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Interfacility Transfers for Isolated Craniomaxillofacial Trauma: Perspectives of the Facial Trauma Surgeon

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Abstract

Study Design: Secondary overtriage is a burden to the medical system. Unnecessary transfers overload trauma centers, occupy emergency transfer resources, and delay definitive patient care. Craniomaxillofacial (CMF) trauma, especially in isolation, is a frequent culprit.

Objective: The aim of this study is to assess the perspectives of facial trauma surgeons regarding the interfacility transfer of patients with isolated CMF trauma.

Methods: A 31-item survey was developed using Likert-type scale and open-ended response systems. Internal consistency testing among facial trauma surgeons yielded a Cronbach's α calculation of .75. The survey was distributed anonymously to the American Society of Maxillofacial Surgeons, the North American Division of AO Craniomaxillofacial, and the American Academy of Facial Plastic and Reconstructive Surgery. Statistical significance in response plurality was determined by nonoverlapping 99.9% confidence intervals ($P < .001$). Sum totals were reported as means with standard deviations and z scores with P values of less than .05 considered significant.

Results: The survey yielded 196 responses. Seventy-seven percent of respondents did not believe that most isolated CMF transfers required emergency surgery and roughly half (49%) thought that most emergency transfers were unnecessary. Fifty-four percent of respondents agreed that most patients transferred could have been referred for outpatient management and 87% thought that transfer guidelines could help decrease unnecessary transfers. Twenty-seven percent of respondents had no pre-transfer communication with the referring facility. Perspectives on the transfer of specific fracture patterns and their presentations were also collected.

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Conclusion: Most facial trauma surgeons in this study believe that emergent transfer for isolated CMF trauma is frequently unnecessary. Such injuries rarely require emergent surgery and can frequently be managed in the outpatient setting without activating emergency transfer services. The fracture-specific data collected are a representation of the national, multidisciplinary opinion of facial trauma surgeons and correlate with previously published data on which specific types of facial fractures are most often transferred unnecessarily. The results of this study can serve as the foundation for interfacility transfer guidelines, which may provide a valuable resource in triaging transfers and decreasing associated health-care costs.

Keywords
isolated, facial, fracture, unnecessary, interfacility, transfer, secondary overtriage

Introduction

A functional trauma system is defined by its timely ability to delegate resources to injured patients.[1-4] This is executed through organization of emergency medical services (EMS), referring facilities and tertiary facilities.[5,6] A critical aspect of this system is to accurately determine which patients require rapid transfer to a higher level of care and which can be managed at lower acuity centers.[1,5-7] Nevertheless, indications for transfer to a higher acuity center can be vague and are generally defined by the severity of injury exceeding the resources available at the referring facility.[8,9] Studies have demonstrated a mortality reduction when critically injured patients are treated at level I trauma centers[1,3,10-16]; however, these findings are not found among patients who are transferred to a trauma center.[17-19]

Primary triage begins in the field and is centered on expeditious patient transport by EMS to an appropriate facility.[5,7,20] Secondary triage involves interfacility patient transfer at the discretion of physicians.[20] Undertriage and overtriage result from a discordance between patient needs and the capabilities of the facility.[9,16] Most agree that overtriage rates of 25% to 50% are admissible in order to maintain an undertriage rate less than 5%.[4,9,16] These percentages are applicable to primary triage only and do not hold for secondary triage.[4,19,20] While the pros and cons of interfacility trauma transfer have been widely studied, secondary overtriage (SO) has only recently gained interest.[5,19] SO refers to patients who are unnecessarily transferred[20] and 6.9% to 38% of all interfacility trauma transfers may be unnecessary.[5,6,16,19,20] The decision to transfer a patient is complex and multifactorial, yet many studies have cited disheartening, nonmedical reasons for transfer, such as patient gender, age, race, time of day, and insurance status.[5,12,20-26] Patients with comorbid medical conditions such as psychiatric disorders, chronic drug and alcohol abuse, and cirrhosis are also at risk for unnecessary transfer.[22] SO appears to be increasing, possibly due to fear of litigation[20] or lack of adequate specialist availability.[19-21] Nevertheless, facilities initiating SO are often equipped with appropriate resources.[27,28]

Single-system head and neck injuries,[5,19] specifically isolated facial trauma,[5,26,28,29] are frequently cited as a source of SO. Unfortunately, no guidelines exist to help triage patients with isolated craniomaxillofacial (CMF) trauma.[26,28,30] Guidelines for interfacility transfers have improved outcomes for trauma patients[1,31,32] and many advocate for the development of more guidelines to decrease SO and decompress regional trauma centers.[6,33] As one of the most common injury patterns implicated in SO, it is reasonable to suggest the development of guidelines to assist in the interfacility triage of patients with isolated CMF trauma. Although the SO of facial trauma patients has become a topic of interest in the literature, the perspectives of the facial trauma surgeons have yet to be evaluated. The aim of this study is to assess the perspectives of facial trauma surgeons regarding the interfacility transfer of patients with isolated CMF trauma. In addition, this study aims to evaluate surgeon perspectives on the transfer of specific injury patterns.

Material and Methods

After approval by the Institutional Review Board (IRB #191215) at Vanderbilt University Medical Center, an electronic, 3-minute, 31-item survey was developed using Likert-type scale and open-ended response systems (Supplemental File 1). After pre-piloting and piloting phases, the survey was tested for internal consistency among facial trauma surgeons. Cronbach's α calculation yielded a value of .75.

Three national organizations were then selected for survey distribution based on their areas of clinical focus. The American Society of Maxillofacial Surgeons (ASMS) is a North American organization dedicated to maxillo- and craniofacial surgeons who specialize in reconstruction of the face. The North American division of the AO Craniomaxillofacial (AO CMF) is a subdivision of the AO organization that is devoted to reconstruction of the craniofacial skeleton. The American Academy of Facial Plastic and Reconstructive Surgery (AAFPRS) is a national organization focused on surgery of the head, neck, and face. All 3 organizations have members practicing plastic and reconstructive surgery, otolaryngology, and oral and maxillofacial surgery. The American Society of Craniofacial Surgeons (ASCFS) was also approached; however, there

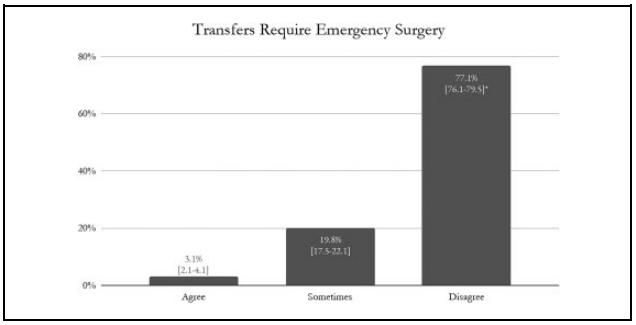


Figure 1. Graph depicting responses to the statement "transfers require emergency surgery." *Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

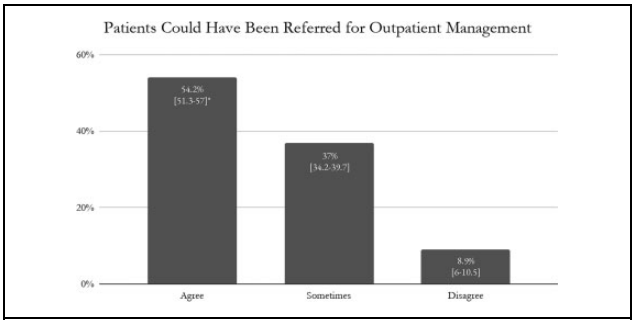


Figure 3. Graph depicting responses to the statement "patients could have been referred for outpatient management." *Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

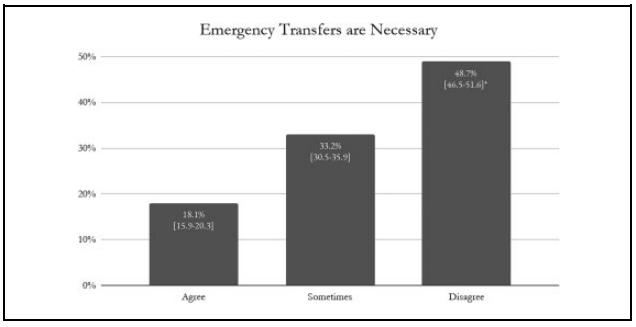


Figure 2. Graph depicting responses to the statement "emergency transfers are necessary." *Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

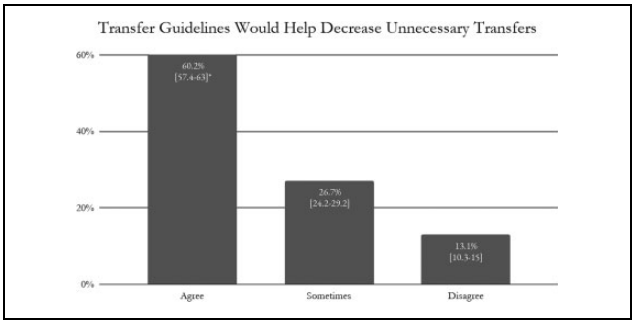


Figure 4. Graph depicting responses to the statement "transfer guidelines would help decrease unnecessary transfers." *Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

was a high degree of membership overlap with ASMS, so the ASCFS was not surveyed to avoid duplicate responses. The American Association of Oral and Maxillofacial Surgeons (AAOMS) was also approached; however, per organizational policy they were unable to distribute electronic surveys. The survey was anonymously distributed to the AO CMF twice over 3 weeks, to the ASMS 3 times over 3 weeks, and to the AAFPRS 4 times over 2 weeks. Distribution schedules were based on organizational survey policies. Results were blinded regarding respondents' training backgrounds.

Question responses were recorded in standard percentages. Five-point Likert-type responses were condensed to a 3-point scale (eg, answers of "usually" and "always" were grouped into the "agree" or "yes" categories, while answers of "rarely" and "never" were grouped into the "disagree" or "no" categories). Statistical significance in response plurality was determined by nonoverlapping 99.9% confidence intervals ($P < .001$). The sum total of responses to "which fractures should be transferred?" and "which soft tissue injuries should be transferred?" was calculated. The mean of this total was 64 with a standard deviation (SD) of 39.92. z scores were then calculated and P values less than .05 were considered significant. All statistical analysis was performed using Microsoft Excel (Richmond, WA).

Results

The survey was distributed to 2695 physicians (388 AO CMF, 1095 ASMS, and 1212 AAFPRS). In total, 196 responses were obtained (response rate 7.3%) and response rates of each organization were as follows: AO CMF 16% (62/388), ASMS 6% (65/1095), and AAFPRS 5.7% (69/1212). On average, respondents took facial trauma call 22 days per year. Seventy-seven percent (148/192) of respondents did not believe that isolated CMF transfers required emergency surgery (Figure 1) and roughly half (49%, 94/193) thought that emergency transfers were unnecessary (Figure 2). More than half (54%, 104/192) of respondents agreed that most transferred patients could have been referred for outpatient management (Figure 3) and 87% (166/191) thought that transfer guidelines could help decrease unnecessary transfers (Figure 4). When asked whether patients were transferred because they are children, responses were mixed: 29% no (55/192), 43% sometimes (83/192), and 28% yes (54/192). Responses were also mixed when asked if there was pre-transfer communication with a provider from a referring facility: 47% yes (91/192), 26% sometimes (50/192), and 27% no (55/192). When asked about whether or not transferred patients had insurance, results were as follows:

Table 1. Depicts Results to the Questions "Should They Be Transferred?" and "Which Should Be Transferred?" in Reference to the Specific Fracture Patterns Listed on the Left.[a]

Fracture	Should they be transferred?			Which should be transferred?				
Frontal sinus	Yes 18% (35/194) [15.8-20.2]	Sometimes 38% (73/194) [34.9-40.4]	No 44% (86/194) [42.1-47.2][c]	Open 126 z: 1.55; *P*: .06		Anterior table 34 z: −0.75; *P*: .22	Posterior table 145 z: 2.03; *P*: .02[b]	
Orbit/ZMC	11% (21/194) [9-12.6]	37% (72/194) [34.3-39.9]	52% (101/194) [50.3-54.9][c]	Open 69 z: 0.13; *P*: .45	Displaced 36 z: −0.70; *P*: .24	Retrobulbar hemorrhage 153 z: 2.23; *P*: .01[b]	EOM entrapment 150 z: 2.15; *P*: .01[b]	
Nasal	3% (6/193) [2.1-4.1]	10% (20/193) [8.6-12.1]	87% (167/193) [85.5-88.5][c]	Open 51 z: −0.33; *P*: .37	Displaced/ dislocated 26 z: −0.95; *P*: .17	Septal hematoma 83 z: 0.48; *P*: .31	Nasal airway obstruction 39 z: −0.63; *P*: .26	NOE 74 z: 0.25; *P*: .40
Zygomatic arch	3% (6/192) [2.1-4.1]	8% (15/192) [6.3-9.4]	89% (171/192) [88.1-90.9][c]	Open 40 z: −0.60; *P*: .27		Displaced 23 z: −1.03; *P*: .15	Restricted TMJ ROM 56 z: −0.20; *P*: .42	
Maxillary sinus	2% (3/193) [0.8-2.3]	9% (17/193) [7.2-10.4]	89% (173/193) [88.9-91.4][c]	Open 51 z: −0.33; *P*: .37			Displaced 21 z: −1.08; *P*: .14	
Hard palate	8% (16/193) [6.7-9.9]	23% (44/193) [29.4-25.2]	69% (133/193) [67.3-71.6][c]	Open 60 z: −0.10; *P*: .46		Displaced/mobile 96 z: 0.80; *P*: .21	Impaired occlusion 50 z: −0.35; *P*: .36	
LeFort	28% (53/192) [25-30.2]	35% (68/192) [32.7-38.2]	37% (71/192) [34.4-39.7]	Open 82 z: 0.45; *P*: .32	LeFort I 65 z: 0.03; *P*: .49	LeFort II 98 z: 0.85; *P*: .19	LeFort III 121 z: 1.43; *P*: .07	Mixed 112 z: 1.20; *P*: .11
Mandible	19% (36/193) [16.4-20.9]	36% (71/193) [34-39.6]	45% (86/193) [42.3-47.4][c]	Open 89 z: 0.63; *P*: .26	Displaced 73 z: 0.23; *P*: .41	TMJ Dislocation 81 z: 0.43; *P*: .33	Airway Compromise 153 z: 2.23; *P*: .01[b]	
Panfacial	62% (120/194) [63.8-69.2][c]	23% (45/194) [20.8-25.6]	15% (29/194) [12.2-17]	Open 74 z: 0.25; *P*: .40		Displaced 64 z: 0; *P*: .5	Airway Compromise 117 z: 1.33; *P*: .09	

Abbreviations: EOM, extraocular muscle; NOE, naso-orbito-ethmoid; ROM, range of motion; TMJ, temporomandibular joint; ZMC, zygomaticomaxillary complex.

[a]Responses to the latter are recorded in number of respondents with corresponding z scores for a standard deviation of 39.92. *P* values are also reported with $P < .05$ considered significant.

[b]Statistically significant results.

[c]Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

Table 2. Depicts Results to the Questions "Should Soft Tissue Injuries Be Transferred?" and "Which Soft Tissue Injuries Should Be Transferred?"[a]

Should soft tissue injuries be transferred?						
Yes		Sometimes		No		
15% (30/194) [13.4-17.5]		48% (93/194) [45.1-50.8][c]		37% (71/194) [34.5-39.4]		
Which soft tissue injuries should be transferred?						
Forehead/brow	Cheek	Eyelid/periorbit	Nose	Ear	Lip	Missing tissue
53 z: −0.28; *P*: .39	54 z: −0.25; *P*: .40	120 z: 1.40; *P*: .08	68 z: 0.1; *P*: .46	78 z: 0.35; *P*: .36	86 z: 0.55; *P*: .29	141 z: 1.93; *P*: .02[b]

[a]Responses to the latter are recorded in number of respondents with corresponding z scores for a standard deviation of 39.92. *P* values are also reported with $P < .05$ considered significant.

[b]Statistically significant results.

[c]Statistically significant ($P < .01$) plurality of responses by nonoverlapping 99.9% confidence intervals.

19% yes (36/1920, 57% sometimes (109/192), and no 24% (47/192).

Table 1 depicts the results of which fracture patterns respondents believed should be transferred. Results were mixed for frontal sinus fractures, but respondents believed that posterior table fractures should be transferred ($z = 2.03$; $P = .02$). The majority (52%) believed that orbit and zygomaticomaxillary complex (ZMC) fractures did not need to be transferred, unless there was retrobulbar hemorrhage ($z = 2.23$; $P = .01$) or extraocular muscle (EOM) entrapment ($z = 2.15$; $P = .02$). The majority of respondents agreed that most nasal bone (87%), zygomatic arch (89%), maxillary sinus (89%), and hard palate (69%) fractures did not require transfer. Results for LeFort pattern and mandible fractures were mixed, but respondents suggested that mandible fractures with airway compromise ($z = 2.23$; $P = .01$) required transfer. The majority (62%) believed that panfacial fractures should be transferred (Table 1). Table 2 depicts the results of which soft tissue injuries respondents thought should be transferred. Results were mixed; however, many agreed that injuries with missing tissue ($z = 1.93$; $P = .03$) should be transferred (Table 2).

Fifty-three (27%) respondents left free text responses. Responses suggested that patients with facial nerve injuries or uncontrollable hemorrhage should be transferred. Many stated that isolated facial fractures should never be transferred; however, some did prefer transfer for logistical reasons. Several responses suggested common nonmedical reasons for transfer, such as time of day and insurance status. Many expressed concern that transfers also resulted from a lack of experience and/or comfort dealing with facial injuries.

Discussion

Nearly 1 million annual emergency department (ED) visits involve CMF injury.[34,35] Single-system CMF injuries are frequently implicated in SO[5,19,26,28,29] and the results of our study support this claim. Forty-nine percent of respondents found emergency transfer of isolated facial injuries to be unnecessary, 77% did not believe transfers required emergency surgery, and 54% agreed that these patients could have instead been referred for outpatient management. SO is not benign, and the cost of care at major trauma centers is significantly higher.[16,36-38] Although this is cost effective for the critically injured,[1,11,12-15,39] it is not for those with less severe injuries.[16,36] Costs over $2000 are incurred for transport alone,[40] and ambulances are subsequently diverted from other life-saving transports, which can be devastating in resource-limited rural areas.[28] Aside from increasing health-care costs,[5,6,19,21] patients who are transferred unnecessarily experience a delay in definitive care, duplicated tests, imaging studies, and procedures.[41,42] An increase in morbidity may occur when duplicated tests or procedures are invasive or if diverted ED staff results in lack of care for other critically ill patients.[19,26,28,41,42] It should be the onus of the regional level 1 center to coordinate expedient, cost effective and dependable care.[19]

Passed in 1986, the Emergency Medical Treatment and Active Labor Act (EMTALA) mandates EDs to evaluate and stabilize all injured patients.[43-46] Patients are then transferred to a higher level of care if resources are not available.[4,23,30,47] Receiving centers are obligated to accept these transfers, namely those with "unstable emergency medical conditions." "Stability" and "emergency medical conditions" are not defined and left to interpretation.[5,23,48] EMTALA does not mandate 24-hour ED specialty service coverage[5,43,49] and concern exists that this may be a motive for transfer, rather than for true medical necessity.[49] Additionally, it has been shown that many minimally injured patients could have received initial care where they had presented.[5,19] Tertiary facilities are required to provide specialty coverage, thereby effectively providing primary

specialty call coverage for referring centers. This can create a dangerous situation in which tertiary facility resources are depleted by patients with minor injuries.[5,6,19,23] EMTALA does not mandate pre-transfer physician-to-physician communication,[23,48] which is reinforced by our study as 27% of respondents have no pre-transfer communication. Referring facilities have also been implicated in using EMTALA to justify nonmedical transfers[22] for provider inconvenience or unfavorable insurance payors.[23,50-54] While originally developed to limit patient dumping and improve emergency health-care delivery,[43,55,56] EMTALA has been a source of confusion and frustration and likely contributes to unnecessary use of emergency transfer services and subsequent SO.[28]

Transfer guidelines may mitigate the SO of patients with isolated CMF trauma. CMF trauma is well-suited for a guideline-based approach as most injuries require limited resources for initial stabilization and management and many can be referred for outpatient management. Initial presentation to the outpatient clinic rather than the ED is associated with a significantly lower cost of total care, specifically for facial fractures.[57] Guidelines may diminish costs associated with SO but also offer a sense of protection and afford referring institutions the ability to manage unrelated medical conditions within their capability in the event that emergent transfer is not required.[28] Respondents in our study agreed that transfer guidelines had the potential to limit unnecessary transfers for isolated CMF trauma (Figure 4). Significant amounts of information can be gleaned from computed tomography scanning, which presents an excellent opportunity for telemedicine and teleradiology, which has shown promise in many other fields.[19,28]

The responses in our study represent the multidisciplinary opinions of facial trauma surgeons. Respondents agreed that orbital, ZMC, nasal bone, zygomatic arch, maxillary sinus, and hard palate fractures infrequently require emergency transfer except for the specific mentions noted in Table 1. These responses correlate with results from a previous study demonstrating that transfers with the same fracture patterns were frequently unnecessary and are more likely to be discharged directly from the ED and less likely to require surgery at any point.[28] Responses from our survey regarding frontal sinus, LeFort, and mandible fractures were mixed, which correlates with prior data showing that transfers for these patterns were more likely to be necessary, more often admitted, and require surgery more frequently.[28] This is intuitive as these are high-energy injuries that usually require symptom management at the least. This would conceivably translate to a lower threshold for transfer. Soft tissue injuries are highly variable and opinions were mixed likely due to the wide spectrum of expertise required for treatment. Previous data show that transfers for isolated facial soft tissue injuries were more likely to be necessary because they usually require a procedure.[28] Soft tissue injury guidelines would likely be more specific and managed on a case-by-case basis.

Aside from the standard biases associated with psychometric research, there is a potential for nonresponse bias in our study. The response rate was low, and therefore the results may not be representative of the national population of facial traumatologists. Additionally, the response rate increases the risk for skewed results as responders were potentially invested in this topic. Nevertheless, most questions elicited a fair distribution of responses. The survey was only distributed among surgeons practicing in the United States and does not account for those facial trauma surgeons who do not belong to the 3 societies that were surveyed. While the fracture pattern-specific responses are promising in their correlation with previous data, we believe this alone is insufficient to develop a set of transfer guidelines. The next stage of our project is to incorporate data acquired from our first 2 studies with an expert consensus and move to the final stages of guideline development. Pre-transfer communication is another area of health care that is in need of improvement.

In conclusion, isolated CMF trauma is implicated in SO, which is a burden to the patient and the health-care system. This study presents the perceptions of facial trauma surgeons practicing in the United States regarding the management of such transfers. Many agree that these transfers are frequently unnecessary, patients rarely require emergent surgery, most can be referred for outpatient management and that transfer guidelines may help decrease these unnecessary transfers. The injury-specific opinions correlate with prior studies on CMF transfer necessity and are another critical piece in the development of transfer guidelines for isolated CMF injuries. Improving trauma care efficiency is paramount, as injuries remain common while health-care costs rise and resources remain limited.[16,58] In the era of the COVID-19 pandemic, the importance of telemedicine and the decompression of tertiary hospitals cannot be overstated.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

References

1. MacKenzie EJ, Rivara FP, Jurkovich GJ, et al. A national evaluation of the effect of trauma-center care on mortality. *N Engl J Med*. 2006;354(4):366-378.

2. Sampalis JS, Denis R, Fréchette P, Brown R, Fleiszer D, Mulder D. Direct transport to tertiary trauma centers versus transfer from lower level facilities: impact on mortality and morbidity among patients with major trauma. *J Trauma*. 1997;43(2):288-295; discussion 295-296.
3. Sampalis JS, Denis R, Lavoie A, et al. Trauma care regionalization: a process-outcome evaluation. *J Trauma*. 1999; 46(4):565-579; discussion 579–581.
4. Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients: recommendations of the National Expert Panel on Field Triage. *MMWR Recommen Rep*. 2009; 58(RR-1):1-35.
5. Cielsa DJ, Sava JA, Street JH, Jordan MH. Secondary overtriage: a consequence of an immature trauma system. *J Am Coll Surg*. 1998;206(1):131-137.
6. Tang A, Hashmi A, Pandit V, et al. A critical analysis of secondary overtriage to a level I trauma center. *J trauma Acute Care Surg*. 2014;77(6):969-973.
7. Utter GH, Maier RV, Rivara FP, et al. Inclusive trauma systems: Do they improve triage or outcomes of the severely injured? *J Trauma*. 2006;60(3):529-535; discussion 535-537.
8. Haas B, Gomez D, Zagorski B, et al. Survival of the fittest: the hidden cost of undertriage of major trauma. *J Am Coll Surg*. 2010;211(6):804-811.
9. American College of Surgeons Committee on Trauma: *Resources for Optimal Care of the Injured Patient*. American College of Surgeons Committee on Trauma; 2006.
10. Mullins RJ. A historical perspective of trauma system development in the United States. *J Trauma Acute Care Surg*. 1999;47(3Suppl):S8-S14.
11. Pracht EE, Tepas JJ , 3rd, Celso BG, Langland-Orban B, Flint L. Survival advantage associated with treatment of injury at designated trauma centers: a bivariate probit model with instrumental variables. *Med Care Res Rev*. 2007;64(1):83-97.
12. Nathens AB, Jurkovich GJ, Rivara FP, Maier RV. Effectiveness of state trauma systems in reducing injury-related mortality: a national evaluation. *J Trauma*. 2000; 48:25-30.
13. Cooper A, Barlow B, DiScala C, String D, Ray K, Mottley L. Efficacy of pediatric trauma care: results of a population-based study. *J Pediatr Surg*. 1993;28(3):299-303.
14. Hulka F, Mullins RJ, Mann NC, et al. Influence of a statewide trauma system on pediatric hospitalization and outcome. *J Trauma*. 1997;42(3):514-519.
15. Pracht EE, Tepas JJ 3rd$44#$32#Langland-Orban B, Simpson L, Pieper P, Flint LM. Do pediatric patients with trauma in Florida have reduced mortality rates when treated in designated trauma centers? *J Pediatr Surg*. 2008;43(1):212-221.
16. Newgard CD, Staudenmayer K, Hsia RY, et al. The cost of overtriage: more than one-third of low-risk injured patients were taken to major trauma centers. *Health Aff (Milwood)*. 2013;32(9):1591-1599.
17. Hill AD, Fowler RA, Nathens AB. Impact of interhospital transfer on outcomes for trauma patients: a systematic review. *J Trauma*. 2011;71(6):1885-1900; discussion 1901.
18. Rivara FP, Koepsell TD, Wang J, Nathens A, Jurkovich GA, Mackenzie EJ. Outcomes of trauma patients after transfer to a level I trauma center. *J Trauma*. 2008;64(6):1594-1599.
19. Sorensen MJ, von Recklinghausean FM, Fulton G, Burchard KW. Secondary overtriage: the burden of unnecessary interfacility transfers in a rural trauma system. *JAMA Surg*. 2013; 148(8):763-768.
20. Osen HB, Bass RR, Abdullah F, Chang DC. Rapid discharge after transfer: risk factors, incidence, and implications for trauma systems. *J Trauma*. 2010;69:602-606.
21. Esposito TJ, Crandall M, Reed RL, Gamelli RL, Luchette FA. Socioeconomic factors, medicolegal issues, and trauma patient transfer trends: Is there a connection? *J Trauma*. 2006;61(6):1380-1386; discussion 1386-1388.
22. Koval KJ, Tingey CW, Spratt KF. Are patients being transferred to level-I trauma centers for reasons other than medical necessity? *J Bone Joint Surg Am*. 2006;88(10):2124-2132.
23. Spain DA, Bellino M, Kopelman A, et al. Requests for 692 transfers to an academic level I trauma center: implications of the Emergency Medical Treatment and Active Labor Act. *J Trauma*. 2007;62(1):63-67; discussion 6768.
24. Nathens AB, Maier RV, Copass MK, Jurkovich GJ. Payer status: the unspoken triage criterion. *J Trauma* 2001;50(5): 776-783.
25. Newgard CD, McConnell KJ, Hedges JR. Variability of trauma transfer practices among non-tertiary care hospital emergency departments. *Acad Emerg Med*. 2006;13(7): 746-754.
26. Drolet BC, Tandon VJ, Ha AY, et al. Unnecessary emergency transfers for evaluation by a plastic surgeon: a burden to patients and the health care system. *Plast Reconstr Surg* 2016;137(6):1927-1933.
27. Medford-Davis LN, Holena DN, Karp D, Kallan MJ, Delgado MK. Which transfers can we avoid: multi-state analysis of factors associated with discharge home without procedure after ED to ED transfer for traumatic injury. *Am J Em Med*. 2018;36(5):797-803.
28. Pontell ME, Colazo JM, Drolet BC. Unnecessary interfacility transfers for craniomaxillofacial trauma. *Plast Reconstr Surg*. 2020;145(5):975e-983e.
29. Ahmad MN, Schaefer GP. Evaluation of which isolated facial trauma needs transfer to a tertiary care center. *J Am Coll Surgeons*. 2018;227(4):e232.
30. Lee TM. An EMTALA primer: the impact of changes in the emergency medicine landscape on EMTALA compliance and enforcement. *Ann Health Law*. 2004;13(1):145-178.
31. Nathens AB, Jurkovich GJ, Cummings P, Rivara FP, Maier RV. The effect of organized systems of trauma care on motor vehicle crash mortality. *JAMA*. 2000;283(15):1990-1994.
32. Celso B, Tepas J, Langland-Orban B, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. *J Trauma*. 2006;60(2):371-378; discussion 378.

33. Bazzoli GJ, Madura KJ, Cooper GF, et al. Progress in the development of trauma systems in the United States. *JAMA*. 1995;273(5):395-401.
34. Niska R, Bhuiya F, Xu J. National hospital ambulatory medical care survey: 2007 emergency department summary. *Natl Health Stat Report*. 2010;26(26):1-31.
35. Peterson SL, Moore EE. The integral role of the plastic surgeon at a level I trauma center. *Plast Reconstr Surg*. 2003; 112:1371-1375; discussion 1377.
36. MacKenzie EJ, Weir S, Rivara FP, et al. The value of trauma center care. *J Trauma*. 2010; 69(1):1-9.
37. Goldfarb MG, Bazzoli GJ, Coffey RM. Trauma systems and the costs of trauma care. *Health Serv Res*. 1996;31(1):71-95.
38. Durham R, Pracht E, Orban B, Lottenburg L, Tepas J, Flint L. Evaluation of a mature trauma system. *Ann Surg*. 2006; 243(6):775-783.
39. Mullins RJ, Veum-Stone J, Helfand M, et al. Outcome of hospitalized injured patients after institution of a trauma system in an urban area. *JAMA*. 1994;271(24):1919-1924.
40. United States Government Accountability Office. Report to congressional committees: costs and Medicare margins varied widely; transports of beneficiaries have increased. Published October, 2012. Accessed April 14, 2020. https://www.gao.gov/assets/650/649018.pdf
41. Fishman PE, Shofer FS, Robey JL, et al. The impact of trauma activations on the care of emergency department patients with potential acute coronary syndromes. *Ann Emerg Med*. 2006;48(4):347-353.
42. Smith DC, Chapital A, Burgess Uperesa BM, Smith ER, Ho C, Ahana A. Trauma activations and their effects on non-trauma patients. *J Emerg Med*. 2011;41(1):90-94.
43. Emergency Medical Treatment and Active Labor Act (EMTALA). Federal Registry. 2003;68:5322-5364.
44. Consolidated Omnibus Budget Reconciliation Act of 1985 (COBRA). PL 99-272, Title IX, Section 9121, 100 Stat 167 (1986).
45. Omnibus Budget Reconciliation Act of 1989 (OBRA). PL 101-239, Section 6211(h)(2), 102 Stat 2106, 42 USC 1395dd.
46. Bitterman RA. *Providing Emergency Care Under Federal Law: EMTALA*: American College of Emergency Physicians; 2001.
47. Hedges JR, Newgard CD, Mullins RJ. Emergency Medical Treatment and Active Labor Act and trauma triage. *Prehosp Emerg Care*. 2006;10(3):332-339.
48. Department of Health and Human Services, Centers for Medicare and Medicaid Services. Clarifying policies related to the responsibilities of Medicare-participating hospitals in treating individuals with emergency medical conditions. Updated March, 2012. Accessed April 14, 2020. https://www.cms.gov/Regulations-and-Guidance/Legislation/EMTALA/Downloads/CMS-1063-F.pdf
49. Southard P. 2003 "clarification" of controversial EMTALA requirement for 24/7 coverage of emergency departments by on-call specialists, significant impact on trauma centers. *J Emerg Nurs*. 2004;30(6):582-583.
50. Schiff RL, Ansell D. Federal anti-patient-dumping provisions: the first decade. *Ann Emerg Med*. 1996; 28(1):77-79.
51. Ansell DA, Schiff RL. Patient dumping: status, implications, and policy recommendations. *JAMA*. 1987;257(11): 1500-1502.
52. Rice MF. Patient dumping, emergency care, and public policy. *J Health Soc Policy*. 1995:11-33.
53. Kahntroff J, Watson R. Refusal of emergency care and patient dumping. *Virtual Mentor*. 2009;11(1):49-53.
54. Menchine MD, Baraff LJ. On-call specialists and higher level of care transfers in California emergency departments. *Acad Emerg Med*. 2008;15(4):329-336.
55. Bitterman RA. EMTALA and the ethical delivery of hospital emergency services. *Emerg Med Clin N Am*. 2006;24(3): 557-577.
56. Peth HA. The Emergency Medical Treatment and Active Labor Act (EMTALA): guidelines for compliance. *Emerg Med Clin N Am*. 2004;22(1):225-240.
57. Dillon JS, Christensen B, McDonald T, et al. The financial burden of mandibular trauma. *J Oral Maxillofac Surg*. 2012; 70(9):2124-2134.
58. Mann NC, Mackenzie E, Teitelbaum SD, Wright D, Anderson C. Trauma system structure and viability in the current healthcare environment: a state-by-state assessment. *J Trauma*. 2005;58(1):136-147.