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Geriatric trauma triage: optimizing systems for older adults—a publication of the American Association for the Surgery of Trauma Geriatric Trauma Committee

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ABSTRACT

Background Geriatric trauma patients are an increasing population of the United States (US), sustaining a high incidence of falls, and suffer greater morbidity and mortality to their younger counterparts. Significant variation and challenges exist to optimize outcomes for this cohort, while being mindful of available resources. This manuscript provides concise summary of locoregional and national practices, including relevant updates in the triage of geriatric trauma in an effort to synthesize the results and provide guidance for further investigation.

Methods We conducted a review of geriatric triage in the United States (US) at multiple stages in the care of the older patient, evaluating existing literature and guidelines. Opportunities for improvement or standardization were identified.

Results Opportunities for improved geriatric trauma triage exist in the pre-hospital setting, in the trauma bay, and continue after admission. They may include physiologic criteria, biochemical markers, radiologic criteria and even age. Recent Trauma Quality Improvement Program (TQIP) Best Practices Guidelines for Geriatric Trauma Management published in 2024 support these findings.

Conclusion Trauma systems must adjust to provide optimal care for older adults. Further investigation is required to provide pertinent guidance.

INTRODUCTION

With increases in life expectancy, the proportion of older individuals in the United States (US) is rising dramatically. This cohort, aged 65 and older, grew by 38.6% over the past decade, approximately five times more rapidly than the growth of the total population.[1] Older adults report an increased incidence of injury compared with other groups, with over 25% reporting falls each year. In fact, unintentional injury is the eighth leading cause of death in this age group in US.[2] Compared with their younger counterparts, older adults suffer greater morbidity and mortality for similar injuries, largely attributable to their age-related physiologic changes, presence of multiple comorbidities, and polypharmacy.[3] Consequently, low-risk mechanisms may confer substantial injury to older persons. Given these factors, an optimal system for identifying those with life-threatening injuries is warranted.

Triage, or the sorting of individuals by degree of urgency, exists to optimize resource utilization to those most in need. Triage principles are applied in trauma systems for all ages, at many points in care, and come with an inherent and accepted rate of mistriage. Mistriage is generally characterized into two groups: *undertriage*, or under-recognition of seriously injured patients, and *overtriage*, utilization of resources for patients without significant injuries, whereas undertriage may result in devastating outcomes for those requiring intervention, overtriage may overwhelm local resources with low-acuity patients. Local, regional and national recommendations have been suggested to optimize field transport and hospital resource utilization. However, despite identification that optimal systems should be investigated and developed, optimal triage protocols for the older adult remain controversial, and, therefore, significant variation exists in the treatment of older trauma patients.

The American College of Surgeons (ACS) Committee on Trauma (COT) requires protocols to address vulnerable patients. Many of the systems established for triage of the injured patient, and accepted rates of overtriage, are based on care for younger patients in hemorrhagic shock. Care of older adults challenges this knowledge and thus our current systems. Evidence-based and specific guidance for the geriatric population remains challenging.[4] Some literature has demonstrated that older trauma patients fare better when they are cared for at a trauma center, however, mechanisms of triage of these patients remain controversial.[5–8] Recent National Trauma Research Action Plan analysis identified geriatric-specific triage and trauma center level and designation as high priority questions for further investigation.[9] New guidelines published by the ACS COT in 2023 suggest that trauma activations can be triggered for the older trauma with different vital sign and mechanism criteria compared with younger patients.[10]

Opportunities for triage exist at many points in treatment—in the field, on hospital arrival and during the hospital admission. Additionally, the

concept of frailty, or the discrepancy between chronologic and physiologic age, has been extensively described, and screening tools have been validated, which can be used at many points of the hospital encounter to assist with appropriate treatment.[11] The goal of this paper is to review existing national and local triage criteria for older adults; in particular, this paper will describe how triage can be used at multiple points in a hospital encounter, identify pitfalls related to mistriage, relate triage criteria to performance improvement and identify gaps for further investigation related to triage criteria.

OPPORTUNITIES FOR TRIAGE

Opportunities for triage exist at several stages of treatment, and as patients are reassessed throughout their course. Triage for injured patients has traditionally been based on physiologic, anatomic and mechanistic criteria and conducted in the prehospital setting. Field triage criteria for older adults are emerging, with evidence-based parameters being integrated into national and local guidelines. However, triage can additionally occur on hospital arrival, either in the ED or in a trauma bay based on the patient's evolving physiologic status or with updated knowledge about their comorbid conditions. Ongoing assessments following admission may be conducted with frailty screening, utilizing biochemical and anthropometric data. Perhaps a combination of multiple points of triage is optimal and is yet to be determined. For example, a patient may present to a designated trauma center and be stratified by non-trauma surgeons prior to escalation and reassessed based on ongoing imaging and bioanalysis. On the contrary, perhaps emergency medical service (EMS) providers may optimally decide a patient's disposition with triage following initial assessment at a primary or community facility. We present the current data and deficiencies in the literature.

Prehospital triage

Prehospital triage allows mobilization of resources for expedient care of the patient on arrival to a healthcare facility by advanced notification of staff. Multiple national trauma organizations suggest lowering the threshold for trauma activation in the older trauma patient. For example, the ACS Trauma Quality Improvement Program (TQIP) guidelines state that 'to mitigate late recognition of significant injuries, a lower threshold for trauma team activation (TTA) should be used for elderly trauma patients'.[12] Likewise, the Eastern Association for the Surgery of Trauma (EAST) recommends utilizing advanced age as a criterion for transfer to a trauma center.[13] These recommendations were based on multiple studies, which have shown that undertriage remains a significant concern for the older trauma patient.

Age criteria

While it is known that older patients are undertriaged, the age at which an adult becomes 'older' remains controversial. Champion *et al* demonstrating an increase in mortality for injured patients greater than 45 years old.[14] A recent systematic review of 11 studies by Boulton *et al* sought to describe current best practices but noted significant heterogeneity. Among the studies, the definition of older age varied between 55, 65, and 70 years.[15] Nakamura *et al* also advised that geriatric patients risk undertriage by virtue of their age. In utilizing data from 105 hospitals in the western USA, they determined that current triage criteria resulted in undertriage of older patients. The authors considered undertriage as a patient with an injury severity score (ISS) ≥16 who failed trauma triage or was transported to a non-trauma center. The authors found an increase in undertriage after age 60.[16]

A 2019 study by Bardes *et al* evaluated TTA for geriatric patients in which age greater than 70 years old and an injury mechanism led to mandatory TTA.[17] A retrospective review of 5 years of trauma activations was performed, evaluating geriatric patients who only met age criteria compared with those who met standard TTA criteria. Standard criteria at their institution included systolic blood pressure (SBP) <90 mm Hg, a heart rate >120 beats/min, Glasgow Coma Scale (GCS) <9, gunshot wound to neck or trunk, and any transfer requiring blood transfusions for maintenance of hemodynamics. Age-specific criteria included age ≥70 with a traumatic mechanism. Triage was considered appropriate if the patient died, required intensive care unit (ICU) admission, intubation in the trauma bay, an OR or interventional radiology (IR) procedure or sustained an ISS >15. They found that only 27% of patients met standard TTA, while the remaining 73% were activations based on age alone. The overtriage rate was 40%; however, standard criteria missed many seriously injured patients. Out of the patients activated based on age alone, 9% died, 27.5% sustained an ISS >15, 56% required ICU admission, 13% were intubated in the ED and 12% required an OR or IR procedure. The authors concluded that adding age as an activation criterion reduces undertriage with acceptable rates of overtriage.[17] This study poses a discussion about overtriage in this patient population. Although this falls within the overtriage rate deemed appropriate by the ACS COT, perhaps implementation of improved triage will identify the highest risk patients.

Vital sign criteria

The threshold at which vital sign changes were meaningful in the older patient also varied. Hemodynamic criteria also varied, with inclusion SBP values below 110 mm Hg, 100 mm Hg and 90 mm Hg to define hypotension. Inclusion of injury patterns (head injury, long bone fractures), and anticoagulation use also differed among these studies.[15] Further support for modified hemodynamic criteria was suggested by Berry *et al*, who reported that SBP <110 mm Hg should be considered for triage. In their study, values below 110 mm Hg resulted in a doubling of mortality for older patients with traumatic brain injury (TBI).[18] A meta-analysis by Hashmi reported that an SBP <90 mm Hg increased the mortality 3.1–5.3 times in the injured older patients.[3] These data suggest that modified hemodynamic parameters should be considered as markers of trauma severity in geriatric trauma patients, and integrated into triage criteria.

Lehmann *et al* also demonstrated that standard physiologic criteria are insufficient for elderly patients. The authors evaluated all patients seen by the trauma service in Washington state. As compared with a younger cohort, those ≥65 years of age presented with lower heart rates and higher blood pressures from the field and did not meet standard criteria for triage of a patient in shock. Among all patients who were undertriaged, defined as requiring ED intervention or direct transfer to the operating room (OR) or ICU without full TTA, older patients demonstrated higher mortality, higher discharge disability, and lower discharge GCS as opposed to younger patients. In fact, the older cohort demonstrated nearly four times greater rates of mortality and discharge disability as compared with younger patients ($p<0.001$).[19]

The current combined ACS COT and Centers for Disease Control and Prevention Guidelines for Field Triage of Injured Patients state that an SBP less than 110 mm Hg or a shock index

>1 confers high risk of serious injury in those ≥65 years and recommend triage to the highest level center. However, it allows for EMS discretion in the triage of patients on anticoagulants and those who have sustained low-level falls.[20]

Activation level

Carr *et al* sought to determine if high level TTA influenced outcomes for older patients. After evaluating 2422 patients ≥70 years with a full TTA, they noted a significant increase in the number of TTA and a decrease in length of stay (LOS), without a mortality benefit.[21] On the contrary, Demetriades *et al* found that utilizing age as a triage criterion for trauma evaluation did confer a mortality benefit. They reviewed all patients requiring trauma evaluation in their facility over 7.5 years. Only 25% of patients met standard TTA criteria, quantified as SBP <90 mm Hg or pulse >120 mm Hg, respiratory rate <10 or > 29, unresponsiveness to pain or gunshot wound to the trunk. Of the remaining 75%, there was a 16% mortality, and 24% ICU admission rate. In fact, of all of their patients in this age range, 63% had an ISS >15 and 25% of those had ISS >30 and did not meet standard TTA criteria.[22]

Regional standards

Creating consistency within each center's prehospital setting, coordinating activation criteria, and providing education to EMS providers for identification of poorly appearing geriatric patients, and centers specialized in the care of these patients may improve outcomes. In addition, the number of hospitals in each center's catchment area is an important factor to consider, whereas certain cities have large catchment areas and fewer hospitals, other densely populated regions house multiple hospitals within a small area.[23] Even among trauma centers, there is variation in geriatric outcomes. Olufajo *et al* found that hospitals with higher geriatric trauma volumes demonstrated lower mortality and lower failure to rescue.[24]

Ohio state has one of the most studied, and more well-developed regional field triage criteria for geriatric patients. Ichwan *et al* reviewed over 100 000 adult trauma patients in Ohio from 2006 to 2011 and compared outcomes prior to, and following changes in statewide geriatric trauma triage.[25] Modifications included increasing the SBP threshold for hypotension from 90 mm Hg to 100 mm Hg, GCS <13 to GCS ≤14, and the addition of long bone fracture following motor vehicle collision, injury to two or more body regions, pedestrian struck and any fall with a TBI. Appropriate triage to a trauma center was defined as a patient having an ISS >15, an OR procedure within 48 hours, any ICU stay and any in-hospital mortality. The patients were divided into those ≥70, and those under. Using both the geriatric-specific and standard trauma triage criteria, the differences in sensitivity and specificity between the two were tabulated, whereas standard adult triage criteria captured severely injured adults (ISS >15) with a sensitivity of 87% for those under 70, the sensitivity for the older cohort was merely 61%. When the modified criteria were utilized, sensitivity for those ≥70 increased to 93%. Likewise, sensitivity for patients ≥70 requiring OR within 48 hours increased from 35% to 47%, ICU stay from 56 to 81%, and, importantly, mortality from 74% to 90%. Although specificity dropped in some cases, the specificity of the geriatric criteria following modifications remained superior to the specificity of the adult criteria being utilized for patients <70 in all categories.[25]

Additional criteria

Additional criteria, such as baseline functional dependent status, additional comorbid conditions, and pre-existing advanced directives or goals of care may also offer important information in the triage of older patients. Much of this information may not be readily available to providers during the triage process, but improvements in these areas would likely benefit triage practices and prevent those with terminal conditions or clear advanced directives to avoid invasive interventions from being alerted as trauma activations.

TRIAGE IN THE TRAUMA BAY AND ED

Following field triage, triage continues on patient arrival to the hospital. Identification of high-risk patients can occur in the ED, trauma bay or following admission. This methodology may be utilized to establish protocols, engage consultants or utilize pathways or resources within the hospitals to prevent poor outcomes. This may allow for early identification of issues, prevention of complications or early rescue of patients who have developed complications.

Early upgrade in the emergency department

At institutions in which adding age as a criterion for trauma activations is not feasible, an approach to identify high-risk patients can occur in the ED, prompting an upgrade in care. This may include a brief physical examination or bloodwork evaluation, leading to trauma team evaluation within 30 min of arrival. While this might offer a mechanism of integrating age-adjusted criteria without fully overburdening the system, it would still require additional allocation of resources to identify these patients beyond the triage vital signs. Implementing this requires adequate staffing, education and commitment from the ED. However, several obstacles must be overcome. Collaboration between ED and trauma teams is imperative. Champions for geriatric care within the ED should be established. Resources must be allocated and rapid evaluation algorithms developed for the older trauma patients who arrive in the ED.

Hatton *et al* reviewed a collaborative model in which the trauma team and the ED partnered to establish protocols for geriatric trauma patients.[26] Due to concern for unrecognized occult hypoperfusion (OH) in the elderly trauma patients, they instituted an early assessment of OH using a base deficit value of less than negative two as a marker.[26] They performed a study comparing standard measures of shock, specifically abnormal hemodynamics (heart rate >120 beats per minute, SBP <90 mm Hg), to those presenting with a base deficit <−2, with preserved hemodynamic parameters (the latter group being defined as OH). Based on the data, it was determined that the patients with OH had a higher probability of mortality and major complications. This is presumably due to a failure to recognize patients requiring early intervention, indicating again that earlier identification and intervention is the key to improving outcomes. Base deficit integration may hold promise as part of ED triage, but requires further investigation.

Given that prior triage tools for trauma activation have been developed for young patients in hemorrhagic shock, criteria such as mechanism of injury and hemodynamic status in older adults must be amended to this population. Several studies have demonstrated that even low-energy mechanisms portend severe injuries in a subset of older adult patients.

TRIAGE FOLLOWING ADMISSION

Triage does not end in the trauma bay: during the patient's hospital stay, triage continues as the specific patient needs are addressed to ensure optimal care. In the prehospital setting, rapid assessment is imperative. However, after admission, one

has perhaps additional time and resources. This affords access to supplementary clinical information, with institutional protocols that can be developed to leverage existing hospital resources for high-risk patients. Examples of application of hospital triage can include protocols, which direct high-risk patients to higher levels of care (ICU or intermediate care areas), specialized admitting services, altered team composition, and protocolized involvement of geriatricians, hospitalists, and geriatric pharmacists. Screening for risk can occur by age or by other measures such as frailty or sarcopenia. Age-friendly units can be designed to focus on age-specific training for nurses, increased presence of physical therapists, dieticians, and speech therapists to better meet the therapeutic needs of these patients as well as institutional protocols to minimize delirium and falls.

Regardless of where the patient is admitted, ACS TQIP trauma management guidelines suggest that it is important that providers familiar with the care of geriatric patients are involved early. They state that programs should develop criteria for early geriatric consultation and include geriatric expertise on multidisciplinary trauma care teams.[10] Local knowledge of available resources and services as well as challenges are important to ensure success. A study by Kalina *et al* concluded that the care provided after the initial encounter in the trauma bay most significantly affects outcomes in the geriatric population. This study focused on patients over the age of 89 and found admission to the trauma service, rather than the level of initial trauma activation, resulted in decreased ICU and hospital LOS, although no mortality benefit was seen.[27]

The EAST practice management guidelines suggest amending the care of trauma patients ≥65 years old to include invasive hemodynamic evaluation in patients presenting in shock and in whom intravascular volume or cardiac status was uncertain (pulmonary artery catheter or arterial line) and base deficit in initial resuscitation.[13 28] These parameters can be obtained after admission, can be repeated, and can be utilized in an ongoing fashion to triage older adult patients.

IN-HOSPITAL FRAILTY AND SARCOPENIA ASSESSMENTS

Finally, two well-described in-hospital screening mechanisms to identify patients at higher risk for complications include assessments of frailty and sarcopenia.[29] A study by Kaplan *et al* compared complications, lengths of stay, disposition, and mortality in trauma patients >65 who underwent CT imaging of the abdomen. Sarcopenia was defined by the volume of the psoas muscle at the third lumbar vertebra (L3), and osteopenia as Hounsfield units less than 100 at L3. In this study, the presence of osteopenia and/or sarcopenia was significantly associated with mortality. The CT scan, a frequently utilized test for geriatric trauma patients, can be used to stratify patients into risk groups.[30]

Frailty screening is another validated tool for the in-hospital assessment of the geriatric patient. A prospective study from Joseph *et al* measured frailty for all trauma patients >65 years of age.[11] The study included 250 patients with a mean age of 78. Outcomes including complications, LOS, and discharge disposition were compared between frail and nonfrail patients. The frailty rate was 41%. Frail patients had significantly more sepsis, hematologic and pulmonary complications as well as increased LOS and more adverse discharge dispositions. On multivariate analysis, frailty, rather than age, was associated with in-hospital complications. Frailty measurement provides an additional tool during a patient's hospital stay to flag geriatric patients at risk for worse outcomes. This was further validated in a nationwide trial conducted by Joseph and sponsored by the American Association for the Surgery of Trauma.[31] In this study, the Trauma-Specific Frailty Index confirmed that frail patients had higher mortality, complications, and adverse discharge dispositions. Patients who were frail continued to demonstrate higher adjusted mortality, complications, and readmissions at 3 months following discharge. In another study, their group also demonstrated that frail patients may benefit from higher level trauma center care.[32]

Frailty screening may be utilized not only for risk stratification but also to improve geriatric patient outcomes. A 2019 study examining preintervention and postintervention data examined the effect of implementation of a frailty screening tool, which triggered a subsequent frailty treatment pathway.[33] Patients were screened using the five-item simple frailty questionairre (FRAIL) scale, which identified 90% of the patients screened as frail. Once identified as frail, the frailty pathway included early ambulation, nonpharmacologic delirium prevention, a bowel regimen, a pain program, nutrition, physical therapy, and a geriatric assessment. The postintervention group demonstrated a 9.1% absolute risk reduction in delirium and a 6.8% risk reduction in 30-day readmission. When the frailty of the trauma patients is addressed while in the hospital with screening and subsequent frailty care pathways, LOS, loss of independence, and 30-day readmission rates are decreased.[34]

The above studies demonstrate that early identification of high-risk older trauma patients may be identified using frailty screening and imaging studies. Proactive targeted interventions in high-risk patients may mitigate the adverse outcomes.

BALANCING FINANCIAL AND STAFF BURDENS OF OVERTRIAGE

Given the data described above, the argument can be made to broaden triage criteria for geriatric patients. While some institutions have altered their activation criteria to include age, others would be unable to do so, as the resultant increase in volumes would encumber their systems and strain their resources. Increased identification of older patients at risk of poor outcomes may be financially burdensome, with application of unneeded resources and dilution of services, shunting attention away from those truly in need.

To evaluate the financial burden of triage modification using hemodynamic criteria, Maughan *et al* retrospectively analyzed the cost-effectiveness of modified triage criteria on a cohort of 3621 injured patients. After creating a model which would triage patients ≥65 to a high-sensitivity arm, the percentage of patients with serious injuries who were transported to a major trauma center increased from 24% to 37%, whereas those without serious injuries transported increased from 16% to 35%. This resulted in an estimated cost increase of approximately $1.2 million dollars per quality-adjusted life years (QALY) . The authors concluded that a high sensitivity field triage criteria for identification of severely injured older adults were not cost-effective as compared with current field triage practices. They, therefore, recommended continued focus on appropriate transport of traditional triage positive older adults to trauma centers.[35]

Knight *et al* performed a study there to evaluate the financial impact of age >65 as a criterion for full TTA in West Virginia, a state in which 20% of the residents are over 65.[36] The authors noted a significant increase in the full TTA in this age group, and an overall decrease in mortality was based on age alone. However, when the intervention year was evaluated, the mortality in those patients who met traditional triage criteria matched that of the normal treatment group, thereby demonstrating that the mortality advantage of the

intervention year was a result of dilution from patients who were overtriaged.[37] The patients who received full TTA for age alone had a lower ISS, a higher GCS, a shorter hospital and ICU LOS, and a longer time in the emergency department/trauma bay. They also required fewer interventions. No appreciable benefit to full ATA could be identified while in the acute resuscitation area. Analysis of cost demonstrated that trauma activation for the 158 patients with the modified criteria cost $604 674–$812 544, without a mortality benefit.

In a secondary analysis of the Carr study, Hammer investigated the economic burden of addition of age >70 to triage criteria. In this, 1645 patients were identified as being overtriaged, at a cost of almost $9 823 940. They noted that full trauma activation at their institution costs $21,000, with $15 000 for partial team activation.[38] Finally, overtriage can lead to exhaustion and decreased alertness of the team when evaluating the patient. It may also strain hospital resources, leading to a huge cost to the system, which translates to a huge increase in cost for the patients, without a significant benefit in outcomes.

Unfortunately, few studies quantify the QALY savings, improvement in lengths of stay or complications as well as long-term or patient-centered outcome benefits when discussing cost. As such, further investigation is required to corroborate the findings of benefit in QALY and these additional outcomes in determining cost–benefit analysis.

Performance improvement and TQIP benchmarking

As the care available to geriatric patients varies widely across institutions, and without best practice recommendations, it is imperative that each institute reviews their regional data, and tailor programs and protocols to ensure that geriatric patients are receiving optimal care. Constant reevaluation of undertriage, unexpected ICU admissions or readmissions, unexpected deaths or complications, and loss of independence or function at discharge can help providers and trauma programs determine where opportunities exist for effective change. TQIP benchmark reporting includes risk-adjusted feedback on three geriatric categories: geriatric trauma, geriatric blunt multisystem, and isolated hip fracture. This report is widely utilized and can be used to drive programs.

Following the 2013 TQIP Geriatric Trauma Management Guidelines, and subsequently the 2023 update to these guidelines, attention has been drawn to improving outcomes in geriatric patients.[10] Many institutions have integrated geriatric review in their performance improvement process. Southerland *et al* evaluated quality measures prior to, and following the implementation of a geriatric consultation service, and found improved adherence to TQIP guidelines.[39] Ho *et al* demonstrated that specific initiatives, including targeted education, consultations, and nurse-led frailty screening, improved local metrics and outcomes after institutional gap analyses demonstrated areas for improvement.[40]

CONCLUSION

Often, the issues facing geriatric triage can be complex, and improving geriatric trauma triage can occur from the prehospital setting via the EMS system through the inpatient admission. Currently, there is no single optimal system dictating an optimal philosophy for implementation of triage in the geriatric population. Current practices demonstrate marked variability in triage criteria and age cutoffs without clear cost-effective benefit. The definition of undertriage also differs, and the outcomes of interest are measured by injury severity and mortality rather than other outcomes. Additional research is needed to ensure that triage modifications are clinically relevant.

Several trials have or are evaluating complexities of triage as they affect the system in which they are present. Despite the argument that complex triage mechanisms may poorly affect outcomes, a systematic review demonstrates improved mortality and lag times.[41 42] Furthermore, artificial intelligence and machine learning algorithms may further our ability to quickly and optimally triage patients, although that is outside the scope of this review. Even still, mortality may not be an accurate indicator of outcomes in this population, as goals of care discussions and patient-centered outcomes should remain at the forefront of the care of this patient population.

Geriatric triage must be confronted head-on by trauma surgeons in collaboration with regional trauma systems. In doing so, attention must be paid to identifying the most vulnerable patients, ensuring appropriate and timely interventions, and providing high-quality survival. Although the increase in the percentage of geriatric patients nationally warrants a national conversation, locoregional resources and requirements must be considered. Considering both local context and national trends, guidelines and parameters must be established to optimize care of this patient population. Mechanisms for triage in the field, in the trauma bay or ED, and during admission must be optimized to ensure care of this vulnerable population, and perhaps include modified hemodynamic parameters, age, and additional frailty assessments. The financial and human resource burden of overtriage must also be considered when developing triage guidelines. At the moment, specific triage guidelines which both optimizes care with acceptable mistriage rates are lacking. Further investigation is required, and gap analyses were performed at the local, regional, and national levels to improve outcomes.

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