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| Question |
| **Should freezing, chemical or heat removal compared with mechanical removal be used for tick removal** |
| **Population:** | Individuals in the first aid setting with a tick attached to the skin |
| **Intervention:** | Chemical, heat or freezing |
| **Comparison:** | Mechanical removal |
| **Main outcomes:** | Transmission of disease (critical), removal of (parts of) the tick (critical), damaged or broken off mouth parts (important) |
| **Setting:** | Healthcare facility, veterinary office, laboratory  |
| **Perspective:** |  |
| **Background:** | A review was undertaken by ILCOR to identify the best removal methods for a tick attached to the skin. One high quality systematic review was found from which data was extracted. An additional literature review identified two additional articles which has additional data was abstracted.  |
| **Conflict of interests:** |  |

# Assessment

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| ProblemIs the problem a priority? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no○ Probably yes● Yes○ Varies○ Don't know | "In 2017, state and local health departments reported a [record number of cases of tickborne diseases](https://www.cdc.gov/ticks/data-summary/index.html) to CDC. The reported numbers of cases of Lyme disease, anaplasmosis/ehrlichiosis, spotted fever rickettsiosis (including Rocky Mountain spotted fever), babesiosis, tularemia, and Powassan virus disease all increased—from a total of 48,610 reported cases in 2016 to a total of 59,349 reported cases in 2017. Reported cases capture only a fraction of the overall number of people with tickborne illnesses. Even so, the number of reported cases of Lyme disease in the United States has tripled since the late 1990s." Lyme and Other Tickborne Diseases Increasing. CDC. https://www.cdc.gov/media/dpk/diseases-and-conditions/lyme-disease/index.htmlThis is an issue in Canada as well, with ticks spreading and the diseases they carry also becoming more prevalent: https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2019-45/issue-4-april-4-2019/article-2-increased-risk-tick-borne-diseases-climate-change.html and <https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html> | Tick bites are a problem. Damaged tick mouthparts are associated with localized infection, granuloma, or abscess formation. The greater morbidity is from transmission of infectious diseases such as Rock Mountain spotted fever, Lyme, etc., which is directly related to the duration of tick attachment. Early removal of a tick is key for preventing infection. Damaged mouth parts may not be related to rates of infection but rather delayed granuloma formation and less important than prevention of infectious disease. |
| Desirable EffectsHow substantial are the desirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ● Trivial○ Small○ Moderate○ Large○ Varies○ Don't know | When comparing chemical or heat treatment with mechanical removal of ticks, two observational studies {Needham 1985 997; De Boer 1993 748} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) were identified. These studies were conducted on animals (pigs and sheep) with researchers applying chemicals or heat to determine if these modalities removed ticks and then providing mechanical removal. Pooled results demonstrated that application of gasoline, nail polish, methylated spirts, petroleum jelly, 70% isopropyl alcohol or a hot kitchen match did not result in detachment of the tick from the animal (0/220). All ticks attached had to be subsequently removed mechanically (220/220). When comparing freezing of a tick with removal using mechanical devices we identified one observational study {Akin Belli 2016 393} with low certainty evidence (downgraded for risk of bias, indirectness and imprecision). In this study dermatologists attempted tick removal with a commercial freezing device (Tickner, Laboratory Tickner AG, Zug Switzerland) or three different mechanical devices [two commercial devices (Trix Ticklasso ®, Innotech, Fridhem, Sweden and Zeckenkarte, SafeCard ApS, Skanderborg, Denmark) and one tweezers]. Freezing removed 0/40 ticks, whereas a card slit and traction device removed 8/40 ticks, a lasso and traction device removed 19/40 ticks and pulling with tweezers by grasping near the mouthparts removed 40/40 ticks, the differences of which were all statistically significant (p<0.001). | Fewer mouth parts that are damaged or left in the skin, likely means less of a chance of granuloma formation or infections, but this is a minor problem compared with the risk of transmission of disease if the tick is not promptly removed. |
| Undesirable EffectsHow substantial are the undesirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Large○ Moderate○ Small● Trivial○ Varies○ Don't know | When comparing chemical or heat treatment with mechanical removal of ticks, two observational studies {Needham 1985 997; De Boer 1993 748} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) were identified. These studies were conducted on animals (pigs and sheep) with researchers applying chemicals or heat to determine if these modalities removed ticks and then providing mechanical removal. Pooled results demonstrated that application of gasoline, nail polish, methylated spirts, petroleum jelly, 70% isopropyl alcohol or a hot kitchen match did not result in detachment of the tick from the animal (0/220). All ticks attached had to be subsequently removed mechanically (220/220). When comparing freezing of a tick with removal using mechanical devices we identified one observational study {Akin Belli 2016 393} with low certainty evidence (downgraded for risk of bias, indirectness and imprecision). In this study dermatologists attempted tick removal with a commercial freezing device (Tickner, Laboratory Tickner AG, Zug Switzerland) or three different mechanical devices [two commercial devices (Trix Ticklasso ®, Innotech, Fridhem, Sweden and Zeckenkarte, SafeCard ApS, Skanderborg, Denmark) and one tweezers]. Freezing removed 0/40 ticks, whereas a card slit and traction device removed 8/40 ticks, a lasso and traction device removed 19/40 ticks and pulling with tweezers by grasping near the mouthparts removed 40/40 ticks, the differences of which were all statistically significant (p<0.001). | Fewer mouth parts that are damaged or left in the skin, likely means less of a chance of granuloma formation or infections, but this is a minor problem compared with the risk of transmission of disease if the tick is not promptly removed. |
| Certainty of evidenceWhat is the overall certainty of the evidence of effects? |
| Judgement | Research evidence | Additional considerations |
| ● Very low○ Low○ Moderate○ High○ No included studies | Only three studies were identified with low to very low certainty evidence. {Needham 1985 997; De Boer 1993 748; Akin Belli 2016 393} |  |
| ValuesIs there important uncertainty about or variability in how much people value the main outcomes? |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability○ Possibly important uncertainty or variability● Probably no important uncertainty or variability○ No important uncertainty or variability | No included studies.  | It is likely that people would desire the main outcomes of intact tick removal and prevention of disease. There is likely little uncertainty or variability in how people value the type of removal technique used. Time of attachment is probably of more value than damage to mouth parts.  |
| Balance of effectsDoes the balance between desirable and undesirable effects favor the intervention or the comparison? |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison● Probably favors the comparison○ Does not favor either the intervention or the comparison○ Probably favors the intervention○ Favors the intervention○ Varies○ Don't know | No included studies | Limited by a few studies and no direct evidence of the critical outcome of disease after manual removal. However, in general it is likely more desirable to remove the tick than leave it in place.  |
| Resources requiredHow large are the resource requirements (costs)? |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs○ Moderate costs● Negligible costs and savings○ Moderate savings○ Large savings○ Varies○ Don't know | No included studies.  | There is likely little difference in cost of resource requirements for these interventions. The cost of tweezers in the US are approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start a $1 USD. Commercial tick devices are around $4-$10. Tweezers would have multiple uses in a first aid kit. The chemicals vary in cost but are generally only a few dollars. These may expire or be less reusable. All interventions are less expensive than visiting a medical professional.  |
| Certainty of evidence of required resourcesWhat is the certainty of the evidence of resource requirements (costs)? |
| Judgement | Research evidence | Additional considerations |
| ○ Very low● Low○ Moderate○ High○ No included studies | No included studies.  | Based on cost research from the internet.  |
| Cost effectivenessDoes the cost-effectiveness of the intervention favor the intervention or the comparison? |
| Judgement | Research evidence | Additional considerations |
| ● Favors the comparison○ Probably favors the comparison○ Does not favor either the intervention or the comparison○ Probably favors the intervention○ Favors the intervention○ Varies○ No included studies | No included studies | There appears to be little efficacy for chemical treatments, mechanical removal appears to be much more efficacious. Chemicals would likely have fewer additional uses in a first aid kit than tweezers.  |
| EquityWhat would be the impact on health equity? |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced○ Probably reduced● Probably no impact○ Probably increased○ Increased○ Varies○ Don't know | No included studies.  | The use of tweezers would probably have no impact since tweezers are widely available and commonly found in households or first aid kits. A commercial device may need to be purchased and may increase disparity. While some of the specific chemicals may be already in a house other may need to be purchased specifically and may increase healthcare disparity. IN addition, the specific freezing device used was a commercial device and would need to be purchased.  |
| AcceptabilityIs the intervention acceptable to key stakeholders? |
| Judgement | Research evidence | Additional considerations |
| ○ No● Probably no○ Probably yes○ Yes○ Varies○ Don't know | No included studies.  | Most first aid providers would rather use an easy-to-use instrument like tweezers than their bare or gloved hands. Likely easier to grasp the tick, as well. Chemicals are less acceptable in some areas of the world when compared with mechanical removal. Heat and freezing could be dangerous and cause harm to the individual. If there is a decrease in contact with healthcare providers, there may be an increase need for an educational component for individuals to self-monitor for symptoms of tick borne illness.  |
| FeasibilityIs the intervention feasible to implement? |
| Judgement | Research evidence | Additional considerations |
| ○ No● Probably no○ Probably yes○ Yes○ Varies○ Don't know | No included studies.  | Due to the lack of efficacy and lack of acceptability, chemical, heat and freezing would likely not be feasible to implement. However, tweezers and commercial mechanical removal devices are likely feasible. Written directions needed (i.e., to grasp as closely to the skin as possible) in course curriculum.  |

# Summary of judgements

|  | **Judgement** |
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| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | **Trivial** | Small | Moderate | Large |  | Varies | Don't know |
| **Undesirable Effects** | Large | Moderate | Small | **Trivial** |  | Varies | Don't know |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | **Probably no important uncertainty or variability** | No important uncertainty or variability |  |  |  |
| **Balance of effects** | Favors the comparison | **Probably favors the comparison** | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | Don't know |
| **Resources required** | Large costs | Moderate costs | **Negligible costs and savings** | Moderate savings | Large savings | Varies | Don't know |
| **Certainty of evidence of required resources** | Very low | **Low** | Moderate | High |  |  | No included studies |
| **Cost effectiveness** | **Favors the comparison** | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | No included studies |
| **Equity** | Reduced | Probably reduced | **Probably no impact** | Probably increased | Increased | Varies | Don't know |
| **Acceptability** | No | **Probably no** | Probably yes | Yes |  | Varies | Don't know |
| **Feasibility** | No | **Probably no** | Probably yes | Yes |  | Varies | Don't know |

# Type of recommendation

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| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| ●  | ○  | ○  | ○  | ○  |

# Conclusions

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| Recommendation |
| We recommend against the use of chemicals, heat or ice in comparison with mechanical methods for the removal of a tick. (strong recommendation, very low certainty evidence)We suggest either pulling with tweezers or using commercial devices according to the manufacturer’s instructions to remove a tick rather than removal by hand. (weak recommendation, very low certainty evidence) |

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| Justification |
| In making this recommendation, the First Aid Task force considered the following:* Early removal of a tick is likely the most important aspect of preventing infection. The Task Force, therefore, prioritized methods of tick removal that would be safe and effective, while promoting early tick removal.
* The Task Force discussed that tweezers are likely more readily available, have more first aid uses, and are less expensive than commercial tick removal devices, and are therefore likely more feasible for use than a commercial tick removal device. It was noted by the Task Force that because tweezers are commonly available, earlier tick removal is more likely than with use of a commercial tick removal device.
* While studies differentiated adult and nymph ticks, different species of ticks and time of tick attachment/engorgement, the Task Force felt it was impractical for lay providers to differentiate their features or the potential need for different devices for removal of each stage. Therefore, these data were combined in this review.
* Only one study evaluated the different methods of removing a tick with tweezers. While this study presented some data that suggested that rotating with tweezers may result in fewer retained mouthpart than pulling, this data was of very low certainty and the study had very limited numbers. The majority of the studies reviewed used pulling with the tweezer after grasping as close to the skin as possible.
* When described in the studies, the tweezers or forceps that were used typically had a thin jaw, similar to Adson forceps, which would allow for gripping of the tick near the skin without crushing the body of the tick. While the term forceps was often used in the studies, the Task Force discussed that these devices would often be described as tweezers by the general public.
* While some studies evaluated commercial devises compared to other commercial devices, this data was of very low certainty and heterogenous in nature. Based on the data, the Task Force did not feel it was possible to recommend one type of device over another.
* The Task Force discussed that while the included studies evaluated removal of the tick and damage to the tick during removal, no studies evaluated disease transmission. In Task Force discussions it was noted that removal of the tick does not guarantee lack of disease transmission and that persons should be aware of signs of both local and systemic illness following tick bites.
* The Task Force discussed that all techniques of tick removal are subject to user error and could result in retained tick mouthparts in the skin. It was noted that persons should evaluate for retained mouthparts following tick removal.
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| Subgroup considerations |
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| Implementation considerations |
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| Monitoring and evaluation |
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| Research priorities |
| * Studies are needed among lay providers to determine the most efficacious methods of tick removal in humans.
* Studies with clinical outcomes of transmission of disease are needed to help determine the best methods of tick removal.
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# References Summary

1. de Boer R, van den Bogaard AE. Removal of attached nymphs and adults of Ixodes ricinus (Acari: Ixodidae). J Med Entomol 1993; 30(4):748-752.
2. Needham GR. Evaluation of five popular methods for tick removal. Pediatrics 1985; 75(6):997-1002.
3. Akin Belli A, Dervis E, Kar S, Ergonul O, Gargili A. Revisiting detachment techniques in human-biting ticks. J Am Acad Dermatol. 2016 Aug;75(2):393-7. doi: 10.1016/j.jaad.2016.01.032. Epub 2016 Mar 2. PMID: 26944595.