Dutchess County Department of Behavioral & Community Health
Tick-Borne Disease Prevention FAQ Series
PERSONAL PROTECTION MEASURES: TICK CHECKS & REMOVAL

The CDC recommends the following protocol for tick checks:

- "Bathe or shower as soon as possible after coming indoors (preferably within two hours) to wash off and more easily find ticks that are crawling on you.

- Conduct a full-body tick check using a hand-held or full-length mirror to view all parts of your body upon return from tick-infested areas. Parents should check their children for ticks under the arms, in and around the ears, inside the belly button, behind the knees, between the legs, around the waist, and especially in their hair.

- Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and daypacks.

- Tumble clothes in a dryer on high heat for an hour to kill remaining ticks. (Some research suggests that shorter drying times may also be effective, particularly if the clothing is not wet.)" (CDC, 2011a).

And the following protocol for the removal of ticks:

1. "Use fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.

2. Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with tweezers. If you are unable to remove the mouth easily with clean tweezers, leave it alone and let the skin heal.

3. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol, an iodine scrub, or soap and water.

Avoid folklore remedies such as "painting" the tick with nail polish or petroleum jelly, or using heat to make the tick detach from the skin. Your goal is to remove the tick as quickly as possible--not waiting for it to detach." (CDC, 2011b).

Summary of Scientific Evidence

Laundering Clothing to Kill Ticks

A 2003 study compared the efficacy of laundering protocols to kill ticks crawling on clothing. An **automatic washer** was **ineffective** at killing *A. americanum* and *I. scapularis* nymphs on cold, warm, and hot settings. Nymphs survived laundering in high percentages when either powder or liquid detergents were added. An **automatic dryer**, set on hot for one hour, was **effective** at killing nymphs of both species. An unheated drying cycle killed some but not all of the ticks (Carroll, 2003).

Scientific Rationale for Frequent Tick Checks and Prompt Removal

Transmission rates of tick borne disease increase with duration of tick attachment (Katavolos, Armstrong, Dawson, & Telford, 1998; Piesman & Dolan, 2002; Piesman & Spielman, 1980; Sood et al., 1997). Studies in animal models have established that there is a "grace period" of 24-36 hours of tick attachment during which *B. burgdorferi*, the agent causing Lyme disease, is unlikely to be transmitted by *Ixodes scapularis* ticks in the northeastern United States (des Vignes et al., 2001; Piesman & Eisen,

2008). Data on transmission rates in people support the conclusion that a similar attachment time is required when *I. scapularis* ticks bite people. Studies have found that only 1-3% of known tick bites result in Lyme disease infection, much lower than the percentage of ticks carrying *B. burgdorferi*. Tick bites of greater than 72 hours duration, as determined by scutal index (a measurement of the degree of blood engorgement in the tick) carry an 18-25% risk of infection (Sood et al., 1997). Most patients with Lyme disease do not recall being bitten by a tick. Ticks that go unnoticed and are able to feed to repletion are considered to be the cause of Lyme disease in the majority of cases. This is the basis for the recommendation that frequent tick checks and prompt removal of attached ticks can prevent transmission of Lyme disease (des Vignes et al., 2001). *I. scapularis* nymphs attach most frequently to lower extremities, while the most frequent site of attachment for adults is the scalp (Falco & Fish, 1988).

The duration of grace periods is not as well defined for other agents. Data on tick attachment time required for transmission of *Anaplasma phagocytophilum*, the organism which causes human granulocytic anaplasmosis, indicates that a grace period exists, but its duration is not consistent. Des Vignes et al showed transmission of *A. phagocytophilum* to mice in under 24 hours (des Vignes et al., 2001). Hodzic et al found that it took 40-48 hours for *I. scapularis* nymphs to transmit *A. phagocytophilum* to mice (Hodzic et al., 1998) and Katavolos et al found that at least 24 hours of attachment is required for disease transmission (Katavolos et al., 1998). A grace period also exists for transmission of *Babesia microti,* though its duration has not been precisely determined. In a study in which *B. microti* infected *I. scapularis* nymphs were allowed to feed on hamsters, infection was transmitted 50% of the time after 54 hours of attachment, 17% of the time after 48 hours, and 9% of the time after 36 hours (Piesman & Spielman, 1980). No grace period can be demonstrated for Powassan virus. In laboratory studies *I. Scapularis* nymphs infected with the virus transmitted it to mice in under fifteen minutes (Ebel & Kramer, 2004).

Tick Removal Method

A 1985 study evaluated the effectiveness of five different methods of tick removal: petroleum jelly application, fingernail polish application, 70% isopropyl alcohol application, hot kitchen match application, and forcible removal with protected fingers or forceps. The first four methods are attempts to get ticks to back out of the skin (passive removal) in lieu of forcible removal, which sometimes results in a portion of the tick being left behind. It is desirable to remove ticks intact in order to avoid a local inflammatory or infectious response to mouthparts remaining attached, and to reduce exposure to tick body fluids which may contain infective organisms. None of the passive removal techniques resulted in ticks detaching within two hours. All of these methods increase risk of disease transmission by increasing the duration of tick attachment. The hot match method poses the additional risk of burning the patient, causing the tick to burst, or causing the tick to regurgitate infectious fluids into the patient. The study went on to compare different techniques for pulling ticks off. Ticks were grasped as close to the skin as possible and then either pulled up with steady pressure, pulled up with a quick motion, pulled up with a twisting motion, or pulled parallel with skin with steady pressure. No difference was found in the effectiveness of these methods for removing ticks intact (Needham, 1985).

Similar results were found in a 1993 study of removal methods conducted using *I. ricinus,* the European vector of Lyme disease (close relative to the American vector of Lyme disease, *I. scapularis).* Fingernail polish, gasoline, and denatured alcohol were all found to be ineffective at inducing detachment of ticks, with no ticks detaching within 30-60 minutes of application. The authors went on to compare mechanical methods for removing ticks, and found that pulling ticks straight left behind more tick tissue than removing ticks with a rotational motion (De Boer & van den Bogaard, 1993).

A 1998 study compared the effectiveness of medium-tipped tweezers, and the commercial products "Ticked Off," "Pro-Tick Remedy," and "The Tick Plier" at removing adults and nymphs of species that attach superficially (*D. variabilis,* the dog tick) and deeply (*A. americanum,* the lone star tick, whose attachment method is similar to *I. scapularis*). Regardless of method, lone star ticks were more difficult to remove than dog ticks, with lone star nymphs posing the most difficulty to remove without leaving mouthparts behind. Medium-tipped tweezers were deemed ineffective for the removal of lone star nymphs, while the three commercial products performed adequately (Stewart, Burgdorfer, & Needham, 1998).

A 2002 study examined the effects of timing and method of tick removal on the transmission of Lyme disease by *I. scapularis* nymphs infected with *B. burgdorferi* in a mouse model. They measured the risk posed by crushing ticks during removal with forceps, the protective benefits of tick removal at a variety of intervals post attachment, and the effectiveness of several tick removal devices:

- Ticks were removed using fine tipped forceps after 48 hours of attachment either using the technique recommended by the CDC (see above) or by grasping the tick across its entire body and crushing it while pulling. 26% of nymphs pulled by grasping the head transmitted infection, while 30% of nymphs whose bodies were crushed during pulling transmitted infection. 70% of infected nymphs allowed to remain attached to repletion transmitted infection. Although no significant difference in Lyme disease transmission was seen due to the crushing of ticks, this is not likely to be true for all tick-borne pathogens, thus it is still preferably to remove ticks without crushing.

- Tick removal at 24 hours provided 100% protection from transmission, removal at 48 hours provided 63% protection, removal at 54 hours provided 52% protection, and removal at 60 hours provided 45% protection. No protective benefit was seen from removing ticks beyond 66 hours of attachment.

- A wide variety was seen in the ability of commercial tick removal devices to remove *I. scapularis* nymphs effectively. While several devices were just as effective as fine tipped forceps (5/5 nymphs removed successfully), two (Tick Extractor and Dr. Webster's Tick Off) were ineffective on all 5 nymphs. The effectiveness of devices has to do with whether or not they were designed to remove adult ticks or nymphs (Piesman & Dolan, 2002).

The question of what tool works best to remove ticks, and pulling versus twisting motions, was revisited in a 2012 study examining *I. ricinus* ticks on pets. The authors determined that devices utilizing a twisting motion worked best based on the decreased time and force required for removal, the condition of the mouthparts of the tick (degree intact), and the reaction of the animal. Tick Twister®, a device that grips the tick in a V-shaped slot and employs a twisting motion for removal, performed best in terms of removing ticks with mouthparts intact (Duscher, Peschke, & Tichy, 2012).

Improper tick removal has been shown to be a risk factor for Lyme disease. A 1988 study of occupational risk in New Jersey found tick removal with gasoline to be a risk factor for Lyme seroprevalence (Schwartz & Goldstein, 1990).

Analysis of Ticks Post Removal

After removal, ticks can be examined to determine their species, life stage, degree of engorgement (scutal index), and they can be tested for the presence of a variety of tick-borne diseases. While doing all this testing is possible, the information learned may not ultimately change the advice or course of treatment doctors give patients that have been bitten by ticks.

Examining ticks for species identification and degree of engorgement (scutal index) provides information on the degree of risk posed by an individual bite. Identification of tick species and life stage can be useful to rule out transmission of diseases that are not carried by that species or life stage (for more information on which ticks transmit which diseases, please see our **Tick Avoidance document**). The scutal index can be used to calculate duration of attachment. Increase in duration of attachment equates with increased risk of transmission (see *Scientific Rationale for Frequent Tick Checks and Prompt Removal,* above). Doctors may find this information useful to help decide if prophylactic treatment is warranted. One study that followed patients who submitted ticks they removed from themselves for testing found an 18% Lyme disease incidence in patients who submitted *I. scapularis* nymphs attached for >72 hours, and an 25% Lyme disease incidence in patients who submitted *I. scapularis* adults attached for >72 hours (Sood et al., 1997). However, it may be difficult to obtain results from laboratories within the window of opportunity for prophylaxis. It has been suggested that in office tick identification and estimates of engorgement could also be used to decide if prophylaxis or treatment is warranted (Matuschka & Spielman, 1993).

Removed ticks can also be tested for the presence of specific pathogens. However, studies have found testing of ticks removed from patients for presence of the Lyme disease agent *B. burgdorferi*, using polymerase chain reaction (PCR) techniques, to have a high rate of false negatives caused by inactivation of the reaction by blood in the ticks. Testing of removed ticks for *B. burgdorferi* thus has limited clinically utility because a positive result doesn't necessarily equate with disease transmission and a negative result is unreliable (Sood et al., 1997).

Opinions on the utility of the information obtained through tick testing in making prophylaxis and/or treatment decisions vary amongst physicians, thus it is advisable to seek the advice of a physician prior to sending ticks out for testing. The New York State Department of Health is not currently offering tick identification and testing services. A number of state and private testing laboratories that do offer tick identification and testing can be found in an internet search.

Evidence of Protective Benefits of Tick Checks and Prompt Removal

Different studies have attempted to measure the effect of tick checks on rates of tick-borne diseases, with varying findings. A 1993 study of Hunterdon County New Jersey residents found that tick checks were utilized by a higher percentage of study participants who did not contract Lyme disease than the group who did contract Lyme disease, but the difference was not statistically significant (Orloski et al., 1998). A 1998 study in Chester County, Pennsylvania found a protective benefit from tick checks performed during outdoor activity. No benefit was seen from tick checks performed after returning inside from outdoor activity (Smith, Wileyto, Hopkins, Cherry, & Maher, 2001). In a survey of Connecticut residents conducted in the early 2000s, no protective benefit was observed from the practice of routine tick checks after outdoor activity. The authors caution that this result may be a reflection of inherent limitations of the study, and should not be used as evidence to cease in the recommendation of tick checks as a protective measure (Vazquez et al., 2008). A result more supportive of the effectiveness of tick checks was seen in a case-control study conducted in 24 Lyme endemic Connecticut communities between April 2005 and November 2007. It found a protective benefit from tick checks performed within 36 hours of spending time in a yard, and bathing within two hours spending time in the yard (Connally et al., 2009).

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