A Geriatric Hip Fracture Care Pathway: An Operational Approach to Quality Improvement

Derek Donegan, MD, MBA[1]
Kelsey Bonilla, MD[1]
Rachel Kleinman, BS, MHSA[1]
Samir Mehta, MD[1]

[1]Department of Orthopaedic Surgery, University of Pennsylvania

Introduction

Hand and upper extremity fractures are exceedingly common injuries in the United States population, and have been estimated to comprise 1.5% of all emergency department visits nationwide.1-3 The most common of these fractures involves the distal forearm (particularly the distal radius), though certain age groups are more likely to be afflicted with certain hand and upper extremity fractures than others.[1,4-6]

These injuries can markedly reduce quality of life. Among the elderly, wrist fractures have been associated with subsequent dependence on caregivers for activities of daily living in addition to the inherent risk for persistent pain and dysfunction.[7-8] Hand and upper extremity fractures also play a major role in disability for younger patients, as they commonly require dedicated time off work with prolonged, aggressive rehabilitation to maximize return to function.[9-10]

A principal goal in healthcare is primary prevention of conditions that result in patient morbidity. Specific to orthopaedic trauma, one critical step in prevention is the identification of associated mechanisms of injury.[11] Falls to the ground on outstretched hands have repeatedly been determined to be the leading cause of hand and upper extremity fractures.[1,6,12-13] Alcohol use and abuse is relatively common[14] and has previously been associated with fractures of the hand and upper extremity via an increased propensity for falls and risky behavior, which could lead to unintentional injury.[15-17] Not only does alcohol use contribute to postural imbalance,[15-16,18] but it also is associated with increased violence and accidents due to impaired judgment. Alcohol consumption has also been identified as a risk factor for both obesity and decreased bone mineral density; this may exacerbate injury risk due to heavier individuals sustaining more forceful impacts on fragile bones.[19-21] To the best of our knowledge, the effects of alcohol consumption on the incidence of traumatic hand and upper extremity fractures has not been reported or investigated.

The purpose of this study is to report national estimates and demographic characteristics of patients presenting to U.S. emergency departments between 2000 and 2017 with traumatic hand and upper extremity fractures associated with alcohol consumption. Our secondary aim is to project alcohol-associated fracture estimates between 2017 and 2030 as well as the annual percentage of the overall number of hand and upper extremity fractures presenting to U.S. emergency departments that are associated with alcohol consumption.

Methods

Data Sources

The Consumer Product Safety Commission's (CPSC) publicly available and deidentified National Electronic Injury Surveillance System (NEISS) was used for this cross-sectional, retrospective epidemiological study. The database is a national representative probability sample of roughly 100 hospital emergency departments that serves the purpose of observing and reliably characterizing the epidemiology of injuries in the United States. It is stratified by both hospital size and geographic location, which allows for statistically validated, weighted national estimates and sampling errors of queried injuries to be derived. The database contains a unique case record for each patient and includes date of treatment, age, sex, race, diagnosis, body part affected, patient disposition, location of injury, as well as narrative fields to provide additional comments. This data is entered into the database by providers and data coordinators and updates (i.e. recognizing and filling in any missing data) are performed daily. The NEISS has previously been utilized in hand surgery studies evaluating the epidemiology of finger amputations[22] and scaphoid fractures.[23] Specific data collection methodologies, quality control precautions, and other general information are available on the CPSC webpage.[24-26]

First, each yearly sample in the NEISS database was queried between 2000 and 2017 using the diagnosis of "fracture" and the affected body parts "finger", "hand", "wrist", and "lower arm" (excluding all injuries at and above the elbow), which were herein considered as "the hand and upper extremity". All hand and upper extremity fracture cases were subsequently identified for each year during this time period.

The narrative sections within these identified case records were then individually analyzed and queried using several keywords to help identify any relevant history of alcohol intoxication or consumption prior to admission and related to the injury event. Examples of these keywords included "alcohol", "drank", "ingested", "consumed", as well as various forms of alcoholic beverages such as "beer", "wine", "vodka", etc. Case records were also included if patients were explicitly noted to be intoxicated with alcohol and had a blood alcohol concentration above 0.08 g/dL. Following the analysis of the narrative section, unique cases of traumatic hand and upper extremity fractures associated with alcohol consumption were subsequently identified for each year during this time period.

As previously described, 27 weighted national estimates were calculated (for total and one-year interval numbers of both total and alcohol associated upper extremity fractures) using a svyset function in a statistical software which uses the NEISS data columns "PSU", "Weight", and "Stratum" as inputs for its sampling unit, sample weight, and strata fields, respectively. The software function then generates weighted national estimates for the given inputs with associated 95% confidence intervals. The incidence of alcohol associated upper extremity fractures out of total upper extremity fractures was then calculated for the total seventeen year time frame as well as one-year intervals. 95% confidence intervals for incidence were calculated using the upper and lower borders from the aforementioned weighted national estimates 95% confidence intervals.

The NEISS database allows for unique case record group analysis and will automatically calculate incidence with respect to various demographic characteristics. Specifically, anatomical location of fracture, age, sex, race, disposition, and location (of injury) were evaluated within our previously identified unique group of hand and upper extremity fractures associated with alcohol. The same svyset function was, again, used to apply standard errors and confidence intervals to the demographic incidence data.

A standard linear regression function (which generates a linear line of best fit for the inputted data and its associated equation) was then used to evaluate trends in the annual national estimate of both total and alcohol-associated hand and upper extremity fractures presenting to U.S. emergency departments over time. Projections were made by applying this regression model forward to the year 2030, by inputting future years into the function to output the predicted national number of injuries if the same linear line were extended forward in time. Significance of trends were determined using adjusted Wald tests. Two-sided p-values < 0.05 were considered significant.

Results

The NEISS database revealed a total of 394,055 cases of patients presenting to an Emergency Department in the United States with traumatic hand and upper extremity fractures between the years 2000 and 2017, which correlated to a total national estimate of 13,544,461 cases. Of these 394,055 cases, 1,541 unique cases of patients whose fracture(s) were associated with alcohol consumption were identified, which correlated to a total national estimate of 62,373 cases. These data by corresponding year, including incidence and their associated 95% CIs are provided in Table 1.

Overall demographics of the patients whose fracture(s) were associated with alcohol consumption can be observed in Table 2. The majority of fractures were located in the hand (37.8%), occurred in young adults between the ages of 20-29 (33.9%), occurred in males (70.9%), occurred in whites (54.7%), were sustained in the home (39.7%), and were also more likely to be treated and admitted to the hospital as opposed to being discharged (60.5%).

The number of total national estimated cases of any cause decreased linearly within this seventeen-year time with a statistically significant p-value of < 0.05 (0.001) and of R2 of -0.79 (Figure 1). Specifically, the number of cases decreased 13% from 788,210 cases in the year 2000 to 686,419 cases in the year 2017 (Table 1).

The number of national estimated cases that were associated with alcohol significantly increased linearly within this seventeen-year time frame with a statistically significant p-value of < 0.05 (0.001) and R2 of -0.86 (Figure 2). Specifically, the number of cases more than doubled from 2,368 cases in the year 2000 or 0.30% to 5,182 cases in the year 2017 or 0.75% (Table 1).

Projected weighted national estimates of traumatic hand and upper extremity fractures associated with alcohol consumption are provided in Figure 3. The existing, current linear trend that has been observed between 2000 and 2017 is projected to continue, with a number of total national estimate cases of 6,802 or 1.04%, by the year 2030.

Discussion

We conclude that the use of an operational management approach to address the inefficiencies in a clinical care pathway

Measure	National Avg {IGFS Member Facilities*)	Pre Pathwav Implementation (Jul 2015–Jun 2016)	Post Pathway Implementation (Jul 2016–Dec 2016)	Long Term Results (Jul 2018–Feb 2020)
Time to Surgery	36 hours	32.4 hours	17.5 hours	17.5 hours
Length of Stay	6.4 days	7.1 days	5.6 days	5.3 days
30 Day Readmission	14.5%	14.29%	8.33%	3.8%
Mortality in Hosoital	3.1%	2.79%	0%	1.3%

Figure 1. International Geriatric Fracture Society[4] averages compared to institutional averages before, immediately after, and several years after pathway implementation.

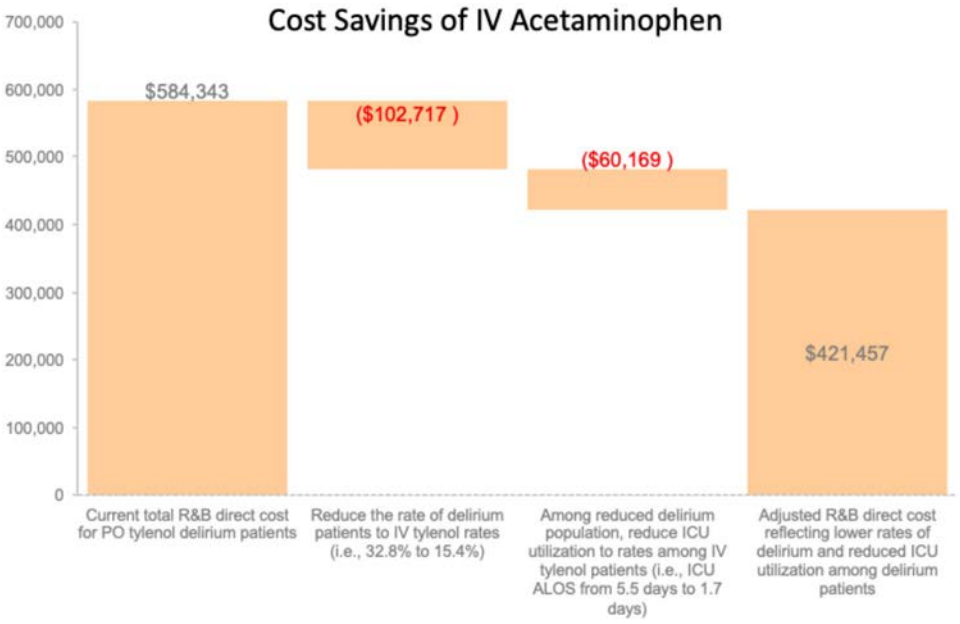

Figure 2. Cost savings of IV acetaminophen compared to oral acetaminophen.

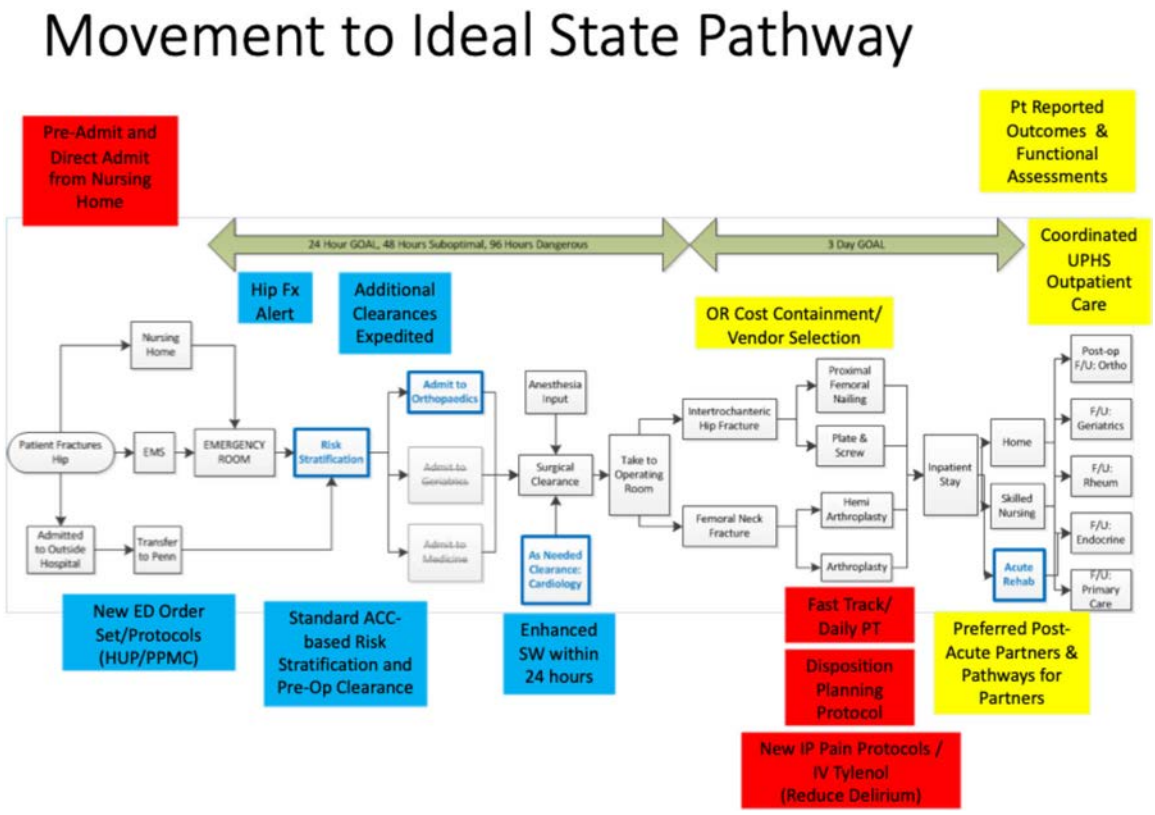

Figure 3. Process map depicting movement to an ideal state pathway with newly implemented changes in red and future directions in yellow.

resulted in a substantial and sustainable improvements in clinically relevant outcome measures in patients sustaining geriatric hip fractures. By systematically identifying the bottlenecks in the system, we have generated an ideal state pathway, which has allowed us to deliver higher quality care to our patients while simultaneously eliminating waste decreasing cost of care. Furthermore, there is a societal need to develop effective strategies of reliably improving patient care while containing costs which makes the operations approach demonstrated here particularly relevant.

References

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