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Assessment of Knowledge, Attitudes, and Practices Toward Ticks and Tickborne Disease among Healthcare Professionals Working in Schools in New York and Maryland

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Abstract

Healthcare Professionals Working in Schools (HPWS) are responsible for providing health services to students and play a role in providing education to prevent illnesses, including tickborne diseases (TBD). Providing TBD education to children has been shown to increase prevention behaviors and knowledge of TBD symptoms, but little is known regarding the current state of TBD awareness among HPWS. In spring 2019 we conducted a cross-sectional knowledge, attitudes, and practices (KAP) survey of HPWS in two states with a high incidence of Lyme disease (LD) to inform design of TBD prevention programs. The survey queried general knowledge of TBDs, school practices regarding TBDs, and availability of TBD resources. Overall, higher confidence, experience, risk perception, prior training on TBD, and more years employed as a HPWS were independently associated with knowledge of LD transmission, symptoms, and correct tick removal practices. State and local health departments should consider prioritizing engagement with HPWS to provide educational opportunities about tickborne diseases.

Keywords

Lyme disease; tickborne disease; school nurse knowledge/perceptions/self-efficacy; school nurse education

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Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

Introduction

Lyme disease (LD) is caused by infection with the bacteria *Borrelia burgdorferi*. In the northeastern and mid-Atlantic states of the United States, it is transmitted to humans through the bite of an infected *Ixodes scapularis* tick. LD is one of the most frequently reported notifiable conditions in these regions, and children (particularly those aged 5–9 years) are consistently at highest risk (Schwartz et al., 2017). It is often a mild disease, typically characterized in early illness by an erythema migrans (EM) rash. However, without appropriate and timely antibiotic treatment, the infection can disseminate, potentially resulting in severe and even life-threatening symptoms (Hu, 2016). In addition to LD, the *I. scapularis* tick can transmit anaplasmosis, babesiosis, and Powassan virus disease to humans.

Given the high risk among children, healthcare providers working in schools (HPWS), including school nurses and other clinicians employed by school-based health centers, may be in a unique position to provide tick bite prevention education, promptly remove attached ticks to decrease risk of disease transmission, and identify symptoms of early LD or other tickborne diseases (TBDs). Previous studies show that providing TBD education to children increases uptake of prevention behaviors and knowledge of TBD symptoms to report to healthcare workers (Beaujean et al., 2016; Shadick et al., 2016). However, a recent survey of school administrators in the mid-Atlantic region of the United States found that while risk of contracting LD is perceived to be high, administrators may not have the monetary resources to implement student education on LD (Machtinger et al., 2019). Otherwise, little is known regarding the current state of LD and TBD education and awareness among HPWS in endemic areas.

Recognizing the aforementioned gaps in awareness, efforts have been underway to provide HPWS with TBD educational materials. In 2018, the New York State Center for School Health (NYSCSH) developed an educational resource toolkit designed to teach school nurses, educators, and students about TBDs and tick bite prevention. School districts across New York State have been provided the toolkit, which includes a presentation slide deck, lesson plans that can be used for classroom instruction, parent letters, and infographics (NYSCSH, 2019). However, awareness of the toolkit amongst HPWS, and whether uptake has increased HPWS knowledge and proficiency in addressing tick and TBD issues, has not been evaluated.

New York State Department of Health and Maryland Department of Health are part of the TickNET Emerging Infections Program for collaborative research on TBDs (Mead et al., 2015). TickNET was formed to collaborate on tickborne disease research projects aimed at disease prevention and education. In this project we described the knowledge, attitudes, and practices (KAP) of HPWS related to TBD in Maryland and New York State; two states with high incidence of LD. The findings of this survey will inform development of tailored educational resources and programs for HPWS regarding TBD recognition and prevention and in New York State will be a means to evaluate the performance of the NYSCSH TBD toolkit.

Methods

Study Design and Recruitment

We conducted a KAP survey for HPWS in Maryland and New York State, excluding New York City.

In Maryland, 24 public school jurisdictions and 442 non-public schools were identified as having potentially eligible HPWS using information obtained from the Maryland State Department of Education. Each public-school jurisdiction provided surveys to its school healthcare staff by an email link to an online survey or hard copy. Maryland Department of Health (MDH) sent printed surveys, with postage-paid return envelopes, by mail to all eligible non-public schools. The electronic survey was available from April 24 – May 26, 2019. In Maryland, 18 of the 24 public school jurisdictions participated in the survey. One jurisdiction elected to have their HPWS complete the voluntary survey during jurisdiction-wide mandatory staff meetings on April 12 and 15, 2019.

In New York, the New York State Department of Health (NYSDOH) mailed invitations to participate in the online survey to all non-New York City public and non-public schools (n = 3,991) listed with the New York State Education Department (NYSED) and school-based health centers (n = 97) listed with the NYSDOH. Printed surveys with postage-paid return envelopes were included in mail-ings to schools in New York that did not have phone numbers listed (n = 70). Invitations to participate were also sent by email to HPWS with publicly available contact information listed on school websites (n = 4,097) identified through internet search. The electronic survey was available from May 1–31, 2019.

Eligible respondents accessed the self-administered online survey via a link in their email invitation, or a web address/Quick Response (QR) code printed on a mailed invitation. The survey was hosted on Research Electronic Data Capture (REDCap), a secure web-based application used for multi-site data collection (Harris et al., 2009; Harris et al., 2019). Hardcopy surveys completed by respondents were mailed back to NYSDOH or MDH where study staff entered responses into REDCap.

All potential participants were screened for eligibility using survey questions pertaining to current employment status and credentials. Respondents who reported that they were a licensed healthcare professional providing health services or consultation to students in a school setting were included in the study. Eligible respondents completed a 10-min survey consisting of 40 questions in Maryland, and 41 questions in New York, where an additional question was asked about the NYSCSH TBD education toolkit (Appendix 1). Respondents were informed that participation was anonymous and voluntary. Upon survey completion, all respondents were given the opportunity to request free educational materials provided by the Centers for Disease Control and Prevention (CDC) and state health department for use in their school-based health practice.

Survey questions included demographic information about the respondent and their school setting, knowledge about ticks and Lyme disease, experience and practices related to ticks and TBD in the school setting. Also included were tick bite prevention recommendations

and resources provided to students, perception of student risk for TBD, degree of confidence when addressing concerns related to ticks and TBDs in the student population, and trusted sources of information about ticks and TBDs (Appendix 2).

The protocol, survey instrument, and recruitment materials were reviewed and approved by institutional review boards from the CDC, NYSDOH, and MDH.

Data Analysis

We analyzed survey responses using descriptive statistics and frequencies and developed indices to group categories of survey questions by knowledge, confidence, experience, and risk perception (Table 1). To explore differences associated with respondent knowledge about TBDs, we conducted bivariate analyzes using chi-square tests for associations between the knowledge index as the outcome of interest and other variables of interest including years as a HPWS, student population age, confidence index, experience index, perceived risk of TBD incidence, prior training on TBDs, and knowledge of the NYSCSH educational materials (alpha of <0.05 level of significance). To calculate odds ratios for answering a minimum of 70% of questions in the knowledge index correctly for each variable associated with a higher knowledge score, we used a univariate logistic regression. Data were analyzed using SAS 9.4 software (SAS Institute, Cary, NC).

Results

Response

A total of 1,560 HPWS (488 from lMaryland; 1,072 from New York State) met eligibility criteria for inclusion in analysis. These respondents answered all demographic questions and at least one other survey question (Table 2).

Demographics

The vast majority of survey respondents (92.6%) were registered nurses. No respondents from Maryland identified as physician's assistants or medical doctors and no New York respondents identified as clinical medical technicians or certified nurse aides. We found that when removed from the dataset, license types other than RN did not mask associations to answers to the survey questions. The majority (72.3%) of respondents reported that they cared for a school population of 200–1,000 students. Length of employment was distributed among <6 years (35.7%), 6–15 years (36.9%), and >15 years (27.4%). The distribution of student populations served was: pre-kindergarten and elementary only (38.7%), middle and high school only (28.3%), and a mix of grades (33.1%).

School Policy and Tick Removal Practices

Approximately 38% of HPWS respondents reported awareness of a policy at their school regarding tick removal; of these, 73.9% reported being permitted to remove ticks from students, 9.1% reported not being permitted to remove ticks, and 17% did not know if they were permitted to remove ticks from students. Of the respondents permitted to remove ticks, 82% reported using the appropriate method of grasping tick mouthparts with fine tipped tweezers and gently pulling out the tick. After removing an attached tick from a

student, most respondents reported routinely alerting the guardian about the event (97.7%) and offering TBD educational materials (50.7%). Few respondents (12.9%) recommended testing for Lyme disease, and 6.8% recommended prophylactic antibiotics to prevent Lyme disease. Less than one-third (28.2%) of respondents attempted to identify the species of the tick; tick identification was most often done with the assistance of a state/local health department or CDC-provided tick identification card (54.7%), or by referencing CDC's website (48.5%).

Student Education

About one-third (33.2%) of respondents said that they typically spoke to students regarding TBD risk; only 4.6% reported ever giving a presentation about TBDs. When asked about which school personnel were responsible for communicating with students about TBD risk, respondents most often answered health teachers (20.2%) and science teachers (9.1%); however, 24% of respondents indicated that no one communicated with students about TBD risk at their school and 32.8% said that they did not know if anyone had that responsibility.

Although 68% of respondents indicated that they knew where to obtain educational materials about TBDs, only 20% had sent materials home with students during the past school year. Almost 87% of respondents said that paper resources would be the most helpful resource for their school health services program rather than online or emailed resources.

HPWS Training

A minority of respondents indicated that they had received prior training on TBDs (17.3% in MD; 20.9% in NY). In New York State, 31% of respondents said that they knew about the NYSCSH TBD toolkit. Nearly 36% of respondents were interested in TBD trainings and in-person meetings. If continuing education credits were offered, almost 60% reported that they would be more willing to participate.

Indices and Associations

Index Overview

Most respondents (87.1%) perceived their students' risk of getting a TBD to be moderate or high (Table 3). Meanwhile, only 52.3% of respondents received a passing score on the knowledge index. Despite the overall low passing rate on TBD knowledge, 70.9% of respondents had moderate or high confidence in their ability to address TBD symptoms and tick bites. Overall, 52.3% of respondents had zero or low experience with TBD in their school practice, and 47.7% of respondents had moderate or high experience with TBDs.

Knowledge

Greater years employed as a HPWS; higher confidence, more experience, increased risk perception, and prior training on TBDs; and knowledge of NYSCSH Educational materials (in NY) were all independently associated with a passing knowledge score (Table 4). Student population age was not significantly associated with knowledge of TBDs.

Experience

Respondents with 6–15 years of HPWS experience had higher odds of a passing knowledge score as compared to respondents with less than 6 years of experience (OR 1.36, 95% CI 1.06–1.76) but respondents with more than 15 years of experience were not statistically different from respondents with less than 6 years of experience with regard to passing knowledge score (Table 5). However, this association is the weakest of all the variables associated with a passing knowledge score.

Respondents with moderate or high levels of experience with tick-related issues in the school setting had significantly higher odds of a passing knowledge score as compared to respondents with no experience (OR 2.42, 95% CI 1.83, 3.20 and OR 2.58 95% CI 1.86, 3.58 respectively). Respondents with low experience did not have significantly different knowledge scores when compared to respondents with no experience with tick removal or TBDs in the school setting.

Confidence

Respondents with moderate or high levels of confidence in their knowledge and abilities related to TBDs had significantly higher odds of a passing knowledge score compared to respondents with low reported confidence. Odds of a passing knowledge score was 2.68 (95% CI 2.07, 3.48) with a moderate confidence score and 7.48 (95% CI 5.03, 11.10) with a high confidence score compared to respondents with low confidence levels.

Risk Perception

Respondents with moderate or high perception of their students' risk of contracting a TBD had significantly higher odds of a passing knowledge score compared to respondents with low risk perception. Odds of a passing knowledge score was 1.77 (95% CI 1.25, 2.50) with a moderate risk perception and 2.18 (95% CI 1.53, 3.11) with a high risk perception compared to respondents with low risk perception.

Training

Lastly, respondents who reported previous TBD training had significantly higher odds of a passing knowledge score than those without previous training (OR 1.59, 95% CI 1.20, 2.11).

Discussion

Based on these survey results, HPWS would benefit from and be interested in public health resources, additional training, and educational opportunities related to ticks and TBDs. Most HPWS who responded to the survey indicated they had not received specific TBD training, despite being front-line providers that can aid in prevention, early diagnosis, and education of TBDs on school property (Hamlen, 2012). We found that HPWS who participated in a training on TBD have more confidence in removing ticks and recognizing symptoms of TBDs. Training and hands-on experience were associated with better knowledge outcomes, while years working as a HPWS was not.

Nearly half of HPWS in this study indicated low confidence in identifying Lyme disease. Recognition of early symptoms of Lyme disease is important to minimize student time out of school and reduce risk of more severe, disseminated disease (Hamlen & Kliman, 2009). Roughly half of participating HPWS indicated they were not confident in their ability to remove a tick and did not know that a single dose of prophylactic antibiotics can be used to reduce Lyme disease risk following a high-risk tick bite (Kimberlin et al., 2018). Early removal of ticks is important to reduce risk of transmission of TBDs (Eisen, 2018). Additional training could help HPWS promptly remove attached ticks and share educational information with parents for what to do after a tick bite. Further, two-thirds of survey respondents indicated that their school did not have a policy regarding tick removal. Implementing a school policy for tick removal would likely increase the prompt and safe removal of ticks attached to students and potentially reduce TBD incidence. In October 2019, NYSCSH issued guidance requiring a tick-removal policy to be issued by school medical directors. Due to the timing of this survey implementation, that guidance was not evaluated.

This survey assessed the awareness and use of educational materials about TBD. In New York State, only 31% of respondents knew about the NYSCSH tickborne disease toolkit, indicating that opportunities to improve access and uptake may exist. Reported barriers to provision of TBD prevention education included a lack of funds for educational materials, lack of time for activities outside their health office, and educational materials not available in languages other than English. Many HPWS reported that TBD prevention education was not seen as a part of their job responsibilities even if they recognized the risk to their students. These results support further efforts of state or local health departments to engage with HPWS and other school-related healthcare entities through expanded training opportunities and tailored educational resources.

Survey respondents indicated that continuing education credits for TBD training would increase willingness to attend trainings. This finding aligns with a nationwide survey of school nurses by the National Association of School Nurses which showed that the top request for continuing education was for evaluation of rashes and other skin conditions (identified by 56.7% of school nurse respondents) and better education about infectious diseases (39.2% of school nurse respondents) (Mangena & Maughan, 2015).

Educating children on health issues is optimal for preventing infectious diseases and chronic conditions throughout life. TBD education provides a salient teaching opportunity that primary prevention and symptom recognition are key to avoid illness (Corapi et al., 2007; Daltroy et al., 2007; de Vries & van Dillen, 2002; Malouin et al., 2003). Collaboration between school districts and local health departments could be one way to facilitate integration of TBD education in schools in areas with high disease incidence.

Limitations

This study is subject to multiple limitations. Given the anonymous nature of the survey and recruitment, we were not able to collect location information to better understand local resource needs and knowledge gaps that could inform targeted educational efforts. We were also unable to gather a complete list of HPWS in both states. Without knowing the total

number of HPWS in these states or the number of HPWS who ultimately were invited to participate, we were not able to calculate survey reach or response rate.

As with most surveys, this study is subject to response bias. It is possible that HPWS who were more interested in this topic were more likely to respond to the invitation to participate, while HPWS not familiar with ticks and TBD were less likely to participate; this would not only limit generalizability but also potentially bias results towards HPWS with greater knowledge and risk perception. Conversely, some HPWS may feel like they have a lot of experience with ticks and TBD and could have elected not to participate in the survey. Without more information regarding the source population – we were unable to adjust or weight responses to increase representativeness.

Conclusion

Our survey results show that targeted education on TBDs is needed and desired by HPWS. A minority of respondents had received prior training on TBD, and nearly half had a failing knowledge index score. Empowering HPWS with training might help to prevent TBD occurrence among students.

Future studies would be beneficial to provide more insights regarding HPWS knowledge and attitudes surrounding Lyme disease and other TBDs. We suggest that this survey be used to examine the efficacy and uptake of resources or trainings designed to improve HPWS knowledge and practices about TBD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Biographies

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Jeré Hutson received her Masters in Public Health from the University of Pennsylvania, Perelman School of Medicine with a concentration in infectious disease epidemiology and global health. She currently serves as Chief of rabies and vector-borne diseases within the Maryland Department of Health, Infectious Disease Epidemiology and Outbreak Response Bureau.

David Crum graduated from Cornell University College of Veterinary Medicine in 2002 and completed his Master of Public Health from George Mason University in 2016. His interests include tickborne diseases and the promotion of the One Health concept, highlighting the relationship between human and animal health.

Adam Rowe primarily works as a Program Research Specialist for TickNet projects joining the Emerging Infections Program in 2018. Before joining the EIP team, he obtained his BA in biology, concentrating in bioinformatics from CUNY Hunter College and worked for SUNY Orange coordinating field operations for mosquito surveillance efforts in Orange County, New York.

Grace Marx received her MD and MPH in epidemiology from the University of Washington in Seattle, Washington. She completed an internal medicine residency and infectious disease fellowship at the University of Colorado. She is a medical epidemiologist with the Centers for Disease Control and Prevention where her work focuses on epidemiology, surveillance, and prevention for bacterial vector-borne diseases including Lyme disease, tularemia, plague, bartonella, and tickborne relapsing fever.

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Table 1.

Index Scoring Methods.

Index	Question Numbers	Scoring points	Scoring Category
Knowledge	9-14, 19[a]	1 point per correct answer	Failing score <5 points Passing score 5-7 points
Confidence	30-32	Not at all confident = 0 points A little confident = 1 point Moderately confident= 2 points Very confident = 3 points	Low confidence <4 points Moderate confidence 4-6 points High confidence 7-9 points
Experience	15, 18, 24	1 point per experience	No experience = 0 points Low experience = 1 point Moderate experience = 2 points High experience = 3 points
Risk Perception	29	No risk = 0 points Low risk = 1 point Moderate risk = 2 points High risk = 3 points	No risk = 0 points Low risk = 1 point Moderate risk = 2 points High risk = 3 points

[a]Question 19 asked about method of tick removal and allowed for multiple answers. Respondents that exclusively chose the correct answer were awarded 1 point.

Table 2.

Sample Characteristics of HPWS in Maryland and New York.

	Maryland (n = 488)		New York (n = 1,072)		Pooled (n = 1,560)	
	total	**%**	**total**	**%**	**total**	**%**
License						
Certified Medical Technician or Certified Nursing Assistant	21	4.3	0	0	21	1.4
Licensed Practical Nurse	24	4.9	46	4.3	70	4.5
Registered Nurse	440	90.2	1,004	93.7	1,444	92.6
Physician Assistant	0	0	2	0.2	2	0.1
Nurse Practitioner	3	0.6	19	1.8	22	1.4
Medical Doctor or Doctor of Osteopathic Medicine	0	0	1	0.1	1	0.1
Years as HPWS						
<6 years	202	41.5	354	33.1	556	35.7
6-15 years	175	35.9	399	37.3	574	36.9
>15 years	110	22.6	317	29.6	427	27.4
Number of Students						
<200	38	7.9	75	7	113	7.3
200- 1,000	274	57.1	843	79.2	1,117	72.3
1,001- 2,000	111	23.1	121	11.4	232	15
> 2,000	57	11.9	26	2.4	83	5.4
Student population						
PreK-elementary only	180	37	421	39.4	601	38.7
mix of grades	181	37.2	333	31.2	514	33.1
middle-high only	126	25.9	314	29.4	440	28.3
Prior training on TBD						
No	365	79	701	76.3	1,066	77.2
Yes	80	17.3	192	20.9	272	19.7
Don’t know	17	3.7	26	2.8	43	3.1
Knowledge of NYSCSH materials[a]						
No	-	-	634	69	-	-
Yes	-	-	285	31	-	-

[a]New York State participants only.

Table 3.

Index Scores of HPWS in Maryland and New York.

	Maryland (n = 488)		New York (n = 1,072)		Pooled (n = 1,560)	
	total	**%**	**total**	**%**	**total**	**%**
Knowledge Index						
Passing	229	50.9	508	53.0	737	52.3
Failing	221	49.1	450	47.0	671	47.7
Confidence Index						
Low	111	24.2	294	31.6	405	29.1
Moderate	294	64.2	481	51.6	775	55.8
High	53	11.6	157	16.9	210	15.1
Experience Index						
None	153	33.1	310	32.9	463	33.0
Low	97	21.0	174	18.5	271	19.3
Moderate	138	29.9	277	29.4	415	29.5
High	74	16.0	182	19.3	256	18.2
Risk Perception						
Low	48	10.4	134	14.2	182	13.0
Moderate	230	49.9	430	45.6	660	47.0
High	183	39.7	380	40.3	563	40.1

Table 4.

Selected Characteristics Associated with Knowledge Index.

	Failing Knowledge Index (0-4 correct)		Passing Knowledge Index (5-7 correct)		
	total	%	total	%	*p*-value*
Years as HPWS					.0236
<6 years	265	39.6	243	33	
6-15 years	226	33.8	291	39.5	
16+	178	26.6	203	27.5	
Student population					.257
PreK-elementary only	270	40.3	281	38.2	
mix of grades	204	30.5	254	34.6	
middle-high only	196	29.3	200	27.2	<.0001
Confidence Index					<.0001
Low	266	41.2	122	17.3	
Moderate	334	51.7	422	59.9	
High	46	7.1	161	22.8	<.0001
Experience Index					<.0001
None	263	40.9	186	25.8	
Low	141	21.9	116	16.1	
Moderate	153	23.8	258	35.7	
High	86	13.4	162	22.4	<.0001
Risk Perception					<.0001
Low	109	16.7	67	9.4	
Moderate	304	46.7	333	46.8	
High	238	36.6	312	43.8	
Prior training on TBD					.0007
Yes	102	16.5	163	24	
No	518	83.6	516	76	
Knowledge of NYSCSH materials [a]					.0036
Yes	112	26.4	168	35.4	
No	312	73.6	306	64.6	

* *p*-value shows chi-square test of homogeneity between groups of knowledge score within each variable, values <0.05 show association between each variable and knowledge score.

[a] New York State participants only.

Table 5.

Univariate Logistic Regression of Knowledge Score and Selected Characteristics.

Variable	Odds Ratio (95% CI)	*p*-value*
Years as HPWS		
<6 years	ref	
6-15 years	1.36 (1.06, 1.76)	.0165
>15 years	1.26 (0.96, 1.66)	.1025
Confidence Category		
Low	ref	
Moderate	2.68 (2.07, 3.48)	<.0001
High	7.48 (5.03, 11.10)	<.0001
Experience Category		
None	ref	
Low	1.19 (0.87, 1.63)	.2777
Moderate	2.42 (1.83, 3.20)	<.0001
High	2.58 (1.86, 3.58)	<.0001
Risk Perception		
Low	ref	
Moderate	1.77 (1.25, 2.50)	.0013
High	2.18 (1.53, 3.11)	<.0001
Prior training on TBD		
Yes	1.59 (1.20, 2.11)	.0012
No	ref	

* *p*-value shows chi-square test of homogeneity between groups of knowledge score within each variable's possible values, *p*-values of <.05 show association between each variable's values and knowledge score.