Appendix A5 FA-1 EtD Table
Cooling of Burns

QUESTION

Should a duration of less than 20 minutes compared with a duration of at least 20 minutes be used for cooling of burns with water?	
POPULATION:	Adults and children with heat induced thermal burns
INTERVENTION:	a duration of less than 20 minutes of cooling the burn area with water
COMPARISON:	a duration of 20 minutes or more of cooling with water
MAIN OUTCOMES:	Size of burn, Depth, Pain, Adverse effects (hypothermia), Wound healing, Complications (Need for skin grafting)
SETTING:	First aid
PERSPECTIVE:	Prehospital care providers
BACKGROUND:	There is inconsistency in guidelines by international organizations for the duration of cooling of thermal burns. Too short a duration of cooling may lead to need for skin grafting, prolonged medical/hospital care, or life-threatening injuries. Too long a duration of cooling of burns may lead to hypothermia or other adverse effects and complications. This review seeks to identify evidence to support recommendations for a duration of cooling with water for less than 20 minutes, or for 20 minutes or more.
CONFLICT OF INTERESTS:	None declared

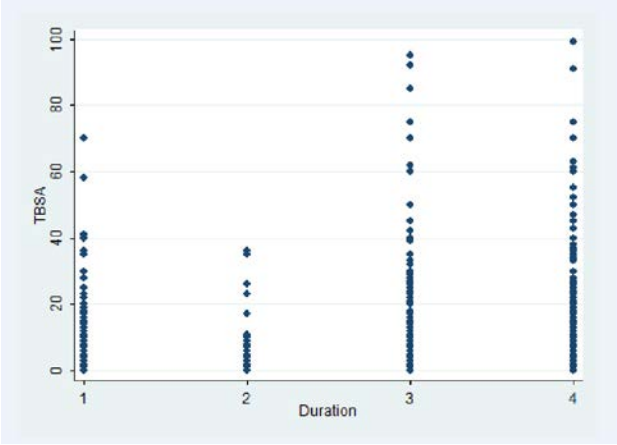
ASSESSMENT

Problem
Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know	Burn injuries remain a global health problem. Fire-related thermal burns cause the deaths of 195,000 people every year {World Health Organization 2011}. Cooling of burns with water for pain relief has been used and shown to be beneficial for many decades {Raghupati 1968 68-72}. A randomized controlled trial of the use of water to cool burns has been shown to be just as effective in reducing skin temperature as manufactured products {Cho 2017 502}. Cooling with lukewarm water has also been shown as an appropriate first aid intervention to reduce burn depth in humans {Wright 2019 1472}.	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	Since no RCTs were found, only observational cohort studies with outcomes assessed at one time were included, analysis has been done on a study population level. Summary of findings Size as a percentage of Total Body Surface Area (TBSA) for the total population: No benefit was found for cooling for 20 minutes or more compared with cooling for less than 20 minutes (Std Mean difference in size of burn in % of TBSA 0.05; 95% CI, -0.15 – 0.04). A scatterplot for size and duration of cooling was completed, see below.  Duration; 1=<5min, 2=5-10min, 3=10-20min, 4=20min or more. The figure indicates confounding by indication, i.e. larger burns have longer durations of cooling. This might be due to the effect of pain relief by cooling or the fear of a worse outcome in larger burns, although this is conjecture by the Task Force.	The depth of a burn together with its size are closely related to the main costs for burn injuries {Eser 2016 1411}. Therefore, any first aid intervention reducing the depth and/or size of a burn may be seen to be cost effective, especially if it reduces complications {Fadeyibi 2015 1322} and hospital length of stay {Riedlinger 2016 462}. The temperature of the water and the cooling technique used (running water or immersion in water) was recorded as in three studies {Fein 2014 609; Griffin 2020 75; Wood 2016 11} as 'cool running water' and in one study as 'cold water' {Cuttle 2009 1028}. An experimental human study {Wright 2019 1472} used water at a temperature of 16°C. A RCT used the coolest possible tap water, (24 °C to 27 °C) {Cho 2017 502}. However, the duration of cooling remains controversial and a lack of consistency between first aid guidance provided by health organisations has been seen. In the UK at least 10 minutes of cooling with water is recommended. The World Health Organisation recommends at least 20 minutes, with animal studies supporting a duration of 20 minutes as optimal. Several cohort studies, assessing real life practice, show that the majority of people cool burns for a much shorter period than 20minutes {Seow 2016 905; Fiandeiro 2015 457; Scheven 2012 1224} which is probably due to poor education and/or compliance {Cox 2015 1435}.

	For the critical outcome of any degree of a full thickness depth burn (yes/no), defined as deep dermal or full thickness burns, we identified very low certainty evidence (downgraded for risk of bias, inconsistency, indirectness and imprecision) from two observational studies enrolling a total of 3597 adults and children {Griffin 2020 75; Wood 2016 11}. Significant heterogeneity limited a meta-analysis, therefore the overall direction of effect could not be determined and effect estimates were used to illustrate the effect range as the synthesis method. In the cohort study in children {Griffin 2020 75}, the result was in favour of cooling for less than 20 minutes compared with cooling for less than 20 minutes (RR 0.90; 95% CI 0.83-0.97). However, in the study on adults {Wood 2016 11}, the result was opposite, i.e. in favour of cooling for 20 minutes or more over cooling for less than 20 minutes (RR 1.11, 95% CI 1.00-1.22). Days to re-epithelialization (wound healing): No benefit was found from cooling for 20 minutes or more when compared with cooling for less than 20 minutes (Std Mean Difference the wound healed 0.01 days later; 95% CI, -0.08 – 0.11). Skin grafting: No benefit was found from cooling for 20 minutes or more when compared with cooling for less than 20 minutes (RR 1.37; 95% CI, 0.61 – 3.08). For the important outcome of pain, a single study {Fein 2014 609} provided information from 24 children aged below five years old. Access to raw data revealed that the majority of children received analgesics; 10 out of 17 (59%) children with a duration of cooling for less than 20 minutes received paracetamol (7), morphine (4), or both (1) compared with 4 out of 7 (57%) children with a duration of cooling for 20 minutes or more, who received paracetamol/ibuprofen(3) and morphine(1). A sensitivity analysis was conducted and failed to demonstrate any difference for: 1. Cooling for less than 10 minutes compared to 20 minutes or more 2. Cooling for less than 10 minutes compared to 10 minutes or more 3. Two studies {Harish 2019 433; Harish 2019 1743} included a group described as receiving “inadequate first aid" without providing a definition. However, patients who did not receive first aid were excluded. Therefore, although these studies were not included in the main analysis, we performed a sensitivity analysis including them; the results remain unchanged. *See Appendix 1 -Table 1 for characteristics of studies* *See Appendix 2 – Less than 20 minutes versus 20 minutes or more* *See Appendix 3 – Less than 10 minutes versus 10 minutes or more* *See Appendix 4 – Less than 10 minutes versus 20 minutes or more*	Skin grafting is prioritized to areas of function. In general, a burn that does not heal in 2 weeks should be grafted due to high risk of scarring. All studies were completed in burn centres and the majority of burns included were small. This might indicate that these small burns were severe or in a location of the body that required hospital care. It is the Task Force’s clinical experience that small burns might not present at a health care facility able to admit to a burn centre.

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ● Moderate ○ Small ○ Trivial ○ Varies ○ Don't know	One study {Fein 2014 609} had data on hypothermia. In all, out of 117 patients, 24 had a reported duration of cooling with water. Among the 117 patients five were classified as hypothermic (36-37 degrees Celsius) or cold with shivering. All five patients were aged below four years old and had a duration of cooling less than 15 minutes. Four out of 5 were cooled in a shower, i.e., cooling of the whole body, not restricted to the burn area.	Too short a duration of cooling may not provide the anticipated effect while prolonged cooling might cause hypothermia, especially in children.

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Certainty was downgraded due to risk of bias (see figures below) and indirectness since the evidence is from studies that indirectly compare the interventions of interest in the population of interest, and only report some of the outcome(s) critical for decision-making. The main reason for downgrading is lack of certainty about how well reported the duration of cooling corresponds to actual performed cooling duration. All cooling durations were self-reported, and all outcomes were assessed after the intervention at one time-point. *See appendix 5 for bias assessment.*	

Values

Is 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 evidence found.	Patient centred outcomes might be • pain • the need for surgery/interventions rather than the size and depth of the burn.

Balance of effects

Does the balance between desirable and undesirable effects favour the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Favours the comparison ○ Probably favours the comparison ● Does not favour either the intervention or the comparison ○ Probably favours the intervention ○ Favours the intervention ○ Varies ○ Don't know	No difference in the size, depth, wound healing or the need for skin grafting was found with any particular length of cooling. All cases with hypothermia (n=5) found in the included studies were in children below 5 years old with burns of TBSA <5% who had a cooling duration of less than 15minutes.	Several studies, including the ones in our review, show that compliance with current recommendations for burn cooling is poor. In the included studies 22% of participants were cooled for less than 10 minutes and 40% for less than 20 minutes; all studies were performed in Australia/New Zealand where guidelines recommend cooling for at least 20 minutes at the time when the studies were performed. Compliance with guidelines for durations might be very poor.

Resources required

How 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 evidence.	Cooling with running water might be cheap and available in most settings. Savings relate to a lack of need to go health care facilities which might be expensive in many countries. We acknowledge that clean running water might not always be available in developing countries where most burns still occur. There is a cost savings if it can be demonstrated that cooling with water could eliminate the expense of buying 'cooling gels', or stocking of cooling devices in first aid kits.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ●No included studies	No evidence.	

Cost effectiveness

Does the cost-effectiveness of the intervention favour the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Favours the comparison ○ Probably favours the comparison ○ Does not favour either the intervention or the comparison ○ Probably favours the intervention ○ Favours the intervention ○ Varies ●No included studies	No evidence.	FA cooling with water could reduce the eventual cost of tertiary care in a burn centre

Equity

What 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 evidence.	The implementation of effective burn prevention programs and improved treatment has resulted in a significant fall in thermal burns in high-income countries. Today about 90–95% of burn injuries occur in low- and middle-income countries. Burns mostly affect the lowest socioeconomic classes and contribute to an important source of paediatric injury {WHO 2011; Wesson 2013 1477; Mitchell 2020 34}. Therefore, this first aid intervention might be very effective.

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know	No evidence.	It would appear that most people cool burns for a shorter duration than the recommended time. We also have seen a pattern that may indicate confounding by indication, i.e. in larger burns the acceptability and compliance to longer cooling durations might be higher. We speculate that this might be due to a possible pain relief by cooling and/or fear of a worse outcome. Since we are only assessing duration of cooling, most casualties who could cool as burn for 10 minutes could probably have cooled for 20 minutes and vice versa.

		Those with burns would likely find the intervention and the comparison acceptable as a mean to decrease pain and potentially reduce the need for advanced medical care.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATSIONS
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know	No evidence.	First aid guidelines exist globally but compliance varies, especially for the smaller size burns. In order to increase potential compliance a major educational programme, with associated cost, is required.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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**

	JUDGEMENT						
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

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

Recommendation

We recommend the immediate active cooling of thermal burns using running water as a first aid intervention for adults and children (strong recommendation, very low-certainty evidence).

Because no difference in outcomes could be demonstrated with the different cooling durations studied, a specific duration of cooling cannot be recommended.

Young children with thermal burns being actively cooled with running water should be monitored for signs and/or symptoms of excessive body cooling (good practice statement).

Justification

This topic was prioritized by the FA Task Force due to ongoing debate about the optimal duration of cooling of thermal burns. In 2015 the International Liaison Committee on Resuscitation (ILCOR) published a consensus on science and treatment recommendation (CoSTR) {Singletary 2015 S269; Zideman 2015 e225} with a strong recommendation for active cooling of thermal burns by first aid providers. It was noted in the Task Force insights of this CoSTR that studies included used different methods for cooling (water, gel pads) with varying temperatures, and the literature suggested that active cooling should take place as soon as possible for a minimum of 10 minutes. This led to criticism of the 10-minute minimum for cooling suggested in the studies and a proposed 20-minutes minimum duration of cooling {Goodwin 2016 1148; Walsh 2016 99}. The 20-minute duration of cooling was based on expert opinion and evidence from animal studies {Bartlett 2008 828; Cuttle 2008 626; Cuttle 2010 673}. Recent national guidelines struggle with similar challenges exemplified by the British National Institute for Health and Care Excellence (NICE) statement in their first aid guidelines (National Institute for Health 2020 webpage) with advice is based mainly on expert opinions versus scientific evidence. The Task Force sought to conduct a rigorous systematic review using studies with higher certainty evidence, utilizing expert systematic reviewers and internationally recognised burns experts.

In making these recommendations, the FA Task Force considered the following:

- Although several large human studies were identified, the evidence was found to be inconclusive to either support or to refute the use of one duration of cooling with water compared with another. Therefore, from an evidence-based perspective, the optimal duration for cooling of thermal burns with water as a first aid intervention, and the optimal technique (running water versus immersion) remains unknown.

- Very low certainty evidence failed to show a benefit in selected outcomes for a cooling duration of less than 20 minutes compared with cooling for 20 minutes or more. Likewise, we found no difference in outcome between less than 10 minutes compared to either 10 minutes or more or 20 minutes or more.

- This treatment recommendation is minimally changed from 2015. In making a strong recommendation for immediate cooling with water despite very low certainty evidence, the Task Force acknowledge that cooling with running water has previously been proved beneficial when compared with not cooling or compared with other methods of cooling in several different study designs; an animal study {Cuttle 2010 673}, an experimental study {Wright 2019 1472}, observational human studies {Cuttle 2009 1028; Tung 2005 12} and in one randomized human study {Cho 2017 502}. Guidelines might need to state a reasonable minimum cooling time suitable for the environment and epidemiology of burns in that specific geographic area.

- In Task Force discussions, it was the consensus opinion that the optimal duration of cooling may not be a rigid time but rather influenced by the burn location, the size and depth of the burn as well as the temperature of the water used for cooling. For example, more severe / extensive / painful burns might require longer durations of cooling to observe a beneficial effect.

- The Task Force discussed the effect of cooling on pain in superficial and partial thickness burns. Since cooling is thought to relieve pain it is possible that first aid providers may cool a burn until the pain has been relieved rather than for a specific duration of time. We did not have enough data to support a recommendation.

- The inclusion of the outcome of burn size was, a priori, deemed to be problematic in the ILCOR First Aid Task Force discussions. In first aid settings it is unreasonable to assume that either surface area or depth of a burn could or should be assessed before starting of cooling. It is plausible that a first aid provider may consider cooling a larger burn for a longer duration of time. A scatterplot comparing burn TBSA and duration of cooling suggests that larger burns induce longer cooling durations. Still, in burn research, the size of the burn is an essential outcome.

- A concern was raised that cooling of burns in young children might result in hypothermia. This complication was identified in children under 4 years of age, particularly following use of full body showering for cooling. Evidence of this complication supports the Good Practice Statement. Even a short cooling duration, especially if full-body cooling is used may result in hypothermia. This highlights the need for instructions on cooling techniques to minimize the risk of hypothermia.

- The review further stresses the poor compliance to the recommended duration of cooling of burns as directed in current guidelines. In total, out of 5978 included causalities with a reported duration of cooling, 2893 (47%) reported a cooling duration in line with current local guidelines (20 minutes or more) {HealthDirect 2020 webpage} and 3600 (60%) reported a cooling duration of 10 minutes or more. The Task Force discussed how the compliance to guidelines might be affected by recommending a shorter or longer duration of cooling. It is possible that recommending a shorter duration may increase compliance but conversely it could shorten the cooling duration further.

For young children with thermal burns that are being actively cooled with running water, we suggest close monitoring for signs and/or symptoms of excessive body cooling (Good Practice Statement).

Appendix A5 FA-2 EtD Table
Rehydration after Exertion-Related Dehydration

QUESTION 1:

Should Carbohydrate-electrolyte solutions vs. water be used for rehydration after exertion-related dehydration?	
POPULATION:	Rehydration after exertion-related dehydration
INTERVENTION:	Carbohydrate-electrolyte solutions
COMPARISON:	Water
MAIN OUTCOMES:	Cumulative urine output; Net fluid balance; Plasma volume changes; Haematocrit; Heart rate; Serum osmolality; Plasma osmolality; Serum sodium concentration; Thirst; Fullness; Nausea; Stomachache; Stomach upset; Bloating; Abdominal discomfort
SETTING:	Out-of-hospital setting, experimental cross-over design
PERSPECTIVE:	Guideline writers on behalf of individuals
BACKGROUND:	Strenuous exercise leads to increased heat production and sweating, which in turn can lead to loss of fluid and electrolytes. If not compensated, thermoregulatory processes will be disrupted, which can have detrimental effects on physiological function and exercise performance. Restoration of fluid balance after exercise can help to minimize this. The electrolyte balance of the ingested fluid plays a key role in the rehydration process.
CONFLICT OF INTERESTS:	None reported

ASSESSMENT

Problem
Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	Human body water accounts for 50-70% of the total body mass but, despite this abundance, it is regulated within narrow ranges. During prolonged exercise, sweat losses generally exceed fluid intake and even low levels of dehydration (about 2% of the body mass) already impair thermoregulation (Kenefick 2018, 1) and cardiovascular strain (Crandall 2010, 407; Adams 2014, 686). When these dysfunctions are allowed to progress, they can lead to impaired physical and cognitive performance (Masento 2014, 1841; Savoie 2015, 1207), syncope due to hypotension and, finally, heat illness that can be fatal (Carter 2005, 1338). In such situations, it is of utmost importance to promote post-	

	exercise drinking to restore fluid balance. For rapid and complete rehydration, the drink volume and composition are key (Osterberg 2010, 245; James 2015, 521). Although the NATA states that up to 150% of the estimated fluid deficit needs to be consumed to effectively replace fluid losses after exercise over a short recovery period (less than 4 hours) (McDermott 2017, 877), there is no clear endorsement regarding the specific type of rehydrating fluid.	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ● Small ○ Moderate ○ Large ○ Varies ○ Don't know	4-9% CE solution vs water One study showed a significant decrease in **cumulative urine output** from 4% CE solution compared with water (MD, -289 ml; 95% CI could not be calculated). In addition, 2 showed a significant decrease in cumulative urine output from 6% CE solution when compared with water (MD, -160 ml and MD, -465 ml; respectively; 95% CI could not be calculated). One study could not demonstrate a difference for cumulative urine output, when comparing 6% CE solution with water. Two showed a significant decrease of cumulative urine output when comparing 6.6% CE solution with water (MD, -241 ml and MD, -277 ml; respectively; 95% CI could not be calculated). In 5 studies a significant difference in cumulative urine output could not be demonstrated when comparing 6.5% CE, 6.9% CE, 7% CE, 8% CE or 8.75% CE solution with water. No significant differences could be demonstrated for net fluid balance, plasma volume change, hematocrit or heart rate when comparing 4-9% CE solutions with water. Low certainty evidence (downgraded for risk of bias and imprecision) from one study showed a significant increase in **serum sodium concentration** 1 h after completion of drinking 6.9% CE solution when compared with water (MD, 4 mmol/L; 95% CI could not be calculated). However, in two other studies of low certainty (downgraded for risk of bias and imprecision) a significant difference in serum sodium concentration 1h15 after completion of drinking 6% CE solution or 30 min after completion of drinking 8.75% CE solution could not be demonstrated when compared with water. Very low certainty evidence (downgraded for risk of bias, imprecision and strongly suspected publication bias) from two studies showed a significant increase in **serum osmolality** 1 h and 1h 15 after completion of drinking 6% CE solution when compared with water (MD, 5.9 mOsm/kg and 4.5 mOsm/kg; respectively; 95% CI could not be calculated). Three studies of low certainty (downgraded for risk of bias and imprecision) could not demonstrate a significant difference in serum osmolality 2 h after completion of drinking 6% CE solution, 1 h after completion of drinking 6.9% CE solution or 30 min after completion of drinking 8.75% CE solution when compared with water could not be demonstrated. No significant differences could be demonstrated for plasma osmolality when comparing 4-9% CE solutions with water. No significant differences could be demonstrated for patient satisfaction outcomes (thirst, stomach fullness, nausea, stomachache, abdominal discomfort, bloating) when comparing 4-9% CE solutions with water.	When consuming a fixed volume of beverage, a reduced urine output indicates a better retention of the consumed beverage and, hence, stimulates the rehydration process. Exertion-related dehydration was characterized by an increase in directly measured serum/plasma osmolality and electrolyte concentrations because sweat is hypotonic relative to plasma (Hooper 2015, e008846). During rehydration, restoring and maintaining high levels of plasma and serum osmolality and electrolyte concentrations is desirable and avoids the stimulation of diuresis. A rapid fall in these outcome measures during rehydration will indeed stimulate urine output and increases the risk of developing (symptoms of) hyponatremia.

	0%-3.9% CE drinks vs water Two RCTs showed a significant decrease in **cumulative urine output** from 0% CE (NaCl) solution and 3.7% CE solution compared with water (MD, -416 ml; 95% CI -786 to -46; MD, -174.5 ml; 95% CI could not be calculated; respectively). However, in 3 other randomized studies a significant difference in cumulative urine volume, when comparing 2% CE, 3.2% CE or 3.9% CE with could not be demonstrated. No significant differences could be demonstrated for net fluid balance, hematocrit or hemoglobin, plasma volume or plasma volume change or heart rate when comparing 0-4% CE solutions with water. One non-RCT and one RCT showed a significant increase in **serum sodium concentration** 1 h after completion of drinking 1.83% CE solution or 3.7% CE solution when compared with water (MD, 3.4 mmol/L and MD, 2 mmol/L; respectively; 95% CI could not be calculated). However, in one other randomized study a significant difference in serum sodium concentration could not be demonstrated, when comparing 3.2% CE solution with water. One non-RCT and one RCT showed a significant increase in **serum osmolality** 1 h after completion of drinking 1.83% CE solution or 3.7% CE solution when compared with water (MD, 9.0 mOsm/kg and MD, 4 mOsm/kg respectively; 95% CI could not be calculated). In one randomized study a significant difference in serum osmolality, 1 h after completion of drinking 3.2% CE when compared with water, could not be demonstrated. Additionally, in 2 other randomized studies, a significant difference in plasma osmolality 1 h after completion of drinking 2% CE or 3.9% CE solution when compared with water could not be demonstrated. Furthermore, a significant difference in plasma osmolality 2 h after completion of drinking 2% CE or 3.9% CE solution when compared with water could also not be demonstrated. No significant differences could be demonstrated for patient satisfaction outcomes (thirst, stomach fullness, nausea, stomach upset) when comparing 4-9% CE solutions with water.	

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	No undesirable effects were identified.	

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Downgraded due to serious risk of bias and imprecision due to small sample sizes and lack of data. In some studies, publication bias is strongly suspected.	Bias was assessed per study and patient satisfaction outcomes were assessed separately, since for these outcomes, lack of blinding may influence the outcome assessment. In addition, we suspect that some study findings may be biased by industry funding and sponsorship

Values

Is 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		

Balance of effects

Does 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 undesirable effects, some beneficial effects.	

Resources required

How 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	Prices of sports drinks in Belgium: Gatorade: 1.83€ for 0.5L Acquarius: 1.60€ for 0.5 L	In general, CE drinks are more expensive than water, particularly tap water.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● No included studies		

Cost effectiveness

Does 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		

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ● Probably reduced ○ Probably no impact ○ Probably increased ○ Increased		The higher cost of CE solutions compared with water will decrease the equity. Particularly in places where tap water is potable.

○ Varies ○ Don't know		

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know		CE drinks are probably very acceptable amongst people performing exercise. On the other hand, the higher cost and requirement to store bottles could make it less acceptable than water, especially in areas where tap water is drinkable. CE drinks may be less feasible than water, primarily due to cost, but it would also require storage of bottles. Particularly in areas where tap water is drinkable.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know		CE drinks may be less feasible than water, primarily due to cost, but it would also require storage of bottles. Particularly in areas where tap water is drinkable.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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			

	JUDGEMENT						
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

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
○	○	○	●	○

QUESTION 2:

Should low-fat or skim milk vs. water be used for rehydration after exertion-related dehydration?	
POPULATION:	Rehydration after exertion-related dehydration
INTERVENTION:	Low-fat or skim milk
COMPARISON:	Water

MAIN OUTCOMES:	Cumulative urine; Net fluid balance; Plasma osmolality; Thirst; Bloating
SETTING:	Out-of-hospital setting, experimental cross-over design
PERSPECTIVE:	Guideline developers on behalf of individuals
BACKGROUND:	Strenuous exercise leads to increased heat production and sweating, which in turn can lead to loss of fluid and electrolytes. If not compensated, thermoregulatory processes will be disrupted, which can have detrimental effects on physiological function and exercise performance. Restoration of fluid balance after exercise can help to minimize this. The electrolyte balance of the ingested fluid plays a key role in the rehydration process.
CONFLICT OF INTERESTS:	None reported

ASSESSMENT

Problem

Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	Human body water accounts for 50-70% of the total body mass but, despite this abundance, it is regulated within narrow ranges. During prolonged exercise, sweat losses generally exceed fluid intake and even low levels of dehydration (about 2% of the body mass) already impair thermoregulation (Kenefick 2018, 1) and cardiovascular strain (Crandall 2010, 407; Adams 2014, 686). When these dysfunctions are allowed to progress, they can lead to impaired physical and cognitive performance (Masento 2014, 1841; Savoie 2015, 1207), syncope due to hypotension and, finally, heat illness that can be fatal (Carter 2005, 1338). In such situations, it is of utmost importance to promote post-exercise drinking to restore fluid balance. For rapid and complete rehydration, the drink volume and composition are key (Osterberg 2010, 245; James 2015, 521). Although the NATA states that up to 150% of the estimated fluid deficit needs to be consumed to effectively replace fluid losses after exercise over a short recovery period (less than 4 hours) (McDermott 2017, 877), there is no clear endorsement regarding the specific type of rehydrating fluid.	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ● Small ○ Moderate ○ Large ○ Varies	Very low certainty evidence (downgraded for risk of bias, imprecision and suspected publication bias) from 4 studies showed a significant decrease of **cumulative urine output** from skim or low-fat cow's milk compared with water (MD, -368 ml; MD, -635 ml; MD, -594 ml and MD, -175 ml; respectively; 95% CI could not be calculated; $P<0.05$).	When consuming a fixed volume of beverage, a reduced urine output indicates a better retention of the consumed beverage and, hence, stimulates the rehydration process.

○ Don't know	Very low certainty evidence (downgraded for risk of bias, imprecision and suspected publication bias) from 3 studies showed a significant increase in **net fluid balance** after 1 h (MD, 655 ml; MD, 368 ml and MD, 111 ml; respectively; 95% CI could not be calculated; P<0.05) and 2 h (MD, 675 ml; MD, 621 ml and MD, 179 ml; respectively; 95% CI could not be calculated; P<0.05) from skim milk when compared with water. In addition, very low certainty evidence from one study showed a significant increase in net fluid balance after 30 min to 1.5 h (MD, 0.26 L; 95% CI could not be calculated; P<0.05) or after 1.5 to 2.5 h (MD, 0.36 L; 95% CI could not be calculated; P<0.05) from low-fat cow's milk when compared with water. Very low certainty evidence (downgraded for risk of bias, imprecision and suspected publication bias) from one study showed a significant increase in **plasma osmolality** after 1.5 to 2.5 h from skim milk when compared with water (MD, 3 mOsm/kg; 95% CI could not be calculated; P<0.05). However, low certainty evidence (downgraded for risk of bias and imprecision due to limited sample size and lack of data) from another study could not demonstrate a significant difference for plasma osmolality from skim milk when compared with water after 1 h and 2.	Restoration of the net fluid balance is beneficial and larger values indicate the sweat losses are replaced effectively. Exertion-related dehydration was characterized by an increase in directly measured serum/plasma osmolality and electrolyte concentrations because sweat is hypotonic relative to plasma (Hooper 2015, e008846). During rehydration, restoring and maintaining high levels of plasma and serum osmolality and electrolyte concentrations is desirable and avoids the stimulation of diuresis. A rapid fall in these outcome measures during rehydration will indeed stimulate urine output and increases the risk of developing (symptoms of) hyponatremia.

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know	Very low certainty evidence (downgraded for risk of bias, imprecision and suspected publication bias) from one study showed significantly more **stomach fullness** immediately after drinking low-fat cow's milk (MD, 10 (30 min rehydration period) and MD, 34 (90 min rehydration period); 95% CI could not be calculated; P<0.05), 30 min after drinking milk (MD, 18 (90 min rehydration period); 95% CI could not be calculated; P<0.05) and 90 min after drinking milk (MD, 17 (30 min rehydration period) and MD, 11 (90 min rehydration period); 95% CI could not be calculated, P<0.05) when compared with water. Very low certainty evidence (downgraded for risk of bias, imprecision and suspected publication bias) from 2 other studies could not demonstrate a significant difference in stomach fullness immediately after drinking skim milk, when compared with water. Very low certainty evidence (downgraded for risk of bias, imprecision and strongly suspected publication bias) from one study showed significantly more bloating immediately after drinking low-fat cow's milk (MD, 9 (30 min rehydration period) and MD, 9 (90 min rehydration period); 95% CI could not be calculated; P<0.05), 30 min after drinking milk (MD, 14 (90 min rehydration period); 95% CI could not be calculated; P<0.05) and 90 min after drinking milk (MD, 10 (30 min rehydration period) and MD, 5 (90 min rehydration period); 95% CI could not be calculated, P<0.05) when compared with drinking water. Very low certainty evidence (downgraded for risk of bias, imprecision and strongly suspected publication bias) from one other study could not demonstrate a significant difference in bloating immediately after or 2 h after drinking skim milk, when compared with water.	Patient satisfaction outcomes (thirst, stomach fullness, bloating, nausea) were measured with a Visual Analogue Scale (VAS). Lower scores are beneficial when assessing patient satisfaction after drinking. For patients with lactose intolerance, the use of milk may induce diarrhea. This could hamper the effect of rehydration or even worsen the dehydration status, and becomes an important undesirable effect in this group of patients,

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Downgraded due to serious risk of bias and imprecision due to small sample sizes and lack of data. In some studies, publication bias is strongly suspected.	Bias was assessed per study and patient satisfaction outcomes were assessed separately, since for these outcomes, lack of blinding may influence the outcome assessment.

Values

Is 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		

Balance of effects

Does 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	There are beneficial effects for rehydration, but there are some undesirable effects when looking at patient satisfaction outcomes	There may be beneficial effects for milk, but fullness and bloating will affect athletics and therefore, performance and may not be used. For patients with lactose intolerance, the undesirable effect of diarrhea may outweigh the desirable effect of rehydration.

Resources required

How 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		Milk is not very expensive but may have a higher cost than water. The cost of whole milk varies between 2.71 USD and 8.99 USD per gallon in the US depending on geography and milk type. https://www.ams.usda.gov/sites/default/files/media/RetailMilkPrices.pdf The equipment or resources for milk storage (e.g. refrigerator, ice bag, or insulation bag) may further increase the cost. From the logistics point of view, the limited period of use also increases the cost of milk.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● No included studies		

Cost effectiveness

Does 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		The monthly cost of water for a family of 4 is 115.50 USD per 150 gal or 0.77 USD per gallon. https://www.circleofblue.org/2019/world/2019-price-of-water/ The cost of milk plus the storage equipment makes milk less cost-effective than water.

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ● Probably reduced ○ Probably no impact ○ Probably increased	Milk is often available and consumed, but this is not the case in all countries (https://www.statista.com/statistics/272003/global-annual-consumption-of-milk-by-region/)	Equity is probably reduced because of the expense and potential refrigeration requirements.

○ Increased ○ Varies ○ Don't know	65% or more of the total human population are lactose intolerant (Vuorisalo 2012, 163). In some regions, the prevalence of lactose intolerance is higher than in other regions, making milk a less suitable rehydration solution. (https://milk.procon.org/lactose-intolerance-by-country/).	

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know	Depends on the perception of what is needed for rehydration. Most people will believe water is best for rehydration, and not think about milk (Saheen 2018, 1346).	Milk may be less acceptable by people that do not use animal products. For patients with lactose intolerance, the undesirable effect of diarrhea may reduce the acceptability.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know		Milk generally requires refrigeration, which may not always be accessible. Skim milk may not always be available versus other milk fat concentrations. Improperly stored or spoiled milk may have significant adverse effect. Storage and taste will be issues affecting usage, particularly in organized sport. Milk is less feasible than water due to cost, refrigeration and reliance on animal product and potentially needing a specific milk fat concentration.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

	JUDGEMENT						
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

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
○	○	○	●	○

QUESTION 3:

Should coconut water (fresh or from concentrate) vs. water be used for rehydration after exertion-related dehydration?	
POPULATION:	Rehydration after exertion-related dehydration
INTERVENTION:	Coconut water (fresh or from concentrate)
COMPARISON:	Water
MAIN OUTCOMES:	Cumulative urine output; Net fluid balance; Plasma volume change; Heart rate; Serum osmolality; Serum sodium concentration; Plasma osmolality; Thirst; Fullness; Nausea; Stomach ache; Stomach upset; Bloating
SETTING:	Out-of-hospital setting, experimental cross-over design
PERSPECTIVE:	Guideline developers on behalf of individuals
BACKGROUND:	Strenuous exercise leads to increased heat production and sweating, which in turn can lead to loss of fluid and electrolytes. If not compensated, thermoregulatory processes will be disrupted, which can have detrimental effects on physiological function and exercise performance. Restoration of fluid balance after exercise can help to minimize this. The electrolyte balance of the ingested fluid plays a key role in the rehydration process.
CONFLICT OF INTERESTS:	None reported

ASSESSMENT

Problem

Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	Human body water accounts for 50-70% of the total body mass but, despite this abundance, it is regulated within narrow ranges. During prolonged exercise, sweat losses generally exceed fluid intake and even low levels of dehydration (about 2% of the body mass) already impair thermoregulation (Kenefick 2018, 1) and cardiovascular strain (Crandall 2010, 407; Adams 2014, 686). When these dysfunctions are allowed to progress, they can lead to impaired physical and cognitive performance (Masento 2014, 1841; Savoie 2015, 1207), syncope due to hypotension and, finally, heat illness that can be fatal (Carter 2005, 1338). In such situations, it is of utmost importance to promote post-exercise drinking to restore fluid balance. For rapid and complete rehydration, the drink volume and composition are key (Osterberg 2010, 245; James 2015, 521). Although the NATA states that up to 150% of the estimated fluid deficit needs to be consumed to effectively replace fluid losses after exercise over a short recovery period (less than 4 hours) (McDermott 2017, 877), there is no clear endorsement regarding the specific type of rehydrating fluid.	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Trivial ● Small ○ Moderate ○ Large ○ Varies ○ Don't know	One study showed a significant increased **serum sodium concentration** 1 h after drinking fresh coconut water, when compared with drinking water (MD, 2 mmol/l; 95% CI could not be calculated; P<0.05). However, another study could not demonstrate a significant difference in serum sodium concentration 1 h after drinking fresh coconut water when compared with drinking water. One study showed a significant increase in **serum osmolality** 1 h after drinking fresh coconut water when compared with water (MD, 3 mOsm/kg; 95% CI could not be calculated; P<0.05). However, another study could not demonstrate a significant difference in serum osmolality 1 h after drinking fresh coconut water when compared with drinking water. One study could not demonstrate a significant difference in plasma osmolality 2 h after drinking fresh coconut water when compared with drinking water. However, the same study showed a significant increase in **plasma osmolality** 2 h after drinking coconut water from concentrate when compared with drinking water (MD, 1.5; 95% CI could not be calculated; P=0.049). Very low certainty evidence (downgraded for risk of bias, imprecision and strongly suspected publication bias) from 2 studies could not demonstrate a significant difference in **nausea** immediately after drinking fresh coconut water when compared with water. On the other hand, low certainty evidence (downgraded for risk of bias and imprecision) from one study showed a significant decrease in **nausea** immediately after and 1 h after drinking fresh coconut water, when compared with drinking water (MD, -1.75 and MD, -1.25 (1-5 scale); respectively; 95% CI could not be calculated; P<0.05). In one study a difference in nausea 1 h after drinking fresh coconut water could not be demonstrated, when compared with drinking water. Low certainty evidence from one study showed a significant decrease in **stomach upset** immediately after drinking fresh coconut water when compared with water (MD, -1, 95% CI could not be calculated; P<0.05). However, in 2 other studies of low certainty (downgraded for risk of bias and imprecision), a significant difference for stomach upset immediately after drinking fresh coconut water could not be demonstrated, when compared with water. Low certainty evidence from one study could also not demonstrate a significant difference for stomach upset immediately after drinking coconut water from concentrate when compared with drinking water.	Exertion-related dehydration was characterized by an increase in directly measured serum/plasma osmolality and electrolyte concentrations because sweat is hypotonic relative to plasma (Hooper 2015, e008846). During rehydration, restoring and maintaining high levels of plasma and serum osmolality and electrolyte concentrations is desirable and avoids the stimulation of diuresis. A rapid fall in these outcome measures during rehydration will indeed stimulate urine output and increases the risk of developing (symptoms of) hyponatremia. Patient satisfaction outcomes (thirst, stomach fullness, bloating, nausea) were measured with a Visual Analogue Scale (VAS). Lower scores are beneficial when assessing patient satisfaction after drinking.

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	Low certainty evidence (downgraded for risk of bias and imprecision) from one study could not demonstrate a significant difference for stomach upset 1 h after drinking fresh coconut water or coconut water from concentrate when compared with drinking water. However, the same study showed a significant increase in **stomach upset** 2 h after drinking fresh coconut water or coconut water from concentrate when compared with water (MD, 1.84 (1-5 scale) and MD, 1.47; respectively; 95% CI could not be calculated; P<0.05).	Patient satisfaction outcomes (thirst, stomach fullness, bloating, nausea) were measured with a Visual Analogue Scale (VAS). Lower scores are beneficial when assessing patient satisfaction after drinking.

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

● Very low ○ Low ○ Moderate ○ High ○ No included studies	Downgraded for serious risk of bias, imprecision and for some studies, publication bias was strongly suspected.	Bias was assessed per study and patient satisfaction outcomes were assessed separately, since for these outcomes, lack of blinding may influence the outcome assessment.

Values

Is 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		

Balance of effects

Does 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	The beneficial effects probably outweigh the undesirable effects for one outcome in one study.	

Resources required

How 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		VitaCoco (fresh coconut water) costs 3.33£ per liter (Amazon). In places where coconuts do not grow naturally, the costs will be higher and coconut water will therefor require more resources.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● No included studies		

Cost effectiveness

Does 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		

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ● Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies	Coconut water is by far the leading plant-based water available for sale worldwide. In 2016, coconut water accounted for 96 percent of the volume share in the global sale of all plant-based water with over 700 million liters sold and with a market value of about 2.2 billion U.S. dollars.	In places where coconuts do not grow naturally, the cost for coconut water is high, and may therefor lead to reduced equity.

○ Don't know	https://www.statista.com/topics/3500/coconut-water/#:~:text=Coconut%20water%20is%20by%20far,about%202.2%20billion%20U.S.%20dollars	

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know		Coconut water is probably an acceptable intervention to key stakeholders. Coconut water has a certain taste and might not be favoured by everyone.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know		The cost may be the biggest factor in feasibility. It is probably more feasible in places where coconuts grow naturally.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

	JUDGEMENT						
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

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
○	○	○	●	○

QUESTION 4:

Should beer (0%-5% alcohol) vs. water be used for rehydration after exertion-related dehydration?	
POPULATION:	Rehydration after exertion-related dehydration
INTERVENTION:	Beer (0-5% alcohol)
COMPARISON:	Water
MAIN OUTCOMES:	Cumulative urine; Fluid balance; Plasma volume change; Serum sodium concentration; Hematocrit.
SETTING:	Out-of-hospital setting, experimental cross-over design
PERSPECTIVE:	Guideline developers on behalf of individuals

BACKGROUND:	Strenuous exercise leads to increased heat production and sweating, which in turn can lead to loss of fluid and electrolytes. If not compensated, thermoregulatory processes will be disrupted, which can have detrimental effects on physiological function and exercise performance. Restoration of fluid balance after exercise can help to minimize this. The electrolyte balance of the ingested fluid plays a key role in the rehydration process.
CONFLICT OF INTERESTS:	None reported

ASSESSMENT

Problem
Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	Human body water accounts for 50-70% of the total body mass but, despite this abundance, it is regulated within narrow ranges. During prolonged exercise, sweat losses generally exceed fluid intake and even low levels of dehydration (about 2% of the body mass) already impair thermoregulation (Kenefick 2018, 1) and cardiovascular strain (Crandall 2010, 407; Adams 2014, 686). When these dysfunctions are allowed to progress, they can lead to impaired physical and cognitive performance (Masento 2014, 1841; Savoie 2015, 1207), syncope due to hypotension and, finally, heat illness that can be fatal (Carter 2005, 1338). In such situations, it is of utmost importance to promote post-exercise drinking to restore fluid balance. For rapid and complete rehydration, the drink volume and composition are key (Osterberg 2010, 245; James 2015, 521). Although the NATA states that up to 150% of the estimated fluid deficit needs to be consumed to effectively replace fluid losses after exercise over a short recovery period (less than 4 hours) (McDermott 2017, 877), there is no clear endorsement regarding the specific type of rehydrating fluid.	Alcohol inhibits arginine vasopressin release, and beverages with an alcohol content above 2% reduce fluid retention during rehydration. However, in well-hydrated individuals, rehydration with beverages containing up to 4% alcohol did not increase urine output. Research also suggests that the influence of hypovolemia on renal fluid retention is more potent than the diuretic effect of alcohol. Drinks with increasing alcohol content (greater than 4%) facilitate excessive diuresis and should be discouraged for fluid replacement. (McDermott 2017, 877).

Desirable Effects
How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	No desirable effects reported	

Undesirable Effects
How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know	Regular beer (4.5-5% alcohol) vs water Very low certainty evidence (downgraded for risk of bias, imprecision and lack of data, and suspected publication bias) from 2 studies could not demonstrate a significant difference in **cumulative urine output** from drinking regular beer compared with drinking water. However, in one study, drinking regular beer compared with water, resulted in a statistically significant increase of cumulative urine output (MD, 444 ml; 95% CI could not be calculated, P=0.043). No undesirable effects reported for 0.5-2% beer or 0% beer.	When consuming a fixed volume of beverage, a reduced urine output indicates a better retention of the consumed beverage and, hence, stimulates the rehydration process.

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Evidence downgraded for serious risk of bias and imprecision. In some studies, publication bias is strongly suspected.	Bias was assessed per study and patient satisfaction outcomes were assessed separately, since for these outcomes, lack of blinding may influence the outcome assessment.

Values

Is 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		

Balance of effects

Does 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	Beer (in any percentage) does not seem to have any beneficial effects, compared with water. There may be small undesirable effects (increased cumulative urine for 4.6% beer in one study).	

Resources required

How 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	The cost for a pint ranges from £0.32 in Venezuela up to £10.86 in Qatar. (https://www.finder.com/uk/international-pint-price-map) The monthly cost of water for a family of 4 is 115.50 USD per 150 gal or 0.77 USD per gallon. https://www.circleofblue.org/2019/world/2019-price-of-water/	In some places, beer is cheaper and more available than water.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● No included studies		

Cost effectiveness

Does 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 significant differences for almost all outcomes, water is most of the time cheaper than beer.

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ● Probably reduced ○ Probably no impact		Beer may not be easily available in all parts of the world. It is not consumed by all populations (e.g. because of age or religion). In addition, in most places, beer is more expensive than water.

○ Probably increased ○ Increased ○ Varies ○ Don't know		

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ● Probably no ○ Probably yes ○ Yes ○ Varies ○ Don't know	The use of alcoholic beverages may have other unwanted effects and is probably not recommended as a rehydration beverage for competitive athletes. Moreover, alcohol may have a diuretic effect, which increases with increasing alcohol levels (Maughan 2016, 717).	Due to the (often) higher cost of beer and some populations that don't drink beer, this may be less acceptable.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ● Probably no ○ Probably yes ○ Yes ○ Varies ○ Don't know		Beer would be less feasible due to cost, acceptability and the risk of intoxication with higher alcohol percentages.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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			

	JUDGEMENT						
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

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

Recommendation

We recommend the use of any readily available rehydration drink or water for treating exertion related dehydration in the first aid setting. (Good Practice Statement)

We suggest rehydration for exertion-related dehydration using a 4-9% carbohydrate-electrolyte drink. Alternative rehydration options include 0-3.9% carbohydrate-electrolyte drinks, water, coconut water or skim or low-fat cow's milk (weak recommendation, very low certainty evidence).

There is insufficient evidence to recommend for or against rehydration with beer (0-5% alcohol).

Justification

Although there is variability among the identified studies, we identified a potential beneficial effect with use of CE drinks compared with water for many of the reviewed outcomes. Differences seen in urine production between the various drinks used for rehydration were discussed by the task force and are likely a result of the drink composition. Ingested drinks with high energy content (i.e. from carbohydrate, fat, protein or alcohol) will empty from the stomach more slowly than drinks containing no energy. They will therefore potentially reduce or delay diuresis when compared with water. In other words, when large volumes of dilute drinks are consumed, a fall in serum electrolyte concentrations and osmolality occurs and urine production and excretion are stimulated. However, if the electrolyte concentration of a rehydration drink is high, this will maintain high serum or plasma electrolyte concentration and osmolality, reducing the excretion of dilute urine. As a consequence, low cumulative urine outputs and, hence, high net fluid balances can be associated with improved fluid retention and, hence, effective rehydration.

In cases of exertional dehydration, it is most important to rehydrate as soon as possible. The choice will often be made based on what the dehydrated person is willing to drink; the drink needs to be palatable to increase patient compliance with the need for increased fluid intake. This is suggested as a good practice statement.

First aid providers are commonly recruited to assist at first aid stations located at sporting and challenge events where exercise-induced dehydration is a common problem. It may not be possible to determine the exact quantity or percent of fluid loss in the first aid setting, nor the volume required for adequate rehydration.

This PICO question specifically looked at sodium levels reported after rehydration in the included studies and agreed that oral rehydration with CE drinks may assist in preventing hyponatremia, although this review did not specifically address exercise-associated hyponatremia. In addition, all included studies conducted exercise in a controlled environment and for a specific time period. Extreme events such as ultramarathons were not included in the evidence evaluation.

Excessive fluid consumption may lead to an electrolyte imbalance, specifically, a drop in plasma/serum sodium concentration. This reduction in sodium concentration may result in clinical hyponatremia, a rare condition but not infrequently seen in endurance athletes. Signs and symptoms of exertional hyponatremia include excessive drinking, nausea, vomiting, dizziness, muscular twitching, peripheral tingling or swelling, headache, disorientation, altered mental status, physical exhaustion, pulmonary edema, seizures, and cerebral edema.

If clean, drinkable water is available, its cost, relative to CE drinks, make it an acceptable alternative. However, water may require a longer time to rehydrate and, in some cases, may be associated with an increased risk of hyponatremia.

Subgroup considerations

Skim or low-fat cow's milk appears to have a similar water, energy and macronutrient content as sports drinks. This explains the beneficial effects of milk on rehydration. However, rehydration with milk may be associated with other issues of patient satisfaction or compliance when compared with water.

The Task Force discussed that the use of alcoholic beverages may have other unwanted effects and is probably not recommended as a rehydration beverage for competitive athletes. Moreover, alcohol may have a diuretic effect, which increases with increasing alcohol levels.

Implementation considerations

In some regions, the prevalence of lactose intolerance is higher than in other regions, making milk a less suitable rehydration solution. The use of milk by people with lactose intolerance may induce adverse effects such as diarrhea, which could hamper the effects of rehydration. A further challenge is that milk generally needs refrigeration, which may not always be accessible.

Coconut water may be more costly in geographic regions where fresh coconuts are not readily available. In addition, some people may find coconut water less palatable than water.

Monitoring and evaluation

Research priorities

How can a first aid provider determine the amount of liquid required for rehydration?

How can a first aid provider determine the amount of time required to ensure adequate rehydration?

How can a first aid provider determine the chemical composition of available rehydration products?

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Appendix A5 FA-3 EtD Table
Paediatric Tourniquet

QUESTION

Should a windlass tourniquet compared with no tourniquet or another tourniquet design be used for control of life-threatening extremity bleeding in children?	
POPULATION:	Children under 19 years of age
INTERVENTION:	Windlass or other design of tourniquet
COMPARISON:	No tourniquet
MAIN OUTCOMES:	Critical: Cessation of bleeding in upper extremities; Cessation of bleeding in lower extremities; Important: Adverse events. Surrogate outcome for cessation of bleeding is obliteration of doppler pulses in extremities.
SETTING:	Healthcare facility or prehospital setting
PERSPECTIVE:	
BACKGROUND:	A systematic review was completed in 2020 on control of life-threatening bleeding in adults and children. Minimal evidence was identified regarding use of a tourniquet in children. Tourniquets are designed for adults and child-specific tourniquets not yet available. A scoping review on this topic identified experimental studies using manikins or PVC pipes, suggesting failure to tighten appropriately on models of small circumference. A systematic review was undertaken to evaluate all evidence from studies performed in children.
CONFLICT OF INTERESTS:	NPC, CG, ES and DZ are authors of the systematic review on control of life-threatening bleeding {Charlton 2020 1}

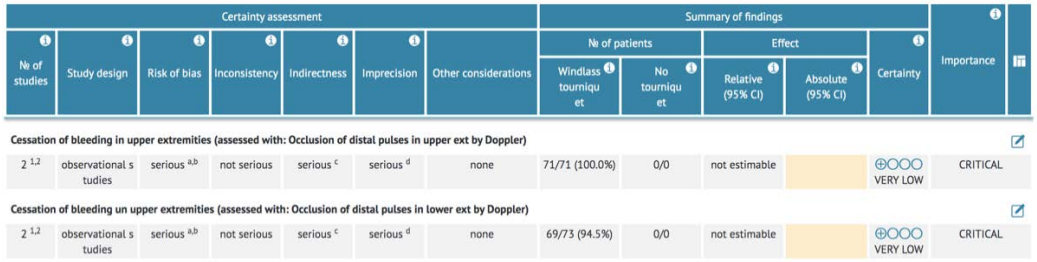
ASSESSMENT

Problem
Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	In 2016, 1,065 children succumbed to injuries sustained in motor vehicle collisions, 187 died after having been struck by a vehicle, and 71 perished due to lacerations. {Ross 2018} Unintentional injury remains the leading cause of death for pediatric persons ages 0–19 years and over 600 children die annually as a result of gun violence. {Gonzalez 2015 4} Military studies have suggested that tourniquets are life-saving in pediatric traumatic extremity injuries. {Sokol 2015 983, Kragh 2012 1361} In addition, pediatric trauma societies recommend the use of tourniquets for life-threatening extremity bleeding the in the pediatric population. {Bobko 2013 94, Cunningham 2018 665}	While pediatric severe limb bleeding is not as frequent as in adults when it occurs, its implications are significant.

Desirable Effects
How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	Two observational studies enrolling children ages 2 to 16 years demonstrated Doppler occlusion of distal pulses in 71/71 upper extremities and 69/73 lower extremities with use of a windlass tourniquet (specifically the Combat Application Tourniquet). {Harke 2019 e20183447, Kelly 2020 644} Participants did not have active bleeding and occlusion of pulses was used as a surrogate outcome for cessation of bleeding. There were no controls so it is unclear how this would relate to direct pressure alone. In addition, prior observational studies performed in adults also demonstrate an improvement in survival with tourniquet use. {Charlton 2020 1}	



Certainty assessment							Summary of findings						
							№ of patients		Effect				
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Windlass tourniquet	No tourniquet	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance	
Cessation of bleeding in upper extremities (assessed with: Occlusion of distal pulses in upper ext by Doppler)													
2 [1,2]	observational studies	serious [a,b]	not serious	serious [c]	serious [d]	none	71/71 (100.0%)	0/0	not estimable		⨁◯◯◯ VERY LOW	CRITICAL	
Cessation of bleeding un upper extremities (assessed with: Occlusion of distal pulses in lower ext by Doppler)													
2 [1,2]	observational studies	serious [a,b]	not serious	serious [c]	serious [d]	none	69/73 (94.5%)	0/0	not estimable		⨁◯◯◯ VERY LOW	CRITICAL	

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know	Pain limiting application of the tourniquet was a factor in 1 child (1 tourniquet application of 120 total applications) reported in one study. {Kelly 2020 644} Prior adult studies do not demonstrate a difference in significant side effects for those who had a tourniquet placed compared with those that did not have a tourniquet placed. {Charlton 2020 1}	Pain is an anticipated adverse effect from tourniquet application but led to premature removal in one child. This was treated as a tourniquet failure.

Certainty assessment							Summary of findings					
							№ of patients		Effect			
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Windlass tourniquet	No tourniquet	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Cessation of bleeding in upper extremities (assessed with: Occlusion of distal pulses in upper ext by Doppler)												
2 [1,2]	observational studies	serious [a,b]	not serious	serious [c]	serious [d]	none	71/71 (100.0%)	0/0	not estimable		⨁◯◯◯ VERY LOW	CRITICAL
Cessation of bleeding un upper extremities (assessed with: Occlusion of distal pulses in lower ext by Doppler)												
2 [1,2]	observational studies	serious [a,b]	not serious	serious [c]	serious [d]	none	69/73 (94.5%)	0/0	not estimable		⨁◯◯◯ VERY LOW	CRITICAL
Adverse events												
1 [1]	observational studies	serious [a,b]	not serious	serious [c]	serious [d]	none	1/120 (0.8%)	0/0	not estimable		⨁◯◯◯ VERY LOW	IMPORTANT

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Very low certainty evidence from observational studies, downgraded for bias, indirectness and imprecision. {Harke 2019 e20183447, Kelly 2020 644} Addition data extrapolated from adult studies. {Charlton 2020 1}	

Values

Is 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 relevant studies	While no relevant studies were identified, it is likely that stakeholders would value the ability to control severe, life-threatening limb bleeding in a pediatric patient.

Balance of effects

Does 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 relevant studies	While there are no relevant studies available for comparison, the studies in this review demonstrate occlusion of distal pulses with the use of a CAT windlass tourniquet. The only adverse event in these studies was pain, limiting application in 1 child. {Kelly 2020 644} Adult studies demonstrate improvement in patient outcome with no increase in adverse events. {Charlton 2020 1}

Resources required

How 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	Per online stores: United States Cost: Generation 7 CAT is $25-35 US SOFT-T $32.95 SWAT-T $11.95 South African cost: CAT - R1034.68 = $56 SWAT T - R259 = $14 US Australian cost: CAT—T approx $65 AUD SOF-T approx $45 AUD	The cost is variable depending on the product but can range from $15-$40 USD. Specifically, the CAT Gen 7 can cost between $25-$35 USD. This represents a significant amount of money in some geographic regions. However, the potential decrease in the need for blood transfusion, length of ICU stays, or lost productivity due to preventable mortality could vastly offset this expense.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	No relevant studies	All data gathered was from online information of average cost of the products per region.

Cost effectiveness

Does 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 relevant studies	There are no available studies to compare the cost effectiveness of manufactured tourniquets compared with direct manual compression on an individual or population level. However, it was felt by the task force that the benefit of saving a life would outweigh the cost of a tourniquet.

Equity

What 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 relevant studies	As with most medical devices, lower socioeconomic groups can experience a reduction in health equity due to the cost of manufactured tourniquets. While on both an individual and population level, the cost of a tourniquet is more than the use of direct manual pressure and in some instances the cost may impair purchase, the potential decrease in the need for blood transfusion, length of ICU stays, or lost

		productivity due to preventable mortality could vastly offset this expense.

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	No relevant studies	Despite the additional expense and training requirements associated with use of a tourniquet, and despite the adverse effect of pain, the task force consensus is that because of its potential life-saving benefits, most stakeholders would consider tourniquets to be an acceptable intervention.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know	No relevant studies	Feasibility would likely vary based upon cost of the tourniquet and resources available. This likely varies on region. Training costs would also vary and depend on the modality used, the training apparatus, and course fees.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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			

	JUDGEMENT						
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

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

Recommendation

We suggest the use of a manufactured windlass tourniquet for the management of life-threatening extremity bleeding in children (weak recommendation, very low certainty of evidence).

We are unable to recommend for or against other tourniquet types in children due to lack of evidence.

For infants and children with extremities that are too small to allow the snug application of a tourniquet before activating the circumferential tightening mechanism, we recommend the use of direct manual pressure with or without the application of a hemostatic trauma dressing. (Good Practice Statement)

Technical Remarks:

In both studies included, the Combat Application Tourniquet Generation 7 was the specific brand of windlass rod tourniquet used.

The included studies evaluated tourniquet use on children from 2 years to 16 years of age with a minimal limb circumference fo 13 cm.

For the purpose of this review, the pediatric age of 18 and younger was chosen by the First Aid and Pediatrics Task Forces and is the same as used in a previous scoping review by ILCOR.

Justification

In making this recommendation, the First Aid Task force considered the following:

· There is a lack of direct evidence demonstrating that tourniquets are a life-saving treatment for life-threatening bleeding in children. However, the First Aid Task Force values the previously established role of a manufactured windlass tourniquet in reducing mortality in adults with life-threatening bleeding. {Charlton 2020 1} The Task Force relied heavily on these adult studies to infer that tourniquets would also be lifesaving for life-threatening bleeding in children.

· There is a lack of direct comparative evidence for the best tourniquet types in children and infants. In formulating treatment recommendations, the Task Force relied on data from two observational studies in healthy pediatric participants. {Harke 2019 e20183447, Kelly 2020 644}. In these studies, a windlass rod style tourniquet, specifically the Combat Application Tourniquet Generation 7 in both studies, was able to occlude distal blood flow in both the upper and lower extremities in children as young as two years of age with a minimum limb circumference of 13 cm.

· In the two studies included, the Combat Application Tourniquet Generation 7 was the specific brand of windlass rod tourniquet used. Other windlass rod tourniquets may vary in their ability to tighten successfully in small limb diameters. While some data is available from manikin studies, these studies were felt to be too indirect to include. {El-Sherif 2019 361, Kragh 2019 41} In accordance with the 2020 CoSTR recommendations for adult severe, life threatening extremity bleeding: “we suggest direct manual pressure with or without use of a hemostatic dressing if the site of bleeding is not amenable to use of a tourniquet.” {Singletary 2020 S284, Singletary 2020 A240 }

· There is no human evidence for the use of either manufactured or improvised tourniquets in children less than 2 years of age. It is the expert opinion of the Task Force that for children less than two years of age, body size and a lower relative pressure would likely make direct manual pressure more efficacious than in adults. Therefore, direct pressure should be used to treat life-threatening extremity bleeding in children less than 2 years of age. Based on extrapolation from adult literature, this should be applied with a hemostatic dressing, if available. {Charlton 2020 1} While it may be difficult for providers to determine whether a child is two years or older, the Task Force discussed that the typical habitus of a toddler, rather than an infant could be used to help make this determination.

· The only adverse effect reported was pain in one child in one study. {Harke 2019 e20183447} This is consistent with studies of adult tourniquets and is an expected effect of tourniquet application {Charlton 2020 1}.

· Inflicting pain in a volunteer study in the pediatric population would be unethical, and therefore, understandably there was a failure of the application of the tourniquet to occlude distal pulses in this study as the force required to do so could cause pain {Harke 2019 e20183447}. The Task Force acknowledges that the survival benefit of tourniquet use in life-threatening bleeding outweighs the risk of pain in both pediatric and adult populations.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

Research priorities

· There is an urgent need for comparative RCTs in the prehospital setting to determine which tourniquet designs produce beneficial outcomes in the pediatric population

· Additional human studies are needed to determine both the lower age and size limits in which these tourniquets can be applied to both upper and lower extremities to enable hemorrhage control

· Studies are needed to identify all the complications of tourniquet use in children

· Further studies are needed to determine the efficacy and rapidity of application of tourniquets on children by first aid providers.

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Appendix A5 FA-4 EtD Table
Tick Removal (1) Freezing, Chemical or Heat vs. Mechanical

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

Problem
Is 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 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.html This 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-	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.

	risk-tick-borne-diseases-climate-change.html and https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html	

Desirable Effects

How 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 Effects

How 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	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.

	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).	

Certainty of evidence

What 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}	

Values

Is 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 effects

Does 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 required

How 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 resources

What 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 effectiveness

Does 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.

Equity

What 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.

Acceptability

Is 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.

Feasibility

Is 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						
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			

	JUDGEMENT						
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

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

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)

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

References

- 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.
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- 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.

Appendix A5 FA-5 EtD Table
Tick Removal (2) Angled Forceps vs. Economy Forceps

QUESTION

Should jeweler's forceps or angled forceps compared with economy forceps be used for tick removal	
POPULATION:	Individuals in the first aid setting with a tick attached to the skin
INTERVENTION:	Jeweler's forceps or angled forceps
COMPARISON:	Economy forceps
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

Problem
Is 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 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.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.

	This 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	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	A single randomized study {Bowles 1992 901} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) was identified that compared types of tweezers on tick removal. In this study 299 ticks were removed by investigators on dogs using three different types of forceps. There was no difference in the number of ticks with damaged mouthparts upon removal between angled forceps (1/73) or economy forceps (2/73; RR 0.50, 95% CI, 0.05-5.40) or between jewelers' forceps (2/72) and economy forceps (2/73; RR 0.90, 95% CI, 0.15-7.00).	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 Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	A single randomized study {Bowles 1992 901} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) was identified that compared types of tweezers on tick removal. In this study 299 ticks were removed by investigators on dogs using three different types of forceps. There was no difference in the number of ticks with damaged mouthparts upon removal between angled forceps (1/73) or economy forceps (2/73; RR 0.50, 95% CI, 0.05-5.40) or between jewelers' forceps (2/72) and economy forceps (2/73; RR 0.90, 95% CI, 0.15-7.00).	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 evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

● Very low ○ Low ○ Moderate ○ High ○ No included studies	Very low certainty evidence based on one randomized study done on animals. {Bowles 1992 901}	

Values

Is 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 effects

Does 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	

Resources required

How 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 the different types of tweezers. The cost of tweezers in US is approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start at $1 USD. Tweezers would have multiple uses in a first aid kit. All interventions are less expensive than visiting a medical professional.

Certainty of evidence of required resources

What 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 effectiveness

Does 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	A single randomized study {Bowles 1992 901} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) was identified that compared types of tweezers on tick removal. In this study 299 ticks were removed by investigators on dogs using three different types of forceps. There was no difference in the number of ticks with damaged mouthparts upon removal between angled forceps (1/73) or economy forceps (2/73; RR 0.50, 95% CI, 0.05-5.40) or between jewelers' forceps (2/72) and economy forceps (2/73; RR 0.90, 95% CI, 0.15-7.00).	

Equity

What 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.

Acceptability

Is 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. 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.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no	No included studies.	Due to the low cost of the interventions and perceived ease of use these interventions are likely feasible. Written directions

● Probably yes ○ Yes ○ Varies ○ Don't know		needed (i.e., to grasp as closely to the skin as possible) in course curriculum.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

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

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)

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

References

1. Bowles DE, McHugh CP, Spradling SL. Evaluation of devices for removing attached Rhipicephalus sanguineus (Acari: Ixodidae). J Med Entomol 1992; 29(5):901-902.

Appendix A5 FA-6 EtD Table
Tick Removal (3) Pulling with Device vs. Tweezers

QUESTION

Should pulling with a device compared with pulling with tweezers be used for tick removal	
POPULATION:	Individuals in the first aid setting with a tick attached to the skin
INTERVENTION:	Pulling with a device (slit and traction device, lasso device, opposing jaw device)
COMPARISON:	Pulling with forceps
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

Problem
Is 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 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.html This 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-	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.

	risk-tick-borne-diseases-climate-change.html and https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	When comparing tweezers/forceps with types of commercial pulling devices, one randomized study {Duscher 2012 1505} and two observational studies {Akin Belli 2016 393; Stewart 1998 137} were identified. In one randomized trial {Duscher 2012 1505} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision), 596 ticks were removed from various pets (e.g., dogs, cats) by veterinarians (n=22) and lay providers (n=4). There was a greater number of ticks with damaged mouthparts upon removal when pulling with an Adson forceps (Sagalain Intl, Parkistan) (36/90) compared with pulling with a commercial slit and traction device (TickPic, Fact Solution GmbH, Germany) (24/100; RR 1.67 1.08-2.56). In an observational study {Akin Belli 2016 393} with low certainty evidence (downgraded for risk of bias and imprecision) dermatologists removed 160 ticks from participants using a commercial freezing device (Tickner, Laboratory Tickner AG, Zug, Switzerland) or three different mechanical tick removal devices (two commercial devices and one tweezers). Freezing removed no ticks. A card slit and traction device (Zeckenkarte, SafeCard ApS, Skanderborg, Denmark) resulted less intact tick removal (3/40) than with tweezers (33/40; RR 0.09, 95% CI, 0.03-0.27). Pulling with a lasso device (Trix Ticklasso®, Innotech, Fridhem, Sweden) also resulted in less intact tick removal (19/40) than pulling with tweezers (33/40; RR 0.58, 95% CI, 0.40-0.83). In a second observational study {Stewart 1998 137} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) three untrained volunteers removed 342 ticks from rabbits using three different mechanical removal devices. Fewer damaged mouthparts were associated with a slit and traction device (Ticked Off™, Ticked Off, Inc, Dover, NH, USA) (9/104) compared with use of medium tipped tweezers (Fisher Scientific, Waltham, MA, USA) (20/79; RR 0.34, 95% CI, 0.16-0.71). When comparing a second slit and traction device (Protick Remedy™, SCS Ltd. Lake Ariel, PA, USA) with use of tweezers, there was no difference in the number of damaged mouthparts (13/82 vs 20/79; RR 0.63, 0.33-1.17). When comparing an opposing jaw and traction device (Tick Nipper™ Joslyn Designs, Mahopac, NY USA) to tweezers there was no difference reported in the number of ticks with damaged mouthparts (10/77 with use of device compared with 20/79 using tweezers (RR 0.51, 95% CI, 0.26-1.02).	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 Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know	When comparing tweezers/forceps with types of commercial pulling devices, one randomized study {Duscher 2012 1505} and two observational studies {Akin Belli 2016 393; Stewart 1998 137} were identified. In one randomized trial {Duscher 2012 1505} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision), 596 ticks were removed from various pets (e.g., dogs, cats) by veterinarians (n=22) and lay providers (n=4). There was a greater number of ticks with damaged mouthparts upon removal when pulling with an Adson forceps (Sagalain Intl, Parkistan) (36/90) compared with pulling with a commercial slit and traction device (TickPic, Fact Solution GmbH, Germany) (24/100; RR 1.67 1.08-2.56). In an observational study {Akin Belli 2016 393} with low certainty evidence (downgraded for risk of bias and imprecision) dermatologists removed 160 ticks from participants using a commercial freezing device (Tickner, Laboratory Tickner AG, Zug, Switzerland) or three different mechanical tick removal devices (two commercial devices and one tweezers). Freezing removed no ticks. A card slit and traction device (Zeckenkarte, SafeCard ApS, Skanderborg, Denmark) resulted less intact tick removal (3/40) than with tweezers (33/40; RR 0.09, 95% CI, 0.03-0.27). Pulling with a lasso device (Trix Ticklasso®, Innotech, Fridhem, Sweden) also resulted in less intact tick removal (19/40) than pulling with tweezers (33/40; RR 0.58, 95% CI, 0.40-0.83). In a second observational study {Stewart 1998 137} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) three untrained volunteers removed 342 ticks from rabbits using three different mechanical removal devices. Fewer damaged mouthparts were associated with a slit and traction device (Ticked Off™, Ticked Off, Inc, Dover, NH, USA) (9/104) compared with use of medium tipped tweezers (Fisher Scientific, Waltham, MA, USA) (20/79; RR 0.34, 95% CI, 0.16-0.71). When comparing a second slit and traction device (Protick Remedy™, SCS Ltd. Lake Ariel, PA, USA) with use of tweezers, there was no difference in the number of damaged mouthparts (13/82 vs 20/79; RR 0.63, 0.33-1.17). When comparing an opposing jaw and traction device (Tick Nipper™ Joslyn Designs, Mahopac, NY USA) to tweezers there was no difference reported in the number of ticks with damaged mouthparts (10/77 with use of device compared with 20/79 using tweezers (RR 0.51, 95% CI, 0.26-1.02).	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 evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

● Very low ○ Low ○ Moderate ○ High ○ No included studies	Data from three studies with low to very low certainty evidence { Akin Belli 2016 393; Duscher 2012 1505; Stewart 1998 137}	

Values

Is 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 critical outcomes of 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 effects

Does 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 with no direct evidence of the critical outcomes such as disease transmission after tick removal. However, in general it is likely more desirable to remove the tick than leave it in place.

Resources required

How 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 but commercial devices appear to be slightly more expensive. The cost of tweezers in the US is approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start at $1 USD. Commercial tick devices are around $4-$10. Tweezers would have multiple uses in a first aid kit. All interventions are less expensive than visiting a medical professional.

Certainty of evidence of required resources

What 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 effectiveness

Does 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.	

Equity

What 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.	A commercial device is of slightly more cost than tweezers, may need to be purchased and may, therefore, increase disparity. The use of tweezers would probably have no impact since tweezers are widely available and commonly found in households or first aid kits.

Acceptability

Is 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 or a commercial removal device than their bare or gloved hands. These mechanical devices likely make it easier to grasp the tick, as well. 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.

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes	No included studies.	Due to the low cost of the interventions and perceived ease of use these interventions are likely feasible. Written directions for

○ Yes ○ Varies ○ Don't know		the use of tweezers or devices would be needed (i.e., to grasp as closely to the skin as possible) in course curriculum.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

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

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)

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

Reference Summary

1. 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.
2. Duscher GG, Peschke R, Tichy A. Mechanical tools for the removal of Ixodes ricinus female ticks--differences of instruments and pulling or twisting? Parasitol Res 2012; 111(4):1505-1511.
3. Stewart RL, Burgdorfer W, Needham GR. Evaluation of three commercial tick removal tools. Wilderness Environ Med 1998; 9(3):137-142.

Appendix A5 FA-7 EtD Table
Tick Removal (4) Tweezers vs. Manual

QUESTION

Should tweezers compared with manual removal be used for tick removal?	
POPULATION:	Individuals in the first aid setting with a tick attached to the skin
INTERVENTION:	Manual hand removal
COMPARISON:	Tweezer
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

Problem
Is 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 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.html This 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-	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.

	risk-tick-borne-diseases-climate-change.html and https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	A single observational study {Sahin 2020 405} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) compared manual removal with removal using tweezers. In this study, lay persons removed the tick by hand (n=21) and health care professionals removed ticks with tweezers (n=26). A lower risk of damaging the tick mouthparts upon removal was associated with use of tweezers (4/22) compared with manual removal (11/21; RR 0.35, 95% CI, 0.13-0.92).	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 Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	A single observational study {Sahin 2020 405} with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) compared manual removal with removal using tweezers. In this study, lay persons removed the tick by hand (n=21) and health care professionals removed ticks with tweezers (n=26). A lower risk of damaging the tick mouthparts upon removal was associated with use of tweezers (4/22) compared with manual removal (11/21; RR 0.35, 95% CI, 0.13-0.92).	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 evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Very low ● Low ○ Moderate ○ High ○ No included studies	Single observational study done with high risk of bias, low certainty evidence. {Sahin 2020 405}	

Values

Is 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 effects

Does 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 single study and no direct evidence of the critical outcomes of disease transmission from broken tick body after tick removal. However, in general it is likely more desirable to remove the tick than leave it in place.

Resources required

How 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.	The cost of tweezers in US is approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start at $1 USD. Commercial tick devices are around $4-$10. Tweezers would have multiple uses in a first aid kit. All interventions are less expensive than visiting a medical professional.

Certainty of evidence of required resources

What 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 effectiveness

Does 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.	Tweezers appear equally efficacious as manual removal for intact tick removal.

Equity

What 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.	Tweezers may need to be purchased and may increase disparity when compared to manual removal, however the cost is not very high and they would have other potential first aid uses. However, gloves would likely need to be warn if removing the tick by hand, which would increase the relative cost of manual removal.

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know	No included studies.	The use of fingers to removal a tick may not be acceptable in some areas. Gloves would likely need to be warn if removing the tick by hand.

Feasibility

Is 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 low cost of the interventions and perceived ease of use these interventions are likely feasible. Written directions needed (i.e., to grasp as closely to the skin as possible) in course curriculum.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

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

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)

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

REFERENCES SUMMARY

1. Şahin AR, Hakkoymaz H, Taşdoğan AM, Kireçci E. Evaluation and comparison of tick detachment techniques and technical mistakes made during tick removal. Ulus Travma Acil Cerrahi Derg. 2020;26(3):405-10.

Appendix A5 FA-8 EtD Table
Tick Removal (5) Twisting vs. Pulling

QUESTION

Should twisting compared with pulling be used for tick removal?	
POPULATION:	Individuals in the first aid setting with a tick attached to the skin
INTERVENTION:	Twisting with a device or tweezers
COMPARISON:	Pulling with a device or tweezers
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

Problem
Is 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 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.html This 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-	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.

	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	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	One randomized study {Duscher 2012 1505} and two observational studies {Needham 1985 997; De Boer 1993 748} were identified with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) that compared different traction methods when removing ticks with a mechanical removal device (TickPic Fact Solution GmbH, Germany; Trix Ticklasso ®, Innotech, Fridhem, Sweden; Tick Twister® O'Tom ® H3D, Lavancia, France; pen-tweezers, WDT, Germany or Adson forceps, Sagalain Intl, Parkistan). In one randomized study {Duscher 2012 1505} veterinarians (n=22) and lay providers (n=4) removed 596 ticks from various pets (e.g., dogs, cats) by either twisting or pulling methods. In this study, twisting methods were superior to pulling methods, resulting in lower number of ticks with damaged mouthparts on removal (37/337 with twisting compared with 60/190 with pulling; RR 0.35, 95% CI, 0.24-0.50). A second observational study {De Boer 1993 748} conducted by researchers on pigs and sheep compared pulling the tick straight out using blunt forceps with rotation with use of an opposing jaw device (Tick Solution, Instruments of Sweden, Inc, Stamford, CT, USA). In this study, there were a greater number of mouthparts of ticks that remained in the skin when pulling straight out with blunt forceps (59/80) compared with rotation with the opposing jaw device (14/69; RR 3.63, 95% CI, 2.24-5.91). A third observational study {Needham 1985 997} compared pulling and twisting methods by researchers for removal of 22 ticks on sheep. A greater number of ticks with damaged mouthpart upon removal was associated with pulling straight up using a quick motion of forceps (7/7) compared with twisting clockwise with forceps (0/5; RR 11.25, 95% CI, 0.79-160.81). Pulling straight up with forceps using steady pressure was also associated with more tick mouthpart breakage (5/5) compared with twisting clockwise with forceps (0/5) (RR 11.00, 95% CI, 0.77-158.01). Pulling with forceps parallel to the skin was associated with more tick mouthpart breakage on removal (5/5) compared with twisting clockwise with forceps (0/5) (RR 11.00, 95% CI, 0.77-158.01). In this study, all ticks were grabbed by the forceps as close to the skin as possible. The type of forceps was not described.	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 Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	One randomized study {Duscher 2012 1505} and two observational studies {Needham 1985 997; De Boer 1993 748} were identified with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision) that compared different traction methods when removing ticks with a mechanical removal device (TickPic Fact Solution GmbH, Germany; Trix Ticklasso ®, Innotech, Fridhem, Sweden; Tick Twister® O'Tom ® H3D, Lavancia, France; pen-tweezers, WDT, Germany or Adson forceps, Sagalain Intl, Parkistan). In one randomized study {Duscher 2012 1505} veterinarians (n=22) and lay providers (n=4) removed 596 ticks from various pets (e.g., dogs, cats) by either twisting or pulling methods. In this study, twisting methods were superior to pulling methods, resulting in lower number of ticks with damaged mouthparts on removal (37/337 with twisting compared with 60/190 with pulling; RR 0.35, 95% CI, 0.24-0.50). A second observational study {De Boer 1993 748} conducted by researchers on pigs and sheep compared pulling the tick straight out using blunt forceps with rotation with use of an opposing jaw device (Tick Solution, Instruments of Sweden, Inc, Stamford, CT, USA). In this study, there were a greater number of mouthparts of ticks that remained in the skin when pulling straight out with blunt forceps (59/80) compared with rotation with the opposing jaw device (14/69; RR 3.63, 95% CI, 2.24-5.91). A third observational study {Needham 1985 997} compared pulling and twisting methods by researchers for removal of 22 ticks on sheep. A greater number of ticks with damaged mouthpart upon removal was associated with pulling straight up using a quick motion of forceps (7/7) compared with twisting clockwise with forceps (0/5; RR 11.25, 95% CI, 0.79-160.81). Pulling straight up with forceps using steady pressure was also associated with more tick mouthpart breakage (5/5) compared with twisting clockwise with forceps (0/5) (RR 11.00, 95% CI, 0.77-158.01). Pulling with forceps parallel to the skin was associated with more tick mouthpart breakage on removal (5/5) compared with twisting clockwise with forceps (0/5) (RR 11.00, 95% CI, 0.77-158.01). In this study, all ticks were grabbed by the forceps as close to the skin as possible. The type of forceps was not described.	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 evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Based on three studies with a high risk of bias and very low certainty evidence. { De Boer 1993 748; Duscher 2012 1505; Needham 1985 997}	

Values

Is 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 critical outcomes of 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 effects

Does 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		Limited by three studies and no direct evidence of the critical outcome of disease transmission after tick removal. However, in general it is likely more desirable to remove the tick than leave it in place.

Resources required

How 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 but commercial devices appear to be slightly more expensive. The cost of tweezers in the US is approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start at $1 USD. Commercial tick devices are around $4-$10. Tweezers would have multiple uses in a first aid kit. All interventions are less expensive than visiting a medical professional.

Certainty of evidence of required resources

What 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 effectiveness

Does 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.	

Equity

What 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. However, the method of twisting or pulling should not have an impact on equity.

Acceptability

Is 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 or a commercial removal device than their bare or gloved hands. These mechanical devices likely make it easier to grasp the tick, as well. 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.

Feasibility

Is 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 low cost of the interventions and perceived ease of use these interventions are likely feasible. Written directions for the use of tweezers or devices would be needed (i.e., to grasp as closely to the skin as possible) in course curriculum.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

	JUDGEMENT						
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

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

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

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

References Summary

1. Duscher GG, Peschke R, Tichy A. Mechanical tools for the removal of Ixodes ricinus female ticks--differences of instruments and pulling or twisting? Parasitol Res 2012; 111(4):1505-1511.
2. 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.
3. Needham GR. Evaluation of five popular methods for tick removal. Pediatrics 1985; 75(6):997-1002.

Appendix A5 FA-9 EtD Table
Tick Removal (6) Twisting with One Device Compared to Twisting with Another Device

QUESTION

Should twisting with one device compared with twisting with another device be used for tick removal	
POPULATION:	Individuals in the first aid setting with a tick attached to the skin
INTERVENTION:	Twisting with one type of device (lasso device, slit and rotation device, opposing jaw device, tweezers)
COMPARISON:	Twisting with another type of device (lasso device, slit and rotation device, opposing jaw device, tweezers)
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

Problem
Is 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 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.html This 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-	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.

	risk-tick-borne-diseases-climate-change.html and https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html	

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	When comparing types of commercial rotation devices, two randomized trials {Duscher 2012 1505; Zenner 2006 526} were identified with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision). In one randomized trial {Duscher 2012 1505}, veterinarians (22) and lay providers (4) removed 596 ticks from various pets (e.g., dogs, cats) with commercial tick removal devices or tweezers. In this study more ticks with damaged mouth parts were reported when rotating with a lasso device (Trix Ticklasso®, Innotech, Fridhem, Sweden) (20/108) compared with rotating with a slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) (7/108; RR 2.86, 95% CI, 1.26-6.48). There was also a higher number of damaged tick mouthparts upon removal when rotating with a lasso device (Trix Ticklasso ®, Innotech, Fridhem, Sweden) (20/108) compared with rotating with an opposing jaw device (pen-tweezers, WDT, Germany) (10/121; RR 2.24; 95% CI, 1.10-4.57). Finally, there was a similar risk of damaged tick mouthparts when rotating with the slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) 7/108) compared with rotation with the opposing jaw device (pen-tweezers, WDT, Germany) (10/121; RR 0.78; 95% CI, 0.31-1.99). In a second randomized trial {Zenner 2006 526} pet owners and veterinarians (unknown numbers) compared commercial devices and tweezers for 236 tick removals on pets. When comparing rotation devices used by pet owners, there was a statistically significant decrease in ticks with damaged mouthparts upon removal when using a slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) compared with either an opposing jaw rotation device (Buster Tick forceps, Kruuse UK Ltd, Langeskov, Denmark) or Adson forceps ($p<0.01$, raw data not available). The same comparison was not performed by the veterinarians.	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 Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	When comparing types of commercial rotation devices, two randomized trials {Duscher 2012 1505; Zenner 2006 526} were identified with very low certainty evidence (downgraded for risk of bias, indirectness and imprecision). In one randomized trial {Duscher 2012 1505}, veterinarians (22) and lay providers (4) removed 596 ticks from various pets (e.g., dogs, cats) with commercial tick removal devices or tweezers. In this study more ticks with damaged mouth parts were reported when rotating with a lasso device (Trix Ticklasso®, Innotech, Fridhem, Sweden) (20/108) compared with rotating with a slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) (7/108; RR 2.86, 95% CI, 1.26-6.48). There was also a higher number of damaged tick mouthparts upon removal when rotating with a lasso device (Trix Ticklasso ®, Innotech, Fridhem, Sweden) (20/108) compared with rotating with an opposing jaw device (pen-tweezers, WDT, Germany) (10/121; RR 2.24; 95% CI, 1.10-4.57). Finally, there was a similar risk of damaged tick mouthparts when rotating with the slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) 7/108) compared with rotation with the opposing jaw device (pen-tweezers, WDT, Germany) (10/121; RR 0.78; 95% CI, 0.31-1.99). In a second randomized trial {Zenner 2006 526} pet owners and veterinarians (unknown numbers) compared commercial devices and tweezers for 236 tick removals on pets. When comparing rotation devices used by pet owners, there was a statistically significant decrease in ticks with damaged mouthparts upon removal when using a slit and rotation device (Tick Twister® O'Tom ® H3D, Lavancia, France) compared with either an opposing jaw rotation device (Buster Tick forceps, Kruuse UK Ltd, Langeskov, Denmark) or Adson forceps (p<0.01, raw data not available). The same comparison was not performed by the veterinarians.	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 evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	Based on two studies with a high risk of bias and very low certainty evidence. {Duscher 2012 1505; Zenner 2006 526}	

Values

Is 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 critical outcomes of 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 effects

Does 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 two studies and no direct evidence of the critical outcome of disease transmission after tick removal. However, in general it is likely more desirable to remove the tick than leave it in place.

Resources required

How 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 but commercial devices appear to be slightly more expensive. The cost of tweezers in the US is approximately $2 - $5. In Canada tweezers are generally $2 CAD and up and in Sweden tweezers start at $1 USD. Commercial tick devices are around $4-$10. Tweezers would have multiple uses in a first aid kit. All interventions are less expensive than visiting a medical professional.

Certainty of evidence of required resources

What 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 effectiveness

Does 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	

Equity

What 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.

Acceptability

Is 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 or a commercial removal device than their bare or gloved hands. These mechanical devices likely make it easier to grasp the tick, as well. 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.

Feasibility

Is 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 low cost of the interventions and perceived ease of use these interventions are likely feasible. Written directions for the use of tweezers or devices would be needed (i.e., to grasp as closely to the skin as possible) in course curriculum.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
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

	JUDGEMENT						
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

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

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

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.

Subgroup considerations

Implementation considerations

Monitoring and evaluation

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.

References Summary:

1. Duscher GG, Peschke R, Tichy A. Mechanical tools for the removal of Ixodes ricinus female ticks--differences of instruments and pulling or twisting? Parasitol Res 2012; 111(4):1505-1511.
2. Zenner L, Drevon-Gaillot E, Callait-Cardinal MP. Evaluation of four manual tick-removal devices for dogs and cats. Vet Rec 2006; 159(16):526-529.