Circulation

2020 International Consensus on First Aid Science With Treatment Recommendations

ABSTRACT: This is the summary publication of the International Liaison Committee on Resuscitation's *2020 International Consensus on First Aid Science With Treatment Recommendations*. It addresses the most recent published evidence reviewed by the First Aid Task Force science experts. This summary addresses the topics of first aid methods of glucose administration for hypoglycemia; techniques for cooling of exertional hyperthermia and heatstroke; recognition of acute stroke; the use of supplementary oxygen in acute stroke; early or first aid use of aspirin for chest pain; control of life-threatening bleeding through the use of tourniquets, hemostatic dressings, direct pressure, or pressure devices; the use of a compression wrap for closed extremity joint injuries; and temporary storage of an avulsed tooth. Additional summaries of scoping reviews are presented for the use of a recovery position, recognition of a concussion, and 6 other first aid topics. The First Aid Task Force has assessed, discussed, and debated the certainty of evidence on the basis of Grading of Recommendations, Assessment, Development, and Evaluation criteria and present their consensus treatment recommendations with evidence-to-decision highlights and identified priority knowledge gaps for future research.

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CONTENTS

The *2020 International Consensus on Cardiopulmonary Resuscitation* (CPR) and *Emergency Cardiovascular Care* (ECC) *Science With Treatment Recommendations* (CoSTR) is the fourth in a series of annual summary publications from the International Liaison Committee on Resuscitation (ILCOR). This 2020 CoSTR for first aid includes new topics addressed by systematic reviews performed within the past 12 months. It also includes updates of the first aid treatment recommendations published from 2010 through 2019 that are based on additional evidence evaluations and updates. As a result, this 2020 CoSTR for first aid represents the most comprehensive update since 2010.

EVIDENCE EVALUATION PROCESS AND TYPES OF REVIEWS

The 3 major types of evidence evaluation supporting this 2020 publication are the systematic review (SysRev), the scoping review (ScopRev), and the evidence update (EvUp). The SysRev is a rigorous process following strict methodology to answer a specific question. Each SysRev ultimately resulted in the generation of the task force CoSTR included in this publication. The SysRevs were performed by a knowledge synthesis unit, an expert systematic reviewer, or by the First Aid Task Force, and many have resulted in separately published SysRevs.

To begin the SysRev, the question to be answered was phrased in terms of the population, intervention, comparator, outcome, study design, time frame (PICOST) format. The methodology used to *identify* the evidence was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.[1] The approach used to *evaluate* the evidence was based on that proposed by the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) working group.[2] The outcomes to be searched were determined through discussion with the task force and the systematic reviewer, and consensus was reached to rank each as

critical, important, or less important. Using this approach for each of the predefined outcomes, the task force rated as high, moderate, low, or very low the certainty/confidence in the estimates of effect of an intervention or assessment across a body of evidence. Randomized controlled trials (RCTs) generally began the analysis as high-certainty evidence, and observational studies generally began the analysis as low-certainty evidence; examination of the evidence using the GRADE approach could result in downgrading or upgrading the certainty of evidence. For additional information, refer to the CoSTR section titled Evidence Evaluation Process and Management of Potential Conflicts of Interest.[3,3a] Disclosure information for writing group members is listed in Appendix 1. Disclosure information for peer reviewers is listed in Appendix 2.

Draft 2020 first aid CoSTRs were posted on the ILCOR website[4] for public comment between October 19, 2018, and January 5, 2019, with comments accepted through January 19, 2019. The 12 first aid draft CoSTR statements were viewed a total of 39011 times, and readers provided 21 comments. All comments were discussed by the task force and resulted in elimination of a minor wording discrepancy between the treatment recommendation in one draft CoSTR and the evidence-to-decision table.

This summary statement contains the final wording of the CoSTR statements as approved by the ILCOR task forces and by the ILCOR member councils after review and consideration of the evidence as well as the comments posted online in response to the draft CoSTRs. Within this publication, each topic includes the PICOST as well as the CoSTR, an expanded section on justification and evidence-to-decision framework highlights, and a list of knowledge gaps suggesting future research studies. An evidence-to-decision table is included for each CoSTR in Appendix A in the Supplemental Materials.

The second major type of evidence evaluation performed to support this 2020 CoSTR for first aid is a ScopRev. ScopRevs are designed to identify the extent, range, and nature of evidence on a topic or a question, and they were performed by topic experts in consultation with the First Aid Task Force. The task force analyzed the identified evidence and determined its value and implications for first aid practice or research. The rationale for the ScopRev, the summary of evidence, and task force insights are all highlighted in the body of this publication. If the ScopRev did not identify evidence that justified consideration of a SysRev, the most recent treatment recommendations are reiterated. The task force noted whether the ScopRev identified substantive evidence suggesting the need for a future SysRev to support the development of an updated CoSTR. All ScopRevs are included in their entirety in Appendix B in the Supplemental Materials.

The third type of evidence evaluation supporting this 2020 CoSTR for first aid is an EvUp. EvUps are generally performed to identify new studies published after the most recent First Aid Task Force evidence evaluation, typically through the use of search terms and methodologies from previous reviews. These EvUps were performed by task force members, collaborating experts, or members of Council writing groups. The EvUps are cited in the body of this publication with a note as to whether the task force agreed that the identified evidence suggested the need to consider a new SysRev. All EvUps are reproduced in their entirety in Appendix C in the Supplemental Materials.

In this publication, no change in treatment recommendations resulted from a ScopRev or an EvUp; if substantial new evidence was identified, the task force recommended consideration of a SysRev.

DEFINITION OF FIRST AID

The evidence evaluation process for the First Aid Task Force began with a review of the working definition of *first aid*, including goals and key principles as viewed by task force members from the international perspective.

First aid is the initial care provided for an acute illness or injury. The goals of first aid include preserving life, alleviating suffering, preventing further illness or injury, and promoting recovery. First aid can be initiated by anyone in any situation, including self-care. General characteristics of the provision of first aid, at any level of training include the following:

- Recognizing, assessing, and prioritizing the need for first aid
- Providing care using appropriate competencies and recognizing limitations
- Seeking additional care when needed, such as activating the emergency medical services system or other medical assistance

Key principles include the following:

- First aid should be medically sound and based on the best available scientific evidence.
- First aid education should be universal; everyone should learn first aid.
- Helping behaviors should be promoted; everyone should act.

The scope of first aid and helping behaviors varies and may be influenced by environmental, resource, training, and regulatory factors.

Because the scope of first aid is not purely scientific, the use of the GRADE evidence-to-decision framework allowed consideration of literature not typically included in SysRevs, including studies such as case series or basic science studies, or consideration of issues related to implementation and feasibility, resources required, health equity, and cost, all with an international perspective.

For SysRevs and ScopRevs, task force members considered and discussed these aspects with the consensus on science to guide treatment recommendations.

SELECTION OF TOPICS

The Chair, Vice Chair, and 15 members of the First Aid Task Force representing 5 ILCOR member councils met in autumn 2017 to review the first aid topics and questions that were evaluated in 2005, 2010, and 2015 as well as past research questions formulated in the PICOST style that were never reviewed. The task force reviewed new questions submitted to the task force after publication of the 2015 first aid CoSTR. Topics were considered based on any identified new evidence that might affect previous ILCOR treatment recommendation strength or direction, new topics identified as priorities for ILCOR member organizations, and topics with areas of controversy. The wording of all PICOST questions was deliberated and, in some cases, updated to reflect recommended changes in the evidence evaluation process after the 2015 CoSTR. An abbreviated literature search was used to determine the volume of new evidence on a topic that might signal a need to rereview a previously evaluated PICOST question. A ranked scored priority list of questions was then created.

SELECTION OF TYPE OF REVIEW

The general evidence evaluation process for first aid started with 5 of the top-ranked first aid questions that were related to the control of life-threatening bleeding. These were combined and expanded to form a complex PICOST, a collection of questions (ie, rather than a single question) assigned to a knowledge synthesis unit for a systematic review with assistance from task force content experts. The size and complexity of this review led to formation of 4 separate CoSTR topics. Three additional PICOST question topics were prioritized for review by expert systematic reviewers with assistance from content experts within the First Aid Task Force. Five topics underwent SysRevs by task force teams with assistance from approved outside content experts and reviewers. Eight topics were known to have limited new evidence and were selected for ScopRevs. An additional 2 topics underwent EvUps without a SysRev or a ScopRev. New topics are noted in the list of topics.

TOPICS REVIEWED IN 2020

First Aid for Medical Emergencies

- Methods of glucose administration for hypoglycemia (FA 1585: SysRev)
- Dietary sugars for treatment of hypoglycemia (FA 795: EvUp)
- Heatstroke cooling (FA 1548: SysRev)
- Recognition of anaphylaxis by first aid providers (FA 513: ScopRev)
- Second dose of epinephrine for anaphylaxis (FA 500: ScopRev)
- Stroke recognition (FA 801: SysRev)
- Supplementary oxygen in acute stroke (FA 1549: SysRev)
- Early/late aspirin for chest pain (FA 586: SysRev)
- Presyncope (FA 798: SysRev)
- Optimal position for shock (FA 520: EvUp)
- Recovery position (FA 517: ScopRev)

First Aid for Trauma Emergencies

- Control of life-threatening bleeding (combined SysRev):
  - Direct pressure, pressure dressings, pressure points (FA 530)
  - Tourniquet versus direct pressure, tourniquet design, manufactured versus improvised tourniquets (FA 768, 1543, 1549)
  - Hemostatic dressings versus direct pressure or tourniquet, types of hemostatic dressings (FA 769)
  - Hemostatic devices: junctional tourniquets, wound clamp (FA 2019)
- Pediatric tourniquets (FA 768 Peds: ScopRev)
- Concussion recognition (FA 799: ScopRev)
- Manual cervical spine stabilization (FA 1547: ScopRev)
- Cervical spine motion restriction (FA 772: ScopRev)
- Superficial thermal injury dressings (FA 1545: ScopRev)
- Compression wrap (FA 511: SysRev)
- Dental avulsion (FA 794: SysRev)

FIRST AID FOR MEDICAL EMERGENCIES

Important medical first aid topics for 2020 included methods of glucose administration for hypoglycemia, dietary sugars for treatment of hypoglycemia, cooling for heatstroke and exertional hyperthermia, recognition of anaphylaxis, second dose of epinephrine for anaphylaxis, stroke recognition, use of supplementary oxygen for acute stroke, early and late aspirin administration for chest pain, immediate interventions for presyncope, and optimal position for shock and recovery position. The recommendations stemming from the review of cooling for heatstroke are particularly relevant in light of increased risk of both heatstroke and exertional hyperthermia worldwide.

ScopRevs included topics with known limited evidence such as the recognition of anaphylaxis and cervical spine motion restriction and manual stabilization. These ScopRevs did not identify new literature to justify new

SysRevs or consideration of a change in the corresponding 2015 first aid treatment recommendations. However, the ScopRev on the use of a recovery position was unique in that the target population of interest was changed from "persons who are unresponsive but breathing normally" to "adults and children with decreased level of consciousness caused by medical illness that do not meet criteria for the initiation of rescue breathing or chest compressions (CPR)." This change is intended to represent more typical presentations that will be encountered by first aid providers and may require the use of a recovery position. The goal was to identify evidence that was missed when the search was limited to only those who were unresponsive and breathing normally.

Methods of Glucose Administration for Mild Hypoglycemia (FA 1585: SysRev)

Rationale for Review

The most recent CoSTR on this topic was published in 2015[5,6] and was developed in conjunction with a SysRev, published in 2017,[7] of dietary forms of glucose compared with glucose tablets to treat symptomatic hypoglycemia. For 2020, the task force prioritized a SysRev, completed in 2019,[8] of methods of glucose administration in first aid for suspected hypoglycemia.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with suspected hypoglycemia (out-of-hospital setting) (*Note:* Neonates are excluded because we believe the identification of hypoglycemia in this age group requires specialized diagnostic and treatment processes well beyond first aid.)
- Intervention: Administration of glucose by any enteral route appropriate for use by first aid providers
- Comparator: Administration of glucose by another enteral route appropriate for use by first aid providers
- Outcome:
  - Resolution of symptoms (critical), defined as the reversal of the initial symptoms as reported by the person with suspected hypoglycemia (dichotomous outcome; yes/no)
  - Time to resolution of symptoms (critical), defined as the time from the administration of the sugar containing solution until the symptoms resolved (continuous outcome)
  - Blood or plasma glucose concentration at 20 minutes (critical), defined as the glucose concentration measured 20 minutes after the administration of the sugar substrate (continuous outcome) or as evidence of blood or plasma glucose elevation at 20 minutes (dichotomous outcome; yes/no)
  - Resolution of hypoglycemia (important), defined as elevation of the blood glucose concentration above the authors' threshold for determining hypoglycemia (dichotomous outcome; yes/no)
  - Time to resolution of hypoglycemia (important), defined as the time from the administration of the sugar containing solution until the blood glucose concentration rose above the threshold for the authors' definition of hypoglycemia (continuous outcome)
  - Any adverse event (important); any event resulting from the administration of sugar, as defined by the study authors (eg, aspiration)
  - Administration delay (important), defined as the delay in administering the sugar as a result of the administration arm (dichotomous outcome; yes/no)
- Study design: Randomized and nonrandomized clinical trials; observational studies were included; unpublished studies (eg, conference abstracts, trial protocols, methods papers) were excluded
- Time frame: All years and all languages were included provided there was an English abstract to December 22, 2017, with an update performed on July 11, 2018.

Studies were included if glucose, table sugar (sucrose), or liquid sugar (eg, corn syrup) was administered by any enteral route appropriate for use by first aid providers (buccal [inserted on the mucosa inside the cheek], sublingual [under the tongue], oral [on top of the tongue]). Glucose and sugar formulations could include spray, gel, liquid, paste, syrup, or tablet form. Buccal administration was defined as application to the cheek mucosa and sublingual administration as application under the tongue, both without swallowing. Mild hypoglycemia was defined as the typical early signs and symptoms of hypoglycemia but with preserved ability to swallow and follow commands.

International Prospective Register of Systematic Reviews (PROSPERO) Registration: CRD42018088637

Consensus on Science

The SysRev identified 4 studies enrolling a total of 83 participants: 2 RCTs, studying children[9] and adults[10] with hypoglycemia, and 2 nonrandomized crossover studies with healthy volunteers.[11,12]

One RCT[9] compared sublingual sugar administration (2.5 g of wet sugar under the tongue) with oral administration (2.5 g of sugar on the tongue) in a specific group of 42 children between 1 and 15 years of age with clinical signs and symptoms of acute malaria or respiratory tract infections and blood glucose concentrations between 50 and 80 mg/dL (2.8–4.4 mmol/L) after overnight fasting. This study did not include children with severe clinical signs and symptoms of hypoglycemia. Blood glucose was measured every 20 minutes for up to 80 minutes after

treatment. The authors reported a significant increase in blood glucose concentrations measured at 20 minutes after sublingual sugar administration compared with blood glucose concentrations measured at 20 minutes after oral sugar administration. A significant decrease in the time to resolution of hypoglycemia and a higher likelihood of resolution of hypoglycemia (ie, reaching a blood glucose concentration of 90 mg/dL [5.0 mmol/L] or greater during the study period) at 80 minutes after treatment was reported after sublingual sugar administration, compared with oral sugar administration. No adverse events were reported in either group. No evidence was identified to address resolution of symptoms, time to resolution of symptoms, or treatment delay.

Two nonrandomized crossover studies compared buccal glucose administration with oral administration.[11,12] The first study looked at 16 healthy fasting adult volunteers who received 10 glucose spray doses (5 doses to the buccal mucosa of each cheek, totaling 0.84 g glucose) compared with a 6 g dextrose tablet to be chewed and swallowed.[11] In the second study of 7 adults, researchers provided 15 g of instant glucose, placed between the teeth and the buccal mucosa of the cheek of each subject, and compared results with 15 g of instant glucose to be swallowed. The subjects who received buccal glucose were encouraged not to swallow.[12] Buccal spray glucose resulted in a lower plasma glucose concentration at 20 minutes after administration compared with the chewed dextrose tablet,[11] and buccal instant glucose (ie, placed against inside cheek) resulted in fewer participants with an increased blood glucose concentration at 20 minutes.[12] Thus, both studies favored oral/swallowed glucose. No evidence was identified to address resolution of symptoms, time to resolution of symptoms, resolution of hypoglycemia, time to resolution of hypoglycemia, or any adverse event or treatment delay.

Finally, 1 RCT with 18 adults with insulin-dependent diabetes and insulin-induced hypoglycemia compared the oral administration of 15 g of glucose supplied as 40 g of a 40% dextrose gel (6 adults), with the oral/swallowed administration of glucose (either a 15 g glucose tablet to be chewed and swallowed without water (6 adults), or a solution of 15 g glucose in 150 mL of water, swallowed (6 adults).[10] In this study, researchers noted that the dextrose gel adhered to the mucosa and was not completely swallowed; for this reason, this administration form is labeled as combined oral and buccal mucosal administration in this review. At 20 minutes or less after the glucose administration, no improvement was identified for either route in the resolution of symptoms or in plasma glucose concentration. No evidence was identified to address time to resolution of symptoms, resolution of hypoglycemia, time to resolution of hypoglycemia, or any adverse event or treatment delay.

All evidence was of low to very low certainty. All studies were downgraded for risk of bias and imprecision. The nonrandomized trials were also downgraded for indirectness. Table 1 provides a summary of evidence for the Consensus on Science for Methods of Glucose Administration.

We did not identify any studies testing the rectal administration of glucose.

Treatment Recommendations

We recommend the use of oral/swallowed glucose for adults and children with suspected hypoglycemia who are conscious and able to swallow (strong recommendation, very low-certainty evidence).

We suggest against buccal glucose administration compared with oral/swallowed glucose administration for adults and children with suspected hypoglycemia who are conscious and able to swallow (weak recommendation, very low-certainty evidence).

If oral glucose (eg, tablet) is not immediately available, we suggest a combined oral and buccal glucose (eg, glucose gel) administration for adults and children with suspected hypoglycemia who are conscious and able to swallow (weak recommendation, very low-certainty evidence).

We suggest the use of sublingual glucose administration for suspected hypoglycemia for children who may be uncooperative with the oral (swallowed) glucose administration route (weak recommendation, very low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The limited evidence available for this review was supplemented by task force discussions and summarized in 3 accompanying evidence-to-decision tables (Supplement Appendix A-1, evidence-to-decision table for buccal glucose compared with oral swallowed glucose; Supplement Appendix A-2, evidence-to-decision table for oral-buccal glucose compared with oral swallowed glucose; Supplement Appendix A-3, evidence-to-decision table for sublingual glucose compared with oral swallowed glucose).

The task force recommends the use of oral/swallowed glucose for adults and children with suspected hypoglycemia who are conscious and able to swallow. This does not imply that in a standard first aid setting, other routes such as buccal or sublingual glucose administration cannot be used, but it does suggest that oral/swallowed glucose be the initial choice in awake adults and children who are able to swallow. No identified studies compared sublingual with buccal administration.

The identified evidence for sublingual glucose administration comes from only 1 study in a group of children with clinical signs of acute malaria or respiratory tract infections. Sublingual administration is favored in this specific population, but whether the results are applicable in a wider population is uncertain. Therefore, the task force suggests the use of sublingual administration of glucose for resource-limited settings in populations

Table 1. Summary of Studies of Methods of Glucose Administration

Outcomes	Intervention: Comparison	Participants (Number of Studies)	RR (95% CI)	Certainty of Evidence (GRADE)	Risk With Control	Risk With Intervention
Resolution of symptoms within 20 min (critical)	Combined oral and buccal versus oral/swallowed glucose administration	18 (1)[10]	0.36 (0.12 to 1.14)	Very low	917 per 1000	330 per 1000 (110 to 1000)
Blood or plasma glucose concentration at 20 min (critical)	Sublingual versus oral/swallowed glucose administration	42 (1)[9]		Very low	The mean blood/plasma glucose concentration at 20 min was 76 mg/dL (4.2 mmol/L)	The MD was 17 mg/dL (0.94 mmol/L) higher (4.4 mg/dL [0.24 mmol/L] higher to 29.6 mg/dL [1.64 mmol/L] higher)
	Buccal versus oral/swallowed glucose administration	16 (1)[11]		Very low	The mean blood/plasma glucose concentration at 20 min was 112 mg/dL (6.16 mmol/L)	The MD was 14.4 mg/dL (0.79 mmol/L) lower (17.5 mg/dL [0.97 mmol/L] lower to 11.4 mg/dL [0.63 mmol/L] lower)
Increased blood glucose at 20 min (critical)	Buccal versus oral/swallowed glucose administration	7 (1)[12]	0.07 (0.00 to 0.98)	Very low	1000 per 1000	70 per 1000 (0 to 980)
Resolution of hypoglycemia within 20 min (important)	Sublingual versus oral/swallowed glucose administration	42 (1)[9]	1.26 (0.91 to 1.74)	Very low	467 per 1000	205 per 1000 (44 to 983)
Resolution of hypoglycemia within 80 min (important)			2.10 (1.24 to 3.54)	Very low	733 per 1000	14 per 1000 (0 to 252)
Time to resolution of hypoglycemia (important)	Sublingual versus oral/swallowed glucose administration	42 (1)[9]		Very low	The mean time to resolution of hypoglycemia was 80 min	The MD was 51.5 min lower (58 min lower to 45 min lower)
Adverse events (important)	Sublingual versus oral/swallowed glucose administration	42 (1)[9]		Very low	No adverse events were reported in either group	

GRADE indicates Grading of Recommendations, Assessment, Development, and Evaluation; MD, mean difference; and RR, relative risk.

with suspected hypoglycemia where there is concern for the ability to follow commands and swallow.

One study evaluated the use of glucose gel placed on the buccal mucosa and then swallowed. It was observed that the gel adhered to the oral mucosa; therefore, the task force elected to consider this as a combined oral and buccal route. The task force recognizes that the findings from this single study are likely unique to glucose gel and may not be extrapolated to other forms of glucose such as sprays or pastes administered buccally and swallowed.

Knowledge Gaps

Research is needed to evaluate the benefits and risks of different glucose administration routes in adults and children with a diminished level of consciousness who are not able to swallow, particularly when advanced care is unavailable such as in rural or wilderness settings. The use of different forms of sugar, such as sprays, pastes, or gels, should be further investigated.

Additional high-certainty studies are needed to evaluate outcomes after enteral treatment, such as mortality, hospital discharge, or need for hospitalization.

Dietary Sugars for Treatment of Hypoglycemia (FA 795: EvUp)

This EvUp was performed to identify any relevant evidence published after the most recent SysRev of dietary sugars for the treatment of hypoglycemia[7] and the 2015 First Aid Task Force findings.[5,6] This EvUp (see Supplement Appendix C-1) identified no evidence to justify a new SysRev or consider a change in the 2015 treatment recommendation about dietary sugars for treatment of hypoglycemia.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with symptomatic hypoglycemia
- Intervention: Administration of dietary forms of sugar
- Comparator: Standard dose (15–20 g) of glucose tablets
- Outcome: Time to resolution of symptoms, complications, blood glucose level after treatment, hypoglycemia (defined as the persistence of symptoms [yes/no] or recurrence of symptomatic

hypoglycemia for more than15 minutes after treatment), hospital length of stay
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion; unpublished studies (eg, conference abstracts, trial protocols) were excluded
- Time frame: All years and all languages were included as long as there was an English abstract.

We reran the existing search strategy on June 25, 2019.

Treatment Recommendations

This treatment recommendation (below) is unchanged from 2015.[5,6]

We recommend that first aid providers administer glucose tablets for treatment of symptomatic hypoglycemia in conscious adults and children (strong recommendation, low-quality evidence).

We suggest that if glucose tablets are not available, various forms of dietary sugars such as Skittles, Mentos©, sugar cubes, jelly beans, or orange juice can be used to treat symptomatic hypoglycemia in conscious adults and children (weak recommendation, very low-quality evidence).

There is insufficient evidence to make a recommendation on the use of whole milk, cornstarch hydrolysate, and glucose solution, or glucose gels as compared with glucose tablets for the treatment of symptomatic hypoglycemia.[5,6]

Cooling of Heatstroke and Exertional Hyperthermia (FA 1548: SysRev)

Rationale for Review

This topic was prioritized for review by the First Aid Task Force based on (a) the importance of the problem, (b) increased number of extreme heat events (heat waves) worldwide, (c) number of major sporting events held in hot climates, and (d) the potential for increased survival and morbidity associated with heatstroke with the use of rapid cooling. The SysRev was completed in 2020.[13]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children (all ages) with heatstroke or exertional hyperthermia; Heatstroke included both exertional and nonexertional (classic) forms; exertional hyperthermia was defined as a core body temperature above 40°C occurring during athletic or recreational activity and influenced by exercise intensity, environmental conditions, clothing, equipment, and individual factors
- Intervention: Any cooling technique (or combination of techniques) appropriate for first aid (conduction, evaporation, convection, or radiation)
- Comparator: Another cooling technique (or combination of techniques) appropriate for first aid; for case series, there will be no comparator or control group; studies without a comparison group will be described narratively
- Outcome: Mortality and rate of body temperature reduction (°C/min or °C/h) were ranked as critical outcomes. Clinically important organ dysfunction, adverse effects (eg, overcooling, hypothermia, injury), and hospital length of stay were ranked as important outcomes.
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), case series of 5 or more were eligible for inclusion. Case series cannot provide high-level evidence, particularly without a comparator group; however, they provide direct evidence about hyperthermic patients in comparison with the indirect evidence derived when using healthy volunteers. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
- Time frame: All years and all languages were included; unpublished studies (eg, conference abstracts, trial protocols) were excluded. Literature search was updated July 11, 2019.
- PROSPERO Registration: CRD42019128445

Consensus on Science

The SysRev identified 12 different interventions for cooling. Most of the included studies that compared cooling techniques involved small groups of healthy adults with exertional hyperthermia, providing indirect evidence to determine the effectiveness of cooling techniques for heatstroke. The direct evidence about cooling for heatstroke was based on both cohort studies and case series. The included studies used core temperature measurements (eg, rectal and esophageal). For all studies, *passive cooling* was by conduction without a heat source or an active cooling intervention. All other methods of cooling (see Table 2) that actively remove heat from a patient's body were considered *active cooling*. Cooling by water immersion was conducted in a variety of shallow inflatable, rigid or semirigid tubs with the person's whole body placed in the tub with water covering the torso or up to the neck.

For the critical outcome of mortality (with the exception of ice-water immersion) and the important outcomes of clinically important organ dysfunction, adverse events, and hospital length of stay, there were no comparator studies evaluating any cooling techniques. A summary of the outcome mean weighted cooling rate by method is found in Table 2.

Many studies of cooling techniques failed to show a significant mean difference in (MD) rate of cooling; these are summarized in Table 3. The following text summarizes the studies where comparison of cooling techniques

Table 2. Mean Weighted Cooling Rate (°C/min) by Cooling Method

Cooling Method	Weighted Average*	Variance	Standard Deviation	Min–Max	References
Ice-water immersion (1°C–5°C water), n=111	0.20	0	0.07	0.14–0.35	a[14–20]
Temperate water immersion (20°C–26°C water), n=47	0.16	0.02	0.13	0.06–0.41	b[17,20–23]
Cold-water immersion (14°C–17°C water), n=110	0.14	0.03	0.18	0.04–0.62	c[14,20–32]
Colder-water immersion (9°C–12°C), n=59	0.14	0	0.07	0.04–0.25	d[20,23,29–31,33]
Commercial cold packs n=41	0.14	0.01	0.12	0.03–0.17	e[34–36]
Shower (20°C) n=17†	0.07	-	0.03	-	f[37]
Ice sheets (3°C) and towels n=47	0.06	0	0.01	0.05–0.06	g[24,33,38]
Hands and feet cold-water immersion (16°C–17°C), n=62	0.05	0	0.05	0.02–0.16	h[24,29,39–42]
Cooling vests and jackets n=81	0.04	0	0.01	0.02–0.05	i[39,43–47]
Cold intravenous fluids (4°C) n=17	0.04	0	0.01	0.06–0.07	j[36,48]
Passive cooling (20°C–39°C ambient) n=391	0.04	0	0.03	–0.01 to 0.12	k[14–16,18,19,22,24,25,27–32,34,35,37–42,44–47,49–53]
Fanning n=9†	0.04	-	0	-	l[39]
Hand-cooling devices n=29	0.03	0	0.01	0.02–0.04	m[46,49,53]
Evaporative cooling n=50	0.03	0	0.03	–0.01 to 0.06	n[24,34,36,52]

Note: All are active cooling techniques with the exception of passive cooling.
*Rounded to 2 decimal places.
†Unweighted.

demonstrated superiority of 1 technique compared with another.

Cold-Water Immersion (14°C–15°C/57.2°F–59°F)

For the critical outcome of rate of core body temperature reduction, we identified low-certainty evidence (downgraded for risk of inconsistency and indirectness) from 7 non-RCTs comparing cold-water immersion (14°C–15°C/57.2°F–59°F) of the torso with passive cooling,[14,22,24,25,27,28,32] recruiting 143 adults with exertional hyperthermia. Researchers reported a faster rate of body temperature reduction associated with cold-water immersion of the torso compared with passive cooling (MD range from 0.01°C/min–0.10°C/min). The substantial heterogeneity across studies precluded pooled estimate of the MD in rate of core body temperature reduction for all studies evaluating cold-water immersion.

Cold-Water Immersion of Hands and Feet (10°C–17°C/50.0°F–62.6°F)

For the critical outcome of rate of core body temperature reduction, we identified moderate-certainty evidence (downgraded for risk of indirectness) from 6 controlled trials[24,29,39–42] recruiting 62 adults with exertional hyperthermia. These studies reported a faster rate of core body temperature reduction with the use of cold-water immersion of the hands and/or feet compared with passive cooling (MD, 0.01°C/min; 95% CI, 0.01–0.01).

Colder-Water Immersion (9°C–12°C/48.2°F–53.6°F)

For the critical outcome of rate of core body temperature reduction, we identified moderate-certainty evidence (downgraded for risk of indirectness) from 3 non-RCTs[29–31] recruiting 30 adults with exertional hyperthermia. The authors reported a faster rate of core body temperature reduction associated with the use of colder-water immersion of the torso compared with passive cooling (MD, 0.11°C/min; 95% CI, 0.07–0.15).

Moderate-certainty evidence (downgraded for risk of indirectness) from 1 non-RCT[23] recruiting 4 adult subjects with exertional hyperthermia also demonstrated a faster rate of core body temperature reduction associated with the use of "colder" water immersion of the torso, compared with temperate water (23.5°C/74.3°F) immersion (MD, 0.08°C/min, 95% CI, 0.02–0.14).

Ice-Water Immersion (1°C–5°C/33.8°F–41.0°F)

For the critical outcome of mortality, we identified very low-certainty evidence (downgraded for risk of imprecision) from 1 small observational cohort study[54] of 23 adults with exertional heatstroke, comparing the prehospital use of ice-water immersion of the torso plus the administration of intravenous 0.9% normal saline at ambient temperature compared with the use of ice bags applied to the axilla. There were no deaths in either group.

For the critical outcome of rate of core body temperature reduction, we identified low-certainty evidence (downgraded for risk of inconsistency and indirectness) from 4 non-RCTs[14,16,18,19] recruiting 54 adults with exertional hyperthermia and low-certainty evidence from 1 prehospital observational cohort study[15] enrolling 21 adult distance runners with exertional heatstroke. These studies reported a faster rate of core body temperature reduction associated with the use of ice-water

Table 3. Cooling Techniques With Comparisons Not Showing a Significant Mean Difference in Cooling Rate

Cold-water immersion of the torso compared with temperate-water immersion of the torso (20°C–26°C/68°F–78.8°F)[21,22,26]
Cold-water immersion (14°C/57.2°F) of the torso compared with the use of colder-water immersion (8°C/46.4°F)[26]
Cold-water immersion (14°C/57.2°F) of the torso compared with ice-water immersion (2°C–5°C/35.6°F–41°F) of the torso[14,26]
Colder-water immersion (9°C/48.2°F) up to the iliac crest compared with passive cooling[50]
Colder-water immersion (10°C–12°C/50.0°F–53.6°F) of the hands/feet compared with the use of colder-water immersion of the torso[29]
Evaporative cooling compared with passive cooling[34,52]
Evaporative cooling compared with use of ice packs applied to the neck, axilla, and groin[34,36]
Evaporative cooling compared with the use of commercial ice packs applied to the whole body[34]
Evaporative cooling combined with the use of commercial ice packs to the neck, axilla, and groin compared with passive cooling[34] and evaporative cooling alone[34]
Evaporative cooling compared with the administration of intravenous 0.9% normal saline at 20°C/68.0°F[36]
Ice-sheet application (bed sheets soaked in ice water kept at 3°C/37.4°F) and towels soaked in ice water kept at 14°C/57.2°F, respectively, to the body compared with passive cooling[24,38]
Ice-sheet application (sheets soaked in ice and water at 5°C–10°C/41.0°F–50°F) to the body compared with colder-water immersion (5°C–10°C/41.0°F–50°F)[33]
Commercial ice packs to the neck, groin, and axilla compared with passive cooling[34,35]
Commercial ice packs to the whole body compared with passive cooling[34]
Fanning alone compared with passive cooling[24,39]
Hand-cooling devices compared with passive cooling[46,49,53]
A commercial cooling jacket compared with passive cooling[44,46]
Various cooling vests compared with passive cooling[24,39,44,45,47]
Reflective blankets compared with passive cooling[51]
Administration of 2 L of intravenous 0.9% normal saline at 20°C/68°F over 20 minutes compared with the use of ice packs to the neck, axilla, and groin[36]
Administration of 2 L of cold (4°C/39.2°F) intravenous 0.9% normal saline over 30 minutes compared with 2 L of intravenous normal saline at 22°C/71.6°F[48]

immersion of the torso (1°C–5°C/33.8°F–41.0°F) compared with passive cooling (MD range from 0.06°C–0.23°C/min). The high heterogeneity across studies precluded calculation of a pooled estimate of the difference in mean rates of body temperature reduction.

We also identified moderate-certainty evidence (downgraded for risk of indirectness) from 2 prehospital non-RCTs[17,26] recruiting 27 adults with exertional hyperthermia. These studies reported a faster rate of core body temperature reduction associated with the use of ice-water torso immersion (2°C/35.6°F) compared with temperate-water torso immersion (20°C–26°C/68.0°F–78.8°F) (MD, 0.14°C/min; 95% CI, 0.09–0.18).

Finally, we identified low-certainty evidence from 1 small observational cohort study[54] of 23 adults with exertional heatstroke. This study reported a faster rate of core body temperature reduction associated with the use of ice-water torso immersion plus administration of intravenous 0.9% normal saline compared with use of ice packs to the axilla (MD, 0.06°C/min; 95% CI, 0.01–0.11).

Evaporative Cooling and Alternative Cooling Devices

We identified several studies evaluating evaporative cooling (with use of mist and fan or fan alone), ice sheets, hand-cooling devices, cooling vests and jackets, and reflective blankets that identified no significant MD in cooling rates compared with alternative cooling methods. These studies are also included in Table 3.

Commercial Ice Packs

For the critical outcome of rate of core body temperature reduction, we identified moderate-certainty evidence (downgraded for risk of indirectness) from 1 non-RCT[35] recruiting 10 adults with exertional hyperthermia. This small study reported a faster rate of core body temperature reduction associated with the use of commercial ice packs to the facial cheeks, palms, and soles compared with passive cooling (MD, 0.18°C/min; 95% CI, 0.12–0.24).

We identified moderate-certainty evidence (downgraded for risk of indirectness) from 1 controlled trial[35] recruiting 10 adults with exertional hyperthermia that reported a faster rate of core body temperature reduction with the use of commercial ice packs to the facial cheeks, palms, and soles compared with the use of commercial ice packs applied to the neck, groin, and axilla (MD, 0.13°C/min; 95% CI, 0.09–0.17).

Cold Shower (20.8°C/69.4°F)

For the critical outcome of rate of core body temperature reduction, we identified moderate-certainty evidence (downgraded for risk of indirectness) from 1 non-RCT[37] recruiting 17 adults with exertional hyperthermia that reported a faster rate of core body temperature reduction associated with the use of cold showers compared with passive cooling (MD, 0.03°C/min; 95% CI, 0.01–0.05).

Intravenous Fluids

With the exception of the single study of ice-water immersion, for the critical outcome of mortality and the important outcomes of clinically important organ dysfunction, adverse events, and hospital length of stay, there were no comparator studies evaluating any of the previously mentioned cooling techniques.

Treatment Recommendations

For adults with exertional hyperthermia or exertional heatstroke:

We recommend immediate active cooling using whole-body (from the neck down) water-immersion techniques (1°C–26°C/33.8°F–78.8°F) until a core body temperature of less than 39°C/102.2°F is reached (weak recommendation, very low-certainty evidence).

We recommend that where water immersion is not available, any other active cooling technique be initiated (weak recommendation, very low-certainty evidence).

We recommend immediate cooling using any active or passive technique available that provides the most rapid rate of cooling (weak recommendation, very low-certainty evidence)

For adults with nonexertional heatstroke, we cannot make a recommendation for or against any specific cooling technique compared with an alternative cooling technique.

For children with exertional or nonexertional heatstroke, we cannot make a recommendation for or against any specific cooling technique compared with an alternative cooling technique.

Justification and Evidence-to-Decision Framework Highlights

In making these recommendations, the First Aid Task Force considered the following points (see Supplement Appendix A-4 for the evidence-to-decision table):

Heat stroke is an emergent condition characterized by severe hyperthermia (>40°C/104°F) and organ dysfunction, typically manifested by central nervous system dysregulation. The target temperature of 39°C/102.2°F was selected because it most closely matched the target temperature of the evaluated published research on cooling for heat stroke and avoids overcooling to a hypothermic state.[20]

The most rapid cooling was achieved using whole-body (from the neck down) immersion in water with temperatures of 1°C–26°C/33.8°F–78.8°F. While there was heterogeneity in cooling rates across different water temperatures, colder water temperatures were associated with faster cooling rates. Cooling rates achieved with water-immersion techniques were faster than other active cooling modalities such as commercial ice packs, cold showers, evaporative cooling, ice sheets and towels, fanning, evaporative cooling, cooling vests, and jackets. However, because confidence intervals overlap for most of the mean weighted cooling rates for cooling techniques studied, we are unable to provide a rank order list. A graph in Supplement Appendix A-4 displays trends in mean weighted cooling rates for cooling techniques evaluated.

The evidence summary consistently reports core body temperature as measured rectally. The unavailability of core rectal temperature measurement should not preclude initiation of whole-body cold-water immersion if available.

With the exception of case series, there were no studies that evaluated cooling techniques for exertional heatstroke. The high morbidity associated with heatstroke creates ethical restraints to using a nontreatment or nonaggressive treatment comparison. In addition, none of the included studies evaluated cooling techniques in children.

We noted that there is wide variability in cooling methods used across different regions and in different settings. Some studies demonstrated feasibility of providing whole-body (from the neck down) cold-water immersion using relatively inexpensive "fit for purpose" equipment or improvised materials, such as inflatable children's pools or tubs in most settings.

The First Aid Task Force expert consensus opinion was that passive cooling (eg, moving the person to a cooler environment) is an essential part of the initial management of exertional hyperthermia and heatstroke. However, it is a slower cooling method compared with most other studied cooling modalities.

Given the clinical consequences of delayed cooling for heatstroke, the task force discussed and agreed that methods to measure core body temperature should be available in first aid settings where there is a high risk of encountering heatstroke, such as sports events, particularly when high ambient temperatures with high humidity are anticipated.[31,54]

The task force recognizes that the optimal immersion time to reduce core temperature to below 39°C/102.2°F is unknown. We considered that even in the absence of core temperature measurement, the use of water immersion, if available, should be continued until symptoms resolve or a reasonable amount of time, such as 15 minutes, has passed, as benefit from water immersion is more likely than harm. To arrive at the 15-minute duration, the task force created scenarios with different initial temperatures and different rates of cooling in an attempt to strike a balance between likely benefits and potential harms. Included studies did not report significant hypothermia or thermal injuries during cold-water immersion across the recommended temperature ranges.

Combinations of techniques associated with slower cooling rates may result in an overall faster cooling rate than any of the techniques used alone, although this has not been studied.

The task force recognizes that the time required to cool a person with heatstroke or exertional hyperthermia will vary with body size, age, and additional factors. A treatment recommendation for specific cooling duration could not be made in the absence of further evidence.

Knowledge Gaps

- There are no prospective comparative studies of cooling techniques for adults and children with

exertional or nonexertional (classic) heatstroke, and only a few cohort studies were identified for cooling of exertional stroke.
- There is an urgent need for studies investigating the optimal duration of cooling by cold-water immersion techniques when core body temperature measurement is unavailable.
- Specific pediatric intervention studies for heat-related illness are lacking.
- There are no comparative studies of combined active-plus-passive cooling techniques (eg, the use of ice packs with evaporative and passive cooling) on rate of cooling and clinical outcomes.
- Research is lacking about the ability of a first aid provider to recognize heatstroke without a core temperature measurement and the educational requirements needed to bridge this gap.

Recognition of Anaphylaxis by First Aid Providers (FA 513: ScopRev)

Rationale for Review

The most recent first aid CoSTR for this topic was published in 2010 and identified very low-certainty evidence from 8 studies highlighting the limited ability of first aid providers to correctly identify anaphylaxis.[55] The First Aid Task Force conducted this ScopRev to identify additional evidence published after 2010, or publications in the gray literature that may require consideration of a new SysRev and revisiting the 2010 treatment recommendations, with a focus on specific symptoms that may improve first aid identification of anaphylaxis.

Population, Intervention, Comparison, Outcome, Study Design, and Time Frame

- Population: Adults and children experiencing anaphylaxis
- Intervention: Description of any specific symptoms to the first aid provider
- Comparator: Absence of any specific description
- Outcome: Anaphylaxis recognition (critical)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), unpublished studies (eg, conference abstracts, trial protocols) and gray literature were eligible for inclusion.
- Time frame: The published literature was searched through October 22, 2019, and the gray literature search was completed on November 18, 2019.

Summary of Evidence

We did not identify any studies that directly addressed our PICOST. However, we did identify data from 2 prospective randomized trials that suggested the rate of recognition of anaphylaxis may be improved with educational interventions.[56,57] Neither study was performed in the first aid setting, but they did include adults (eg, schoolteachers) who often function as first aid providers. See Supplement Appendix B-1 for the full ScopRev and summary of studies identified.

Task Force Insights

Our primary outcome for this ScopRev was anaphylaxis recognition. We did not examine other treatment outcomes such as the time to epinephrine administration that depend on identification of anaphylaxis. The previous version of this PICOST identified low rates of correct identification of anaphylaxis, even among healthcare providers. We did not identify any data to suggest that the presence or absence of any specific symptom may improve the accuracy of recognizing anaphylaxis in the first aid setting. Two different educational interventions were identified that improved the knowledge about anaphylaxis recognition and care, although their use was not tested in a real-life scenario. The studies highlight the key role that education can play in anaphylaxis recognition.

Given these discussion points, combined with the limited additional information identified in this review, the task force did not feel there was sufficient information to pursue a SysRev or to warrant reconsideration of the existing ILCOR treatment recommendations. While outside the scope of this review, education about anaphylaxis recognition, management, and epinephrine administration, especially when applied to clinical scenarios and in the first aid setting, may be considered as the subject of a future SysRev or ScopRev.

Treatment Recommendations

This treatment recommendation (below) is unchanged from 2010.[55]

First aid providers should not be expected to recognize the signs and symptoms of anaphylaxis without repeated episodes of training and encounters with victims of anaphylaxis.

Second Dose of Epinephrine for Anaphylaxis (FA 500: ScopRev)

Rationale for Review

The 2015 ILCOR Consensus on Science for this topic identified very low-certainty evidence from 9 observational studies evaluating the critical outcomes of resolution of symptoms, adverse effects, and complications of a second dose of epinephrine for anaphylaxis.[5,6] After that review, the ILCOR continuous evidence evaluation process included automated regular database searches for new studies, without identifying results that would suggest the need for a new SysRev. The First Aid Task Force sought to conduct a ScopRev to search for

additional publications in the gray literature that would support past recommendations or lead to a SysRev.

Population, Intervention, Comparison, Outcome, Study Design, and Time Frame

- Population: Adults and children experiencing anaphylaxis requiring the use of epinephrine
- Intervention: Administration of a second dose of epinephrine
- Comparator: Administration of only 1 dose
- Outcome: Resolution of symptoms (critical), adverse effects (critical), complications (critical)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), unpublished studies (eg, conference abstracts, trial protocols) and gray literature were eligible for inclusion.
- Time frame: Scoping search strategy: all years and all languages were included as long as there was an English abstract. We reran the existing 2015 PICOST strategy, from January 1, 2014, to October 22, 2019. There were no date restrictions for the gray literature search that was run on November 18, 2019.

Summary of Evidence

Two studies in the healthcare setting were identified from our PubMed search comparing outcomes of patients who received a single dose of epinephrine and those who received a second dose of epinephrine.[58,59] See Supplement Appendix B-2 for the full ScopRev and summary of evidence.

Task Force Insights

We used the outcomes from the 2015 PICOST to perform the search. Alternative outcomes were identified through this ScopRev (eg, hospital admission, time to resolution of symptoms) that may need to be considered in future reviews. In reviewing the publications identified, we noted several studies that sought to determine predictors of the need for repeated doses of epinephrine. While this issue was outside the scope of this review, it is relevant to the field of anaphylaxis management and epinephrine administration and may be the topic of a future SysRev or ScopRev. We did not identify any prospective randomized trials comparing the efficacy of a second dose of epinephrine.

There remains uncertainty around epinephrine dose and the need for a second dose. The task force expressed concern that in some countries, the initial recommended and administered dose of epinephrine is lower than that recommended and administered in other countries, which may be associated with a greater likelihood that a second dose will be needed.

Given these discussion points, combined with the limited additional information identified in this review, the task force did not feel there was sufficient information to alter the existing ILCOR treatment recommendations or to pursue a SysRev.

Treatment Recommendation

This treatment recommendation (below) is unchanged from 2015.[5,6]

We suggest a second dose of epinephrine be administered by autoinjector to adults and children with severe anaphylaxis whose symptoms are not relieved by an initial dose (weak recommendation, very low-quality evidence).

First Aid Stroke Recognition (FA 801: SysRev)

Rationale for Review

The previous first aid CoSTR about recognition of stroke was published in 2015,[5,6] but the evidence evaluation did not include a SysRev. Because the prompt recognition of stroke is critical for effective treatment,[60] the First Aid Task Force conducted a SysRev of stroke recognition for first aid providers, and this was completed in 2020.[61]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults with suspected acute stroke
- Intervention: Use of a rapid stroke scoring system, scale, or test
- Comparator: First aid assessment without the use of a rapid stroke scoring system, scale or test
- Outcome:
  - Change time to treatment (eg, symptom onset to hospital/emergency department arrival or hospital admission) (critical)
  - Improved recognition of stroke (critical)
    - High number considered beneficial for observational study
    - High sensitivity and high specificity considered beneficial for diagnosis study
  - Discharge with favorable neurological status (increase considered beneficial) (important)
  - Survival with favorable neurological outcome (increase considered beneficial) (important)
  - Increased public/layperson recognition of stroke signs (important)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Unpublished studies (for example, conference abstracts, trial protocols, posters) were excluded.
- Time frame and languages: All years and all languages were included provided there was an English abstract. Literature search was updated to September 28, 2019.

Table 4. Stroke Scales and Published Studies Evaluating Them

Stroke Scale	Studies (First Author and Year)
FAST	Bergs, 2010[62]; Fothergill 2013[63]; Berglund 2014[64]; Pickham 2019[65]; Harbison 2003[66]
FASTER	O'Brien 2012[67]
LAPSS	Asimos 2014[68]; Bergs 2010[62]; Bray 2005[69]; Chen 2013[70]; Kidwell 2000[71]; Wojner-Alexandrov 2005[72]
OPSS	Chenkin 2009[73]
CPSS	Asimos 2014[68]; Bergs 2010[62]; Bray 2010[74]; Bray 2005[69]; Frendl 2009[75]; Kothari 2019[76]; Ramanujam 2008[77]; English 2018[78]; Kim 2017[79]; Vanni 2011[80]; Greenberg 2017[81]; Studnek 2013[82]
KPSS	Iguchi 2011[83]
ROSIER	Fothergill 2013[63]
MASS	Bergs 2010[62]; Bray 2010[74]; Bray 2005[69]
MedPACS	Studnek 2013[82]
BEFAST	Pickham 2019[65]
PreHAST	Andsberg 2017[84]

BEFAST indicates Balance, Eyes, Face, Arm, Speech, Time to call; CPSS, Cincinnati Prehospital Stroke Scale; FAST, Face, Arm, Speech, Time to call; FASTER, Face, Arm, Speech, Time, Emergency Response Protocol; KPSS, Kurashiki Prehospital Stroke Scale; LAPSS, Los Angeles Prehospital Stroke Scale; MASS, Melbourne Ambulance Stroke Screen; MedPACS, Medic Prehospital Assessment for Code Stroke; OPSS, Ontario Prehospital Stroke Scale; PreHAST, Prehospital Ambulance Stroke Test; and ROSIER, Recognition of Stroke in the Emergency Room.

Consensus on Science

The names and description of all evaluated stroke scales and scoring tools are found in Table 4. All of the studies used trained emergency medical services providers or nurses to apply these scales in the prehospital setting, and the level of certainty was therefore downgraded for indirectness.

Time to Treatment

For the critical outcome of time to treatment, we identified 4 observational studies evaluating 4 different stroke scales: KPSS,[83] LAPSS,[72] OPSS,[73] and FASTER.[67]

For KPSS, very low-certainty evidence (downgraded for risk of bias and indirectness) from 1 retrospective observational study[83] enrolling 430 adults with suspected acute stroke, reported an association between the use of the KPSS and an increase in the number of patients with time from symptom onset to hospital arrival within 3 hours. Among patients with emergency medical services use of the KPSS, 62.9% arrived within 3 hours compared with 52.3% who did not have the scale applied (RR, 1.2; 95% CI, 1.01–1.43). This same study reported an association between the prehospital use of the KPSS and a shorter elapsed time from symptom onset to hospital admission (mean time 2.1 hours [1.0–6.2]), compared with no prehospital KPSS use (mean time 2.7 hours [1.2–9.7]; *P*=0.024).

For LAPSS, very low-certainty evidence (downgraded for indirectness) from 1 cohort study[72] enrolling 1518 participants with a suspected acute stroke reported an association between the use of LAPSS and an increased time (minutes) from symptom onset to emergency department arrival. The mean time was 358 minutes for those who had a LAPSS screening tool applied (postintervention phase) compared with 226 minutes for those without the use of a LAPSS screening tool (preintervention phase) (MD, 132.00 minutes; [95% CI, 14.68–249.32]). This same study did not find a benefit associated with the use of LAPSS in a prehospital setting for the rate of patients admitted within 120 minutes (RR, 1.07; [95% CI, 0.96–1.19]).

For OPSS, very low-certainty evidence (downgraded for risk of bias) from 1 observational study[73] enrolling 861 participants suspected of acute stroke showed an association between the use of OPSS and an increase in the number of patients with time from symptom onset to hospital arrival within 3 hours. Of patients who had the OPSS applied, 32.1% arrived within 3 hours compared with 22.5% who did not have the scale applied (RR, 1.43; [95% CI, 1.12–1.82]).

For FASTER, very low-certainty evidence (downgraded for risk of bias and imprecision) from 1 observational study[67] enrolling 115 participants showed an association between the use of FASTER and a shortened time from symptom onset to time of treatment with tissue plasminogen activator (tPA) (MD, –32 minutes; [95% CI, –53 to –11]; *P*=0.005). This same study showed an association between the use of FASTER and shortened door-to-computerized tomography time for patients receiving tPA (MD, –30 minutes; [95% CI, –49 to –11]; *P*=0.004). Among patients receiving tPA, no differences were associated with or without the use of the stroke screening tool and time from symptom onset to hospital.

We did not identify any comparative studies evaluating the other scales (FAST, ROSIER, MASS, CPSS, MedPACS and PreHAST) for the critical outcome of time to treatment.

Recognition of Stroke: Intervention Studies

For the critical outcome of recognition of stroke (interventional studies, outcome defined as definitive stroke diagnosis or administration of thrombolytic), we identified 5 observational studies evaluating 5 different stroke scales: FAST,[66] KPSS,[83] FASTER,[67] OPSS,[73] LAPSS.[72]

For FAST, low-certainty evidence (downgraded for serious risk of bias and imprecision) from 1 observational study[66] enrolling 356 participants with suspected stroke, showed an association between the use of FAST and an increase in the number of patients with confirmed stroke or transient ischemic attack who were admitted within 3 hours after symptom onset (48.2% compared with 14.6%; RR, 3.3; [95% CI, 2.29–4.75]).

For KPSS, low-certainty evidence (downgraded for risk of bias and indirectness) from 1 observational study[83] enrolling 430 participants with suspected stroke showed no association between the use of KPSS and

receipt of thrombolytic therapy for patients who were ultimately diagnosed with stroke.

For LAPSS, moderate-certainty evidence (downgraded for indirectness) from 1 observational preimplementation and active implementation study[72] enrolling 1518 adults showed an association between the bundle of changes including the use of LAPSS by paramedics and an increase in the number of correct initial diagnoses of stroke confirmed by a neurologist (79.21% compared with 61.3%; RR, 1.29; [95% CI, 1.18–1.42]). The same study showed no association between the rate of treatment with intravenous tPA among patients with confirmed stroke and the bundle of changes including the use of LAPSS.

For OPSS, low-certainty evidence (downgraded for risk of bias) from 1 observational study[73] enrolling 861 participants suspected of stroke showed no association between the use of OPSS and the rate of recognition of ischemic stroke. This same study did show an association between the use of OPSS and an increase in the rate of thrombolytic therapy of all patients with ischemic stroke (10.10% compared with 5.86%; RR, 1.72; [95% CI, 1.03–2.88]), as well as an association between the use of OPSS and an increased rate of thrombolytic therapy for patients with ischemic stroke arriving within 3 hours (32.13% compared with 22.46%; RR, 1.43; [95% CI, 1.12–1.82]).

For FASTER, very low-certainty evidence (downgraded for serious risk of bias) from 1 observational study[67] including 181 participants with suspected acute stroke showed an association between the use of FASTER and the number of patients who received thrombolytic therapy. Of patients who had the scale applied, 19.1% received thrombolytic therapy compared with 7.5% who did not have the scale applied (RR, 2.56; 95% CI, 1.02–6.45).

Recognition of Stroke: Diagnostic Studies

For the important outcome of recognition of stroke (diagnostic studies, outcome defined as correct stroke diagnosis), we identified 19 observational studies[62–65,68–71,73–82,84] including 8153 participants, studying 9 different screening tools (FAST, LAPSS, OPSS, CPSS, ROSIER, MASS, BEFAST, MedPACS, PreHAST). All studies used the same positivity threshold for each scale (1 or greater). The reported prevalence, sensitivity, and specificity of each scale is reported in Table 5.

Stroke Scales With Blood Glucose Measurement

The task force divided the evaluated studies into subgroups based on whether the stroke scales included blood glucose measurement. For the stroke scales that included blood glucose measurement (LAPSS, OPSS, ROSIER, MASS, MedPACS), the estimated summary sensitivity across all studies for each scale ranged from a low of 0.74 to a high of 0.97. The estimated summary sensitivity for the stroke scales not including blood glucose measurement ranged from the lowest reported sensitivity of 0.80 to the highest reported sensitivity of 1.00 (ie, FAST, CPSS, PreHAST, BEFAST). The estimated summary specificity of stroke scales including blood glucose measurement ranged between 0.18 to 0.86 compared with estimated summary specificity of 0.26 to 0.55 for those scales not including blood glucose measurement (PreHAST, FAST, CPSS, BEFAST).

Increased Public/Layperson Recognition of Signs of Stroke

For the important outcome of increased public/layperson recognition of the signs of stroke, we identified very low-certainty evidence (downgraded for risk of bias) from 1 observational study[85] enrolling 72 members of the public. This study showed an association between the use of training in the recognition of stroke and an improved identification of signs of stroke, from 76.4% (55/72) recognition before training compared with 94.4% (68/72) immediately after training (RR, 1.24; 95% CI, 1.07–1.42), with 96.9% (63/65) still able to identify signs of stroke 3 months after training (RR, 1.27; 95% CI, 1.11–1.45).

No comparison studies were identified for the important outcomes of discharge with favorable neurological status and survival with favorable neurological outcome.

Treatment Recommendations

We recommend that first aid providers use stroke assessment scales/tools for adults with suspected acute stroke (strong recommendation, low-certainty evidence).

For first aid, we suggest the use of FAST, MASS, CPSS or LAPSS scales/tools for stroke assessment (weak recommendation, low-certainty evidence).

For first aid, we suggest the use of stroke assessment scales/tools that include blood glucose measurement when available, such as MASS or LAPSS, to increase specificity of stroke recognition (weak recommendation, low-certainty evidence).

For first aid, we suggest the use of FAST or CPSS stroke assessment scales/tools when blood glucose measurement is unavailable (weak recommendation, low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The search for this 2020 SysRev identified 8 studies[64,65,68,78–81,84] meeting inclusion criteria since the publication of the 2015 first aid CoSTR; these were incorporated into this 2020 consensus on science and GRADE evaluations.

The task force considers that an ideal stroke assessment system for first aid use must have few steps; must be easily understood, learned, and remembered; must have high sensitivity for likely stroke; and must take a minimal time to complete. These considerations influenced the choice of tests that were evaluated. The task

Table 5. Sensitivities and Specificities of Prehospital Stroke Scales

Stroke Scale	Study	Sample Size	Stroke Prevalence Number/Total (%)	Sensitivity (95% CI)	Specificity (95% CI)	LR+ (95% CI)	LR– (95% CI)
FAST	Bergs 2010[62]	31	19/31 (61%)	0.95 (0.74, 1.00)	0.33 (0.10, 0.65)	1.42 (0.94, 2.15)	0.16 (0.02, 1.25)
	Fothergill 2013[63]	295	177/295 (60%)	0.97 (0.93, 0.99)	0.13 (0.07, 0.20)	1.11 (1.03, 1.19)	0.27 (0.11, 0.67)
	Berglund 2012[64]	900	472/900 (52%)	0.64 (0.59, 0.68)	0.75 (0.71, 0.79)	2.55 (2.14, 3.05)	0.48 (0.42, 0.55)
	Pickham 2019[65]	359	159/359 (44%)	0.76 (0.69, 0.82)	0.46 (0.38, 0.53)	1.40 (1.20, 1.63)	0.53 (0.38, 0.72)
CPSS	Asimos 2014[68]	1217	663/1217 (54%)	0.80 (0.77, 0.83)	0.48 (0.44, 0.52)	1.55 (1.42, 1.70)	0.41 (0.35, 0.48)
	Bergs 2010[62]	31	19/31 (61%)	0.95 (0.74, 1.00)	0.33 (0.10, 0.65)	1.42 (0.94, 2.15)	0.16 (0.02, 1.25)
	Bray 2010[74]	850	199/850 (23%)	0.88 (0.83, 0.93)	0.79 (0.75, 0.82)	4.17 (3.57, 4.88)	0.15 (0.10, 0.22)
	Bray 2005[69]	100	73/100 (73%)	0.95 (0.87, 0.98)	0.56 (0.35, 0.75)	2.13 (1.39, 3.25)	0.10 (0.04, 0.27)
	Frendl 2009[75]	154	61/154 (40%)	0.70 (0.57, 0.81)	0.52 (0.41, 0.62)	1.46 (1.12, 1.90)	0.57 (0.37, 0.88)
	Kothari 1999[76]	171	49/171 (29%)	0.59 (0.52, 0.66)	0.88 (0.85, 0.91)	4.88 (3.74, 6.37)	0.47 (0.40, 0.55)
	Ramanujam 2008[77]	1045	440/1045 (42%)	0.44 (0.39, 0.49)	0.53 (0.49,0.57)	0.93 (0.82, 1.07)	1.06 (0.95, 1.18)
	English 2018[78]	130	96/130 (74%)	0.75 (0.65, 0.83)	0.21 (0.09, 0.38)	0.94 (0.77, 1.16)	1.21 (0.58, 2.56)
	Kim 2017[79]	268	152/268 (57%)	0.93 (0.88, 0.97)	0.73 (0.64, 0.81)	3.50 (2.58, 4.74)	0.09 (0.07, 0.17)
	Studnek 2013[82]	416	186/416 (45%)	0.79 (0.72, 0.85)	0.24 (0.19, 0.30)	1.04 (0.94, 1.15)	0.88 (0.61, 1.26)
	Vanni 2011[80]	155	87/155 (56%)	Not estimated	Not estimated	Not estimated	Not estimated
	Greenberg 2017[81]	305	79 (26%)	Not estimated	Not estimated	Not estimated	Not estimated
LAPSS	Asimos 2014[68]	1225	805/1225 (66%)	0.74 (0.71, 0.77)	0.48 (0.43, 0.53)	1.42 (1.28, 1.57)	0.54 (0.47, 0.63)
	Bergs 2010[62]	31	19/31 (61%)	0.74 (0.49, 0.91)	0.83 (0.52, 0.98)	4.42 (1.21, 16.12)	0.32 (0.14, 0.70)
	Bray 2005[69]	100	73/100 (73%)	0.78 (0.67, 0.87)	0.85 (0.66, 0.96)	5.27 (2.12, 13.13)	0.26 (0.16, 0.41)
	Chen 2013[70]	1130	997/1130 (88%)	0.78 (0.76, 0.81)	0.90 (0.84, 0.95)	8.02 (4.78, 13.46)	0.24 (0.21, 0.27)
	Kidwell 2000[71]	206	34/206 (16%)	0.91 (0.76, 0.98)	0.97 (0.93, 0.99]	31.36 (13.14, 74.87)	0.09 (0.03, 0.27)
MASS	Bergs 2010[62]	31	19/31 (61%)	0.74 (0.49, 0.91)	0.67 (0.35, 0.90)	2.21 (0.95, 5.14)	0.39 (0.17, 0.93)
	Bray 2010[74]	850	199/850 (23.4%)	0.83 (0.78, 0.88)	0.86 (0.83, 0.88)	5.90 (4.84, 7.20)	0.19 (0.14, 0.26)
	Bray 2005[69]	100	73/100 (73%)	0.90 (0.81, 0.96)	0.74 (0.54, 0.89)	3.49 (1.84, 6.63)	0.13 (0.06, 0.27)
MedPACS	Studnek 2013[82]	416	186/416 (45%)	0.74 (0.67, 0.80)	0.33 (0.27, 0.39)	1.10 (0.97, 1.25)	0.79 (0.58, 1.08)
OPSS	Chenkin 2009[73]	554	214/554 (39%)	0.87 (0.82, 0.92)	0.59 (0.54, 0.65)	2.15 (1.87, 2.47)	0.21 (0.15, 0.31)
ROSIER	Fothergill 2013[63]	295	177/295 (60%)	0.97 (0.93, 0.99)	0.18 (0.11, 0.26)	1.18 (1.08, 1.28)	0.19 (0.08, 0.46)
PreHAST	Andsberg 2017[84]	69	26/69 (38%)	1.00 (0.87, 1.00)	0.40 (0.25, 0.56)	1.65 (1.30, 2.11)	0.00
BEFAST	Pickham 2019[65]	359	159/359 (44%)	0.91 (0.86, 0.95)	0.26 (0.20, 0.33)	1.23 (1.12,1.36)	0.34 (0.19, 0.59)

BEFAST indicates Balance, Eyes, Face, Arm, Speech, Time to call; CPSS, Cincinnati Prehospital Stroke Scale; FAST, Face, Arm, Speech, Time to call; KPSS, Kurashiki Prehospital Stroke Scale; LAPSS, Los Angeles Prehospital Stroke Scale; LR, likelihood ratio; LR+, positive likelihood ratio; LR–, negative likelihood ratio; MASS, Melbourne Ambulance Stroke Screen; MedPACS, Medic Prehospital Assessment for Code Stroke; OPSS, Ontario Prehospital Stroke Scale; PreHAST, Prehospital Ambulance Stroke Test; and ROSIER, Recognition of Stroke in the Emergency Room.

force recognized that in all studies evaluated for this review, the stroke assessment was performed by paramedics or nurses, so the recommendations are based on extrapolation of benefit when these tools are used by laypersons or first aid providers. The lack of data demonstrating benefit of these tools when used by first aid providers is a substantial weakness of the evidence base.

Early treatment of stroke can minimize a potentially devastating neurological injury. In recommending the first aid use of stroke scales or tools, the task force agreed that such tools can assist in early stroke recognition, reduce time from symptom onset to arrival at a hospital emergency department or hospital admission, and ultimately enable more rapid initiation of treatment for patients with confirmed stroke.

The First Aid Task Force concluded that the anticipated benefit of training first aid providers in the correct use of stroke assessment scales or tools outweighs the risks, which are largely limited to false-positive identification by first aid providers. The task force considered that the lay public or first aid providers should use the stroke scale assessment tool/scale/protocol that provides the highest sensitivity and the lowest number of false negatives.

Four scales have been the subject of several studies involving a large number of adults (FAST, CPSS, LAPSS, MASS). Four scales (OPSS,[73] ROSIER,[63] BEFAST,[65] MedPACS[82]) were each evaluated by a single published study enrolling between 250 and 600 adults. The PreHAST scale reportedly had high sensitivity but was

only tested in a single study, with 26 adults with potential stroke.[84] For these reasons, the task force agreed to limit its conclusions concerning stroke scales to those studies with larger numbers of enrollees and to exclude data from scales evaluated by single studies or studies with few enrollees.

In this SysRev, the stroke assessment scales include a variety of components, such as looking for specific signs and evaluation of blood glucose. Our review found that the LAPSS and MASS instruments, which included blood glucose measurement, had similar sensitivity but increased specificity to more accurately identify stroke compared with FAST and CPSS, which did not include blood glucose measurement. We recognize that first aid providers may not have access to or the skill or authority to use a properly calibrated glucose measurement device. Although use of blood glucose measurement is not routinely included in first aid training, glucose measurement devices are commonly available and used by the public.

The cost of introducing the use of the stroke scales in first aid can be limited to the training. However, the task force considered the fact that assessment scales including blood glucose measurement will require additional training and the acquisition of measurement devices that can be costly. Furthermore, for some countries, the use of glucose measurement devices by first aid providers is not authorized by law.

Those developing local guidelines for first aid providers can use the results of this review to determine if the benefit of increased specificity with stroke scales or tools that include glucose measurement would be desirable in their settings compared with using simpler stroke assessment tools that do not include glucose measurement, with similar sensitivity but lower specificity.

For further information, refer to the evidence-to-decision table in Supplement Appendix A-5.

Knowledge Gaps

- Studies are needed to assess the ability of laypersons to correctly apply the recommended scales.
- Future studies should evaluate survival rates or cerebral performance category with use of a rapid stroke assessment scale or tool.
- We identified no RCTs comparing the use of stroke assessment tools with standard first aid in any patient population.

First Aid Supplementary Oxygen for Acute Stroke (FA 1549: SysRev)

Rationale for Review

The most recent (2015) CoSTR about first aid use of oxygen did not focus on oxygen administration for stroke.[5,6] As a result, the First Aid Task Force requested a new SysRev on this topic that was completed in 2020.[86]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults with suspected acute stroke
- Intervention: Use of supplementary oxygen
- Comparator: No use of supplementary oxygen
- Outcome:
  - Clinical outcomes: survival, neurological outcomes (eg, National Institutes of Health Stroke Scale [NIHSS] score, Scandinavian Stroke Scale score, modified Rankin scale [mRS] score), and neurological recovery in the acute phase (critical)
  - Quality of life measures (eg, Barthel Index, EuroQol, Nottingham ADL score*) and hospital length of stay (important)
  - Adverse effects and complications: Pneumonia, pulmonary edema, necessity of noninvasive positive pressure ventilation, intubation with mechanical ventilation (important)
  - Imaging outcomes: MRI indicators (eg, diffusion-weighted imaging, lesion volume, diffusion/perfusion mismatch, magnetic resonance spectroscopic indicators) and reperfusion rate (important)
  - Laboratory outcomes: Oxygen saturation (eg, highest, lowest, incidence or duration of oxygen saturation less than 90% or 95%) (limited importance)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
- Time frame: All years and all languages were included; unpublished studies (eg, conference abstracts, trial protocols) were excluded. Literature search was updated to December 16, 2019.
- PROSPERO Registration: CRD42020162958

Consensus on Science

For the critical outcome of survival at 1 week and 3 months, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[87] recruiting 8003 adults with acute stroke showing no benefit from the use of continuous supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours (n=2668) compared with the use of room air (oxygen delivered only if clinically indicated; n=2668).

For the critical outcome of survival at 6 months and at 1 year, we identified moderate-certainty evidence (downgraded for indirectness) from 2 RCTs[88,89] recruiting 289 and 550 adult patients, respectively, with

*Barthel Index: a scale that measures disability or dependence in activities of daily living in stroke patients; EuroQol index: a standardized instrument for measuring generic quality of life; Nottingham ADL score: a measure of activities of daily living ability in stroke patients, including mobility, household ability, and leisure activity

acute stroke that demonstrated no benefit with the use of supplementary oxygen at 2 to 3 L/min via nasal cannulae for 24 to 72 hours compared with the use of room air.

For the critical neurological outcome of NIHSS at 1 week, we identified moderate-certainty evidence (downgraded for indirectness) from 5 RCTs[87,88,90–92] recruiting 5969 adult patients with acute stroke showing no benefit with the use of either supplementary oxygen at 2 to 4 L/min via nasal cannula or the use of oxygen by face mask for 8 to 72 hours compared with the use of room air.

For the critical neurological outcome of NIHSS at 3 months, we identified very low-certainty evidence (downgraded for risk of bias, indirectness and imprecision) from 2 RCTs[90,91] recruiting 54 adult patients with acute stroke showing no benefit with the use of supplementary oxygen at 10 to 45 L/min via face mask for 8 to 12 hours compared with the use of room air (with oxygen added only if clinically indicated).

For the critical neurological outcome of NIHSS difference between baseline and 1 week, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[92] recruiting 289 adults with acute stroke showing no benefit with the use of continuous supplementary oxygen via nasal cannula at 2 to 3 L/min for 72 hours compared with the use of room air.

For the critical neurological outcome of improvement of NIHSS score of more than 4 at 1 week, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[92] recruiting 289 adults with acute stroke showing that the patients receiving supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours had higher chance of NIHSS improvement of more than 4 at 1 week as compared to those breathing room air (RR, 2.19; 95% CI, 1.37–3.51).

For the critical neurological outcome of favorable mRS score at hospital discharge, we identified very low-certainty evidence (downgraded for risk of bias) from 1 retrospective observational study[93] involving 1352 patients with acute stroke and without hypoxemia at baseline showing no difference associated with prehospital supplementary oxygen compared with breathing room air. The dose of supplementary oxygen was not provided in this study.

For the critical neurological outcome of mRS score at 3 months, we identified moderate-certainty evidence (downgraded for indirectness) from 3 RCTs.[87,90,91] The largest RCT[87] of 8003 adults showed no difference in mRS score in the group receiving supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours and the group receiving room air. A small RCT[91] of 16 patients with acute stroke found no beneficial effect on the mRS score for those receiving supplementary oxygen at 45 L/min by face mask for 8 hours compared with the group receiving room air. In this small study, oxygen was delivered to enrollees if clinically indicated.[91]

For the critical neurological outcome of mRS score at 6 months and mRS score less than 3 at 6 months, we identified low-certainty evidence (downgraded for risk of bias and indirectness) from 2 RCTs[88,94] recruiting 340 adults with acute stroke that demonstrated no benefit in mRS score from the use of supplementary oxygen via nasal cannula or venturi mask for 12 to 72 hours compared with room air (oxygen delivered only if clinically indicated).

For the critical neurological outcome of Scandinavian Stroke Scale at 3 months, we identified low-certainty evidence (downgraded for indirectness and imprecision) from 1 RCT[91] recruiting 16 adults with acute stroke showing no benefit with the use of supplementary oxygen at 45 L/min via simple face mask for 8 hours compared with room air (oxygen delivered if clinically indicated).

For the critical neurological outcome of Scandinavian Stroke Scale at 7 months, we identified low-certainty evidence (downgraded for risk of bias and indirectness) from 1 RCT[89] recruiting 550 adults with acute stroke showing benefit (ie, lower score) with use of supplementary oxygen at 3 L/min via nasal cannula for 24 hours compared with room air (score at 7 months: absolute difference, –0.50; 95% CI, –0.98 to –0.02).

For the important quality of life outcome of Barthel Index at 3 months, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[87] recruiting 8003 adults with acute stroke showing no benefit with the use of supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours compared with room air.

For the important quality of life outcome of Barthel Index at 6 months, we identified very low-certainty evidence (downgraded for risk of bias, indirectness and imprecision) from 1 RCT[94] recruiting 51 adults with acute stroke showing no benefit with the use of supplementary oxygen via venturi mask for 12 hours compared with room air.

For the important quality of life outcome of Barthel Index at 7 months, we identified low-certainty evidence (downgraded for risk of bias and indirectness) from 1 RCT[89] recruiting 550 adults with acute stroke showing that patients receiving supplementary oxygen at 3 L/min via nasal cannula for 24 hours had a lower Barthel Index compared with those breathing room air (absolute difference, –5.00; 95% CI, –6.24 to –3.76 points).

For the important quality of life outcome of Nottingham Extended ADL score at 3 months and the EuroQol (EQ5D-3 L) quality of life outcome score at 3 months, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[87] recruiting 8003 adults with acute stroke showing no benefit with the use of

supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours compared with room air.

For the important quality of life outcome of visual analog scale at 3 months, we identified moderate-certainty evidence (downgraded for indirectness) from 1 RCT[87] recruiting 8003 adults with acute stroke showing no benefit with the use of supplementary oxygen at 2 to 3 L/min via nasal cannula for 72 hours compared with room air.

For the important imaging outcome of lesion volume change at 6 hours, at 24 hours, and at hospital discharge, we identified low-certainty evidence (downgraded for indirectness and imprecision) from 1 RCT[95] recruiting 16 adults with acute stroke showing no difference with the use of high-flow supplementary oxygen via face mask for 8 hours compared with room air.

For the important adverse effects and complications outcome of hospital-acquired pneumonia, we identified very low-certainty evidence (downgraded for risk of bias) from 1 retrospective observational study[93] involving 1352 adults with acute stroke and without hypoxemia at baseline showing the association of prehospital supplementary oxygen with a lower rate of hospital-acquired pneumonia than reported among those breathing room air (RR, 0.50; 95% CI, 0.26–0.98).

For the important adverse effects and complications outcome of any documentation of pneumonia at hospital discharge, this same study showed no association between the administration of prehospital supplementary oxygen and documentation of pneumonia.

For the important adverse effects and complications outcomes of pulmonary edema and the use of noninvasive positive-pressure ventilation, this same study[93] showed no association between the administration of prehospital supplementary oxygen and need for noninvasive positive-pressure ventilation.

For the important adverse effects and complications outcome of tracheal intubation with mechanical ventilation and the outcome of any respiratory complications during hospitalization, we identified very low-certainty evidence (downgraded for risk of bias) from 1 retrospective observational study[93] involving 1352 adults with acute stroke and without hypoxemia at baseline showing an association between the administration of prehospital supplementary oxygen and a higher rate of tracheal intubation with mechanical ventilation than among patients who breathed room air in the prehospital setting (RR, 2.80; 95% CI, 2.1–3.70). This study also documented an association between the administration of prehospital supplementary oxygen and a higher rate of respiratory complications in comparison with those breathing room air (RR, 1.92; 95% CI, 1.54–2.39).

Treatment Recommendations

For adults with suspected acute stroke, we suggest against the routine use of supplementary oxygen in the first aid setting compared with no use of supplementary oxygen (weak recommendation, low- to moderate-certainty evidence)

Justification and Evidence-to-Decision Framework Highlights

A single observational study was identified and considered as direct evidence from the prehospital setting to inform this review.[93] All RCTs identified were from the in-hospital setting. All studies compared the use of supplementary oxygen (using varying flow rates and delivery methods) with no use of supplementary oxygen (ie, room air) in adults with acute stroke. With few exceptions, the results of these studies consistently failed to find a benefit from oxygen administration for critical outcomes such as survival and neurological outcomes, including NIHSS score, and for important outcomes related to the quality of life. A limitation of some included RCTs[90,91] was the inclusion in the comparison (ie, no oxygen) group patients who received low-dose oxygen when clinically indicated; the results would have been more reflective of any benefit of oxygen administration if those patients had been analyzed separately.

We also considered potential harm from use of supplementary oxygen. A single retrospective observational stroke registry study reported on rates of respiratory complications as well as neurological outcomes (eg, NIHSS score). The largest retrospective observational study[93] grouped patients by (1) oxygen needed and received to treat hypoxemia, (2) oxygen delivery despite normoxemia (so-called hyperoxia group), and (3) no oxygen given (control group). They evaluated mean prehospital and discharge NIHSS score and respiratory complications for each of the 3 groups and concluded that when controlling for confounders, there was no significant increase in respiratory complications or difference in neurological outcomes at discharge associated with oxygen use, suggesting that brief, early administration of supplementary oxygen for stroke may be safe to evaluate prospectively.

In making this recommendation, the task force recognizes there is currently equipoise (balance) in the currently available evidence related to the use of supplementary oxygen for acute stroke, creating an opportunity for conducting definitive randomized trials. Task force deliberations are summarized in the evidence-to-decision table regarding oxygen for stroke in Supplement Appendix A-6.

The resources required for oxygen delivery are considerable, including oxygen equipment and supplies, the need for a carrying container, and need for oxygen storage. A specialized course and certification in first aid oxygen use may be required, and some countries may require a prescription or a license to use oxygen. The expense associated with equipment, supplies, and training may be considerable when compared with no costs

linked to the use of room air and may contribute to a potential negative impact on health equity in resource-limited countries. The stocking, storage, or transportation of equipment and supplies may not be feasible or acceptable to first aid providers or first responders. Occupational and other injuries and mishaps related to the use of oxygen canisters were also considered in task force discussion. Finally, the task force expressed concern that first aid attention to the process of setting up and administering oxygen may delay other critical immediate care goals, such as calling a designated emergency number or transporting a person to a hospital.

Knowledge Gaps

- There are no RCTs comparing the routine administration of supplementary oxygen with room air in acute stroke patients in first aid settings.
- The effect of short-term use of supplementary oxygen only in the first aid settings remains unknown.
- There are no studies about optimal concentration of administered supplementary oxygen or comparing the delivery methods of oxygen for adults with suspected acute stroke.

First Aid Administration of Aspirin for Chest Pain: Early Compared With Late (FA 586: SysRev)

Rationale for Review

The previous (2015) evidence evaluation of aspirin administration for chest pain included evaluation of early compared with late aspirin administration but did not include a formal SysRev. As a result, the First Aid Task Force requested a SysRev on this topic that was completed in 2020.[96]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults who experience nontraumatic chest pain
- Intervention: Early or first aid administration of aspirin
- Comparator: Late or in-hospital administration of aspirin
- Outcome: Survival, complications, and incidence of cardiac arrest were ranked as critical outcomes. Cardiac functional outcome, infarct size, and chest pain resolution were ranked as important outcomes.
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), case series of 5 or more subjects were eligible for inclusion. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
- Time frame: All years and all languages were included; unpublished studies (eg, conference abstracts, trial protocols) were excluded. Literature search was updated to October 22, 2019.
- PROSPERO Registration: CRD42020153316

Consensus on Science

The new SysRev included all settings and doses for aspirin administration. *Early administration* was defined as administration of aspirin in the prehospital phase or within 2 hours from onset of chest pain, regardless of the setting in which administration occurred. *Late administration* was defined as administration of aspirin more than 2 hours from the onset of chest pain or in-hospital. The included studies assessed time to aspirin administration in relation to outcome. However, since it was expected that studies including first aid providers would be lacking, the search for studies involving the administration of aspirin was not restricted to first aid providers.

For the critical outcome of survival (at 7 days), we identified very low-certainty evidence (downgraded for risk of bias and indirectness) from 2 observational studies[97,98] of 2122 patients with acute myocardial infarction (MI), using 160 mg aspirin[97] and greater than 200 mg aspirin.[98] These studies reported the association of improved survival with the prehospital early administration of aspirin (median 1.6 hours from pain onset) compared with late administration of aspirin (median 3.5 hours from pain onset, given at hospital admission) (97.5% compared with 93.5%; $P<0.001$; RR, 1.04; 95% CI, 1.02–1.06; 37 more patients per 1000 treated survived to 7 days with early administration of aspirin; 95% CI, from 18 more to 56 more).

For the critical outcome of survival (at 30 days), we identified very low-certainty evidence (downgraded for risk of bias and indirectness) from 2 observational studies[97,98] with a total of 2122 patients with acute MI who received either 160 mg aspirin[97] or greater than 200 mg aspirin.[98] These studies showed an association of improved survival with the early administration of aspirin (median 1.6 hours from pain onset) compared with the late administration of aspirin (median 3.5 hours from pain onset, given at hospital admission) (95.2% compared with 91.2%; RR, 1.05; 95% CI, 1.01–1.09; 46 more patients per 1000 treated survived to 30 days with early administration of aspirin; 95% CI, from 9 more to 82 more).

For the critical outcome of survival (at 35 days), we identified low-certainty evidence (downgraded for indirectness) from subgroup analysis of 8587 patients from 1 RCT[99] enrolling 17 187 patients with acute MI showing no benefit from the administration of 162.5 mg enteric-coated aspirin within 2 hours of the onset of symptoms, compared with the administration of 162.5 mg enteric-coated aspirin 3 to 24 hours after symptom onset.

For the critical outcome of survival (at 1 year), we identified very low-certainty evidence (downgraded for indirectness) from 1 observational study[97] of 1200 patients with acute MI showing an association between increased survival and the early administration of 160 mg aspirin (median 1.6 hours from pain onset) compared with late administration of 160 mg aspirin (median 3.5 hours from pain onset) (95.0% compared with 89.4%; RR, 1.06; 95% CI, 1.03–1.10; 54 more patients per 1000 treated survived to 30 days with early administration of aspirin; 95% CI, from 26 more to 89 more).

For the critical outcome of complications, we identified very low-certainty evidence (downgraded for indirectness) from 2 observational studies[97,98] with a total of 2122 patients with acute MI showing no significant difference in incidence of complications whether 160 mg of aspirin was delivered at a median of 1.6 hours or greater when compared with 200 mg aspirin was delivered at a median of 3.5 hours from pain onset.

For the critical outcome of incidence of cardiac arrest, we identified very low-certainty evidence (downgraded for risk of bias and indirectness) from 2 observational studies[97,98] with conflicting results. In 1 observational study[98] of 922 adults with acute MI, there was an association between reduction in the incidence of asystole (2% compared with 7%, $P<0.001$), in the need for resuscitation (RR, 0.38; 95% CI, 0.20–0.69) and early (compared with late) administration of greater than 200 mg of aspirin. By comparison, the second observational study[97] of 1200 patients with acute MI reported an association between a higher incidence of ventricular tachycardia and fibrillation and early (median 1.6 hours from pain onset) compared with late (median 3.5 hours from pain onset) administration of 160 mg aspirin. (RR, 1.53; 95% CI, 1.12–2.08).

For the important outcomes of cardiac functional outcome and infarct size as well as the important outcome of chest pain resolution, there were no comparator studies evaluating the time of aspirin administration.

Treatment Recommendations

For adults with nontraumatic chest pain, we suggest the early administration of aspirin in the first aid setting as compared with the late, in-hospital administration of aspirin (weak recommendation, very low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The 2015 CoSTR on this topic[5,6] assessed early compared with late administration of aspirin for chest pain and suspected MI. This current review differs in that the population of interest in the first aid setting includes adults with symptoms of nontraumatic chest pain rather than limiting the search to only adults with chest pain and suspected MI. This change in the search to identify chest pain in general, not limited to first aid suspicion of an MI, reflects the task force's desire to identify all relevant evidence associated with aspirin administration for signs and symptoms alone (rather than narrowing the search only to 1 potential cause). Studies were included if the intervals from the onset of pain to administration and outcomes were presented.

The only difference between the 2020 treatment recommendation and the recommendation provided in the 2015 CoSTR regarding early compared with late administration of aspirin is the description of the population as adults with symptoms of nontraumatic chest pain. For additional information, refer to the evidence-to-decision table for first aid administration of aspirin for chest pain, early compared with late, in Supplement Appendix A-7.

We recognize that although we identified the population of interest for our evidence search to be adults with symptoms of nontraumatic chest pain in the first aid setting, the identified evidence is considered to be indirect because it was limited to adults with suspected MI and not all causes of nontraumatic chest pain.

We place a higher value on the benefits of aspirin, such as increased survival from an MI, which outweigh the possible risks identified in 1 study, that is, an increased risk of ventricular tachycardia or ventricular fibrillation in-hospital not influencing survival, and the adverse effect of minor bleeding identified in ISIS 2[99] and described in a 2015 CoSTR.[5,6]

We did not perform a meta-analysis of the 3 included studies even though they report survival outcomes at similar times (30 days and 35 days). The task force discussed the possibility that these studies may have included different populations (suspected MI compared with ST-segment elevation MI) and different doses of administered aspirin; they may have different study designs (cohort compared with RCT); and the studies were performed at different chronological times (1988 compared with 2002) and clinical practice, such as reperfusion therapy, has since changed both the management and outcomes of MI.

We recognize that all included studies were performed about 2 to 3 decades ago and that even if the population and exposure might be comparable to the care offered today, the outcome of MI has improved. The task force agreed that it is unlikely that any major new studies will be performed on this topic.

First aid guideline groups will need to consider that local national, regional, state, or provincial regulations and prescribing practices (eg, in Europe and Asia) might require self-administration for first aid rather than direct administration of aspirin by a first aid provider.

The task force discussed concerns about first aid providers' ability to differentiate chest pain of cardiac origin from other causes of chest discomfort. The term *nontraumatic* was added to the descriptor to enhance and simplify the clinical signs and the differential

diagnosis of chest pain possibly related to the onset of a MI. However, with any treatment recommendation using a symptoms-based approach to problems such as chest pain, the task force agreed that first aid educational materials must teach the signs and symptoms a first aid provider is able to learn, remember, and identify. Furthermore, it is important for educational materials to teach the absolute contraindications for the administration of aspirin (ie, allergy or active bleeding). Guideline organizations may also want to consider including additional local first aid behaviors, such as activating emergency medical services.

Knowledge Gaps

- Additional studies are needed to determine if aspirin is safe when given to patients with nontraumatic chest pain of all causes (ie, not limited to suspected MI).
- Further research is needed to identify the critical interval after the onset of chest pain and aspirin administration that is beneficial for adult patients with acute MI.
- Further research is needed to determine the minimal effective dose and formulation for the oral administration of aspirin for nontraumatic chest pain in adults.

First Aid Interventions for Presyncope (2019 CoSTR, FA 798: SysRev)

In 2019, the First Aid Task Force requested a SysRev[100] and published a CoSTR[101,102] and on the topic of first aid interventions for presyncope. This review resulted in the recommendation for physical counterpressure maneuvers, including hand grip, squatting, leg crossing with tensing, and abdominal core muscle tensing.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with signs and symptoms of faintness or presyncope of suspected vasovagal or orthostatic origin
- Intervention: Physical counterpressure maneuvers, body positioning, hydration, or other
- Comparator: No intervention or each other
- Outcome: Abortion of syncope, injuries or adverse events (all critical), symptom improvement, change in heart rate, systolic or diastolic blood pressure (all important)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Case series and unpublished studies (for example, conference abstracts, trial protocols) were excluded.
- Time frame and languages: All years and all languages were included, provided an English abstract was available.
- PROSPERO Registration: CRD42018107726

Treatment Recommendations

This recommendation (below) is unchanged from 2019.[101,102]

We recommend the use of any type of physical counterpressure maneuver by individuals with acute symptoms of presyncope due to vasovagal or orthostatic causes in the first aid setting (strong recommendation, low- and very low-certainty evidence).

We suggest that lower body physical counterpressure maneuvers are preferable to upper body and abdominal physical counterpressure maneuvers (weak recommendation, very low-certainty evidence).

Optimal Position for Shock (FA 520: EvUp)

The First Aid Task Force most recently reviewed the topic of optimal position for the person in shock in 2015.[5,6] The task force requested an EvUp to identify any relevant evidence published after 2015; the EvUp did not identify evidence to justify a SysRev or a change in the 2015 treatment recommendation (see the EvUp in Supplement Appendix C-2).

Population, Intervention, Control, Outcome, Study Design, and Time Frame

- Population: Adults and children who receive first aid for shock
- Intervention: Positioning of the patient
- Comparator: Compared with not positioning the patient
- Outcome: Any clinical outcome
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Unpublished studies (eg, conference abstracts, trial protocols) were excluded.
- Time frame: All years and all languages were included as long as there was an English abstract.

We reran the existing search strategy, from January 1, 2015, to November 29, 2019.

Treatment Recommendations

This treatment recommendation (below) is unchanged from 2015.[5,6]

We suggest first aid providers place persons with shock in the supine position as opposed to the upright position (weak recommendation, low-certainty evidence).

Recovery Position for Persons With Decreased Level of Consciousness of Nontraumatic Etiology Not Requiring Rescue Breathing or Chest Compressions (FA 517: ScopRev)

Rationale for Review

The benefit of lateral positioning of adults and children with decreased level of consciousness has been widely accepted despite limited supportive scientific evidence. The most recent ILCOR evidence review on this topic in 2015[5,6] addressed use of the recovery position for those with decreased level of consciousness but breathing normally.

Opioid-associated deaths have increased internationally in recent years[103]; death is typically preceded by decreased level of consciousness and respiratory depression or compromise. Recent studies suggest that placing persons in the recovery position may hinder the detection of cardiac arrest.[104–106] As a result, the First Aid Task Force sought a ScopRev on the recovery position, modifying the search strategy used in 2015 to include persons who do not meet the criteria for cardiopulmonary resuscitation but have diminished level of consciousness/responsiveness (eg, from alcohol or drug overdose, intracranial hemorrhage) coupled with breathing abnormality (ie, they are not breathing normally). The outcomes included in the search were expanded to include outcomes of hypoxic events.

The revised and updated search strategy identified more indirect evidence, such as research examining the role of patient positioning in obstructive sleep apnea and cadaver models of cervical spine instability.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with decreased level of consciousness due to medical illness who do not meet criteria for the initiation of rescue breathing or chest compressions (CPR)
- Intervention: Positioning in any specific position
- Comparator: Supine or other recovery position
- Outcome: Any relevant clinical outcomes including but not limited to survival, need for airway management, incidence of aspiration, hypoxia, incidence of cardiac arrest (all critical); and likelihood of cervical spine injury and complications (important): venous occlusion, arterial insufficiency, left arm discomfort/pain discomfort/pain, aspiration pneumonia
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion. Case series and case reports, unpublished studies and reports (eg, conference abstracts, trial protocols, technical reports, incident reports, medical examiner and coroners' reports) were also considered for inclusion.
- Time frame: The scoping search strategy included all years and all languages as long as there was an English abstract. We reran the existing 2015 search strategy on November 4, 2019, with no date/time restrictions.

Summary of Evidence

Thirty-one studies,[104,106–135] a case report,[136] and 2 letters to the editor[105,137] were identified from our database and gray literature search. Nine studies involved patients with a medical, medically induced, or toxicological decreased level of consciousness.[105,107–112,131,136] Eight studies enrolled healthy participants,[104,106,113–117,137] 15 studies assessed patient positioning for ventilation during sleep,[118–128,132–135] and 2 studies involved cadaveric models of cervical spine instability in recovery positions.[129,130] The positions studied, airway maneuvers used, and outcomes reported in the included studies were highly variable. Seven distinct lateral recumbent recovery positions were identified, ranging from lateral to prone, and in many studies, the details of the position used (eg, degree of torso rotation, arm and head position) were not described in sufficient detail to allow for reproducibility. The comparison positions studied, when reported, were also highly variable, ranging from prone to semirecumbent and supine with manual airway maneuvers such as the head tilt–chin lift.

The gray literature search revealed a near-universal adoption of the recovery position for a decreased level of consciousness with normal breathing from unknown causes as well as known or presumed causes such as seizure, stroke, poisoning, and opioid overdose. Treatment guidelines for ski patrollers, lifeguards, prison guards, schoolteachers, and combat medics all recommended a variation of the lateral recumbent recovery position.

See Supplement Appendix B-3 for the full ScopRev and summary of evidence identified.

Task Force Insights

Most studies of the recovery position were performed in healthy volunteers (who have normal muscle tone rather than the reduced tone that may be present in an unresponsive person) and report outcomes such as dependent arm perfusion and comfort associated with positioning. For the focus area of opioid overdose, only a single study was identified, suggesting that a semirecumbent position may be preferable to lateral position.[107] The First Aid Task Force agreed that additional studies are needed to confirm this finding. For other medical causes of decreased mental status, such as stroke, induced sedation, and decreased level of consciousness, the lateral recumbent position was reported to be associated with beneficial outcomes.

As noted, despite a true paucity of research to support its use, the task force acknowledged that the recovery position in its many forms has become universally recommended in first aid settings for persons with decreased level of consciousness from nontraumatic cause, provided they do not require rescue breathing or chest compressions. As a result, a change in practice will likely require substantial evidence and education.

Studies of positional interventions for sleep-disordered breathing help describe the effect of body positions on ventilation in persons with decreased level of consciousness. Most studies reviewed report lateral positioning improving outcomes of interest such as apnea, hypopnea, and oxygen desaturation. However, they may not be directly applicable to the use of the recovery position for persons with decreased level of consciousness from medical, toxicological, and nontraumatic etiology.

The task force discussion focused on the optimal position to promote adequate breathing while optimizing the detection of respiratory and/or cardiac arrest. Although the included evidence favors the use of a lateral recumbent position, the task force voiced concerns about the use of a recovery position in scenarios such as with opioid overdose when hypoxic respiratory arrest or cardiopulmonary arrest may be imminent. It is the consensus of the task force that this topic should be the subject of a SysRev in the near future.

Treatment Recommendation

This treatment recommendation (below) is unchanged from 2015.[5,6]

We suggest that first aid providers position individuals who are unresponsive and breathing normally into a lateral, side-lying recovery position (lateral recumbent) as opposed to leaving them supine (weak recommendation, very low-quality evidence).

FIRST AID FOR TRAUMA EMERGENCIES

Important trauma topics for first aid pertained to control of life-threatening external bleeding, including use of direct pressure and pressure dressings, tourniquets (both manufactured and improvised), hemostatic dressings, hemostatic devices, tourniquets in children, concussion recognition, manual cervical spine stabilization, cervical spine motion restriction, superficial thermal injury dressings, compression wraps for closed extremity joint injuries, and temporary storage of a tooth after dental avulsion.

Control of life-threatening external bleeding was subdivided into 4 topics for SysRevs, all with the same PICOST. These 4 topics are pressure dressings, bandages, devices, or proximal pressure; tourniquets; hemostatic dressings; and hemostatic devices. We included all studies from the prehospital setting (direct evidence), studies performed in combat (military) settings, and simulations (ie, human volunteers, human cadaver, or other models excluding animal models). In-hospital studies (eg, arterial endovascular) were included only if prehospital studies were lacking and if judged to be informative. Evidence about the use of tourniquets in children was sought in a separate ScopRev. This combined SysRev did not explore the timing or order of interventions to control life-threatening external bleeding. This is an important consideration for future reviews.

Control of Severe, Life-Threatening External Bleeding: Pressure Dressings, Bandages, Devices, or Proximal Manual Pressure (FA New 2019: SysRev)

Rationale for Review

The most recent (2015) review of the evidence about control of bleeding evaluated studies of direct pressure, application of cold therapy, elevation of extremities, and use of pressure points (proximal manual pressure).[5,6] The First Aid Task Force requested a new combined SysRev to apply a common search strategy and evaluate and compare the outcomes of several interventions to control severe external bleeding in adults and children in the out-of-hospital setting. The SysRev was completed in 2019.[138]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

Note: These PICOST criteria were used to identify studies analyzed for all topics related to treatment of severe, life-threatening bleeding.

- Population: Adults and children with severe, life-threatening external bleeding in out-of-hospital settings; bleeding from both compressible and noncompressible external sites were included
- Intervention: All bleeding-control methods applicable for use by trained or untrained first aid providers, including manufactured or improvised tourniquets, hemostatic dressings or agents, cryotherapy, direct (manual) pressure, pressure points, pressure dressings or bandages, or elevation of the injured area; manufactured tourniquets included windlass-style or elastic, with single or double application
- Comparator: Studies with comparators of bleeding control methods were included, as well as observational cohorts with a single bleeding-control technique, which, in an observational meta-analysis, may allow comparison of one technique against another.
- Outcome: Mortality due to bleeding, cessation of bleeding/achieving hemostasis, time to achieving

Table 6. Time to Hemostasis for Compression Devices and Manual Pressure

Study Type/Reference	Device	Mean Time to Hemostasis (min)	Device	Mean Time to Hemostasis (min)	Manual Pressure Mean Time to Hemostasis (min)	*P* Value
RCT[140]	Pneumatic	15.6±4.8	Clamp	14.5±4.5	13.9±3.5	0.006
RCT[141]	FemoStop™	35.2±12.3			12.9±12.4	<0.001
RCT[139]	FemoStop™	40.2±23.2	C-clamp	32.6±9.8	27.5±6.3	<0.0001
Cohort[143]	C-clamp	35 [10–110]*			20 [10–45]†	<0.001
Cohort[142]	Mechanical clamp	19.9			33.5	Not reported

*Median time [min-max].
†Median time [min-max].
RCT indicates randomized controlled trial.

hemostasis (all critical); mortality from any cause, decrease in bleeding, complications/adverse effects (all important)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion.
- Time frame: All years and all languages were included as long as there was an English abstract; unpublished studies (eg, conference abstracts, trial protocols) were excluded. The literature search was updated to November 22, 2019.
- PROSPERO Registration: CRD42018091326

Consensus on Science

Pressure Dressings/Bandages/Devices Compared With Direct Manual Pressure

For the critical outcome of time to hemostasis, no direct evidence was found from the prehospital setting. However, we identified very low-certainty evidence (downgraded for very serious indirectness and serious imprecision) from 3 RCTs[139–141] in the in-hospital setting with a total of 918 patients undergoing endovascular procedures. As a result of significant heterogeneity, these studies could not be combined for meta-analysis. In 1 study,[140] the mean time to hemostasis with the use of a pneumatic device was 15.6±4.81 minutes compared with a mean time of 14.5±4.5 minutes with the use of a clamp and 13.9±3.5 minutes in the manual compression group (overall *P*=0.006). In another study,[141] the mean time to hemostasis in the FemoStop™ device group was 35.2±12.3 minutes compared with the manual compression time of 12.9±12.4 minutes (*P*<0.001). In the third study,[139] mean time to hemostasis by device was as follows: FemoStop™ 40.2±23.2, C-clamp 32.6±9.8, and manual 27.5±6.3 minutes. All 3 RCTs demonstrated a significantly longer time to hemostasis with use of mechanical pressure devices compared with use of direct manual pressure.

We identified very low-certainty evidence (downgraded for serious risk of bias, indirectness, and imprecision) from 2 in-hospital cohort studies[142,143] of 3528 patients undergoing endovascular procedures. Use of a C-clamp was associated with a longer time to hemostasis compared with manual pressure in the first study[143] whereas in the second study of 3255 patients, a shorter time to hemostasis was associated with use of a mechanical clamp compared with use of direct manual pressure.[142] See Table 6 for time to hemostasis results.

For the critical outcome of cessation of bleeding, we identified very low-certainty evidence (downgraded for very serious indirectness and serious imprecision) from 1 in-hospital RCT[140] of 400 patients undergoing endovascular procedures. This study showed benefit in the combined clamp compression and manual compression group compared with the pneumatic compression group (99% compared with 73%) in achieving hemostasis (overall *P*<0.0001).

We identified very low-certainty evidence (downgraded for serious risk of bias, indirectness, and imprecision) from 1 in-hospital cohort study[144] of 64 patients with arterio-venous fistula puncture for hemodialysis. This study showed an association with higher rates of bleeding cessation with the use of a commercial, elasticized compression bandage (82%) compared with manual pressure (47% and 44%, first and third weeks of the block study design, *P*<0.05).

For the important outcome of complications/adverse effects, we identified very low-certainty evidence (downgraded for very serious indirectness and serious imprecision) from 3 in-hospital RCTs[139–141] of 918 patients undergoing endovascular procedures and from 3 in-hospital observational studies[142–144] of 3647 patients undergoing either an arterio-venous fistula puncture or endovascular procedure. The heterogeneity of these studies prevented combination of results for meta-analysis. However, none of the studies reported a significant difference in complications with use of either pressure devices or with manual pressure.

We did not find evidence for the critical outcome of mortality resulting from bleeding or the important outcome of mortality from any cause.

Pressure Points Compared With Direct Manual Pressure

We did not identify any human studies comparing pressure points with direct manual pressure.

Treatment Recommendations

We recommend that first aid providers use direct manual compression compared with the use of external compression devises or pressure dressings/bandages for severe, life-threatening external bleeding (strong recommendation, very low-certainty evidence).

We recommend against the use of pressure points compared with the use of direct manual pressure by first aid providers for severe, life-threatening external bleeding (strong recommendation, very low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

In making a strong recommendation, the First Aid Task Force considered direct manual pressure as the fundamental first step in the initial management of any life-threatening external bleeding. Two evidence-to-decision tables present task force insights: Supplement Appendix A-8, pressure points versus direct pressure, and Supplement Appendix A-9, pressure dressings versus direct pressure.

The task force was strongly influenced by 3 RCTs[139–141] demonstrating that the use of manual compression achieved hemostasis in a shorter average time than the use of pressure dressings/bandages/devices.

Direct manual pressure is available to all first aid providers, has no cost, and can be provided equitably in all countries. The use of pressure dressings or devices may increase treatment and training costs and, therefore, healthcare disparities.

The task force acknowledges that improved education is likely to be needed to enhance the quality of direct manual pressure for the cessation of life-threatening external bleeding. The task force agreed that this training should be incorporated into all standard first aid training and also agreed that no additional resources would be needed. However, the study results are inconsistent and indirect, and external compression devices/bandages may also be efficacious when applied appropriately.

The task force also placed considerable value on the fact that there is no direct human evidence showing that the use of pressure points is effective in the control of life-threatening external bleeding.

The task force agreed that the use of in-hospital data derived from arterial endovascular and arterio-venous puncture may not be applicable to first aid control of life-threatening bleeding. Of note, in-hospital subjects in the studies often received anticoagulants that likely complicated the control of bleeding.

Although we identified no studies performed exclusively in children, the task force agreed that it is reasonable to apply these recommendations to children.

Knowledge Gaps

- Experimental or observational studies are needed comparing pressure dressings, bandages, devices, or pressure points with direct manual pressure in patients with severe, life-threatening external bleeding in the prehospital or first aid setting.
- Research is needed to identify optimal techniques to provide direct manual pressure while minimizing rescuer fatigue.
- Experimental or observational studies are needed for control of life-threatening bleeding with use of pressure dressings, bandages or devices in children.
- It is unclear if first aid providers can appropriately locate pressure points.

Control of Severe, Life-Threatening External Extremity Bleeding: Tourniquets (FA 768, 1543,1549: SysRev)

Rationale for Review

The most recent CoSTR about the use of tourniquets was published in 2015.[5,6] As noted, the First Aid Task Force requested a new, combined SysRev to compare evidence across multiple interventions for control of life-threatening external bleeding. This CoSTR summarizes data comparing use of tourniquets with direct pressure, manufactured with improvised tourniquet designs, hemostatic dressings with direct pressure and tourniquets, and hemostatic devices with direct pressure for control of life-threatening external bleeding in extremities. A separate ScopRev on the topic of pediatric tourniquet designs was also completed.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

See PICOST for Control of Severe, Life-Threatening External Bleeding: Pressure Dressings, Bandages, Devices, or Proximal Manual Pressure.

Consensus on Science

Tourniquets Compared With Direct Manual Pressure

For the critical outcome of mortality from bleeding, we identified very low-certainty evidence (downgraded for serious risk of bias, inconsistency and imprecision) from 4 prehospital civilian cohort studies[145–148] of 527 participants. In these studies, there was no significant reduction in mortality from bleeding with the use of tourniquets compared with the use of direct manual pressure alone.

For the critical outcome of cessation of bleeding, we identified very low-certainty evidence (downgraded for serious risk of bias and imprecision) from 2 prehospital military cohort studies[149,150] of 76 participants. In the largest cohort study[149] of 70 participants, a higher rate of bleeding cessation on hospital arrival was associated with the use of tourniquets (35/42 [83.3%] compared with the use of direct manual pressure alone 17/28 [60.7%]; P=0.033). A very small cohort study[150] of 6

participants noted that bleeding cessation occurred in 6/6 participants with or without the use of a tourniquet.

For the important outcome of mortality from all causes, we identified 6 civilian prehospital cohort studies[145–148,151,152] of 1811 participants. Study heterogeneity prevented combining results for meta-analysis. The overall certainty of evidence was rated as very low resulting from serious risk of bias, inconsistency, and imprecision. In unadjusted analyses, 5 of the 6 studies failed to demonstrate a statistically significant reduction in all-cause mortality associated with the use of a tourniquet compared with the use of direct manual pressure alone.[145–148,151] In a sixth large cohort study[152] of 1026 total participants, the use of direct manual pressure alone was associated with a higher risk for all-cause mortality compared with the use of a tourniquet when evaluated by multivariable analysis (adjusted OR, 5.86; 95% CI, 1.41–24.47; *P*=0.015).

We identified very low-certainty evidence (downgraded for serious risk of bias and inconsistency) from 6 prehospital military cohort studies[149,150,153–156] of 6163 participants. None showed a reduction in all-cause mortality associated with the use of a tourniquet compared with use of direct manual pressure alone.

For the important outcome of complications/adverse effects (including compartment syndrome nerve palsy, fasciotomy, thromboembolic episodes), we identified very low-certainty evidence (downgraded for serious risk of bias and imprecision) from 3 prehospital civilian cohort studies[148,151,152] of 1420 participants. Study heterogeneity prevented combining results for meta-analysis. These studies reported inconsistent results when comparing a tourniquet with the use of direct manual pressure alone, with no significant increase in adverse events with use of one modality or the other.

We identified very low-certainty evidence (downgraded for serious risk of bias) from 5 prehospital civilian cohort studies[145,148,151,152,157] of 1686 participants reporting the complication of amputation. Study heterogeneity prevented combining the results for meta-analysis, and all reported similar amputation rates with the use of tourniquets compared with the use of direct manual pressure alone.

We identified very low-certainty evidence (downgraded for risk of bias and imprecision) from 1 prehospital military cohort study[149] of 165 participants. This study reported similar amputation rates with the use of tourniquets compared with the use of direct manual pressure alone.

For the critical outcome of time to hemostasis, no comparative studies were identified.

Tourniquets Compared With Hemostatic Dressings

For the critical outcome of mortality caused by bleeding, we identified very low-certainty evidence (downgraded for serious risk of bias and imprecision) from 1 prehospital military cohort study[158] of 96 adults with external extremity bleeding, which showed no significant difference in mortality among those with the use of a tourniquet compared with the use of a hemostatic dressing.

For the important outcome of all-cause mortality, we identified very low-certainty evidence (downgraded for serious risk of bias and imprecision) from 1 prehospital military cohort study[158] of 96 adults. Tourniquet use was associated with a significant all-cause mortality risk reduction; 6% (4/66) mortality was associated with the use of a tourniquet compared with 30% (9/30) mortality associated with the use of hemostatic dressings (RR, 0.20; 95% CI, 0.07–0.60; adjusted RR, 24 fewer per 1000 participants; 95% CI, from 12 fewer to 28 fewer). However, in this study, the types and locations of wounds weren't reported, and it is unknown if the injuries were comparable.

For the important outcome of complications/adverse effects, no comparative studies were identified.

For the critical outcome of time to hemostasis, we identified no direct evidence from comparative studies.

Manufactured Tourniquets Compared With Improvised Tourniquets

We did not identify any human studies comparing manufactured tourniquets with improvised tourniquets for the management of severe, life-threatening external extremity bleeding. However, 4 observational simulation studies[159–162] provided information about the ability of first aid providers to stop bleeding with the use of manufactured compared with improvised tourniquets. The first study[159] reported the association of higher pulse cessation in lower extremities (85% compared with 10%) and upper extremities (100% compared with 75%) with manufactured compared with improvised tourniquets. One observational study[161] reported 100%, 40%, and 10% simulated bleeding cessation with the application of a manufactured tourniquet compared with an improvised cravat tourniquet compared with a bandana tourniquet, respectively.

Windlass-Style Manufactured Tourniquets Compared With Other Types of Manufactured Tourniquets

We did not identify any human studies comparing windlass-style manufactured tourniquets (ie, one with a rod to tighten the tourniquet) with other types of manufactured tourniquets for the management of severe, life-threatening external extremity bleeding. Ten simulation studies[163–172] provided information about the feasibility of the use of windlass-style manufactured tourniquets compared with other designs of manufactured tourniquets.

Treatment Recommendations

We suggest that first aid providers use a tourniquet in comparison with direct manual pressure alone for

severe, life-threatening external extremity bleeding that is amenable to the application of a tourniquet (weak recommendation, very low-certainty evidence).

We suggest that first aid providers use a tourniquet compared with a hemostatic dressing for severe, life-threatening external bleeding that is amenable to the use of a tourniquet (weak recommendation, very low-certainty evidence).

If a tourniquet is not immediately available, we suggest direct manual pressure to control life-threatening external bleeding from an extremity until a tourniquet can be applied (good practice statement).

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 (good practice statement).

We suggest that first aid providers use a manufactured tourniquet compared with an improvised tourniquet for severe, life-threatening external bleeding (weak recommendation, very low-certainty evidence).

For the treatment of severe, life-threatening external bleeding by first aid providers, we are unable to recommend any one particular design of tourniquet compared with another.

Justification and Evidence-to-Decision Framework Highlights

The application of pressure stops bleeding. Tourniquets apply circumferential pressure remote from the bleeding point. There are few comparative studies of tourniquet use and direct pressure alone; a more robust body of lower-certainty evidence suggests that tourniquets, when applied appropriately, stop bleeding in most cases, and this was considered by the task force when formulating treatment recommendations (see Supplement Appendix A-10, evidence-to-decision table for tourniquets compared with direct pressure).

In addition, although this review did not evaluate the timing or order of interventions to control life-threatening bleeding, the task force considered results of 1 observational study[145] demonstrating the association of greater risk of hemorrhagic death with hospital compared with prehospital tourniquet placement (14% compared with 3.0%, P=0.01). The study did not describe bleeding control techniques in lieu of tourniquets but may suggest that early prehospital tourniquet use may reduce mortality, although effectiveness may be time sensitive.

Although the task force recognizes that there is limited data comparing use of tourniquets with hemostatic dressings for similar wounds, the consensus of the task force is that use of a tourniquet is preferable. See Supplement Appendix A-11, evidence-to-decision table for tourniquets compared with hemostatic dressings.

Not every area of the body is amenable to the use of a tourniquet, and a tourniquet may not always be immediately available. Direct manual pressure can be effective until a tourniquet can be applied. In multiple casualty situations, the use of a tourniquet may free resources to attend to other life-threatening injuries. Because some comparative studies suggested a lack of superiority for outcomes of cessation of bleeding or mortality from bleeding with the use of a tourniquet, the task force agreed to include a good practice statement for situations when a tourniquet is not available, or when a wound is not amenable to the use of a tourniquet (ie, proximal extremity wounds, wounds on limbs of a size that will not permit successful placement of a tourniquet). This statement also integrates the use of direct pressure with evidence from the systematic review of control of severe, life-threatening external bleeding: hemostatic dressings. A *good practice statement* is one for which there is a high level of certainty that the recommendation will do more good than harm, but there is little direct evidence. Likewise, a good practice statement recommending *against* a treatment is one for which there is a high level of certainty that the treatment will do more harm than good, but there is little direct evidence.

In recommending the use of manufactured tourniquets, the task force was influenced by 2 observational studies[159,161] that demonstrated an improvement in simulated bleeding cessation rates associated with the use of manufactured tourniquets compared with the use of improvised tourniquets. The task force interpreted the results as examples of practical information about ability of providers to use manufactured compared with improvised tourniquets to stop simulated bleeding. Task force members noted that when faced with life-threatening bleeding from a limb and a manufactured tourniquet is unavailable and bleeding cannot be controlled by direct pressure with or without hemostatic dressings, first aid providers could consider the use of an improvised tourniquet, made to appropriate specifications (eg, wide and tight). See Supplement Appendix A-12, the evidence-to-decision table for manufactured tourniquets compared with improvised tourniquet.

Simulation data about the use of a windlass tourniquet compared with other tourniquet designs did not show superiority of any one type of tourniquet. See Supplement Appendix A-13, windlass tourniquets compared with other tourniquet designs.

Knowledge Gaps

- Sufficiently powered experimental or observational studies are needed that compare the use of manufactured tourniquets with hemostatic dressings or improvised tourniquets and studies that compare windlass tourniquets with other tourniquet

designs for severe, life-threatening prehospital bleeding.
- There is an urgent need for comparative studies involving children (see FA New 2019: ScopRev below).
- Studies are needed to determine if first aid providers can recognize injuries that are amenable to tourniquet placement.
- Studies are needed to determine the educational requirements necessary to teach first aid providers to appropriately deploy tourniquets on a mass scale (eg, just-in-time training).

Control of Severe, Life-Threatening External Bleeding: Hemostatic Dressings (FA 769: SysRev)

Rationale for Review

The most recent CoSTR about the use of hemostatic dressings was published in 2015.[5,6]

The First Aid Task Force requested a new SysRev evaluating multiple interventions for control of external bleeding that yielded a large evidence base to answer several questions about control of life-threatening bleeding. This CoSTR compares use of hemostatic dressings with direct pressure and summarizes evidence comparing several hemostatic dressing types for control of life-threatening external bleeding.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

See PICOST for Control of Severe, Life-Threatening External Bleeding: Pressure Dressings, Bandages, Devices, or Proximal Manual Pressure.

Consensus on Science

Hemostatic Dressings Plus Direct Pressure Compared With Direct Pressure Alone

For the critical outcome of cessation of bleeding, we identified very low-certainty evidence (downgraded for serious risk of bias, indirectness, and imprecision) from 1 in-hospital civilian RCT[173] comparing the use of chitosan-coated gauze dressings plus direct pressure with simple pressure dressings in 160 patients. Complete cessation of bleeding was achieved in all patients in both groups whether hemostatic dressings plus direct pressure with simple pressure dressings or direct pressure alone were used.

We identified very low-certainty evidence (downgraded for serious risk of bias, very serious indirectness, and serious imprecision) from 2 in-hospital RCTs[174,175] of 141 participants treated with a hemostatic dressing or manual compression after an endovascular procedure. Heterogeneity of these studies precluded meta-analysis. In the first RCT,[174] the use of a hemostatic dressing plus direct pressure was not beneficial compared with the use of manual compression for cessation of bleeding. In the second RCT[175] cessation of arterial site bleeding was achieved in all 21 children, whether hemostatic dressings plus direct pressure or direct pressure alone were used.

We identified very low-certainty evidence (downgraded for serious risk of bias, very serious indirectness, and serious imprecision) from 1 in-hospital cohort study[176] of 88 patients treated with a hemostatic dressing plus direct pressure or direct pressure alone after an endovascular procedure. The use of hemostatic dressings were associated with no benefit compared with direct pressure alone because cessation of bleeding was achieved in all participants.

For the critical outcome of time to hemostasis, we identified low-certainty evidence (downgraded for serious risk of bias and indirectness) from 1 in-hospital civilian RCT[173] with 160 patients. Hemostatic dressings with direct pressure were beneficial because cessation of bleeding was achieved within 5 minutes with the use of chitosan-coated gauze plus direct pressure (41/80 [51.2%] compared with pressure dressings 26/80 [32.5%]; RR, 1.58; 95% CI, 1.08–2.31).

We identified low-certainty evidence (downgraded for very serious indirectness) from fourteen in-hospital RCTs[174,175,177–188] with 2419 civilian adults and children (1 study) undergoing endovascular procedures. Heterogeneity precluded combining these studies, but they demonstrated more rapid hemostasis (range 4.6–17.8 minutes) with the use of hemostatic dressings plus manual pressure compared with direct manual pressure alone (12.4–43.5 minutes). MDs across studies ranged from 2 minutes (95% CI, 0.46–3.54) to 32 minutes (95% CI, 28.03–35.97).

For the important outcome of all-cause mortality, we identified very low-certainty evidence (downgraded for serious risk of bias and imprecision) from 1 prehospital military cohort study[189] with 190 participants. Use of hemostatic dressings was not associated with lower mortality compared with direct manual pressure alone.

We identified very low-certainty evidence (downgraded for very serious indirectness and serious imprecision) from 2 in-hospital civilian RCTs[186,190] with 1028 adults undergoing endovascular procedures. These studies showed no reduction in all-cause mortality with the use of hemostatic dressings plus direct pressure compared with direct manual pressure alone. One RCT[190] reported no deaths in 100 patients randomized to either the hemostatic dressing with pressure or direct pressure alone. However, in this study, the duration of compression was much longer in the manual compression-only group compared with the use of a hemostatic dressing plus direct pressure (2 hours compared with 15 minutes). A second RCT[186] compared 908 patients randomized to receive treatment with 1 of 2 possible hemostatic dressings plus direct pressure or a pneumatic

compression device and also reported no deaths in any of the groups.

For the important outcome of decrease in bleeding, we identified low-certainty evidence (downgraded for serious risk of bias and indirectness) from 1 in-hospital civilian RCT[173] with 160 patients. This study showed benefit as measured by the mean number of blood-soaked gauzes associated with the use of hemostatic dressings (chitosan-coated gauze) plus direct pressure compared with use of direct pressure alone (MD, 0.43 fewer gauzes; 95% CI, 0.85–0.01 fewer).

For the important outcome of complications/adverse effects, we identified very low-certainty evidence (downgraded for very serious indirectness and serious imprecision) from 4 in-hospital civilian RCTs[174,187,190,191] of 1040 patients undergoing endovascular procedures. None of the studies demonstrated a benefit (ie, reduced complications) with the use of hemostatic dressings plus direct pressure compared with the use of direct pressure alone. Three of the RCTs[174,190,191] reported no complications including major bleeding in either group. One RCT[187] reported no benefit (reduction in major bleeding complications) from hemostatic dressings.

For the outcome of adverse effects (as reported by pain scores), we identified very low-certainty evidence (downgraded for serious risk of bias, indirectness, and imprecision) from 2 in-hospital civilian cohort studies[176,177] of 224 patients undergoing endovascular procedures. There was no benefit associated with the use of hemostatic dressings plus direct pressure compared with direct pressure alone. One study[176] reported no significant differences in pain scores between the use of hemostatic dressing plus pressure and the use of direct pressure alone.

We identified no evidence for the critical outcome of mortality caused by bleeding.

One Hemostatic Dressing Type Compared With Other Hemostatic Dressings

For the critical outcome of time to hemostasis, we identified moderate-certainty evidence (downgraded for serious indirectness) from 3 in-hospital civilian RCTs[181,184,186] with 750 patients undergoing endovascular procedures. Heterogeneity precluded meta-analysis. However, all 3 studies found no superiority in time to hemostasis after the use of a calcium ion releasing dressing pad (a poly-N-acetylglucosamine hemostatic pad) or a chitosan-based hemostasis pad compared with a hemostatic thrombin bandage or a biopolymer-based hemostatic pad.

For the important outcome of all-cause mortality, we identified very low-certainty evidence (downgraded for serious indirectness and imprecision) from 1 in-hospital civilian RCT[184] with 90 patients undergoing endovascular procedures. There was no reduction in all-cause mortality after use of chitosan-based Chito-Seal (Abbott Vascular, Redwood City, California) compared with a biopolymer-based Clo-Sur P.A.D. (Scion Biomedical, Miami, Florida) hemostatic dressing; no deaths were reported in either of the 2 study arms.

For the important outcome of adverse effects, we identified very low-certainty evidence (downgraded for serious risk of bias, indirectness, and imprecision) from 2 in-hospital civilian RCTs[184,186] of 696 patients undergoing endovascular procedures that reported rebleeding. These studies reported inconsistent results when comparing different types of hemostatic dressings. One RCT[186] with 606 participants demonstrated a lower rate of minor bleeding after the use of a calcium ion releasing wound dressing pad (Neptune Pad [TZ Medical, Portland, Oregon]; 6.6% [20/303]) compared with using a hemostatic thrombin-covered bandage (D-Stat Dry [Teleflex, Morrisville, North Carolina]; 12.2% [37/303]) (RR, 0.54; 95% CI, 0.32–0.91; *P*=0.02). The second RCT[184] with 90 participants reported a similar rate of rebleeding after the use of a chitosan-based hemostasis pad (Chito-Seal; 21.2% [10/47]) compared with using a biopolymer-based hemostatic pad (Clo-Sur P.A.D.; 23.2% [10/43]).

We did not find evidence reporting the critical outcomes of mortality due to bleeding and cessation of bleeding, or the important outcomes of any complication/adverse events.

Treatment Recommendations

We suggest that first aid providers use a hemostatic dressing with direct pressure as opposed to direct pressure alone for severe, life-threatening external bleeding (weak recommendation, very low-certainty evidence).

As the result of the very low confidence in effect estimates, we are unable to recommend the use of any one specific type of hemostatic dressing for severe, life-threatening external bleeding.

Justification and Evidence-to-Decision Framework Highlights

See Supplement Appendix A-14 for the evidence-to-decision table regarding hemostatic dressings compared with direct pressure alone; see Supplement Appendix A-15 for comparison across hemostatic dressing types. In making this recommendation, the task force was strongly influenced by 1 civilian in-hospital RCT[173] demonstrating higher frequency (51.2% compared with 32.5%) of cessation of bleeding within 5 minutes with the use of a hemostatic dressing plus direct pressure compared with direct pressure alone.

Direct manual pressure stops bleeding and, when used appropriately, hemostatic dressings in conjunction with direct pressure may stop life-threatening external bleeding in more cases.

Some studies included children. However, these numbers were limited and data specifically pertaining to children were sparse. Despite the lack of pediatric-specific evidence, the First Aid Task Force agreed that it would be reasonable for these recommendations to apply to control of life-threatening bleeding in children.

The task force recognizes that the use of hemostatic dressings requires additional equipment and training expense that may increase healthcare disparity in some cases. In addition, in some areas, hemostatic dressings may not be available to lay providers.

The task force recognizes the lack of prehospital studies and therefore downgraded certainty of evidence of all in-hospital studies. Many of these in-hospital studies may include confounders such as simultaneous use of anticoagulants.

Knowledge Gaps

- Additional research is needed to determine if first aid providers are able to use hemostatic dressings properly and whether any one type of hemostatic dressing or agent is superior.
- Research is needed to assess risks and benefits of hemostatic dressings in children.

Control of Severe, Life-Threatening External Bleeding: Hemostatic Devices (2020 New FA: SysRev)

Rationale for Review

The most recent CoSTR about the use of control of bleeding was published in 2015,[5,6] but it did not include the use of hemostatic devices. The First Aid Task Force requested a new, combined SysRev to compare evidence of multiple interventions for control of life-threatening external bleeding, including hemostatic devices.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

See PICOST for Control of Severe, Life-Threatening External Bleeding: Pressure Dressings, Bandages, Devices, or Proximal Manual Pressure.

Consensus on Science

This consensus on science focuses on the published evidence about the effectiveness of medical devices designed for control of bleeding, including junctional tourniquets (a tourniquet designed to control hemorrhage and bleeding in inguinal or axilla areas) and wound clamps (a device for the temporary control of severe bleeding that works by sealing the edges of a wound closed).

Junctional Tourniquets Compared With Direct Pressure

We did not identify any human studies comparing junctional tourniquets with direct pressure for the management of severe, life-threatening external bleeding. Although 12 simulation studies[192–203] were identified, they were excluded from review because the task force agreed that the evidence was too indirect for inclusion.

Wound Clamps Compared With Direct Pressure

We did not identify any human studies comparing wound clamps with direct pressure for the management of severe, life-threatening external bleeding. However, we identified 2 prehospital case series[204,205] involving application of an invasive medical device by healthcare professionals in 10 participants. Although outcomes in this study were positive, they provide only indirect evidence for first aid use.

Treatment Recommendations

In the absence of comparative evidence, we are unable to recommend for or against the use of a junctional tourniquet by first aid providers in comparison with direct manual pressure alone for severe, life-threatening external bleeding.

In the absence of comparative evidence, we are unable to recommend for or against the use of wound clamps by first aid providers in comparison with other hemostatic techniques for severe, life-threatening external bleeding.

Justification and Evidence-to-Decision Framework Highlights

The task force agreed that there was inadequate evidence to compare the use of junctional tourniquets or wound clamps to direct pressure. See the evidence-to-decision tables for junctional pressure devices compared with direct pressure in Supplement Appendix A-16, and wound clamps compared with other hemostatic techniques in Supplement Appendix A-17.

Data about the use of junctional tourniquets and wound clamps by first aid providers comes primarily from simulation studies or case series, without comparison with direct pressure. The task force has concerns about the ability of first aid providers to learn and properly apply junctional tourniquets or wound clamps in a prehospital setting. In addition, regulatory restrictions, cost, and risks may prohibit the use of these devices by unlicensed care providers. Finally, the use of direct manual pressure by first aid providers is a traditional gold standard technique for control of bleeding that can be quickly applied with minimal training.

The task force recognizes that benefits of junctional tourniquets may justify their use in specific populations (eg, military organizations) that require hands-free control of life-threatening external bleeding in locations not amenable to alternative methods for the control of bleeding.

Knowledge Gaps

- There are no experimental or observational studies comparing use of junctional tourniquets or wound clamps with use of direct manual pressure in adults or children with severe, life-threatening bleeding in the prehospital setting.
- It is unclear if first aid providers are able to recognize wounds that would be amenable to junctional tourniquets and if they are able to apply them properly.

Pediatric Tourniquet Designs for Life-Threatening Extremity Hemorrhage (FA New 2019: ScopRev)

Rationale for Review

In 2017 ILCOR commissioned a combined SysRev on the topic of control of life-threatening bleeding in adults and children, including use of tourniquets. Although studies were found for the use of tourniquets in adults, there was very little literature found pertaining to children. While the evidence in support of direct manual pressure and hemostatic gauze may be extrapolated to children, the First Aid Task Force was concerned that the smaller limb circumferences in children may limit the successful use of tourniquets that are designed for use in adults. This ScopRev is intended to evaluate all available literature on tourniquet use in the pediatric population.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Children (younger than 19 years) with severe, life-threatening bleeding from an extremity wound
- Intervention: Commercial elastic wrap tourniquet or commercial ratcheting tourniquet
- Comparator: Commercial windlass-type tourniquet
- Outcome: Any clinical outcome
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) and case series were eligible for inclusion. Unpublished studies (eg, conference abstracts, trial protocols) were included.
- Time frame: All years and all languages were included as long as there was an English abstract.

Summary of Evidence

The ScopRev identified 2 position statements from national pediatric trauma organizations,[206,207] 2 retrospective reviews of tourniquet use in pediatric casualties in US military hospitals or war zones,[208,209] 2 models of pediatric limb circumferences to test the application of multiple different tourniquet models,[210,211] 2 observational trials using healthy pediatric volunteers,[212,213] 1 case report of tourniquet use in a child,[214] and 3 websites. Of the 3 websites included,[215–217] all summarized preexisting data or expert opinion on pediatric tourniquet use and did not add any significant information to the studies already identified. The position statements from the Pediatric Trauma Society[206] and the Committee for Tactical Emergency Casualty Care Pediatric Working Group[207] both recommend use of tourniquets for life-threatening extremity hemorrhage in the children.

In 2 observational studies, the use of a windlass design of tourniquet (specifically the C-A-T GEN 7 [North American Rescue, Greer, South Carolina]) abolished distal pulses in both the upper and lower extremities in children as young as 2 years of age with a minimum limb circumference of 13 cm.[212,213] The first study[212] enrolled 7 healthy outpatient volunteers, 6 to 16 years of age. The success rate in eliminating distal pulses with the tourniquet was 100% (60/60) in the upper extremities and 93% (56/60) in the lower extremities. A second study[213] enrolled children 2 to 7 years of age undergoing elective orthopedic surgery, reporting successful application of the C-A-T GEN 7 in all 24 children (11 upper extremities and 13 lower extremities) with a 100% success rate in occluding distal pulses down to a minimal limb circumference of 13 cm. Two studies using models or manikins[210,211] reported that elastic type tourniquets (SWAT-T [H&H Medical Corporation, Williamsburg, Virginia] and R.A.T.S. [RATS Medical, Salt Lake City, Utah]) and pediatric-specific ratcheting tourniquets were the designs capable of tightening on the smallest models (to a circumference of 11.9 cm for the CRMT [M2 Inc, Colchester, Vermont] and R.A.T.S. and of 10.8 cm for the SWAT-T). See Supplement Appendix B-4 for the full ScopRev with summary of evidence identified.

Task Force Insights

The task force recognized the importance of the early control of severe life-threatening bleeding in children younger than 2 years of age, especially in light of their small blood volume. In the absence of evidence for the effective use of tourniquets in this age group, the task force discussed using direct pressure to control life-threatening bleeding. It agreed that more research is needed into the design and use of tourniquets, particularly for children younger than 2 years of age. The topic of tourniquet design and their use in children warrants a potential future SysRev. Until a new SysRev is completed and analyzed, the new 2020 treatment recommendations for tourniquet use apply to children as well as adults.

Treatment Recommendations

We suggest that first aid providers use a tourniquet in comparison with direct manual pressure alone for severe, life-threatening external extremity bleeding in a child that is amenable to the application of a tourniquet (weak recommendation, very low-certainty evidence).

If a tourniquet is not immediately available, we suggest direct manual pressure to control life-threatening external bleeding from an extremity until a tourniquet can be applied (Good Practice Statement).

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 (good practice statement).

Note: These recommendations follow from the 2020 SysRev on the topic of Control of Severe, Life-Threatening External Extremity Bleeding: Tourniquets Compared With Direct Manual Pressure.

Simple Single-Stage Concussion Scoring System(s) in the First Aid Setting (FA 799: ScopRev)

Rationale for Review

The topic of a simple single-stage concussion scoring system in the first aid setting was reviewed in 2015,[5,6] but we identified no evidence to support the use of any scoring system relevant to the first aid setting. The First Aid Task Force prioritized this topic for review because there remains a need to identify a simple, validated single-stage concussion scoring system for use by first aid providers in the first aid environment.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with suspected head injury without loss of consciousness
- Intervention: Use of a simple single-stage concussion scoring system
- Comparator: Standard first aid assessment without a scoring system
- Outcome: Any clinical outcome
- Study design: RCTs, controlled clinical trial, clinical trial, comparative study, nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies, case-control, cross-sectional, epidemiological), case series (n>5), survey and unpublished studies (eg, conference abstracts, trial protocols), editorials, commentary, and case reports were eligible for inclusion.
- Time frame: All years and all languages were included as long as there was an English abstract. We reran the existing 2015 search strategy, from January 1, 2014, to December 6, 2019.

Summary of Evidence

Our extensive search strategy yielded many publications; unfortunately, subsequent review resulted in the identification of no publications reporting on a single-stage concussion scoring system in the first aid environment by nonmedical providers. We did identify concussion assessment tools (such as the Sport Concussion Assessment Tool 5[218]) currently recommended for use in sports, but these require a 2-stage assessment, including baseline testing plus evaluation after a head injury; preincident/baseline testing is impractical for use in the typical first aid setting. The Concussion Recognition Tool is a recently introduced tool designed for nonhealthcare providers that has not yet been validated.[219] See Supplement Appendix B-5 for the full ScopRev and summary of evidence identified.

Task Force Insights

The First Aid Task Force is aware of potential consequences of failure to recognize a concussion in the first aid setting, and the need for a simple, single stage assessment system for first aid use. Alternative scoring systems and scales (eg, Glasgow Coma Scale, adult and pediatric; the Alert, Responds to Verbal Stimuli, Responds to Pain, Unresponsive [AVPU] Scale) used to assess level of consciousness were considered and are described in the full ScopRev in Supplement Appendix B-5.

However, given the limited additional evidence identified in this review, the task force did not feel there was sufficient information to prompt consideration of a new SysRev or the reconsideration of current treatment recommendations. As a result, the 2015 treatment recommendation (ie, a nonrecommendation—see immediately below) remains in effect.[5,6]

Treatment Recommendation

This treatment recommendation (below) is unchanged from 2015.[5,6]

No recommendation; we acknowledge the role that a simple, validated, single-stage concussion scoring system could play in first aid providers' recognition and referral of victims suspected of head injury. However, review of the available literature shows no evidence about the application of such scoring systems by first aid providers.

Manual Cervical Spine Stabilization (FA 1547: ScopRev)

Rationale for Review

The topic of manual cervical spine stabilization/motion restriction was reviewed in 2005,[220] 2010,[55] and 2015.[5,6] The reviews included use of devices as well as use of manual motion restriction but did not identify studies specific to manual stabilization; in addition, no SysRev was performed. In 2015, the First Aid Task Force recommended against the use of cervical collars by first aid providers but made no recommendation about manual stabilization.[5,6] This led to questions from experts who were writing council guidelines. The First Aid Task Force requested a ScopRev using a newly developed PICOST question to search for published evidence that would support the consideration of a SysRev on the topic of first aid for adults with a suspected cervical spinal injury, with a focus on manual stabilization techniques.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Injured adults with identified high-risk for cervical spinal injury
- Intervention: Use of any manual cervical stabilization technique (ie, trap-squeeze or head-squeeze techniques) by first aid/lay providers
- Comparator: Another technique or no manual stabilization
- Outcome: Any clinical or biomechanical outcomes
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies), case

reports or series, unpublished studies (eg, conference abstracts, trial protocols), and all gray literature were eligible for inclusion.
- Time frame: All languages were included as long as there was an English abstract. Final searches were run with a date limit of 1999 to 2019 and were last run in November 2019.

Summary of Evidence

No studies were identified that evaluated manual stabilization as applied in a first aid or first responder setting for adults identified at high risk for a cervical spine injury. The ScopRev included 2 studies involving trained paramedics[221] or experienced athletic trainers[222] applying cervical spine stabilization techniques to healthy adult volunteers during lift and transfer.

The ScopRev also identified a narrative review of cervical spine motion during vehicle extrication.[223]This review included 1 small series using high-speed infrared motion-detection cameras[224] that measured less cervical spine motion in conscious injured adults who self-extricated without a cervical collar compared with cervical spine motion during extrication with traditional equipment, including a cervical collar (mean movement 13.33°±2.67° from the neutral in-line position compared with 18.84°±3.46°).

In a review of the gray literature in Google Scholar, the ScopRev identified multiple webpages with blog-style articles discussing the pros and cons of cervical collar use in blunt trauma casualties but no articles describing manual stabilization or support of the cervical spine. Database searches also provided some information related to in-hospital manual in-line stabilization of the injured cervical spine during airway management. These in-hospital studies were excluded from our review as the result of extreme indirectness. See Supplement Appendix B-6 for the full ScopRev on manual cervical spine stabilization.

Task Force Insights

The First Aid Task Force discussed many issues relating to evaluating manual stabilization of the cervical spine. Our paraphrased question was, "When caring for a person who is considered at high risk for a cervical spine injury, should a first aid provider use manual stabilization techniques to support the person's head, with the goal of preventing further movement (and potential injury) prior to arrival of emergency medical services and application of spinal motion restriction?" The techniques for manual stabilization are skills requiring education and potential spaced training and practice to perform correctly. In addition, they require teamwork and are likely beyond the scope of first aid.

The First Aid Task Force reported that first aid guidelines in several countries (eg, Japan, Australia, New Zealand, the United Kingdom) recommend manual support of the head for adults with a suspected cervical spine injury. The Royal College of Surgeons of Edinburgh published a consensus statement that states, "Manual in-line stabilization is a suitable alternative to a cervical collar."[225] Other countries such as Norway have national guidelines for prehospital spinal stabilization that use a strategy of minimal handling.[226]

The task force consensus opinion is that injured adults who are not alert or awake may benefit from gentle support of the head, similar to the head squeeze stabilization technique, to prevent inadvertent movement whereas injured adults who are awake may not require manual stabilization.

Given these discussion points, combined with the limited additional information identified in this review, the task force agreed that there is insufficient information to pursue a SysRev, so the most recent (2010) recommendation about manual cervical spine stabilization remains in effect.

Treatment Recommendation

This treatment recommendation (below) is unchanged from 2010.[55]

There is insufficient evidence for or against manual cervical spine restriction of motion (current terminology is *manual stabilization*).

Cervical Spinal Motion Restriction (FA 772: ScopRev)

Rationale for Review

The 2015 (most recent) first aid CoSTR for this topic identified very low-certainty evidence from 8 observational studies evaluating outcomes related to cervical spine motion restriction.[5,6] That review was limited to mechanical cervical immobilization devices, including cervical collars and sandbags with tape, that are accessible to first aid providers; it did not include spine boards. No evidence was identified to address the critical outcomes of neurological injury and complications or other important outcomes. The First Aid Task Force sought to conduct a ScopRev to search for additional publications that would support past recommendations or suggest the need for a new SysRev.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with possible traumatic cervical spinal injury
- Intervention: Spinal motion restriction
- Comparator: No spinal motion restriction or another type of spinal motion restriction
- Outcome: Any clinical or biomechanical outcome
- Study design: All study designs and gray literature were eligible for inclusion.
- Time frame: All languages were included as long as there was an English abstract. Final searches were run with a date limit of 1999 to 2019 and were last run in November 2019.

Summary of Evidence

Six studies[223,227–231] were identified for inclusion for this ScopRev. Similar to the 2015 CoSTR on cervical spinal motion restriction,[5,6] we identified biomechanical and cohort studies[228–230] that report the ability to restrict varying amounts of cervical motion with the use of cervical collars. We also identified 1 case report[231] that described a complication of worsening neurological status, and a small prospective cohort study in healthy volunteers[227] demonstrating a false-positive tenderness with midline vertebral palpation after use of a cervical collar in combination with spinal motion restriction using a long backboard.

No studies were identified that directly addressed other outcomes such as neurological injury, survival, hospital length of stay, or additional outcomes such as the ability to correctly apply a cervical collar. The full ScopRev with summary of evidence is found in Supplement Appendix B-7.

Task Force Insights

The task force noted that the ability to properly apply a cervical collar is not a skill typically taught in first aid courses, although some large groups of first aid providers or first responders may receive specialized training and regular practice to allow them to use cervical collars, such as those who might respond to sports-associated injuries. First Aid Task Force members representing multiple different countries and continents noted that cervical collars are no longer used routinely for trauma; they are reserved for injuries consistent with a high risk of cervical spinal injury. Additional concerns were expressed over the ability of a first aid provider to discriminate between those at high or low risk for spine injury. The First Aid Task Force presented criteria for determining high risk for cervical spine injury in 2010[55] but noted that other criteria have been developed by various organizations after that publication. The task force agreed that the topic of first aid recognition of high risk for cervical spine injury may require a future SysRev or ScopRev. Given these discussion points, combined with the limited additional evidence identified in this review, the task force did not feel there was sufficient information to prompt new SysRevs or the reconsideration of current first aid guidelines or treatment recommendations. As a result, the 2015 recommendation remains in effect.

Treatment Recommendation

This treatment recommendation (below) is unchanged from 2015.[5,6]

We suggest against the use of cervical collars by first aid providers (weak recommendation, very low-quality evidence.

First Aid Dressings for Superficial Thermal Burns (FA New 2019: ScopRev)

Rationale for Review

First aid providers must often determine the appropriate advice to offer for a thermal burn. In the most recent (2015) CoSTR, the evidence focused on comparing wet to dry dressings for thermal burns in the first aid setting.[5,6] This topic was revised and prioritized for 2020 because thermal injuries occur frequently and the task force sought to identify the dressing type that is most effective and available in the first aid setting, with a new focus on dressings for superficial thermal burns. Thus, this is a new question.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with superficial thermal injuries
- Intervention: Any specific type of dressing applied in the first aid setting
- Comparator: Another type of dressing
- Outcome: Any clinical outcome
- Study design: All study designs and gray literature were eligible for inclusion.
- Time frame: All years and all languages were included as long as there was an English abstract.

Summary of Evidence

An extensive search strategy identified many potential publications but resulted in the identification of no publications that compared the unique effects or demonstrated effectiveness of burn dressings applied in the first aid setting by first aid providers for superficial thermal burns. We did identify other types of interventions applied to thermal burns, but these did not meet the inclusion criteria and did not involve a direct comparison of dressings. Many of the studies involved dressings that were applied to partial thickness or full thickness burns after admission to the emergency department or on transfer to a burn unit. There were studies that reported the risks and management of continued burning and heat entrapment with the use of hydrogel dressings. Finally, there were a significant number of articles about the benefits of honey in the use of acute wound management, including burns.

The gray literature search yielded information about basic care (as opposed to research studies) for thermal, chemical, and electric injuries; 15 guidelines and position statements; and 8 additional publications. All 44 documents addressed burns from superficial to full-thickness and therapeutic interventions used in the first aid setting. Full results of the summary of evidence can be found with the ScopRev in Supplement Appendix B-8.

Task Force Insights

The task force expressed concern for the consequences of failure to properly treat a superficial burn in the first aid setting and the need for an effective treatment strategy. The task force agreed that immediate and effective cooling of the burn is still the primary intervention with proven efficacy and should be performed first, once the patient is removed from the thermal source.

The ScopRev did not identify evaluation of any dressing in the first aid setting for superficial thermal burns but instead identified studies focused on dressings as part of ongoing medical care, particularly for partial and full thickness rather than superficial burns. Further task force discussions focused on the effectiveness, accessibility, and feasibility of the application of cling film or use of honey in the first aid setting after immediate cooling of the burn. A SysRev may be beneficial to identify the risks of the use of hydrogel dressings in the first aid setting. Although not directly part of this ScopRev, the task force agreed that identified evidence could support consideration of a SysRev of alternative therapies after active cooling for superficial thermal burns. Until a future SysRev is completed and analyzed, there is no recommendation about the optimal dressing type to use for thermal burns.

Treatment Recommendation

No treatment recommendation is made at this time.

Compression Wrap for Closed Extremity Joint Injuries (FA 511: SysRev)

Rationale for Review

This topic was last reviewed in 2010.[55] However, it did not lead to a treatment recommendation because the task force agreed that the evidence was too limited. Because musculoskeletal injuries are so common, the First Aid Task Force requested a SysRev of compression bandages or wraps for closed extremity joint injuries that was completed in 2020.[232]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults in the prehospital setting with a closed extremity joint injury
- Intervention: Compression wrap, elastic wrap
- Comparator: No compression wrap or elastic wrap
- Outcome: Reduction of pain, reduction of swelling/edema (critical outcomes); recovery time, range of motion, adverse effects (important outcomes)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion.
- Time frame: All years and all languages were included as long as there was an English abstract; unpublished studies (eg, conference abstracts, trial protocols) were excluded. Literature search was updated to November 3, 2019.
- PROSPERO Registration: CRD42020153123

Consensus on Science

For the critical outcome of reduction of pain, we identified low-certainty evidence (downgraded for indirectness and imprecision) from 2 randomized trials[233,234] and 3 nonrandomized trials.[235–237] None reported reduction of pain with use of a compression bandage compared with no compressive bandage, a noncompressive bandage, or a splint or brace.

For the critical outcome reduction of swelling/edema, we identified very low-certainty evidence (downgraded for risk of bias, indirectness, and imprecision) from 3 randomized trials[233,237,238] and 1 nonrandomized trial[235]: no study showed that the use of a compression bandage reduced swelling. One RCT found significantly less reduction of swelling with the use of an elastic bandage compared with no compression (SMD 2.02; 95% CI [0.90; 3.15], P=0.0004). However, this finding disappeared in meta-analysis of all 4 studies.

For the important outcomes of range of motion and recovery time, we identified low- to very low-certainty evidence (downgraded for indirectness, imprecision or risk of bias) from 5 randomized trials[233,234,237,239,240] enrolling adult patients with ankle sprains; none demonstrated benefit from the use of a compression bandage compared with an ankle brace. Recovery time and range of motion were measured by the Karlsson score of function,[241]* percent of uninjured ankle range of motion, and time to return to work or to normal walking, stair climbing and full weight bearing.

For the important outcome of recovery time (measured by return to sports), we identified very low-certainty evidence (downgraded for risk of bias, indirectness and imprecision) from 1 randomized trial[237] enrolling 117 adults with ankle sprains, showing benefit from the use of a compression bandage when compared with the use of noncompressive stockings (only median number of days reported; 95% CI could not be calculated; P<0.02).

Full results of findings for the consensus on science for use of a compression wrap are found in Table 7.

Treatment Recommendations

This treatment recommendation (below) is unchanged from 2010.[55]

There is insufficient evidence to recommend for or against the application of a compression bandage for an acute closed extremity joint injury.

*The Karlsson score ranks ankle joint injuries based on evaluation of pain, swelling, instability, stiffness, stair climbing, running, work activities performed, and the need for/use of ankle support, with higher scores for no impairment and lower scores for significant pain or impairment. Scores can range from a high of 100 for no pain, swelling, or instability and normal function to a low of 0 for constant severe pain, swelling, and instability with inability to complete normal tasks/substantial compromise in function.

Table 7. Overview of Outcomes and Effect Sizes for Compression Bandage Compared With No Compression Bandage

Outcome	Study Type/ Certainty	Number of Studies/ Reference	Comparison	Effect Size	Number of Patients	*P* Value	Benefit
Pain							
Reduction of pain (visual analog scale)	RCT/very low	2[233,234]	Elastic bandage versus Aircast ankle brace; elastic bandage versus no support	SMD, 0.34; 95% CI, −0.10 to 0.79	122	0.12	No
	Non-RCT/very low	1[235]	Elastic bandage versus splint				
Free from pain on walking after 4 d	Non-RCT/very low	1[236]	Compression bandage versus no treatment	RR, 1.28; 95% CI, 0.78 to 2.11	100	0.33	No
Free from pain on walking after 8 d				RR, 1.39; 95% CI, 0.98 to 1.95		0.06	No
Pain at rest	RCT/low	1[237]	Compression bandage versus noncompressive stocking	SMD, 0.32; 95% CI, −0.68 to 0.05	117	0.09	No
Pain at walking				SMD, −0.14; 95% CI, −0.50 to 0.22		0.45	No
Swelling							
Reduction of swelling	RCT/very low	3[233,237,238]	Elastic bandage versus noncompressive stocking; Aircast ankle brace; no compression	SMD, 0.54; 95% CI, −0.14 to 1.22	172	0.12	No
	Non-RCT/very low	1[235]	Elastic bandage versus splint		51		
Ankle Joint Function							
Ankle joint function after 10 d	RCT/very low	2[233,234]	Elastic bandage versus Aircast ankle brace; no support	SMD, −0.34; 95% CI, −1.16 to 0.49	71	0.42	No
Ankle joint function after 1 mo	RCT/very low			SMD, −0.29; 95% CI, −1.11 to 0.53		0.49	No
Range of Motion							
Active ROM after 3–5 d	RCT/very low	1[239]	Compression bandage versus Air-Stirrup ankle brace	MD, −7%; 95% CI could not be calculated	73	>0.05	No
Active ROM after 2 wk				MD, 0%; 95% CI could not be calculated			
Active ROM after 4 wk				MD, 2%; 95% CI could not be calculated			
Recovery Time							
Time to return to normal walking	RCT/very low	1[240]	Elastic bandage versus Air-Stirrup ankle brace	MD, 0.83; 95% CI could not be calculated	142	>0.05	No
Time to return to stair climbing				MD, 0.62 (*Grade I sprains*) or MD, 3.00 (*Grade II sprains*); 95% CI could not be calculated			No
Time to return to walking with full weight-bearing				MD, 0.83 (*Grade I sprains*) or MD, −2.83 (*Grade II sprains*); 95% CI could not be calculated			No

(*Continued*)

Table 7. Continued

Outcome	Study Type/ Certainty	Number of Studies/ Reference	Comparison	Effect Size	Number of Patients	*P* Value	Benefit
Return to work	RCT/low	1[237]	Compression bandage versus noncompressive stockings	MD, −1	117	0.20	No
	RCT/very low	1[239]	Compression bandage versus Aircast ankle brace	MD, 3.8	73	<0.05	Less benefit
	RCT/very low	1[234]	Elastic bandage versus no compression	SMD, −0.50; 95% CI, −1.17 to 0.16	36	0.14	No
Return to sports	RCT/very low	1[237]	Compression bandage versus noncompressive stockings	MD, −22	58	<0.02	Yes

MD indicates mean difference; non-RCT, nonrandomized controlled trial; RCT, randomized controlled trial; ROM, range of motion; RR, relative risk; and SMD, standardized mean difference.

Justification and Evidence-to-Decision Framework Highlights

We did not identify any evidence about the use of compression bandages for closed extremity joint injuries in the prehospital setting. All evidence is from an in-hospital setting and therefore downgraded for indirectness.

Studies applying standard first aid for acute joint injuries to the comparator group, such as elevation of the injured extremity or application of cold packs, splints, braces, or stockings, were included in this review, provided that no compression was applied. The results may therefore suffer from confounding.

Most studies do not explain how much pressure was applied with the compression bandages, what the direction of application was (ie, proximal to distal or distal to proximal), whether they were applied with circumferential or sequential pressure, or for how many hours or days the compression bandages were applied.

For additional information, refer to the evidence-to-decision table regarding compression wrap for closed extremity joint injuries (FA 511) in Supplement Appendix A-18.

Knowledge Gaps

- Additional research is needed to determine whether compression wraps may be beneficial for other acute closed joint injuries, such as to the wrist, and to confirm findings of the included studies in the prehospital setting.
- Future research should include additional outcomes, such as stakeholder satisfaction, and the first aid provider's ability to properly apply a compression wrap without training or with use of simple video instructions available online.
- It is unclear how much pressure may be effective for important outcomes and if compression bandages may augment the effect of other adjunct therapies administered in the first aid setting.

Storage of an Avulsed Permanent Tooth Before Replantation (FA 794: SysRev)

Rationale for Review

The evidence supporting use of various media in which to store an avulsed tooth before replantation was last reviewed in 2015, but it did not include a SysRev.[5,6] A new SysRev of storage techniques for an avulsed permanent tooth before replantation was completed in 2020.[242]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in any setting (in-hospital or out-of-hospital) with an avulsed permanent tooth
- Intervention: Any storage media, container, or technique
- Comparator: Storage in whole milk or the patient's saliva
- Outcome: Success of replantation and tooth survival or viability (critical outcomes); color of the tooth, infection rate, malfunction (eating, speech), and pain (important outcomes)
- Study design: RCTs and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, cohort studies) were eligible for inclusion.
- Time frame: All years and all languages were included as long as there was an English abstract; unpublished studies (eg, conference abstracts, trial protocols) were excluded. Literature search was updated to September 2, 2019.
- PROSPERO Registration: CRD42020152903

Consensus on Science

The critical outcome of viability was measured in most studies as cell viability by harvesting periodontal ligament (PDL) cells, staining them with 0.4% (wt/vol) trypan blue, and counting them under a light microscope with a hemocytometer.

Table 8. Media Showing Greater Tooth Cell Viability (Number or Percentage of Periodontal Ligament Cells) Compared With Milk (Any Form, Any Percentage) During Storage

Storage Medium	Time	Study Type/Certainty Assessment	Number of Studies/ Reference	Effect Size (95% CI)	*P* Value	Body of Evidence in Favor of
HBSS	15 min–24 h	RCT/low	12[243–254]	SMD, 2.47 (1.59; 3.34)	<0.00001	HBSS
		Non-RCT/very low	1[262]			
Saliva and thereafter HBSS (versus saliva and thereafter milk)	30 min	Non-RCT/very low	1[261]	MD, −1% (CI not calculable [standard errors are not reported])	>0.05	Saliva and thereafter HBSS
	60 min			MD, 2.4% (CI not calculable)	<0.05	
Propolis	45–180 min	RCT/very low	3[244,249,250]	SMD, 1.73 (1.12; 2.33)	<0.00001	Propolis
Oral rehydration salt solution	45–90 min	RCT/very low	2[251,252]	SMD, 4.16 (2.10; 6.23)	<0.0001	Oral rehydration salt solution
Rice water	30 min	RCT/very low	1[259]	MD, 11 (5.29; 16.71)	<0.00001	Rice water
Cling film	120 min	RCT/very low	1[260]	Rate of cell growth at 7 days: MD, 0.45 (CI not calculable); 14 days: MD, 0.41 (CI not calculable)	0.033	Cling film

HBSS indicates Hanks' Balanced Salt Solution; MD, mean difference; non-RCT, nonrandomized controlled trial; RCT, randomized controlled trial; and SMD, standardized mean difference.

Media Demonstrating Benefit Compared With Milk

For the critical outcome of viability, as measured by number or percentage of viable PDL cells, we identified low-certainty evidence (downgraded for risk of bias and indirectness) from 12 RCTs[243–254] showing benefit from immersion in Hanks' Balanced Salt Solution (HBSS) when compared with milk. No benefit from immersion in HBSS was demonstrated in 1 RCT,[255] and no benefit was associated with HBSS in 3 other non-RCTs.[256–258]

For the critical outcome of viability, as measured by the number or percentage of PDL cells or the rate of cell growth, we identified very low-certainty evidence in 7 RCTs (downgraded for risk of bias, indirectness and imprecision) demonstrating a benefit from immersion in propolis (a resinous compound

Table 9. Media Associated With Reduced Success of Replantation or Preservation of Cell Viability (Number or Percentage of Cells) During Storage Compared With Milk (Any Form, Any Fat Percentage)

Storage Medium	Time	Study Type/Certainty Assessment	Number of Studies/ Reference	Effect size (95% CI)	*P* Value	Body of Evidence in Favor of
0.9% saline solution	30–120 min	RCT/very low	3[249,253,265]	SMD, −4.35 (−7.55; −1.14)	0.008	Milk
		Non-RCT/very low	2[266,267]			
	45 min	Non-RCT/very low	2[257,258]	Not calculable*	>0.05	
		Non-RCT/very low	1[256]	MD, −12.79 (CI not calculable)		
	N/A	Observational study/ very low	3[268–270]	RR, 1.20 (0.74; 1.95)*	0.47	
Tap water	45 min	Non-RCT/very low	1[256]	MD, −45.42 (CI not calculable)	<0.05	Milk
	60 min	RCT/very low	1[254]	MD, −18.53% (−23.53; −13.53)	<0.00001	
	180 min			MD, −16.47% (−22.56; −10.38)		
	6 h			MD, −15.20% (−18.52; −18.22)		
	24 h			MD, −7.33% (−9.26; −5.40)		
Castor oil	45 min	RCT/very low	1[255]	Not calculable*	<0.05	Milk
Buttermilk	45 min	RCT/very low	1[263]	MD, −12646 (−14084.66; −11208.48)	<0.00001	Milk
Turmeric extract	30 min	RCT/very low	1[264]	MD, −8.35% (−11.29; −5.41)	<0.00001	Milk
GC Tooth Mousse	30 min	Non-RCT/very low	1[266]	MD, −2% (−3.39; −0.61)	0.005	Milk
	60 min			MD, −2.3% (−3.91; −0.69)		

*Success of replantation.

MD indicates mean difference; non-RCT, nonrandomized controlled trial; RCT, randomized controlled trial; RR, relative risk; and SMD, standardized mean difference.

produced by bees and available commercially as an extract),[244,249,250] oral rehydration salt solution (including Ricetral),[251,252] rice water,[259] or storage in cling film.[260] One non-RCT reported greater PDL cell viability associated with initial storage in the person's own saliva followed by immersion in HBSS compared with storage in milk.[261]

See full results in Table 8.

Media Demonstrating Harm When Compared With Milk

For the critical outcome of viability, as measured by the number or percentage of viable PDL cells, we identified very low-certainty evidence (downgraded for risk of bias, indirectness, and imprecision) from 3 RCTs demonstrating harm from immersion in buttermilk,[263] castor oil,[255] and turmeric extract.[264] In addition, we identified very low-certainty evidence (downgraded for risk of bias, indirectness, inconsistency between trials, and imprecision) from 4 RCTs[249,253,254,265] and 5 non-RCTs[256–258,266,267] reporting a decreased number or percentage of viable PDL cells (ie, harm) from immersion in tap water, 0.9% saline solution, or GC Tooth Mousse when compared with storage in milk.

See Table 9 for full results.

Media With No Association of Benefit Compared With Milk or With Saliva for Cell Viability or Success of Replantation

For the critical outcome of viability, as measured by the number or percentage of viable PDL cells, we identified very low-certainty evidence (downgraded for risk of bias, inconsistency between trials, indirectness, and imprecision) from 6 RCTs[243,247,253,263,265,271] showing inconsistent evidence of benefit of coconut water and aloe vera when compared with milk. Furthermore, very low-certainty evidence (downgraded for risk of bias, indirectness, and imprecision) from 6 RCTs that did not demonstrate a benefit for viability from immersion in egg white,[244,248,259,271] epigallocatechin-3-gallate,[245] or neem extract (an evergreen tree extract)[264] compared with milk. We also identified 2 non-RCTs demonstrating no association of improved benefit and the use of probiotic media[257,258] compared with milk.

For the critical outcome of success of replantation (as measured by periodontal or functional healing) we identified very low-certainty evidence (downgraded for risk of bias, and imprecision) from 3 observational studies[268–270] that found no association of improved periodontal or functional healing and immersion in 0.9% saline solution when compared with milk.

For the critical outcome of success of replantation, as measured by periodontal or functional healing, we have identified very low-certainty evidence (downgraded for risk of bias and imprecision) from 5 observational studies,[268–270,272,273] which did not demonstrate an increased periodontal or functional healing associated with storage in saliva and Dentosafe box when compared with milk.

Media With No Association of Benefit Compared With Saliva for Success of Replantation or Preservation of Cell Viability

For the critical outcome of success of replantation, as measured by periodontal or functional healing, we identified very low-certainty evidence (downgraded for risk of bias and imprecision) from 4 observational studies,[268,272,274,275] demonstrating no association between increased periodontal or functional healing and storage in another person's mouth/saliva, 0.9% saline or Dentosafe box compared with their own saliva.

Treatment Recommendations

We suggest the use of HBSS; propolis (from 0.04 mg to 2.5 mg per mL of 0.4% ethanol); oral rehydration salt solutions including Ricetral (a commercial form of oral rehydration salt); solutions containing sodium chloride, glucose, potassium chloride, citrate, or extruded rice; or cling film compared with any form of cow's milk for temporary storage of an avulsed tooth that cannot be immediately replanted (weak recommendation, very low-certainty evidence).

If none of these choices are available, we suggest the use of cow's milk (with any percent fat or form) compared with tap water, buttermilk, castor oil, turmeric extract, or saline (0.9% sodium chloride) for temporary storage of an avulsed tooth (weak recommendation, very low-certainty evidence).

There is insufficient evidence to recommend for or against temporary storage of an avulsed tooth in the person's own saliva compared with alternative solutions.

There is insufficient evidence to recommend for or against temporary storage of an avulsed tooth in probiotic media, epigallocatechin-3-gallate, Dentosafe box, or egg white compared with cow's milk.

Justification and Evidence-to-Decision Framework Highlights

We identified many studies evaluating different storage solutions or techniques for avulsed teeth. Table 10 provides an overview of all solutions evaluated, including the number and certainty of studies for each comparison and the direction of the results. This table provides a summary of the different comparisons evaluated by the task force.

In making these recommendations, we recognize that survival of an avulsed tooth requires replantation as soon as possible, but this procedure may not be possible in the first aid setting. The use of a suitable temporary storage solution or technique for an avulsed tooth should not delay efforts at replantation, but it may aid in the survival of the tooth until replantation.

The original wording of the 2020 PICOST question specified the use of whole milk as a comparison. However, the studies identified used cow's milk with varying fat percentages as the comparators, and some milk was pasteurized or homogenized; that is a limitation of the review. We therefore only recommend that cow's milk be used, without a specific fat percentage.

Table 10. Summary of Evidence of Different Media to Use to Store Avulsed Tooth

Intervention	Comparison	Number of Studies	Certainty of Evidence	Evidence in Favor of
HBSS	Cow's milk	17[243–258,262]	Low	HBSS
Propolis (10%, 50%, or 100%)	Cow's milk	3[244,249,250]	Very low	Propolis
Oral rehydration salts (including Ricetral)	Cow's milk	2[251,252]	Very low	Oral rehydration salts/Ricetral
Cling film	Cow's milk	1[260]	Very low	Cling film
Tap water	Cow's milk	2[254,256]	Very low	Cow's milk
Buttermilk	Cow's milk	1[263]	Very low	Cow's milk
Castor oil	Cow's milk	1[255]	Very low	Cow's milk
Turmeric extract	Cow's milk	1[264]	Very low	Cow's milk
Saline solution	Cow's milk	11[249,253,256–258,265–270]	Very low	Cow's milk
Saline solution	Saliva	3[268,274,275]	Very low	Both
Probiotic media (eg, probiotic yoghurt, lactobacillus reuteri solution)	Cow's milk	2[257,258]	Very low	Both
Rice water	Cow's milk	1[259]	Very low	Rice water
Saliva	Cow's milk	3[268,272,273]	Very low	Both
Alpha modification of Eagle's Medium	Saliva and thereafter cow's milk	1[261]	Very low	Inconclusive
Epigallocatechin-3-gallate	Cow's milk	1[245]	Very low	Both
Another person's mouth	Patient's mouth (saliva)	2[274,275]	Very low	Both
Dentosafe box	Cow's milk	3[269,270,272]	Very low	Both
Dentosafe box	Saliva	1[272]	Very low	Both
GC Tooth Mousse	Cow's milk	1[266]	Very low	Cow's milk
Saliva and thereafter HBSS	Saliva and thereafter cow's milk	1[261]	Very low	Saliva and thereafter HBSS
Aloe vera gel	Cow's milk	2[243,271]	Very low	Inconsistent evidence
Coconut water	Cow's milk	4[247,253,263,265]	Very low	Inconsistent evidence
Egg white	Cow's milk	4[244,248,259,271]	Very low	Both

HBSS indicates Hanks' Balanced Salt Solution.

This updated treatment recommendation varies from the previous treatment recommendations in 2015[5,6] in the following ways:

- We no longer recommend coconut water as a storage solution because recent studies provide inconsistent evidence of benefit; we no longer recommend egg white because a beneficial effect was not confirmed by new studies.
- Oral rehydration solution, rice water, and cling film are added as recommended solutions or techniques for temporary storage of an avulsed tooth when compared with milk.
- The recommendation to store an avulsed tooth in milk in comparison with saline is retained, but we now also recommend storage in milk rather than tap water, buttermilk, castor oil, and turmeric extract.

Cling film is easily applicable since it is found in most households and widely available. It has a very limited cost.

Oral rehydration salts are available in most first aid kits and, therefore, easily used in most settings.

Although evidence from 1 study shows benefit for immersion in rice water when compared with milk, the task force decided not to recommend it. If rice water must be made (ie, boiling rice in water and allowing to cool), this could create a delay; it may, therefore, be preferable to use an alternative storage technique that is readily available.

A recommendation was not made for Eagle's Medium, aloe vera, or coconut water because evidence of their benefit was inconclusive or inconsistent.

The evidence-to-decision tables provide further insight into task force discussions that assisted in developing these treatment recommendations (see Supplement Appendix A-19 for the evidence-to-decision table on oral rehydration solution compared with milk; Supplement Appendix A-20, evidence-to-decision table on rice water compared with milk; Supplement Appendix A-21, evidence-to-decision table on cling film compared with milk; Supplement Appendix A-22, evidence-to-decision table on tap water, butter milk, castor oil, and turmeric compared with milk).

Knowledge Gaps

- There is a lack of studies with traumatic avulsed teeth (instead of extracted teeth), measuring tooth viability (not cell viability), and success of replantation.
- There are no studies that evaluate replanting the tooth in the dental socket compared with storage in a temporary storage medium for outcomes of viability.
- It is unclear if training in dental replantation for first aid providers feasible and effective.

TOPICS NOT REVIEWED IN 2020

The following topics were not reviewed in 2020:

Cooling of Burns (FA 770)

Among adults and children with thermal injuries (P), does active cooling of burns by a specific technique or for any particular duration (I), compared with passive cooling (C), change (O)?

Exertion-Related Dehydration and Rehydration Therapy (FA 584)

Among adults and children with exertion-related dehydration (P), does drinking oral carbohydrate-electrolyte liquids (I), compared with drinking water (C), change (O)?

First Aid Treatment for Open Chest Wound (FA 586)

Among adults and children who are being treated for an open chest wound outside of a hospital (P), does occlusive bandage application or occlusive device (I), compared with a nonocclusive dressing (C), change (O)?

Jellyfish Stings: Topical Applications to Prevent Nematocyst Discharge (FA 516)

Among adults and children with a suspected jellyfish sting, does any intervention (ie, vinegar, heat, cold, commercial jellyfish products) compared with any other intervention or no treatment, change clinical outcomes?

Snake Bite: Pressure Immobilization (FA 531)

Among adults and children who are victims of a venomous snakebite in any setting (P), does pressure immobilization of the injured extremity (I), compared with no therapy (C), change (O)?

Bronchodilator Administration (FA 534)

Among adults and children in the prehospital setting who suffer from asthma and are experiencing difficulty in breathing (P), does bronchodilator administration (I), compared with no bronchodilator administration (C), change (O)?

Oxygen Administration for First Aid (FA 519)

Among adults and children who exhibit symptoms or signs of shortness of breath, difficulty breathing or hypoxia outside of a hospital (P), does administration of oxygen (I), compared with no administration of oxygen (C), change (O)?

Eye Injuries

- Irrigation (FA 540)

Among adults and children who are exposed to a chemical agent (ie, cleaning solutions, known acidic or alkaline substance) in the eye (P), does irrigation with saline, tap water, or commercial eye irrigation solution (I) compared with each other (C), change (O)?

- Foreign Body (FA 1544)

Among adults and children who develop a sensation of dirt (foreign body) in the eye (P), does irrigation with isotonic saline (ie, contact lens solution) compared with tap water (C) change (O)?

Poisoning: Dilution With Milk or Water (FA 537)

Among adults and children who are being treated for ingestion of a caustic substance outside of a hospital (P), does milk or water administration (I), compared with no use of milk or water (C), change (O)?

Preservation of Amputated Body Part (FA 539)

Among adults and children who are being treated for amputated body parts outside of a hospital (P), does cooling the amputated part (I), compared with not cooling the amputated part (C), change (O)?

Cold Injury: Anti-inflammatory Drugs (FA 502)

Among adults and children who are being treated for frostbite outside of a hospital (P), does NSAID administration (I), compared with no use of NSAID (C), change (O)?

Irrigation of Skin for Toxic Substance Exposure (FA 522)

Among adults and children who are exposed outside of a hospital to a toxin on the skin (P), does irrigation with water (I), compared with irrigation with other fluids (C), change (O)?

Medical Examination Gloves

Among first aid providers in the setting of potential exposure to blood or body fluids (P), does use of nitrile medical examination gloves (I), compared with vinyl medical examination gloves (C), change (O)?

ARTICLE INFORMATION

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Disclosures

Appendix 1. Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
Eunice M. Singletary	University of Virginia	None	None	None	None	None	American Red Cross Scientific Advisory Council (Volunteer Chairperson)*	None
David A. Zideman	Thames Valley Air Ambulance (United Kingdom)	None	None	None	None	None	None	None
Jason C. Bendall	University of Newcastle (Australia)	None	None	None	None	None	None	None
David C. Berry	Pharm3r	None	None	None	None	None	None	None
Vere Borra	Belgian Red Cross (Belgium)	None	None	None	None	None	None	None
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David S. Markenson	American Red Cross	None	None	None	None	None	None	None
Daniel Meyran	French Red Cross (France)	None	None	None	None	None	None	None
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Janel M. Swain	Emergency Health Services Nova Scotia (Canada)	None	None	None	None	None	None	None
Jeff A. Woodin	Tualatin Valley Fire & Rescue	None	None	None	None	None	None	None

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Appendix 2. Reviewer Disclosures

Reviewer	Employment	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
Jason E. Buick	University of Toronto (Canada)	None	None	None	None	None	None	None
Mohamud Daya	Oregon Health & Science University	None	None	None	None	None	None	None
Jeffrey Ferguson	Virginia Commonwealth University	None	None	None	None	None	None	None
Rita Herrington	Indiana University	None	None	None	None	None	None	None
Adam J. Singer	Stony Brook University	None	None	None	None	None	None	None
Will Smith	Wilderness and Emergency Medicine Consulting (WEMC)	None	None	None	None	None	None	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

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