A High Proportion of Orthopaedic Hand Trauma Transfers are Unnecessary: A Systematic Review

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Objectives: The purpose of this study is to assess the prevalence of inappropriate hand trauma transfers and related medical and economic impact based on currently published literature.

Design: Systematic literature review.

Main Outcome Measurements: Appropriateness of transfer, patient or other factors associated with transfer, cost of transfer.

Results: The search produced 273 articles regarding "inappropriate hand transfers," of which six were used for the review, and an additional five were included that were found outside of the software search. A significant finding was that uninsured or underinsured patients were associated with inappropriate transfers. Other associations involving transfers were the time of day of transfer and the type and complexity of the injury.

Conclusions: A significant number of hand trauma transfers are inappropriate, with time and health insurance coverage as contributing factors. This has a significant clinical and financial impact on affected patients and healthcare institutions.

Level of Evidence: Level IV; Systematic Review of level IV or higher evidence

Key Words: Business, management, human resources, cost, value, efficiency

INTRODUCTION

Transferring an unstable patient to a care center with a higher acuity is a common practice in our healthcare system. The decision to initiate a patient transfer rests with the clinical judgment of the initial healthcare provider. In the United States, Level 1 centers have the broadest capabilities and are often tertiary referral centers.[1] A higher-level hospital must accept a patient in transfer if it can care for the patient after stabilization at preliminary facilities.[2]

One common area of injury leading to a transfer to a higher acuity level of care is hand pathology. Certain hand pathologies may require emergent intervention, such as digit replantation procedures, high-pressure injection injuries, compartment syndrome, and flexor tenosynovitis. Many Southwest EDs do not have hand coverage (71% of 345 regional Hospitals and EDs), and staff do not have training on acute hand pathologies (7% of ED providers).[3] Poor access to specialized hand trauma care in the community without defined guidelines for non-specialized providers managing these patients leads to the transfer of patients to a higher acuity setting and higher cost of care.[4] A survey of Level I and II hospitals demonstrated widely inconsistent availability of hand and microvascular surgeons (55% and 29%). American College of Surgeons states hand surgery capabilities must be available for level I trauma centers but does not specify the need for microvascular replantation to have level I status.[5]

The financial impact of medical care and medical procedures on our treatment facilities, providers, and patients is becoming of greater interest to the academic community.[6,7] Reimbursements or other economic incentives may influence patients' care.[8,9,10,11] Making decisions to treat patients that prioritize efficiency may result in satisfactory medical care and prudent financial decisions.[12,13,14,15] Despite these financial realities, scholarship regarding financial practices in orthopaedics is not widespread. Further studies regarding medical financial practices are challenging to generalize due to discrepancies in costs, charges, and collections of care.[16,17,18] A major goal is to

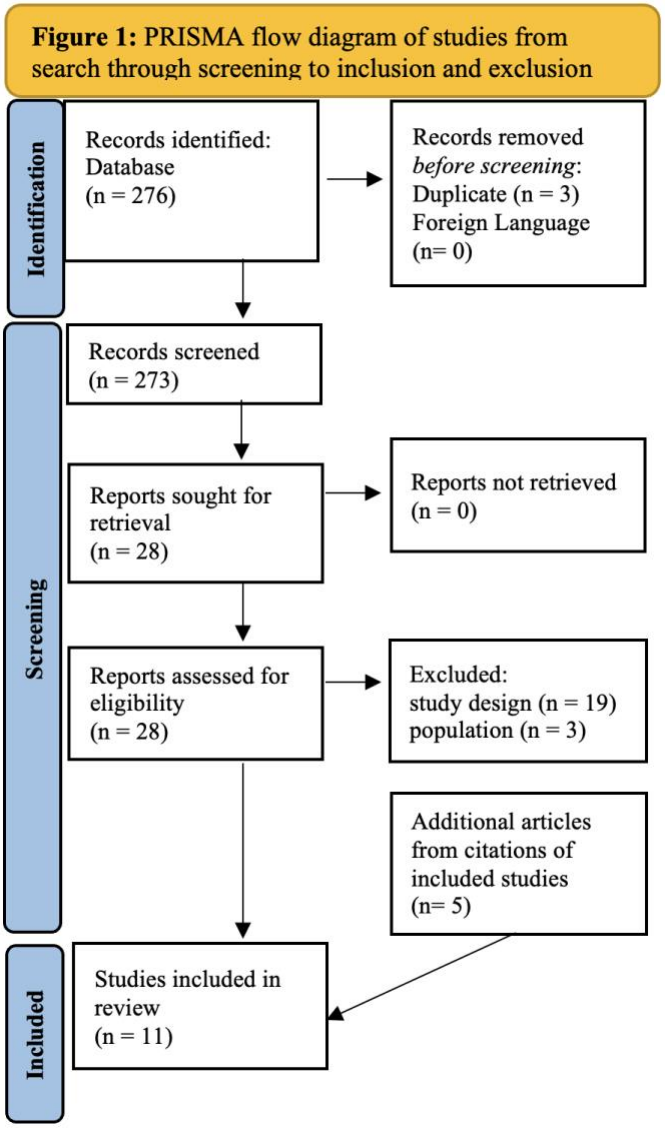

Figure 1: PRISMA flow diagram of studies from search through screening to inclusion and exclusion

identify ways orthopedic surgeons can provide cost-effective care to empower providers to advocate for positive change in healthcare.[19] Reviewing existing literature on this topic can give insight into the consensus and possible application of cost-effectiveness of care in trauma transfers related to hand pathology.[20]

This systematic review is intended to present existing literature on patients with hand pathology transferred to a higher acuity care center. The primary outcome is the appropriateness of transfer. Secondary outcomes include factors associated with transfers and significant determinants of inappropriate transfers. Tertiary outcomes include costs related to such transfers. Based on experience, we hypothesize there will be a varied but high percentage of inappropriate hand transfers, and the associated costs will also be variable based on each study.[21] A review such as this is helpful because studies will commonly use information from their own institution, which may need to be more broadly applicable.

Additionally, few studies of rigorous methodology have identified relevant and generalizable costs of hand trauma transfers. A large review will be able to incorporate numerous studies that may demonstrate varied estimates regarding data on hand trauma transfers. This approach is best suited to incorporating these varied estimates and finding a value closest to the true costs.[22,23]

METHODS

This systematic review was performed following PRISMA guidelines for methodology and reporting. Eligibility criteria included study design, type of participants, and types of comparisons. Study designs included cohort studies or case series. Participants were limited to adult patients who were transferred to hospitals with hand trauma in the United States. Studies were included if comparisons were made to analyze hand transfers and appropriateness. Studies were excluded if they did not make comparisons on hand transfers.

The search was performed in Google Scholar via Harzing PoP software version 8[24] for the following keywords: "inappropriate" AND "hand" AND "transfer." Results from 2005 through 2022 were obtained. Additional articles were found through a literature review of the articles found in the search.

All results were cataloged and independently reviewed by two authors. In the first phase, study titles were screened for eligibility. The remaining abstracts were screened, and for those that met the inclusion criteria, full articles were reviewed.

Data collected from articles included study aim, study type, population, number of participants, comparators, and author's findings. The methods of the

Table 1: Included 11 studies. Insurance status was a common factor in the transfer of hand trauma. Other factors played a role such and time of day and day of the week

Author (year)	Study Type	n	Population	Author's Findings
Patterson (2010)[38]	Prospective Single-Center Cohort Study	53	Transfers to level I trauma center for hand surgery eval	24% required the resources of a level I trauma center. Most transferred without prior evaluation by hand surgeon, despite there being an on-staff hand surgeon.
Putnam (2020)[39]	Retrospective Single-Center Cohort Study	256	Transfers to level I trauma center for hand surgery eval	Over 30% of transfers may have been unnecessarily transferred. 21% of transfers had inaccurate pre-transfer diagnoses, flexor tenosynovitis and vascular injury had an increased likelihood of inaccuracy
Petkovic (2018)[40]	Retrospective Single-Center Cohort Study	213	Transfers to level I trauma center for hand surgery eval	The risk of inappropriate transfers was 68.5%. Evening shift (second shift) was associated with inappropriate transfers.
Friebe (2013)[41]	Retrospective Single-Center Cohort Study	95	Transfers to level I trauma center for hand surgery eval	66 % of the transfers were considered inappropriate by the surveyed physicians. Inappropriate transfers were statistically more likely to be under insured or transferred during non-business hours.
Daly (2018)[42]	Retrospective Single-Center Cohort Study	9,036	Upper extremity trauma at Level I hand trauma center for the state of Maryland	After Medicaid expansion insured status in transferred patients increased from 59.9% to 71%. After expansion, the likelihood of transfers being appropriate remained the same.
Cho (2018)[43]	Retrospective Multi-Center Cohort Study	11,560	Isolated upper extremity trauma from Maryland Trauma Registry	Uninsured patients had an increased odds of being transferred by 35%. The proportion of inappropriate transfers increased over time. Initial evaluation at referring hospitals increased the appropriateness of transfers.
Mahmoudi (2016)[44]	Retrospective Multi-Center Cohort Study	6,214	Isolated upper extremity trauma at Level III-I trauma centers from NTDB	Patients with Medicaid were more likely to be transferred from level III trauma centers to another center compared with privately insured patients.
Butala (2014)[45]	Retrospective Single-Center Cohort Study	1,147	Hand trauma transfers at a single University Medical Center	Uninsured patients were more frequently transferred at night compared to privately insured patients with similarly complex injuries. Privately insured patients were less likely to be transferred at night.
Drolet (2016)[46]	Retrospective Single-Center Cohort Study	1,181	Transfers for plastic surgery eval at a Level I trauma center	74.1% of the patients transferred were done unnecessarily. Patients with less favorable insurance were significantly more likely to be unnecessarily transferred than those with more favorable insurance. The expense for these unnecessary transfers exceeded $4.6 million.
Eberlin (2013)[47]	Retrospective Two-Center Cohort Study	1,172	Hand injuries at two level 1 trauma referral centers	Patients transferred to tertiary care centers for emergency upper extremity evaluation have a higher rate of undesirable or no insurance and are more likely to be male or unemployed.
Daly (2019)[48]	Retrospective Single-Center Cohort Study	12,009	Maryland State Upper Extremity Trauma Database	After Medicaid expansion, the percentage of trauma patients with Medicaid coverage increased from 15% to 24%, and uninsured from 31% to 24%. Non-transfer patient appropriateness decreased, and appropriateness of transfers remained consistent across all payers.

remaining articles were scrutinized to determine what was included and excluded in how the transfers were compared. We extracted the relevant results that evaluated variables involved in transferring hand trauma patients.

RESULTS

The search yielded 273 articles, with three eliminated due to being duplicates. Of the 270 screened, 28 were sought for retrieval, with 22 being found irrelevant to our review based on wrong study design (n = 19) or wrong population (n = 3). Of the remaining full-text articles, six were included. An additional five articles were found to be relevant during the review process of the full-text articles (Figure 1).[1-11]

The studies included 53 to 12,009 patients (Table 1). The studies used various comparators to find associations with transfer appropriateness. A significant finding was that uninsured or underinsured patients were associated with inappropriate transfers. Minor findings showed that evening or late shifts, type of injury, and complexity were also associated with inappropriate transfers.

DISCUSSION

We hypothesized that hand trauma transfers from different facilities would have a varying reported number of hand transfers, their costs, and the appropriateness of transfer. Results varied by study, but a significant proportion of hand transfer patients were determined inappropriate based on the judgment of the hand specialist at the referral facility. However, only one study offered any estimation of the costs of these transfers. The appropriateness of hand transfers varied as determined by accepting facilities. Other secondary and tertiary outcomes not included in our hypothesis were the elevated rates of hand transfers in uninsured patients compared to patients with health insurance, and the time of day (evening and overnight) was associated with inappropriate transfers.

This study's results agreed mainly with other literature addressing hand injuries in emergency departments and subsequent transfers. It has been previously reported that 33% of hand transfers may have a transfer diagnosis found to be inaccurate upon evaluation at the receiving facility.[24] This may contribute to a high number of inappropriate transfers. Other studies have found high rates of inappropriate transfers to level 1 trauma centers, with many being discharged without requiring a hand specialist evaluation or procedure.[25] While many hand specialists believe the frequency of hand transfers needs to be lowered, many emergency medicine physicians believe the frequency is appropriate.[26]

While providing a safety net to surrounding under-resourced providers, transferring patients is not benign to patients, their providers, and the healthcare system. Transferring a patient incurs the cost of transport along with any additional care. The cost of transportation can be significant, mainly if the patient receives air transportation, which may or may not be necessary.[27] Hand transfer patients may travel via air to be assessed for a possible time-sensitive digit replantation procedure despite most of these patients not actually undergoing replantation.[28] Medical debt is increasingly becoming a significant proportion of contemporary bankruptcy.[29] Providers should be able to justify the medical need for transfer and the method of transfer to minimize medical and financial morbidity. A recent survey found that less than half of hand specialists who routinely took hand call were satisfied with their experience, often citing pay, burnout, and OR availability as contributors.[30]

Transferring a patient increases the cost of care. As a higher proportion of hand transfers are uninsured, the costs of their care can lead to millions of uncollected charges by healthcare charges.[14] Existing data shows financial viability for hand specialist salaries and hospital revenue related to hand transfers only in a population with a low incidence of uninsured patients.[31] These costs can be reduced by limiting inappropriate transfers.

Transferring patients with orthopedic injuries to level 1 trauma centers has been reported previously, with many studies documenting that a significantly higher number of transferred patients lack health insurance.[32,33] Evenings and weekends have also been associated with higher rates of orthopedic transfers.[34,35] Our review of hand injuries agrees with these previous findings.

This study has weaknesses inherent to a systematic review. The data is limited by the methods of each individual study included, and there are no standardized methods for estimating the 'appropriateness' of a trauma transfer. Additionally, this review sought to clarify the financial impact of trauma transfers, especially those deemed inappropriate, and data regarding this was lacking.

This study helped to identify levels of inappropriate hand trauma transfers as well as factors that contribute to them. The outcomes of this study may

help institutions recognize the risk of inappropriately transferring patients with hand pathology to minimize waste while appropriately treating this cohort of patients. Previous studies have mentioned options for improving appropriate care. One might include earlier intervention of a consulting physician to prevent inappropriate transfer, which has been successful in some settings.[36] Defined metrics for hand transfers have also been proposed to improve the proportion of appropriate transfers.[37]

This study describes the conditions and inappropriateness of hand trauma transfers. Further studies are warranted regarding the medical and financial impact of acute orthopaedic surgical care.

CONCLUSION

This study found that many hand trauma transfers are inappropriate, associated with uninsured patients, and related to evening or weekend time periods. This has a significant clinical and financial impact on the healthcare community.

REFERENCES

1. Mulholland MW, Lillemoe KD, Doherty GM, Maier RV, Simeone DM, Upchurch GR. Greenfield's surgery: Scientific principles & practice. Lippincott Williams & Wilkins; 2012 Sep 11.

2. Goldfarb CA, Borrelli Jr J, Lu M, Ricci WM. A prospective evaluation of patients with isolated orthopedic injuries transferred to a level I trauma center. Journal of orthopaedic trauma. 2006 Oct 1;20(9):613-7. https://doi.org/10.1097/01.bot.0000249415.47871.e5

3. Brown TS, Hinojosa LS, Cline KE, Black SR, Jamieson MD, Starr AJ. Lack of acute hand care in the southwest United States. Journal of orthopaedic trauma. 2016 Apr 1;30(4):e129-31. https://doi.org/10.1097/BOT.0000000000000487

4. Maroukis BL, Chung KC, MacEachern M, Mahmoudi E. Hand trauma care in the United States: a literature review. Plastic and reconstructive surgery. 2016 Jan;137(1):100e. https://doi.org/10.1097/PRS.0000000000001879

5. Peterson BC, Mangiapani D, Kellogg R, Leversedge FJ. Hand and microvascular replantation call availability study: a national real-time survey of level-I and level-II trauma centers. JBJS. 2012 Dec 19;94(24):e185. https://doi.org/10.2106/JBJS.K.01167

6. Thomas, N., Sandler, A., Fernandez, I., Simson, J., Tihista, M., Wells, M., & Childs, B. (2022). Orthopaedic Business is the Focus of 3.4% of Articles in Top General Orthopaedic Journals. Journal of Orthopaedic Business, 2(1), 10–18. https://doi.org/10.55576/job.v2i1.11

7. Hamid KS, Nwachukwu BU, Bozic KJ. Decisions and incisions: a value-driven practice framework for academic surgeons. JBJS. 2017 May 17;99(10):e50.

8. Green, C., Polmear, M., Dunn, J., Parnes, N., & Scanaliato, J. (2021). Care of low-income patients with sports injuries disincentivized by government reimbursement. Journal of Orthopaedic Business, 1(1), 4–7. https://doi.org/10.55576/job.v1i1.3

9. Eckhoff, M., & Tadlock, J. (2022). Medicaid Reimbursement of Pediatric Surgeries. Journal of Orthopaedic Business, 2(1), 1–3. https://doi.org/10.55576/job.v2i1.10

10. Dunn, J., Scanaliato, J., Green, C., Rhee, P. C., & Nesti, L. (2022). Reimbursement for Complex Carpal Trauma. Journal of Orthopaedic Business, 2(1), 19–23. https://doi.org/10.55576/job.v2i1.12

11. Hayward, D., Hawkes, C., Perry, C., de Riese, W., & Zumwalt, M. (2022). Potential Patient Bias by Insurance Coverage on CG-CAHPS Surveys: Impact on Physician Reimbursement. Journal of Orthopaedic Business, 2(3), 1–4. https://doi.org/10.55576/job.v2i3.18

12. Cognetti, D., Handcox , J. ., Anderson, K., Aden, J., & Hurley, R. The Economic Process Behind Surgical Innovation: Changes in Coding and Compensation Correlate with Increased Minimally Invasive Sacroiliac Joint Fusion in the National Surgical Quality Improvement Program (NSQIP) Database. Journal of Orthopaedic Business, 2(4), 5–9. https://doi.org/10.55576/job.v2i4.24

13. Wells, M., Klahs, K., Polmear, M., Nesti, L., & Dunn, J. (2021). Free-vascularized bone grafts for scaphoid non-unions viable as outpatient procedure? No 30-day complications in NSQIP data . Journal of Orthopaedic Business, 1(2), 5–8. https://doi.org/10.55576/job.v1i2.6

14. Perry, C., Rossettie, S., Hayward, D., Folsom, A., Jacobson, A., Adler, A., & Polmear, M. (2022). Medical Management of Common Comorbidities in Elderly Patients with Proximal Femur Fractures: Review and Evidence Based Note Template. Journal of Orthopaedic Business, 2(2), 19–36. https://doi.org/10.55576/job.v2i2.17

15. Gavalas, A., Perry, C. ., Tihista, M., Adler, A., Purcell, R., & Polmear, M. Geriatric Distal Femur Fracture Management Protocols: A Review and Evidence-based Template. Journal of Orthopaedic Business, 2(4), 14–23. https://doi.org/10.55576/job.v2i4.25

16. Johnson, C., Folsom, A., Powlan, F., Renfro, K., Tompkins, R., Sandler, A., Parnes, N., Fitzpatrick, K., Scanaliato, J., & Childs, B. (2022). Business Articles in Shoulder and Elbow Surgery Support Outpatient Total Shoulder Arthroplasty and Identify Factors Impacting Surgery Cost: Review of Shoulder and Elbow Related Business Publications. Journal of Orthopaedic Business, 2(3), 18–31. https://doi.org/10.55576/job.v2i3.20

17. Simson, J. E., Vazquez, E., Dunn, J. C., & Nelson, J. H. (2022). Level II trauma centers have highest charges for hip fractures. Journal of Orthopaedic Business, 2(1), 4–6. https://doi.org/10.55576/job.v2i1.5

18. Flinn, D., Gurnea, T., & Althausen, P. (2021). The Financial Impact of the Surgical Treatment of Infection on the Practice of Orthopedic Trauma. Journal of Orthopaedic Business, 1(1), 1–3. https://doi.org/10.55576/job.v1i1.4

19. Childs, B., Breslin, M., Swetz, A., Nguyen, M., Simske, N., Whiting, P., Vasireddy, V., Wilson, E., & Vallier, H. (2022). Use, Refine, Repeat: Implementation of a mobile application for patient education. Journal of Orthopaedic Business, 2(3), 12–17. https://doi.org/10.55576/job.v2i3.14

20. Rajan PV, Qudsi RA, Wolf LL, Losina E. Cost-effectiveness analyses in orthopaedic surgery: Raising the bar. The Journal of bone and joint surgery. American volume. 2017 Jul 5;99(13):e71.

21. Nicholson, T., Polmear, M., VanTienderen , R., Adler, A., & Blair, J. (2022). Cost of orthopaedic injuries sustained during unsanctioned crossings of the U.S.-Mexico border treated at a single level 1 trauma center. Journal of Orthopaedic Business, 2(3), 5–11. https://doi.org/10.55576/job.v2i3.19

22. Galton F. Vox populi (the wisdom of crowds). Nature. 1907 Mar;75(7):450-1.

23. Smith, T., Evans, J., Moriel, K., Tihista, M., Bacak, C., Dunn, J., Rajani , R., & Childs, B. The Cost of OR Time is $46.04 per Minute . Journal of Orthopaedic Business, 2(4), 10–13. https://doi.org/10.55576/job.v2i4.23

24. Ortiz R, Wilkens S, Gottlieb R, Sood RF, Cetrulo CL, Chen NC, Eberlin KR. Patient transfer for hand and upper extremity injuries: Diagnostic accuracy at the time of referral. Plastic and Reconstructive Surgery. 2020 Apr 30;146(2):332-8. https://doi.org/10.1097/PRS.0000000000006981

25. Hartzell TL, Kuo P, Eberlin KR, Winograd JM, Day CS. The overutilization of resources in patients with acute upper extremity trauma and infection. The Journal of Hand Surgery. 2013 Apr 1;38(4):766-73. https://doi.org/10.1016/j.jhsa.2012.12.016

26. Drolet BC, Lifchez SD, Jacoby SM, Varone A, Regan LA, Baren JM, Akelman E, Osterman AL, Levin LS. Perceptions of emergency medicine residency and hand surgery fellowship program directors in the appropriate disposition of upper extremity emergencies. The Journal of Hand Surgery. 2015 Dec 1;40(12):2435-9. https://doi.org/10.1016/j.jhsa.2015.09.014

27. Madiraju SK, Catino J, Kokaram C, Genuit T, Bukur M. In by helicopter out by cab: the financial cost of aeromedical overtriage of trauma patients. Journal of surgical research. 2017 Oct 1;218:261-70. https://doi.org/10.1016/j.jss.2017.05.102

28. Ozer K, Kramer W, Gillani S, Williams A, Smith W. Replantation versus revision of amputated fingers in patients air-transported to a level 1 trauma center. The Journal of hand surgery. 2010 Jun 1;35(6):936-40. https://doi.org/10.1016/j.jhsa.2010.02.031

29. Himmelstein DU, Thorne D, Warren E, Woolhandler S. Medical bankruptcy in the United States, 2007: results of a national study. The American journal of medicine. 2009 Aug 1;122(8):741-6. https://doi.org/10.1016/j.amjmed.2009.04.012

30. Douleh DG, Ipaktchi K, Lauder A. Hand Call Practices and Satisfaction: Survey Results From Hand Surgeons in the United States. The Journal of Hand Surgery. 2022 Nov 1;47(11):1120-e1. https://doi.org/10.1016/j.jhsa.2021.08.021

31. Alderman AK, Storey AF, Chung KC. Financial impact of emergency hand trauma on the health care system. Journal of the American College of Surgeons. 2008 Feb 1;206(2):233-8. https://doi.org/10.1016/j.jamcollsurg.2007.07.043

32. Archdeacon MT, Simon PM, Wyrick JD. The influence of insurance status on the transfer of femoral fracture patients to a level-I trauma center. JBJS. 2007 Dec 1;89(12):2625-31. https://doi.org/10.2106/JBJS.F.01499

33. Thakur NA, Plante MJ, Kayiaros S, Reinert SE, Ehrlich MG. Inappropriate transfer of patients with orthopaedic injuries to a Level I trauma center: a prospective study. Journal of orthopaedic trauma. 2010 Jun 1;24(6):336-9. https://doi.org/10.1097/BOT.0b013e3181b18b89

34. Koval KJ, Tingey CW, Spratt KF. Are patients being transferred to level-I trauma centers for reasons other than medical necessity?. JBJS. 2006 Oct 1;88(10):2124-32. https://doi.org/10.2106/JBJS.F.00245

35. Kuo P, Hartzell TL, Eberlin KR, Miao D, Zurakowski D, Winograd JM, Day CS. The characteristics of referring facilities and transferred hand surgery patients: factors associated with emergency patient transfers. JBJS. 2014 Mar 19;96(6):e48. https://doi.org/10.2106/JBJS.L.01213

36. Tripod M, Tait M, Bracey J, Sexton K, Beck W, Wyrick TO. The use of telemedicine decreases unnecessary hand trauma transfers. Hand. 2020 May;15(3):422-7. https://doi.org/10.1177/1558944718810877

37. Shipp MM, Cho BH, Sanghavi KK, Daly CA, Giladi AM. The curtis hand injury matrix score: determining the need for specialized upper extremity care. The Journal of Hand Surgery. 2022 Jan 1;47(1):43-53. https://doi.org/10.1016/j.jhsa.2021.07.034

38. Patterson JM, Boyer MI, Ricci WM, Goldfarb CA. Hand trauma: a prospective evaluation of patients transferred to a level I trauma center. Am J Orthop. 2010 Apr 1;39(4):196-200.

39. Putnam J, Pedreira R, Fox P. Hand Surgery Transfers to Level 1 Center: Variables Affecting Transfer Method and Diagnostic Accuracy. Plastic and Reconstructive Surgery Global Open. 2020 Dec;8(12). https://doi.org/10.1097/GOX.0000000000003279

40. Petkovic D, Wongworawat MD, Anderson SR. Factors affecting appropriateness of interfacility transfer for hand injuries. Hand. 2018 Jan;13(1):108-13. https://doi.org/10.1177/1558944716675147

41. Friebe I, Isaacs J, Mallu S, Kurdin A, Mounasamy V, Dhindsa H. Evaluation of appropriateness of patient transfers for hand and

microsurgery to a level I trauma center. Hand. 2013 Dec;8(4):417-21. https://doi.org/10.1007/s11552-013-9538-1

42. Daly CA, Cho BH, Desale S, Mete M, Aliu O, Giladi AM. Effects of Medicaid Expansion on Hand Trauma and Quaternary Care: Level 4 Evidence. Journal of Hand Surgery. 2018 Sep 1;43(9):S2.

43. Cho BH, Daly CA, Desale S, Aliu O, Giladi A. Change in Payer Mix and Transfer Appropriateness at a Quaternary Hand Trauma Referral Center after Medicaid Expansion under the Affordable Care Act. Plastic and Reconstructive Surgery Global Open. 2018 Apr;6(4 Suppl). https://doi.org/10.1097/01.GOX.0000533866.10282.e0

44. Mahmoudi E, Squitieri L, Maroukis BL, Chung KC, Waljee JF. Care transfers for patients with upper extremity trauma: influence of health insurance type. The Journal of Hand Surgery. 2016 Apr 1;41(4):516-25. https://doi.org/10.1016/j.jhsa.2016.01.010

45. Butala P, Fisher MD, Blueschke G, Ruch DS, Richard MJ, Hollenbeck ST, Levinson H, Leversedge FJ, Erdmann D. Factors associated with transfer of hand injuries to a level 1 trauma center: a descriptive analysis of 1147 cases. Plastic and reconstructive surgery. 2014 Apr 1;133(4):842-8. https://doi.org/10.1097/PRS.0000000000000017

46. Drolet BC, Tandon VJ, Ha AY, Guo Y, Phillips BZ, Akelman E, Schmidt ST. Unnecessary emergency transfers for evaluation by a plastic surgeon: a burden to patients and the health care system. Plastic and Reconstructive Surgery. 2016 Jun 1;137(6):1927-33. https://doi.org/10.1097/PRS.0000000000002147

47. Eberlin KR, Hartzell TL, Kuo P, Winograd J, Day C. Patients transferred for emergency upper extremity evaluation: does insurance status matter?. Plastic and reconstructive surgery. 2013 Mar 1;131(3):593-600. https://doi.org/10.1097/PRS.0b013e31827c6e82

48. Daly CA, Cho BH, Desale S, Aliu O, Mete M, Giladi AM. The effects of Medicaid expansion on triage and regional transfer after upper-extremity trauma. The Journal of Hand Surgery. 2019 Sep 1;44(9):720-7. https://doi.org/10.1016/j.jhsa.2019.05.020