

Right Patient, Right Place, Right Time: Prospective Validation of a Revised EMS Triage Protocol

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Table of Contents

Executive Summary.....	3
Information/Qualifications of Investigators.....	3
Background.....	4
Methods.....	8
Results.....	10
Discussion.....	21
Limitations.....	22
Conclusion.....	22
References.....	23

Executive Summary:

The Northern Ohio Trauma System (NOTS) was created to improve the care of trauma patients in northern Ohio. A key to the success of NOTS is the development of treatment protocols. While a major focus of trauma is directed on treatment after the patient arrives at the hospital, important decisions are made at the scene. These decisions impact both treatment and transport. Many of these decisions are made based on a scene triage protocol. A committee of emergency physicians, fire chiefs, EMS personnel, trauma surgeons and trauma managers reviewed the current protocol and made several suggestions. These suggestions were incorporated into a new revised scene triage protocol. This protocol was tested in a pilot study and revised. The new revised protocol went live in December of 2012. The goal of this study was to test the effectiveness of this protocol.

Information/Qualifications of Investigators:

The principal investigator for the project is Michael J. Nowak, Ph.D. He has an extensive background in research and informatics and will be responsible for the project implementation and analysis. Dr. Nowak has received over 25 federal contracts and is a recipient of an EMS grant. Jeffrey Claridge MD, MS is the Director of the Division of Trauma, Critical Care and Burns at MetroHealth Medical Center and is the Medical Director of the Northern Ohio Trauma System. Dr. Claridge is an accomplished researcher and has received multiple grants. Aman Banerjee, MD is a general surgery resident at Case Western Reserve University/University Hospitals Case Medical Center Program. He is conducting trauma and critical care outcomes research with Dr. Claridge at MetroHealth Medical Center. Debra Allen RN, BSN, CCRN is the Trauma Program Manager for NOTS. Deb has an extensive background in trauma working as

the Trauma Program Manager at several trauma centers in Cleveland, St. Paul, Milwaukee and Dallas.

Background:

In 2010 the Northern Ohio Trauma System (NOTS) was created to improve care of the trauma patient. NOTS is a collaboration between The MetroHealth System and the Cleveland Clinic System and comprises northern Ohio's Level I and Level II trauma centers. A major focus of NOTS was to create treatment protocols with the goal of standardizing trauma care throughout the region. The standardization of care has been shown to reduce mortality.

Patients and communities benefit from regionalized trauma systems. One of the challenges for the modern trauma system is how best to adapt to changing financial and regulatory environments while continuing to provide superior patient care. Recently there has been a reduction in the number of level II trauma centers in the area. As resources become scarcer, a trauma system's ability to establish an efficient and effective trauma triage protocol that reliably identifies the severity of a patient's injury and safely delivers that patient to the appropriate level of care becomes imperative.

Current Ohio state law requires all victims of trauma to be transported to the nearest trauma center. Current EMS triage guidelines are based on the following criteria: the age of the trauma patient, the mechanism of injury, and a series of subjective estimates, such as vehicle speed, abdominal tenderness, and degree of abdominal distention. This triage protocol results in the inefficient use of system resources to first transport a significant number of mildly or

uninjured patients to a regional trauma center who is ultimately responsible for the patient work-up and disposition.

The EMS scene treatment protocol was developed by a committee of emergency physicians, fire chiefs, EMS personnel, trauma surgeons and trauma managers. EMS providers expressed their concern that trauma patients were experiencing inappropriate triage based on outdated triage guidelines. The discussion focused on improved automotive safety and cited examples where patients walked away from high speed rollover crashes where the occupants walked away. The occupants were not injured but current protocol required transport to a trauma center. The committee worked diligently over several months examining every aspect of current triage guidelines.

Changes from the current protocol include decreasing the Glasgow Coma Scale (GCS) score from less than or equal to 13 to <12. The abdominal tenderness, distension, or a seat belt sign indications were removed. Speed of a motor vehicle crash (MVC) was no longer included. Finally, the age requiring a trauma center was increased from 55 to 70.

A checklist was created which divided patients into 3 categories, Red, Yellow, or Green. Red patients were those most likely to be severely injured and require the services of the Level 1 trauma center. This was a departure from the current protocol which does not specifically dictate which particular patient requires treatment at a Level 1 center. Yellow patients have the potential to be moderately to severely injured and would benefit from being transported to a Level 1 or 2 trauma center. Finally, Green patients meet none of the physiologic, anatomic, or mechanistic conditions on the checklist. They are considered less likely to have a serious injury and are less likely to require the expertise and resources of a trauma center. These patients,

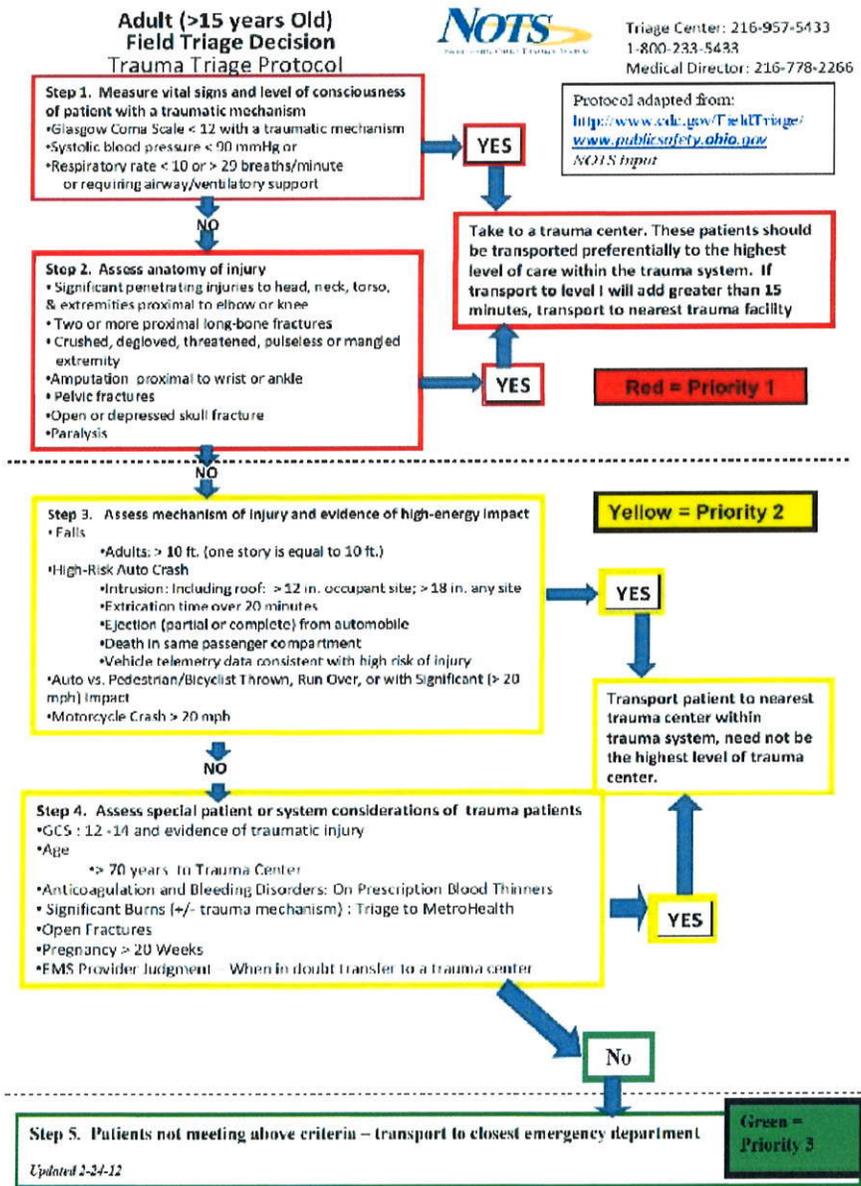
according to the revised trauma protocol would be transported to the nearest emergency department instead of a trauma center. The result is a revised protocol illustrated in Figure 1.

In March of 2011 a pilot study was conducted in conjunction with Cleveland EMS. The focus of the study was to determine the impact of the revised protocol on trauma triage. The Cleveland EMS pen based tablet system (Zoll) was adapted incorporate the new protocol and EMS and fire personnel were trained. Personnel were directed to triage the patient by following the new protocol, recording the decision in the Zoll tablet. However, this triage was only in the computer. EMS personnel were directed to follow their current protocols for transport. The pilot concluded in June 2011.

The pilot study showed that the proposed revised trauma triage protocol could effectively decrease the burden on EMS and the trauma system while keeping patients safe. Thirty-three percent of patients in this study could have been transported to the nearest ED rather than the trauma center. This had the potential to cut down on EMS run times and help to spread some of the region's trauma burden away from the designated trauma centers. Most of the runs to trauma centers require a longer transport time. Allowing the green patients to go to the closer hospital will both reduce the run time to the hospital and the down time of the EMS units.

Most importantly, this study suggested that changes could be made to the current protocol while still providing quality and safe care to patients injured in the region. There was a 2% under-triage rate which is consistent with the 5% acceptable rate described in the ACS Resources for Optimal Care of the Injured Patient 2006. After reviewing the patients who were under-triaged the following modifications to the protocol were proposed. (1)The fall height was

Figure 1



changed from “falls > 20ft” to “falls > 10ft”. The analysis showed significant injuries associated with falls greater than 10ft.

These results were analyzed by a general surgery resident and were presented at both the American College of Surgeons Ohio Committee on Trauma meeting its regional meeting in 2011. The final protocol was approved by the committee and sent to the board for approval.

Method:

The objectives of this study are to (1) determine the over-triage and under-triage rates after initiation of a revised statewide EMS triage protocol, and (2) assess EMS compliance with the revised EMS protocol. Over-triage is defined as the percentage of patients identified by the revised protocol as severely injured that did not require admission to the hospital or ICU/OR. Under-triage is defined as the percentage of patients identified as uninjured by the revised protocol that required hospital admission or admission to the ICU/OR.

The new revised protocol developed by NOTS was implemented by Cleveland EMS and Fire. The protocol was incorporated into the pen based tablet system by Zoll. Paramedics will document their triage decisions directly into the tablet. This information was sent to NOTS via a secure server at MetroHealth Medical Center through a dedicated FTP site. Patients were fitted with a trauma band which contains a unique identification number. This number was entered into the tablet. The trauma band was developed based on a project funded by an EMS Grant (Trauma Bands: The Link Between EMS and Trauma Repositories) funded in 2011. To date 96.4% of Cleveland trauma patients have been banded. Upon arrival at the trauma hospital the trauma band number was recorded into the patients medical record. Information on the visit will

documented in the hospitals Trauma Registry. The banding will provide an electronic link between the EMS data and the hospitals Trauma Registry.

EMS personnel were trained on the new protocol. Data was collected for a 4 month period after the initiation of the revised protocol. EMS data collected include the name of the responding EMS unit, accepting hospital name and triage decision. Patient demographics and outcomes information were collected by trauma registrars included as age, injury severity score, abbreviated injury score (AIS) of the head, chest, abdomen, mechanism of injury, arrival systolic blood pressure, arrival heart rate, GCS, ED disposition, total hospital length of stay (LOS), intensive care unit LOS, hospital disposition, multiple hospital transfer rate and mortality. The trauma band was used to match patients that were recorded in the trauma registry.

Patients were divided into Red, Yellow, or Green groups based on injury mechanism and physiologic derangement. Red and Yellow patients included those most likely to be severely injured requiring transport to a trauma center. Green patients consisted of those with a low likelihood of injury and were transported to the nearest emergency department (ED) for treatment.

Pre-hospital and hospital records for consecutive adult trauma patients transported by Cleveland EMS and Fire from December 2012 through March 2013 were reviewed. Protocol compliance was evaluated through an audit of EMS triage checklists for accurate completion and transport to appropriate hospital. Patients treated at non-trauma hospitals were evaluated for under-triage, defined as the need for admission, operation, ICU admission, trauma center transfer or death.

Results:

Cleveland EMS and Fire transported patients to 13 hospitals in the Cleveland area. Seven hospitals are located within Cleveland city limits and six hospitals are located outside the city. Two of the hospitals located in Cleveland are trauma centers The MetroHealth System (Level I) & Fairview Hospital Level II). A third trauma center Hillcrest Hospital (Level II) is located outside Cleveland. There are no Level III trauma centers located in the City of Cleveland. Nine of the hospitals belong to the Northern Ohio Trauma System. A majority of the patients (92.4%) were transported to NOTS hospitals.

There were 536 patients transported during the study period, of these 77 (14%) were Red, 229 (43%) were Yellow, and 230 (43%) were Green (Table 1). Patients were transported to both

Table 1: Triage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Red	77	14.4	14.4	14.4
	Yellow	229	42.7	42.7	57.1
	Green	230	42.9	42.9	100.0
	Total	536	100.0	100.0	

trauma and non trauma hospitals. Because there are three trauma centers located within the transport zones of Cleveland EMS there were a number of green patients that were transported to a trauma center due to the proximity to the trauma center. In fact, there were 122 Green patients transported to a trauma center (Table 2). Seventy Six (98.7%) of the Red patients and 224 (97.8%) of the Yellow patients were transported to trauma centers. Overall, 300 (98%) of both the Red and Yellow patients were transported to a trauma center. Of the 114 patients transported to non-trauma hospitals 1 (1%) was designated Red, 5 (4%) were Yellow and 108 (95%) were

Table 2: Triage Checklist * Was Initial Hospital a Non-Trauma Hospital Cross tabulation

		Was Initial Hospital a Non-Trauma Hospital?		Total
		Trauma Hospital	Non-Trauma Hospital	
Triage Checklist	1 (Red)	76 (14.2%)	1 (0.2%)	77 (14.4%)
	2 (Yellow)	224 (41.8%)	5 (0.9%)	229 (42.7%)
	3 (Green)	122 (22.8%)	108 (20.1%)	230 (42.9%)
	Total	422 (78.8%)	114 (21.2%)	536 (100%)

Green. The focus of the study was on the triage of Green patients so the 5 Yellow patients that were transported to non trauma hospitals were not reviewed. The one Red patient who went to a non trauma hospital was a DOA.

An audit was conducted on patient charts by a trained physician. The audit was to determine whether EMS personnel followed the protocol and did the protocol correctly triage patients. Because several of the patients were transported to hospitals that were not affiliated with NOTS there was some difficulty in obtaining charts. A decision was made to limit the review to patients that were transported to NOTS hospitals. An audit of 200 available patient charts showed an overall protocol compliance of 86.5% (Table 3). Therefore, EMS personnel

Table 3: Protocol Compliance

		Frequency	Percent
Valid	Non-Compliant	27	13.5
	Compliant	173	86.5
Total		200	100

correctly triaged 173 patients to non trauma hospitals according to the protocol.

During the triage process EMS personnel were asked to complete a checklist documenting their decision process. The checklist (Figure 2) is incorporated into the electronic pen system and follows the triage guidelines as outlined in Figure 1. EMS personnel were asked to check off the primary reason for their triage decision. The results show that EMS personnel

Table 4: Did EMS correctly complete check list?

		Frequency	Percent
Valid	Form Incorrectly Completed	21	10.6
	Form Correctly completed	177	89.4
Total		198	

correctly completed the checklist in 89% of patients. The primary reason that was checked for the Green patients was Priority 3: Step 5 “Patients not meeting the above criteria”. This choice was selected in 99% of the transports. In one only case was another box checked. The box selected was Priority 2: Step 4 “EMS Provider Judgement”.

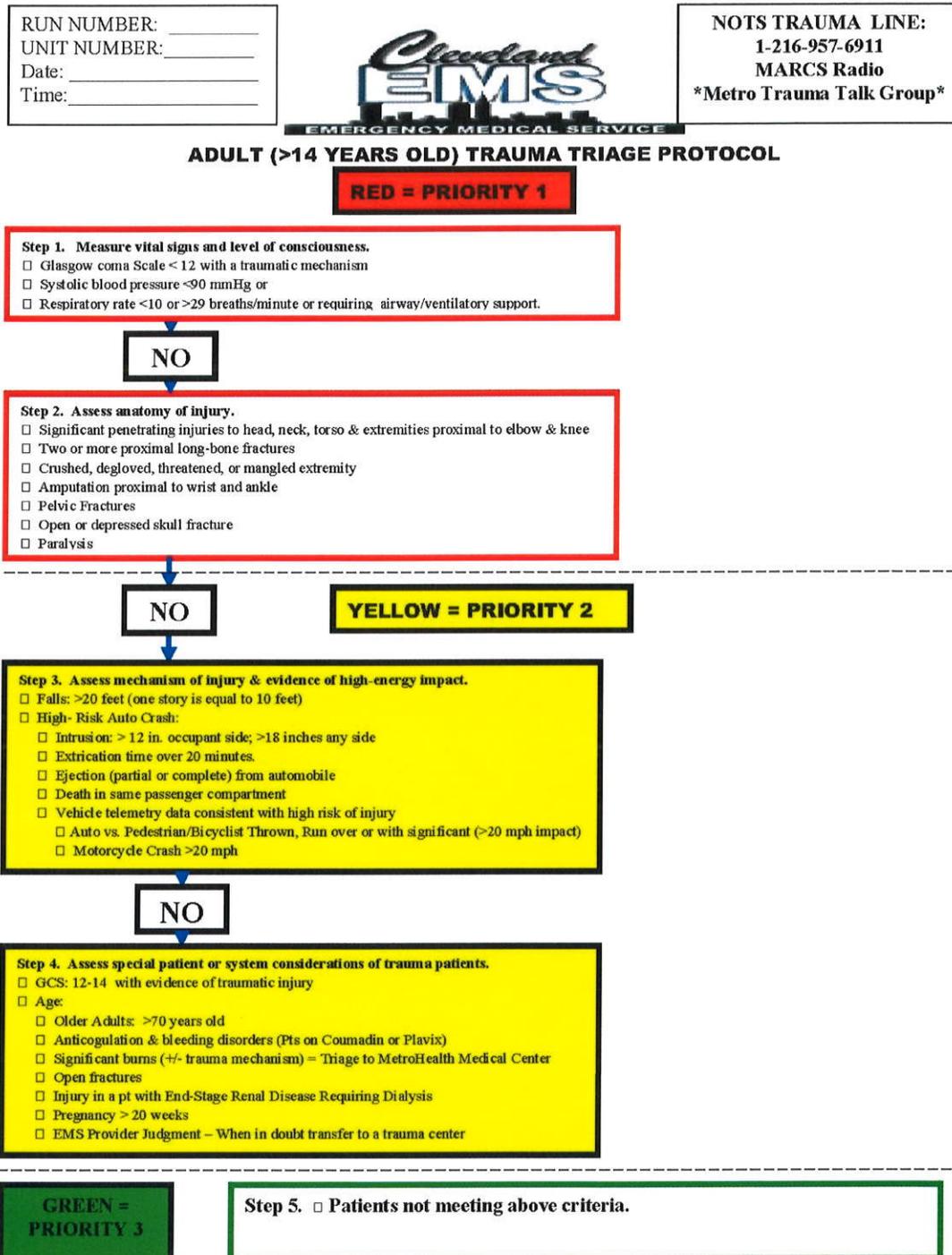
A component of the review was to determine whether the Green patients were transported to the appropriate hospital (Table 5). The results show that 93% of patients were transported to

Table 5: Did EMS Take Patient to Hospital Indicated by Protocol?

		Frequency	Percent
Valid	EMS did not Transport Patient to Appropriate Hospital	14	7.0
	EMS Transported Patient to Appropriate Hospital	186	93.0
Total		200	100.0

the correct hospital based on the triage guidelines. Fourteen patients (7.0%) were not transported

Figure 2



to the appropriate hospital.

The determination of the correct triage of the patient is core to this study. If the triage protocol was 100% effective all patients would be triaged appropriately. Table 6 breaks down the

Table 6: Triage Over/Under

		Frequency	Percent
Valid	Under Triaged	29	14.7
	Triaged Appropriately	165	83.8
	Over Triaged	3	1.5
Total		197	100

triage activity and shows whether the patient was under triaged, over triaged or triaged appropriately. The results show that 165 patients were triaged appropriately. There were three patients over-triaged. While these three patients were not triaged appropriately they were transported to a facility that met their required level of care. There were 29 (5.4%) patients who were under-triaged. Of the 29 patients 3 patients were reviewed because they were trauma patients taken to non trauma hospitals. Two of the patients were Priority 2 (Yellow) and one patient was a Priority 1 (Red). The following is a listing of these patients.

Under Triaged Priority 1 & Priority 2 Patients

- Pedestrian vs. Truck, asystole at scene was down prior to arrival 20 minutes, EMS unable to get IV access or intubate patient. Expired in ED
- Fall from standing on warfarin, head CT: L frontal cortical to subcortical petechial hemorrhage CT face: R orbital and facial bone Fx. Transfer to Metro,

- Fall from Standing, Had Left comminuted Femur Fx, Went to OR with Ortho. Was not taken to a trauma hospital by EMS

The other 26 patients were Priority 3 (Green) patients. These patients can be classified into four categories: Accidents (4), Fall's (16), Penetrating (4) and Other (2). Three of the accidents involved pedestrians and three of the accidents involved alcohol. The largest category was falls. Ten of the falls were falls from standing. Seven of the falls were flagged because the patients were over 70 years old. Priority 2 includes patients older than 70. Two patients in the penetrating category had gunshot wounds that resulted in an open fracture. These patients would be Priority 2 based on the open fracture. The other two patients in the penetrating category received stab wounds. These patients are Priority 1 based on the protocol. In the other category, one patient went to the OR for an amputated thumb tip and the other was admitted with facial fractures due to an assault. The following list provides further detail on each patient.

Under Triaged Priority 3 Patients

Accidents

- Bicycle accident, ETOH+, paranoid schizophrenia, on Aspirin/Plavix for PVD, CT head: R frontal hemorrhagic contusion.
- Pedestrian struck by car, +ETOH. Ortho c/s for R distal radial fracture.
- Pedestrian vs. Vehicle, Cat 2 activation, seen by trauma team.
- MVA, ETOH+, unrestrained, Seen by trauma. CT Head, c-spine, CAP, T/L spine: negative Admit for Observation

Falls

- Fall 4 days prior to presentation, CT head: negative. Evaluated 12/30 in ED, discharged home, re-admitted 12/31 s/p fall, CT head/c-spine: negative admitted to Medicine
- Fall after syncopal episode, CT head: Neg. CT face; left inferior orbital wall/rim fxs, maxillary sinus fx. R mandibular condyle fx.
- Fall from standing, fractured right hip, left lateral malleolus fracture, 2 rib fractures. OR with Ortho SICU after decomp on floor post-op.
- Fall from standing, CT head: negative. Labs showed AKI, admitted to medicine
- Fall from standing, R inter trochanteric femur fracture, to OR with Ortho.
- Fall from standing. L 9-12 rib fx, L5 non displaced endplate fx, and Left L2-3 transverse process fx.
- Fall off toilet. Trauma w/u negative. Admitted for dehydration, generalized weakness.
- Fall from standing with multiple medical problems. No anticoagulation. Isolated L distal femur fracture. Transferred to Metro from Fairview
- Fall from standing, head laceration. CT head, c-spine: Negative, seen by trauma. Admit for Observation
- Fall from standing, multiple. Possible hairline fracture, Right proximal fibula. Admit to medicine for further w/u of recurrent falling. Ortho c/s for Fx.
- Fall in bathroom, polysubstance, bipolar, CT head/c-spine: negative admit to Hepatology for hepatic encephalopathy
- Fall, ETOH +, substance abuse. left type V bicondylar tibial plateau fracture. Admitted to Ortho service

- Fall from standing, thrombocytopenia, pelvic fracture with blush on CT, went to IR for embolization but no source found on angiogram. Ortho c/s: non-operative management pelvic fx
- Fall from standing with right bimalleolar ankle fracture. Ortho c/s: had ORIF on PTD 2.
- Fall down 14 stairs 1 day prior to ED. left ankle fracture ; multiple left rib fractures; left pneumothorax; burst fracture of T1; compression fracture of T3
- Fall from standing. CT head: R peri-ventricular chronic microangiopathic infarcts CT c-spine: possible osteophyte fx of c4. Seen by trauma, neurosurgery, neurology, cardiology c/s

Penetrating

- GSW to left LE, extruded bone fragments on exam, open L tibia/fibula fx. ICU post-op for laryngospasm requiring re-intubation.
- GSW to right index finger. Went to OR with Ortho for I&D, discharged from PACU.
- Stab to face 10 cm, left neck supraclavicular region 8 x 8 cm, and left shoulder. Trauma and face c/s. Stab to lower back and left arm. Trauma c/s. CT A/P: negative.

Other

- Amputation of right thumb at work. Went to OR with Plastics for completion amputation of right thumb tip.
- Assault with L orbital floor fracture, eyelid abrasions, zygomatic fracture, Plastics and Optho c/s, admit to floor.

The data from the first six tables deal with protocol compliance. According to the protocol the Green patients have less severe injuries that can be treated at a non trauma center. The next set of tables looks at the condition of the patient and the severity of their injuries.

One way to determine the seriousness of the injury is whether the patient was admitted to the hospital. Patients that were sent home from the hospital are less likely to have a serious injury. Likewise, patients admitted to the hospital will have a more severe injury which will require specialized treatment or further observation. In this study there were 172 patients (86.9%) who were sent home from the Emergency Room. There were 26 green patients (13.1)

Table 7: Any Admission

		Frequency	Percent
Valid	Not admitted	172	86.9
	Admitted to hospital	26	13.1
Total		198	100

admitted to the hospital.

Besides hospital admission there are other indicators of a more serious injury. For example, an injury that requires surgical repair would be more serious. Of the 26 green patients admitted to the hospital there were 11 patients who required surgery. These patients (Table 8)

Table 8: Any OR Procedure

		Frequency	Percent
Valid	Did not have an operation	187	94.4
	Went to OR	11	5.6
Total		198	100

represent 5.6% of the total Green patients. In addition, the 11 patients represent 42% of the Green patients who were admitted to the hospital. Overall, only 11 patients or 5.6% of the Green patients required surgery. For this analysis the type of surgery was not considered so the procedure could have been minor.

Another indicator of a serious injury is when a patient is admitted to the ICU. Patients in the ICU require a higher level of care. Therefore, when the patient is admitted to the ICU we can assume a more serious injury. This is especially true with today with the shortage of critical care beds. Table 9, provides a breakdown of patients who were admitted to the ICU. There were five Green patients who required and admission to the ICU. This number represents 2.5% of the total

Table 9: Any ICU

		Frequency	Percent
Valid	No ICU Admission	193	97.5
	Admitted to ICU	5	2.5
Total		198	100

Green patients. Of the 26 green patients admitted to the hospital there were 5 (19.2%) patients who were admitted to the ICU.

Another indicator of a potential serious injury is the need to consult with a surgical sub specialty. Consultation may indicate a complex injury where further expertise is required or an isolated injury where consultation with an expert in the field is warranted. Consultation with a surgeon does not imply that an admission was necessary. In contrast the lack of consultation supports the decision to send the patient home. Table 10 provides a breakdown of consultations

Table 10: Required any Surgical Subspecialty Consult

		Frequency	Cumulative Percent
Valid	Did not require a consult	149	75.3
	Required a consult	49	24.7
Total		198	100

for Green patients. In 75.3% of the cases it was not deemed necessary to consult a surgical subspecialty.

This section deals with patient transfer to a trauma center. This type of transfer would occur when a patient was transported to a non trauma hospital with injuries that required a subsequent transfer to a trauma center. Subsequent transfer to a trauma center would be the result of under triage by EMS personnel and is not a desired outcome. Table 11 provides a breakdown

Table 11: Patient Transferred to Trauma Hospital

		Frequency	Percent
Valid	Patient Stayed at Hospital	195	98.5
	Patient Transferred to Trauma Hospital	2	4.0
	Patient Transferred to inpatient Psych Facility	1	0.5
Total		198	100

of patient transfers. Of all the patients who were triaged Green only 2 (0.5%) patients were referred to a trauma center. Another patient was transferred to an inpatient psychiatric facility. Overall, 98.5% of the patients stayed at the original hospital. This means that 98.5 % of the Green patients were able to be treated at the original destination

The final section deals with patient mortality. There were no deaths in the Green group.

Discussion

The results show that a considerable number of patients (42.9%) were triaged as Green. The Green classification allowed EMS personnel to transfer patients to a non-trauma hospital thereby reducing run times and resources at the trauma hospitals. The run times are reduced since the ambulances do not have to travel across town to a trauma center. The run to the trauma center can add an additional 20 minutes of transport time. The 20 minutes of extra run time plus an additional 20 minutes to return can take the ambulance out of service for 40 – 60 minutes. While this ambulance is out of service other ambulances may have to travel additional miles to cover calls. Any reduction in trauma runs would improve EMS response times.

The reduction in traffic to the trauma center allows resources to be directed to the more seriously injured patients. Even in the situation where patients were taken to the trauma center because it was the closest facility there are major implications for resource utilization. In many of these cases the patients were treated by Emergency Department personnel. The trauma service was not involved.

The results of this study also show a high protocol compliance rate of 86.5%. This rate is impressive considering EMS personnel had to change their mindset on trauma triage and where to transport. Under the previous protocol patients were always transported to the trauma center. There are now three choices. The new guidelines involve more decision making by EMS personnel.

The City of Cleveland uses a pen based notebook system to document patient transports. The protocol is loaded into the system and boxes are checked to document their decisions. This is an important step because the checklist should be used to guide to decision making. Therefore, a box should be checked 100% of the time. The audit determined that a box was checked for 89.4% of the patients.

The results of the audit show that 26 patients were under triaged. A majority of these cases involved falls. Several of the falls were falls from standing. There does not appear to be a pattern with the other cases except that three of the accidents involved pedestrians. Earlier discussions with EMS personnel revealed that there was some confusion on both assaults and falls. The data appears to support their contentions. The protocol will be reviewed against these cases to determine if changes to the protocol are warranted.

Limitations

Because of the difficulty in obtaining charts the audit consisted of only patients from NOTS hospitals. In addition, the audit focused on the triage of green patients. The audit did not examine Red or Yellow triage.

Conclusion

Compliance with the revised EMS trauma triage protocol is associated with an acceptable rate of under-triage and no mortality. Further EMS training and performance feedback on the revised protocol is required to improve protocol compliance.

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