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Lyme Disease Risk Assessment No. 16-61-A2WW-94, Fort Knox, Kentucky, 20-21 November 1993

[From the backside of the title page:]

Since 1942, USAEHA has provided worldwide preventive medicine support to the Army, Department of Defense and other Federal agencies. The USAEHA accomplishes this mission by providing information and consultative services to leaders and decision makers charged with the responsibility for the occupational and environmental health of military and civilian service members and associated communities worldwide. THe USAEHA is unique nationally in its ability to matrix and tailor its staff, representing a wide array of scientific disciplines, for immediate response to occupational and environmental health crises and issues.

DEPARTMENT OF THE ARMY
U.S. Army Environmental Hygiene Activity-North
Fort George G. Meade, Maryland 20755-5225

[Seal of Department of Defense, United States of America]

REPLY TO ATTENTION OF:

HSHB-AN-P (40-5f) 23 MAR 1994

MEMORANDUM FOR Commander, U.S. Army Training and Doctrine Command, ATTN:
ATBO-L, Fort Monroe, VA 23651-5451

SUBJECT: Lyme Disease Risk Assessment, 16-61-A2WW-94, Fort Knox, Kentucky, 20-21 November 1993

1. Two copies of the subject report are enclosed; a brief summary is provided below. Please call me at DSN 923-5281/6502 or commercial (301)
677-5281/6502 if this report does not meet your needs or if you require additional information on this risk assessment or support in the areas of occupational and environmental health.

2. The Lyme disease vector, Ixodes scapularis, was not found on 107 deer examined on Fort Knox. Lyme disease antibodies were detected in two of 99 deer blood samples tested. Data for 1993 from the Kentucky Department for Health Services, revealed thirteen confirmed cases of human Lyme disease in Kentucky and one case in Hardin County, where Fort Knox is located. This information and the documented continuing spread of Lyme disease, indicates that the present risk of contracting Lyme disease on Fort Knox, is MODERATE. Implementation of personal protective measures for military, civilians, and family members using Fort Knox for outdoor training or recreation is recommended.

FOR THE COMMANDER:

[signed by]

GEORGE J. MAGNON
MAJ, MS
Chief, Entomological Sciences Division

DEPARTMENT OF THE ARMY
U.S. Army Environmental Hygiene Activity-North
Fort George G. Meade, Maryland 20755-5225

[Seal of Department of Defense, United States of America]

REPLY TO ATTENTION OF:

HSHB-AN-P (40-5f) 23 MAR 1994

LYME DISEASE RISK ASSESSMENT NO. 16-61-A2WW-94
FORT KNOX, KENTUCKY
20-21 NOVEMBER 1993

1. REFERENCES. See Appendix A.

2. AUTHORITY. AEHA Form 250-R, TRADOC, 1 October 1993.

3. PURPOSE. To asses the risk of Lyme disease to Fort Knox personnel by examining deer for the tick vector, Ixodes scapularis, and to assay ticks and deer blood for evidence of the Lyme disease etiologic agent, Borrelia burgdorferi, in accordance with AR 40-5, paragraph 10-7.f.

4. GENERAL

a. Risk Definition. The term "risk", as used in this report, is a nonstatistical evaluation of qualitative and quantitative information available on Lyme disease locally. To the extent available, information
evaluated included the following elements:

(1) History of Lyme disease in the area
(2) The presence of the tick vector of (I. scapularis) and a host
population needed to sustain a viable population of the vector
(3) The presence of the Lyme disease-causing spirochete (B. burgdorferi) in the tick population
(4) The presence of antibodies to B. burgdorferi in mammalian host population
Once gathered, this information was used to determine risk in the following manner:

Low - Some elements of the Lyme disease cycle identified in nearby areas, but not on the installation

Moderate - Some elements of Lyme disease cycle identified from the installation or human cases of Lyme disease reported from the local area

High - All elements of the Lyme disease cycle present on the

installation

b. Personnel Contacted. The purpose and methodology of this assessment were discussed with Mr. Robert Ruddell, Environmental Health Technician, Preventive Medicine Service, U.S. Army Medical Department Activity. 1LT Riccelli, Environmental Health Section, Preventive Medicine Service (PVNTMED Svc), Fort Knox, Kentucky was contacted for information on cases of human Lyme disease contracted at Fort Knox. Ms. Patricia Beeler, Health Data Survey Technician, Kentucky Department for Health Services (KDHS), was contacted for information on cases of human Lyme disease in the State of Kentucky. COL Lyman Roberts, Entomology Consultant, Department of the Army (DA), Office of the Surgeon General (OTSG) was contacted for information on reported cases of human Lyme disease from Army installations.

c. Survey Conduct. Personnel of the PVNTMED Svc, Fort Knox, conducted the deer examinations and collected tick and deer blood samples during the period 20-21 November 1993. Ticks were identified and assayed via Direct Fluorescent Antibody (DFA) tests by personnel of this Activity. Serum samples were assayed via Indirect Fluorescent Antibody (IFA) tests by personnel of the U.S. Army Regional Veterinary Laboratory, Fort Sam Houston, Texas, for the presence of Lyme disease antibodies.

d. Technical Assistance. Technical assistance or further informal advice may be obtained by contacting Chief, Entomological Sciences Division, this Activity, commercial (310)677-5281/6502 or DSN 923-5281/6502.

5. BACKGROUND

a. Lyme disease is a multi-symptomatic infectious disease caused by the bacterial spirochete, Borrelia burgdorferi, which is transmitted to humans by the bite of an infected tick. This disease is most often referred to as Lyme disease or Lyme arthritis in the United States. Lyme disease has become the most prevalent arthropod-borne illness in North America. Its geographic range is expanding and the number of reported cases continues to rise each year.

b. The number of reported cases of Lyme disease received by the DA OTSG, however, has declined sharply over the past 5 years: year (number of cases); 1989 (113); 1990 (70); 1991 (26); 1992 (14); 1993 (9). Public awareness and Lyme disease prevention programs may have contributed to this decline in the number of cases reported, but inconsistent reporting is also a factor. The lack of a rapid, reliable, and cost effective diagnostic test for Lyme disease can result in over- or under-reporting. The increased burden of reports of all kinds on medical treatment facilities may also be a factor. Personnel concerned with Lyme disease prevention and control should not assume that human risk of Lyme disease has changed based on number of reported cases alone. The need to protect soldiers and other personnel working on Army installations has increased with the documented spread of this disease.

c. Epidemiologic data for 1993 from the KDHS revealed 1 confirmed

case of human Lyme disease in Hardin County, where Fort Knox is located.
A statewide total of 13 human cases was reported for Kentucky in 1993.

d. In 1992 all 107 ticks collected were Dermacentor albipictus, however, none of the ticks collected tested positive for Borrelia spp. (reference 7). In 1991 261 ticks were collected (255 Dermacentor albipictus, 6 Amblyomma americanum, but no I. scapularis). Six Dermacentor albipictus and 1 Amblyomma americanum tested positive for Borrelia spp. but not B. burgdorferi (reference 8).

6. METHODS

a. Deer examinations. The head, neck, and ears of hunter-shot white-tailed deer (Odocoileus virginianus) were examined for the presence of ticks. The deer hair was stroked against the naturally, using the hand edge, to search for ticks. Ticks were removed using fine-point (No. 5) jeweler's forceps and returned to this Activity for identification and testing. Total examination time per carcass was approximately 5-10 minutes.

b. Tick Testing. Collected ticks were tested via a two-phase DFA assay. Ticks were first tested using a polyclonal DFA procedure that tests for the presence of spirochetes belonging to the genus Borrelia. Ticks identified as containing these Borrelia spp. spirochetes were tested further by a species-specific DFA procedure to ascertain if the spirochetes were B. burgdorferi. However, since there were no ticks positive for Borrelia spp., this second phase DFA procedure was not performed.

c. Serum testing. Blood pooled in the deer body cavities was collected using clean 4 ml disposable plastic pipettes. Samples were placed in 7 ml labeled tubes and spun for at least five minutes. The sera were separated and frozen (-9 degrees C) until IFA testing could be
performed.

7. RESULTS. (Also see Appendices B and C)

a. No ticks of the genus I. scapularis were collected from the 107 deer examined on Fort Knox.

b. Two hundred and seventy D. albipictus ticks were collected from 92 (86%) of the 107 deer examined. All of these ticks except one were tested for spirochetes by personnel of this Activity. None of the ticks tested were positive for Borrelia spp. spirochetes.

c. Two of 99 (2%) deer serum samples collected tested positive (greater than 1:128 titer level) for antibodies to B. burgdorferi.

8. DISCUSSION.

a. The significance of the presence of non-burgdorferi, Borrelia spp. in ticks is yet to be determined. Research institutions and the Centers for Disease Control and Prevention (CDC) are currently

investigating differences in Borrelia species and strains relative to their geographic occurrence, host tick species, and the pathogenic implications.

b. The presence of Borrelia spp. spirochetes on Fort Knox was first documented by this Activity in Lyme Disease Risk Assessment No. 16-61-AL85-92 (reference 8). In this 1991 assessment, data indicated that the risk to Fort Knox personnel was moderate; seven non-I. scapularis were positive for Borrelia spp. spirochetes and none of the deer serum samples tested positive for antibodies. In 1992 (reference 7), however, all ticks and deer serum samples were negative. Despite the fact that the tick vector was not collected in this most recent survey, evidence of antibodies to B. burgdorferi in the deer host population and the confirmed cases of human Lyme disease reported from the local area, indicate that participants in outdoor and natural resource activities remain at risk for contracting Lyme disease. This information, combined with historical evidence of Lyme disease in the surrounding areas and the environmental conditions necessary for the occurrence of Lyme disease, makes Fort Knox an area warranting continued vigilance.

9. CONCLUSIONS. The presence of antibodies to B. burgdorferi among the deer population and the information from the KDHS on the epidemiology of Lyme disease in the surrounding area, indicate that the present risk of contracting human Lyme disease on Fort Knox is Moderate.

10. RECOMMENDATIONS.

a. Implement risk reduction measures in Appendix D.

b. Make military, civilians, and family members aware of information on repellents contained in Appendices E and F.

c. Assist this Activity in conducting biennial follow-up surveillance using the methods described in reference 3 and paragraph 6,above.

d. Report all Lyme disease cases to the DA OTSG and [Kentucky] State Epidemiologist (AR 40-5, paragraph 3-2 and AR 40-400, paragraph 6-16).

11. ADDITIONAL ASSISTANCE. Additional direct support in the fields of pest management, pesticide risk management, water supply management, wastewater management, hazardous waste management, worksite hazards management, health care hazards management, ergonomic evaluation, sanitation and hygiene, and installation industrial hygiene management is available, and may be requested from USAEHA-North at DSN 923-6502/5281/6205, or commercial (301)677-6502/5281/6205.

[signed by]

MELISSA K. MILLER
Entomologist
Entomological Sciences Division

APPENDIX A

REFERENCES

1. AR 40-5, Preventive Medicine, 15 October 1990.

2. AR 40-400, Patient Administration, 1 November 1983.

3. Armed Forces Pest Management Board Technical Information Memorandum No. 26, Lyme Disease: Vector Surveillance and Control, March 1990.

4. Lyme Disease Surveillance Summary, Vol. 4, No. 3, Centers for Disease Control and Prevention, June 1993.

5. Oliver, J.H., et al. 1993. Conspecificity of Ticks Ixodes scapularis and Ixodes dammini (Acari: Ixodidae). J. Med. Ent., 30(1) 54-
63.

6. Anderson, John F. and L. Magnarelli, 1984. Avain and Mammalian Hosts for Spirochete-Infected Ticks and Insects in a Lyme Disease Focus in Connecticut. The Yale J. of Biol. and Med., 57(1984), 627-641.

7. Memorandum, USAEHA-North, HSHB-AN-P, 06 May 1992, subject: Lyme Disease Risk Assessment, No. 16-61-AW42-92, Fort Knox, Kentucky, 21 November and 19 December, 1992.

8. Memorandum, USAEHA-North, HSHB-AN-P, 03 April 1992, subject: Lyme Disease Risk Assessment, No. 16-61-AL85-91, Fort Knox, Kentucky, 24 and 30 November, and 1 December 1991.

APPENDIX B

DATA SUMMARY SHEET
DOD LYME DISEASE SURVEY
U.S. ARMY ENVIRONMENTAL HYGIENE ACTIVITY-NORTH
FORT KNOX, KENTUCKY
20-21 NOVEMBER 1993

# DEER EXAMINED	107
# DEER WITH Ixodes scapularis[1]	0
# DEER WITH TICKS	92
# DEER SERUM SAMPLES TESTED	99
# DEER SERUM SAMPLES POSITIVE[2]	2
# HUMAN LYME DISEASE CASES, 1993 - HARDIN CO.	1

1 Ixodes dammini and Ixodes scapularis have been synonymized by Oliver et al. (1993).
2 Screening titer levels greater than 1:128.

APPENDIX C

TICK TESTING[1], SERUM TESTING RESULTS[2]
FORT KNOX, KENTUCKY
20-21 NOVEMBER 1993

Table C-1. Dermacentor albipictus collected from 92 of 107 deer and tested via DFA for Borrelia species and Borrelia burgdorferi

		Borrelia spp.			B. burgdorferi		
	#COLLECTED	#TESTED	# +	% +	#TESTED	# +	% +
LARVAE	1	1	0	0	0	0	0
NYMPHS	64	64	0	0	0	0	0
FEMALES	69	68	0	0	0	0	0
MALES	136	136	0	0	0	0	0
TOTAL	270	269	0	0	0	0	0

Table C-2. SERUM SAMPLES taken from 36 deer and tested via IFA for Borrelia burgdorferi

		B. burgdorferi		
	#COLLECTED	#TESTED	# +	% +
TOTAL	99	99	2	2

1 Direct Fluorescent Antibody (DFA) testing method
2 Indirect Fluorescent Antibody (IFA) testing method

APPENDIX D

Lyme Disease Risk Reduction Measures

1. Emphasize public awareness programs to educate troops, family members, civilian employees and visitors on personal protective measures
and Lyme disease. Methods should include, but not be limited to:

a. Distribution of printed Lyme disease handouts, such as tick

identification cards (USAMD-7/89), pamphlets, and fact sheets.

b. Notifications in the installation newsletter and post electronic media (e.g., closed-circuit TV), especially prior to the high-risk months (May-September).

c. Making available, for viewing, videos "Lyme Disease: A growing threat" (FAUPIN No. 504494DD, Army TVT number 8-196) and "Application of the Arthropod Repellent System" (No. 708575, Army TVT number 8-232).

2. Submit any collected tick specimens (both field-collected or ticks that have been removed from individuals) alive for identification and DFA testing to USAEHA-N, Fort Meade, Maryland, 20755-5225.

3. Stock Permethrin Arthropod Repellent (NSN 6940-01-278-1336, box of 12 cans for $36.99), and 3M [Trademark] Insect Repellent (NSN 6840-01-284-3982, box of 12 tubes, $29.30) for distribution. Emphasize tick habitat avoidance, proper wearing of clothing, and use of repellents.

4. Report all confirmed and suspected cases of Lyme disease [e.g., suspicious febrile illnesses, arthralgias, rashes, (Erythema Migrans)] by special telegraphic report [MED-16(R4)] for all soldiers and civilian medical care beneficiaries.

5. Identify high risk foci in cantonment areas via tick dragging/flagging, small mammal trapping, deer checks and the assaying of collected ticks for B. burgdorferi. Sampling should be performed in early summer when I. scapularis nymphs (the life stage responsible for most human Lyme disease infections) are active. Post DA Poster 40-5,to identify high risk areas.

6. Avoid high tick population areas for troop training or recreation. Such areas can be identified by tick dragging or flagging prior to use. Case by case surveillance is necessary due to the patchy distribution of I. scapularis.

7. Eliminate tick habitat in heavily used, infested areas (e.g., wooded recreation areas) by removing low brush and leaf litter. Tick infestations should be verified via tick flagging or dragging prior to habitat modification. Clearing should be done in low risk months (i.e., January and February).

8. Prepare, as a contingency, to treat high-use areas with pesticides to decrease tick numbers if surveillance reveals high tick numbers and if nonchemical control techniques (e.g., brush removal, mowing, raking) do not provide adequate control.

APPENDIX E

REPELLENTS

1. Several arthropod repellents are available through the Defense General Supply Center (DGSC) or Self Service Supply System. When used in accordance with directions on the label and in conjunction with the proper wearing of clothing, they provide personal protection against a wide variety of medically important insect/arthropod pests. Availability and current pricing can be obtained by calling the DGSC at DSN 695-4865 or commercial (804) 790-4865. Repellents available for use are described below:

a. Insect/Arthropod Repellent Lotion (cream, 2 fluid ounces) for application to exposed skin. The lotion, NSN 6840-01-284-3982, is not labeled for ticks, but will repel chigger mites and many biting flies.

b. Permethrin Arthropod Repellent, Insect Repellent, Clothing Application (aerosol, 6 ounces) NSN 6840-01-278-1336. Seventy-five percent of the can is used to apply to the field uniform and the remainder is used to treat mosquito netting. The product provides protection from ticks and mosquitoes for a maximum of five weeks or five launderings. Apply more frequently if "buddy checks" reveal attached ticks.

c. Insect Repellent Fabric Treatment (liquid, 5.1 fluid ounces) NSN 6840-01-334-2666. The contents are added to 2 gallons of water and applied with the 2-gallon sprayer from a field sanitation kit at a pressure of 55 pounds per square inch to field uniforms, mosquito netting, and tent fabric to provide protection from ticks, biting flies, and other insects. Since most sprayers are not equipped with the required pressure gauge (NSN 3740-01-332-8746), it will be necessary to obtain a pressure gauge and filter (NSN 4330-01-332-1639), in order to complete the retrofitting. Proper application can provide protection for the normal life of the uniform (up to 180 days in the field), six launderings of mosquito netting, and 6-9 months of treatment for tent fabric, depending on the climate.

2. Detailed directions for the use of these and other repellents can be found in the U.S. Army Environmental Hygiene Agency Technical Guide (TG) 174, Personal Protective Techniques Against Insects and Other Arthropods of Military Significance, June 1991.

3. The Tick-Borne Disease Card (GTA 8-5-56) is available from the Entomological Sciences Division, USAEHA-North, by calling DSN 923-5281 or commercial (301) 677-5281.

APPENDIX F

FACT SHEET - MOSQUITO AND TICK REPELLENTS

* DEET (N,N-Diethyl-m-tolumide) containing repellents offer good protection against mosquitoes, and are formulated for application to exposed skin.

* Permethrin containing repellents offer excellent protection against ticks, and are formulated for application to clothing.

* DEET will also offer protection against ticks, keeping them from attaching to treated skin. However, ticks generally do not attach in exposed areas, the only areas DEET may be applied to.

* Permethrin, on the other hand, will also offer protection against mosquitoes, but may not be applied to exposed skin where mosquitoes bite. It is useful in treating bed netting.

* Combined use of DEET on exposed skin for mosquito repellency and Permethrin on clothing for tick repellency offers maximum protection against both pests. Always read and follow the label before using any compound.

* Do not use tick and flea collars. A toxic reaction can result. Humans have sweat glands in their skin that serve as an avenue for chemical absorption. Dogs on the other hand, respire by panting, lacking sweat glands. In addition, pets have a thicker hair barrier than most humans to protect them from direct contact with the collars.

* Various lotion products have acclaimed as offering protection against mosquitoes. Professional literature both supports and refutes benefits from lotions. However, there is a consensus that mineral oil, a component of many lotions, does substantially reduce mosquito bites on treated skin.

* Tests have shown that DEET products containing a high concentration (greater than 50%) of DEET do not offer greater protection than those products containing 30-50% DEET.

* The following practices enhance the effectiveness of protection against mosquitoes and ticks when used in conjunction with repellents:
  - Cover as much exposed skin as possible. Consider loose fitting long-sleeved shirts in summer.
  - Tuck pants inside socks or boots to keep ticks out.
  - Wear light-colored clothing to make seeing ticks easier.
  - Plan ahead and treat clothing with permethrin before your outdoor activity begins. Permethrin binds with fabric and is persistent through several washings.
  - Store treated clothing in a plastic bag to help preserve repellent effectiveness and identify treated clothing.
