References

[1] Hatzaras IS, Bible JE, Koullias GJ, Tranquilli M, Singh M, Elefteriades JA. Role of exertion or emotion as inciting events for acute aortic dissection. Am J Cardiol 2007; 100:1470–2.
[2] Inamasu J, Miyatake S, Yagi T, Noma S. Acute coronary syndromes occurring while driving: frequency and patient characteristics. Environ Health Prev Med 2017;22 (1):82.
[3] Inamasu J, Miyatake S, Yagi T, Noma S. Resuscitation outcomes of cardiac arrest patients who caused witnessed non-fatal road traffic accidents while driving. Resuscitation 2017;119:e15–6.
[4] Kojima S, Sumiyoshi M, Nakata Y, Daida H. Triggers and circadian distribution of the onset of acute aortic dissection. Circ J 2002;66:232–5.
[5] Yoshizaki T, Kimura N, Hirano T, Yamaguchi A, Adachi H. Acute aortic dissection occurring "behind the wheel", report of 11 cases. Ann Vasc Dis 2016;9:205–8.

Use of sedatives and restraints for treatment of agitation in the emergency department

Agitation is a growing and pervasive problem in emergency departments (EDs) across the United States, with an estimated 1.7 million events occurring annually in emergency settings [1,2]. Treatment routinely involves the use of coercive measures consisting of physical restraints and sedatives, but they can lead to significant harm for patients. Cited adverse events have included lasting psychological distress, respiratory depression, physical trauma, and asphyxiation leading to cardiac arrest [3-5]. Efforts to reduce threats to patient safety have recently led to calls for utilization of evidence-based algorithms to help clinicians determine when coercive measures are most appropriate [6].

Despite these recommendations, there remains a lack of standardization for initiation of coercive measures in the ED [7,8]. In part, this variation in practice has been attributed to limited existing knowledge regarding agitation characteristics specific to the emergency setting [9]. Unlike the inpatient or psychiatric units, the ED faces higher acuity of agitation with more varied and complex patient presentations that may lead to aggression and violence [10,11]. Currently, characterization of ED agitation events are mostly derived from health worker surveys in the context of addressing workplace violence [12,13]. In contrast, we sought to examine the use of sedatives and restraints when treating agitation in the ED through prospective observations of patient encounters. This will aid in identifying potential mechanisms requiring additional research and evaluation to better aid clinical decisions for using coercive measures in ED agitation management.

We conducted a prospective cohort study of adult patients aged 18 years or older with acute or escalating agitation during their ED visit. The clinical site was a 944-bed tertiary care academic referral center with an average annual adult ED volume of 100,000 visits. Consecutive patients were enrolled through observations performed during eight-hour blocks by four trained research associates (RAs) encompassing enrollment hours between 11 am to 2:59 am (for all seven days, 80 h per week). Eligibility included any clinical encounter that required a response from protective services personnel. In addition, the research associates regularly walked through the entire clinical unit to identify early cases of escalating patient agitation.

In order to provide a comprehensive description of agitation events, we incorporated a broad spectrum of potential factors and clinical variables to our observation instrument. We compiled our final list (Fig. 1) based on a synthesis of factors identified from our prior literature review

Factor	Method of Data Collection
Patient characteristics (Level 1)	
Demographics: age, gender, race/ethnicity	Chart Review
Triage chief complaint	Chart Review
Report of drug use (per EMS or patient)	Direct Observation
Apparent impairment	Direct Observation
Total number of prior ED visits in the past year	Chart Review
Staff/healthcare team factors (Levels 2 & 3)	
Number of staff involved	Direct Observation
Team leader present	Direct Observation
Any de-escalation attempted	Direct Observation
Reported staff familiarity with patient	Direct Observation
Team Emergency Assessment Measure (TEAM) score [16]	Direct Observation
Environmental/system factors (Levels 4 & 5)	
Treatment step (triage, during treatment, at disposition)	Direct Observation
Hallway occurrence	Direct Observation
Coercion into ED (per EMS or patient)	Direct Observation
Time of agitation event	Direct Observation
Number of patients in ED during agitation event	Direct Observation
Physical Restraint Use	Direct Observation
Chemical Sedative Use	Direct Observation

Fig. 1. Agitation Event Observation Instrument. Each factor and its method of data collection are listed. Categories correspond to levels of the ED agitation framework from Wong et al. [15]. The TEAM score is derived from Cooper et al. [16].

Table 1
Patient characteristics and clinical outcomes.

	Total N (%)
N	95
Patient characteristics	
Median age, years (IQR)	42 (32, 57)
Gender	
Male	59 (62.1)
Female	36 (37.9)
Race	
White	54 (56.8)
Black	29 (30.5)
Other	12 (12.6)
Ethnicity	
Non-Hispanic	78 (82.1)
Hispanic	17 (17.9)
Triage chief complaint	
Alcohol/drug use	36 (37.9)
Psychiatric/mental health	22 (23.2)
Medical illness	9 (9.5)
Trauma	9 (9.5)
Delirium/altered mental status	8 (8.4)
Other/multiple	11 (11.6)
EMS reports of alcohol/drug use	
No/uncertain	33 (34.7)
Yes	62 (65.3)
Apparent impairment	
None	12 (12.6)
Alcohol/drug intoxication	46 (48.4)
Mental/psychiatric	13 (13.7)
Neurologic/cognitive	5 (5.3)
Multiple	19 (20.0)
Median prior ED visits in past year (IQR)	3 (0, 8)

of use of coercive measures [14] and the systems framework created for ED agitation management through mixed-methods analysis of staff data [15]. For the bivariable analyses, we conducted Pearson's χ^2 or Fisher's exact tests for categorical data as appropriate, independent *t*-tests for normal continuous data, and Wilcoxon-Mann-Whitney *U* tests for non-parametric data. Correction of p-values for multiple comparisons was not made.

Between June and August 2017, a total of 95 agitation events on unique patients were observed during enrollment hours (Table 1). The median age of the cohort was 42 years (IQR 32, 57), 62.1% were male, 56.8% were white, and 30.5% were black. For chief complaints, 23.2% presented were psychiatric, 9.5% were medical, 9.5% were trauma, 8.4% were delirium/altered mental status, 37.9% were alcohol or drug use, and 11.6% were other or had multiple complaints. EMS reported possible alcohol/drug use in 65.3% of visits. Observed apparent impairments included 48.4% alcohol/drug intoxication, 12.6% mental/psychiatric impairment, 5.3% neurologic/cognitive impairment, 20.0% multiple types, and 12.6% with no apparent impairment. Median number of prior ED visits in the past year was 3 (IQR 0, 8).

Bivariable analyses with sedative and restraint use are listed in Table 2. No significant associations were seen for any patient characteristics. Within staff/healthcare team factors, significant higher median numbers of staff were involved for patients both with sedative use (6 vs 8, $p < 0.01$) and with restraint use (5 vs 8, $p < 0.01$). A significantly lower percentage of events with restraint use had an observable attempt at de-escalation versus events without restraint use (65.1% vs 93.8%, $p < 0.01$). Within environmental/systems factors, hallway occurrence had a lower percentage for events with sedative use (9.8% vs 31.5%, $p = 0.01$).

Our prospective cohort of agitated patients in the ED included significant representation of alcohol/drug intoxication and psychiatric illness, but also demonstrated a breadth of patient classes and diagnoses. Several staff and environmental factors were found to be associated with use of coercive measures. Although reducing use of restraints and sedatives is critical for patient safety, challenges specific to the ED may pose barriers for health workers to implement these non-coercive strategies. Behavioral techniques likely will need to be tailored specifically for the unique characteristics of ED agitation in order to effectively minimize use of coercion. We hope that this prospective characterization of agitation events can establish baseline measures for factors contributing to sedative and restraint use and help build future studies to measure agitation in a structured, rigorous fashion.

Presentations

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References

[1] Holloman Jr GH, Zeller SL. Overview of Project BETA: best practices in evaluation and treatment of agitation. West J Emerg Med 2012;13:1–2.
[2] Miner JR, Klein LR, Cole JB, et al. The characteristics and prevalence of agitation in an urban county emergency department. Ann Emerg Med 2018;72:361–70.

Table 2
Factors associated with sedative or restraint use.

	Sedatives used			Restraints used		
	No (%)	Yes (%)	p-Value	No (%)	Yes (%)	p-Value
N	54	41		32	63	
Patient characteristics						
Median age, years (IQR)	44 (32, 59)	38 (31, 51)	0.45	49 (37, 62)	37 (31, 53)	0.56
Gender			0.82			0.96
Male	33 (61.1)	26 (63.4)		20 (62.5)	39 (61.9)	
Female	21 (38.9)	15 (36.6)		12 (37.5)	24 (38.1)	
Race			0.53			0.93
White	33 (61.1)	21 (51.2)		19 (59.4)	35 (55.6)	
Black	14 (25.9)	15 (36.6)		9 (28.1)	20 (31.7)	
Other	7 (13.0)	5 (12.2)		4 (12.5)	8 (12.7)	
Ethnicity			0.72			0.88
Non-Hispanic	45 (83.3)	33 (80.5)		26 (81.3)	52 (82.5)	
Hispanic	9 (16.7)	8 (19.5)		6 (18.8)	11 (17.5)	
Chief complaint			0.53			0.67
Alcohol/drug use	22 (40.7)	14 (34.1)		12 (37.5)	24 (38.1)	
Psychiatric/mental health	14 (25.9)	8 (19.5)		7 (21.9)	15 (23.8)	
Medical illness	5 (9.3)	4 (9.8)		5 (15.6)	4 (6.3)	
Trauma	3 (5.6)	6 (14.6)		3 (9.4)	6 (9.5)	
Delirium/altered mental status	3 (5.6)	5 (12.2)		3 (9.4)	5 (7.9)	
Other/multiple	7 (13.0)	4 (9.8)		2 (6.3)	9 (14.3)	
Reported alcohol/drug use (by EMS or patient)			0.23			0.69
No/uncertain	16 (29.6)	17 (41.5)		12 (37.5)	21 (33.3)	
Yes	38 (70.4)	24 (58.5)		20 (62.5)	42 (66.7)	
Apparent impairment			0.36			0.06
None	8 (14.8)	4 (9.8)		6 (18.8)	6 (9.5)	
Alcohol/drug intoxication	28 (51.2)	18 (43.9)		14 (43.8)	32 (50.8)	
Mental/psychiatric	8 (14.8)	5 (12.2)		4 (12.5)	9 (14.3)	
Neurologic/cognitive	1 (1.9)	4 (9.8)		6 (18.8)	3 (4.8)	
Multiple	9 (16.7)	10 (24.4)		2 (6.3)	13 (20.6)	
Median prior ED visits in past year (IQR)	4 (0, 10)	3 (0, 5)	0.14	6 (2, 10)	2 (0, 7)	0.11
Staff/healthcare team factors						
Median number of staff involved (IQR)	6 (4, 8)	8 (6, 10)	**<0.01**	5 (3, 6)	8 (6, 10)	**<0.01**
Team leader			0.20			0.56
No	42 (77.8)	27 (65.9)		22 (68.8)	47 (74.6)	
Yes	12 (22.2)	14 (34.1)		10 (31.3)	16 (25.4)	
Any de-escalation attempted?			0.21			**<0.01**
No	11 (20.4)	13 (31.7)		2 (6.3)	22 (34.9)	
Yes	43 (79.6)	29 (68.3)		30 (93.8)	41 (65.1)	
Reported staff familiarity with patient			0.67			0.08
No	32 (64.0)	28 (68.3)		16 (53.3)	44 (72.1)	
Yes	18 (36.0)	13 (31.7)		14 (46.7)	17 (27.9)	
Mean total TEAM score (SD)	27.7 (12.8)	32.0 (9.1)	0.08	26.3 (14.1)	31.2 (9.7)	0.06
Environmental/system factors						
Treatment step			0.46			0.12
Triage	23 (42.6)	18 (43.9)		12 (37.5)	29 (46.0)	
During treatment	29 (53.7)	23 (56.1)		18 (56.3)	34 (54.0)	
Disposition	2 (3.7)	0 (0.0)		2 (6.3)	0 (0.0)	
Hallway occurrence			**0.01**			0.31
No	37 (68.5)	37 (90.2)		23 (71.9)	51 (81.0)	
Yes	17 (31.5)	4 (9.8)		9 (28.1)	12 (19.0)	
Coercion into ED (per EMS or patient)			0.10			0.14
No	23 (46.0)	11 (28.9)		14 (50.0)	20 (33.3)	
Yes	27 (54.0)	27 (71.1)		14 (50.0)	40 (66.7)	
Time of agitation event			0.45			0.33
0700–1459	6 (14.3)	3(9.7)		5 (17.2)	4 (9.1)	
1500–2259	32 (76.2)	27 (87.1)		21 (72.4)	38 (86.4)	
2300–0659	4 (9.5)	1 (3.2)		3 (10.3)	2 (4.5)	
Total patients in the ED during agitation event	86.5 (23.4)	85.7 (21.3)	0.87	87.1 (21.4)	85.7 (23.1)	0.77

Bold values indicates significance at $p < 0.05$.

[3] Mohr WK, Petti TA, Mohr BD. Adverse effects associated with physical restraint. Can J Psychiatry 2003;48:330–7.
[4] Karger B, Fracasso T, Pfeiffer H. Fatalities related to medical restraint devices-asphyxia is a common finding. Forensic Sci Int 2008;178:178–84.
[5] Korczak V, Kirby A, Gunja N. Chemical agents for the sedation of agitated patients in the ED: a systematic review. Am J Emerg Med 2016;34:2426–31.
[6] Nordstrom K, Zun LS, Wilson MP, et al. Medical evaluation and triage of the agitated patient: consensus statement of the american association for emergency psychiatry project Beta medical evaluation workgroup. West J Emerg Med 2012;13:3–10.
[7] Chapman R, Ogle KR, Martin C, et al. Australian nurses' perceptions of the use of manual restraint in the Emergency Department: a qualitative perspective. J Clin Nurs 2016;25:1273–81.
[8] van der Zwan R, Davies L, Andrews D, Brooks A. Aggression and violence in the ED: issues associated with the implementation of restraint and seclusion. Health Promot J Austr 2011;22:124–7.
[9] Phillips JP. Workplace violence against health care workers in the United States. N Engl J Med 2016;374:1661–9.
[10] Downey LV, Zun LS, Gonzales SJ. Frequency of alternative to restraints and seclusion and uses of agitation reduction techniques in the emergency department. Gen Hosp Psychiatry 2007;29:470–4.
[11] Zun LS. A prospective study of the complication rate of use of patient restraint in the emergency department. J Emerg Med 2003;24:119–24.
[12] Kowalenko T, Gates D, Gillespie GL, et al. Prospective study of violence against ED workers. Am J Emerg Med 2013;31:197–205.

[13] May DD, Grubbs LM. The extent, nature, and precipitating factors of nurse assault among three groups of registered nurses in a regional medical center. J Emerg Nurs 2002;28:11–7.
[14] Wong AH, Taylor RA, Ray JM, Bernstein SL. Physical Restraint Use in Adult Patients Presenting to a General Emergency Department. Ann Emerg Med 2018 Aug 14. https://doi.org/10.1016/j.annemergmed.2018.06.020 pii: S0196-0644(18)30551-1.
[15] Wong AH, Ruppel H, Crispino L, et al. Deriving a Framework for Systems-Based Approach to Agitated Patient Care in the Emergency Department. Jt Comm J Qual Patient Saf 2018;44:279–92.
[16] Cooper S, Cant R, Porter J, et al. Rating medical emergency teamwork performance: development of the Team Emergency Assessment Measure (TEAM). Resuscitation 2010;81:446–52.

Life on the farm: A community-based study of tractor-related injuries and fatalities

Agriculture is a particularly dangerous industry when taking into account occupational injury and fatality rates. In 2010, the fatality rate for agriculture was 27.9 per 100,000 workers, which is dramatically higher than the reported incidence of 3.6 deaths per 100,000 workers for all other occupations combined [1]. Tractor mishaps are a significant cause of machinery-related injuries on farms, accounting for an estimated 4–14% of nonfatal injuries and one-third of fatal agricultural injuries [2]. Safety equipment such as rollover protective structures, master shields covering the power take-off (PTO), and driveline and power input connection guards have been introduced in newer tractors in order to help prevent injury [3]. However many tractors currently in use were manufactured prior to these installments and operators may find it too expensive or cumbersome to have their equipment fitted with these devices [3]. Misuse of equipment, having children on or around these machines, and use of tractors on public roads also introduce an increased chance for injury or death [3]. Emergency department (ED) personnel may have little or no familiarity or knowledge about the hazards of agricultural work, including what to expect with tractor-related injuries. The purpose of this study was to characterize the incidence, injury characteristics, and outcomes of tractor-related injuries in West Michigan.

We conducted a retrospective cohort analysis of ED patients with a tractor-related injury seen in seven participating hospitals in West Michigan from January 2002 to August 2016. Data was collected on demographics, mechanisms of injury, diagnoses, treatment provided, and mortality rate. Additional farm fatalities secondary to tractor-related incidents were identified using data from the Michigan Fatality Assessment and Control Evaluation (MIFACE) research program [4]. These fatalities occurred in West Michigan during the study period but were not seen in participating hospitals. Descriptive statistics and frequency tables were used to describe the key quantitative and qualitative variables.

We evaluated 208 patients presenting to participating hospitals with 507 tractor-related injuries during the study period. The mean age was 42.0 ± 20.0 with a range of 3–86 years. Twenty-nine patients (13.9%) were <18 years of age and 11 (5.3%) were >70 years old. A total of 73 patients (35.1%) had injuries classified as severe (trauma priority 1 or 2). Leading types of injury in all age groups were fractures (n = 119, 57.2%) followed by open wounds and contusions/abrasions (Table 1). The majority of fractures involved the upper or lower extremities (79.3%), followed by fractures to the spine (11.5%), pelvis (4.8%) and skull (4.4%).

Overall, the most common mechanisms of nonfatal tractor-related injuries were having an extremity pinned, caught or lacerated (n = 81, 38.9%), followed by tractor run over (n = 34, 16.4%) (Table 2). The frequencies of the injury mechanisms were different in children with the most common mechanism being a fall/jump/ejection (n = 16, 55.2%), followed by a run over (n = 7, 24.1%). A total of 76 patients (36.9%) were admitted to the hospital (LOS 7.9 ± 7.7 days) with four subsequent fatalities (1.9%).

Table 1
Injury characteristics.

	Number of patients (%)
Fracture	119 (57.2%)
Open wound	83 (39.9%)
Contusion/abrasion	77 (37.0%)
Crush injury	40 (19.2%)
Head injury	37 (17.8%)
Sprain/strain	35 (16.8%)
Chest injury	19 (9.1%)
Extremity amputations	17 (8.2%)
Abdominal injury	14 (6.7%)
Dislocation	9 (4.3%)
Burn	8 (3.9%)
Other	9 (4.3%)

According to MIFACE, a total of 119 agriculture fatalities occurred in Western Michigan between 2002 and 2016, and 63 (52.9%) were tractor-related [4]. Causes of death included tractor overturn (46%), run over (16%), and road collisions (11%), among others. Documented reasons for these fatalities include a relative lack of safety training and seat belt use, fatigue and carelessness, lack of emergency preparedness, and exposure of high risk groups like children and elderly to hazardous environments.

Our study supports facts previously found in that various processes may lead to a tractor-related injury, and these mechanisms vary by age and impact on the severity of the resulting injury [1]. Although fractures and soft-tissue extremity wounds are commonly reported, in our study approximately one-third of patients had severe traumatic injuries. ED physicians must be prepared to handle a wide variety of injuries in tractor-related incidents. A particularly disturbing aspect of this study is the frequency of injuries to children, who make up a substantial portion of rural farm staff. It is common for children to work in agriculture at a young age, especially since they are protected by Federal labor laws implemented by the US Department of Labor to a lesser extent than children in other areas of the workforce. For example, laws declare it hazardous for children under 16 years of age to operate a tractor and other heavy machinery on farms, but in other realms, individuals must be 18 or older to operate hazardous equipment [5]. Investigation of unsafe working conditions is often completed by the Office of Safety and Health Administration (OSHA), of which there are both Federal and State offices [6]. Reports to these offices must be taken seriously and investigated thoroughly. Ensuring proper training and oversight for agricultural workers is a must. It would also be prudent to ensure heavy machinery such as tractors either

Table 2
Tractor related injuries in West Michigan 2002–2016.

	Number of patients (%)
Pinned/caught/cut	81 (38.9%)
Tractor - run over	34 (16.4%)
Tractor - fall/jump/ejection	30 (14.4%)
Tractor - overturn	16 (7.7%)
Struck	8 (3.8%)
Tractor PTO entanglement	7 (3.4%)
Road collisions	3 (1.4%)
Other	29 (13.9%)