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National Guideline for the Field Triage of Injured Patients: Recommendations of the National Expert Panel on Field Triage, 2021

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BACKGROUND

In the United States, unintentional injury remains the leading cause of death and years of potential life lost among children and young adults, and the third most common cause of death overall.[1,2] Injury is the most common reason for use of 9-1-1 emergency medical services (EMS) in the US,[3] with EMS playing a critical role in the early evaluation and care of injured patients.[4] An important aspect of EMS care is field triage - the process of identifying seriously injured patients in need of care in specialized trauma centers from among the larger number of patients with minor to moderate injuries who can be cared for in non-trauma hospitals. To accomplish this task quickly and efficiently, EMS clinicians use specific prehospital criteria known as the field triage guideline. The triage guideline was originally developed in 1976, with periodic revisions every 5 to 10 years.[5] The most recent evidence-based revisions to the field triage guideline were completed in 2011.[6]

Concentrating the most seriously injured patients in trauma centers through field triage is predicated on the principle that patients have better outcomes in these hospitals. A landmark study demonstrated 20% lower in-hospital mortality and 25% lower 1-year mortality among seriously injured adults treated in Level I trauma centers compared to non-trauma hospitals.[7] Other studies have shown that regionalized trauma systems are associated with reductions in mortality,[8-11] with the benefit driven primarily by Level I trauma centers.[8,9] The benefits are similar for children, particularly when treated in pediatric trauma centers[12-14] and in trauma centers with high emergency department (ED) pediatric readiness.[15,16] For older adults, the benefit of tertiary trauma centers is less clear, with some studies showing reduced mortality[17,18] and others no effect.[7,19] Until

the evidence becomes clearer, the prevailing view is that seriously injured older adults should be managed in trauma centers.

The effectiveness of field triage is measured at the system level using metrics termed "under-triage" and "over-triage". *Under-triage* is the percentage of seriously injured patients missed by field triage processes and transported to non-trauma hospitals, which is associated with increased mortality in adults and children.[20-23] *Over-triage* is the percentage of patients with minor to moderate injuries identified by field triage criteria as having serious injuries and transported to trauma centers unnecessarily, representing overuse of limited resources and inefficiency in the system. Under- and over-triage are inversely related.[24] Trauma systems have prioritized the goal of minimizing under-triage and accepting a higher level of over-triage to avoid increased mortality, with targets set at $\leq 5\%$ and $\leq 35\%$, respectively.[4] A systematic review of field triage performance across all ages showed 14% to 34% under-triage and 12% to 31% over-triage.[25] Under-triage of children is up to 51%[26] and has increased with recent triage guidelines.[27] Under-triage is highest among older adults,[28-30] with half of seriously injured older adults treated in non-trauma centers nationally.[31] Reducing under-triage was an important goal of the Panel for the current guideline revision.

The purpose of this report is to present the final 2021 field triage guideline and to describe the process of guideline development and the supporting evidence. The guideline is intended for use in civilian 9-1-1 EMS systems and is *not* intended to guide mass casualty events or in-hospital trauma team responses. The evidence to support the current guideline is based on civilian trauma

systems. The guideline is intended for patients in whom maximal resuscitative care is appropriate and does not apply to patients with limited goals of care.

METHODS

Study Design

We conducted an evidence-based revision of the field triage guideline using an interdisciplinary national Expert Panel and systematic reviews of the field triage literature. We used the Reporting Tool for Practice Guidelines in Health Care (RIGHT)[32] to report the 2021 revision to the field triage guideline. A complete RIGHT checklist is included as supplemental online content (Supplemental Digital Content, http://links.lww.com/TA/C515).

Panel Participant Recruitment

The Expert Panel included EMS clinicians, EMS physicians, emergency physicians, trauma surgeons, pediatric surgeons, nurses, EMS medical directors, experts in EMS training and education, EMS and trauma system administrators, researchers, and representatives from stakeholder organizations. The function of the Panel was to review the evidence base, provide stakeholder feedback, assess usability and feasibility, and make informed decisions about revisions to the triage guideline.

Systematic Reviews & Evidence Base

We organized multiple systematic reviews in advance of the guideline revision. The reviews were targeted to controversial aspects of the guideline, opportunities for new or modified criteria, and to identify relevant literature published since the 2011 guideline, including assessment

of the quality of evidence and risk of bias. The systematic reviews included the predictive utility of out-of-hospital motor Glasgow Coma Scale (GCS) score versus total GCS,[33] circulatory measures,[34] respiratory measures,[35] mechanism of injury and special considerations criteria,[36] and the overall performance of the triage guideline.[25]

An inherent challenge in field triage is defining a "seriously injured" patient, which has varied widely across studies. Most triage research has used one of the following categories to define "serious injury": 1) anatomic injury severity (e.g., Injury Severity Score [ISS] ≥ 16); 2) critical resource use (e.g., blood transfusion requirements, certain operative interventions, and specific "life-saving" procedures); 3) in-hospital mortality, or 4) a combination of categories.[25,33-36] We considered any of these definitions to represent "serious injury".

Criteria for addition and removal of triage criteria

For the 2011 guideline, the threshold to add new triage criteria was a positive predictive value (PPV) of 20% or greater, with removal of criteria when predictive evidence was lacking.[6] Because the PPV is dependent on the prevalence of disease (e.g., serious injury) and therefore not readily comparable across studies, we worked with experts in predictive analytics to identify rigorous statistical criteria to guide the addition and removal of triage criteria. Ultimately, we opted to use positive likelihood ratios (+LRs) and area under the receiver operating characteristic curves (AUROCs) because they combine sensitivity and specificity, are not influenced by disease prevalence, and provide more balanced metrics (Table 1). We used +LRs because individual triage criteria generally favor specificity over sensitivity; when all triage criteria are combined, the

collective sensitivity of the guideline is raised. We also considered ease-of-use in the field and quality of the evidence.

Process for generating the updated guidelines

We assembled a Steering Committee years in advance to develop key questions for the systematic reviews, organize, plan, and orchestrate the revision process. The Expert Panel met for two days in April 2021 to review the evidence base and discuss potential revisions to the guideline. Following the meeting, the Steering Committee drafted proposed revisions to the guideline and compiled additional data to address questions from the Panel. A second meeting with the Panel was held two months later to discuss the draft revisions, present additional data, and reach consensus on recommendations for the new guideline. Following the second meeting, the Steering Committee integrated the additional revisions and sent the draft guideline to stakeholder organizations for feedback. The Steering Committee integrated feedback from each of these organizations and again returned the updated guideline to the Expert Panel for review. This process was repeated until all comments, suggestions, and feedback had been addressed.

In parallel with preparations for revisions to the guideline, the EMS Subcommittee of the American College of Surgeons Committee On Trauma (ACS COT) developed and piloted a 40-question electronic end-user feedback tool in the fall of 2020. The tool was distributed to 29 national organizations to gather information about use of the field triage guideline directly from EMS clinicians. Responses from 3,958 EMS clinicians[37] were shared with the Expert Panel and integrated into the guideline revision process.

RESULTS

Overview

The 2021 field triage guideline includes important clarifications regarding nomenclature and terminology. The name has been revised to the "National Guideline for the Field Triage of Injured Patients," reflecting the goal and intended function of the document. The name can be shortened to the "Field Triage Guideline" (FTG), as needed.

Format and Structure

There are substantive changes to the format and structure of the guideline. Because stakeholder feedback and research indicated that the step-wise algorithmic format of prior versions was overly complex for field use, the Expert Panel modified the structure to align with the flow of information to EMS and actual use of the guideline.[37-39] The redesigned structure consolidates triage criteria into two main categories based on risk of serious injury: 1) *high risk criteria* (red box), including Injury Patterns (previously "Anatomic Criteria") and Mental Status and Vital Signs (previously "Physiologic Criteria"); and 2) *moderate risk criteria* (yellow box), including Mechanism of Injury and EMS Judgment (previously "Special Considerations"). Each risk category is aligned with recommendations for a destination hospital. The guideline is intended to be read from top-to-bottom (risk) and left-to-right (flow of information to EMS).

Specific Field Triage Guideline Recommendations

The 2021 guideline is detailed in Figure 1. Changes from the 2011 field triage guideline are summarized in Table 2. The 2011 guideline is included in the on-line Supplement for reference (Supplemental Digital Content, http://links.lww.com/TA/C516).

Injury patterns (previously *Step 2 Anatomic Criteria*)

Injury patterns are highly specific, yet insensitive for identifying seriously injured patients.[40] We added one new criterion and revised 6 criteria for clarity. Two criteria remain unchanged. We also revised the order of criteria to align with a head-to-toe field-based rapid physical assessment.

New criteria

- New criterion: ***Active bleeding requiring a tourniquet or wound packing with continuous pressure***

Rationale: Research in military settings has shown that early field application of tourniquets is associated with improved survival and few complications.[41-43] Tourniquet use was not included in the 2011 guideline due to insufficient evidence in the civilian setting. Multiple civilian studies have since been published on the appropriate application of field tourniquets, safety, effectiveness, and specificity for serious injury. Among 306 civilian trauma patients with tourniquet application, 92% required surgical intervention within 8 hours and field application was associated with lower transfusion requirements and higher survival.[44] Additional studies showed similar results.[45-47] The Panel added "wound packing with continuous pressure" to capture external bleeding requiring operative intervention in anatomic locations not amenable to tourniquet placement.

- Criterion clarified: ***Penetrating injuries to the head, neck, torso, and proximal extremities***

Rationale: This criterion was revised from "proximal to elbow or knee"[6] to "proximal extremities" to simplify the criterion based on EMS feedback. This criterion includes impalement.

- Criterion clarified: ***Skull deformity, suspected skull fracture***

Rationale: This criterion was revised from "Open or depressed skull fracture" based on EMS feedback.

- Criterion clarified: ***Suspected spinal injury with new motor or sensory loss***

Rationale: This criterion was revised from "Paralysis" based on EMS feedback.

- Criterion clarified: ***Chest wall instability, deformity or suspected flail chest***

Rationale: This criterion was revised from "Chest wall instability or deformity (e.g., flail chest)" based on EMS feedback.

- Criterion clarified: ***Suspected pelvic fracture***

Rationale: This criterion was revised from "Pelvic fractures" based on EMS feedback. While field use of this criterion has shown lower predictive utility than other anatomic criteria, having a pelvic fracture by ICD9 diagnosis codes increased the +LR to 6.2.[40] The Panel felt this criterion should be retained, noting an opportunity for EMS training.

- Criterion clarified: ***Suspected fracture of two or more proximal long bones***

Rationale: This criterion was revised from "Two or more proximal long-bone fractures" based on EMS feedback.

<u>Retained criteria (no changes):</u>

- Retained criterion: ***Crushed, degloved, mangled, or pulseless extremity***
- Retained criterion: ***Amputation proximal to wrist or ankle***

Rationale: While the Panel debated changes to the level of amputation (e.g., hand, digit) based on the limited availability of hand surgeons in many regions, they ultimately decided to retain the criterion without changes.

Mental Status and Vital Signs (previously *Step 1 Physiologic Criteria*)

These criteria are highly specific, but insensitive, for identifying seriously injured patients. The Panel focused on expanding this category based on new evidence, with attention to feasibility of use in the field. There are five new criteria, three retained criteria, and three criteria removed.

New criteria

- New criterion: ***Unable to follow commands (motor GCS < 6)*** replaces total "Glasgow Coma Scale ≤ 13".

Rationale: Twelve head-to-head studies compared total GCS to motor GCS, with high AUROCs for both measures (0.8-0.9).[33] The AUROC difference in predictive performance between the two measures was small and unlikely to have clinical impact,[33] particularly considering ease of use and the dichotomized cut-point used for field triage. Feedback from EMS and the Expert Panel indicated strong preference for simplifying the criterion for feasibility and EMS training. This measure also applies to young children,[48,49] as lacking spontaneous or purposeful movements. Patients with language barriers who are unable to understand commands is a potential limitation of this criterion.

- New criterion: ***heart rate > SBP*** (adults and older adults).

Rationale: The systematic review of circulatory predictors identified 29 studies evaluating shock index (HR/SBP), most of which used a value of 1.0.[34] Among out-of-hospital studies, pooled estimates showed sensitivity 37%, specificity 85%, and an AUROC of 0.72 for identifying seriously injured patients.[34] Among five head-to-head studies comparing shock index to SBP, all favored shock index, although the quality of evidence was low.[34] Assessing if HR is greater than SBP achieves the goal of identifying patients with a shock index > 1.0 and facilitates EMS training.

Pediatric studies have used an age-adjusted shock index to predict serious injury,[50, 51] but the Panel felt that calculating an age-adjusted shock index would be cumbersome and non-feasible for field use. Therefore, this criterion only applies to adults and older adults.

- New criterion: ***SBP < 70mmHg + (2 x age)*** (children 0-9 years)

Rationale: Two studies showed that age-adjusted hypotension (calculated using this formula) in the ED is an independent predictor of mortality among injured children.[12, 16] Inclusion of this criterion aligns the triage guideline with Advanced Trauma Life Support (ATLS) training[52] and was viewed by the Panel as a pediatric-specific training opportunity for EMS. Children over 9 years reach the adult threshold of SBP < 90 mmHg using the formula. Because hypotension is a late finding of pediatric shock (decompensated shock), EMS training on the use of visual cues (e.g., pallor, mottling, cyanosis) is encouraged, as represented in the Pediatric Assessment Triangle.[53-55]

- New criterion: ***Respiratory distress or need for respiratory support*** replaces "need for ventilatory support" and "respiratory rate < 20 in infant aged < 1 year".

Rationale: The criterion "need for ventilatory support" was added in 2011[6] based on three studies showing that need for airway management and assisted ventilation were highly predictive of serious injury and death.[56-58] There have since been four studies evaluating the need for respiratory support (variably defined as assisted ventilation, intubation, or need for mechanical ventilation), which showed sensitivity 8% to 53% and specificity 61% to 100% for patients with serious injury.[35] The Panel revised the wording to "need for respiratory support" based on EMS feedback. Because there is not a specific respiratory rate threshold for injured infants,[58] the "respiratory rate < 20 in infants" criterion was removed. The Panel included "respiratory distress" to facilitate EMS

training on important exam findings that precede the need for respiratory support, particularly in children..[53-55]

- New criterion: ***Room-air pulse oximetry < 90%***

Rationale: Pulse oximetry is widely available on portable monitors used by EMS and has been evaluated in 5 studies, with most using a cut-point of < 90%.[35] Pulse oximetry had AUROC values 0.59 to 0.76 for identifying patients with serious injury, similar to the respiratory rate criterion.[35] While most studies were conducted in adults, one study demonstrated the predictive utility of pulse oximetry in injured children[57] and another study showed the benefit of respiratory support and correction of hypoxia among young children with traumatic brain injury.[59] Therefore, this criterion applies to patients of all ages.

<u>Retained criteria (no changes):</u>

- Retained criterion: *SBP < 90 mmHg*

Rationale: The predictive utility of hypotension is supported by 49 studies, most of which evaluated a cut-point of SBP < 90 mmHg.[34] A meta-analysis of 17 studies showed that prehospital SBP < 90 mmHg had a pooled sensitivity 19%, specificity 95%, and AUROC 0.67 for patients with serious injuries.[34] Higher thresholds for SBP modestly raised sensitivity, but lowered specificity,[34] and the Panel sought to preserve the specificity of this measure. This criterion applies to patients 10 years and older, with use of a higher threshold for older adults.

- Retained criterion: *SBP < 110 for older adults*

Rationale: The criterion "SBP < 110 might represent shock after age 65 years" was added to the "Special Considerations" section in 2011 to address the issue of under-triage among older adults.[6] Because SBP < 90 mmHg has sensitivity of 4-5% for identifying seriously injured older adults, a

higher SBP threshold improves sensitivity (13-29%), while preserving specificity (83-93%) in this population.[34] This criterion was moved from the Special Considerations section to Mental Status and Vital Signs for clarity and consistency.

- Retained criterion: *RR < 10 or > 29 breaths/minute*

Rationale: Respiratory rate is the most commonly studied respiratory triage criterion (25 studies), with RR < 10 or > 29 breaths/minute being the most studied parameters.[35] This criterion had a pooled sensitivity 13% and specificity 96% for identifying seriously injured patients, with an AUROC of 0.70.[35] While most studies were conducted in adults, a respiratory rate < 10 or > 29 breaths/minute demonstrated good predictive utility in children and older adults, yet with more variability in the accuracy estimates.[35] This criterion applies to patients of all ages.

Mechanism of Injury Criteria

Because anatomic and physiologic criteria identify less than half of patients with serious injuries,[28, 60, 61] the mechanism criteria are important in the triage process. However, the mechanism criteria are less specific for serious injuries (lower +LR) and therefore are included in the "moderate risk" category. Based on high under-triage associated with previous versions of the guideline,[25-27, 29] the Panel considered changes to reduce under-triage, particularly in children. There is one new criterion, three modified criteria, and 4 unchanged criteria.

<u>New criteria</u>

- New criterion: ***Child (age 0-9 years) unrestrained or in unsecured child safety seat***

Rationale: Motor vehicle crashes (MVCs) are a common cause of pediatric injury. Lack of appropriate restraints is a consistent factor among seriously injured children.[62-66] Unrestrained

children have higher injury severity, greater trauma resource needs, and are more likely to die than restrained children.[62-64] Lack of restraint use also has been shown to predict seriously injured children involved in MVCs.[66] The Panel felt that this criterion was most pertinent for children 0 to 9 years, which provided consistency with the age range for pediatric blood pressure to simplify EMS training.

Modified criteria

- Modified criterion: ***Significant intrusion (including roof) > 12 inches occupant site or > 18 inches any site or need for extrication of the entrapped patient***

Rationale: As criteria already present in the guideline,[6, 67] additional studies have confirmed the predictive utility of these criteria in adults and children.[36, 60, 61, 68] Extrication > 20 minutes was removed from the 2006 guideline based on varying definitions of "prolonged extrication" in the literature and the belief that the intrusion criteria would capture patients requiring extrication.[6, 67] However, a systematic review showed that extrication of any duration was a significant predictor of serious injury in adults and children[36] and that predictive utility was retained down to ≥ 5 minutes.[61] Based on these studies, the Panel added the extrication criterion back to the guideline, without a specific time requirement. Because different studies used "extrication" and "entrapment" interchangeably, the Panel integrated these terms for the criterion.

- Modified criterion: ***Rider separated from transport vehicle with significant impact (e.g., Motorcycle, ATV, Horse, etc.)***

Rationale: Different versions of the motorcycle crash criterion have been present since the 1990 guideline,[5] despite limited data. A study of adults not meeting physiologic or anatomic criteria showed that motorcycle crash > 20 mph or with rider separation had poor overall predictive utility

(+LR 1.0-1.2).[61] With only a single study evaluating the motorcycle criterion in the past 10 years[36] and the speed component offering little predictive yield,[61] the Panel removed the speed requirement and broadened the type of transport vehicle for greater application to children.[60]

- Modified criterion: ***fall from height > 10 feet (all ages)***

Rationale: The 2011 guideline specified falls > 20 feet in adults and > 10 feet in children (or 2-3 times the height of the child).[6] However, the > 10 feet criterion has good predictive utility for children[60] and adults.[61] The criterion specifying 2-3 times the height of the child was based on research in young children falling from bunk beds,[69] but has not demonstrated improved prediction compared to a > 10 feet criterion.[60] For consistency and simplicity, the Panel opted to use the same fall height for children and adults and to remove the age-based height for children.

- Modified criterion: ***Pedestrian/Bicycle rider thrown, run over, or with significant impact***

Rationale: This triage criterion was included in the 1987 guideline, with slight modifications over time.[5, 6] Six studies published since 2011 showed mixed results (+LR 0.4 – 2.8).[36] In a study of children not meeting physiologic or anatomic criteria, the pedestrian criterion was predictive for patients run over and with significant impact (> 20 mph).[60] Among adults, this criterion demonstrated predictive utility with higher speed of impact (+LR ≥ 2.2).[61] Because this criterion has long existed in the triage guidelines with reasonable predictive utility for children, the Panel retained the criterion and simplified the wording.

<u>Retained criteria (no changes)</u>

- Retained criterion: ***Ejection (partial or complete) from automobile***

Rationale: Among multiple studies published since 2011, most showed that ejection remains a significant predictor of serious injury and death in adults and children.[36, 60, 61]

- Retained criterion: ***Death in passenger compartment***

Rationale: In several studies published since 2011, death of another passenger in the same vehicle predicted serious injury in adults and children.[36, 60, 61]

- Retained criterion: ***Vehicle telemetry data consistent with severe injury***

Rationale: This criterion was added to the 2006 guideline based on promising developments in automated collision notification systems and retained in 2011 based on 6 studies demonstrating predictive utility and the potential for transmission to 9-1-1 dispatch centers.[6] In five recent studies, crash algorithms had good predictive utility (+LR 4.7 to 22.2),[36] yet studies evaluating real-time use of vehicle telemetry for field triage are lacking.

Emergency Medical Services Judgement (previously *Step 4 Special Considerations*)

The "Special Considerations" step has changed over time to include special populations, unique triage factors, and EMS provider judgment.[6] While some studies of EMS provider judgment have had mixed results,[70, 71] others have shown judgment to be independently associated with serious injury.[72] The Panel felt that EMS judgment plays an important role in field triage, but is dependent on training and experience. For the current guideline, the Panel created a category for "EMS Judgment" to replace "Special Considerations" and provided structured guidance on factors to consider in the decision-making process. The criteria in this section generally have less evidence and lower predictive utility, but remain important considerations in field triage. There are three new criteria, one modified criterion, and 3 unchanged criteria.

New criteria:

- New criterion: ***Suspicion of Child Abuse***

Rationale: Child abuse can be difficult to diagnose and have subtle presentations, yet with potentially devastating consequences. Mortality is elevated among abused children, especially with recurrent episodes of abuse.[73] Abused children frequently require specialty care to address their injuries and the complex legal, logistical, social, and investigative aspects of these incidents. Trauma centers are required to have protocols in place to provide comprehensive evaluation of such children, with guidelines and best practices published by several national trauma organizations.[74-76] Training EMS clinicians to recognize the signs of child abuse and integration of prehospital information into ED-based clinical decision support systems[77, 78] are supported by multiple national organizations. Based on these considerations, the Panel added suspicion of child abuse.

- New criterion: ***Special, high resource healthcare needs***

Rationale: Various comorbid conditions were in the triage guidelines from 1987 through 2006, but were removed in 2011 due to lack of evidence.[5, 6] Among five recent studies evaluating the use of comorbidities for field triage,[36] some showed that comorbidities were independently associated with death and could reduce under-triage among older adults.[36] However, the predictive utility of comorbidities varied across studies (+LR 0.8 to 3.1).[36] The Panel recognized that injured patients with special healthcare needs related to comorbidities (e.g., ventilator dependence or ventricular assist devices) may require the resources and expertise of trauma centers.

Modified criteria:

- Modified criterion: ***Low level falls in young children (age ≤ 5 years) or older adults (age ≥ 65 years) with significant head impact.***

Rationale: The Panel moved these criteria from the Mechanism and Special Considerations sections to EMS Judgment. Research has shown that some children incur serious injuries from low-height falls, including falls from standing,[60] and that such falls are a common cause of traumatic brain injury in young children.[79] For older adults, ground-level falls can cause serious injury and death,[19, 80-82] which were the reasons for inclusion in the 2011 guideline.[6] However, ground-level falls are common among older persons and therefore are relatively non-specific for serious injury (+LR 1.2 to 1.9).[25] Based on concerns that these criteria could result in over-triage, the Panel included these factors under EMS Judgment and added "with significant head impact".

- Modified criterion: ***Anticoagulation use***

Rationale: "Coagulopathy" was added to the triage guideline in 1990[5] and included in the 2011 guideline as "Anticoagulants and bleeding disorders – patients with head injury are at high risk for rapid deterioration."[6] Five recent studies evaluating anticoagulant use for triage showed relatively low predictive utility (+LR 0.73 - 1.8).[36] Some research suggests that such a criterion could help identify older adults with intracranial hemorrhage,[83] but other studies show otherwise.[84] In a prospective study of older adults transported by EMS, the incidence of brain hemorrhage was similar between patients taking versus not taking anticoagulants.[85] Based on these data, the Panel felt that use of anticoagulants (including anti-platelet agents) was best considered in the context of EMS Judgment.

Retained criteria (no changes):

- Retained criterion: ***Pregnancy > 20 weeks***

Rationale: The pregnancy criterion was added to the 1999 guideline[5] and refined to "pregnancy > 20 weeks" in 2006.[67] While pregnancy does not necessarily increase the likelihood of serious injury, simultaneous management of the mother and unborn child can create complex clinical scenarios requiring trauma centers with obstetrics capabilities. Therefore, the Panel felt that this factor should be part of EMS Judgment.

- Retained criterion: ***Burns in conjunction with trauma***

Rationale: Consistent with ATLS teaching, when a burn patient has other injuries, the injuries should be evaluated and potentially prioritized over the burn. Trauma centers have the capability to quickly evaluate these patients to expedite care for both clinical conditions.

- Retained criterion: ***Children should be triaged preferentially to pediatric capable trauma centers***

Rationale: For injured children, research has demonstrated higher survival in pediatric trauma centers compared to adult or mixed trauma centers.[12] However, many regions do not have access to pediatric trauma centers.[86] While transport to a pediatric trauma center is preferable, the Panel felt that transport to pediatric versus adult trauma centers should be determined by local protocols and proximity. Based on stakeholder and expert feedback, the Panel chose not to use a specific age to define children, as there is insufficient evidence for a specific age limit and systems have established varying age limits based on local resources and practice patterns. Because high ED pediatric readiness has been associated with improved short- and long-term survival of children in US trauma centers,[15, 16] all trauma centers are strongly encouraged to meet such criteria.

TRANSPORT RECOMMENDATIONS

Emergency Medical Services systems vary by geography, organization, resources, service levels, staffing, training, access to air medical services, travel times, oversight, and governance. Trauma centers are hospitals that are prepared to provide emergent care for seriously injured patients through resources, personnel, expertise, education, and quality improvement programs. There are national standards for adult and pediatric trauma centers, with trauma center designation (Levels I through V) typically made at the state level (Table 3). State trauma systems may be inclusive or exclusive, with inclusive systems categorizing most hospitals and demonstrating lower injury-related mortality.[87]

Recognizing the variability in EMS and trauma systems, transport recommendations in the guideline allow local flexibility. There is not a "one size fits all" that will work for all systems. While the survival benefit of regionalized trauma care is driven primarily by Level I hospitals,[7-9] there are large regions across the US that do not have immediate access to such trauma centers. Although 84% - 88% of US residents have access to a Level I or II trauma center within 60 minutes, these proportions are substantially lower when limited to ground travel and shorter time windows.[88, 89] Access to pediatric trauma centers is even lower,[86] with widely variable proximity by state.[90] Rural regions have the most limited access to Level I-II trauma centers,[86, 88, 89] resulting in higher under-triage, more inter-hospital transfers, and longer transfer distances compared to urban settings.[91] The triage guidelines are intended to provide a template that can be adapted for use in all systems.

When feasible, patients meeting the "high risk" criteria should be triaged to the highest-level trauma center within the region, including consideration of air medical services. Injured patients meeting the physiologic criteria have lower mortality when cared for in Level I trauma centers.[92] Air medical services may offer advanced care clinicians, access to additional interventions, and more rapid transport. EMS medical directors and trauma system managers are encouraged to evaluate the resources relevant to their systems to guide implementation of the field triage guideline. Because time is known to be crucial for certain trauma patients,[93] field triage favors short time intervals. However, the current evidence is insufficient to make specific recommendations regarding transport times and when air medical services should be activated.[94] Some EMS systems may opt to implement a closest hospital approach for patients with an unstable airway, severe shock, traumatic arrest, or other "extremis" conditions for initial stabilization, prior to higher level transport for definitive care.

IMPLEMENTATION AND ADHERENCE TO THE FIELD TRIAGE GUIDELINE

The triage guideline is not useful if not fully implemented into trauma systems and adopted by EMS clinicians. Following the 2006 triage guideline, only 17% of states had full adoption of the new guideline, with 61% using an older version or a different protocol altogether.[95] In a study of 6 metropolitan regions, only one region had adopted the most recent triage guideline within two years and 36% of triage criteria in use had been previously removed or never included.[96] Compliance with the field triage guideline varies widely, with lowest adherence for the physiologic criteria.[97] Strict adherence would reduce under-triage.[98] While there are many hurdles to implementing an updated guideline, translating the science into practice is arguably the most important step of realizing effective field triage practices. The 2021 guideline is organized to

facilitate ease of use, increase speed of decision-making, and promote adherence. We recommend adoption at the state level (similar to the trauma center designation process), allowing regional and local EMS and trauma systems to determine system-specific adaptations for hospital selection.

FUTURE RESEARCH

There is substantial need for future research to inform the triage guideline. Non-invasive monitor technology and point-of-care (POC) testing hold promise for field triage, particularly for seriously injured patients not meeting the high-risk criteria. Systematic reviews of circulatory and respiratory criteria identified several promising measures (e.g., POC lactate, end-tidal CO2, and heart rate variability), but more research and technology are needed to facilitate field use.[34, 35] Research on new criteria added to the 2021 guideline will be particularly important, as well as studies on the real-time use of automated collision notification systems for field triage.

The 2021 guideline includes changes in format, structure, and content. Research is needed to evaluate the usability, performance, adherence, and application of the new guideline (including the impact on health outcomes), particularly compared to the 2011 guideline. Research on efficient and effective training methods, including training frequency, are also needed. Understanding how and why EMS clinicians make triage decisions, including concordance versus discordance with the guideline, will be important in optimizing triage performance. Based on the slow and variable uptake of previous triage guidelines,[95,96] creating new ways of disseminating, implementing, and monitoring adherence will be important to realizing the true potential of the guideline. Finally, there is a need for more system-based research to inform transport times, when air medical services should be activated, and the role of different provider levels.

CONCLUSIONS

The 2021 field triage guideline is based on the most current science, a national panel of interdisciplinary experts, direct feedback from EMS clinicians, and input from many stakeholders. This guideline presents an opportunity to improve the prehospital care of injured patients across the US. Effective field triage is foundational to trauma systems, concentrating the most seriously injured patients in trauma centers to improve survival after injury.

AUTHOR CONTRIBUTIONS

Study conception and design:	EMB, CDN, PEF, MG, HNM.
Systematic reviews:	RC, JL.
Literature search (systematic reviews and other):	RC, JL, EMB, CDN.
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Panel leadership:	EMB.
Interpretation of results:	All authors.
Obtained funding:	EMB.
Drafting of manuscript:	CDN.
Critical revision:	All authors.

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Figure 1. 2021 National Guideline for the Field Triage of Injured Patients.

Supplemental Digital Content.

eFigure 1. 2011 Guideline for the field triage of injured patients.

Figure 1

*For the RED CRITERIA transport recommendations, patients in extremis (e.g., unstable airway, severe shock, or traumatic arrest) may require transport to the closest hospital for initial stabilization, prior to transport to a level I-II trauma center for definitive care. Pediatric patients meeting the RED CRITERIA should be preferentially triaged to pediatric-capable trauma centers.
†The EMS Judgement criteria should be considered in the context of resources available in the regional trauma system, including consideration of on-line medical control for further direction.
‡Examples of patients with special, high resource healthcare needs include tracheostomy with ventilator dependence, cardiac assist devices, etc.
‖Patients with combined burns and trauma should be preferentially transported to a trauma center with burn care capability. If not available, then a trauma center takes precedence over a burn center.
#Specific age used to define "children" is based on local system resources and practice patterns.

Table 1. Statistical criteria used to add and remove individual triage criteria.

- To *add* a new field triage criterion: *+LR ≥ 2* or *AUROC ≥ 0.60*.
  Magnitude of predictive utility:
  - large effect: +LR ≥ 10, AUROC ≥ 0.80
  - moderate effect: +LR 5-9, AUROC 0.7-0.79
  - small effect: +LR 2-4, AUROC 0.6-0.69

- To *remove* a field triage criterion: *no evidence* or *+LR 1.0 - 1.5* or *AUROC 0.50-0.55* across multiple studies (triage criteria were not removed based on a single study)

*LR = likelihood ratio. AUROC = area under the receiver operating characteristic curve.

Table 2. Summary of changes to the field triage guidelines.

Type of change:	Changes in 2021 field triage guidelines	Age range	2011 field triage guidelines
Format and structure	Two categories of triage criteria, based on risk of serious injury - high risk versus moderate risk (from top to bottom organization)	All ages	4 categories of triage criteria, classified as "steps"
	Within each risk category, the groups of criteria are listed from left to right to follow the flow of information to EMS		No alignment with flow of information to EMS
	Injury Patterns criteria are organized from head-to-toe to align with rapid field assessment		No specific order
	Mental Status and Vital Signs	All ages	Physiologic criteria (step 1)
New criteria	Motor GCS < 6 (unable to follow commands)	All ages	GCS ≤ 13
	Heart rate > SBP	≥ 10 years	None
	SBP < 70 mmHg + (2 x age in years)	0-9 years	None
	Respiratory distress or need for respiratory support	All ages	Respiratory rate < 20 in infant aged < 1 year; ventilator support
	Room air pulse oximetry < 90%	All ages	None
Relocated criteria	SBP < 110 mmHg for older adults	≥ 65 years	SBP < 110 might represent shock after age 65 years (Special Considerations section)
	Injury Patterns	All ages	Anatomic criteria (step 2)
New criterion	Active bleeding requiring a tourniquet or wound packing with continuous pressure	All ages	None
Clarified criteria	Skull deformity, suspected skull fracture	All ages	Open or depressed skull fracture
	Suspected spinal injury with new motor or sensory loss	All ages	Paralysis
	Chest wall instability, deformity or suspected flail chest	All ages	Chest wall instability or deformity (e.g., flail chest)
	Suspected pelvic fracture	All ages	Pelvic fractures
	Suspected fracture of two or more proximal long bones	All ages	Two or more proximal long-bone fractures
	Mechanism of Injury criteria	All ages	Mechanism criteria (step 3)
New criterion	Child (age 0-9 years) unrestrained or in unsecured child safety seat	0-9 years	None

Modified criteria	Rider separate from transport vehicle with significant impact (e.g., motorcycle, ATV, horse, etc.)	All ages	Motor cycle crash > 20 mph
	Fall from height > 10 feet (all ages)	All ages	Adults: > 20 feet (one story is equal to 10 feet) Children: > 10 feet or two to three times the height of the child
Modified criterion	Pedestrian/bicycle rider thrown, run over, or with significant impact		Auto vs. pedestrian/bicyclist thrown, run over, or with significant (> 20 mph) impact
	EMS Judgment	All ages	Special considerations criteria (step 4)
New criteria	Low level falls in young children (≤ 5 years) or older adults (≥ 65 years) with significant head impact	0-5 years, ≥ 65 years	Older adults – low impact mechanisms (e.g., ground level falls) might result in severe injury.
	Suspicion of child abuse	Any child, with focus on ≤ 5 years	None
	Special, high resource healthcare needs	All ages	None
Modified criteria	Anticoagulation use	All ages	Anticoagulants and bleeding disorders – patients with head injury are at high risk for rapid deterioration
Transport recommendations	Patients meeting any of the high risk criteria (Injury Patterns and Mental Status & Vital Signs) "should be preferentially transported to the highest level trauma center available within the geographic constraints of the regional trauma system".		Patients meeting any of the Step one (physiologic) or Step two (anatomic) criteria "should be transported preferentially to the highest level of care within the defined trauma system".
	Patients not meeting high risk criteria, but meeting any of the moderate risk criteria "should be preferentially transported to a trauma center, as available within the geographic constraints of the regional trauma system (need not be the highest level trauma center)".		Patients not meeting Step one or two criteria, but meeting Step three criteria "transport to a trauma center, which, depending upon the defined trauma system, need not be the highest level trauma center". Patients not meeting Steps one, two, or three, but meeting Step four criteria "transport to a trauma center or hospital capable of timely and thorough evaluation and initial management of potentially serious injuries. Consider consultation with medical control."

Table 3. Characteristics of trauma centers.

Level	Criteria
I	• Regional resource center expected to manage large numbers of seriously injured patients • Admit ≥ 1,200 trauma patients or have ≥ 240 admissions with ISS ≥ 16 per year • Attending trauma surgeon participates in major resuscitations in ED, present at operative procedures, and actively involved in critical care of all seriously injured patients (24-hour in-house availability) • Immediate availability of board-certified emergency physicians, general surgeons, anesthesiologists, neurosurgeons, and orthopedic surgeons • Maintain a surgically-directed critical care service • Participate in resident training • Be a leader in education and outreach activities • Conduct trauma research
II	• Regional resource center expected to manage large numbers of seriously injured patients • Same standards for provision of clinical care without the volume requirements • No requirement for resident training, education, outreach, trauma research, or surgically directed critical care service
III	• Capability to initially manage the majority of injured patients • Transfer agreements with Level I or II trauma centers for seriously injured patients • Continuous general surgical coverage
IV	• Often serve rural regions and supplement care within a larger trauma system • Initial evaluation and assessment of injured patients, with expected transfer of many patients to higher-level trauma centers • Transfer agreements with higher level trauma centers • 24-hour emergency coverage by a physician or midlevel provider • Frequently lack continuous surgical coverage

*From Resources for the Optimal Care of the Injured Patient, Committee on Trauma, American College of Surgeons, 2014. There is variation in state-to-state definitions and designations of trauma centers. There are separate processes and criteria for pediatric trauma centers.