Tick-borne Disease Survey for Dutchess County Healthcare Providers – 2014

Summary Report

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Contents

Background and Methods

The Dutchess County Department of Health redeveloped a fourteen question survey for healthcare providers on knowledge, attitudes, and current practices in the diagnosis and treatment of tick-borne diseases. The survey built on previous versions administered in 2005, 2008, and 2010. A number of the questions were modified to fine-tune the specificity of responses, particularly with respect to different tick-borne diseases, and a new question was added about laboratory testing. Trends over time were evaluated for questions that were closely comparable.

The 2014 survey was widely distributed by email and fax to medical practices throughout Dutchess County in the months of March through May of 2014. Healthcare professionals having an MD, DO, PA, or NP degree and currently practicing in Dutchess County were invited to participate in the survey. Participants were instructed to complete the survey individually. Surveys were self-administered either online using SurveyMonkey or by submitting a paper copy via fax. No identifying information was collected in the survey. A copy of the survey is included in the Appendix.

Results

Sample Size and Exclusions

A total of 125 surveys were returned to DCDOH; 87 were completed in SurveyMonkey and 38 were completed by hand and returned via fax. Two duplicates were identified and excluded. Twelve additional survey responses were excluded because they were over 70% incomplete, and one record was excluded because the respondent did not provide medical degree information and therefore we could not ascertain eligibility. A total of 111 responses were included in the final analysis.

With respect to the overall number of Dutchess County practitioners, we estimated a response rate of approximately 10%-15% based on limited data available (see Limitations). Further estimation of response rates by specialty were not possible.

Respondent Characteristics

Over sixty percent of the respondents held an MD, 19% were Nurse Practitioners, 15% were Physician Assistants, and 4% held a DO (Table 1). A large majority (85%) were employed in a group practice.

Medical specialties were grouped as follows: pediatrics and family medicine (35%, including one college health professional), internal medicine and urgent care (26%), relevant specialties (19%), and all other specialties (20%). The first two categories aimed to capture primary child and adult healthcare practitioners, respectively, who would be expected to most frequently encounter patients seeking diagnosis or care for tick-borne diseases. Relevant specialties were those expected, *a priori*, to occasionally diagnose or treat patients for tick-borne diseases or their sequelae, including: obstetrics & gynecology (n=9), orthopedic medicine (n=6), cardiology (n=2), neurology (n=2), and dermatology (n=1). The other specialty group included practitioners who completed the survey but who would infrequently be expected to see patients for the diagnosis or management of tick-borne diseases, including: surgeons

(n=4), oncologists (n=3), neonatologists (n=3), anesthesiologists (n=3), radiologists (n=2), gastroenterologists (n=2), podiatrists (n=1), occupational medicine practitioners (n=1), hospitalists (n=1), urologists (n=1), and pathologists (n=1).

Table 1. Characteristics of Respondents by Type of Degree, Practice, and Specialty

Characteristic	N	%
Degree		
Medical Degree (MD)	68	61%
Doctor of Osteopathy (DO)	4	4%
Nurse Practitioner (NP)	21	19%
Physician Assistant (PA)	18	16%
Practice Type		
Group	94	85%
Solo	15	14%
Unspecified	2	2%
Specialty Type		
Pediatrics /Family Medicine	39	35%
Internal Medicine and Urgent Care	29	26%
Relevant Specialties	21	19%
Other Specialties	22	20%
Total	**111**	**100%**

Level of Concern about Tick-borne Diseases

Approximately two-thirds of practitioners who responded to the survey were of the opinion that tick-borne diseases are a serious health concern in Dutchess County, and all but three of the remaining providers expressed a moderate level of concern. There were no significant differences by specialty (Fisher's exact test, p = 0.575).

Table 2. Overall opinion on tick-borne diseases in Dutchess County, by specialty

	Opinion: Number and Row Percent				
Specialty	***No opinion or missing****	**Not at all a health concern**	**Minor health concern**	**Moderate health concern**	**Serious health concern**
Pediatrics/Family Medicine	*1*	0 (0%)	0 (0%)	14 (37%)	24 (63%)
Internal Med/Urgent Care	*1*	0 (0%)	2 (7%)	8 (29%)	18 (64%)
Relevant Specialties	*0*	0 (0%)	0 (0%)	7 (33%)	14 (66%)
Other Specialties	*2*	0 (0%)	1 (5%)	6 (27%)	13 (59%)
Total	***4***	**0 (0%)**	**3 (3%)**	**35 (32%)**	**69 (63%)**

**Not included in calculation of percentages or statistical tests.*

The proportion of providers who selected "serious health concern" in 2014 (63%) closely matched the proportion who strongly agreed with a similar statement posed in 2005 and 2008, although it was specific to Lyme disease: "Lyme disease is a serious health concern for Dutchess County residents" (59% and 63% respectively). Likewise, the proportion who selected "moderate health concern" (32%) closely matched the proportion who agreed with (but not strongly agreed with) the aforementioned statement in 2005 (31%) and 2008 (33%). In 2010, 98% of respondents agreed with the statement "Tick-borne diseases are a serious health concern for Dutchess County," but because the response structure did not specify level of agreement, it may have overestimated this proportion as demonstrated by the 2014 survey.

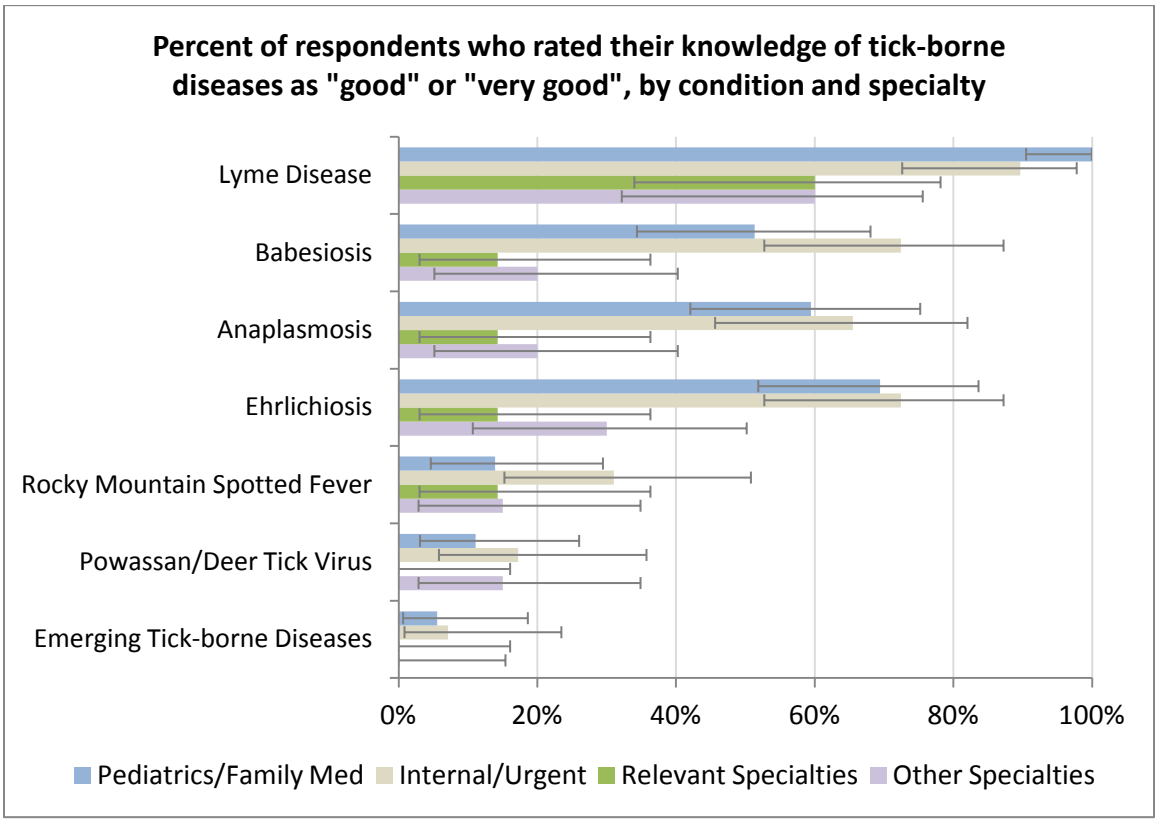
Knowledge about Different Tick-borne Diseases

Most pediatric and adult primary care providers ranked their knowledge of Lyme disease as good or very good, and the majority also reported a high degree of knowledge about babesiosis, anaplasmosis, and ehrlichiosis (Fig 1). With the exception of Lyme disease, non-primary care specialists typically did *not* report having good or very good knowledge of tick-borne diseases. The differences in self-reported knowledge between specialty types for Lyme disease, babesiosis, anaplasmosis, and ehrlichiosis were highly significant (Fisher's exact test, $p \leq 0.001$ for each disease).

Meanwhile, very few practitioners of any type reported having good or very good knowledge of Rocky Mountain Spotted Fever, Powassan/Deer Tick Virus, or emerging tick-borne diseases such as *B. myamotoi*. There were no significant differences by specialty. The number of missing responses that were excluded ranged from 0% to 14% of respondents by disease and specialty.

The question was not directly comparable with earlier surveys.

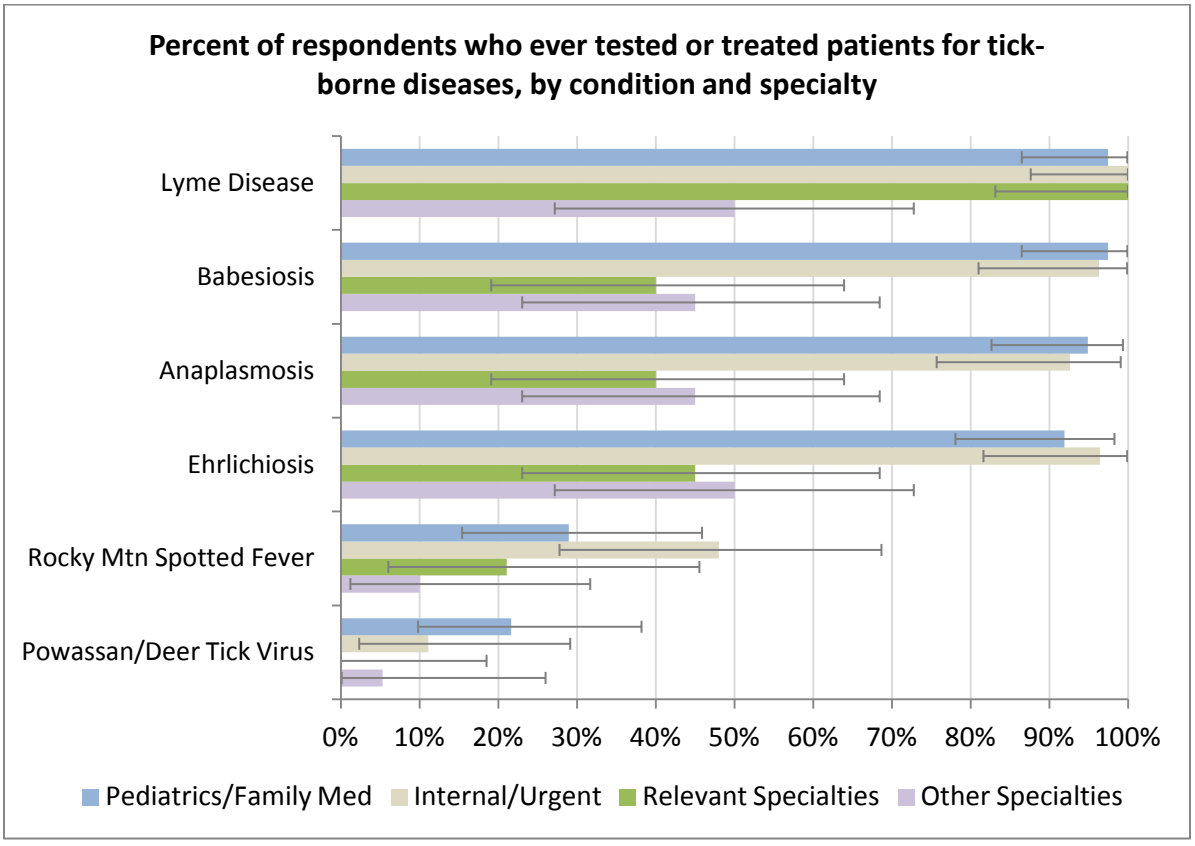
Figure 1.


Percent of respondents who rated their knowledge of tick-borne diseases as "good" or "very good", by condition and specialty
Lyme Disease
Babesiosis
Anaplasmosis
Ehrlichiosis
Rocky Mountain Spotted Fever
Powassan/Deer Tick Virus
Emerging Tick-borne Diseases
0%
20%
40%
60%
80%
100%
Pediatrics/Family Med
Internal/Urgent
Relevant Specialties
Other Specialties

Experience Diagnosing or Treating Different Tick-borne Diseases

Almost all respondents in adult and child primary care and relevant specialty practices had ever tested or treated patients for Lyme disease (Fig 2), compared with 50% of other specialists (Fisher's exact test, $p < 0.001$). Over 90% of adult and child primary care providers had also tested or treated patients for babesiosis, anaplasmosis, or ehrlichiosis compared with about half of relevant specialists and other specialists ($p < 0.001$ for each disease). On the other hand, less than half of *all* respondents ever tested or treated patients for Rocky Mountain Spotted Fever, and less than a quarter ever tested or treated patients for Powassan/Deer Tick Virus; differences between specialty types were borderline significant (RMSF: $p = 0.06$, Powassan: $p = 0.07$). The percent of missing responses, which were excluded, varied between 0% and 14% across diseases and specialties.

Figure 2.



When do Providers Test Patients for Tick-borne Diseases?

The vast majority of survey participants (88%) reported testing for tick-borne diseases when patients presented with symptoms or other abnormal lab findings typical of tick-borne diseases (Table 3). The next most frequent reason for testing was recurrent symptoms in a patient with a history of Lyme disease (64%), which was about the same in 2010 (63%) and 2008 (68%).

Patient request, the third most common reason for testing, has decreased over time from 82% in 2005 to 68% in 2008, 57% in 2010, and 55% in 2014.

About half of the respondents tested patients having a recent history of tick bite, regardless of symptoms; one practitioner further specified that he or she tested "with history of tick bite and insistent parent." See Table 6 for responses to a specific case study on a patient with a recent history of a tick bite.

The proportion who routinely tested healthy patients for tick-borne diseases at the time of an annual check-up was 7%; the proportion was also 7% in 2010, compared with 5% in 2008 and 3% in 2005.

Seven of the other open-ended responses included statements to the effect of "not seen in my practice" or "refer patient to primary care provider."

Table 3. When do you test patients for tick-borne diseases (n=104)?

When testing occurs	Number	Percent
When patient presents symptoms or abnormal lab findings typical of a tick-borne disease[1]	91	88%
When patient with a history of Lyme disease has recurrent symptoms	67	64%
Per patient request	57	55%
When patient presents with a recent history of a tick bite	50	48%
When patient presents with sudden cardiac arrhythmias	39	38%
To confirm that treatment for a tick-borne disease has been effective	11	11%
At the time of a routine physical, without symptoms of tick-borne disease	7	7%
Other (specify)	8	8%

What Tests do Providers Order to Diagnose Tick-borne Diseases?

Providers were asked to select which tests they had ordered to diagnose or treat each condition, choosing from complete blood count (CBC), blood smear, enzyme immunoassay (EIA) or indirect immunofluorescence assay (IFA), polymerase chain reaction (PCR), cerebrospinal fluid (CSF) analysis, and ECG/EKG for disseminated stage Lyme disease.

The responses are compared with laboratory testing recommendations in the CDC's *Tickborne Diseases of the United States: A Reference Manual for Healthcare Providers*, *1st Edition (2013)*.

[1] Includes 3 providers who did not select this response, but chose "Other" and mentioned EM rash or other symptoms.

Table 4a. Laboratory Tests used to Diagnose or Treat Lyme Disease (n=96)

Test	Purpose/Role in Lyme Diagnosis	Percent
EIA/IFA	For first tier of diagnosis – positive and equivocal findings should be followed by Western blot for confirmation.	81%
CBC	Supplemental: elevated erythrocyte sedimentation rate, mildly elevated liver enzymes, microscopic hematuria or proteinuria	45%
PCR	PCR tests currently are *not* recommended for the diagnosis of Lyme disease due to very low sensitivity in serum and CSF.	41%
CSF analysis	Supplemental (for Lyme meningitis): lymphocytic pleocytosis, slightly elevated protein	21%
ECG/ECK	For diagnosis of cardiac complications	19%
Other – Specify	Western blot (see mention of Western blot in EIA/IFA, above) "Lyme profile"	6% 1%

Table 4b. Laboratory Tests used to Diagnose or Treat Babesiosis (n=81)

Test	Purpose/Role in Babesiosis Diagnosis	Percent
Blood smear	For confirmatory diagnosis – identification of *Babesia* parasites	57%
PCR	For confirmatory diagnosis, alternative to blood smear	26%
CBC	Supplemental: decreased hemocrit, thrombocytopenia, elevated serum creatinine and blood urea nitrogen, mildly elevated liver enzymes	63%
IFA	Supportive evidence, does not distinguish active vs prior infection	33%
CSF analysis	Not specifically indicated for babesiosis	5%
Other – Specify	"Babesiosis titer"	1%

Table 4c. Laboratory Tests used to Diagnose or Treat Anaplasmosis (n=79)

Test	Purpose/Role in Anaplasmosis Diagnosis	Percent
IFA	For confirmatory diagnosis in paired serum samples	34%
PCR	For confirmatory diagnosis, from whole blood, most sensitive in first week of illness	22%
CBC	Supplemental: mild anemia, thrombocytopenia, leukopenia, mildly elevated liver enzymes	76%
Blood smear	Supportive evidence, visualization of morulae in cytoplasm of granulocytes is highly suggestive of diagnosis, but blood smear is insensitive and should not be relied upon solely	37%
CSF analysis	Not specifically indicated for anaplasmosis	8%
Other – Specify	Liver function test	3%

Table 4d. Laboratory Tests used to Diagnose or Treat Ehrlichiosis (n=80)

Test	Purpose/Role in Ehrlichiosis Diagnosis	Percent
IFA	For confirmatory diagnosis in paired serum samples	38%
PCR	For confirmatory diagnosis, from whole blood, most sensitive in first week of illness	23%
CBC	Supplemental: mild anemia, thrombocytopenia, leukopenia, mildly elevated liver enzymes	69%
Blood smear	Supportive evidence, visualization of morulae in cytoplasm of granulocytes in about 20% of patients	33%
CSF analysis	Not specifically indicated for ehrlichiosis	5%
Other – Specify	Liver function test "Ehrlichiosis panel"	1% 1%

Table 4e. Laboratory Tests used to Diagnose or Treat Rocky Mountain Spotted Fever (n=29)

Test	Purpose/Role in RMSF Diagnosis	Percent
IFA	For confirmatory diagnosis in paired serum samples	41%
PCR	For confirmatory diagnosis, from skin biopsy from rash	21%
CBC	Supplemental: thrombocytopenia, mildly elevated liver enzymes, hyponatremia	55%
CSF analysis	Not specifically indicated for RMSF	7%
Other - Specify	IHC stain (alternate test for confirmatory diagnosis)	3%

Table 4f. Laboratory Tests used to Diagnose or Treat Powassan/Deer Tick Virus (n=12)
Note: As of the date of publication, no commercially available tests are available; testing for Powassan Disease must be done by CDC or NYSDOH.

Test	Purpose	Percent
IFA	For diagnosis using serum or CSF, with plaque reduction neutralization to confirm diagnosis due to cross reaction with other flaviviruses	33%
PCR	For diagnosis, RT-PCR of tissue or CSF samples; however the sensitivity is not yet known	67%
CSF analysis	Supplemental: Lymphocytic pleocytosis, normal to mildly elevated protein, normal glucose	25%
CBC	Not specifically indicated for Powassan/DTV	42%

Disease Reporting Practices

Most providers (77%) reported relying on the laboratory to report positive test results to the Health Department. There were no significant differences by specialty (Fisher's exact test, p = 0.878). Nine (40%) other specialists did not answer the question, most likely due to the fact that they would not be expected to frequently encounter tick-borne diseases in their practices (Table 5).

The proportion of active reporting has fluctuated substantially over time, with 40% in 2010 indicating they directly faxed or phoned in reports to the Health Department, 32% indicating the same in 2008, and about 64% in 2005. The current survey reflects the lowest proportion (23%) of active reporting measured to date.

Table 5. Usual process for handling notification of tick-borne disease results

Specialty	*Missing**	Practice primarily reports suspected and confirmed cases by phone or fax to the Health Department		Practice primarily depends on lab to report positive test results to the Health Department	
		Number	Percent	Number	Percent
Pediatrics/Family	*5*	7	21%	27	79%
Internal/Urgent	*1*	6	21%	22	79%
Relevant Specialties	*3*	4	22%	14	78%
Other Specialties	*9*	4	31%	9	69%
Total	***18***	**21**	**23%**	**72**	**77%**

**Not included in calculation of percentages or statistical tests.*

Lyme Disease Treatment Practices – Case Study

In areas where Lyme disease is endemic, including Dutchess County, the 2006 Guidelines of the Infectious Disease Society of America recommend prescribing a single dose of doxycycline (200 mg) as prophylaxis to asymptomatic adults (excluding pregnant women) and children eight years of age and older, who present with evidence of a deer tick bite with attachment for at least 36 hours, provided no more than 72 hours have passed since the tick was discovered.

The following case study was presented:

> "A 17 year-old patient presents to your practice approximately 24 hours after removing an engorged deer tick from her lower leg. She reports a history of local outdoor activity two days before she discovered the tick. The patient exhibits no rash and denies any other symptoms of tick-borne illness. Which of the following responses best reflects your first course of action?"

Assuming the tick was attached for at least 36 hours during the two days prior to discovery, doxycycline prophylaxis would be appropriate under the given circumstances.

Single dose prophylaxis was the most popular choice among internal medicine and urgent care providers (67%), while pediatricians and family medicine providers were more evenly split between single dose prophylaxis and waiting 4 to 6 weeks to test the patient for Lyme disease (Table 6). Not surprisingly, the most common choice of both categories of other specialists was "refer patient to her primary care provider or an infectious disease specialist". Comparing single dose doxycycline prophylaxis with all other responses, the differences between specialty types was statistically significant ($p = 0.002$).

Among other responses offered, five (5%) mentioned prescribing a single dose doxycycline prophylaxis and watching for symptoms, but not scheduling a blood test. Two alternative prophylaxis approaches were cited; one provider stated he/she would prescribe 10 days of 200 mg doxycycline prophylaxis, and another would offer 30-60 day doxycycline prophylaxis. Four providers stated they would have patients watch and wait for symptoms only. One specialist (Ob/Gyn) would have strongly encouraged the patient to see her primary care provider and start a 3-week prophylactic treatment. Two other remarked that the question was not applicable due to their area of specialty.

Table 6. Response to case study on asymptomatic patient with evidence of a deer tick bite

Specialty	*Miss-ing**	Prescribe single dose of doxycycline and schedule blood test		Prescribe 14 to 21 days of antibiotics and schedule blood test		Test patient in 4 to 6 weeks and treat only if test is positive		Refer to primary care or infectious disease specialist		Other	
		N	%	N	%	N	%	N	%	N	%
Pediatrics/Family	*2*	14	38%	3	8%	14	38%	0	0%	6	16%
Internal/Urgent	*0*	20	69%	2	7%	2	7%	1	3%	4	14%
Relevant Specialties	*0*	4	19%	3	14%	4	19%	8	38%	2	10%
Other Specialties	*3*	6	32%	0	0%	1	5%	10	53%	2	11%
Total	***5***	**44**	**42%**	**8**	**8%**	**21**	**20%**	**19**	**18%**	**14**	**13%**

**Not included in calculation of percentages or statistical tests.*

Patient Education Practices

Pediatricians and family medicine practitioners had the highest proportion of respondents who reported discussing tick-borne disease prevention *most of the time* or *always* during routine check-ups (50%), followed by internal medicine and urgent care providers (29%). As expected, other specialists were significantly less likely to routinely discuss tick-borne disease prevention (Fisher's exact test, $p < 0.001$).

Table 7a. How often does your practice provide <u>verbal discussion during routine check-ups</u> about the prevention of tick-borne diseases?

	Routine Verbal Discussion: Number and Row Percent			
Specialty	***Missing****	**Never**	**Sometimes**	**Most of the Time or Always**
Pediatrics/Family Medicine	*1*	2 (5%)	17 (45%)	19 (50%)
Internal Med/Urgent Care	*1*	2 (7%)	18 (64%)	8 (29%)
Relevant Specialties	*0*	5 (24%)	14 (67%)	2 (10%)
Other Specialties	*1*	12 (57%)	7 (33%)	2 (10%)
Total	***3***	**21 (19%)**	**56 (52%)**	**31 (29%)**

**Not included in calculation of percentages or statistical tests.*

Similarly, pediatric and family medicine practitioners were the most likely to post pamphlets or brochures about tick-borne diseases in waiting areas *most of the time* or *always* (56%), followed closely

by internists and urgent care providers (43%). Very few other specialists routinely provide pamphlets or brochures in waiting areas about tick-borne disease prevention. The differences were highly significant (Fisher's exact test, $p < 0.001$).

Table 7b. How often does your practice provide pamphlets or brochures in waiting areas about the prevention of tick-borne diseases?

	Educational Materials: Number and Row Percent			
Specialty	***Missing****	**Never**	**Sometimes**	**Most of the Time or Always**
Pediatrics/Family Medicine	*3*	4 (11%)	12(33%)	20 (56%)
Internal Med/Urgent Care	*1*	6 (21%)	10 (36%)	12 (43%)
Relevant Specialties	*1*	12 (60%)	7 (35%)	1 (5%)
Other Specialties	*3*	18 (95%)	0 (0%)	1 (5%)
Total	***8***	**40 (39%)**	**29 (28%)**	**34 (33%)**

** Not included in calculation of percentages or statistical tests.*

Source of Patient Education Materials

Among healthcare providers who reported supplying patient education materials on tick-borne diseases at least some of the time (n = 63), the majority obtained these resources from the Dutchess County Department of Health, the US Centers for Disease Control and Prevention, and the New York State Department of Health (Table 8).

Table 8. Sources of patient education materials, among providers who supplied pamphlets or brochures in waiting areas at least some of the time

Source of Patient Educational Materials	**Number**	**Percent of Providers who Supply Educational Materials (n = 63)**
Dutchess County Department of Health	44	70%
US Centers for Disease Control and Prevention	42	67%
New York State Department of Health	38	60%
Pharmaceutical company materials	3	5%
Other (specify)	3	5%

Other sources mentioned in the open-ended response category included the New York State Dept. of Environmental Conservation and publications by individual practitioners.

References Used by Providers to Learn About Tick-borne Diseases

The U.S. Centers for Disease Control and Prevention website was the top source of information healthcare providers reported using to obtain information for themselves about tick-borne diseases (62%), followed by academic journals (49%), the New York State Department of Health website (34%), and the Dutchess County Department of Health website (23%). These were followed by printed materials from all three agencies. Other specific sources of information written-in by respondents include UpToDate® (n=3), the New York City Department of Health (n=2), the Infectious Disease Society of America (n=1), the NYS Department of Environmental Conservation (n=1), and the International Lyme and Associated Diseases Society (n=1).

Table 9. Which of these resources do you use to obtain information about tick-borne diseases?

Resource	Number	Percent
CDC website	69	62%
Medical or public health journals	54	49%
New York State DOH website	38	34%
Dutchess County DOH website	26	23%
CDC printed materials	20	18%
New York State DOH printed materials	19	17%
Dutchess County DOH printed materials	16	14%
Other	14	13%
None	7	6%

Medical and public health journals have steadily declined as a reference source from 93% in 2005 to 81% in 2008, 62% in 2010, and 49% in 2014.

Interest in Future Training/CME for Tick-borne Disease Education

There was no single preferred training format when providers were asked to choose between live seminars, printed materials, and internet-based trainings on tick-borne diseases, and there were no differences between specialties (Table 10, Fisher's exact test, $p = 0.336$).

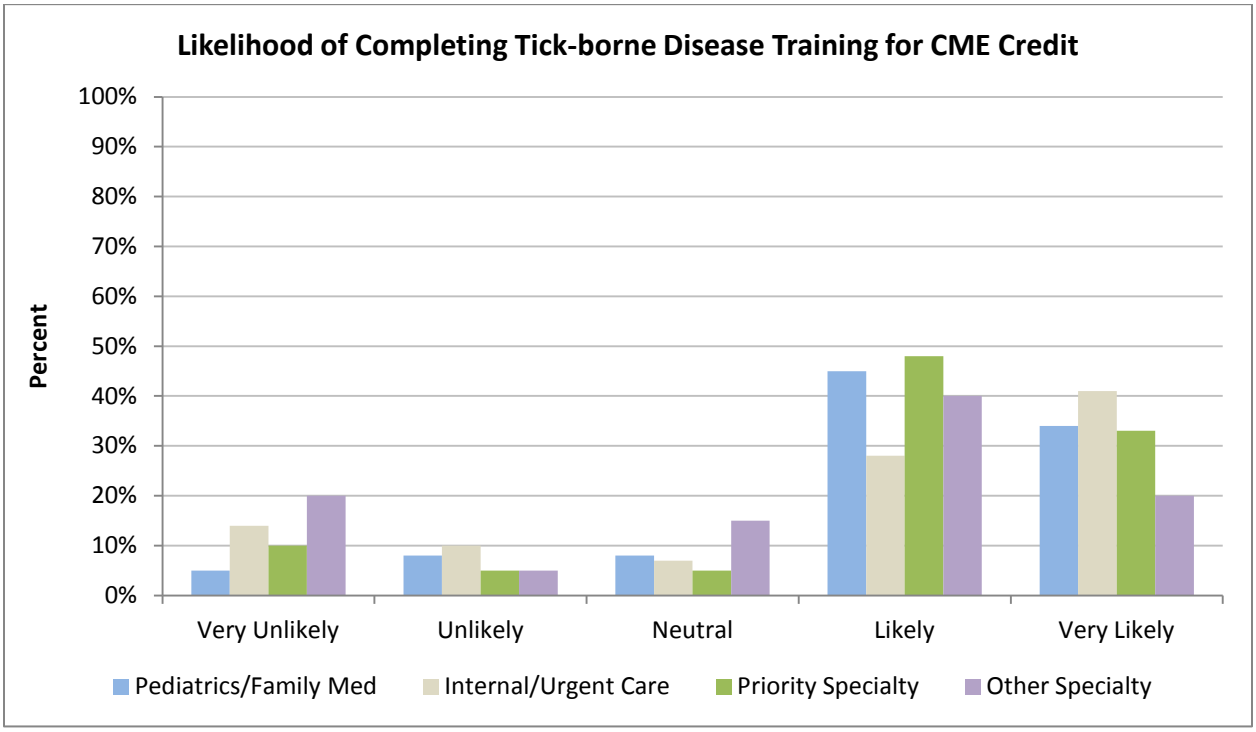
However, the opportunity to receive CME would be an important factor to consider in planning training, as the majority of providers reported being "likely" or "very likely" to attend or complete a tick-borne disease training that offered CME (Fig. 3). There were no significant differences between specialties in the proportion of respondents interested in completing training for CME (Fisher's exact test, $p = 0.765$).

Table 10. Which of the following training formats would you most prefer to learn more about tick-borne diseases?

Specialty	Preferred Method of Training: Number and Row Percent				
	Missing*	**None**	**Live Seminar**	**Printed Materials**	**Internet-Based**
Pediatrics/Family	*3*	0 (0%)	16 (44%)	9 (25%)	11 (31%)
Internal/Urgent	*3*	0 (0%)	5 (19%)	10 (38%)	11 (42%)
Relevant Specialty	*0*	1 (5%)	9 (43%)	5 (24%)	6 (29%)
Other Specialty	*2*	1 (5%)	6 (30%)	4 (20%)	9 (45%)
Total	***8***	**2 (2%)**	**36 (35%)**	**28 (27%)**	**37 (36%)**

**Not included in calculation of percentages or statistical tests.*

Figure 3



Discussion

Limitations

Although the survey was widely distributed to medical practices throughout Dutchess County, it should not be considered a representative sample. Because providers participated voluntarily and anonymously, we could not determine the proportion of practices that had at least one provider participate. With respect to the overall provider population, in 2013 the NYS Education Department Office of the Professions reported a total of 1,240 registered medical doctors with primary mailing addresses in Dutchess County who were licensed to practice in New York State. Naturally, this does not indicate the total number of physicians practicing within Dutchess County, as some providers may live in Dutchess and work elsewhere, and others may work in Dutchess and live elsewhere. Moreover, not only MDs, but also DOs, NPs, and PAs were invited to participate in the survey, and made up nearly 40% of the sample size. DCDOH's internal physician contact database for medical alerts included, as of July 31, 2014, 74 solo physicians and 163 group practices. Assuming a low-end average of 3 MDs/DOs/NPs/PAs per group practice, the projected total would be 563 practitioners. With a higher average of 5 per practice, it would increase to 890. Neither of estimates would be fully inclusive of providers who practice solely in hospital settings, which is also unknown. At best guess, the 111 respondents would represent roughly between 10% and 15% of a hypothetical "ball park" range of 750-1250 providers actively practicing in Dutchess County.

Because of the non-representative sample, there is a good possibility that providers who responded to the survey tended to have more experience, interest, or concern regarding tick-borne diseases than the overall population of physicians, physician assistants, and nurse practitioners providing care in Dutchess County.

Conclusions

The majority of providers who responded to the survey felt that tick-borne diseases are a serious health concern in Dutchess County, and all but three of the remaining respondents felt that tick-borne diseases are at least a moderate health concern. As noted under Limitations, the level of concern in the sample may be somewhat higher than would be expected of all providers, on average, due to the voluntary nature of the survey and low response rate.

Nonetheless, there appears to be room for improvement in knowledge about tick-borne diseases, especially for diseases other than Lyme disease, and especially for non-primary care providers who might occasionally encounter symptoms of tick-borne diseases in their patients. There is also room for improvement in the routine discussion about tick-borne diseases with patients in primary care settings and availability of education materials in doctors' offices.

Less than one quarter of providers actively report suspected and confirmed cases of tick-borne diseases to the Dutchess County Department of Health. Practices that rely solely on laboratories to report positive test results may contribute to the undercounting of Lyme disease cases, since the diagnosis of

Lyme disease may be made on the basis of erythema migrans (EM) rash in early stage illness without a blood test, as serological tests are insensitive during early infection. In 2013, the CDC estimated that there are about ten times as many cases of Lyme disease diagnosed each year compared with the number that are actually reported (http://www.cdc.gov/media/releases/2013/p0819-lyme-disease.html).

With the exception of internal/urgent care providers, fewer than half of practitioners surveyed would prescribe a single 200 mg dose of doxycycline to an asymptomatic patient that appeared to meet the prophylaxis criteria for Lyme disease set forth in the 2006 IDSA guidelines. It is possible that some providers felt there were insufficient details in the case study to ascertain whether or not the case fully met the requirements of the 2006 guidelines, such as potential unknown contraindications like pregnancy, or insufficient knowledge of the length of tick attachment. However, we provided respondents the opportunity to write in responses other than one of the designated choices, and none of the written responses indicated that either of these issues were concerns. On the other hand, almost 10% of providers would prescribe a *longer* course of prophylactic antibiotics than recommended by CDC/IDSA. More education may be needed on the current Lyme disease prophylaxis guidelines. Focus groups may also be useful to determine why providers who are aware of the guidelines opt for other approaches.

Just over 80% of providers reported using the appropriate EIA tests for diagnosis of Lyme disease according to the CDC's 2013 Tickborne Disease Reference Manual. It should be noted that Western blot, which is currently recommended as the second tier of a confirmatory diagnosis following a positive or questionable EIA result, was not specifically addressed by the survey, but a handful of providers mentioned it in the open-ended response. One striking finding was the substantial number of providers (41%) who reported using PCR for the diagnosis of Lyme disease*,* which is generally *not recommended* by CDC or FDA *(http://www.cdc.gov/lyme/healthcare/clinicians.html).*

Over 80% of respondents reported using either of the appropriate tests for babesiosis (blood smear or PCR), while only about half of providers who ever tested for anaplasmosis or ehrlichiosis reporting using the recommended IFA or PCR tests. Many providers reported ordering a complete blood count for most patients, which can provide supplemental information to aid in diagnosis or treatment; however, general CBC findings would not provide sufficient evidence to rule in or rule out a diagnosis for any of these conditions. It is possible, meanwhile, that appropriate testing was ordered in some cases without knowing which particular tests were being carried out. In the open-ended response, a small number of providers mentioned ordering tick-borne disease panels or antibody titers.

We observed that 19% of providers ever ordered an ECG/EKG for patients having or suspected of having disseminated stage Lyme disease to look for cardiac symptoms. Given the recently and highly publicized *MMWR* study on Lyme carditis[2], it will be interesting to re-assess this in the future.

[2] CDC. Three sudden cardiac deaths associated with Lyme carditis – United States, November 2012-July 2013. MMWR 2013;62(49);993-996.

Providers expressed strong preferences on the opportunity to received CME for future training, whereas there was no single preferred method of training.

Recommendations

The survey results suggest a need for increasing knowledge in several areas, including:

1) Familiarity with tick-borne diseases other than Lyme disease,
2) Awareness of testing recommendations,
3) Implementation of Lyme disease prophylaxis guidelines, and
4) Importance of reporting tick-borne diseases to the Department of Health.

The best approach to future training would be Continuing Medical Education. Online CME should be investigated in order to maximize resources and provide flexibility, convenience, and ongoing availability to accommodate the largest number of providers.