



# Interfacility Transfer Utilization in the Management Pediatric Hand Injuries

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## Introduction

Emergent interfacility transfer is a means of ensuring that patients with complex injuries obtain tertiary evaluation in timely and seamless fashion; however, there are significant costs associated with its use. In addition, many patients undergoing transfer do not ultimately require the tertiary services suspected at initial triage.<sup>1,2</sup> More accurate characterization of the factors driving the decision to transfer patients to a higher level of care may improve resource allocation and reduce healthcare expenditures.

Accidental injuries are the most common reason for presentation of pediatric patients to the ED,<sup>3</sup> with hand injuries representing nearly two percent of all visits to one pediatric tertiary referral center.<sup>4</sup> Severe injuries, such as traumatic amputations, may result in substantial and permanent functional and emotional impairment.<sup>5-7</sup> Optimal outcomes require a multidisciplinary team of emergency physicians, hand surgeons, and anesthesiologists with expertise in the care of the pediatric trauma patient. As a result, many patients with such injuries that are initially triaged at regional hospitals subsequently undergo interfacility transfer for definitive evaluation and treatment. By analyzing our series of patients undergoing interfacility transfer for hand injuries, we sought to identify factors that may be associated with disproportionate rates of transfer utilization to better facilitate educational outreach and resource allocation.

## Materials and Methods

Children's Hospital of Philadelphia is a pediatric level one trauma center and academic tertiary referral center receiving a large volume of interfacility transfers. Institutional review board approval was obtained prior to commencement of this study. Electronic medical records were reviewed from the two-year period from July 1<sup>st</sup>, 2009 to June 30<sup>th</sup>, 2011 to identify all patients that were transferred to our institution, as well as the subset of these patients that were transferred for evaluation or treatment of a traumatic injury to the hand or wrist. Data regarding age, gender, diagnosis, site of injury, acuity, arrival time, admission status, and procedures performed during the hospitalization were collected. In addition, a list of facilities referring at least one hand injury was generated, and these facilities

were organized into four categories based on the following capabilities: 1) hand surgery and pediatric admission/anesthesia, 2) hand surgery but no pediatric admission/anesthesia, 3) pediatric admission/anesthesia but no hand surgery, and 4) neither hand surgery nor pediatric admission/anesthesia.

The list of referring facilities was used to identify all transfers originating from these facilities for comparison of the hand injury transfer rate to the category-specific transfer rates using the chi-square test. The cohort of patients undergoing transfer for hand trauma was subsequently stratified by site of injury, time of transfer, admission status, and need for surgical intervention. The distributions of patients in each of these subcategories were compared to the expected distributions from the overall cohort using the chi-square test. P values less than 0.05 were considered significant.

## Results

A total of 13,193 patients were transferred to Children's Hospital of Philadelphia during the two-year study period. Of these, 169 patients were transferred for evaluation or management of an injury to the hand or wrist. Demographic data and injury characteristics for this cohort are reported in Table 1. No significant deviations from expected values occurred based on day of week or time of transfer. Hospital admission was required in 59 (35%) patients, of which 51 (86%) underwent a surgical procedure within 24 hours of presentation. Of the remaining 110 (65%) patients who were discharged from the emergency room, 27 (25%) underwent elective surgical intervention within two weeks of discharge.

Hand injury transfers originated from a total of 48 surrounding hospitals; patients from these institutions were responsible for 81.2% of the total transfer volume during the study period (Table 2). Hand injuries were responsible for 1.6% of patients transferred from these hospitals. Hand surgical coverage and pediatric admission/anesthesia capability was available at 16 hospitals, hand surgical coverage only at 12, pediatric admission/anesthesia capability only at 5, and neither hand surgical coverage nor pediatric admission/anesthesia capability at 15. Hospitals in these four categories were responsible for 41%, 18%, 11%, and 30% of all

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**Table 1. Demographics and diagnoses of study population**

	no.	(%)*
No. patients transferred with hand injuries	169	(100)
Age (years)**	8.4 ± 5.1	
Gender		
Male	116	(69)
Female	53	(31)
Diagnosis		
Fracture	73	(43)
Amputation	44	(26)
Laceration	22	(13)
Infection	18	(11)
Dislocation	5	(3)
GSW	3	(2)
Blast	1	(1)
Burn	1	(1)
Congenital	1	(1)
Vascular	1	(1)
Contusion	0	(0)
Injury site		
Finger	71	(42)
Wrist	68	(40)
Hand	26	(15)
Arm	4	(2)

GSW, gunshot wound

\*Percent of total transfers due to hand injuries (n=169).

\*\*Values=Mean±SD.

transfers, and 36%, 7%, 22%, and 36% of hand injury transfers, respectively. A highly-significant difference ( $p > 0.001$ ) in the proportions of transfers originating from hospitals in these four categories was present if an equal 25% per category expected rate of hand injury transfers was assumed; however, this was reduced to a trend toward significance ( $p = 0.07$ ) if the expected hand injury transfer rate by category was assumed to be proportional to the volume of overall transfers received in each category (Table 2). The trend toward higher-than-expected rates of transfers was seen from hospitals with no pediatric admission/anesthesia capability, whether or not hand surgical coverage was present.

## Discussion

Although hand injuries represent a relatively small proportion (1.6%) of the total volume of patients transferred during the study period, only 35% required admission after

evaluation. Of those admitted, 86% underwent a procedure within 24 hours (30% of total). The majority (65%) of patients transferred were able to be discharged from the ED with outpatient followup and elective surgical intervention, if required. In a series of 24,905 transfers, Li *et al* found that 24.7% of patients transferred to academic pediatric EDs were discharged directly from the ED.<sup>8</sup> The authors noted a higher rate of discharge from the ED (48.5%) among patients with orthopaedic diagnoses, with only 25.4% requiring admission longer than 24 hours. While the authors do not report separately on hand or wrist injuries, our findings support the conclusion that orthopaedic complaints represent a disproportionate number of transfers that do not ultimately require acute hospitalization or intervention.

We hypothesized that the presence of hand surgical coverage and/or pediatric admission/anesthesia capability at the referring institution may influence the decision to pursue transfer, as demonstrated by disproportionate distribution of transfers from institutions lacking these capabilities. The overall volume of transfers received from each institution by category was used to determine the expected proportions of hand injury transfers in each category. A trend toward a greater number of hand injury transfers was observed originating from institutions without pediatric admission/anesthesia capability (97 patients) versus the volume-weighted expected value (81 patients). This finding suggests that concerns regarding pediatric sedation or anesthesia may play a role in the decision to initiate transfer in patients with hand injuries. Cimpello *et al* reviewed the analgesia and sedation practice patterns of pediatric and general emergency physicians and found a similar hesitation on the part of both groups to administer analgesic medications during encounters for extremity injuries in children.<sup>9</sup> The authors noted that pediatric ED physicians were more likely to utilize sedatives and analgesics in combination for procedural sedation than were general ED physicians, though large proportions of patients in this and other series receive no analgesia whatsoever for even reductions of severely-displaced fractures.<sup>10</sup> Given the well-characterized safety profile of pediatric procedural sedation and analgesia,<sup>11</sup> even in a community ED setting,<sup>12</sup> these findings may be a result of the variable exposure to and comfort with use of these medications on the part of ED physicians.<sup>13</sup> Transfers of pediatric patients for the purposes of procedural sedation or anesthesia alone may represent an under-recognized contribution to the overall cost burden of the practice of defensive medicine.

While the limited number of hand injury transfers seen during the study period precludes the formulation of firm treatment recommendations, several areas can be identified for further study that may result in improved resource utilization. First, the value of educational outreach by physicians at tertiary referral centers cannot be overstated. While only diagnostic and decision-making services are practical with current teleconferencing technology, future advances may make additional remote services feasible and cost-effective. Perhaps the most important and practical initiative on the part of tertiary centers treating a large volume of upper extremity

**Table 2. Transfer rates by institution characteristics**

Total transfers (7/1/2009-6/30/2011)	13193									
Total no. institutions referring hand injuries	48									
Total transfers from institutions referring hand injuries	10707									
No. patients transferred with hand injuries	169									
Overall hand injury transfer rate	0.016									
			Hand/No		Peds/No				P	
			Peds		Hand		Neither		value	
No. institutions referring hand injuries by category	16		12		5		15			
Total transfers from institutions referring hand injuries by category	4355	(41)	1880	(18)	1210	(11)	3262	(30)		
Actual hand injury transfers by category	60	(36)	37	(22)	12	(7)	60	(36)		
Expected hand injury transfers by category (25% proportions)	42.25	(25)	42.25	(25)	42.25	(25)	42.25	(25)	0.001	
Expected hand injury transfers by category (volume-weighted)	69	(41)	30	(18)	19	(11)	51	(30)	0.073	

P values calculated by the chi-square test.

injuries is to ensure the availability of short-term outpatient appointments for patients that may require subacute surgical intervention. A closed-feedback system that notifies referring providers when patients have been seen and evaluated in a timely fashion helps build trust among community ED physicians, and may reduce interfacility transfers in cases where there are concerns regarding access to care.

There are a number of important limitations to the conclusions that may be drawn from this study. First, the study was conducted at a single center in a densely-populated area with a large number of referring hospitals of varying size and capabilities. Our findings have the potential to be affected greatly both by increased travel time and lesser subspecialization seen in less densely-populated regions, which limit their generalizability. Second, the availability of detailed data on hand injury transfers alone, as opposed to the entire cohort, limits the forms of statistical analysis that could be performed, and the power of these comparisons. Lastly, limited data were available regarding referring institutions with multiple locations or decentralized specialty centers. Our best attempts were made to approximate the overall capabilities of each discrete referring hospital based on geographic proximity and knowledge of regional institutional affiliations.

## Conclusion

The appropriate use of emergent interfacility transfers may represent an opportunity for improved healthcare resource utilization. Children sustaining injuries to the hand or wrist make up a disproportionate number of patients undergoing transfer but not ultimately requiring admission or urgent surgical intervention. While the availability of hand surgical or pediatric admission/anesthesia capabilities at the referring institution may play a role in the decision to initiate transfer, these and other patient factors were not strongly associated with increased numbers of hand transfers from hospitals in each of these subcategories. Improvements in inter-institutional provider communication and the consistent

availability of short-term outpatient followup may help reduce rates of transfers for subacute conditions. Further study is necessary to better characterize the decision-making behind initiation of emergent transfer for pediatric hand injuries and to identify factors that may improve quality, access, and cost-effectiveness.

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