

Factors Affecting Appropriateness of Interfacility Transfer for Hand Injuries

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Abstract

Background: Transfers of patients with higher acuity injuries to trauma centers have helped improve care since the enactment of Emergency Medical Treatment and Active Labor Act. However, an unintended consequence is the inappropriate transfer of patients who do not truly require handover of care. **Methods:** We retrospectively reviewed the records of all patients transferred to our level I trauma center for injuries distal to the ulnohumeral joint between April 1, 2013, and March 31, 2014; 213 patients were included. We examined the records for appropriateness of transfer based on whether the patient required the care of the receiving hospital's attending surgeon (appropriate transfer) or whether junior-level residents treated the patient alone (inappropriate transfer) and calculated odds ratios. We performed logistic regression to identify factors associated with appropriateness of transfer; these factors included specialist evaluation prior to transfer, age, insurance status, race, injury type, sex, shift time, distance traveled, and median income. **Results:** The risk of inappropriate transfers was 68.5% (146/213). Specialist evaluation at the referring hospital was not associated with a lower risk of inappropriate transfers (odds ratio 1.62 [95% CI: 0.48-5.34], $P = .383$). Only evening shift (15:01 to 23:00) was associated with inappropriate transfers. Amputations and open fractures were associated with appropriate transfers. **Conclusion:** Second shift and type of injury (namely, amputations and open fractures) were significant factors to appropriateness of transfer. No significant association was found between specialist evaluation and appropriate transfers. Future studies may focus on finding reasons and aligning incentives to minimize inappropriate transfers and associated systems costs.

Keywords: hand injuries, interfacility transfers, inappropriate transfers, higher level of care, EMTALA, trauma centers, costs of medicine

Background

With the passage of the Emergency Medical Treatment and Active Labor Act (EMTALA) in 1986, Medicare-participating hospitals have been required to provide emergency care to all individuals regardless of ability to pay. These hospitals are required to stabilize the patient or, if unable to provide this care, they must transfer the patient to a hospital with higher level of care. This hospital is required to accept the patient if they have capacity.⁶ As a result, since the establishment of government-funded level I trauma centers, there has been a clear benefit in terms of improved rates of morbidity and mortality.⁹ However, with the requirement that the receiving facility accept patients regardless of perception of need for transfer, there is a potential incentive for community hospitals to transfer patients for nonmedical reasons. Revisions to EMTALA in 2003 could further skew the responsibilities of the on-call physician at a referring hospital, who may not be able or willing to treat a low acuity injury at his facility due to other responsibilities.¹⁴ The unintended consequence of these laws can be the inappropriate

transfer of patients with low acuity injuries to level I trauma centers. This can cause harm systemically in terms of increased costs to society and crowding of trauma centers with limited capacity. In addition, this situation can also cause harm to a patient who may not only get a delay in delivery of care, but now must travel to and from a tertiary center that may be far away from their home.

Other studies have investigated this phenomenon on inappropriate transfers and their causes. Multiple studies have found a relatively high rate of inappropriate transfers using different criteria.^{2,4,7,14} These studies have looked at various factors associated with appropriateness including insurance status,^{1,2,6,7,10,13,17} injury severity,^{7,14,17} time of transfer,^{2,7,8,16} and race.⁷ There have been studies that have

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focused on the phenomenon where emergency physicians frequently accept transfers without discussing with the on-call orthopedist.¹⁶ There have also been associations found between transferred patients and inferior outcomes.¹⁷ Still other studies have focused on the low rate of evaluation by available orthopedic surgeons at the referring facility.^{3,8,14} However, there have not been any studies to date that have looked at whether evaluation of patients by specialists from the referring hospital would make a difference in outcomes of transferred patients.

We intend to fill this gap by investigating whether evaluation by a specialist at the community centers makes a difference in the rate of inappropriate transfers. We also aim to investigate factors that are associated with inappropriate transfers for hand injuries at a single level I trauma center. Our goal is to answer the following questions: (1) What is the risk of inappropriate interfacility transfer for higher level of care? (2) Does evaluation by a specialist at the referring hospital lessen the risk of inappropriate transfers? (3) What other factors are associated with inappropriate transfers?

Materials and Methods

After obtaining institutional review board approval, we retrospectively reviewed all patients transferred to our level I trauma center from April 1, 2013, through March 31, 2014. We included all patients who had been directly transferred from an outside hospital. We analyzed the database for reason of transfer and included all patients who were transferred for upper extremity pathology at or below the ulnohumeral joint that would normally be treated by a hand surgeon. We excluded all patients without injuries distal to the ulnohumeral joint. We surveyed all notes and demographic information from our electronic medical records. We were able to find 213 patients who were transferred for injuries below the ulnohumeral joint. Of these, 151 (70.9%) were male and 62 (29.1%) were female. There were 102 white patients (47.9%), 15 black patients (7.0%), 83 Hispanic patients (39.0%), and 13 patients of other races (6.1%). There were 95 injuries to the left upper extremity (44.6%), 115 injuries to the right upper extremity (54.0%), and 3 bilateral injuries (1.4%).

We checked the electronic record for information on who had previously examined the patient. If this information was not apparent from the transfer record, we made attempts to contact the outside hospital to determine whether a hand specialist had actually examined the patient. If it could not be determined who had originally examined the patient at the outside hospital, the patient was categorized as unknown but was kept in our database.

Our main outcome variable was appropriateness of transfer. This was determined by finding the highest level physician who treated the patient. If the patient is treated and discharged from the hospital by junior residents alone,

without specialist involvement, and the attending surgeon at morning sign-out agrees with the treatment given, then the case is deemed an inappropriate transfer, because the patient did not require higher level of care. If it is determined that the case indeed required attending hand surgeon intervention, then the patient's transfer is deemed appropriate. We calculated the odds ratio of inappropriate transfer comparing those seen by a specialist at the transferring hospital to those seen by a nonspecialist prior to transfer.

Other factors included in our analysis included sex, age, race, insurance status, time of transfer, type of injury, distance from referring hospital, and median household income of the zip code from which the patient was transferred. The variables of age, median household income, and distance traveled were studied as continuous variables. The rest of the variables were collected as categorical variables. Subcategories of race included white, black, Hispanic, Asian, and other. Subcategories of insurance status included none, private, public, Medicare, Worker's compensation, and other. Time of transfer was divided into day (07:01-15:00), evening (15:01-23:00), and night (23:01-07:00). Type of injury was subcategorized into closed fracture, infection, laceration, amputation, open fracture, and other.

Statistical Analysis

We compared the ratio of appropriately transferred patients who were originally seen by an emergency department or primary care physician at the outside hospital to the ratio of appropriate transfers who had originally been seen by an orthopedic surgeon, plastic surgeon, or other specialist. Our continuous variables were studied using a Student *t* test and mean difference was calculated. We then calculated the odds ratio of inappropriate transfer based on the physician who had examined the patient at the outside hospital. Furthermore, we performed univariate chi-square analysis on each variable and its effect on the appropriateness of a transfer using the variable with the highest number of cases as a reference.

Sample size calculation was made for our primary research question regarding specialist evaluation. Assuming an inappropriate transfer risk of 60% based on the results of other studies^{2,4,5,12,14} when evaluated by nonspecialists, assuming a 50% reduction in inappropriate transfer if seen by a specialist (30% inappropriate transfer risk), assuming that there would be 6 times as many nonspecialist evaluations as specialist evaluations at the referring hospital,^{3,6,8,14} and given an alpha value of 0.05 and beta of 0.20, we calculated that 139 patients and 23 patients would be required in the nonspecialist and specialist groups, respectively, to achieve 80% power.

For variables that had a significant relationship on the appropriateness of transfer ($P < .1$), we performed multivariate logistic regression analysis to determine which

Table 1. Univariate Analysis of Effect of Referring Hospital on Appropriateness of Transfer.

Variable	Appropriate	Inappropriate	Mean difference or odds ratio (95% CI)	P
	n (%)	n (%)		
Outside hospital referral				
Ortho/hand	6 (33)	9 (67)		Reference
ED/no specialist	47 (29)	114 (71)	1.62 (0.48-5.34)	.383
Unknown	14 (38)	23 (62)	1.10 (0.27-4.40)	.885

Note. ED = emergency department; CI = confidence interval; P = p-value.

effects truly were important in our model. Significance for the multivariate model was set at $P < .05$.

Results

The risk of inappropriate transfers was 68.5% (146/213) according to our criteria.

Nonspecialist (emergency department [ED] physician or primary care) evaluation at the initial hospital was not associated with greater proportion of inappropriate transfers (114/161 [70.8%]) when compared with those with orthopedic/hand specialist evaluation (9/15 [60%]), with an odds ratio of 1.62 [95% CI: 0.48-5.34], $P = .383$. When comparing patients seen by referring physicians of unknown specialty designation with those referred by nonspecialist, this was also not associated with greater proportion of inappropriate transfers (23/37 [62.2%]) when compared with those with orthopedic/hand specialist evaluation, with an odds ratio of 1.10 [95% CI: 0.27-4.40], $P = .885$ (Table 1).

After multivariate analysis, the only factor associated with inappropriate transfer was evening shift (beta = -1.054 [-1.945 to -0.162], $P = .021$). Factors associated with more appropriate transfer were amputation (beta = 1.904 [0.039 to 3.769], $P = .045$) and open fracture (beta = 2.312 [0.441 to 4.183], $P = .015$). Initial univariate analysis showed age, injury type, insurance, and time of transfer as potential associated factors (Table 2), but multivariate analysis retained only shift and injury type as associated factors (Table 3).

Discussion

The passing of the EMTALA act has resulted in clear benefits toward severely ill patients, but the unintended consequences of inappropriate transfers have led to some system losses. Different studies have looked at factors responsible for these inefficiencies with various results, though no studies to our knowledge have specifically addressed the effect that outside hospital evaluation has on the suitability of the transfer. Our aims were determine (1) the rate of inappropriate transfers, (2) how the physician who evaluates the patient at the outside hospital affects the appropriateness of transfer, and (3) what other factors are associated with inappropriate transfers.

Our findings should be interpreted in light of the limitations of our study. First of all, we did not always have complete information on what evaluation the patients received at the outside hospital, and we often depended on the information documented by the transfer center. We ended up with 37 patients (17.4%) for whom we were unable to determine what type of physician evaluated the patient at the referring hospital, while only 15 patients had any evaluation by a hand specialist or orthopedic surgeon. It is unclear whether we had enough patients to determine if evaluation from an outside specialist made a difference in the appropriateness of the transfer. We did come close to the number of patients needed from our power analysis, but we could not evaluate any more patients due to a change in our medical records documentation.

Furthermore, as noted previously, our method of determining appropriate transfers has not been rigorously validated. Other studies have defined appropriateness using a variety of methods, though there has been no validation of these methods to date. Patterson et al deemed cases inappropriate or not based on a 10-point visual analog scale that the researchers themselves had developed but had no independent validation.¹⁴ Friebe et al based their assessments on the judgment of a panel of experts.⁴ Other reports looked mainly at Injury Severity score.^{7,17} However, our investigation did not differ significantly from the methods of Bauer et al, who looked at the highest level of physician who treated patients transferred to their institution.² Although our study did not have a validated method of determining propriety, it is intuitive that if a junior resident is able to treat an injury without involvement of a specialized hand surgeon, that transfer is likely to be inappropriate. It is important to recognize the limitations of using a junior resident's decisions to treat injuries as the data for our study, but on review of the data, we did not find any examples of complications due to delays in treatment.

Our rate of inappropriate transfers was 68.5%, which shows that the majority of transfers were adequately stabilized and sent home by the junior resident without the intervention of an attending surgeon. Similar low rates of proper transfers were found in other studies such as Friebe et al (66% inappropriate),⁴ Bauer et al (52% never saw a hand surgeon),² Gardiner and Hartzell (53% did not require

Table 2. Univariate Analysis of Effect of Other Variables Studied on Appropriateness of Transfer.

Variable	Appropriate	Inappropriate	Mean difference or odds ratio (95% CI)	P
	Mean \pm SD or n (%)	Mean \pm SD or n (%)		
Age	34.5 \pm 22.6	26.7 \pm 23.6	7.8 (1.0 to 14.6)	.026
Sex				
Male	48 (31)	103 (69)	1.00	Reference
Female	19 (32)	43 (68)	1.06 (0.53 to 2.10)	.870
Injury type				
Open fracture	22 (61)	14 (39)	1.00	Reference
Closed fracture	13 (19)	56 (81)	6.77 (2.52 to 18.58)	< .001
Infection	9 (29)	22 (71)	3.84 (1.23 to 12.29)	.009
Laceration	4 (13)	26 (87)	10.21 (2.59 to 43.89)	< .001
Amputation	17 (50)	17 (50)	1.57 (0.55 to 4.54)	.350
Other	2 (15)	11 (85)	8.64 (1.44 to 66.78)	.005
Race				
White	35 (34)	67 (66)	1.00	Reference
Black	3 (20)	12 (80)	2.09 (0.50 to 10.04)	.269
Hispanic	24 (39)	59 (71)	1.28 (0.65 to 2.52)	.433
Other	5 (42)	8 (58)	0.84 (0.22 to 3.22)	.767
Insurance type				
Worker's compensation	10 (71)	4 (29)	1.00	Reference
Private	24 (35)	45 (65)	4.69 (1.17 to 20.15)	.011
Public	15 (17)	74 (83)	12.33 (2.99 to 55.00)	<.001
Medicare	1 (50)	1 (50)	2.50 (0.05 to 128.35)	.541
None	14(41)	20 (59)	3.57 (0.79 to 17.19)	.057
Other	3 (60)	2 (40)	1.67 (0.13 to 22.49)	.637
Time of transfer				
23:01-07:00	21 (49)	22 (51)	1.00	Reference
07:01-15:00	27 (36)	48 (64)	1.70 (0.74 to 3.90)	.172
15:01-23:00	19 (20)	76 (80)	3.82 (1.63 to 9.01)	<.001
Distance traveled	44.6 \pm 13.5	42.8 \pm 7.1	1.8 (-7.7 to 11.2)	.687
Median income (in thousands)	51.30 \pm 3.14	49.68 \pm 4.04	1.61 (-2.40 to 5.63)	.459

Note. Boldface text highlights variables that reached significance (p -value less than 0.1 for univariate analysis). SD = standard deviation; CI = confidence interval; P = p -value.

evaluation by a hand surgeon),⁵ Ozer et al (65% of patients airlifted for replantation did not get this surgery),¹² and Patterson et al (75% did not need transfer to a level I trauma center).¹⁴ This points to a likely misuse of resources, as an attending physician at the referring hospital could likely stabilize these patients.

We found that evaluation by outside physicians did not make a difference to the ultimate appropriateness of the transfer. However, given that our odds ratio did not come close to significance while coming close to our number of patients from our power analysis, we believe that our results represent a true negative where there truly was no difference between the appropriate and inappropriate groups. This was a mildly surprising fact, given that intuitively one would think evaluation by a specialist would minimize inappropriate transfers. Other studies have also touched on this topic, and hinted at a problem with specialists not seeing patients before transfer. In one facility, more than 97%

of inappropriate transfers were accepted by emergency department physicians without communicating with the on-call orthopedist.¹⁶ Patterson et al. looked at 53 patients who were transferred for higher level of care of hand injuries and found that only 13 of these patients needed the care of a level I trauma center. Out of 15 cases in which there was an on-call hand surgeon at the outside facility, only 3 cases were evaluated by that on-call orthopedist.¹⁴ Crichlow et al also found a minority of transferred patients were evaluated by the available on-call surgeon at the referring hospital.³ Although these studies do find a trend of lack of evaluation by specialists prior to transfer, we could find no evidence that the specialization of referring physician made a difference in the propriety of the transfer.

We found time of transfer and injury type to be relevant to appropriateness of transfer, though other authors have found different factors to be important. Other studies have also found time of transfer to be relevant, as many inappropriate

Table 3. Multivariate Analysis of Factors Associated With Appropriateness of Transfer.

Variable	Beta (95% CI)	P
Age	0.000 (−0.018 to 0.017)	.970
Shift		
3rd shift	Reference	0
1st shift	−0.427 (−1.339 to 0.487)	.360
2nd shift	−1.054 (−1.945 to −0.162)	.021
Insurance		
Other	Reference	0
None	−0.286 (−3.730 to 3.165)	.871
Public	−1.133 (−4.605 to 2.302)	.518
Medicare	1.219 (−2.847 to 5.325)	.561
Worker's compensation	1.110 (−2.538 to 4.755)	.550
Private	−0.068 (−3.474 to 3.343)	.969
Type of injury		
Other	Reference	0
Infection	1.162 (−0.705 to 3.031)	.223
Open fracture	2.312 (0.441 to 4.183)	.015
Closed fracture	0.841 (−1.033 to 2.713)	.379
Laceration	−0.232 (−2.343 to 1.877)	.829
Amputation	1.904 (0.039 to 3.769)	.045

Note. Boldface text highlights variables that reached significance (*p*-value less than 0.05 for multivariate analysis). CI = confidence interval; P = *p*-value.

transfers take place after hours or on weekends.^{2,7,8,16} The fact that time of transfer is relevant may also be related to the fact that there is difficulty obtaining subspecialty coverage, a problem that has worsened since the advent of EMTALA.^{11,15} In addition, the type of injury sustained by the transferred patient was found to be relevant to appropriate transfers, namely open fractures and amputation-type of injuries. In general, amputations and open fractures tend to be more serious injuries, and we would expect that these would require a higher level of care if community hospitals are unable to properly treat these injuries. Our method of determining appropriate transfers certainly could have affected these results. A junior resident is unable to effectively treat some injuries in these categories without taking it to the operating room, which requires the presence of an attending surgeon. Interestingly, insurance status was not found to be a statistically relevant factor in appropriateness of transfer, and there is some disagreement in the literature as to its importance. Although some studies have found insurance status to be a significant factor to appropriate transfers,^{1,7,17} other studies have also found no relationship.^{2,10,13} Another potential situation for which we are unable to account is the possibility that some transfers deemed inappropriate might have been sent to our institution due to a contractual obligation set forth by insurance companies. This specific information is not available through medical record review and may have affected our results. The discrepancy in findings on insurance status

suggests that this is a complex issue likely related to a multitude of factors. It is possible that with EMTALA, insurance status is taken out of the equation, and receiving hospitals are now unable to discriminate based on insurance.

In summary, we have found that evaluation by an outside specialist did not make a significant difference in the appropriateness of transfer of hand injuries to a level I trauma center. However, timing of transfer and type of injury did make a difference in the appropriateness of transfer. While it inherently makes sense that injury type should be related to the acuity of injury and need for more specialized care, the fact that different times of day are related to whether a transfer is warranted points to an externality in the system that may call for further study. We must think about system costs and how time of transfer can affect this, as nonmedical factors like timing and convenience may influence the decision to transfer. Further studies can look into incentives for evaluating and stabilizing patients with lower acuity injuries at the referring hospital despite inconvenience. Future research may also look into ways to improve support for local emergency department coverage at inconvenient hours, including possible incorporation of remote consultation between local hospitals and trauma hospitals. Goals of future studies would also include follow-up with a larger number of cases that were evaluated by attending hand surgeons at the referring hospital. As we enter an era in which the value of care is increasingly important, identifying inefficiencies in the system can make a significant difference in delivering cost-effective care.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Statement of Informed Consent

Written consent was obtained from the Loma Linda University institutional review board, which waived the requirement for informed consent from patients (IRB number 5140040).

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Montri D. Wongworawat is a board or committee member of the AAOS, Alumni Association for the School of Medicine at Loma Linda University, Association of Bone and Joint Surgeons, Health Services International, Neufeld Society Alumni Association, and the San Bernardino County Medical Society. He is also on the editorial board of *Clinical Orthopaedics and Related Research*.

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References

1. Archdeacon MT, Simon PM, Wyrick JD. The influence of insurance status on the transfer of femoral fracture patients to a level-I trauma center. *J Bone Joint Surg Am.* 2007;89(12):2625-2631.
2. Bauer AS, Blazar PE, Earp BE, et al. Characteristics of emergency department transfers for hand surgery consultation. *Hand.* 2013;8(1):12-16.
3. Crichlow RJ, Zeni A, Reveal G, et al. Appropriateness of patient transfer with associated orthopaedic injuries to a level I trauma center. *J Orthop Trauma.* 2010;24(6):331-335.
4. Friebe I, Isaacs J, Mallu S, et al. Evaluation of appropriateness of patient transfers for hand and microsurgery to a level I trauma center. *Hand.* 2013;8(4):417-421.
5. Gardiner S, Hartzell TL. Telemedicine and plastic surgery: a review of its applications, limitations and legal pitfalls. *J Plast Reconstr Aesthet Surg.* 2012;65(3):e47-e53.
6. Goldfarb CA, Borrelli J Jr, Lu M, et al. A prospective evaluation of patients with isolated orthopedic injuries transferred to a level I trauma center. *J Orthop Trauma.* 2006;20(9):613-617.
7. 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.
8. Kuo P, Hartzell TL, Eberlin KR, et al. The characteristics of referring facilities and transferred hand surgery patients: factors associated with emergency patient transfers. *J Bone Joint Surg Am.* 2014;96(6):e48-e48.
9. 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.
10. Melkun ET, Ford C, Brundage SI, et al. Demographic and financial analysis of EMTALA hand patient transfers. *Hand.* 2010;5(1):72-76.
11. 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.
12. Ozer K, Kramer W, Gillani S, et al. Replantation versus revision of amputated fingers in patients air-transported to a level I trauma center. *J Hand Surg Am.* 2010;35(6):936-940.
13. Parks J, Gentilello LM, Shafi S. Financial triage in transfer of trauma patients: a myth or a reality? *Am J Surg.* 2009;198(3):e35-e38.
14. Patterson JM, Boyer MI, Ricci WM, et al. Hand trauma: a prospective evaluation of patients transferred to a level I trauma center. *Am J Orthop.* 2010;39(4):196-200.
15. Rudkin SE, Oman J, Langdorf MI, et al. The state of ED on-call coverage in California. *Am J Emerg Med.* 2004;22(7):575-581.
16. Thakur NA, Plante MJ, Kayiaros S, et al. Inappropriate transfer of patients with orthopaedic injuries to a level I trauma center: a prospective study. *J Orthop Trauma.* 2010;24(6):336-339.
17. Vallier HA, Parker NA, Beddow ME. Reasons for transfer to a level I trauma center and barriers to timely definitive fracture fixation. *J Orthop Trauma.* 2014;28(12):e284-e289.