Family Doctor

A Journal of the New York State Academy of Family Physicians

Focus:

Vector Borne Disease

Summer 2024

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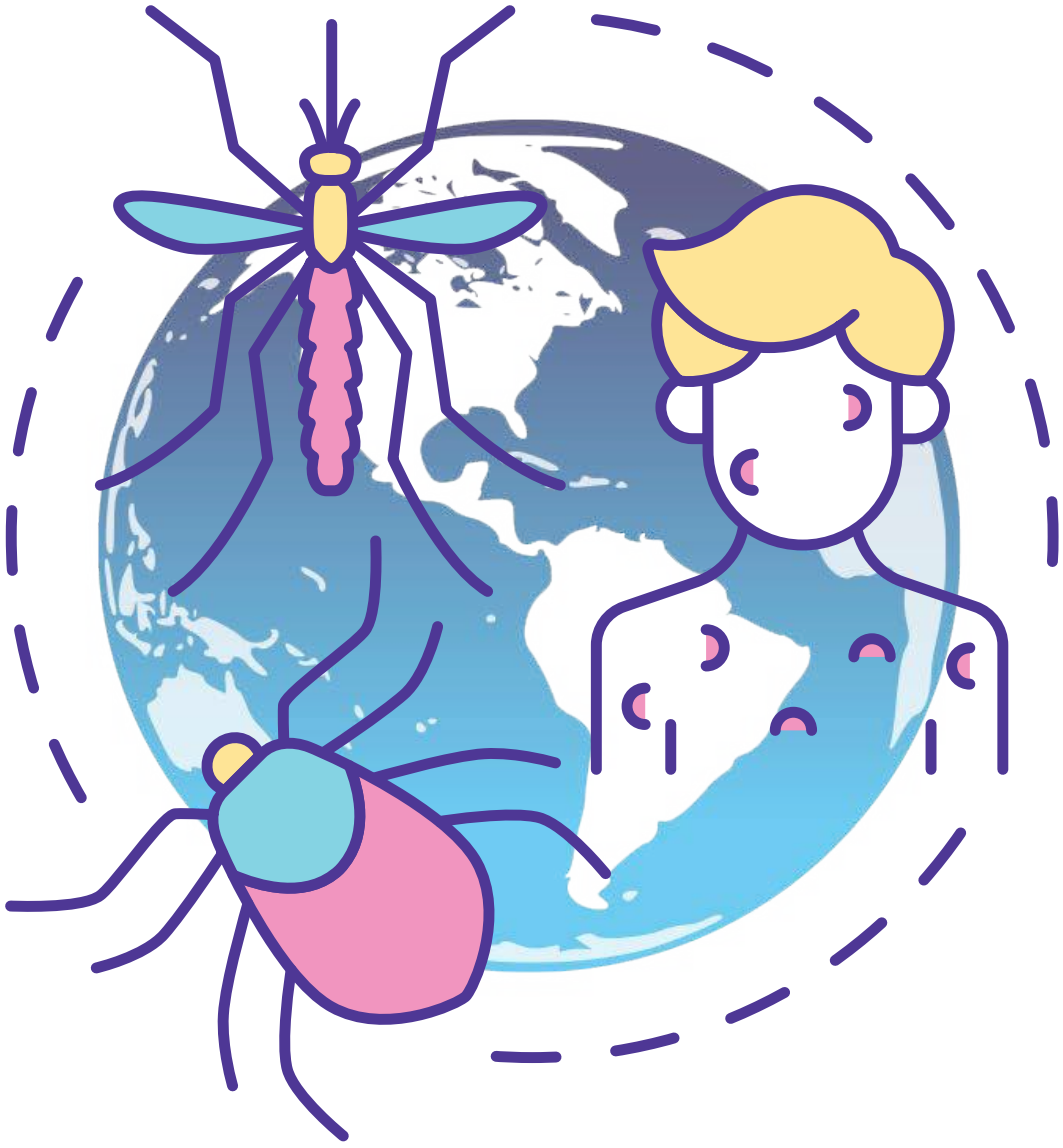

FEATURE ARTICLES:

New York State Academy of Family Physicians

From the Executive Vice President

By Vito Grasso, MPA, CAE

On May 22nd , we closed our office at the Sage Estate. We had been operating as a virtual office since before COVID and used the Sage Estate office to receive mail, hold meetings and to store files and furnishings. As virtual meetings replaced in-person meetings and technology has reduced our need to retain paper files, we decided to close the office to save money.

In the course of packing, I had the opportunity to review materials which reflect significant activities and achievements in the history of the NYSAFP. We will, of course, retain important historical documents in storage and in our digital account with the Center for the History of Family Medicine. I found, however, that our history is replete with advocacy that transcends generations and offers insights into the state of health care and family medicine today.

The materials are voluminous. There are minutes of CODs, annual reports of past presidents, issues of journals and newsletters, correspondence and financial records. I found it difficult not to get caught up in reading various documents.

A document titled "Significant Historical Dates" included some interesting items:

- November 5 to 12th, 1971: NYSAFP sponsored its first medical seminar outside the continental United States in Vienna.
- September 25 to 28th, 1972: The AAFP held their 25th annual convention in New York City. Members could reserve a single room at the Plaza for $30+ and at the Waldorf Astoria for $24+.
- 1976: New York becomes the first state to put restrictions in its State Code on family physicians practicing obstetrics.
- November 7, 1977: Albany Medical College becomes the first private medical college in New York State to establish a department of family practice.
- February 10 to 13th, 1983: The NYSAFP has its first Winter Weekend in Lake Placid. Bruce A. Bagley, MD was chairman of the committee.
- 1983: Dr. Harry Metcalf is elected to the AAFP Board of Directors. He will be elected chair in 1986 and president in 1987.
- January 1st, 1985: The date that Dr. G. Alx. Galvin plans to retire after 45 years of medical practice in Ithaca, NY. Dr. Galvin helped lead the fight to desegregate Tompkins County Hospital. In 1938, blacks were restricted to one ward of the hospital but after objection, the hospital was soon desegregated.
- 1987: Dr. Richard Sadovsky comments on the HIV/AIDS pandemic and the ethical considerations it has raised for all health care providers in the 80s. Some prominent surgeons refused to perform surgery on patients with HIV antibody positive blood and major teaching hospitals in NYC said in a poll that they would rather not provide care for AIDS patients. Dr. Sadovsky advises family physicians to continue their role as patient advocates for all their patients.
- 1990: The average debt of medical students is $48,000+ and the average resident salary is $25,000.
- 1991/1992: The Academy drafts model legislation titled The Family Practice Development Act, proposing initiatives that would address the following goals: (1) train and support family physicians to provide primary care in medically underserved communities and populations, (2) increase the number of family physicians practicing in NYS, and (3) ensure their ability to practice within the full scope their training and ability (i.e. hospital privileges).
- July 1996: In the summer newsletter, a guest article titled "Family Practice and the Internet" explains the concepts of the internet, world wide web, URL (universal resource locator) and HTML (hypertext markup language) and search engines. The article summarizes how physicians can search for medically related information.

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President's Post

By Rachelle Brilliant, DO, FAAFP

I am proud and honored to be your president this coming year. As I reflect on my journey, I can't help but notice the parallels between my hobby, pottery, and family medicine. When I became interested in pottery in high school, I wasn't focused on improvement and my pots all had the same flaws. After coming back to it following medical school, I focused on improving and trying new things.

Most people involved in crafts will understand that things don't always go as planned. When you heat a pot to 2000 degrees, the unexpected can and will happen. Glazes in a kiln become liquid glass and can act unpredictably. Sometimes that is a good thing, but at other times, it can make a dish non-functional. As with pottery, things in our offices don't always go as planned. The patient scheduled for a routine physical is no longer routine once they mention ongoing abdominal pain. Pottery has taught me to reflect on the unexpected. If we learn from the "oh by the ways," we can become more resilient doctors and, in the process, forge stronger relationships with our patients.

There is a parable in pottery of a professor giving his class a choice. They could either make one perfect pot or they could make 100 okay pots. At the end of the class everyone rated the pots and the better pots came from those that made 100. Why? They practiced, they continued to improve, they tried new things, and learned from the results. The others sat around trying to figure out what made a perfect pot and never got anything done. Around the time I first heard this story I was reading a book on leadership and goal setting. I decided to set a goal for myself of making 100 mugs.

The challenge of making these mugs taught me a lot about myself and medicine. As a group, physicians are very goal oriented and strive for perfection. That culture of perfectionism is causing significant burnout among us. We are inundated with messages before we even start pre-med. Perfect grades are required to get into medical school. If you don't do well in medical school you may not get the residency you want. As an attending, the demands and pressures of practice get even worse: get your notes done in 24 hours, make sure you check all the boxes, get the billing done, answer the portal messages, renew the medications, make sure your notes support your billing and protect you from malpractice in case you make a mistake. We are all human and we will all make mistakes. What matters the most is how we deal with them. We need to set up systems so we can catch the mistakes before they cause harm.

The mugs taught me how to accept imperfection, how to move on after a bad day. We have to learn to accept imperfection in our professional life as well. We need to accept that our notes aren't going to be perfect and as long as they contain what is essential then we can finalize them and move on. We need to start spending our time with things that matter to us as physicians and not the minutiae that only matters to the insurance companies. I'm not suggesting we don't write notes or submit our billing. As well as helping our patients, we want to make a living, pay off our debt, and prevent lawsuits. Many of us tend to say yes to every little task and we need to learn to use the word "no" sometimes.

Pottery and art energize me. They help me relax and look at things in new and different ways. What energizes you? I challenge each of you to find what awakens your soul, and find the time for it, even if it's not something you can do every day.

Spending time among dedicated family physicians that come from different backgrounds and practice in different environments helps me from feeling isolated. When I have an issue with a patient there is someone among Academy colleagues who can offer advice. When management is a nuisance there are always NYSAFP members who can provide guidance. I suspect that is why many of you are involved as well. Our Academy can also help prevent burnout. The goal of the NYSAFP Board of Directors is to help our colleagues who are not active members learn about these benefits.

As I look to the future, my goals for this year are simple, but hard.

I hope to bring new members into our Academy who will become active on many levels. I plan to reach out to all the residents that attended our Meet and Greet sessions over the past two years to make sure they are aware of what this Academy is doing for them.

I have several challenges for each of you this year:

1. Find what awakens your soul and schedule time to do it. Actually, put it in your schedule. Do it on a regular basis, whether that is once a week or once a month.
2. Reach out and do something new with the Academy. Come to Winter Weekend or to one of our regional conferences. If your county chapter is not active, we have scholarships available to attend the Congress of Delegates. Watch for people new to your organization and invite anyone whose bio says they are a member of AAFP to your next local event.
3. Stop trying to be perfect. You will never succeed. Instead, try to be better than you were. There will never be an end to our ability to improve.

Sometimes our job feels like an uphill battle, but by maintaining our family physician community we can feel connected to something greater than ourselves.

Thank you for your confidence in electing me to be your president for this next year. I look forward to working with all of you and to hearing about your passion projects.

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- September 17th, 1999: Dr. Bruce A. Bagley is inaugurated as president of the AAFP during the Scientific Assembly.
- June 2000: The Congress of Delegates pass a resolution that the NYSAFP should work to increase physician awareness of racial and ethnic disparities in health. Specifically, the Academy should work with the NYS DOH on programs aimed at ending these differences. The Healthy People 2010 report shows that low income and education levels are statistically correlated with increased rates of heart disease, asthma, diabetes, obesity, elevated blood lead level, and low birth weight.
- 9/2001: After the events of 9/11, the academy publicizes phone numbers provided by the Governor's office for physicians to call to volunteer. The response is overwhelming. No NYSAFP members are among the casualties but the terrorist attacks do claim the lives of two AAFP members, Drs. Frederick Rimmele of Marblehead, MA and Paul Ambrose of Washington, DC. Both were on flights that crashed into the towers and were 32 years of age.
- 1/10/02: Executive VP Vito Grasso and Drs. Wendy Van Bellingham and Jun David speak at a press conference regarding the Albany Family Practice Residency Program (FPRP) and Department. AMC had announced plans the previous month to close the FPRP as part of a plan to reduce a $25 million deficit. AMC decides to retain the program and family practice clinic, although at reduced levels.
- April 2006: Dr. Jose "Jun" David receives the AMA Foundation Excellence in Medicine Award. This is given to a physician who exhibits outstanding leadership in organized medicine, education and community service.
- September 27th, 2006: The AAFP Board of Directors select Dr. L. Thomas Wolff as recipient of the AAFP Thomas W. Johnson Award for Career Contributions to Family Medicine Education. This award is given annually to an AAFP member who has made outstanding contributions to education for family medicine in undergraduate, graduate and continuing education spheres.
- October 2006: Drs. Jose David, Denis Chagnon, Maggie Blackburn, Henry Francis, Marianne LaBarbera, and EVP Vito Grasso rally for health care reform on Capitol Hill during the AAFP Congress of Delegates. NYSAFP proposes a resolution for a single payer system but the AAFP endorses a multiple payer system instead.

The list ends in 2014. I will work on updating it. As I do, I expect there will be more opportunities to reflect on aspects of our past in informing our present and future endeavors. I expect, as well, to also extract content which will inspire future EVP columns.

Buzz Off! How to Keep Your Kids Safe From Vector Borne Diseases

By Sandy Wang MD, MPH and Arthi Chawla MD, FAAFP

Introduction

Vector borne diseases (VBD) include a varied group of illnesses that are carried by common backyard arthropods such as mosquitoes, fleas, ticks, and sand flies. More tropical illnesses will continue to spread northward given global warming trends[1] and can cause severe illness in the immunocompromised, especially in the pediatric population who are vulnerable to lack of protection when playing outdoors.[2] Currently there are few vaccines and treatment options for VBD. Unfortunately, most pesticides are toxic to children and many states actually regulate, restrict, and even ban the use of pesticides in school buildings or school grounds, thus it is more important to focus on safer prevention options as presented below.

In this paper we seek to review common practical ways to help prevent transmission of VBD with a special focus on the pediatric patient population. We reference guidelines from the American Academy of Pediatrics (AAP), US Environmental Protection Agency, New York State Department of Health, and CDC, while promoting other evidence- based techniques commonly used by outdoor professionals. We hope this will help our family medicine colleagues provide guidance on insect prevention to parents, and more importantly, on a public health level in which a combination of public education, mosquito control programs, and effective repellents, will be needed.[3]

Epidemiology

In the Northeast United States, the most commonly encountered tick species are the blacklegged tick, *Ixodes sp* (i.e. blacklegged tick, rabbit tick), and *Dermacentor variabilis* (dog tick species).[4] Ticks usually have 3 host tick life cycles, where all three active states of life (larvae, nymph, adult) feed on a different individual host animal per phase. Larvae tend to cluster on blades of grass and ascend as they mature to await a host. They detect hosts through various odors, visual cues such as shadows, vibrations, and body heat. Ticks cannot fly or jump, thus when they sense these stimuli, they will wave their front legs to grab a passing host.

The blacklegged tick (*Ixodes scapularis*) is the most commonly encountered tick in the Northeast and is notoriously known as the "deer" tick that transmits the causal agents of Lyme disease, babesiosis, and human granulocytic anaplasmosis. These ticks do not hibernate and can be active throughout the year; due to their longer lifespans and multiple hosts, they have a high likelihood of being heavily infected with babesiosis.[4] Since these ticks do not hibernate, patients can still present with Lyme even in warmer winter months.

Dog ticks (*Dermacentor variabilis*) preferentially feed on dogs but can also feed on other medium to large mammals including common backyard visitors such as racoons, opossums, skunks, foxes, and squirrels. The American dog tick species lives for 2 years compared to the year cycle in those that reside in the Southern US. They are often encountered in roadsides, marshy areas, busy woodlands, meadows and pastures. They are also associated with the causal agent of Rocky Mountain spotted fever (RMSF) and a vector for tularemia. RMSF is overall rare in New England, but with global climate changes, the incidence is increasing and special attention must be paid to pediatric populations, as children <15 years of age make up 2/3 of the overall cases. The highest rate in children is the 5-9 year- old age group for both Lyme and RMSF.[4] Peak symptoms present at 6 days with the classic spotted rash after a few days of nonspecific symptoms such as fevers, severe headache, muscle pain, and palmar/soles of feet rash that can easily be confused with hand foot and mouth disease. Compared to Lyme, RMSF tends to present in the summer months. Thus, it is important that clinicians have RMSF high on their differentials during the summer months especially in the absence of sore throat.

Basic Tips for Preventing VBDs

Tables 1 and 2, on page 8, provide basic information for preventing vector borne diseases through the creation of safer outdoor environments.

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Table 1: Pediatric Prevention Tips for the Outdoors [4]	
Stay on the Paths	• Avoid cutting through woods to school or playing near wooded edges of ball fields • Cover strollers and baby carriers with mosquito netting
Clothing Choice	• Light colored clothing and long pants tucked into shoes • Avoid bright and flower printed clothing • Avoid scented soaps, perfumes, hair sprays • Wear socks • Do NOT wear open toed shoes or sandals
Humidity Matters	• Most ticks will die in less than 4 days at 65% relative humidity. *I scapularis* can survive for 6 months at 93-100% relative humidity • Keep home dry and well circulated with fans and avoid shady parts of home
Post Outdoors Routine	• Place clothing in the dryer for 10 minutes on high heat which will kill any ticks attached to the clothing • Shower after being outside to wash away any attached ticks • Perform tick checks • Do not try to remove difficult to remove adult tick parts; it will not change the chance of Lyme disease • Do not apply petroleum jelly to suffocate tick

Table 2: Backyard Prevention Methods[4]	
General Recommendations	**Pediatric Specific**
• Remove leaf litter appropriately rather than moving to another part of property • Open yard to direct sun exposure by trimming up branches • Keep grass short • Widen woodland trails on your property • Keep pets out of woods • Restrict groundcover use such as vine like plants that would create shady areas for vectors in areas frequented by family and roaming pets • Get rid of any standing water at least on a weekly basis • Keep swimming pools treated and circulating • Make sure door and window screens are in good repair • Replace exotic invasive shrubs with native shrubs • Plant bird feeders further away from home • Deer repellent - Fencing - Applying repellent - Planting deer resistant plantings	• Move swing sets and playgrounds away from woodland edge • Keep children from playing with leaf litter • Consider planting low water requirement plantings in areas that are frequently visited by children to keep exposure from bodies of water that would breed vectors

Backyard Precautions: Creating Vector Safe Zones

The main consideration for reducing a conducive VBD habitat is increasing sunlight and lowering humidity in the backyard as you upkeep and prepare your homes for the warmer months. While ticks and mosquitoes are direct vectors, it is important to consider other hosts of vectors and their behaviors. Chemical control for rodents may not be safe for pediatric populations, thus judicious landscaping may be better options. For example, shady overgrown areas tend to harbor mice and chipmunks which can be vectors for ticks and mosquitoes, while deer can transmit ticks to our pets.

Pets and Transmission

A special consideration for the pediatric population is their exposure to VBDs via beloved family pets. Vectors can attach onto pets and then transmit onto children during playtime. There are a number of ways to keep our furry friends and children safe. First, it is important to talk to your veterinarian, who can recommend different medications that are a good fit for your pet while killing fleas and ticks. These medications can come in different formulations including oral, topical, and even collars. There are a few formulations that help prevent ticks from attaching in the first place. As addressed above, *Ixodes scapularis* can survive all year, so it is now recommended that flea and tick prevention medicines are to be given year-round, and not just in the summer months.

Additionally, avoiding known high risk activities such as walking in wooded areas with high grass, keeping the play area safe, and checking your dog after coming in can help

Table 3: Pediatric Insect Repellent Use Recommendations[4,5,6,7]	
Repellent Active Ingredient	**Pediatric recommendations**
DEET (N,N diethyl 3- methylbenzamide)	• Prevent insects that bite but not stingers • Most studied and proven effective but banned in EU for toxicity concerns • Canadian guidelines are stricter than US • Use only once a day for children <12 years old • Avoid concurrent use with MGK repellent products due to concerns for human carcinogen - Maximum concentration <2.5% • 20-30% concentrations most effective; maximum allowed dosage is 30% for pediatrics[6] - Conservatively 10% in children <12 y/o • Avoid in small children especially <2 months of age due to need of reapplication which can increase toxic reaction • Can damage synthetic fabrics, plastics, car, furniture finishes • Concentrate on shoe tops, socks, lower pants
Permethrin	• Repellent used to treat clothing that can continue to provide protection after multiple washings • Use only on clothing. Do not put directly on skin[8] • Very effective against ticks
Picaridin (KBR 3023) *I.e Cutter® Advanced*	• Effective against mosquitos and ticks • Less greasy and less likely to cause skin irritation in pediatrics • Good option for parents concerned about DEET but there is overall less data
IR3535 *I.e Skin-So-Soft Bug Guard Plus Insect Repellent*	• Mosquito and tick repellent - 15% IR3535 as effective as 30% DEET • Avoid near face- strong eye irritant
Botanical and Natural Based Repellants *I.e Oil of Lemon Eucalyptus (OLE)* *2- undecanone* *Soybean, peppermint, geranium, citronella*	• Protection <3 hours for mosquitoes; no tick protection • Do not use products containing OLE or PMD on children under 3 years old • Caution about contact dermatitis in children • Do not use citronella <2 years of age
Ingested products *I.e garlic or B1*	• Confer little repellent against mosquitoes or ticks
Devices	• -Ultrasound devices do not repel VBDs and wristbands with citronella or DEET not recommended - these products are shown to not be effective

further prevent transmission of VBDs. If there are bugs on your pet, you can safely remove them with a flea/tick comb, tick key, and/or a sticky lint roller. All of these devices help safely remove the insect without you having to directly touch the bugs.[10]

Repellent Use in Pediatrics

While backyard and clothing choice can be the first line of prevention, sometimes repellant use is warranted to further protect pediatric populations. It is also important to wear EPA approved insect repellents which we discuss in Table 3.[5]

Overall recommendations for insect repellent use includes:

- Always follow the product label instructions.
- Reapply repellent as directed.
- Do not apply repellent on the skin under clothing.
- If you are using sunscreen, apply sunscreen first and insect repellent second when using on your child.
- Avoid combination repellent and sunscreen products.
- Always follow label instructions.
- Keep out of reach where small children can ingest the products.
- Do not apply repellent to a child's hands, eyes, mouth, cuts, or irritated skin.
- Apply repellent onto your hands and then apply to a child's face rather than spraying directly to the face.
- Have the Poison Control Center's hotline available on fridge/ clear visualized area - 1-800-222-1222.

Endnotes

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Resources for Patients

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Upcoming Events

2024

November 3
Fall Cluster
Virtual Board Meeting; Commission meetings virtual prior

2025

January 23-26, 2025
Winter Weekend
Lake Placid

February 23, 2025
Winter Cluster

February 24, 2025
Advocacy Day

May 10, 2025
Congress of Delegates
Opening Day

May 17-18, 2025
Congress of Delegates
Reconvenes

For updates or registration information for these events go to www.nysafp.org

Albany Report

By Reid, McNally & Savage

The regularly scheduled 2024 legislative session in New York concluded with the Senate adjourning Friday, June 7th late in the evening while the Assembly worked through the morning, gaveling out at 7am on June 8th. In total, over 800 individual bills were passed by both houses during the 2024 legislative session out of approximately 17,000 bills introduced since the session started in January. Passed bills will now need to be transmitted to Governor Hochul's desk before the end of the year for her to sign, veto or seek chapter amendments for.

While many issues dominated state discussions this year including housing, cannabis reform, retail theft, internet child safety, and climate change, the Governor's last-minute decision to halt the MTA's congestion pricing program for Manhattan, scheduled to go into effect on June 30th, threw the Legislature into chaos in the final days of the session. Governor Hochul suggested increasing the payroll mobility tax to make up for the $1 billion shortfall this year due to the suspension, but this was rejected by the legislature. There was also discussion of committing money from the state's general or rainy-day funds to make up for the $1 billion in lost revenue.

Ultimately, no agreement was reached. The Governor will have to call the Legislature back for a special session if there is a deal to approve. Lawmakers have now returned to their districts with many facing primary challenges on June 25th and general elections on November 5th this year. Absent a call for a "special session" legislators won't return to Albany again until January 2025 when the next session begins.

Below is a summary of positive outcomes for the SFY 2025 Final State Budget and NYSAFP's advocacy efforts on priority bills on behalf of its members and the patients family physicians serve:

Final State Budget Achievements

- $15.865 million in full funding for Doctors Across NY
- $2.7 million in funding for Area Health Education Centers (AHEC); An additional $500,000 from previous years
- Physician Assistant Scope of Practice Expansion Rejected
- Physician Excess Medical Malpractice Program Restructuring Rejected and Program Extended through June 30, 2025
- Committee for Physician Health Program Discontinuation Rejected
- Telehealth Rate Parity Extension through April 1, 2026 Included
- Continuous Medicaid and Child Health Plus Coverage for Eligible Children Ages 0-6 Included

Physician Assistant Independent Practice Defeated

Several bills were introduced this session that would eliminate supervision requirements for physician assistants (PAs). A.8378/S.9038 would have eliminated supervision requirements for PAs with 8,000 practice hours and those practicing in primary care or hospital settings. S.5520/A.5012 would have authorized PAs with 3,600 practice hours to practice without supervision and S.2124/A.7725 would allow PAs to serve as primary care practitioners for Medicaid managed care plans.

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These bills were one of the main priorities on NYSAFP's annual Advocacy Day at the NYS Capitol on February 26th, 2024. Dozens of physicians, residents, and students met with their legislators to share their experiences and urge rejection and defeat of these bills.

NYSAFP members advocate with legislators at 2024 Advocacy Day.

Further, throughout the budget process and session, we worked in partnership with several specialty society groups and others to expand physician advocacy influence opposing these legislative proposals. We put out action alerts for members to directly voice their opposition to their representatives, with 87 members participating, and continuously met with legislators throughout the session utilizing our strong relationships to negotiate provisions and make clear that patient safety would be at risk.

Hearing these concerns, Assemblywoman Paulin and Senator May amended their legislation, A.8378/S.9038, to no longer grant PAs independent practice. The new legislation, which the Assembly and Senate both passed, would expand the ratio of PAs that a physician can supervise from 4:1 to 6:1 in private practice and from 6:1 to 8:1 in DOCCS facilities, and would authorize PAs to prescribe or issue a non-patient specific standing order to nurses for immunizations, emergency anaphylaxis, several tests and screenings, and other services. Both houses also passed S.2124/ A.7725, but physicians would still be supervising care and overseeing a patient's care plan in managed care plan networks.

Ultimately, PAs were not granted independent practice and soon we will be sending a letter to Governor Hochul requesting that she veto S.2124/A.7725, similar to the action she took in 2022 when this bill passed. The letter will highlight that while physicians would still be overseeing care, this legislation could create complications between physicians and PAs related to roles and practice standards and potentially result in a lower standard of care for beneficiaries in Medicaid managed care plans.

"Wrongful Death" Bill Passed Both Houses

As expected, this bill (S8485B/A9232B), vetoed twice by Governor Hochul, was passed by the Legislature in the final days of session; while amended from last year's version, there were no significant changes made. This legislation still authorizes an award in a wrongful death action to include compensation for grief or anguish, the loss of services, support, and inheritance, and the loss of nurture and guidance and would have significant adverse impact to New York's healthcare system.

Academy members opposed this measure at the annual Advocacy Day, voicing already high malpractice liability costs and concerns about having to leave New York for other states to be able to continue practicing, and over 70 sent messages to their legislators urging opposition at the end of session. We will work with MSSNY, other specialty societies, business groups, hospitals, and others to ask the Governor to again veto the bill, in addition to other potential efforts like an advertising campaign and another action alert, prior to the bill being sent to her desk.

Medical Aid in Dying Continues to 'Gain Ground

While the Medical Aid in Dying Act (MAID) was not passed by the Legislature, the bill (S2445C/ A995C) got closer than ever to passing in its 9-year history. This year, the Medical Society of NYS, the NYS Bar Association, and the NYS Council of Churches changed their position to be in support of MAID, many legislators became co-sponsors including Assemblyman Al Taylor, a church leader representing Upper Manhattan, and Assembly Speaker Carl Heastie publicly announced that he will vote in favor of the legislation and indicated that it would pass in the Assembly if it was brought to vote.

The Medical Society's flip, and possibly others, was influenced in part due to new safeguards being added to MAID by the bill sponsors including ensuring health insurers wouldn't be incentivized to prescribe death-inducing medications and protecting physicians from getting sued for choosing to opt-out. MAID also made headlines with the *Times Union Editorial Board* writing in support of its passage and several opinion pieces being published in newspapers across the state like the *Buffalo News, Syracuse.com, Lohud,* and *Staten Island Advance*.

Several NYSAFP members also attended a press conference in March joining bill sponsors, Compassion & Choices, and others to advocate for the bill. This momentum, along with the Academy's long-standing support and members annual advocacy, will hopefully bring MAID to the finish line next year.

Legislation to Extend Further Protections to Families and Clinicians of Young People Receiving Gender-Affirming Care in New York State Passed in the Senate

In collaboration with NY Civil Liberties Union, NYS Psychiatric Association, and others, NYSAFP members joined RMS in meetings to urge lawmakers to pass this important legislation (S7506A/A7687A) that would strengthen the gender-affirming care shield law signed

into law last year. Additionally, in May, nearly 90 NYSAFP members sent messages urging Governor Hochul and their state legislators to take- action and pass the bill.

While the bill did not advance out of the Judiciary Committee in the Assembly in the final days of session, meetings with leadership and key staff helped us learn about their concerns with language in the legislation and how they could be addressed through amendments. This information and the Senate's support will undoubtedly aid in advocacy efforts for next session.

Tax Credit for Clinical Preceptors

NYSAFP has been very supportive and working with the bill sponsors to advance legislation to establish a clinical preceptorship tax credit for health care professionals including physicians who provide instruction to students. The bill (S2067/A2230) provides $1000 for each 100 hours of instruction up to $3000 per taxable year. For the first time since introduction several years ago this legislation passed the Senate during the 2024 session. We are so grateful to the bill sponsors Senator Stavisky and Assemblymember Gunther for prioritizing this bill which we will now work to get similarly advanced through the Assembly when the new session begins in January 2025.

Department of Health Commissioner Attended COD

On Saturday, May 18th, State Health Commissioner Dr. James McDonald, M.D., M.P.H. addressed attendees at NYSAFP's annual Congress of Delegates in Albany. He discussed what guides his work every day, health equity, and the priorities and challenges being faced in healthcare, consistent with NYSAFP's priorities.

Legislation of Interest Passed by Both Houses

Please review our comprehensive health/mental hygiene summary of bills that passed both the Senate and Assembly this session here. These bills, spanning several sectors such as hospitals/institutional care, health professions, public health, insurance and more, will now need to be transmitted to Governor Hochul's desk before the end of the year for her to sign into law, veto, or seek chapter amendments for. Please see below bill summaries of particular interest to NYSAFP for bills we have been advocating for or tracking this session.

Hospital Flu Vaccines for Admitted Persons Age 50+ (A9886, Peoples-Stokes/ S9550, Skoufis)

This bill amends the public health law to lower the age requirement for hospitals to offer inpatients the influenza vaccine from age 65 to age 50.

Controlled Substance Dispensing (A5984-B, McDonald/ S7177-B, Fernandez)

This bill would allow clinicians working in a hospital without a full-time pharmacy to dispense three days of buprenorphine and methadone, consistent with the Drug Enforcement Agency (DEA).

Health Care Proxy (A7872-A, Paulin/S8632-A, Hoylman-Sigal)

This bill would require a patient's attending health care practitioner to counsel a patient receiving palliative care about the benefits of completing a health care proxy and appointing a health care agent. We are working to gain confirmation from the State that medical residents would be included within the health care practitioner definition, as we were told by the bill sponsors.

HIV Testing (A8475, Paulin/ S7809, Hoylman-Sigal)

This bill would expand the means allowed for providing the required notice that an HIV-related test will be performed to include verbally, in writing, or by electronic means or other appropriate form of communication. The notice must also include the information that HIV testing is voluntary and a notice that pre-and post-exposure prophylaxis medications (PrEP and PEP) are available to persons at risk of infection.

Physician Assistants as PCPs under Medicaid Managed Care (S2124, Rivera/ A7725, Paulin)

This bill would authorize physician assistants (PAs) to serve as primary care providers (PCPs) under Medicaid managed care.

Physician Assistant Expanded Practice (S9038-A, May/ A8378-A, Paulin)

This bill would:

- Expand the ratio of PAs that a physician can supervise to 6:1 in private practice and 8:1 in Department of Corrections and Community Supervision (DOCCS) facilities;
- Authorize PAs to prescribe or issue a non-patient specific standing order to registered professional nurses for immunizations, emergency anaphylaxis, PPD or other TB tests, HIV testing, hepatitis C testing, naloxone or similar for opioid overdose, syphilis, gonorrhea and chlamydia screening, EKG tests, point of care glucose testing, administering tests/IV lines to persons with sepsis/septic shock, pregnancy tests and COVID-19 and flu tests;
- States with a PA employed/privileged by a hospital may write medical orders for DME under supervision of a physician; and
- The provision allowing PAs to issue standing orders to nurses for COVID-19/flu testing would expire 7/1/26.

Wrongful Death Expansion (A9232--B, Weinstein/ S8485B, Hoylman-Sigal)

This bill would expand the possible damages in a wrongful death action to include compensation for grief or anguish, the loss of services, support, assistance, and loss or diminishment of inheritance, and the loss of nurture, guidance, counsel, advice, training, companionship and education resulting from the decedent's death. Limits those eligible to file for wrongful death to a decedent's spouse, domestic partner, distributees, or any person standing in loco parentis to the decedent.

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Workers Compensation Care by OT & PT Assistants (A1204-A, Zebrowski/ S9462-A, Ramos)
This bill would allow occupational therapy assistants and physical therapist assistants to provide care to workers' compensation patients under the direction and supervision of an authorized provider (occupational therapist/ physical therapist).

CoPays for OT/PT Care (S1470, Breslin/ S6345, Weprin)
This bill would require that copayment or coinsurance amounts charged to an insured by state-regulated commercial insurance plans for physical therapy and occupational therapy services be no greater than the copayments/coinsurance imposed on an insured for services for an office visit for the service of a licensed primary care physician or osteopathic doctor for the same or a similar diagnosed condition.

Permit Mobile Ambulance Services to Initiate Blood Transfusions (A5789-A, Woerner/ S6226-A, Hinchey)
This bill would amend the public health law to permit ambulance services and advanced life support first response services that provide transportation by motor vehicle to store/ distribute blood and initiate/administer blood transfusions, as is currently authorized for ambulance services that provide transportation by aircraft.

Electronic Notice for Professional License Registration (A771-A, Hyndman/ S6112-A, Stavisky)
This bill would amend education law to allow the State Education Department Office of the Professions to provide registration applications to licensees for each profession by means other than mail and requires applications to be mailed 45 days prior to the end date of a registration period to any licensee that has not yet registered.

Routine Maternal Depression Care (S2039-B, Brouk/ A2870-B, Solages)
This bill would direct DOH in consultation with OMH and other stakeholders to develop guidance for incorporating maternal depression screenings into routine perinatal care. The guidance would also specify when these services should be initiated and the frequency during pregnancy and postpartum. Guidelines would also include recommendations for screenings for social needs, substance use disorders, and related referrals as well as recommended reimbursement methodologies.

Doula Access in Maternal Health Care Facilities (S5992-A, Persaud/ A6168-A, Solages)
This bill would allow a pregnant person to designate a doula to be fully accessible to them in a maternal healthcare facility during delivery and/or inpatient care post-delivery.

Allow Presence of Doulas During C-Sections (S5991-A, Persaud/ A7606, Solages)
This bill would require maternal healthcare facilities to permit doulas to be present in the operating room while a cesarean section is being performed. Requires such facilities to publicly post this information as well as provide information packets in waiting areas.

Gender-Affirming Care Changes (S8058 Hoylman-Sigal/ A8627 Bronson)
This bill makes several updates to the gender-affirming care protection law (S2475-B/ A6046-B) signed by Governor Hochul in June of 2023 including:

- Prohibiting a New York court from applying any law that authorizes a child to be removed from their parent because the parent allowed the child to receive gender-affirming care;
- Prohibits a court from considering a finding of "abuse, neglect, or maltreatment" that is based on a parent's consent to a child receiving gender-affirming care;
- Clarifies that a New York court may consider a finding of "abuse, neglect, or maltreatment" if the underlying conduct would be unlawful in New York State, even if that conduct occurred elsewhere;
- Standardizes the definition of gender-affirming care across several areas of law

Breast Cancer Screening for Incarcerated Individuals (S204, Cleare/ A4957, Jean-Pierre)
This bill would require that routine mammogram screenings be offered every two years at no cost to individuals housed in state and local correctional facilities. Requires the Department of Corrections and Community Supervision to provide incarcerated individuals with educational programs focused on the importance of preventative health care, including breast self-examinations.

Health Insurance for Pregnant Individuals (A2656, Walker/ S201, Cleare)
This bill would permit pregnant individuals to enroll in the state health insurance exchange during a special enrollment period without incurring fees or penalties.

Written Notice of Adverse Determination to Step Therapy Override Request (A8501, McDonald/ S8038, Breslin)
This bill would require written notice of an adverse determination made by a utilization review agent in relation to a step therapy protocol override determination which includes the clinical review criteria relied upon to make such determination to enhance this process for all entities involved and accountable.

Prohibits Discrimination for PrEP Use (A8834-B, Weprin/ S8144, Breslin)
This bill would prohibit discrimination against individuals who were prescribed PrEP medication for HIV prevention with respect to life, accident, and health insurance coverage.

Step Therapy Rules (A901-A, McDonald/ S1267-A, Breslin)
This bill would require a utilization review agent to follow certain rules when establishing a step therapy protocol and that the protocol accepts any attestation submitted by the insured's health care professional stating that a required drug has failed as sufficient evidence that the required drug has failed.

Provider Network Data System
(A7214, McDonald/S3472, Rivera)

This bill would update the Provider Network Data System to require that health care plan provider network information be included and authorize a designee to register, transmit, enter and update information on their behalf to improve compliance.

HIV Treatment Access
(S1001-A, Hoylman-Sigal/A1619-A, Rosenthal)

This bill would prohibit state regulated commercial health insurance policies that provides coverage for antiretroviral prescription drugs prescribed for the treatment or prevention of the human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS) from subjecting such drugs to prior authorization.

Medicaid Ambulance Services
(S 8486-C, Hinchey/A9102-C, Kelles)

This bill would authorize Medicaid reimbursement to emergency medical service agencies for:

- providing emergency medical care to Medicaid enrollees without requiring the transportation of these patients from the location where the medical care was administered; and
- providing emergency medical care to Medicaid enrollees and transporting them to alternative destinations (locations other than a hospital), such as an urgent care clinic or mental health or rehabilitation facility.

Medicaid Coverage Reviews for Health Technologies/Services
(A6022-A, Paulin/ S4787-A, Rivera)

This bill would add a process by which providers of health technologies and services can be assured that their applications for Medicaid coverage are reviewed by DOH. The amendments require DOH to publish receipt of the application, to notify the Legislature when such reviews of coverage occur and sets timeframes for review by DOH. The bill would also require DOH to detail deficiencies in such application and notify the applicant of the completeness of application before review begins.

Enhanced Insurance Coverage for Supplemental Breast Cancer Screening (A1696-C, Hunter/ S2465-C, Persaud)

This bill would amend the insurance law to require individual, group, and Article 43 health insurance policies to cover supplemental breast cancer screening and diagnostic imaging via breast ultrasound or MRI, as recommended by a physician and nationally recognized clinical practice guidelines. The bill also exempts high deductible health plans (HDHPs) from the prohibition against annual deductibles and coinsurance unless the deductible limit is reached, or if the service is considered preventive care by the IRS. This measure protects health savings account eligibility for those with HDHPs. The bill has an effective date of January 1, 2026.

Coverage for Prenatal Vitamins
(A3865-A, Gunther/S1965-A, Addabbo)

This bill would amend the insurance law to require individual, group or blanket medical policies, and all contracts issued by corporations that provide prescription drug coverage, to provide coverage for prenatal vitamins, when prescribed by a health care practitioner. Such coverage would be subject to annual deductibles and coinsurance.

Coverage for Tattooing Performed During Breast Reconstruction Surgery (A5729-A, Paulin/ S6146-A, Cleare)

This bill would amend the insurance law to require commercial insurance coverage for tattooing of the nipple-areolar complex as part of breast reconstruction surgery, if such tattooing is performed by a licensed physician or other licensed or certified health care practitioner.

Medicaid Coverage for Remote Ultrasound and Fetal Non-Stress Tests (A8168, Paulin/ S7690, Webb)

This bill would amend social services law to require Medicaid coverage for remote ultrasound scans and remote fetal non-stress tests when recommended by a physician or other health care practitioner under Title 8 of the education law, for the purposes of improving maternal health outcomes and reduction of maternal mortality.

PrEP Copayments (S9842 Hoylman al one-Sigal/ A10461 Simone)

This bill would prohibit insurers from requiring copayments for PrEP if it has in effect a rating of 'A' or 'B' in the current recommendations of the U.S. Preventive Services Task Force.

Epinephrine Auto-Injector Coverage
(S7114-A Rivera/ A6425-A O'Donnell)

This bill would require insurance coverage of epinephrine auto-injectors and sets a maximum copayment of $100 annually for two epinephrine auto-injector devices, with an exemption for certain high deductible plans to comply with federal law.

Human Donor Milk Expanded Coverage
(A7790-A Solages/ S6674-A Hoylman-Sigal)

This legislation would require individual, small group, large group, and Article 43 health insurance plans to cover outpatient use of pasteurized donor human milk to support preterm infants and mothers who have difficulty producing breast milk after they have left the hospital.

All of us at Reid, McNally & Savage wish NYSAFP members and your families an enjoyable summer and thank you for your continued support for the Academy's successful advocacy program in New York State.

TWO VIEWS: Climate Change and Vector-Borne Disease

VIEW ONE

THE FUTURE OF VECTOR-BORNE DISEASES IN THE ERA OF CLIMATE CHANGE

By Oladimeji Oki, MD and Joel Bumol, MD

Global climate change, driven by human generation of greenhouse gasses, and its potential for significant impact on human health, has been well documented for generations.[1] From changes in food production/availability to extreme weather events, the effects on human health and safety have the potential to be catastrophic. Additionally, the increase in incidence of and prevalence of vector-borne diseases due to climate change has, and will continue to have, a significant impact on human health.[2] There have already been documented changes in vector seasonality, incidence, and ease of transmission, as well as new pathogens arising due to adaptation pressures with warmer climates and more extreme weather events, such as flooding.[2] This paper aims to review select vector-borne disease, the effects of climate change on their epidemiology, and how New York State family doctors should prepare their clinical practices and advocacy work to mitigate these future threats.

Human based vector-borne diseases are infectious agents that are transmitted by an organism (vector), usually an arthropod, from an infected source (human or animal) to an uninfected human. Examples of common vector-borne diseases include malaria, Dengue, Lyme disease, West Nile disease, and chikungunya.[3] Many arthropods are ectotherms, meaning they thrive in warmer climates. The warming of the climate can be expected to potentially increase incidence and prevalence of vector-borne diseases by increasing vector abundance, length of the vector transmission season, and vector survival, leading to increased rates of infection, morbidity and mortality.[3]

Attributing changes in vector-borne disease incidence/prevalence in a population solely to climate change can be difficult. There are yearly variations in local infection rates due to a variety of factors. For example, after a flooding event, one would expect to see higher rates of mosquito-borne illnesses, as the standing water serves as a reservoir for their larvae. Likewise, there are also concurrent active mitigation strategies that may mask rising vector infection rates. For example, if a municipality starts widespread mosquito eradication strategies, that could potentially blunt an increase in infections or cause a decrease in reported infections despite a local increase in the amount of vectors present. Wild animal studies have actually been very useful in tracking the burden of infection, as there are often no mitigation strategies used for animal-based vector-borne diseases. For example, in the case of avian malaria, a sharp increase in latitudinal and altitudinal ranges of disease has been well documented over the past 20 years. This is further confirmation that the change in climate is driving increases in vector-borne diseases. Tracking vector-borne diseases in wild animals can be

VIEW TWO

THE IMPACT OF CLIMATE CHANGE ON VECTOR BORNE DISEASES

By Tochi Iroku-Malize, MD

According to the NY State Climate Study, we have faced historically unprecedented warming during this century, even under a low-emission scenario, with increases in sea level rise more than global projections, tidal flood days, and winter precipitation falling as rain rather than snow. In addition, climate change has the potential to influence the distribution and behavior of disease-carrying vectors, such as mosquitoes and ticks, in our region. Rising temperatures and changing precipitation patterns create favorable conditions for the expansion of these vectors and the diseases they transmit. As family physicians, we need to stay informed about the changing patterns of vector-borne diseases in New York and be prepared to diagnose and treat them effectively. These changes can lead to an increase in the incidence and severity of diseases such as Lyme disease here in New York.

The first step is educating ourselves on how climate change affects vector-borne pathogens and how to identify certain illnesses that may arise out of season due to this shift. Warmer temperatures and increased rainfall can expand the range of the Aedes mosquitoes which are vectors for dengue and Zika.[1,2] The warmer seasons can increase the transmission period for Culex mosquitoes which are the primary vectors for West Nile virus.[1] As mentioned previously, Lyme disease is more worrisome because of the warmer winters and longer summers that can extend the activity period of ticks (Ixodes scapularis), which can also expand the seasonality of anaplasmosis.[1] In New York, the most prevalent vector-borne diseases influenced by climate change include Lyme disease and West Nile virus.

Family physicians and other clinicians can take several steps to increase their knowledge and skillset on this topic. Enroll in CME courses focused on infectious diseases and vector-borne illnesses or engage in self-study activities. The AAFP has several articles on this topic in the AFP journal as well as an online CME course titled "Treating Infectious Diseases". Attend (live or virtually) medical conferences and seminars that focus on this issue and provide opportunities for interactive learning, networking, and sharing of best practices. Some mechanisms for participation include research projects, case discussions and online forums. They should also regularly consult updated guidelines from the CDC and WHO - join the listserv for updated information. These guidelines provide evidence-based recommendations for diagnosis,

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seen as an early predictor of the effect of climate change, as there are no concurrent mitigation efforts being undertaken.[4]

Vector-borne diseases that can be seen in clinical practice in the New York area include Lyme disease, West Nile virus, and chikungunya. Malaria and dengue are much rarer and often are related to travel from countries with higher rates of infection. However there have been instances in the continental US of locally acquired malaria and dengue. Over the past two decades, there has been an overall increase in many of the more common vector-borne diseases in the US. For example, Lyme disease, Rocky Mountain spotted fever and ehrlichiosis have all had periods of a marked increase in the incidence of infection.[5] A similar pattern holds true for less common infections in the US. The incidence of dengue fever has increased several- fold over the past 15 years in more endemic areas such as Puerto Rico and the US Virgin Islands.[5] While autochthonous transmission of infections such dengue and chikungunya virus have been relatively limited (only 11 cases in southern Florida), this may change overtime if the *Aedes aegypti* mosquito, which serves as a vector for both viruses, becomes more widespread due to warmer climates and extreme weather events. The next section of this paper will examine select vector-borne diseases and discuss how climate change may drive changes in their epidemiology.

ZIKA VIRUS

Zika virus is a flavivirus first identified in 1947. Initially thought to cause a mild febrile illness, and with a prevalence limited to Africa and Asia, Zika virus was not identified in the Americas until 2015. Starting with an outbreak in Brazil and eventually spreading to 33 countries in the Americas, Zika was associated with microcephaly and other fetal abnormalities causing developmental delay in infants/children. Zika is transmitted via a mosquito vector, with *A. aegypti* and *A. albopictus* being the endemic vectors in the Americas. In the US specifically, infections are noted in Puerto Rico and the US Virgin Islands, and the mosquitos are widely distributed in the eastern portion of the US and Hawaii. Zika can also be transmitted perinatally via mother to child transmission and is also thought to be transmitted sexually as well.[6]

Along with the febrile illness caused by Zika, infection often presents with a maculopapular rash, arthralgias, and myalgias. Zika has also been associated with Guillain Barre syndrome. The most concerning potential clinical outcomes of Zika infection occur in pregnant patients and the impact on a fetus. Microcephaly is the main identified disfigurement associated with perinatal Zika infection and associated fetal brain destruction. Early fetal loss and fetal death have also been associated with Zika infection.[6]

When the Zika outbreak first occurred in the Americas, there was a large public health campaign to be able to identify those at risk who should be tested. Zika laboratory detection is not currently widespread and can require special collection and submission to regulated sites. There has been an increasing incidence in Zika in the Americas since the initial outbreak, although Zika seems to have left the public consciousness. Modeling studies have shown that tropical areas are moving towards a year-round transmission cycle for Zika. Temperate areas, where previous models showed lack of favorability for transmission of *A. aegypti* infections, are transitioning to a six-month susceptibility cycle with periods of diapause. In a model by Ryan et al., it is suggested that by 2050 temperate climate transmission cycles may increase by 1-2 months, while increased survivability in tropical areas will sustain a year-round susceptibility.[7]

WEST NILE VIRUS

The West Nile virus was first discovered in Uganda in 1937 and first became prevalent in the US in 1999, quickly becoming endemic. Historically, infections were associated with mild febrile illness; however, in the 1990s neurological infections were identified, most commonly encephalitis. By 2012 all 48 continental US states reported local spread of the virus. Similar to the Zika virus, West Nile virus is transmitted by a mosquito vector. While most commonly transmitted by mosquitos, it can also be spread person to person via blood donation, organ donation, across the placenta and through breast milk.[8] The Culex species, specifically *C. pipens* in the eastern part of the US, are the main vectors for the virus. These mosquitoes undergo a seasonality transmission cycle, with infections spiking in the summer before significantly dropping in the fall. As mosquitos can survive longer, the transmission cycle may mimic that which is being seen with Zika, leading to longer transmission seasons. While there are significant mitigation strategies that municipalities undertake during the summer months to limit West Nile spread, such as removing standing water, spraying insecticide, and public health campaigns to educate on ways to reduce risk, the infection has been able to spread to all US states and become endemic. As climate change progresses, the rates of West Nile virus are predicted to continue to rise, and more municipalities will need to budget for proper mitigation strategies.[9]

LYME DISEASE

Lyme disease is an infection caused by the bacteria *Borrelia burgdorferi*, often transmitted by the *Ixodes scapularis* tick in North America.[10] Lyme disease often presents with a rash, commonly erythema migrans, which can appear as the classic "bull's eye" but also can be associated with uniform erythema or even increased central erythema. Associated symptoms include myalgias, arthralgias, fatigue, headache and fever. In later stages, Lyme disease can present with nerve palsies (especially facial nerve palsies) as well as cardiac issues (often heart block).[10]

The tick vector is often found in forests and other wooded areas, and bacteria are transmitted as the tick bites the skin. Lyme disease incidence rates have been increasing as well throughout the Americas. A study in Ontario showed that in 2017, Lyme disease had reached the highest recorded levels since tracking began in the 1980s.[11] June, July and August are the peak time for reported human infections. As the *I. scapularis* does have a latent ability to survive colder temperatures, there is a complex relationship to how Lyme disease could progress with climate change. Studies have suggested a northward expansion of Lyme, which is already being seen in Canada.[12] Human activity, however, needs to be accounted for. There is a misconception that ticks cannot survive cold weather, so hikers who experience a warmer winter day may feel more secure in hiking without taking proper tick precautions. As the overall climate begins to change, we may experience more of these "warm winter days" and a potential for a change to the seasonal infection patterns.[12] Lyme disease is covered in greater depth elsewhere in this issue.

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DENGUE & MALARIA

Dengue infections have historically been rare in North America, usually isolated to travelers from other countries, specifically tropical and subtropical countries. Dengue can be asymptomatic or can present initially with a high fever, rash, vomiting, myalgias and joint pain. Severe cases can result in dengue shock syndrome characterized by shock, mucosal bleeding, third spacing (pleural effusions and ascites) and death.[3] Dengue is one of the most globally prevalent vector-borne diseases, with up to 390 million cases annually and 20,000 deaths.[14] Dengue has no antiviral therapy, and treatment is currently supportive. There have been two dengue vaccines developed in the past decade. The first vaccine CYD-TDV had production stopped by its manufacturer due to lack of global demand.[15] The second vaccine TAK-003 manufactured by Takeda shows promise. The originally published stage 3 study showed an 80.9% efficacy amongst children age 4-16 including a 74.9% efficacy amongst trial participants seronegative at baseline.[16] Though not currently available in the United States, the World Health Organization recently prequalified this new vaccine for use in children 6-16 years old.[17] There is one FDA approved dengue vaccine for children, ages 9-16, who have a previous documented infection of dengue, which became available in 2022. However, the manufacturer, Sanofi Pasteur, announced they would be discontinuing the vaccine production due to lack of global demand. Dengue's vector is the mosquito *Aedes aegypti*. The rate of incidence of dengue has been rising over the past few decades, going from 23 million in 1990 to 100 million in 2017, and is likely significantly underreported.[18] Local climate and El Nino southern oscillations have been shown to be important drivers of infection rate and transmission. Warmer climates as well as precipitation may prolong and enhance larval development and survival, and these can be predictors of future dengue epidemics.[19]

Malaria is also a tropical mosquito borne illness that has high levels of prevalence and mortality worldwide, affecting countries mostly in Africa, Asia, and Latin America. In 2019 approximately 229 million cases of malaria were reported, resulting in over 400,000 deaths globally; 94% of these cases came from Africa.[20] Malaria is primarily spread by the *Anopheles* species of mosquito. As with other mosquito vector driven diseases, changes in temperature and rainfall patterns have caused higher incidence rates as well as changes in seasonality. Two recent climate events (cyclone Ida in Mozambique in 2019 and flooding in Pakistan in 2022) resulted in significant increases in malaria infections in the weeks following these events. The stagnant waters, along with the loss of safety protection (such as bed nets), likely contributed to the rise of mosquitoes and transmission.[21]

Both dengue and malaria are relatively rare in the United States, with most cases being travelers from countries with endemic levels of infection. Both infections, however, have had documented cases of locally acquired infection in the continental US in the past decade.[22,23] As the climate continues to change to favor more local infection and spread, there is a possibility of a municipality driving enough local spread for the infections to potentially become endemic in the future.

NEXT STEPS

Climate change will have a significant impact on human health for generations to come. Family physicians have a significant role to play in the clinic as well as in public advocacy efforts to help mitigate the potential effects climate change can have on patients, specifically around vector-borne diseases.

Pretravel visits are the most obvious method of infection control for our patients. Physicians should be vigilant in screening patients for travel/exposure and advising them of the risk of vector-borne diseases. The CDC's travel page can be a great source for clinicians looking for up to date warnings for patients on travel to countries with elevated risk of disease. Advising the use of topical insect repellants, wearing long sleeved clothing, and use of mosquito nets should all become part of routine practice. In terms of tick-borne diseases, counseling patients not only during the typical season for Lyme disease (late spring/summer), but year-round may become paramount as the seasonality of the infection begins to change.

Likewise, clinicians will need to familiarize themselves with the presentation of many of the vector-borne diseases, even if they were previously not a clinical concern in their location of practice. This will also include removing travel as a prerequisite for certain infections belonging to a differential diagnosis. In 2023 there were multiple cases of locally transmitted malaria in Florida and a single case of transmission in Texas and Maryland.[24] However, with further climate change and increased weather events, there is a possibility that sustained local transmission of malaria and other vector-borne mosquito illnesses like dengue could become more common.

With a rise in vector-borne illnesses, vector control will be a primary source of mitigation. Family doctors can get involved with advocacy and assisting their public health departments to come up with population scale mitigation strategies such as eliminating sources of standing water and vector control (such as insecticide). Community campaigns on the importance of insect repellant, wearing appropriate clothing when hiking/entering high tick burden areas, and assessing for tick bites in high-risk areas will be critical. In the future, the idea of insecticide treated nets when camping (or even in the home) may be a consideration, along with regular indoor residual spraying of insecticide to limit mosquito resting areas.[25]

Vaccine development is another potential strategy for addressing the rise in vector-borne diseases caused by climate change. There have been varying levels of success with vaccine development for vector-borne illnesses, such as dengue, Lyme disease, malaria, Zika virus and West Nile virus. None of these have achieved widespread global use at this time, although there are other vector-borne diseases that have had success with routine use of vaccines (yellow fever vaccine and Japanese encephalitis). Other vaccines, such as those for malaria and dengue, have been approved but have very low efficacy (36% for malaria after 3-4 doses) or are still in the very early stages of vaccine roll out.[26] Though the manufacturer of CYD-TDV has since stopped producing the vaccine, some studies pointed to possible increased rates of severe dengue in dengue naive individuals. TAK-003 is currently unavailable in the United States and not a current viable

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treatment, and prevention. There are other online resources from platforms such as Medscape and UpToDate with comprehensive information and updates.

In terms of implementing strategies in clinical practice, it requires patient education, early detection and reporting, vaccination and prophylaxis, collaboration, and environmental health advocacy. For patient education, discussing preventive measures, such as using insect repellents, wearing protective clothing, and avoiding outdoor activities during peak vector activity, is important. Patients should be taught to check for ticks after outdoor activities and the proper way to remove them. In the case of contact with a vector, they should be advised to reach out early, which requires physicians and clinicians to be prepared for early detection and reporting. Use the history and physical for the preliminary diagnosis and utilize appropriate diagnostic tests when warranted to confirm cases. This would then lead to vaccination or prophylactic measures (like prophylactic antibiotics for Lyme disease).

Additionally, physicians should collaborate with public health agencies and participate in surveillance programs to monitor the emergence and spread of vector-borne diseases in their communities. Being a part of the community outreach programs to spread awareness is important, especially as family physicians are usually the trusted resource for many patients. By staying informed and taking proactive measures, family medicine physicians can play a crucial role in mitigating the impact of climate change on vector-borne diseases and protecting the health of their patients. Advocating for policies that address climate change is part of the process along with supporting vector control programs in the community.

Family physicians can go upstream to address and mitigate climate change itself within their offices and with their patients by adopting sustainable practices and promoting environmentally friendly behaviors. Energy-efficient measures in their offices, such as using renewable energy sources, reducing waste, and promoting recycling are options. In terms of energy efficiency, the use of energy-efficient lighting, properly insulating buildings and optimizing heating and cooling systems can reduce greenhouse gas emissions. For waste management, recycling, composting and properly disposing hazardous materials will reduce waste generation. Also, the use of digital tools, like the EMR and tablets, reduces waste. Utilization of multidose vials and powdered inhalers when able are also mitigation strategies. Practices should implement water saving measures such as low-flow faucets and toilets and advocate for sustainable transportation options for staff and patients (e.g. carpooling, bicycle storage, telemedicine consultations). Create green spaces within the practice and community. When making purchasing decisions, opt for environmentally friendly products and equipment, and when prescribing medication, avoid overprescribing, promote generic medications and implement a medication return or take-back program. Many of these actions may be beyond the ability of clinicians to implement in total, however, simple steps can make a difference – even a plant or a lightbulb.

Physicians can advocate for policies and practices that promote sustainability and address climate change at their workplace, in their cities, towns, states and nationally. Physicians who are part of hospitals can discuss implementing low-flow anesthesia techniques and using inhalation agents with lower global warming potential, as well as reusable surgical instruments and equipment whenever feasible. They can also ask for environmentally friendly sterilization and disinfection methods like steam sterilization. Physicians should get involved with organizations that are working towards climate action and collaborating with others to raise awareness about the connection between individual actions, environmental sustainability and public health. These may not be for all physicians or practices, but for those who are inclined or have the opportunity to do more in this space, keep these suggestions in mind.

Physicians can also educate their patients about the health benefits of sustainable lifestyle choices, such as walking or biking instead of driving (when able or accessible), increasing the proportion of plant-based nutrition in their diets, and practicing energy conservation at home. Physicians and clinicians can emphasize the importance of preventive healthcare to reduce the need for resource-intensive treatments. Let patients know about local sustainability initiatives and encourage them to participate.

By incorporating climate change discussions into patient consultations and providing guidance on sustainable living, no matter how small, family physicians can empower individuals to make positive changes that not only benefit their health but also contribute to reducing the impact of climate change on a larger scale. This is what we do best every day, sharing information with our patients to help them do what is needed for themselves and their communities.

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containment measure locally.[27] However, as a potentially more efficacious vaccine than CYD-TDV, it could be utilized as part of a future public health strategy pending its efficacy with wider usage of the vaccine and FDA approval in the United States.

Finally, family physicians can continue to engage in climate advocacy. Whether this advocacy is work towards individual sustainability actions, organizational efforts for sustainability such as decreasing paper waste and utilizing automatic lights in exam rooms, or larger scale policy advocacy, there will be many avenues for physicians to be a part of solutions to address climate change. There was a global commitment to lower greenhouse gas emissions with the goal to avoid a 1.5-degree Celsius increase in global temperature by 2050. The US temporarily pulled out of the agreement before rejoining again in 2021. It is unclear how this will play out going forward, but physicians can engage in local policy efforts to create sustainable goals towards minimizing greenhouse gas production. The global south is already struggling with the effects of climate change on infectious disease, food production, shelter and livelihood. Many countries in Asia/Africa/Latin America are seeing higher rates of flooding and resultant malaria/dengue breakouts. The US, due to its wealth and privilege, has so far been able to avoid the severe morbidity and mortality associated with climate change. The most vulnerable will likely be those who are first to be affected by illnesses when the US starts to see significant changes in vector-borne illness seasonality. This phenomenon is referred to as the climate gap, where countries that are contributing least to climate change are experiencing the harshest effects of climate change. We have an obligation to put equity first in climate adaptation.

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IN THE SPOTLIGHT

Congratulations to the 2024-2025 NYSAFP Board Officers and Members

OFFICERS

President – Rachelle Brilliant, DO
President-Elect – Christine Doucet, MD
Vice President – Wayne Strouse, MD
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Alternate Student Representative Upstate – Eliana DeGlopper
Student Representative Downstate – Claudia Serna
Alternate Student Representative Downstate – Oluwafunke Kolawole

2024 Family Physician of the Year

The NYSAFP's Family Physician of the Year Award recognizes Dr. David Kwiatkowski as an exemplary member of the family medicine profession who has worked tirelessly to ensure the highest quality of care for his patients during his career. Dr. David Kwiatkowski of Owego was nominated by his patients, students, and colleagues for his outstanding service to patients and community and devotion to family practice. He works as Medical Director for United Health Services Medical Group and has served his hometown of Owego for over 40 years. In addition to this position, Dr. Kwiatkowski teaches Upstate University medical students in his office every year as a preceptor and conducts board review sessions biweekly for family medicine residents. Congratulations Dr. Kwiatkowski!

2024 Family Practice Educator of the Year

The NYSAFP's Family Practice Educator of the Year Award recognizes Dr. Jiana Menendez, who has made outstanding contributions to education for family practice in undergraduate, graduate, and continuing education. Dr. Jiana Menendez of the New York City region was nominated by her students, patients and colleagues for her strong commitment to family medicine and teaching the next generation of family physicians. She is a full-spectrum family medicine physician with a particular focus on reproductive health and gender-affirming, trauma-informed health care. As the clinical director of the Institute of Family Health's Trauma-Informed Linkage to Care Clinic, she provides primary care to people who have experienced human trafficking, sexual assault, or other forms of sexual violence, including medical evaluation of asylum seekers. Congratulations Dr. Menendez!

From the Membership Commission

Member Numbers Decline or Stagnate- Ideas to Remedy the Problem
Dr. Bill Klepack, 2023-2024 Membership Commission Chair

The decline in some and the stagnation in other NYSAFP member numbers have raised concern within the Academy's Membership Commission over the past couple of years. Accordingly, at this year's Congress of Delegates (COD) the commission departed from the traditional form of annual reports and put forth a white paper with detailed, actionable suggestions. Our request is that you, the Academy's commissions, its Board of Directors, and its staff read and consider them.

The ideas were deemed by the Membership Commission to be strategies that could boost our member numbers among medical students, residents, and practicing family physicians.

Some of the ideas are "low hanging fruit" requiring only that they be chosen as focus area(s) for an Academy commission, or for the NYSAFP Board. Others require more resources. Some are appropriate for a particular commission to take on while others would involve more than one and might also involve the NYSAFP Board. Some can only be achieved with staff support. But all deserve to be read and contemplated.

With our decline in member numbers over the years one may ask how can we afford to do some of the suggestions? Our answer is to start with the doable, think creatively regarding marshalling resources, and as membership numbers increase, so will revenue and capacity to take on the more challenging ideas.

Far from being a criticism of past performance, the Membership Commission views the report as necessary and a reflection of the changes in the practice of family physicians over the past two decades. The diverse ways in which family physicians choose to practice creates a rich tapestry. But its complexity challenges our ability to take it all in. To be of relevance and value to our current and prospective members, the Academy must openly affirm physicians' diverse concerns and needs and demonstrate that we are not only aware of these needs, but are working to address them.

Many steps have been taken in the past few years. This report contains many additional ideas to further the goal of increasing value and membership numbers.

Nothing will happen, however, unless the report is read and contemplated by members, commissions, and the board. This Spotlight feature is intended to draw attention to the report and to ask you to take ten minutes to read it. Then percolate the ideas, consider which ones you see feasible to address and take the initial steps.

The Membership Commission can do its part but this must be a group effort.

Please read the report. Go to: https://drive.google.com/file/d/1jf6TsoX1w5FKyAMdhLpNAD5HSssRSUlS/view?pli=1 and scroll down to page 55.

Some Topics Addressed in the Membership Committee Report:

- When you are unhappy with your employer, why its legal to collectively bargain and how to start
- Why direct primary care may be a solution for burnout – what it is and how to do it
- How to get the administrative skills you need and how to find a mentor
- Medical students need to hear your message – how to mentor and do it easily
- What your Academy can do for you post-residency and how and why to stay in touch
- You want to advance in your academic appointment – how the Academy offers you opportunities to add value to your CV

NYSAFP Family Physicians Receive Honorary Degree from the American Academy of Family Physicians

Congratulations to the following NYSAFP members for attaining status of Fellow of the American Academy of Family Physicians (AAFP). Established in 1971, the AAFP Degree of Fellow recognizes family physicians who have distinguished themselves through service to family medicine and ongoing professional development.

Jillian Alfonso MD, FAAFP, a family physician in Brooklyn, NY
Arthi Chawla MD, FAAFP, a family physician in Webster, NY
Himabindu Ekanadham MD, MS, FAAFP, a family physician in Bronx, NY
Carlos Lucien Elguero MD, FAAFP, a family physician in Slingerlands, NY
Alexander William Filipski DO, FAAFP, a family physician in Baldwinsville, NY
Nick Florio MD, FAAFP, a family physician in Putnam Valley, NY
Kristin Lake Mack DO, FAAFP, a family physician in Putnam Station, NY
Lisa Mamakos MD, FAAFP, a family physician in Huntington, NY
David S Newberger MD, FAAFP, a family physician in Buffalo, NY
Nanna A. Oseitutu-Ebanks MD, FAAFP, a family physician in Baldwin, NY
Juan Carlos Robles MD, FAAFP, a family physician in Bronx, NY
Jane Marie Simpson DO, FAAFP, a family physician in Binghamton, NY
John C Welch Jr, DO, FAAFP, a family physician in Binghamton, NY
Sandhya Kumar MD, FAAFP, a family physician in New Fairfield, CT

A Better Understanding of Lyme Disease Complexity: From Historical Insights to Varied Presentations

Michael Raghunath, MD, MS

Figure 1: Ixodes scapularis

Figure 2: Ixodes pacificus

Introduction

Earliest records of vector-borne illness emerged in the 1870s when Rocky Mountain Spotted Fever yielded geographic clusters of high mortality rates in western Montana.[1,2] Lyme borreliosis, the most common tick-borne infection in both the United States[3] and Europe,[4] is most often transmitted by the black legged deer-ticks, *Ixodes scapularis*, *Ixodes pacificus* (most commonly found in Western North America),[5,6] as well as the *Ixodes ricinus* species (more often found in Europe).[4] A State of Connecticut Department of Health circular letter in August of 1976 first identified several cases of arthritis in children in Old Lyme, Lyme, and East Haddam, CT.[7] It was discovered that the bacterium spirochete of the *Borrelia* genus was primarily responsible for these clusters of symptoms.[8] Around the same time period, a similar spirochete was identified in Switzerland[9] as well as in Liguria, Italy.[10] Even prior, the classic erythema migrans (EM) rash that would eventually be associated with this illness was discovered as early as the 1920s.[11]

The bacteria would be labeled *Borrelia burgdorferi* and would commonly be known as the most transmitted spirochete to cause Lyme disease. At this point, there are nearly two dozen species in the *B. burgdorferi sensu lato complex*, with *B. burgdorferi sensu stricto (Bbss)* being most prevalent cause of borreliosis in the USA and *B. garinii, B. afzelii,* and *Bbss* causing most cases of Lyme disease in Europe.[12] Over the decades, with the use of genomic sequencing and techniques, it has been concluded that a common ancestor of *B. burgdorferi* across the globe likely originated in Europe, has been prevalent in North America for several million years, and the emergence of Lyme borreliosis in North America in the late 1900s represented the reintroduction of this tick-borne pathogen out of refuges into new woodland habitats.[13] In fact, a 5,300-year-old Tyrolean Iceman was discovered in 1991 in the Italian part of the Ötztal Alps and was found to be the earliest human case of infection with the pathogen that causes Lyme borreliosis.[14]

Epidemiology

Since the 1980s, the incidence of Lyme borreliosis has increased across the United States. There are three main regions in the United States where *B. burgdorferi* is now prevalent: the Northeast, the upper Midwest, and northern coastal California.[13] Within the past decade, *Ixodes scapularis* (Figure 1)[15] has been collected from up to 37 states, from the eastern seaboard to the eastern edge of the Great Plains, and *Ixodes pacificus* (Figure 2)[16] has been collected from 6 western states.[17] Despite tick's inherent constraint to local geographic ranges due to local abiotic factors,[18] reasons for increased prevalence in both tick sightings and disease

transmission could be multifactorial, including recolonization and repopulation of white-tailed deer over the last century,[19] climate change,[19] and bird migration patterns.[20] Geographic range models of *Ixodes* species exist that help predict suitable habitats for further expansion and disease distribution.[21]

As per the New York State Department of Health, the average lifespan of a tick is approximately 2 years. Over that time, ticks go through four life stages. Tick eggs are fertilized in the first stage during the fall and are deposited in leaf litter the following spring. The larvae stage starts that summer, when the larva attaches to its first host, typically medium-sized mammals or birds, and feeds for several days. During this time, the tick may become infected with *Borrelia*. After, they molt into their nymph stage and remain dormant until the following spring, where they seek a new host. Most reported Lyme disease cases are transmitted by nymphal deer ticks. Nymphs will then molt into the larger adult ticks, most seen in the fall, with a peak in October through November (Figure 3)[22] Female ticks will lay eggs after feeding.[23]

The Center for Disease Control (CDC) states that there is an annual rate of roughly 30,000 Lyme disease cases reported.[3] Seven-thousand of those cases reported yearly are from New York State.[24] Despite the known prevalence of ticks in heavily wooded areas, living in an urban area like New York City also poses significant risks for infectivity.[25] In 2020, there were 704 reported cases in NYC.[26] Note the operative word has been, "reported", as literature supports that Lyme disease cases have been drastically underreported for decades.[27-29] It is estimated that the actual number of annual cases is in the ballpark of 300,000 to over 400,000 domestically.[28,30-33] The peak incidence is in children ages 5-9.[34]

Skin Manifestations

Classically, we associate the presentation of Lyme borreliosis with the EM, "bulls-eye" rash, either with or without recollection of an actual *Ixodes* bite. However, data shows that less than 30% of people who developed EM in North America reported finding a tick bite.[35] Some reports show numbers with less than 20% of those with Lyme disease recognizing an initial tick bite.[36]

Erythema migrans can be described as a centrifugally-expanding, slow-growing, annular-shaped, homogenously erythematous macule, sometimes with central clearing, purpura, or vesiculation, and possibly a central depressed or raised area on the spot of a previous tick bite.[37,38]

The dermatologic appearance of EM can vary and can confuse providers, as the classic "bullseye" appearance (Figure 4) occurs in only 9%-19% of cases,[38] while it is much more common to see homogeneous erythema (59%, Figure 5)[39] or central erythema (30%, Figure 6).[40] In addition, 7% of lesions have vesicles or ulcerations (Figure 7)[41] and 2% can have central purpura. The rash is usually asymptomatic, but some cases may burn or itch.[42]

EM occurs during the early localized disease stage of Lyme.[43] It can frequently present with a low-grade fever and usually appears within 1-30 days after tick bite,[44] but most commonly within 7-14 days,[45] with a range of diameters from 5 cm to greater than 68 cm.[42] Up to 40% of people with Lyme disease never present with, or do not notice an EM rash, making prompt diagnosis even more difficult.[46] Race also plays a role as it is even more difficult to recognize EM in people of color (Figure 8).[47,48,49] EM can disappear naturally if left untreated over days to weeks.[50]

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Figure 3: Developmental stages of ticks

Figure 4: Bullseye rash (authors own photo)

Figure 5: A broad erythematous patch on the abdomen (Image used with permission from VisualDx- www.visualdx.com)

Figure 6: A thin erythematous annular plaque with a central darker portion, on the leg (Image used with permission from VisualDx- www.visualdx.com)

Figure 7: Confluent erythematous thin plaques surrounding a central hemorrhagic excoriation near the axilla (Image used with permission from VisualDx- www.visualdx.com)

Figure 8: A close-up of a vesiculated erythematous plaque with a central crust on the dorsal hand(Image used with permission from VisualDx- www.visualdx.com)

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Banadyha et al[51] recounted a case where a 6-year-old girl from a Lyme-endemic area presented to her doctor with a circular rash on the left side of her face and no history of a tick bite. She was diagnosed with allergic dermatitis and topical steroids were prescribed. The rash proceeded to spread to the back of the head, and she began exhibiting malaise and a low-grade fever. Initial enzyme-linked immunosorbent assay (ELISA) also did not demonstrate detectable IgG/IgM anti-Bbss antibodies. Based on clinical judgment alone, the child was treated with oral cefuroxime. Repeat Lyme two-tiered serologies (ELISA followed by Western blotting) performed 2 months after the onset of symptoms then returned positive IgG for Lyme borreliosis. She remained asymptomatic at 1.5 year follow-up.

Another case report by Khanna and Goebel[52] writes about a 69-year-old female who presented with pruritic, purplish, papular, oval EM rashes on her abdomen and other areas which developed six days following a tick bite. Serologic testing confirmed Lyme IgM by ELISA, but the confirmatory Western blot test was negative. She was treated empirically with doxycycline and had significant improvement of the rash with no additional symptoms.

Suzuki et al[53] discussed a 43-year-old avid gardener from Wisconsin who developed pink papules that evolved into painless vesicles with surrounding faint erythema behind her right knee, fever, chills, neck pain and malaise. Primary doctors initially treated her with valacyclovir for suspected varicella zoster but the blisters increased in size and showed purple discoloration. She was prescribed ceftriaxone followed by cephalexin and trimethoprim-sulfamethoxazole for cellulitis. After symptoms failed to resolve, she was presumed to have necrotizing fasciitis with a temperature of 101.3°F and was referred to infectious disease. Given the season, geographic location, outdoor activity, and progression despite treatment for cellulitis and shingles, she was clinically diagnosed with early Lyme disease, and her rash resolved after doxycycline. Two-tiered Lyme antibodies came back as IgM positive/IgG negative.

These cases are mentioned to highlight the variability in presentation of EM, the inconsistencies that can be found with Lyme testing, and difficulties providers encounter when diagnosing Lyme disease. Based on the 2020 Infectious Disease Society of America (ISDA) guidelines,[54] a clinical diagnosis of Lyme disease without serologic testing is sufficient in patients with potential tick exposure in a Lyme disease endemic area who have 1 or more skin lesions compatible with EM. In the absence of EM, guidelines recommend two-tier serologic testing with an ELISA or indirect fluorescent antibody (IFA) test, followed by a Western blot only if the acute-phase sample is positive. However, there are studies that report low sensitivities to two-tier serologic testing (around 35%),[55,56] a better but still low-sensitivity complement peptide C6 ELISA (sensitivity of 66.5% in 403 patients with early EM),[57] and interlaboratory variation in results[58] which confound management. Some reports demonstrate that seronegativity can remain despite serial antibody measurements.[59,60] Moreover, two-tier serological testing is most reliable after infection has disseminated or the patient has late-stage Lyme disease, which is past the opportune time to treat patients.[61] This has led to some physicians, including those in the International Lyme and Associated Diseases Society (ILADS), to suggest less reliability on testing when making a diagnosis of Lyme disease.[62,63]

Borrelial lymphocytoma (BL), also known as lymphadenosis benigna cutis, is the rarest skin manifestation of Lyme borreliosis.[64] One of the most common types of cutaneous B cell pseudolymphomas,[65] BL is often caused by *B. afzelii*, and is often transmitted by *I. Ricinus*. Though most frequently appearing in Europe, there have been case reports of people who had tick exposure while traveling to Europe, and then returning to their home-country with an eventual presentation of BL. It has a predilection for children over adults.[64-66]

BL manifests as a painless bluish-red nodule or plaque, usually found on the ear lobe, ear helix, breast or scrotum.[67] It can sometimes present simultaneously with EM.[68] If untreated, BL may persist for months and other manifestations of LB may follow.[69]

Acrodermatitis chronica atrophicans (ACA) is a long-lasting, usually progressive manifestation that typically presents in the late stage of Lyme borreliosis.[70] Also predominately seen in Europe, ACA manifests mostly in adults, and has a female predilection, although ACA-like lesions have been reported in children as well.[71] ACA is characterized by reddish or bluish-red lesions, usually on the extensor surfaces of the extremities, often with doughy swelling. As the skin atrophies, sclerodermic changes develop along with fibroid nodules.[72]

Large-fiber axonal polyneuropathy with mild sensory symptoms can be experienced due to peripheral nerve involvement at the site of the skin lesion of ACA.[72,73] Lower extremity lesions can be misinterpreted to be vascular insufficiency, acrocyanosis, livedo reticularis, lymphedema, chilblains, or even age-related skin changes.[67] Fibrous nodules are often misdiagnosed as rheumatoid nodules, tophi, or erythema nodosum. ACA can also cause joint deformities with swelling, effusion, dysesthesias, hyperesthesias or paresthesias.[74,75]

Early Localized Disease

The range of clinical presentations of Lyme borreliosis can be divided into three stages: early localized disease, early disseminated disease, and late stage disease. Aside from the often-variable appearance of EM, which is not guaranteed to present, patients may experience any combination of malaise, fatigue, headache, arthralgias, myalgias, dysesthesias, fever, and regional lymphadenopathy during this early localized disease state.[76,77]

Early Disseminated Disease: Multiple EM and the Jarisch-Herxheimer Reaction

Early disseminated infection occurs anywhere from days to weeks after transmission. Since the *Borrelia* spirochete travels from the site of the tick bite to other areas of the body, a wide-range of presentations can occur. In addition to BL and ACA, simultaneous EM rashes at multiple sites with differing sizes is another cutaneous manifestation of early or late disseminated Lyme disease. Extracutaneous manifestations of Lyme disease can widely vary, with a high incidence of affecting the peripheral and/or central nervous system, the heart, and the joints.[77]

Zhang et al[78] described a patient who presented with a Lyme disease rash that could have been mistaken for herpes. A woman in her 30s developed a small red bump and surrounding swelling on

her back, along with a rash in her left axilla and left ipsilateral swollen lymph node. She was prescribed cephalexin for a presumed cellulitis. The rash grew, showing a large, circular, well-demarcated erythematous plaque on the back with a central cluster of herpetiform vesicles, bullae, and purple necrotic puncta. There were two additional erythematous patches on the breast and chest. She was diagnosed with vesiculobullous EM in the setting of early disseminated Lyme disease. She was successfully treated with doxycycline, noting that she experienced a Jarisch-Herxheimer reaction after start of treatment. Two-tiered serologies were positive 6 weeks after treatment.

The Jarisch-Herxheimer reaction (JHR) is a phenomena that occurs in patients treated for infection by spirochetes including syphilis, leptospirosis, Lyme disease, and relapsing fever. JHR can manifest as fever, chills, rigors, nausea and vomiting, headache, tachycardia, hypotension, hyperventilation, flushing, myalgia, and exacerbation of skin lesions.[79] Nykytyuk et al[80] reported a case of a 13-year-old boy with Lyme arthritis who developed a Jarisch-Herxheimer reaction when treated with doxycycline after being diagnosed with Lyme disease after 6 months of misdiagnoses. On the 7th day of doxycycline treatment the child developed a low-grade fever, severe arthralgias with intense hip, ankle and cervical spine pain, and myalgias developed. The boy also had elevated CRP and ESR. Spinal tap was unremarkable. Steroids were prescribed. After 4 weeks of intravenous ceftriaxone, the joint swelling resolved and arthralgias improved.

Another case report by Haney et al[81], details a more severe Herxheimer reaction in response to doxycycline in a 24-year-old male diagnosed with Lyme disease after 4 years of multiple, non-specific symptoms. He experienced a low-grade fever, sore throat, sinus congestion, watery diarrhea, headache, stabbing pain in the upper back muscles, increased fasciculations and fatigue. Webster et al[82] discussed a 14-year-old girl with abdominal pain and fevers who was treated with ciprofloxacin for presumed pyelonephritis and became tachycardic and hypotensive after her first dose. She then developed disseminated intravascular coagulation and needed to be hospitalized. Peripheral blood smear revealed spirochetes consistent with *Borrelia*. This was the first case of JHR after ceftriaxone in literature.

Early Disseminated Disease: Lyme Neuroborrelioses

Lyme neuroborreliosis (LNB) is a condition of early disseminated Lyme infection presenting with the triad of 1) lymphocytic meningitis, often presenting with episodic headaches and mild neck stiffness, 2) cranial neuritis, sometimes with facial palsy, and 3) motor or sensory radiculoneuritis.[83-85] Some patients might have cerebellar ataxia or encephalomyelitis.[86] Peripheral axonal nerves seem to demonstrate lesions with denervation with lymphocytic and plasma cellular infiltration.[87]

Omotosho et al[83] reported a case of a 66-year-old male who presented with 2 weeks of mid-back pain radiating to his neck, headache with scalp tenderness, and neck stiffness after he was bitten by two ticks while performing yard work. Six days after initial symptoms, his pain radiated into his upper and lower extremities, leading to right arm weakness and new onset urinary retention. His doctor initially suspected pneumonia and prescribed him an antibiotic, but his symptoms worsened. He had diminished deep tendon reflexes bilaterally, elevated inflammatory markers, a white blood cell count of 12 k/uL, and a creatinine kinase of 27 units/L. ELISA and Western Blots were both positive. Lumbar puncture showed lymphocytic pleocytosis and a positive Lyme disease titer.

This man was diagnosed with Bannwarth syndrome (BWS) based on his severe radiculopathy, upper extremity weakness, and urinary dysfunction. BWS is a form of neuroborreliosis with painful radiculoneuritis, characterized as severe, burning, often dermatomal pain. In most cases, BWS affects the limbs, with only a few reported cases of sacral radiculitis causing neurogenic urinary dysfunction, as in this patient. BWS is characterized by a wide range of symptoms including radicular pain, sleep disturbances, headache, fatigue, malaise, paresthesia, peripheral nerve palsy, meningeal signs, and paresis. The pain is often severe zoster-like segmental pain that is worse at night, with character of burning, stabbing, biting, or tearing. It usually responds poorly to all common analgesics. The patient was treated with IV ceftriaxone and his symptoms improved and his urinary retention resolved. BWS has been reported most often in Europe, however there are cases that have emerged in the United States.[88]

Sayad et al[89] reported a case of neuroborreliosis with new-onset seizures in a 55-year-old man. Initially he had mild headache, low-grade fever, malaise, anorexia, and vomiting. He eventually presented to the emergency department with tonic-clonic seizures leading to intubation. With a past medical history of treated brucellosis, his routine laboratory tests were normal, except for a positive Wright and 2-mercaptoethanol tests. The doctors suspected neuroborreliosis and both serum anti-Borrelia antibodies (IgM and IgG) tests returned positive. The patient was treated successfully with IV ceftriaxone for Lyme disease and had a complete resolution of his seizures.

Visual manifestations of Lyme disease can also vary. Sathiamoorthi et al[90] discusses conditions caused by Lyme that can affect the eyes including optic neuritis, uveitis, vitreitis, retinal vasculitis, cotton wool spots, choroiditis, macular edema and endophthalmitis. Complications such as macular edema, chorioretinitis and optic neuropathy may be vision-threatening. They even note that despite a case report of Lyme uveitis finding spirochetes in vitreous material, serological testing was negative for Lyme antibodies.

Early Disseminated Disease: Neurologic Manifestations in Children

Children with Lyme disease have reported neurological, psychiatric and cognitive symptoms that can greatly impair their ability to learn and grow in the classroom. Adolescents find difficulty connecting with their peers or participating in extracurricular activities. Tager et al[91] presented 20 children, ages 8 to 16, with "marked fatigue (100%), arthralgias (100%), frequent and severe headaches (100%), irritability/depression (94%), short-term memory problems (94%), schoolwork deterioration (94%), myalgias (88%), brain fog (88%), neck pain (88%), insomnia (82%), distractibility (82%), word-finding problems

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(82%), severe flu (80%), sensory hyperacusis to sound (58%) and/or light (74%), insomnia (77%); and radicular pains (56%) despite antibiotic treatment for Lyme disease. The children with Lyme disease reported more learning and attention problems, feelings of ineffectiveness, and mood problems than controls. McAuliffe et al[92] described 25 adolescents with "significant deficits in cognition, as well as worse attendance, grades, and subjective reports of memory problems that were far worse than controls."

In 1998, Swedo et al[93] conducted a systematic evaluation of 50 prepubertal children who had the presence of relapsing-remitting obsessive-compulsive disorder (OCD) and/or a tic disorder, with other neurologic and psychiatric abnormalities, associated with Group A beta-hemolyitic streptococcus infections, and termed this disorder Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal infections (PANDAS). Also in 1998, Reidel et al[94] wrote about a child with LNB presenting as Tourette's syndrome. It has been discovered that a range of infections, including LNB, can trigger the PANDAS symptoms[95], and PANDAS has been grouped as a subset of a larger group of disorders termed Pediatric Acute-onset Neuropsychiatric Syndrome (PANS).[96] Neuropsychiatric presentations in PANS included restrictive eating, separation anxiety, urinary urgency, enuresis, hyperactivity, impulsivity, emotional lability, aggression, opposition, deterioration in handwriting, and decline in school performance.

Cross et al,[97] reported a 7-year-old girl who developed multiple physical and neuropsychiatric symptoms six months after travelling to a tick endemic region. She was diagnosed with PANDAS based on symptoms, a history of three strep pharyngitis infections, a positive ASO titer, and a slightly elevated DNase B titer. However, despite treatment, the patient's symptoms continued to worsen. Upon further testing, a CDC Lyme Western Blot was negative, but repeated Lyme testing through IGeneX Laboratory revealed a positive Lyme Western Blot IgM, Lyme IgG, as well as *Bartonella henselae*, mycoplasma, *Babesia duncani* antibodies. Her academic performance declined from advanced placement to being "unable to add beyond the number 10" and she developed selective amnesia. She was treated with multiple courses of oral and IV antibiotics, as well as IVIG, over a span of 31 consecutive months. After greater than 3 years, she experienced complete remission. Improvement in neuropsychiatric symptoms would not have occurred unless all her co-infections were addressed and resolved.

Early Disseminated Disease: Cardiac Manifestations

The heart can also be affected during early disseminated infection and mostly manifests as fluctuating degrees of atrioventricular nodal block. Less common manifestations include acute myopericarditis, mild left ventricular dysfunction, and rarely, cardiomegaly or pancarditis.[70] Acute carditis usually resolves within weeks, even without antibiotic therapy. Fatal cases have been reported.[98] The spirochete has been isolated from myocardial biopsy samples in patients.[98,99]

Isha et al[100] reported a case of Lyme carditis in a 21-year-old man, when he was found unresponsive with severe bradycardia a few weeks after a tick bite. An electrocardiogram (ECG) revealed a complete heart block with diffuse T-wave abnormalities. He reported having visited a Lyme endemic area 2 weeks prior. Lyme testing was positive by IgM but negative by IgG, which is reportedly not typical for Lyme carditis. He was also positive for *Babesia microti*. He was treated with IV ceftriaxone and received a temporary pacemaker. The AV block gradually improved. Typically, patients with early disseminated Lyme carditis carry a good prognosis. This case report further underlines how delayed management can result in long-term complications and poor cardiac outcomes.

Late-Stage Lyme Borreliosis

The late-stage symptoms of Lyme disease are also very diverse and can affect numerous body systems.[77] In a study of patients with EM who were not treated with antibiotics, approximately 60% of them developed arthritis after an average time course of 6 months.[101] Joint swelling and pain typically occurred in intermittent attacks primarily in large joints, especially the knee, over a period of several years, but some patients had persistent synovitis for 4–5 years. Lyme arthritis usually resolves following appropriate oral or intravenous antibiotic therapy.[102] However, some patients have persistent, proliferative synovitis for months to several years, which is termed post-infectious, antibiotic-refractory Lyme arthritis.[103]

Steppat et al[104] described a man in his 70's who presented with dactylitis, onycholysis, and a bluish-red discoloration and induration of the skin of the left upper extremity. He was diagnosed with psoriatic arthritis but did not respond to treatment with corticosteroids or disease-modifying antirheumatic drugs over the course of months. A skin biopsy was performed showing histopathological changes compatible with Lyme borreliosis and serum contained IgG antibodies against Borrelia burgdorferi. The man did not recall a tick bite but reported that his fingers first began to swell several weeks after gardening. It was concluded that the patient had manifestations of dactylitis, arthritis and ACA. After 1 week of penicillin, the swelling of the patient's fingers improved. After 6 months, the arthritis, tenosynovitis, soft tissue swelling and skin rash had completely resolved.

Kaiser et al[105] reported a case where a 56-year-old avid gardener in Pennsylvania developed transverse myelitis as a complication of Lyme disease. His symptoms included abdominal and back muscle spasms, tactile allodynia, formication, band-like sensation around his thorax, chills, urinary hesitancy, incomplete voiding, writhing in pain, a suspended sensory level between T6-10 on the right and T7-11 on the left, characterized by decreased light touch, pinprick, and temperature sensation. The patient was initially suspected to have herpes zoster without a rash. The patient worsened after famciclovir treatment. Thoracic MRI was consistent with acute transverse myelitis, showing an expansile T2 hyperintensity that was longitudinally extensive involving T7-10. Tests confirmed the diagnosis of Lyme disease and he had complete resolution of symptoms after 3 weeks of IV ceftriaxone.

Dixit et al[106] mentioned a 69-year-old male who was evaluated for headaches and diplopia. He had left-sided 3rd cranial nerve palsy on his examination. He underwent extensive testing and blood tests for

Lyme disease were positive. His spinal tap showed a highly elevated Lyme disease titer. His diagnosis was based on a pleocytosis in the spinal fluid. He was treated for oculomotor nerve palsy secondary to Lyme meningitis with acyclovir and four weeks of intravenous ceftriaxone. His diplopia resolved, and he remained free of symptoms two months after starting treatment.

Post-Treatment Lyme Disease Syndrome

The complexity of Lyme disease manifestations seem endless, because if the spirochete isn't promptly addressed, patients can suffer morbidity. Numerous case reports have shown that finding the proper diagnosis sometimes can take multiple clinical visits and various tests. Many patients have gone through numerous specialists, treatments, and tests, just to find a final diagnosis. Even after all this, there are a small group of individuals who are not diagnosed early enough, and will suffer from Post-Treatment Lyme Disease Syndrome (PTLDS).

PTLDS is the presence of subjective symptoms that begin within 6 months after the diagnosis and treatment of Lyme disease and persists for at least 6 months.[77,102] Depression in patients with PTLDS should be addressed. Symptomatic therapy is recommended to treat symptoms. Multidisciplinary approaches that combine medications with non-pharmacological therapies, for example, cognitive behavioral therapy, acupuncture or massage have shown some benefit.[107] Better education on tick-borne illnesses would be of great benefit to the medical community.[108] It is imperative to keep an open mind and broad differential for people who present with vague symptoms in highly endemic areas for tick exposure. Teaching patients how to avoid ticks, how to look for ticks and remove them, as well as the signs and symptoms of Lyme disease are important for disease prevention. Educating clinicians on recognizing the signs and symptoms will help expedite proper diagnosis and treatment.

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Magical Thinking and the Knowledge Gaps We Fill

By Thomas C. Rosenthal, MD

The miasmic theory held that rotting organic material generated smelly bad air that carried disease from swamps and ghetto slums to humans. The real cause of malaria (Italian for bad air) was not discovered until 1880 and the mosquito vector that carried the malaria parasite was discovered in 1908. Miasma (Greek for pollution) was blamed for most childhood illnesses, cholera, yellow fever, black plague, typhus, and many other illnesses. Today we understand that cholera is caused by a bacterium carried by water, yellow fever by a virus with a mosquito vector, black plague by bacteria with a flea vector, and typhus by bacteria with lice or chiggers as vectors. Before the germ theory of bacteria and viruses, miasmic theory seemed to explain how disease spread through communities. Theories about smells became so pervasive that late into the nineteenth century, smelling food was blamed for obesity.[1]

Poisonous miasmic mists were believed to contain a mysterious force that caused illness. Its signature was a foul smell. A miasma could blanket locales downwind from organic putrefaction, or worse, be held in place by stagnant air. Medieval writers referred to "corruption of the air," "pestilential air" or "putrefaction of the air" and postulated that incense and perfumes not only covered the stench, but cured the air of its corruption.[2] By the 1800s, the perfume industry took off, with eliminating stench as its goal.[3]

During the 1854 Crimean war, Florence Nightingale, a steadfast miasmic believer, campaigned to clean up hospital wards. She believed crowded conditions in stagnant surroundings created their own miasma and produced gangrene. Her solution was to assure that every bedside had a window to be opened in the daytime, but closed at dusk to keep out the ever more dangerous night air.[2]

It was Hippocrates who first described the theory of foul air in the fourth century BC, but the word miasma was not used until the fourteenth century. The first century BC Roman architect, Vitruvius, warned that morning breezes from fetid swamplands carried the poisonous breath of marsh creatures. In *Suspicions about the Hidden Realities of the Air* (1674), the great alchemist, Sir Robert Boyle, wrote that air is the agency of adverse chemical reactions. The ancient Chinese believed heat, moisture, dead air and invisible insect waste made up dangerous miasmata.[2]

Dr. William Farr, then a London government official, plotted the cases of cholera during the epidemic of 1848-1854 and used it to confirm that miasma diminished the further away one lived from the rotting organic matter floating in the River Thames. He speculated that pockets of disease were caused when poor housekeeping concentrated miasma. To his credit, Farr considered the agent in miasma might be a living contagion and called it cholerine. However, he concluded that any such agent must be a non-specific substance capable of producing a wide range of symptoms.[4]

By 1865, the idea of bad air inspired New York City sanitary advocates to emphasize eliminating stench by improving ventilation in New York City apartments.[5] In 1912, New York City rebuilt East River apartments with open passageways, capacious courtyards, floor-to-ceiling windows and outdoor staircases.[5]

But, despite the focus on ventilation, the three cholera epidemics of the nineteenth century forced medical practitioners to ask more questions about the spread of disease. The 1832 cholera epidemic killed nearly ten percent of its victims and miasmic theory seemed inadequate to explain its spread. When cholera returned in 1848, London's John Snow promoted a radical hypothesis that cholera's poison was, "either swallowed in water, or got directly from [an] other person..." Snow employed the epidemiologic protocol first used by New York's Austin Flint to map cholera deaths and then convinced authorities he was right by taking the pump handle off the Broad Street well, an act that stopped cholera's spread.[6,7] When a post-Civil War cholera pandemic struck, it was largely mitigated by public health measures and quarantines. A decade later, Louis Pasteur proved spontaneous generation was a myth and living germs could be found most anywhere. Finally,

An 1831 color lithograph by Robert Seymour depicts cholera as a robed, skeletal creature emanating a deadly black cloud – sourced from Wikipedia

in 1876, Robert Koch proved that a specific bacterium, *Bacillus anthracis*, caused a specific disease, anthrax. Only then did most physicians accept the idea that specific live agents caused unique, identifiable disease.[8]

But the germ theory has not eliminated the fear of stagnant air. The mainstay of miasmic theory's fear of bad air persists, and for some remains easier to accept than germ theory. Stench avoidance is so ingrained that it delayed the adoption of indoor plumbing until someone invented the U-shaped drain trap. When President James Garfield was shot in the back in 1881, New York newspapers reported it was not the bullet, but the sewer smell arising from White House indoor plumbing that killed him.[9]

Pre-germ theory beliefs arose out of a need to explain the unknown. They were the product of magical thinking. Long-held beliefs in miasmic theory did not surrender easily, despite Leeuwenhoek's reported finding of microscopic animalcules (today we call them bacteria) in 1673.

Even physicians hang on to aspects of magical thinking. Seventy percent of today's physicians believe they know colleagues who work under a black cloud.[10] Many attend clinics without a room[13] and feel a little out of sorts if one aspect of a morning routine is missed. It is a little like the priest forgetting to bless the warrior's sword. Magical thinking provides comfort when there is no better explanation, and who's to say that a doctor wearing a friendship bracelet is not a better healer?[11]

Science requires skepticism and seeks to apply rigid methods to evaluate a hypothesis. Magical thinking generates hypotheses when situations change faster than science can investigate. Too often, an investment in magical thinking overwhelms evidence.

In the middle of the twentieth century, concerns about smog reversed ventilation policies, resulting in buildings with windows that did not open.[5] Filtered, indoor air circulating at an average of 0.3mph seemed comfortable and decreased symptoms of allergies and irritants. When COVID-19 came along, group thinking reversed again and windows had to be opened, despite evidence that distance from cough produced micro-droplets may be more important.[12] Ventilation was easier than room expansion. Many schools closed before any research could balance the impact of ventilation, distance, or school non-attendance.[13,14] Even in the twenty-first century, miasma avoidance was an easy sell, and would continue to be an easier sell than more rigidly tested vaccines.[15] Imagine how difficult it must have been to convince the nineteenth century population that a mosquito carried a living agent that caused malaria or yellow fever.

History should teach us that all knowledge is incomplete, and all logic is subject to cognitive bias. Science and magical thinking are in a perpetual competition to tame nature's chaos.[16,17] Every new crisis exposes gaps in knowledge. Medicine grabs for solutions, and some 'obvious' solutions prove little more than placebo. Again, looking at COVID-19, we only recently learned that nirmatrelvir (Paxlovid) does little to lessen symptoms in low-risk patients with COVID-19.[18] Science has proven placebos produce quantifiable effects on illness, and early assumptions often fall victim to the placebo effect.[19]

As we review this issue of *Family Doctor*, we must give thanks for all the testing of magic thinking that has preceded us. Also, we must ponder what of our beliefs today will fall to further testing. Filling gaps is the art of medicine, and the demanding role filled by family doctors.

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Prevention and Diagnosis of Lyme Disease

By Krishna M. Desai, MD; Molly Warren, MD and Alexandra Greenberg, MD

Overview

Tick-borne diseases (TBDs) are a major public health concern as they become increasingly more widespread geographically. Nearly half a million people have been diagnosed and treated for a TBD, yet these diseases are under-reported, under-diagnosed, and under-treated.[1] Among TBDs, Lyme disease is the most common in New York State, with more than 7,000 cases being reported each year.[2] *Borrelia burgdorferi*, a spirochete that causes Lyme disease, is transmitted to humans by the bite of the *Ixodes scapularis* (blacklegged or deer tick).[1] Although TBDs can present with mild, self-resolving symptoms, they can also lead to significant morbidity, involving multiple organ systems. Fortunately, TBDs and their sequelae can be mitigated through effective prevention measures as well as accurate and timely diagnosis and treatment. Diagnosis of Lyme disease can be challenging for a multitude of reasons, which often leads to missed opportunities for accurate diagnosis and timely treatment. This review will focus on prevention and diagnosis for Lyme disease including the diagnostic challenges often faced by clinicians. Prevention strategies should be considered at the individual, community, and public health levels to mitigate the morbidity associated with Lyme disease in New York State.

Diagnosis of Lyme Disease

Diagnosing Lyme disease is challenging due to well recognized limitations of currently available FDA approved diagnostic tests, the wide range of clinical presentations, and differing published guidelines and opinions on diagnostic approaches among experts. It is important that clinicians include Lyme disease as part of their differential diagnosis, especially if there is a high likelihood that a patient may have been bitten by a tick and they reside in an endemic area. It is prudent to recognize that many patients who are ultimately diagnosed with Lyme disease do not recall a tick bite. Children ages 5 to 9 make up 25% of those diagnosed with Lyme disease each year and may have a particularly difficult time recalling a tick bite.[3] Ruling out Lyme disease based on absence of a history of tick bite leads to missed opportunities for timely and accurate diagnosis. Clinical assessment should begin with a detailed history including travel history, history of tick bites, timing, duration, and severity of symptoms, and physical exam. Diagnostic tests should be carefully considered based on historical details and clinical presentation.

Signs and Symptoms of Lyme Disease

Signs and symptoms of Lyme disease can be categorized into 3 stages: early Lyme disease (3-30 days after tick bite), disseminated Lyme disease (days to months after bite), and late or chronic Lyme disease (months to years after initial infection).[4]

Early Lyme disease usually presents 3-30 days after the tick bite and approximately 70-80% of infected individuals will develop erythema migrans (EM) rash.[5] Only about 20-30% of rashes due to Lyme disease will have the classic bull's eye presentation. Lyme rashes can have a variety of presentations, some of which include: uniform singular erythematous macule, papule, nodule, or patch that is gradually expanding; expanding rash with central crust, or multiple rashes. The rashes can also vary in color and size. Lyme rashes on darker skin may appear as bruise-like discoloration, may be less distinct, and less immediately recognizable compared to its presentation on lighter skin tones. The rashes may be asymptomatic or associated with mild pruritus or pain.[6] If left untreated, the rash usually persists for 2-3 weeks with some patients having recurrent episodes which is a sign of disseminated Lyme disease infection. Other symptoms of early Lyme disease include fevers, chills, fatigue, headache, joint pain, and swollen lymph nodes.[5] The photos on page 25 of this issue show a variety of rash presentations.

Disseminated Lyme disease and late stage or chronic Lyme disease can develop if earlier stages are left untreated or if initial treatment with antibiotics therapy was ineffective. Chronic Lyme disease is a multisystem illness with a wide range of symptoms, musculoskeletal and neurologic symptoms being the most common though any system may be involved. Patients often present with a waxing and waning constellation of symptoms that include, but are not limited to, arthritis of large joints, myalgias, fatigue, headache, malaise, cognitive dysfunction ("brain fog").[7]

Image 1. Blacklegged ticks: larva, nymph, adult male and adult female from left to right

Diagnostic Tests for Lyme Disease

Serological tests during early stages are expected to be false negative with low sensitivities since the immune system has not had sufficient time to produce antibodies, and positive antibody testing does not provide information regarding active or past infections.[4] Lyme disease should be clinically diagnosed and treated without further laboratory testing if patients present with EM rash and potential tick exposure. However, if diagnosis is less clear and Lyme disease at any stage is suspected, serologic antibody testing should be performed.[8] It can take 6-8 weeks for seroconversion and serologic tests to become positive, making timely diagnosis and treatment challenging. The US Centers for Disease Control and Prevention (CDC) recommends either a standard 2-tier testing (STTT) or modified 2-tier testing (MTTT) when diagnostic laboratory testing is clinically indicated. The first- tier test consists of an enzyme immunoassay (EIA) or an immunofluorescence assay (IFA) to detect antibodies against *Borrelia burgdorferi*. If this initial test is positive or equivocal, a second- tier test, the western blot, is performed to confirm the diagnosis.[1] If testing is performed when early stage of Lyme disease is suspected (< 30 days of onset of symptoms), serologic testing should be performed on acute phase serum sample followed by a convalescent-phase serum sample 2-3 weeks later if the initial result is negative.[8] Positive IgM titers are highly specific for acute infection however are only reliable when measured within the first 30 days of initial symptoms and any subsequent positive results are considered false positive.[9] For Western blot, the IgM test is positive if any two of the following three bands are present (in kilodaltons): 23, 39, and 41. The IgG test is positive if any five of the following bands are present: 18, 21, 28, 30, 39, 41, 45, 58, 66, 93.[10] IgG antibodies will remain positive indefinitely and should not be used to determine disease progression or effectiveness of treatment. The MTTT consists of the same first tier test (EIA or IFA) as STTT followed by another EIA test with a different antigenic target instead of the western blot. The MTTT provides a more sensitive method for diagnosing Lyme disease which is beneficial during earlier stages. This method simplifies the diagnostic process by using two EIAs and reducing the subjectivity associated with interpreting western blot results.[9]

Clinical Context and Lyme Disease Testing

Whether to test for Lyme disease and which tests to perform depends on the clinical presentation and history for any given patient, as outlined in the 2020 Infectious Disease Society of America (IDSA) Guidelines for the Prevention, Diagnosis and Treatment of Lyme Disease.[8] For patients presenting with skin findings consistent with EM who have potential tick exposure or are living in or with recent travel to areas where Lyme disease is endemic, clinical diagnosis is sufficient. However, if a patient is presenting with less pathognomonic but concerning skin findings, then further confirmatory testing for early stage Lyme disease, as outlined above, is strongly recommended based on current evidence.[8] In the case of patients with arthralgias and concern for Lyme arthritis based on initial evaluation, serum antibody testing should be performed first followed by synovial fluid or tissue testing via PCR for further work-up, as necessary. There is limited evidence to support Borrelia culture of tissues or fluid.[8] Based on assessment of risk for exposure, in patients with acute myocarditis or pericarditis of unclear etiology, serological testing for Lyme disease may also be appropriate. In patients with concern for exposure to Lyme and presenting with meningitis, painful radiculoneuritis, mononeuropathy multiplex, and/or acute cranial neuropathies as well as in patients with spinal cord or, less commonly, brain inflammation associated with painful radiculitis, testing for Lyme disease is also warranted. In those patients where there is concern for infiltration of the central or peripheral nervous system, serum antibody testing is still recommended first, with testing of CSF only indicated to determine the CSF:serum antibody ratio and limited evidence to support PCR or culture of CSF or serum.[8]

Prevention

Most public health prevention recommendations for Lyme disease focus on personal prevention of tick exposure and timely tick detection and removal. It is important for family physicians to be aware of preventive measures to counsel patients effectively. Lyme disease is spread by a bite from an infected black-legged or "deer tick". In New York State, black-legged ticks are not established in Manhattan, Brooklyn, or Queens, but are prevalent in Long Island, Staten Island, North Bronx, upstate and central New York.[11] Personal prevention is the most effective evidence-based recommendations available, as environmental measures to decrease tick burden, community measures, and vaccination development have many challenges.

Individual Prevention

To avoid black-legged tick exposure, it's important to be aware that they live in shady, moist areas and are usually found close to the ground, often in grass and brush 18-24 inches from the ground.[2] It is advised to wear long-sleeve and long-legged clothes, which can be pre-treated with a 0.5% permethrin spray prior to use.[2,13] Pants can be tucked into shoes, and frequent tick checks on skin exposed areas while outside can prevent a tick bite.

Insect repellent containing N,N-Diethyl-meta-toluamide (DEET), picaridin, ethyl-3-(N-n-butyl-N-acetyl) aminopropionate (IR3535), oil of lemon eucalyptus (OLE) are all recommended by the New York State DOH, Infectious Disease Society of America (IDSA) and American Academy of Pediatrics (AAP).[2,8,13] A product with 10% DEET will provide protection for 2 hours, while a 30% will provide protection for 5 hours, however, DEET concentrations do not have to exceed 50%.[13] While outdoors, one should avoid activities that are more prone to ticks, such as sitting in the grass, on old logs, or on stone walls.[2,12]

After spending time in tick infested areas, there are several other preventative measures that can be taken. Clothes can be removed and placed in the dryer for 10 to 15 minutes. A hot shower can rinse off any ticks that have not latched, and a thorough, full-body tick check can help identify any ticks that may be present. Children and pets should also be checked.[2]

Being able to identify a deer tick at its different life stages is an important component of prevention. Image 1 shows deer ticks as larva and nymph, which are more common in the spring, and male and female adults, which are more common in the fall.[11] If a tick is found, proper removal within 36 hours of attachment can prevent transmission of Lyme disease if the tick is infected. To remove the tick, a pair of pointed tweezers should be placed where the tick head

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or mouthpiece enters the skin, it should be grasped firmly, and pulled directly outward (not twisted). The area should be cleaned, and the site monitored for 30 days for development of the EM rash.[2] If the tick was present for more than 36 hours, is identified as a black-legged tick, and it has been within 72 hours of removal, a prophylactic one- time dose of doxycycline 4.4mg/kg up to 200 mg can be used if there are no contraindications to doxycycline.

Environmental and Community Prevention

Efforts aimed at environmental tick reduction or targeting the reservoir host (rodents and deer) have not shown to be effective in reducing rates of Lyme disease. Efforts to reduce tick habitats in community used spaces such as mowing grass, using wood chips, or placing playgrounds away from the forest edge are readily accepted by the public as an effort to reduce exposure to ticks. A vaccine was developed in the 1990s and was found to have a good safety profile, but due to poor sales production was discontinued. There are ongoing trials in Europe for new vaccine development.[12]

Conclusion

As the burden of TBDs and in particular Lyme disease increases in areas including New York State, it has become increasingly important to stay informed regarding prevention methods and have up-to-date, clear diagnostic criteria and evidence-based, standardized approaches to testing to ensure prompt and appropriately targeted treatment. By recognizing signs of Lyme disease and understanding the distinction between early, disseminated and late stage disease we can continue to detect and stop the progression of illness. To do this, providers can apply the outlined recommendations from the IDSA regarding testing, with prioritization of serological studies when indicated and recognition of clinical contexts in which Lyme disease diagnostics are warranted and further testing may be appropriate. This requires accurate assessment of risk of exposure based on both geographic location and travel history and determination of the relevance of current and recent symptomology. Additionally, Lyme disease and its epidemiological, community, and individual impacts can be preemptively addressed through prevention methods which family medicine practitioners are ideally positioned to promote and implement.

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Prevention of Tick-Borne Disease for Participants in Outdoor Activities in New York State: A Summary of the Literature

By Nicholas Taylor; Rachel Conley and David Colman, MD

Tick-borne diseases pose a significant public health concern for individuals engaging in outdoor activities in New York State and throughout the Northeastern United States. Among these diseases, Lyme, babesiosis, and anaplasmosis are the most prevalent, with cases of ehrlichiosis and Rocky Mountain spotted fever noted sporadically. Increasing incidence and economic impact of tick-borne diseases make it imperative for family medicine practitioners to be well-versed in the common clinical presentation of these diseases as well as preventive strategies and management approaches (Table 1).[1]

Lyme disease is the most common vector-borne disease in the United States, typically found in the Northeast and Midwest and transmitted by the *Ixodes scapularis* tick. It affects approximately 476,000 Americans annually. When patients contract the disease, there are three stages: early localized, early disseminated, and late. Symptoms typically start 7-14 days following the initial tick bite. The early localized stage is characterized by the erythema migrans, or "bull's eye", rash along with flu-like symptoms including fever, headache, malaise, and body aches. The second stage occurs 3-10 weeks following the initial bite; clinical signs and symptoms of this stage include migratory arthralgia, early neuroborreliosis, Lyme carditis, cutaneous symptoms, and ocular symptoms. The final stage of Lyme disease occurs months to years after an untreated infection and consists of Lyme arthritis, late neuroborreliosis, and acrodermatitis chronica atrophicans. Lyme disease is diagnosed clinically and then confirmed with serology; typically, with ELISA or indirect fluorescent antibody test followed by Western Blot.[2,3]

Babesiosis is another common vector borne disease found in the Northeast and upper Midwest, including New England, New York, New Jersey, Wisconsin, and Minnesota. Cases have been on the rise in the past decade, particularly in the Northeast. It is primarily transmitted through the *Ixodes scapularis* tick. Similar to Lyme disease, the diagnosis is made clinically and often confirmed with blood smear or PCR.[4]

Anaplasmosis is caused by the bacterium *Anaplasma phagocytophilum* and is transmitted by the *Ixodes scapularis* and *Ixodes pacificus* ticks. It is primarily found in the Northeastern and Upper Midwestern United States. The bacteria invade granulocytes and thus evade the immune system, causing systemic disease. Clinical features include fever, chills, headache, malaise, and myalgias, while less commonly causing nausea, vomiting, cough, and neurological symptoms. Laboratory findings may show mild anemia, leukopenia, and thrombocytopenia as well as mild transaminitis. Intracytoplasmic aggregates, called morulae, can be seen on peripheral blood smear.[5]

Ehrlichiosis has a similar pathophysiology to anaplasmosis in that the bacteria *Ehrlichia chaffeensis* is an obligate intracellular organism that invades immune cells, specifically monocytes and macrophages, avoiding both the innate and adaptive immune system. It is primarily found in the Southern United States and up the east coast with 30% of infections found in Oklahoma, Missouri, and Arkansas. Although it is less common in New York, it is important to include it in the differential diagnosis and is on most tick-borne disease test panels.[6]

Finally, Rocky Mountain spotted fever, caused by the pathogen *Rickettsia rickettsii*, is primarily transmitted by the *Dermacentor* tick. The highest density of cases is in the Northeast and Southern United States. Doxycycline has been found to be the most effective medication in preventing severe illness and death if given within the first 5 days of symptom onset. Up to 25% of untreated cases can be fatal within 7 to 9 days of illness; therefore, empiric treatment is recommended for all patients with suspected infection.[7]

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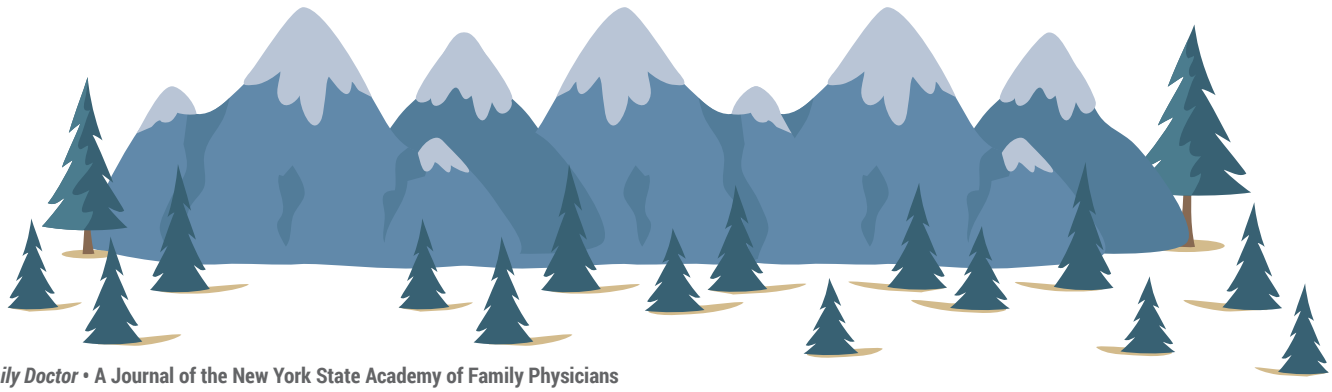
Table 1. Overview of Tick-Borne Diseases

Disease	Lyme Disease	Babesiosis	Anaplasmosis	Ehrlichiosis	Rocky Mountain Spotted Fever
Transmission	Ixodes scapularis tick	Ixodes scapularis tick	Ixodes scapularis, Ixodes pacificus ticks	Lone star tick (Amblyomma americanum)	Dermacentor ticks
Early Signs & Symptoms	Erythema migrans ("bull's eye") rash, fever, headache, malaise, myalgia	Fever, chills, malaise, myalgia, signs of anemia	Fever, chills, headache, malaise, myalgia	Fever, chills, headache, malaise, myalgia	Fever, headache, blanching maculopapular rash (starting on the wrists/ankles)
Progressive Symptoms	Migratory arthralgia, early neuroborreliosis, Lyme carditis, cutaneous and ocular symptoms	Hemolysis, jaundice, hemoglobinuria	Nausea, vomiting, cough, neurological symptoms	Nausea, vomiting, diarrhea, confusion	Rash (transitioning to petechial and/or hemorrhagic), nausea, vomiting, diarrhea
Late Symptoms	Lyme arthritis, late neuroborreliosis, acrodermatitis chronica atrophicans	Severe hemolytic anemia, organ failure (rare)	Severe complications are rare but may include anemia	Severe illness with multi-organ involvement	Severe vascular damage, Organ failure
Common Laboratory Findings	Elevated ESR, leukocytopenia, thrombocytopenia	Parasitemia, anemia, elevated LDH, transaminitis, elevated BUN/Cr, proteinuria	Mild anemia, leukopenia, thrombocytopenia, mild transaminitis, morulae	Leukopenia, thrombocytopenia, transaminitis, morulae, hyponatremia	Thrombocytopenia, transaminitis, hyponatremia, CSF pleocytosis
Geographical Distribution	Northeast and Midwest USA	Northeast and Upper Midwest USA	Northeastern and Upper Midwestern USA	Southern USA and East Coast	Northeast and Southern USA
Treatment	Doxycycline OR Amoxicillin (children/pregnant women)	Atovaquone PLUS Azithromycin	Doxycycline	Doxycycline	Doxycycline (within first 5 days)

Table 2. Methods of TBI Prevention by Exposure Period

Pre-Exposure (Activity Planning)	Exposure (During Recreation)	Post-Exposure (After Activities)
Patient education on tick habitats	Tick identification and avoidance of tick habitats (e.g., tall grass or brush)	Self-tick checks or partner checks
Application of insect repellents	Reapplication of insect repellents	Tick removal techniques
Choice of clothing (permethrin-treated, long-sleeve, light colors)		Post-exposure prophylactic medications (1-time dose of doxycycline)



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Given the increasing incidence and disease burden of tick-borne illness, prevention is a vital aspect of primary care medicine. Encouraging patients to employ preventative strategies before engaging in outdoor activities can decrease the likelihood of contracting a tick-borne disease. Patients at risk of contracting a tick-borne disease are those who spend significant time outdoors, particularly in areas with long grass or highly wooded areas. It is important to remember that unhoused patients are also at risk.

Family physicians play a vital role in educating patients on preventive strategies during peak infection months and providing antibiotic prophylaxis in appropriate cases. Implementation of these recommendations into clinical practice can lead to improved patient outcomes and reduced incidence of tick-borne diseases. In this paper, we provide an overview of the current recommendations in preventing tick-borne infections that are most applicable to patients residing within New York State. We discuss the utilization of insect repellents, self-checking for ticks, tick removal, as well as clothing and behavioral modification for patients with the highest risk of being bitten by a tick (Table 2).

The first step in prevention is to educate patients about tick habitats and behaviors. In preparing for and partaking in outdoor recreation, utilization of protective clothing, such as long pants and shirts, along with application of insect repellents containing DEET are effective strategies. After potential exposure, conducting thorough post-activity tick checks, performing timely removal of ticks, and providing post exposure prophylaxis are key strategies to minimize tick-borne illness (TBI).

Pre-Exposure: One of the most effective strategies in preventing TBI is the use of tick and insect repellents when engaging in outdoor activities. DEET (N, N-Diethyl-meta-toluamide) was initially developed by the U.S. Army in 1946 to safeguard soldiers from mosquito-borne illnesses in insect infested areas where it demonstrated exceptional efficacy in repelling not only mosquitos but also other insects including ticks. This effectiveness led to its widespread adoption and civilian use about a decade after its conception. Further research after the introduction of DEET to the public demonstrated protection against pests that can transmit serious diseases such as Lyme disease from ticks as well as malaria, yellow fever, dengue fever, and encephalitis from mosquitoes. In December 1980, a Registration Standard for DEET was issued, setting the groundwork for its regulatory assessment. Further scrutiny in 1988 required additional data on animal and avian toxicity, culminating in a comprehensive Reregistration Eligibility Decision (RED) document that reassessed all submitted data to ensure its safety and efficacy. DEET's unique application directly to skin and clothing allows for effective intermittent use, typically over days or weeks, with minimal long-term exposure. This robust safety profile, combined with its proven effectiveness, ensures that DEET remains a trusted and reliable defender against insect-borne threats, both historically and today.

DEET has the advantage of being used in a general population for a longer period with the absolute risks of human exposure estimated to be very low. Neurological side effects, including seizures, are possible with DEET toxicity; however, according to the U.S. EPA, in 1998 approximately 21% of households in the United States, or by about 30% of the U.S. population, had used DEET that year with an estimated incidence of toxicity induced seizure at one person per 100 million uses of DEET.[8,9] The most common side effect of DEET exposure is dermatitis, described as a burning sensation, skin eruption, erythema, itchiness, or blisters. Rarely, patients have experienced encephalopathies with tremors, coma, and seizures along with hypotension and bradycardia. In these cases, discontinuing use of DEET and supportive treatment typically leads to symptom resolution and full recovery. In the past 60 years, there have only been 9 documented deaths from DEET intoxication; four from intentional ingestion and five from high concentrations of dermal exposure. Three of the deaths related to dermal exposure were in children and all of them were related to misuse of DEET.[10] The American Academy of Pediatrics advises against using DEET on children younger than two months old and recommends concentrations of 10% or less for those under twelve years of age.

Picaridin and permethrin were also introduced in the late 20th century and have been used in commercial insect repellents. Picaridin, developed in the 1980s as a DEET alternative and available in the US since the mid-2000s, offers a similar level of efficacy in insect repulsion. Compared to DEET, it has a better safety profile, does not damage synthetic fabrics, and is odorless. Permethrin differs from picaridin in that it is typically applied to clothing and not directly on the skin. Permethrin also acts as both a repellent and an insecticide.[11] Studies involving volunteers, military personnel, and forestry workers have shown that permethrin-treated clothing significantly reduces tick attachments and bites. While direct comparisons with DEET and other repellents are varied in methodology, permethrin and DEET are generally seen as equally effective. Combining permethrin-treated clothing with topical DEET or Picaridin has been shown to enhance protection against mosquito bites, suggesting a potentially synergistic effect for tick bite prevention as well.[12]

Other repellents, including essential oils, citriodiol (oil of eucalyptus), and ethyl butylacetylaminopropionate, as well as newer compounds like nootkatone, generally offer lower efficacy and shorter protection durations compared to DEET. Therefore, while patients may choose to use these natural alternatives or newer compounds, they are not recommended as primary choices for tick prevention.[11]

In summarizing the use of insect repellents, DEET, picaridin, and permethrin-treated clothing are recommended as the most effective repellents, with natural options requiring further development and research into their efficacy. DEET and picaridin offer reliable skin protection, while permethrin-treated clothing can also be an effective option, especially when combined with topical repellents.

Aside from the application of permethrin to clothing, it has been suggested that one's choice of clothing can play a role in preventing tick bites. The CDC recommends wearing long-sleeved clothing to limit a tick's ability to latch onto the skin, with the thought that covering more skin reduces the likelihood of a tick bite. Although this strategy lacks direct studies on its effectiveness in preventing

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tick-borne illnesses, it is considered a practical, low-risk intervention endorsed by experts. Additionally, wearing light-colored clothing is advised to aid in the visualization of ticks during checks, despite some reports that certain ticks may be attracted to light-colored clothing. This discrepancy highlights the complexity of tick behavior and emphasizes the importance of regular tick checks. Furthermore, other behavioral modifications recommended by the CDC include avoiding areas with high grass or leaf litter and walking in the middle of cleared trails, away from neighboring vegetation. By combining these low-cost strategies with practically no associated risks, individuals can adopt a comprehensive approach to minimize the risk of tick bites and potentially lower the incidence of tick-borne illnesses.[11,13]

Post-Exposure: The principle behind performing individual body exams for ticks is that upon identification of a tick bite, early detection and removal reduces the chance of disease transmission. Several studies and expert recommendations support the effectiveness of regular tick checks in reducing the risk of tick-borne diseases. A study published in the Journal of Medical Entomology found that prompt removal of attached ticks within 24 hours significantly reduced the risk of acquiring Lyme disease.[14] Furthermore, the Centers for Disease Control and Prevention (CDC) recommends conducting thorough tick checks on oneself, family members, and pets after spending time in areas where ticks are prevalent, such as wooded and grassy areas. This includes examining areas of the body where ticks are commonly found, such as the scalp, armpits, groin, and behind the ears. It can be particularly challenging to identify and remove ticks latched to the skin in these areas and for that reason, self-checking for ticks is not a definitive measure for preventing tick-borne infections in and of itself.

Despite the current recommendations, controlled studies with supporting evidence are also lacking. Researchers Vásquez et al. conducted a matched case–control study from July 2000 to February 2003 and determined that self-checking one's body for ticks after engaging in outdoor activities did not confer a measurable reduction in the incidence Lyme disease. In contrast, other studies have suggested that performing self-checks does offer a reduction in the chance of contracting Lyme disease.[15-17]

Various methods for removing ticks have been described, leading to the development of several commercial devices with different approaches to removing embedded ticks. While studies comparing these mechanical removal techniques have produced conflicting results, forceps removal has been associated with a lower rate of certain infections. Passive methods such as applying substances like petroleum jelly or isopropyl alcohol have not shown efficacy in promoting tick detachment. Although there are no established guidelines on optimal removal techniques, recommendations should be given for the mechanical removal with forceps, emphasizing pulling upward with steady pressure and discouraging passive removal techniques or the use of local/systemic medications like anesthetics or ivermectin.

The timing of tick removal and total duration of attachment to the skin have been correlated to the risk of Lyme disease transmission. While early studies suggested a minimum attachment time of 48 hours for Lyme transmission, recent reviews indicate transmission may occur within 24 hours. Consequently, the CDC has split this time difference and advises removing ticks within 36 hours of attachment to significantly reduce the risk of Lyme disease. It is unlikely patients will be able to accurately or confidently provide the duration for which a tick has been latched to their skin and thus a general emphasis on rapid tick removal should be given.

When a patient does present following a tick bite, the decision must be made whether to prophylactically treat them. Current guidelines recommend initiating a single dose of prophylactic doxycycline if: the tick is removed >36 hours but <72 hours from initial attachment, local rate of infection of ticks with Lyme is >20%, and the tick is identified as an *Ixodes* tick. The efficacy of antibiotic prophylaxis against anaplasmosis and babesiosis is unknown.

Family medicine providers are uniquely positioned to significantly aid in the prevention of tick-borne diseases due to their long-term relationship with patients who may be at risk. It is therefore imperative that family physicians in New York State are well-versed in the epidemiology, transmission, and prevention of tick-borne illnesses in the area. This knowledge enables family physicians to have informed and educational discussions with their patients, emphasizing strategies to reduce the incidence of these diseases.

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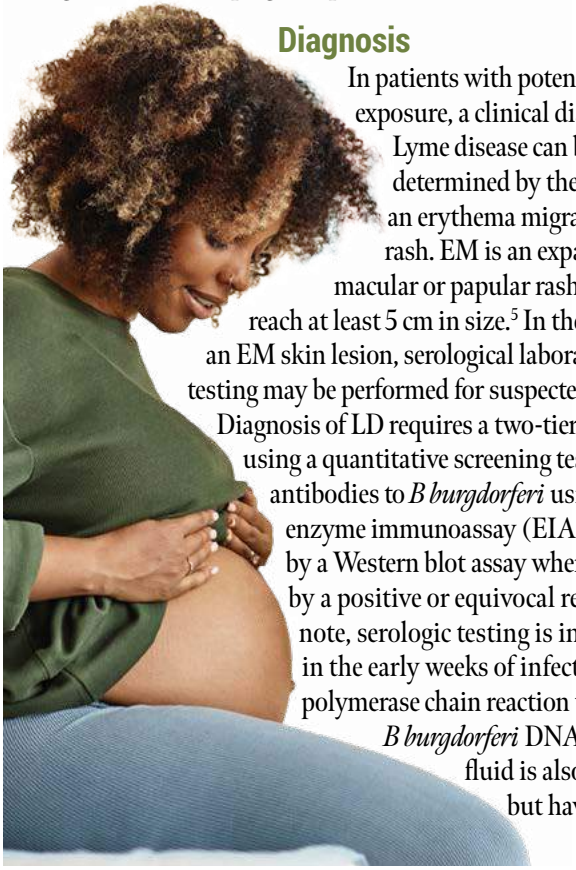
Lyme Disease in Pregnancy: Insights into Maternal and Fetal Health

By Lyssa Dimapanat, MS; Saaniyah Sajed; Hope Daskalakis, DO, Octavia Flanagan, RN, WHNP-BC, PhD

Background

Lyme disease (LD) is the most common tick-borne disease in North America caused by the *Borrelia burgdoferi* spirochete and transmitted to humans by the *Ixodes spp*. About 476,000 people are diagnosed and treated with LD each year. In 2022, 63000 cases were reported to the US Centers for Disease Control and Prevention (CDC). Early signs and symptoms are erythema migrans and flu-like symptoms including fever and arthralgias. If left untreated, LD can result in serious neurological and cardiac complications including arthritis.[1] Due to known development of congenital disease caused by another spirochete, *Treponema pallidum*, there are concerns on the impact of LD in pregnant and breastfeeding patients. Studies focused on transplacental transmission of *B. burgdoferi* from infected patient to the child in utero have been limited and inconsistent in their findings.[2] Early case studies have reported a potential link of LD and adverse birth outcomes, citing presence of spirochetes in fetal brain, liver, heart, lung and kidney.[3] However, further epidemiological and serological studies have continued to be inconclusive in establishing a significant causal association between LD and adverse birth outcomes.[4] The aim of this article is to explore existing clinical guidelines regarding management of LD in pregnant patients.



Diagnosis

In patients with potential tick exposure, a clinical diagnosis of Lyme disease can be determined by the presence of an erythema migrans (EM) rash. EM is an expanding macular or papular rash that must reach at least 5 cm in size.[5] In the absence of an EM skin lesion, serological laboratory testing may be performed for suspected LD. Diagnosis of LD requires a two-tier protocol using a quantitative screening test for serum antibodies to *B burgdorferi* using an enzyme immunoassay (EIA) followed by a Western blot assay when preceded by a positive or equivocal result.[6] Of note, serologic testing is insensitive in the early weeks of infection.[7] A polymerase chain reaction testing of *B burgdorferi* DNA in synovial fluid is also available but have not yet been standardized for routine laboratory use.[8] Joint aspiration is recommended when septic arthritis is suspected. In pregnant women, the same diagnostic methods mentioned above are employed.[9]

Clinical Course

The clinical course of LD is classified into three stages. The first stage is early localized disease and occurs 1 to 28 days after tick bite. Symptoms include erythema migrans and a low-grade fever resembling a viral-like illness associated with myalgia, headache and neck stiffness. The classic Lyme "bullseye" rash is typically seen 5 to 7 days following tick bite. The second stage is early disseminated disease that usually develops 3 to 12 weeks after initial infection. Symptoms include cardiac, dermatological, musculoskeletal and neurological presentation. Encephalopathy, meningitis and cranial nerve neuropathy are seen in 20% of patients with Bell's palsy specifically occurring in 5% of patients.[10] The third stage is late disseminated disease which occurs months or years after the initial infection. This stage typically presents with recurring arthritis and neurological problems along with arrhythmias and transient heart block. A key manifestation of late-stage disease in LD is arthritis, typically affecting the knee.[11]

Adverse Fetal Outcomes

Pregnant women are the single largest vulnerable population in society, and infections in pregnant women affect the mother as well as her carrying fetus, which can lead to downstream issues in the fetus as it develops and after birth. Infections can be transmitted from the mother to the fetus via blood exchange, mucosal exposure, and through breastfeeding. The first documented case of a pregnant woman with LD occurred in 1985 to a 28-year-old mother who acquired Lyme disease in her first trimester, had an erythema migrans rash, and delivered at 35 weeks. After delivery, the patient showed a positive LD indirect fluorescent antibody assay. The child died of congenital heart disease. Autopsy report showed spirochetes in the spleen, kidneys, and bone marrow. Other similar cases have been reported throughout the years. Studies have shown that *B. burgdorferi* has a high ability to penetrate mammalian placentae due to its active movement, antigenic, and morphological variation, which causes diagnostic difficulties.[12]

Treatment and Management

For treatment of LD, the first line antibiotic treatment is oral doxycycline with 10-to-21-day course of treatment depending upon symptoms manifested. Cefuroxime axetil and azithromycin may be used as well. For pregnant and lactating patients, doxycycline is contraindicated due to risk of permanent tooth staining and effects on fetal bone formation.[13] For pregnant patients, the main objective

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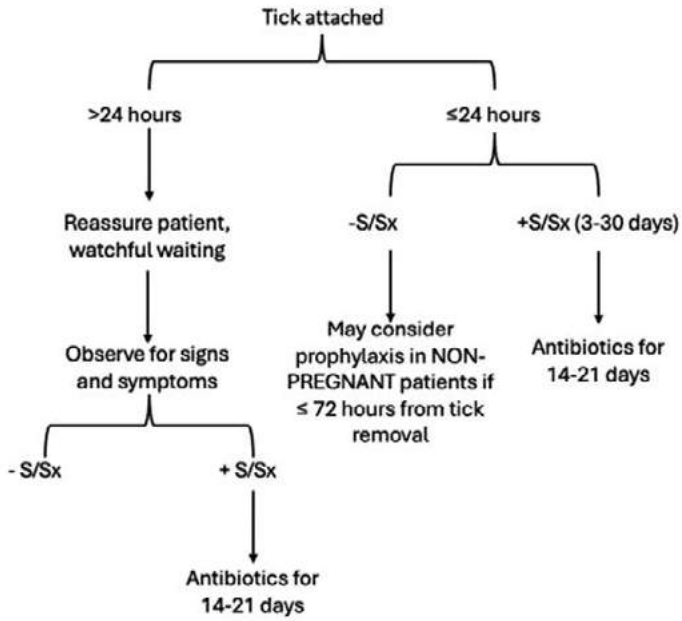
is to use safe medications during pregnancy to effectively eradicate the infection. Amoxicillin is typically used as it is considered non-teratogenic, with a dosage of 500 mg orally three times a day for 14 to 21 days depending on disease manifestation (Table 1). Azithromycin is considered a second line agent due to lower efficacy. As per the CDC and Infectious Disease Society of America Guidelines (IDSA) post exposure prophylaxis, a single dose of doxycycline can be administered and therefore not recommended for pregnant patients. For patients with a confirmed tick bite, the Journal of Obstetrics and Gynaecology Canada (JOGC) developed an algorithm for its management (Figure 1)[10]

Figure 1. Algorithm for Management of Tick Bite in Pregnancy



Note. Adapted from "Management of Tick Bites and Lyme Disease During Pregnancy," by G.N., I, Smith 2012, Journal Name, J Obstet Gynaecol Can. 2012;34(11):1087-1091. doi:10.1016/S1701-2163(16)35439-1 Copyright statement.

Table 1. Treatment of specific Manifestations in Lyme Disease per IDSA Guidelines[5]

Medication	Route and Dosage	Disease manifestation
Doxycycline	Contraindicated in pregnancy	Erythema migrans, meningitis, radiculopathy, cranial nerve palsy
Amoxicillin	500 mg PO three times a day for 14-21 or 28 days[a,b,c]	Erythema migrans, carditis, arthritis, acrodermatitis chronica atrophicans
Cefuroxime axetil	500 mg PO twice a day for 14-21 or 28 days[a,b,c]	Erythema migrans, carditis, arthritis, acrodermatitis chronica atrophicans

[a]14 days for EM
[b]14-21 days for carditis (optimal duration uncertain)
[c]28 days for arthritis

Discussion

Due to their all-encompassing approach to patient care, family medicine physicians are essential in the management of Lyme disease in pregnant patients. It is important to understand how LD affects pregnancy and current guidelines for early diagnosis and treatment. It is important to recognize the possibility of serious complications for mothers, such as arthritis, neurological disorders, and heart problems, which can make managing a pregnancy more difficult if left untreated. In addition, despite limited significant association between adverse birth outcomes and LD, earlier documented reports must be considered regarding potential fetal effects of *B. burdoferi* such as premature birth and stillbirth. Early intervention by combined watchful waiting for symptoms and appropriate antibiotic therapy can mitigate adverse outcomes for both mother and fetus. Family physicians are in a unique position to offer holistic care, which addresses the psychological and social support that pregnant patients require in addition to the infection. Preventative measures must also be utilized, especially in endemic areas where residents must be educated how to avoid tick bites and must be taught to identify signs and symptoms of LD.[14]

Conclusion

Currently, there is no evidence of congenital abnormalities caused by Lyme disease. The same standard of care for non-pregnant patients is applied to pregnant patients. However, family medicine physicians should be aware that the fetal implications of LD in pregnant patients are still poorly understood. Family medicine physicians play a vital role in increasing awareness and educating pregnant patients about LD, which can empower patients to practice protective behaviors against tick bites. As mentioned earlier, there are still research gaps involving transmission, treatment, and disease presentation of LD. Therefore, stronger research efforts are required, especially in endemic areas that will help develop standard management of LD in pregnant patients.

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Babesiosis: Diagnosis, Treatment, and Prevention

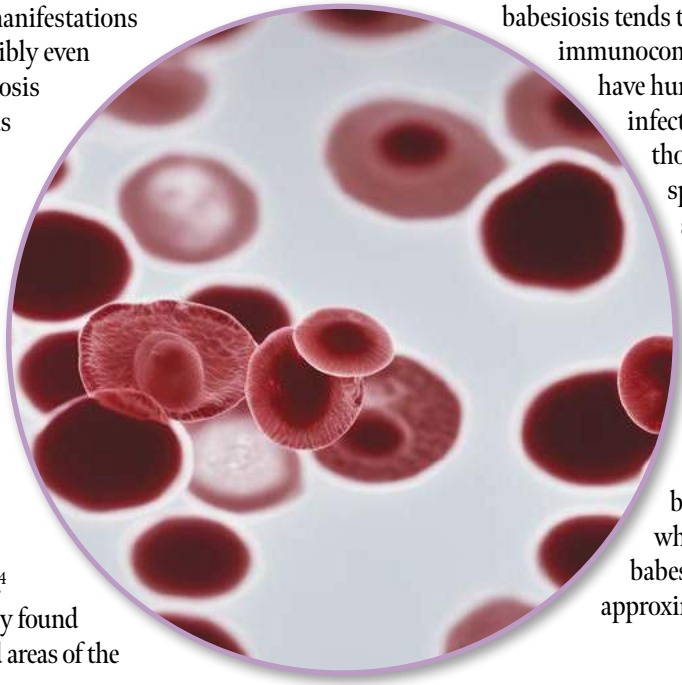
By Olivia Hildesheim, DO; Lily Sitisa, MMS; Colton Davis; Rebecca Cyrek and Elizabeth Loomis MD, FAAFP

Overview

Tick bites are a common chief complaint in the outpatient clinic, especially in rural areas. Babesiosis is a vector-borne tick illness endemic to the Northeastern and Midwestern United States. From 2011 to 2019, the total number of babesiosis cases reported to the Centers for Disease Control and Prevention (CDC) was 16,456, with New York reporting the highest number of cases with a total of 4,738 or an average of 526.4 per year.[1] The typical presentation of babesiosis infection includes nonspecific symptoms including fever, fatigue, headache, and anorexia. Severe infection can result in disseminated intravascular coagulation, acute respiratory distress syndrome, and congestive heart failure. The diagnosis should be considered based on epidemiological risk factors and confirmed by a peripheral blood smear or PCR.[2] Drug-resistant babesiosis is becoming more prevalent due to the widespread use of antibiotics. Historically, babesiosis has responded well to doxycycline and the anti-fungal/anti-parasitic drug, atovaquone, but now, it is responding better to the anti-malarial drug, tafenoquine. Recent research has also found the combination of tafenoquine and atovaquone can provide immunity against future infections.[3] This article will overview the diagnosis and prevention of babesiosis, as well as provide updates on new treatments and preventative strategies.

Introduction - What is Babesiosis?

Babesia microti is an intraerythrocytic protozoan parasite that can infect and destroy red blood cells causing a disease known as babesiosis. Individuals that are infected by *B. microti* may be asymptomatic or symptomatic and individuals who are symptomatic may exhibit clinical manifestations that range from mild to severe, possibly even resulting in death. Although babesiosis can be treated, complications such as pulmonary edema, disseminated intravascular coagulation, congestive heart failure, renal failure, and splenic rupture can occur particularly in people who are older than 50 years, are immunocompromised, or have pre-existing comorbidities.[4]



The primary vector of *B. microti* is *Ixodes scapularis* ticks, but *B. microti* can also be transmitted via blood transfusions and trans-placentally, although less commonly.[4] Since *I. scapularis* ticks are commonly found in tall grass, low shrubs, and wooded areas of the Northeastern and Upper Midwestern regions of the United States, babesiosis has become endemic in these regions. The prevalence of babesiosis ranges from 1% in newly endemic regions to 20% in well-established endemic regions.[4] Between 2011 to 2019, the total number of babesiosis cases reported to the CDC was 16,456, with New York reporting the largest number of cases with a total of 4,738 or an average of 526.4 per year.[1] Babesiosis can be diagnosed anytime throughout the year but is primarily diagnosed during the summer because the tick life cycle is active during the warmer months. As the weather becomes warmer, more people are going on hikes, doing yard work, etc., which increases the risk of *B. microti* infection.

Clinical Presentation and Differentiating Between Other Tick-borne Illnesses

The clinical presentation of a babesiosis infection can vary from patient to patient and can present as a mild infection with nonspecific symptoms to a lethal disease process that requires hospitalization. The typical symptom onset occurs anywhere between 1 and 4 weeks after the tick bite. Initial symptoms include fatigue followed by fever. Other nonspecific symptoms follow such as headache, myalgia, anorexia, arthralgia, and nausea. These symptoms often last for 1-2 weeks in an immunocompetent patient, but the fatigue may last for approximately a year if left untreated. Physical exams may reveal hepatomegaly, splenomegaly, and jaundice.[5]

The immune status of a patient plays the most important role in determining the severity and course of the illness. Immunocompetent patients often have asymptomatic or mild infections as described above. Severe infections caused by babesiosis tends to occur in patients who are immunocompromised including patients who have human immunodeficiency virus infection, cancer, hemoglobinopathy, and those who have undergone a splenectomy. Complications from a severe babesiosis infection include acute renal failure, liver failure, splenic rupture, acute respiratory distress syndrome, and disseminated intravascular coagulopathy. Those patients with immunosuppression have a fatality rate of approximately 21% with a babesiosis infection and those patients who are simply just hospitalized with a babesiosis infection have a fatality rate of approximately 6-9%.[5]

Table 1: Distinguishing Features Among Tick-Born Illnesses	
Tick-Borne Disease	**Key Distinguishing Features and Differences**
Lyme Disease	Location – Cases have been reported in all continental US states with highest prevalence in the Northeast and Midwestern states.[6] Tick – *Ixodes scapularis* and *Ixodes pacificus* Causative Organism – *Borrelia burgdorferi* Signs and Symptoms – Typically presents with a macular dermatitis called erythema migrans ("bullseye rash"). Can also cause facial palsy and atrioventricular heart blocks.[7]
Rocky Mountain Spotted Fever	Location – Southeastern and southern states[6] Tick – *Dermacentor* species Causative Organism – *Rickettsia rickettsii* Signs and Symptoms – Initial maculopapular or petechial rash that begins on the extremities and spreads centripetally.[7]
Ehrlichiosis	Location – Eastern coast and central states are the most prevalent. Tick – *Amblyomma americanum* or *Ixodes scapularis*[6] Causative Organism – *Ehrlichia chaffeensis* Signs and Symptoms – Maculopapular or petechial rash following the onset of a febrile illness.[7]
Anaplasmosis	Location – Northeastern and Midwestern states.[6] Tick – *Ixodes scapularis* Causitive Organism – *Anaplasma phagocytophilum* Signs and Symptoms – Headache and myalgias without a rash.
Tularemia	Location – Cases have been reported in the entire continental US. Tick – *Amblyomma americanum* in the southeast and *Dermacentor andersoni* in the western states.[6] Causative Organism – *Francisella tularensis* Signs and Symptoms – Initial ulcer at the site of tick bite followed by painful lymphadenopathy. Other modes of transmission – inhalation, ingestion, direct contact with infection organism.[7]
Powassan Virus	Location – Northeast and Great Lakes region.[6] Tick – *Ixodes scapularis* Causative Organism – Member of the *Flavivirus* genus Signs and Symptoms – High fever with a fine, lacey rash. It can present with neurological symptoms such as slurred speech and decreased motor function.[7]
Tick-Borne Relapsing Fever	Location – Remote settings in the west.[6] Tick – *Ornithodoros* species Causative Organism – *Borrelia hermsii, B. turicate, B. parkeri* Signs and Symptoms – Cyclical fevers that last for a few days and then are absent for a week.[7]

Work-Up and Diagnosis

Epidemiological risk factors should be considered when diagnosing babesiosis (Table 1). The risk factors include living in an endemic area, recently traveling to an endemic area, or receiving a blood transfusion within the past 6 months.[2] Other risk factors include pregnancy with the further possibility that the mother could spread babesiosis to the neonate during delivery. While these risk factors are relevant, it is important to receive confirmation to accurately diagnose babesiosis. Confirmation of babesiosis is achieved in 1 of 2 ways by either a blood smear identifying trophozoites or babesia DNA which is detected via polymerase chain reaction (PCR).[2] Blood smear is the faster method when possible.

Indirect immunofluorescence assay is used to detect babesia antibodies. Antibody testing is not recommended as the first line test, as it can remain positive long after exposure. IgG titers will increase four-fold within the first two months after infection and decrease over time but still be detectable 12 months later.[5] For any patient found to have a positive antibody test, a blood smear or PCR should follow.[4]

Babesia species can be seen on Giemsa or Wright-stained blood smears. The Maltese cross is a tetrad of merozoites and is seen on the Giemsa or Wright-stained blood smears of the Babesia species, *B. microti* and *B. duncani*.[5] The merozoites of the Babesia species, *B. divergens* and *B. venatorum* can appear as tetrads, but more commonly appear in pairs and are pear-shaped.[5] PCR can be used as a confirmation in cases where babesiosis diagnosis is likely but blood smear results were negative. PCR is highly sensitive and specific for detecting Babesia DNA.[5]

Other tests can provide support for the diagnosis of babesiosis, even though they are non-confirmatory. These include a complete blood count and complete metabolic profile, as both would likely show findings consistent with hemolytic anemia. Imaging can be useful as well, as it would reveal splenomegaly.

Treatment

Drug-resistant babesiosis is becoming more prevalent due to the widespread use of antibiotics. Historically, babesiosis responded well to antibiotics doxycycline, clindamycin, and azithromycin and

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the anti-fungal/anti-parasitic drugs atovaquone and quinine. Currently, it is responding better to the anti-malarial drug, tafenoquine. Recent research found the combination of tafenoquine and atovaquone can provide immunity against future infections.[9] Those with severe infection or those with infection with *B. divergens* may require blood transfusion in addition to antimicrobial therapy.[8]

The preferred treatment for mild to moderate babesiosis infection in adults is 750 mg of atovaquone twice daily and 500 mg of azithromycin on day 1 followed by 250 mg on day 2, continuing once daily for 7 to 10 days.[4] Alternative treatment involves 600 mg of clindamycin and 650 mg of quinine sulfate, both three times a day for 7 to 10 days.[4] For a severe infection, the preferred treatment involves intravenous azithromycin until symptoms subside, then the patient will be converted to oral antimicrobials. The alternative treatment involves using the intravenous form of clindamycin. It is recommended that therapy continue for at least 6 weeks for highly immunocompromised patients, as well as 2 weeks beyond the last positive blood smear.[4]

The results of a study published in the *Journal of Infectious Diseases* earlier this year revealed that combination therapy eliminated infection in mice models. Mice models infected with *B. microti* and *B. duncani* treated with atovaquone and tafenoquine revealed undetectable parasitemia levels through 45 days post-infection.[10] More research needs to be done before this combination therapy can be used in humans. These studies were not completed on mice with glucose-6-phosphate dehydrogenase (G6PD) deficiency. Further testing will need to be done to prove the effectiveness of atovaquone and tafenoquine over atovaquone and azithromycin, as tafenoquine can cause a severe hemolytic anemia in G6PD deficient humans.[10]

Co-infection with Lyme disease is always a possibility given both *Borrelia burgdorferi* and *Babesia microti* both share the same vector, the *Ixodes scapularis* tick. Babesiosis patients co-infected with Lyme disease may or may not have the characteristic bull's eye rash also known as erythema migrans. For patients diagnosed with babesiosis infection where Lyme disease is endemic, doxycycline therapy should be started empirically.[11]

Preventative Measures

As the weather becomes warmer, people are more likely to spend their time outside doing things such as going to the park, going on hikes, or doing yard work which increases their risk of *B. microti* infection. Unfortunately, there is currently no vaccine available for babesiosis.[11] To reduce the risk of *B. microti* infection, it is recommended that individuals avoid endemic areas, wear white or light-colored clothing to help identify and remove ticks before attachment, wear a long-sleeved shirt tucked into pants and long pants tucked into socks to minimize skin exposure, wear clothing treated with acaricides such as permethrin, use tick repellent containing N,N-Diethyl-m-toluamide (DEET), and perform frequent body checks for ticks to facilitate early removal.[12] Other preventative measures include taking a bath or shower within 2 hours of tick exposure to prevent tick attachment and spraying pesticides around the home to reduce tick populations.[11]

Conclusion

Tick bites are a common chief complaint encountered by family medicine physicians in the Northeastern United States. Important clinical symptoms to be aware when taking a history include headache, myalgia, anorexia, arthralgia, and nausea while considering the patient's baseline immune status. Physical exam findings that can increase suspicion for a babesiosis infection include hepatosplenomegaly and jaundice. Diagnosis of babesiosis is confirmed with a blood smear showing a Maltese cross or Babesia DNA via PCR. Treatment includes atovaquone and azithromycin for 7-10 days in immunocompetent patients or for at least 6 weeks in those who are immunocompromised. Patients can be educated on the preventative measures such as wearing light colored clothing or wearing permethrin-treated clothing when going outdoors. Due to the potential fatality related to babesiosis infection it is essential that physicians in endemic locations can promptly identify and treat affected patients.

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Proximity of Residents to Bodies of Water and Risk for West Nile Virus Infection: A Retrospective Analysis in New York

By Justin Skariah, MSc; Ishan Aggarwal; Stanley Joseph and Christina Johnson Skariah, DO

Summary of the Clinical Study

This retrospective analysis investigates the correlation between proximity to bodies of water and the risk of West Nile Virus (WNV) infection in New York State from 1999 to 2023. Data from the CDC on WNV cases was categorized into counties adjacent to the Atlantic Ocean (AO), the Great Lakes (GL), and non-coastal (NC) counties. Statistical analyses, including generalized linear models (Poisson or negative binomial, based on data dispersion) and Kruskal-Wallis tests (for pairwise comparisons), revealed that eleven counties (Bronx, Erie, Kings, Monroe, Nassau, New York, Onondaga, Queens, Richmond, Suffolk, and Westchester) had significant relationships with WNV cases.

Key findings indicate that counties near the Atlantic Ocean had significantly higher WNV and neuroinvasive WNV (nWNV) cases compared to those near the Great Lakes and non-coastal counties. The rate of WNV in GL-bordered counties was only 7.2% of AO-bordered counties, while NC counties had about 1.5% of the rate in AO counties.

For New York physicians, it is crucial to recognize that counties near the Atlantic Ocean and Great Lakes are at higher risk for WNV. Physicians should include WNV in their differential diagnoses for patients presenting with fever, headache, and neuroinvasive symptoms. Proper testing and reporting of WNV cases are essential for accurate surveillance and public health responses. Additionally, educating the public on reducing exposure to mosquitoes, particularly in high-prevalence areas, is vital for prevention. This study underscores the importance of geographical factors in WNV prevalence and provides critical insights for healthcare providers in New York.

Introduction

West Nile Virus (WNV) is the leading cause of mosquito-borne vector diseases in the United States and is defined as a zoonotic arbovirus that can infect various mammals, including humans. WNV primarily circulates through *Culex* mosquitoes, which act as the main vector, and birds, predominantly from the *Corvidae* family, which serve as the primary reservoir host.[1]

WNV is transmitted through mosquito bites, and while some patients infected with WNV are asymptomatic, studies show that about 26% of infected individuals develop symptoms.[2] The incubation period typically ranges from 2-14 days. Mild, self-limiting symptoms include fever, headache, fatigue, myalgias, decreased appetite, vomiting, diarrhea, and/or rash, collectively known as West Nile fever.[3]

More concerning clinical presentations of WNV involve the central nervous system, particularly encephalitis or meningitis, and is defined as neuroinvasive WNV (nWNV). Symptoms that raise concern for nWNV include significantly high fever, intractable headaches, seizures, weakness, and altered mental status (ranging from stupor to coma). Certain risk factors can increase the potential for neuroinvasive disease, with advancing age, level of immunosuppression, and geographic location being the biggest concerns. In 2023, 2,406 WNV disease cases were identified in the United States (U.S.), with 1,599 of those cases being neuroinvasive.[4] Due to the incidence of nWNV and the non-specific clinical manifestations, it is important for clinicians to increase their understanding and awareness of WNV cases in their local region.

At this time, there is no FDA-approved antiviral therapy for WNV. For mild cases of WNV, current management is mainly supportive with treatment involving the use of antipyretic agents, increasing hydration, and rest. For more severe variants of WNV warranting hospitalization, treatment includes intravenous fluids, pain management, respiratory support (ranging from supplemental nasal cannula to mechanical ventilation), anti-epileptic therapy and corticosteroid therapy along with consultation with infectious disease specialists. Proper surveillance, treatment, and management can help prevent progression of mild cases of WNL to more severe neuroinvasive forms.

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Most cases of West Nile Virus (WNV) are reported in August and September, coinciding with the peak of mosquito season, which starts in the summer and extends into the fall. Additionally, WNV cases tend to be more prevalent around bodies of water. Mosquitoes utilize stagnant or slow-moving water as their breeding grounds. Concomitantly, these bodies of water attract many bird species as well, further increasing the risk of transmission.[5]

Several studies have been conducted to understand the prevalence of WNV in different states within the U.S. according to their geographic location. These studies describe a higher prevalence of WNV around bodies of water. A case-control study published in 2011 demonstrated that proximity to slow moving water increased the risk of infection with WNV in the metropolis of Houston, Texas.[6] Similarly, we aim to evaluate correlations between the prevalence of WNV, particularly neuroinvasive WNV, to the distance from a body of water in populations across the state of New York.

With this information, we can enhance awareness and provide targeted resources to healthcare facilities and physicians in counties with a higher prevalence of WNV. This will help ensure that WNV is considered in the differential diagnosis for patients presenting with relevant symptoms in these areas. Effective identification, education, and prompt treatment of WNV are invaluable for healthcare providers.

A better understanding of the patterns of WNV across New York counties will significantly contribute to disease surveillance and management, ultimately improving public health outcomes. By focusing on these high-prevalence areas, healthcare providers can be better prepared to recognize and treat WNV, reducing the risk of severe outcomes for infected individuals.

Methods

To determine the prevalence of WNV throughout New York, data was collected from the Centers for Disease Control and Prevention (CDC) outlining WNV cases and nWNV in New York counties from 1999 to 2023. To investigate the geographical effects of each county against both total WNV cases and nWNV cases, counties were grouped based on 3 parameters: counties adjacent to the Atlantic Ocean (AO), counties adjacent to the Great Lakes (GL), non-coastal counties that are not adjacent to a body of water (NC).

The initial analysis assessed the normality of the dataset using the Shapiro-Wilk Test, which indicated that the data did not follow a normal distribution. As a result, a generalized linear model was utilized with either Poisson or negative binomial distribution depending on the overdispersion of the data. To ensure the model chosen was appropriate for the dataset, an overdispersion greater than 1.5 meant that overdispersion was present, and a negative binomial generalized linear model was used. Otherwise, a Poisson generalized linear model was utilized. With this approach, we were able to identify whether there was a relationship between the occurrence of WNV in New York counties and a relationship between the occurrence of WNV in New York counties based on their geographical characteristics.

A Kruskal-Wallis test was utilized to compare geographical characteristics against total cases and neuroinvasive cases. Significance of the Kruskal-Wallis test warranted a subsequent Dunn's test for post-hoc pairwise comparisons via the Bonferroni method.

Results

Eleven counties displayed statistically significant relationships with total cases of West Nile virus ($p < 0.05$). These counties included Bronx, Erie, Kings, Monroe, Nassau, New York, Onondaga, Queens, Richmond, Suffolk, and Westchester. Further analysis on the incidence of neuroinvasive cases of WNV demonstrated that these same eleven counties developed a higher incidence in comparison to other regions of New York State ($p < 0.05$) (Figure 1).

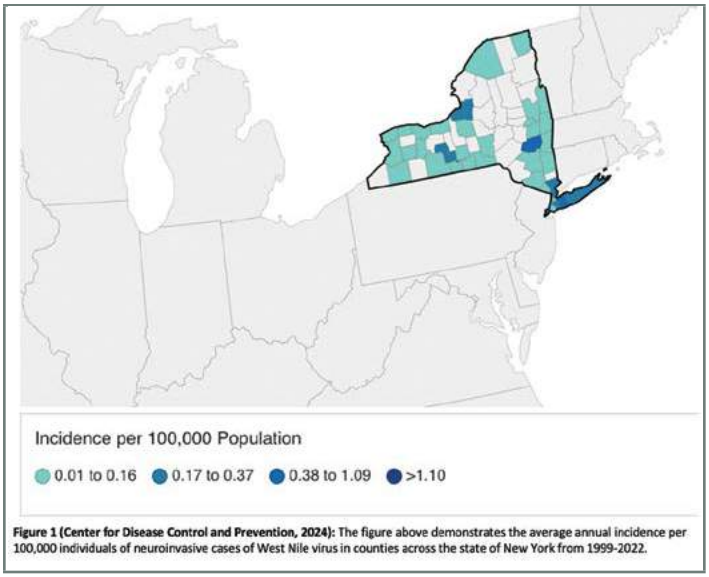

Figure 1 (Center for Disease Control and Prevention, 2024): The figure above demonstrates the average annual incidence per 100,000 individuals of neuroinvasive cases of West Nile virus in counties across the state of New York from 1999-2022.

When evaluating geographical characteristics in relation to the total cases of West Nile virus, the Kruskal-Wallis test revealed statistically significant differences among the groups ($p < 0.001$). A subsequent Dunn's Test for pairwise comparisons provided strong evidence that the differences in WNV cases between counties bordered by the Atlantic Ocean, the Great Lakes, and those not adjacent to water were significant ($p < 0.001$) for the comparisons between AO-GL, AO-NC, and GL-NC, respectively. Similar analysis of neuroinvasive cases showed statistically significant Kruskal-Wallis Test ($p < 0.001$), respectively.

Lastly, the generalized linear model comparing the WNV cases to the geographical characteristics of the county, we see that the rate of total cases in the GL-bordered counties is only 7.2% of the rate in AO-bordered counties ($\beta = -2.63; p < 0.001$) and the rate of total cases in NC-bordered counties is about 1.5% of the rate in AO-bordered counties ($\beta = -4.17; p < 2e\text{-}16$). With respect to neuroinvasive cases, we see that the rate of total cases in the GL-bordered counties only 6.5% of the rate in AO-bordered counties ($\beta = -2.74; p < 2e\text{-}16$) and the rate of total cases in NC counties is about 1.6% of the rate in AO-bordered counties ($\beta = -4.11; p < 2e\text{-}16$).

Conclusion

This study is the first known case-control investigation to perform a geographic analysis of New York State's counties, assessing the relationship between WNV incidence and proximity to major bodies of water from 1999 to 2023. By categorizing counties into three groups – those bordering the Atlantic Ocean, those bordering the Great Lakes, and non-coastal counties – we identified a statistically significant higher prevalence of reported West Nile virus cases in counties adjacent to the Atlantic Ocean and the Great Lakes.

We believe that counties near bodies of water are particularly susceptible to WNV cases. Recent studies have shown that standing water provides mosquitoes, the primary vectors of WNV, with optimal breeding grounds[7] which can facilitate the spread of disease. Additionally, greater rainfall has been observed in areas surrounding lakes[8] and oceans[9], leading to increased risk of standing water, especially in regions with poor drainage. Counties bordering the Great Lakes and the Atlantic Ocean meet these criteria, thereby elevating their risk of harboring mosquitoes and, consequently, the risk of WNV and nWNV cases.

Our study supports that counties bordering the Atlantic Ocean have a higher incidence of total WNV cases compared to those bordering the Great Lakes or non-coastal counties based on the generalized linear model comparing the WNV cases to the geographical characteristics of the county. In addition to proximity to bodies of water, we hypothesize that population density in a particular region could also play a role in the infectious spread of WNV. The counties adjacent to the Atlantic Ocean such as New York, Bronx, Kings, Nassau, Queens, Richmond, Suffolk, and Westchester, have population densities ranging from 632.2 to 48,180.1 people per square mile.[10] These counties are among the top 15 in terms of population density in New York State. Population density has previously been positively correlated with WNV and nWNV cases[11] which aids in understanding why countries bordered by the Atlantic Ocean had a statistically significant increase in total WNV cases in comparison to those bordered by the Great Lakes.

In the United States, all WNV and nWNV cases must be reported to the CDC upon diagnosis. Although accurate reporting efforts are the goal for any disease surveillance effort, one limitation is the prevalence of under-reporting by clinicians and health care professionals. WNV can present with very non-specific symptoms, with mild illness (non-neuroinvasive disease) being more likely to be underreported compared to more severe disease (neuroinvasive) states. Clinicians should include WNV on their differential, order the correct testing, and report the diagnosis to the appropriate reportable agencies. Additionally, the awareness of the disease among healthcare professionals and the promptness with which patients seek medical attention can significantly influence the accuracy of reported disease prevalence. Another limitation includes current surveillance data being reported by county of residence, not the precise location of exposure. It is possible that a patient could be infected in a specific county, city, or state and seek treatment in a different location. These limitations are important to consider when evaluating the current data provided by the CDC for WNV.

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Our study suggests that there is a relationship between the proximity to large bodies of water and prevalence of WNV and nWNV cases in the state of New York. Future studies should be conducted to analyze other states in a similar matter. Studies may also incorporate coastal surface area or population density as additional variables to explore the prevalence of WNV and nWNV cases.

Our study sheds light on counties that have a high prevalence of WNV and nWNV. We can make the conclusion that counties bordering the Atlantic Ocean, or the Great Lakes have significantly more WNV and nWNV cases than non-coastal counties in New York. Clinicians in New York counties that surround water should also have WNV and nWNV on their differential until it can be adequately ruled out. All healthcare providers who notice symptoms that correlate with WNV or nWNV should take a detailed travel history especially during the months of high prevalence. We believe that greater efforts to contain the virus should be placed in these counties. The use of public education on mosquito-borne illnesses and their relation to geographic location and standing water should be dispersed to healthcare providers to help prevent and treat future WNV cases.

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