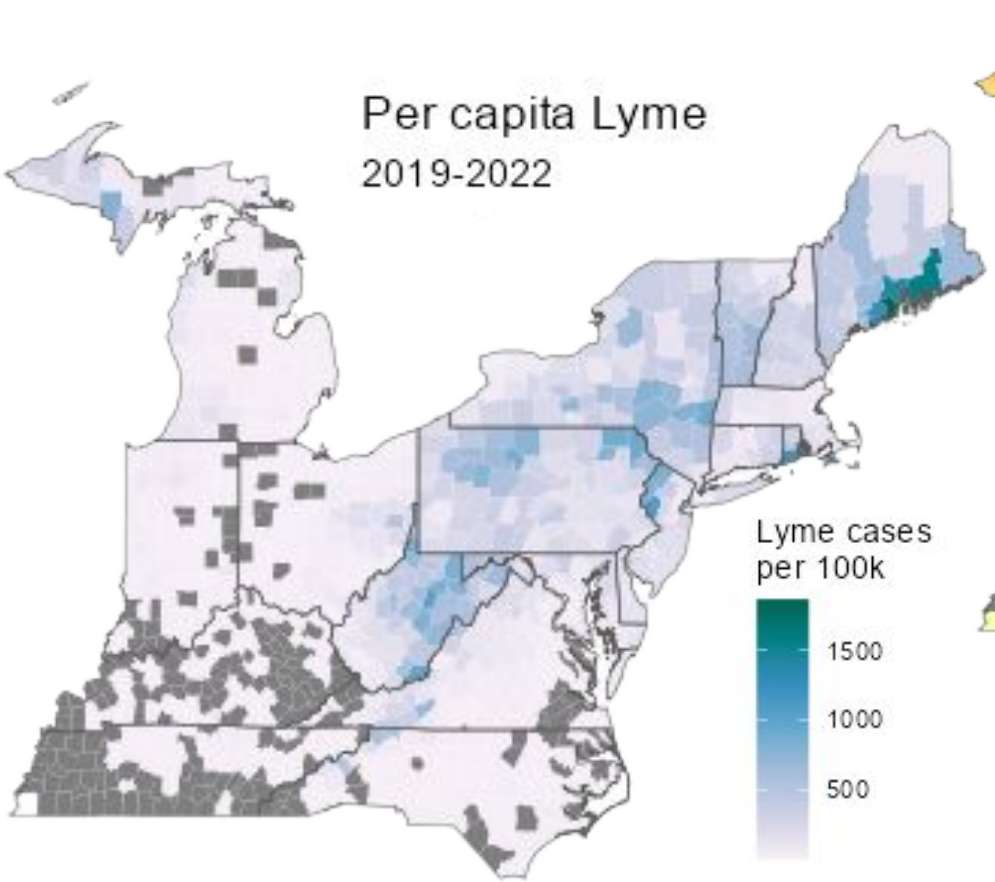
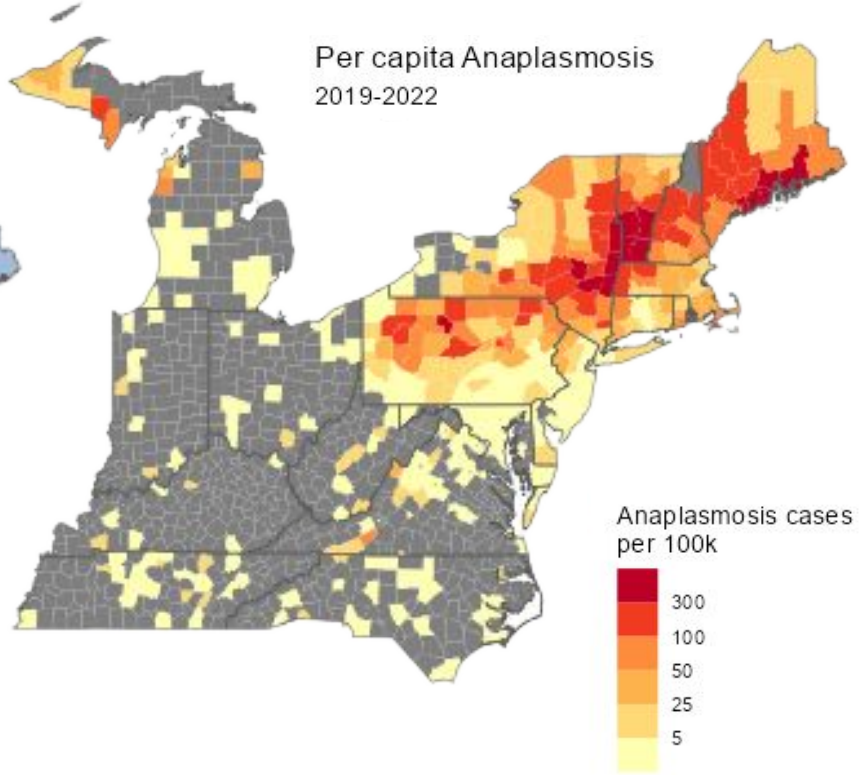

Per capita Babesiosis
2019-2022
Babesiosis cases
per 100k
100
50
25
10
Reporting issue?


Per capita Anaplasmosis
2019-2022
Anaplasmosis cases
per 100k
300
100
50
25
5

Babesiosis vs anaplasmosis

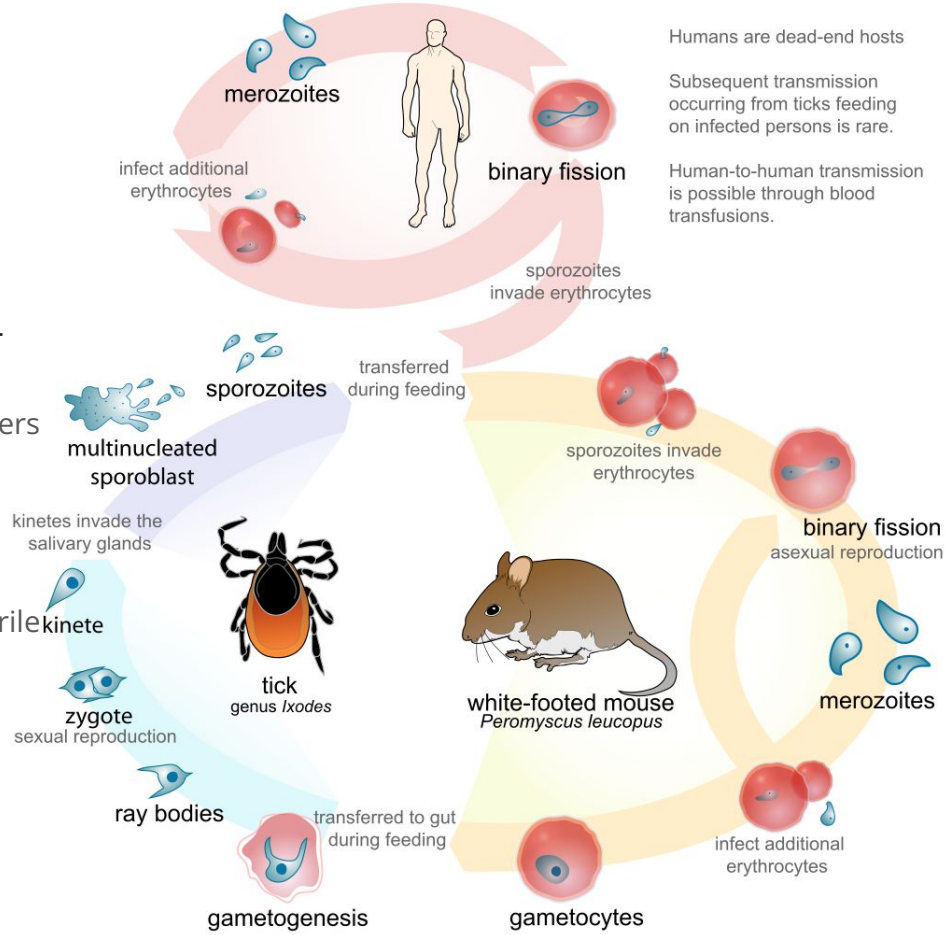



Per capita Lyme
2019-2022
Lyme cases
per 100k
1500
1000
500


Per capita Anaplasmosis
2019-2022
Anaplasmosis cases
per 100k
300
100
50
25
5

Babesiosis

- Intra-erythrocytic inclusions (merozoites, which cause the "Maltese cross") may appear similar to malaria
- Clinical infection also appears very similar to malaria
  - Hemolytic anemia, thrombocytopenia, fevers
  - Severe disease: includes DIC, renal failure, ARDS
- Risk factors for severe disease includes asplenia
  - Immunocompetent may have isolated febrile illness (&/or asymptomatic parasitemia)



Babesiosis: Treatment [33501959, IDSA 2020]

- Mainstay antimicrobial therapy is **atovaquone** + **azithromycin**
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  - High-grade parasitemia (>10%)
  - Severe hemolytic anemia
  - End organ damage: pulmonary, renal, hepatic

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Adjunctive treatment of clinically severe babesiosis with red blood cell exchange: a case series of nineteen patients

Christian P. Nixon, Sangshin Park, Christina E. Nixon, Rebecca M. Reece, Joseph D. Sweeney (2019)