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submitted by Dr. Michael Wadman

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Submersion Injuries and Drowning in the Rural Emergency Department

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Vignette

On Memorial Day, you are working as solo coverage in a small community emergency department (ED) and three patients arrive by ambulance from the scene of a personal watercraft accident at a nearby lake. A 13-year old male was the passenger riding with a 19-year old male when they struck a submerged tree trunk and crashed. Bystanders reported that the older rider was motionless after the crash and the younger rider struggled to keep them both above the water until rescuers arrived twelve minutes later. One 32-year old female rescuer also came for evaluation because she “swallowed some water” during extrication. Upon arrival in the ED, the 19-year old has a pulse of 52, BP 88/50 with mumble sounds as his best speech, a nasal fracture, and weak respiratory effort. The 13-year old is awake but confused, tachypneic, and has diminished breath sounds on the right. The 32-year old female is ambulatory with a normal physical exam, but appears mentally distant with a flattened affect. As you prepare your airway cart, you begin to consider key management decision points, including:

1. *How likely is concomitant injury or intoxication in drowning victims?*
2. *What is needed to stabilize drowning victims in the ED?*
3. *What features of a drowning patient drive the decision for transfer?*
4. *What evidence exists about the prognosis for drowning victims and futility of resuscitation?*

Epidemiology of drowning in rural settings

The World Congress on Drowning and the World Health Organization have adopted the definition of “drowning” as “a process resulting in primary respiratory impairment from submersion in a liquid medium.”¹ This definition was adopted in hopes of improving epidemiologic study and reporting.² In engaging the literature it is important to realize that “drowning” refers to a process, not an outcome. The use of the term “near-drowning” is still common in the literature but discouraged by experts because it prevents survivors of drowning events from being counted among the victims.¹

The CDC reports that from 2004-2010, an average of 4924 Americans died annually from drowning.³ In the US drowning is the sixth most common reported cause of accidental traumatic death across all ages, with the young disproportionately affected. In 2010, drowning was the leading cause of unintentional traumatic death reported in the US for those 1-4 years old; for those ages 5-14 years, it was second only to motor vehicle collisions.³ Verbal autopsy reports from Bangladesh likewise show that children ages 1-4 are more likely to die from drowning than any other age group from any other

external cause.⁴ On average, there are 32 pediatric farm drowning deaths per year in the US, accounting for one third of farm deaths in American children.⁵ Rural pediatric drowning victims have risk factors in common with urban victims: absence of adult supervision, developmental stage, and a lack of effective barriers between children and the water.⁶

Rural location may increase mortality risk according to one study of pediatric patients with loss of consciousness in a freshwater drowning event, which found only 21% survived from rivers and creeks, compared with 65% survival among those who drowned at home.⁷ While reporting factors and rural emergency medicine services are hypothesized to account for some of the disparities between nations, the literature contains no comparisons clear enough to determine whether regional differences are demonstrating differences in the data or in how drowning victims are managed. For example, a Canadian study of unintentional adult deaths found a significantly elevated risk for accidental death by drowning in the most rural areas of the country, with similar findings reported in Ireland and China.⁸⁻¹⁰ A neutral effect was shown in a study of drowning mortality in Australia, which found no increased risk for drowning death in rural populations.¹¹ A still more negative study from Norway concluded the opposite, that trauma systems have benefitted urban areas but not helped limit mortality from drowning in rural areas, as rural drowning victims still tend to die at the scene.¹² Other adult risk factors such as alcohol use have been identified and may be more important than rural location in predicting the prognosis and mortality of severe drowning injury.¹³

Based on the elevated risk in many rural communities and established risk factors, public health education and preventive measures should be considered appropriate primary prevention in rural communities. A cost-effectiveness analysis in Bangladesh found that educational programs cost \$362 per disability-adjusted life year saved.¹⁴ While this data in favor of prevention is encouraging, such success may be difficult to replicate in other regions with higher costs of education and lower incidence of pediatric mortality and morbidity from drowning. More research is needed to determine the cost effectiveness of drowning

prevention measures in industrialized settings. The National Drowning Prevention Alliance (<http://www.ndpa.org>) is a US nonprofit organization that provides free and low-cost educational programs to prevent drowning.

Clinical and economic relevance in rural ED care

In 2010, the CDC reports that of the 12,900 patients who presented to the ED due to drowning, 20% were admitted to the same hospital at a total cost of \$40 million for ED and inpatient care.¹⁵ Realizing that a minority of patients are admitted to the presenting hospital, a structured evaluation of drowning victims will allow the rural practitioner to identify the few patients who require local admission among the majority whose best disposition is either discharge home or transfer to higher care.

Pathophysiology and spectrum of drowning injury

Drowning injury, regardless of the medium, involves a series of insults that ultimately result in respiratory failure. Upon being submerged, the victim usually struggles to maintain the mouth and nose above water. Once unable to maintain access to air, volitional breath-holding is usually performed until hypercarbia and hypoxia trigger an involuntary gasp. Gaspings may occur earlier in cold-water submersion. Laryngospasm may preclude large-volume aspiration for some victims while others with a patent larynx will allow large-volume aspiration. The distinction of low-volume aspiration drowning events as “dry drowning” is not a significant clinical distinction from high-volume liquid aspiration, as patients’ pathophysiology and management needs remain similar throughout their course.² Hypotonic aspirates may enter the bloodstream via the alveolar capillaries and contribute to blood volume, while hypertonic aspirates may draw water into the alveolar space. In either scenario, the alveolar interface is obstructed, resulting in diffusion limitation and hypoxic respiratory failure.

The spectrum of presentation after a drowning event ranges from asymptomatic to critically ill, and patients of intermediate severity may deteriorate quickly due to pulmonary inflammation and acute respiratory distress

syndrome (ARDS). Pollutants and organic matter in the aspirated liquid may accelerate the onset of ARDS.

Cardiovascular collapse in drowning victims should be considered secondary to the common pathway of respiratory failure, hypoxia, and acidemia. Though laboratory models have been able to provoke significant electrolyte and volume changes in animals, human drowning victims in fresh or salt water do not commonly develop significant changes in hematocrit or serum electrolyte levels.¹⁶ Routine testing for electrolytes remains indicated for these patients as a component of either initiating critical care measures or a short but comprehensive period of cardiac monitoring. However, given the low probability of significant disturbances a patient need not be transferred to a higher level of care if only for the purpose of laboratory evaluation.

Evaluating the drowning patient in the rural ED

When given the opportunity to speak with prehospital providers in the field, the rural ED physician should have a structured method for deciding which patients are appropriate for presentation to a small ED and which

patients might benefit best from rapid transport to a larger institution with ICU capabilities. Table 1 is a guide for advising transport decisions for prehospital providers on scene prior to initial hospital transport.

For those patients received at the rural ED, standard attention should be given to airway, breathing, circulation, and mental status. History about the drowning event and early management, gathered from witnesses and EMS, is especially important for assessing risk in the unresponsive patient. On secondary survey, specific attention should be given to seek concomitant hypothermia, intoxication, and injury, depending on the setting. It should be noted that this triage scheme allows for educated release of asymptomatic patients, yet as with many conditions their management would be different if presenting to the hospital setting. The existing evidence suggests that a physician providing medical command for EMS personnel in the field can accept informed refusal of transport for the asymptomatic patient, given their low risk of significant deterioration. In such situations, medical command physicians should maintain vigilance for those patients who may lack capacity due to intoxication or concomitant injury.

Table 1: Prehospital Management and Classification of Drowning Patients

	The Asymptomatic Patient		The Symptomatic Patient			The Patient in Respiratory of Cardiopulmonary Arrest	
Grade	0	1	2	3	4	5	6
Mortality (%)	0	0	0.6	5.2	19	44	93
Pulmonary Exam	No cough or dyspnea	Normal auscultation with cough	Rales, small amount of foam	Acute pulmonary edema	Acute pulmonary edema	Respiratory arrest	Cardiopulmonary arrest
Cardiovascular	Radial pulses	Radial pulses	Radial pulses	Radial pulses	Hypotension	Hypotension	
On-Scene Management	Release at scene, education	Rest, Rewarm, Reassure, Release	O2 via nasal cannula; observe for 6-24 hr	O2 via NRB; ACLS	O2 via NRB; ACLS	Load and Go	
Transport	No	No	Transport or observation	Yes	Rapid	Rapid	
En Route Management			Vital Signs	Vital Signs	Possible ETT and manage pressure	ACLS	
Hospital			ED or overnight observation	Admission for observation	ICU	ICU	ICU

Courtesy of Tracy Cushing, MD. Adapted from Cushing TA, Hawkins SC, Sempstrott J, Schoene RB. *Submersion Injuries and Drowning*. Sixth Edit. (Auerbach P, ed.). Elsevier Inc.; 2012:1494-1513.e5.¹⁷ Originally adapted from Szpilman D: Near-drowning and drowning classification: A proposal to stratify mortality based on the analysis of 1,831 cases, *Chest* 112:660, 1997.¹⁸

Concomitant Intoxication: A large-scale study in Sweden¹⁹ examined blood ethanol and drug levels among drowning fatalities. Among unintentional drowning victims who died, 44% tested positive for ethanol. Males were more likely positive than females, risk peaked at ages 30-69, and the proportion of alcohol-positive drowning was highest among those who drowned in streams and rivers. Positive tests for ethanol were found in 68% of snowmobile riders who drowned after breaking through ice, 54% of those who fell from boats, and 30% of those drowned in other motor vehicles; conversely, of 44 patients in SCUBA diving accidents there were no positive tests. Almost 25% of those who drowned had one or more pharmaceuticals in their blood. Benzodiazepines and antidepressants were most common, especially in the older age groups. Compared to unintentional drowning, suicide events were associated with a higher prevalence of psychoactive drug use. An American study showed similar findings among boaters, with risk of death increasing in proportion with blood alcohol content.²⁰ For those adolescents and adults who survive to hospital presentation, it is reasonable to presume alcohol and drug use preceded any drowning event, regardless whether the drowning was accidental or intentional. While some populations such as divers have shown low rates of concomitant intoxication, it is still reasonable to presume substance use during early management and testing.

Cormorbid Injuries: Most drowning victims are uninjured. A review of 2,244 patients in Washington State found only 0.5% of cases had cervical spine injuries, with all such injuries having occurred in open water, all had clinical signs of serious injury, and all had a history of either diving into water, motorized vehicle crash, or fall from height. No cervical spine fractures were identified in low-impact submersions.²¹

A similar retrospective review of 143 pediatric drowning victims found that the only injuries identified were cervical spine injuries. These injuries occurred in boys and girls equally, occurred in older children and teenagers, and all but one were caused by a diving mechanism.²² Given the available evidence, it is considered prudent to immobilize

the cervical spine of drowning patients when there is a clear history of traumatic injury or diving, signs of serious trauma, or an entirely unwitnessed event.

Management Decisions

Initial ED management for the acute drowning victim is focused on assessment and correction of the patient’s underlying hypoxic respiratory failure. Initial symptoms may include cough, throat pain, chest pain, or dyspnea. Symptoms can evolve rapidly in the 4-6 hours following a drowning event, so all patients should be monitored for at least four hours regardless of condition on initial presentation to the ED.

For those patients whose oxygen saturation is not maintained on a high-flow mask, or whose respiratory status is rapidly deteriorating, CPAP or endotracheal intubation with mechanical ventilation should be instituted. Serial arterial blood gas measurements can be used to monitor sufficiency of alveolar ventilation, gas exchange, and peripheral perfusion. For those patients who demonstrate mental status alterations out of proportion to respiratory failure or blood gas findings, consider further workup for intoxication or intracranial trauma, to include transfer as necessary. Nearly all patients who arrive without having undergone cardiac arrest are expected to survive with good neurologic outcomes.^{1,23}

Table 2: Prognostic factors for drowning victims in the Emergency Department	
Good	Alert on admission, hypothermic, brief submersion time, on-scene basic or advanced life support, good response to initial resuscitation measures
Bad	Fixed dilated pupils in ED, submerged >5 min, no resuscitation attempts for more than 10 minutes, preexisting chronic disease, arterial pH <7.10, coma on admission to ED

Courtesy of Tracy Cushing, MD. Adapted from Cushing TA, Hawkins SC, Sempstrott J, Schoene RB. *Submersion Injuries and Drowning*. Sixth Edit. (Auerbach P, ed.). Elsevier Inc.; 2012:1494-1513.e5.¹⁷

For patients who arrive comatose, the management priorities remain the same in order to optimize

oxygenation and perfusion of the brain. Drowning victims who sustain cardiac arrest then regain adequate spontaneous circulation but remain comatose should not be actively re-warmed to temperature values above 32° to 34° C (90° to 93° F). If core temperature exceeds 34° C (93.2° F), hypothermia at 32° to 34° C (90° to 93° F) should be achieved as soon as possible and sustained for 12 to 24 hours.²⁴

Patients who present with fever, altered mental status, or worsening respiratory distress more than 24 hours after a drowning or immersion event may have been inoculated with endemic bacteria, parasites, or fungi.²⁵ A careful examination should focus on central nervous system, nasopharyngeal and pulmonary sources of infection and

treatment tailored to local environmental risks.

Evidence Review Section: The following questions were chosen in the hopes of addressing questions that are expected to naturally arise in the treatment of most drowning patients, whose answers might reduce iatrogenic complications, guide decision-making in resource-limited settings, and improve patient-centered outcomes such as disability and death. For a broader discussion of drowning in a wider variety of clinical settings, the handbook published by The World Congress on Drowning is the benchmark for expert consensus and review of literature.¹ The recommendations in this section are offered according to the American College of Chest Physicians' 2006 guidelines for grading quality of evidence.²⁶

Table 3: Evaluation and Disposition of Drowning Victims in the Rural Emergency Department
<p>Check Airway/Ventilation</p> <ul style="list-style-type: none"> • Adequate Ventilation <ul style="list-style-type: none"> ○ Supplemental oxygen: nonrebreathing mask at 12-15 L/min • Inadequate ventilation <ul style="list-style-type: none"> ○ Borderline patients: consider CPAP ○ Comatose patients or those with PaO₂<90 mmHg on 15 L/min nonrebreathing mask or PaCO₂>45: endotracheal intubation with PEEP as necessary
<p>Diagnostics</p> <ul style="list-style-type: none"> • Arterial blood gas (ABG) studies for mechanically ventilated patients, SpO₂ monitor for spontaneously breathing patients • Chest radiograph • Cardiac monitor • Cervical spine radiograph/trauma evaluation if indicated by mechanism • Assessment for hypothermia, hypoglycemia, electrolyte abnormalities • Assessment for intoxication if mental status altered out of proportion to injuries and ABG
<p>Further Interventions</p> <ul style="list-style-type: none"> • Intravenous access, hydration • Nasogastric tube if significant aspiration/ingestion of water
<p>Disposition</p> <ul style="list-style-type: none"> • Criteria for 4-6 hour observation then discharge: <ul style="list-style-type: none"> ○ Asymptomatic (no cough or respiratory complaints) ○ No vital sign or exam abnormalities to include normal SpO₂ in room air, normal lung auscultation, normal Glasgow Coma Scale ○ No diagnostic abnormalities (normal chest radiograph) ○ No preexisting condition that prevents accurate assessment of above • Local admission <ul style="list-style-type: none"> ○ Patients with normal findings being admitted for observation only, such as those with normal findings but tenuous preexisting illness. • Transfer to higher echelon of care or ICU admission <ul style="list-style-type: none"> ○ ICU admission preferred for all patients with vital sign abnormalities, respiratory symptoms, chest radiograph findings, cervical spine trauma. ○ Cardiopulmonary status should be managed as fully as possible prior to transfer ○ Oxygenation to PaO₂ >60mmHg and perfusion with MAP > 65 are desirable endpoints before and during transfer

Adapted, with permission, from Cushing TA, Hawkins SC, Sempsrott J, Schoene RB. *Submersion Injuries and Drowning*. Sixth Edit. (Auerbach P, ed.). Elsevier Inc.; 2012:1494-1513.e5.¹⁷

Question #1: For victims of drowning or submersion injuries, does the use of prophylactic antibiotics improve disease severity or mortality when compared with standard treatment?

Search parameters: Database MEDLINE, terms (((drowning) OR (immersion) OR (near-drowning) OR (submersion)) AND ((antibiotics) OR (prophylactic antibiotics) OR (antimicrobial) OR (antifungal))) with limits (English language), (human species). This search rendered 175 results, five of which were relevant.

The five available studies are retrospective case review series. None found a significant difference between patients treated with prophylactic antibiotics and those who did not receive prophylactic antibiotics with respect to pneumonia, ARDS, septicemia, CNS infection, or death.^{16,27-30}

Recommendation: Prophylactic antibiotics should not be routinely given to victims of drowning or submersion. Unless the medium aspirated was grossly contaminated, microbiology diagnostics and antimicrobial treatments should be withheld but implemented promptly at the onset of clinical signs of infection. Recommendation rating: 2C

Question #2: In victims of drowning, does therapeutic hypothermia improve neurologic outcomes or survival when compared with standard treatment?

Unfortunately, no randomized controlled trials exist on the role of targeted temperature therapy in drowning victims, with most of the body of evidence coming from retrospective case series. The standard of care remains driven primarily by expert opinion, as there is no clear evidence to show that therapeutic hypothermia causes harm or benefit to drowning victims.³¹ The existing reports have suggested neutral effects³² as well as benefit,³³⁻³⁶ while the only existing study suggesting harm is on a birth asphyxia population.³⁷

A panel of experts during the World Congress on Drowning in 2002 concluded that “drowning victims with restoration of adequate spontaneous circulation who remain comatose should not be actively re-warmed to temperature values above 32° to 34° C (90° to 93° F). If core temperature exceeds 34° C (93.2° F), hypothermia at 32° to 34° C (90° to 93° F) should be achieved as soon as possible and sustained for 12 to 24 hours.”²⁴ The World Congress on Drowning in 2002 ultimately deferred to local guidelines for cardiac arrest.¹

Local practice for management of cardiac arrest is usually informed by guidelines published by the American Heart Association (AHA) and the International Liaison Committee on Resuscitation (ILCOR). The 2010 AHA and international consensus guidelines³⁸ for management of cardiac arrest recommend that comatose patients with spontaneous circulation after out-of-hospital arrest from ventricular fibrillation should be cooled to 32 to 34°C for 12 to 24 hours. Benefit is unclear but considered possible in those with return of spontaneous circulation (ROSC) from asystole. The ILCOR guidelines from 2003 were used in formulating the 2010 guidelines and state that, “Unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32°C to 34°C for 12 to 24 hours when the initial rhythm was ventricular fibrillation.”³⁹ The target temperature of choice for post-arrest cooling therapy was brought into question by a benchmark 2013 study⁴⁰ that enrolled comatose patients with ROSC after out-of-hospital arrest of any initial rhythm, randomized them into two treatment arms with targeted temperatures of 33°C or 36°C, and found no significant difference in neurologic disability or death. In response to that 2013 study, ILCOR issued an update to their 2003 guidelines stating that while further research is necessary to establish the ideal temperature to target in postarrest care, their recommendations remain unchanged from 2010.⁴¹ In this 2013 update, ILCOR neither endorsed nor condemned the use practice of targeting 36°C.

The use of therapeutic hypothermia after out-of-hospital cardiac arrest is thus an active area of controversy beyond the scope of this discussion. There is no strong evidence

available at this time to suggest that drowning patients with cardiac arrest should be treated differently from those in arrest without having drowned. Concomitant conditions such as hypothermia or spinal injury may, however, guide significant changes in resuscitation management.

Recommendation: Adherence to the 2002 World Congress on Drowning recommendations that recommend targeted temperature management, as it is currently aligned with recommendations rendered by the AHA and ILCOR: “drowning victims with restoration of adequate spontaneous circulation who remain comatose should not be actively re-warmed to temperature values above 32° to

34° C (90° to 93° F). If core temperature exceeds 34° C (93.2° F), hypothermia at 32° to 34° C (90° to 93° F) should be achieved as soon as possible and sustained for 12 to 24 hours.”²⁴ Grade: 2C

Question #3: In victims of drowning, what elements of physical examination or diagnostic studies predict poor neurologic outcome or death?

Several scoring systems have been devised to improve triage and prognostics for drowning victims (Table 4).⁴²⁻⁴⁵ All published scoring systems were built using retrospective chart review data.

Table 4: Comparison of Scoring Systems to Determine Prognosis of Drowning Patients in the Emergency Department ³¹⁻³⁴

Study	Methods	n, type	Outcome	Scoring	Subgroups	n	Outcome Present	Odds Ratio (95% CI)	p
Gonzalez-Luis, 2001	retrospective chart review	60, children	death or serious neurologic impairment	Pediatric Risk of Mortality Score (PRISM)	< or = 8	16	0	control	n/a
					17 to 23	9	6	61 (2.8-1359.2)	0.0092
					24 and over	8	8	561 (10.2-30825.9)	0.002
Christensen, 1997	retrospective multivariate analysis	274, children	death or serious neurologic impairment	Derived Rule	Predicted good	195	15	control	n/a
					Predicted poor	79	74	177.6 (62.3-506.4)	<.0001
Modell, 1980	retrospective chart review	131, 57 adults, 74 children	death or serious neurologic impairment	Neurologic Exam at 1-2h	Awake	61	0	control	n/a
					Blunted	31	3	15.1 (0.75-302.3)	0.075
					Comatose	29	13	100.6 (5.7-1783.0)	0.0017
Conn, 1980	retrospective chart review	96, children	death or severe neurologic impairment	Neurologic Exam at 1-2h	Awake	51	0	control	n/a
					Blunted	6	0	7.9 (0.1-434.3)	0.31
					Comatose 1 (decorticate)	9	3	55.5 (2.56-1198.9)	0.01
					Comatose 2 (decerebrate)	16	7	81.3 (4.27-1546.2)	0.003
					Comatose 3 (flaccid)	14	12	515 (23.2-11416.7)	0.0001

While these systems suggest that a comatose presentation is a statistically significant risk for death or disability, it is important to note that there are patients in each series who made full unpredicted recoveries. No system yet devised is fully predictive of a poor outcome. Given the catastrophic impact of a poor outcome on the patient and the patient's family, it is reasonable to presume for the first 48 hours that every comatose patient has the rare, and still unpredictable, potential for full recovery.

Recommendation: For drowning victims who present comatose, families should be counseled on the relatively poor prognosis as these patients have elevated likelihood of death or neurologic disability. Given the unpredictable yet finite possibility full recovery, full-spectrum intensive care should be offered for at least the first 48 hours.
Grade: 1C.

Vignette Resolution:

You first secure the cervical spine and airway of the obtunded 19-year old patient and begin to manage him for presumed neurologic shock secondary to cervical spine injury. Second, you focus on the confused 13-year old and note his SpO₂ is 88% on 10 liters of supplemental oxygen. You preoxygenate him using non-invasive positive pressure ventilation then intubate him for hypoxemic respiratory failure with impending ARDS, start a lung-protective ventilator protocol based on ARDSnet⁴⁶, and you give no antibiotics. As the boys are having their post-intubation x-rays done, you initiate ICU transfers for both of them to give full-spectrum care for at least 48 hours. The woman with a normal exam was observed by the nurses with attention to oxygen saturation and respiratory status until you are free to see her. With a normal chest x-ray, electrolytes, and exam, she is simply monitored on cardiac telemetry and pulse oximetry for four hours, then released home with a referral to a counselor for traumatic stress.

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An Introduction to Traumatic Injuries and Environmental Hazards on the Farm: Part I Tractors - What the Heck is a PTO?

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A 21-year old farmer was using a tractor to power equipment that was unloading silage (chopped corn plants) into a blower to fill a silo. He decided to step over the driveline shaft behind the tractor instead of walking around. As he did so, the farmer slipped and his slightly torn sweatshirt got caught in the knuckle area where the shaft connects to the power take-off (PTO) post of the tractor. Almost immediately, his right arm was wrapped around the shaft and the shaft was spinning against the inside of his arm and chest. Fortunately, the farmer's father was nearby running the blower and was able to shut off the PTO in less than a minute and call EMS. First responders report he has multiple open fractures of his forearm and humerus and are wondering what they should do as the arm is still wrapped around the driveline shaft.

A 65 year old farmer was mowing a ditch near his farm when the tractor rolled over. The tractor had no rollover protective structure. EMS is calling you because he is alive but has a head injury, and the tractor is pinning his legs and is lying partially across his pelvis. Gas is leaking down onto the patient's face and torso. They are asking for your advice regarding how to proceed.

Introduction

Life on the farm is very dangerous. In fact, according to a Bureau of Labor and Statistics report from 2012, the agriculture, fishing and forestry sector had more occupational fatalities per 100,000 full-time equivalent workers than any other industry.¹ There are many reasons for this high rate of injury including a relative lack of safety training and personal protective device use, fatigue and carelessness, lack of emergency preparedness, and the exposure of high risk groups like children and elderly to hazardous environments.

The incidence of farm injuries is probably underestimated due to a lack of epidemiological studies surveillance data.

Less than 20 states maintain databases on farm fatalities.² Death certificates are useful, but often do not provide enough detail to determine the specific agent involved or cause of farm-related deaths. Press clippings of deaths and more serious injuries in agriculture have also been used as a surveillance tool.^{3,4} Purdue University has a database in which they have been collecting U.S. injury and death cases related to grain bin and gravity flow wagon events, and agricultural confined spaces.⁵ One of the best sources for national data is the Census of Fatal Occupational Injuries which is maintained by the Bureau of Labor Statistics.⁶ However, the incidence of less

severe agricultural injuries is largely unknown, as most occur on smaller farms where mandatory reporting is not required.

Tractor incidents are the leading cause of machinery-related death and injury on farms.^{7,8} From 2003-2011, there were 1,533 tractor-related deaths in the U.S.⁸ The tractor is an essential piece of machinery that is used nearly every day on the average farm. There are many ways that one may be injured due to the tractor's wide range of applications including pulling and powering the use of other implements both on- and off-road. Although regular maintenance of tractors includes making sure all safety equipment is functional, nonuse or lack of basic safety equipment is a major contributor to injuries. More recent safety innovations are lacking on older tractors which are still widely used across the country.

Many healthcare providers may have little or no experience or knowledge about the hazards of farm-related work. This article is the first of three in which we will introduce basic terminology, safety concerns, mechanisms of injury, and rescue information related to the agricultural environment. Knowledge of the mechanisms involved is invaluable in assessing patients with agricultural mishaps and appreciating the injuries that might result. In Part I, we will

explore the safety issues related to tractors.

Rollovers and Rollover Protective Structures

Tractor rollovers are a common cause of agriculture-related deaths and serious injuries and result in about 200 deaths per year.⁹ Most commonly these rollovers are to the side (85%) and often occur while operating on sloped land, or in a ditch while performing maintenance mowing or while driving along a road.¹⁰ Tractors have a relatively high center of gravity which makes them more vulnerable to rollovers. This can be exacerbated when a front loader on a tractor is carried too high during travel. See **Figure 1**.

Rear rollovers usually occur when there is an unsafe hitch attachment with a chain or winch from the tractor to a relatively immobile object that needs to be moved, such as a tree stump or farm equipment mired in mud. In such a situation, the rear tires become a pivot point if hitched higher than the tractor drawbar. Distraction usually contributes to the rollover, as focus is directed on getting the object out rather than on a potential safety hazard. The tractor can turnover in less than a second crushing the operator.

Figure 1. Front end loader. Tractor with a slightly raised front end loader.



A Rollover Protective Structure or ROPS, as it is commonly called, is a safety device designed to protect the driver in the event the tractor overturns. The ROPS is a roll bar that may be built into the cab of a tractor or be exposed in tractors without cabs. See **Figure 2**. All tractors with ROPS have seat belts and use of the seat belt is critical to keeping the driver within the zone of protection. Tractor rollover-related injuries and death are reduced by 99% when ROPS are combined with operator use of a seatbelt.¹¹ However, rollover injuries are still prevalent, because many tractors do not have ROPS or the seat belts are not used.

ROPS and seatbelts have been installed on virtually all new tractors sold in the U.S. since 1985 following a voluntary agreement of tractor manufacturers to improve

from tractor rollovers through implementation of mandatory ROPS installation.^{12, 23-25}

Unfortunately, U.S. farmers often do not use their seat belts when driving ROPS-equipped tractors.^{9, 14} Excuses for not belting include inconvenience due to frequently getting in and out of the seat during chores, being uncomfortable, and not believing that they are necessary for safety. Although a ROPS tractor cab will usually keep the driver in the critical zone of protection, operators have been thrown out of cabs during overturns and they are more likely to be injured inside the cab if not wearing a seat belt.

It should be noted that not all cabs have ROPS. Older tractors may only have a weather cab without a ROPS

Figure 2. Rollover protective structure (ROPS).

The first photo shows a tractor with a ROPS (the bar structure just behind the seat) and the second shows a farmer driving an older tractor without a ROPS.



Safety.¹² However, the average age of tractors on U.S. farms is approximately 26 years old¹³, and only about 50% of the estimated 4.8 million tractors in the U.S. have ROPS installed.^{9, 14-17} For many older tractors, manufacturers have made an aftermarket ROPS retrofit, which is available for approximately one-half of the U.S. tractors currently lacking them.^{18, 19} Purchase and installation of a ROPS retrofit has been estimated to cost between \$400 and \$2500.^{18, 20-22} This cost and the perceived lack of benefit by U.S. farmers have limited the success of retrofitting efforts.²¹ In contrast, Northern European countries have virtually eliminated fatalities which will offer very little, if

any, protection in a rollover. A cab where the seat does not have a seat belt indicates there is no ROPS (unless the seat belt was removed by a previous owner).

The key points are that a ROPS and seatbelt must be used concurrently in order to decrease rollover related injury and death²⁶, and farmers with older tractors should be encouraged to have them retrofitted with ROPS and seatbelts.²⁷ See Box 1 for tractor rollover rescue procedures from the Farm Safety Association which has been amalgamated into the Workplace Safety & Prevention Services organization in Canada.²⁸

Box 1. Tractor Rollover Rescue Procedures²⁸

- Shut off the tractor engine. Even if it isn't running, rear wheel movement could start it up.
- Always block or crib the tractor to prevent it from tipping or shifting and causing more injuries.
- If the ground is soft, it may be possible to dig the victim out from under the tractor.
- Lifting the tractor is the best way to deal with rollovers of large, modern tractors. A second tractor or a tow truck will be needed to perform the lift.
- If a tractor must be rolled away from the victim, careful blocking is required to minimize settling of the lower side.
- Place cribbing under the tractor as it is raised. Nonessential rescuers should stand well clear to avoid injury if the cable or chain breaks.
- Hydraulic jacks can be used to lift smaller tractors. Block the axle on both sides to prevent the tractor from rocking onto the victim.
- Air bags can be used to raise an overturned tractor. They are more stable if stacked alternately with the blocking.
- If a victim is pinned under one side of a small tractor, eight to 10 people may be able to roll the machine enough to free the victim.
- Fire is a threat in an overturn situation as spilled fuel may be present. A fire hose or ABC-type extinguisher should be available throughout the rescue.
- Consider alternative methods before using oxyacetylene cutting equipment to free a victim.

Extra Riders on Tractors

Studies have shown run-overs are the second leading cause of tractor-related death and that 50% of these involve an extra rider who falls off and is run over by the tractor.²⁹

³⁰ Except for specially designed tractors with a trainee seat, only the operator should be allowed on a tractor. Often, extra riders sit on fenders, stand on hitches, ride in loader buckets, or ride in the cab. The most common cause of injury with extra riders is being run over by a wheel of the tractor or equipment being towed, often after the tractor hits a bump, a person loses their grip or a fender bolt loosens.

A study from Ohio found that 97% of tractor fatalities related to extra riders were in children age 15 or younger.³¹ Despite the dangers, up to 80 percent of farm children routinely ride with family members on tractors.¹³ Parents perceive less risk when they feel in control and probably feel a false sense of security in having a child on a tractor with them. But, in fact, most fatalities result from a child falling off the tractor with their parent driving. The

only fail safe prevention is implementation of a strict no-rider rule on tractors.

Child Operators

It is typical for farm children to be driving tractors by age ten.³² Many are operating them at even younger ages and in some cases, parents have modified tractor levers and pedals to enable a smaller child to reach them. Young operators often learn to drive on older tractors that lack a ROPS which may put them at greater risk of injury should something unexpectedly happen.

Many children lack the strength to routinely and effectively operate brakes, clutches, and steering mechanisms. Due to their size, they may also lack a full field of vision compared to an adult operator.¹³ Moreover, even if a child is physically able to operate a tractor, they may not be ready mentally. Many children simply do not have the cognitive abilities to process all stimuli and make appropriate judgment calls while operating a tractor or other machinery. A Michigan/Ohio

study found that tractor operators under 14 were involved in 9 times more accidents per hour of exposure than those 25-44 years of age.³³

Children on farms often operate tractors and other machinery on roads and pose a risk to themselves and other vehicles sharing the road. Only 14 states have laws regulating youth operating tractors on public roadways and only 6 states require a driver's license to operate a tractor on a public road.^{34, 35} While there are national regulations limiting employment of those less than 16 years of age in agriculture, those regulations do not apply if working for parents or legal guardians.³⁵ See Box 2 for some recommendations related to young tractor driver development with information from the North American Guidelines for Children's Agricultural Tasks (NAGCAT).³⁶

Use on Public Roads

Tractors and other machinery are often used on public roads so that farmers may move supplies and crops from field to field or to market. This is inherently dangerous to both the machinery operator and to other motorists on the road because of the increased risk of a crash (37-39). This is most likely to occur during the fall harvest season with October usually being the worst month (40). A motor vehicle collision (MVC) with a farm vehicle is about 5 times more likely to produce a fatality than other types of MVCs (40). In addition, the non-farm vehicle driver in a crash is over 5 times more likely to be injured than the driver of the farm vehicle (41).

A major hazard of tractors and other machinery being on public roads is their speed. Most self-propelled farm

Box 2. Recommendations for Young Tractor Driver Development including information from the North American Guidelines for Children's Agricultural Tasks (NAGCAT)³⁶

- Parents should utilize NAGCAT to explore whether their child's physical, perceptual, cognitive, social and sociocultural development is advanced enough to start driving tractors.
- Before starting, adults need to make sure that:
 - All safety features are in place (rollover protection structures, seatbelts, shields, proper lighting and marking)
 - Basic service check is completed
 - Children do not operate tractors after dark or in bad weather
 - Work area has no hazards
 - Child and adult can communicate by cell phone, walkie-talkies, other methods
 - Long hair is tied up
- Parent should closely observe how they handle different situations, how often and easily the child is distracted, and how quickly they respond.
- Let the child get the feel of the tractor by performing little jobs around the homestead first.
- When ready to make the next step, have the child work in a large, open, flat field and keep a close eye at first to see how they get along.
- Parents may want to verbally test the child to see how they would handle various situations.
- WATCH constantly at first. When the child shows he or she can do the job, CHECK every few minutes. Appropriate supervision will change as a young driver gains experience and matures.
- A child should be 16 years or older to drive an articulated tractor or drive on a public road.

machinery has a maximum speed ranging between 15 and 35 mph. This can be dangerous for other motorists because it is extremely difficult to judge the speed of a slow moving vehicle (SMV). If traveling 55 mph, it only takes 5 seconds to close a gap the length of a football field on a tractor driving 15 mph.⁴² This is also true for towed equipment, as pickups and other vehicles are often used to pull machinery on public roads at slow speed. Often the machinery is wider than the lane or even the entire road, creating another hazard. Meeting another vehicle on the crest of a hill (resulting in decreased time for reaction) or while on a bridge (minimal room to maneuver) can be devastating. Therefore it is important for both the general public and farm machinery operators to be aware of these dangers, and to be patient while sharing the road.^{43,44}

Tractors making a left turn on a public road can also create a potentially dangerous situation. Often the tractor operator will swing to the right just prior to turning, in order to make a wide left turn. To a motorist, it may appear that the machinery is turning right or that the operator is moving over to allow them to pass. However, this is often not the case and a crash occurs as the farm machinery turns left into the path of the passing vehicle.

Devices that improve safety on public roads include lights and turn signals (however, a lot of farm equipment lack these), and SMV signage. Lighting and signage requirements on farm equipment vary by state.³⁵ Although all states require SMVs to have at least one headlight and taillight (some require two), there are no other universal laws. Blinking or flashing lights on farm vehicles alert traffic and may mitigate roadway crashes.⁴³

Many states, but not all, require SMV emblems on equipment traveling less than 25 mph. This emblem is a large, highly reflective orange and red colored triangular sign. See **Figure 3**. It should be mounted with the point facing upwards and bottom edge centered 3-6 feet above the ground on the rear of any vehicle or towed equipment traveling at speeds less than 25 mph. Unfortunately, some farm operators do not place the emblems on their equipment or fail to maintain them.¹⁶ A serious concern is that less than 30 percent of the general public is able to identify and state the meaning of the SMV emblem.³⁵

The use of pilot or escort vehicles is another way to

Figure 3. Slow moving vehicle (SMV) emblem. The SMV emblem should be mounted at the rear of any vehicle or towed equipment traveling less than 25 mph.



increase tractor and other agricultural machinery safety on public roads. Pilot vehicles drive ahead and/or behind a wide load, with the operator warning traffic of a possible hazard with the use of lights or signs.

By-Pass Starting

By-pass starting, sometimes called jump-starting, involves starting a tractor using some other means than the normal starting system. Almost always this involves starting the vehicle while standing on the ground, usually between the front and rear wheels. Farmers may do this if it is too cold to get an engine to turn over without a boost to the battery, or it may seem easier to warm up the engine by starting it using a screwdriver to arc across the starter terminals rather than climbing up onto the tractor seat and properly starting the vehicle. This creates a very dangerous situation if the tractor was previously left in gear, as the vehicle will lurch forward during by-pass starting and may run over someone on the ground, often the person who started the vehicle. This occurs so suddenly that most farmers cannot react fast enough to avoid catastrophe.⁴⁵ A strict rule of “no bypass-starting” is the best way to avoid this danger.

Duals

The term ‘duals’ refers to an extra set of wheels that may be added to the tractor by the operator in order to increase traction and decrease soil compaction by increasing the area of contact between the tractor and the ground. The process of adding the extra tires is hazardous due to the size and weight of the wheels, which are usually handled manually during installation. The wheels, weighing hundreds of pound each, can fall on the handler causing a crush injury.

Tire Ballast

Fluid, which is referred to as ballast, is sometimes added to tractor tires to increase their weight if extra traction is needed. Common liquids used for ballast include water, calcium chloride, ethylene chloride, propylene glycol, windshield washer fluid, methanol, and flat fill/polyurethane foam. It is an important safety issue for workers to know which fluid is in the tires, and what measures should be taken if exposed to that liquid. When adding air to fluid-filled tires, liquid can blow into one’s eyes or onto the skin if the air nozzle is not completely secure on the tire. Basic first aid should be started no matter what fluid comes in contact with the skin or eyes, including flushing with copious amounts of clean water.

Loaders

Front end loaders are a very useful tractor accessory and commonplace on farms. When a loader bucket is attached to a tractor, the weight distribution of the tractor is changed. Furthermore, the weight distribution changes every time something is picked up or removed from the loader. Adding counterweights to the tractor is essential to maintain weight balance when a loader is attached.

One of the more common causes of tractor rollovers is the altered weight balance caused by front end loaders, including when working on inclines. Other potential hazards of a front end loader include people riding in the loader, or being lifted in the loader to repair objects otherwise out of reach. See Figure 4. Front end loaders are not engineered to lift people, and there are no safety features available for someone riding in the bucket.⁴⁶

Hitching

Figure 4. Front end loader being used as a lift. This is a very dangerous situation, and loaders should never be used in this manner.



tractor and is a safety hazard that is often overlooked. The act of hitching is dangerous because there is usually one person standing between the implement and the tractor to ensure proper alignment, while another person is operating the tractor. The person on the ground is susceptible to crush injuries and being run over.

One needs to ensure proper safety when disconnecting an implement from a tractor or other vehicle as well. The implement should be parked on a flat surface with wheel stops placed in front of and behind the implement wheels to prevent it from rolling on its own. Common wheel stops, or chocks, include pieces of wood, cement block or bricks.

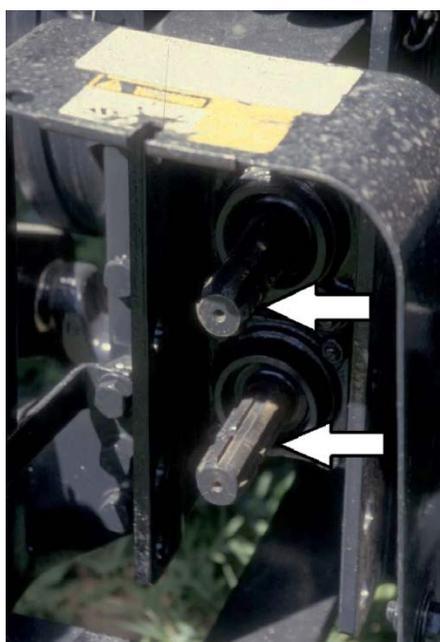
Improper hitching is another area of concern. Tractors have areas that are meant for attaching loads, including a drawbar or three point attachment depending on the load. Attaching the load to an incorrect area of the tractor is a very common cause of rear rollovers (see rollover section above).⁴⁶

Power Take-Off (PTO)

A PTO is a post at the back of the tractor that transfers power from the tractor to another implement such as a grain auger, manure spreader, or hay baler. See Figure 5. Implements which utilize a PTO have a driveline shaft which connects to the PTO post of the tractor via a knuckle area at the end of the shaft called a U-joint. When the

tractor PTO is engaged, the connected driveline shaft spins under power from the tractor's engine, providing power to move the implement's component parts. The PTO spins fast, the usual standard is 540-1000 revolutions per minute (RPM) or about 9-16 rotations per second, and in a clockwise direction.

Figure 5. Power take-off (PTO). The PTO is a post (in this case, two posts) at the back of the tractor which can be used to transfer power to another implement to move its component parts. The implement connects to the PTO via a driveline shaft which has a U-joint at the end of it.

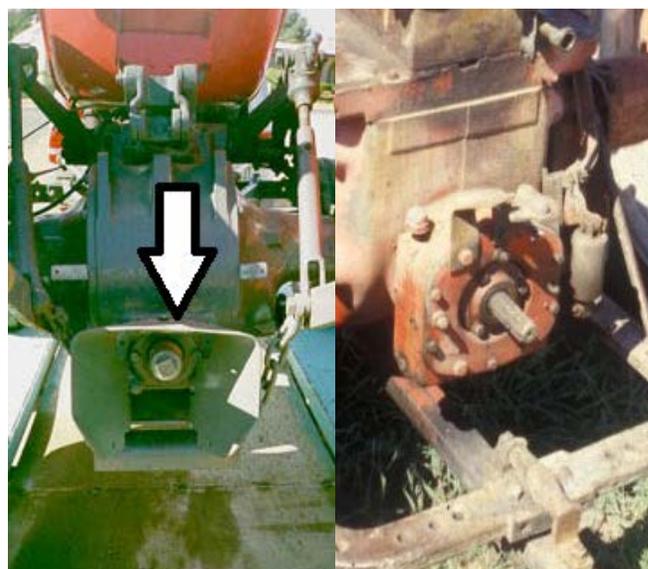


The most common mechanism of injury is when a piece of loose clothing or hair gets caught around the spinning shaft, usually at the U-joint where it is connected to the tractor or where the two parts of the driveline shaft slide together. Once caught around the shaft, there is no time for the person to react due to its high rate of speed, and the person may be pulled into and around the shaft resulting in limb fractures, amputations, and even death. In fact, of the 674 cases involving a PTO identified in the U.S. from 1970-2003, 40% of them were deaths, and about 40% of the survivors whose injuries were known had suffered an amputation.⁴⁷

Shielding is standard equipment on PTO units and has

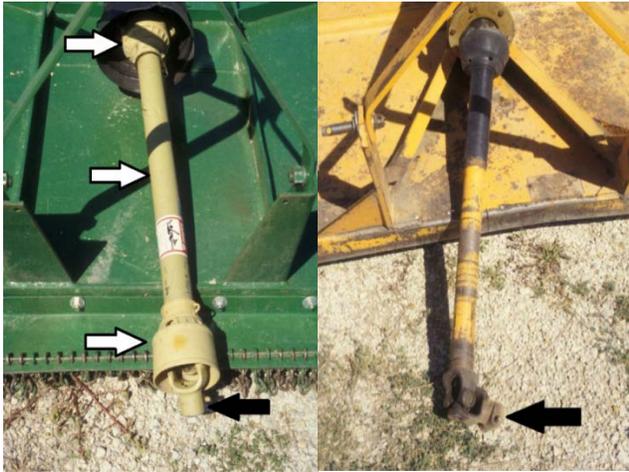
greatly reduced the danger of using new equipment. This includes master shields over the tractor PTO post (see Figure 6) and driveline guards and power input connection guards over the driveline shaft of implements (see Figure 7). However, these shields are easily removed for maintenance and are often not replaced.¹⁶ Since 1994, the industry standard is that all master shields for PTO tractor posts are hinged to facilitate servicing and this has been very effective in preventing routine removal. Still, there are countless old, modified, damaged and unguarded PTOs and driveline shafts that are presently being used that are dangerous. In one study, shielding was either missing or damaged in 70% of PTO entanglement injuries.⁴⁸

Figure 6. Master shield. The first photo shows a tractor with a master shield over the PTO post. In the second photo, the master shield has been removed, probably for servicing, and never replaced. This increases the danger of possible entanglement when the PTO is being used.



It is important to replace PTO master and driveline shaft shields after performing maintenance. Replacements may be purchased if they are worn out or missing. Many companies even offer free replacement PTO master shields and decals. Driveline shaft shields can usually be purchased for \$50 or less. Unfortunately, farmers are often reluctant to replace shields due to the time involved, and often prefer to accept the increased risk.⁴⁹

Figure 7. Driveline and power input connection guards. The first photo shows an implement with these guards in place (see white arrows) and the second photo demonstrates an unguarded driveline shaft. At the end of the shaft is the U-joint (see black arrows) which connects to the PTO post of a tractor.



Seventy-eight percent of PTO injuries involve the machinery operator.⁴⁸ One should never wear loose clothing when operating machinery, especially around PTOs. Shirt tails, shirt sleeves, and pant legs should be tucked in tight. A study has shown that lighter materials such as cotton thread as compared to heavier materials such as leather bootlaces, and longer material as

compared to shorter, are more likely to become entangled.⁵⁰ One should never have loose hair around PTOs as there have been many reports of scalping injuries, especially in females.^{47,51} It is also important to not exit or enter a tractor from the rear when the PTO is attached and the tractor is running as this may accidentally engage the PTO starting mechanism. In addition, the tractor engine should be shut off completely when doing any maintenance, as most injuries occur when the tractor is idling. See Box 3 for National Institute of Occupational Safety and Health (NIOSH) recommendations to prevent PTO and driveline injuries.⁵²

If someone is injured by a PTO shaft, a basic set of safety steps should be followed during rescue efforts. First, make sure the source of power is turned off and disconnect the implement driveline shaft from the tractor PTO post. The rescuer may need to turn the shaft in a counter clockwise direction to free the person. Most implement driveline shafts have two components that facilitate attachment to the tractor (a male shaft sliding into the female shaft). If one pulls the shaft straight out after disconnecting it from the tractor, it may come apart into the 2 pieces, making it easier to free the person. It is also acceptable to bring the entire shaft with the person into the Emergency Department. See Box 4 for PTO rescue procedures from the Farm Safety Association which has been amalgamated into the Workplace Safety & Prevention Services organization in Canada.²⁸

Box 3. Recommendations to Prevent PTO and Driveline Injuries from the National Institute of Occupational Safety and Health (NIOSH)⁵²

- Always disengage the PTO and turn off the tractor ignition before leaving the tractor seat and approaching the driveline.
- Do not perform maintenance or adjustments until both the driveline and the machinery have completely stopped moving.
- Follow the manufacturer's instructions whenever maintenance or adjustments are performed on any farm machinery.
- Warn anyone who might come near an operating PTO about the entanglement hazard.
- Instruct all farm family children and untrained adolescents never to approach, operate, or perform maintenance on PTO-driven machinery.
- Do not wear loose-fitting clothing or jewelry near operating farm machinery.
- Tie back or otherwise secure loose hair, but be aware that even short or tied-back hair may become entangled in moving equipment.

Box 4. PTO Rescue Procedures²⁸

Always start by shutting off the tractor and making sure it will not restart.

- Next, chock the tractor wheels so that the tractor cannot move.
- There are several methods that can be used to remove a victim from a PTO shaft:
 1. Disconnect the PTO shaft from the rest of the tractor, and turn the shaft counterclockwise to unwrap the tightly wrapped cloth and tissue that may be around the shaft. This material will not slip off the shaft after the PTO shaft is disconnected, but must be unwrapped.
 2. Place the PTO drive unit in neutral and turn the PTO shaft counterclockwise to unwrap the person from the shaft. This may require using a large pipe wrench or putting a small shaft or bar into the yoke of the PTO unit and turning with considerable pressure.
 3. You may be able to disconnect the hitch pin that attaches the trailing equipment to the tractor and move the tractor forward to pull the PTO shaft apart. After the PTO shaft separates into two parts, you will have to turn the shaft counterclockwise to remove the victim. If the shaft is solid, the rescuers may have to cut it with a cutting device such as a portable power grinder, hacksaw or oxyacetylene torch.
- If there are combustible materials in the area, rescuers should be extremely careful when using any type of flame-producing equipment, or even portable grinders that produce sparks. If such equipment must be used, adequate fire equipment must be readily available in case a fire starts. If explosive products such as gasoline have been spilled in the area, open flames must not be used. In this case, rescuers and observers should be alert and not smoke in the area.
- While the victim is being removed from the PTO shaft, other rescuers must provide life support to the victim and monitor vital signs continuously. Extrication is only the first step of saving the victim's life.
- If an arm, foot, leg or other part of the body was amputated, it should be located and handled properly for possible reattachment and transported with the victim.

Summary

This article is the first of three intended to be a resource for health professionals across the spectrum wishing to become more knowledgeable about deaths and injuries associated with agricultural work and their prevention or treatment. In Part I, we have focused on tractor-related injuries. See Box 5 for a summary of

tractor safety recommendations from the Centers for Disease Control and Prevention (CDC).⁵³ Awareness of the varied and ever present hazards in the farm workplace, and how that might impact the rescue and treatment of related injuries is essential to the well-being of ranchers and farmers, as well as their families and employees.

Box 5. Tractor Safety Recommendations from the Centers of Disease Control and Prevention (CDC)⁵³

- All tractors should be equipped with a rollover protective structure (ROPS). Limit use of tractors not equipped with ROPS.
- A seatbelt should always be used when operating a tractor equipped with ROPS.
- Avoid crossing slopes whenever possible and use appropriate speeds for the operating conditions.
- Do not allow extra riders on tractors and other farm equipment; follow the “ONE SEAT-ONE RIDER” rule.
- Hitch only to the drawbar and hitch points that the manufacturer recommends.
- When transporting materials using a loader, keep bucket in lowered position.
- Lower hydraulic equipment to the ground when not in use; raised equipment can lower suddenly if the hydraulic lines lose pressure—crushing anything, or anyone, underneath.
- Use available handholds and care when getting on or off the tractor; slips and falls cause injuries.
- Know and follow medication labeling; some medications may impair judgment and/or ability to operate vehicles or machinery.
- Always start the tractor from the operator’s seat with the transmission and power takeoff in neutral and the parking brake engaged. You should never bypass-start a tractor.
- Always disengage the PTO and turn off the tractor ignition before leaving the tractor seat and approaching the driveline.
- Ensure that tractors are properly shut down after each use.

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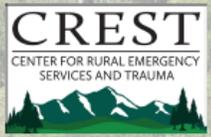


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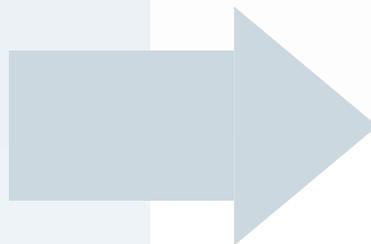
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Defining “Rural” – What’s in a Name?

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Keywords: rural, emergency medicine,
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Over a decade ago the American College of Emergency Physicians (ACEP) supported the first Rural Emergency Medicine Task Force. As one consequence the ACEP Rural Section was born in 2004 to recognize that much of emergency medicine (EM) is practiced in non-urban environments with unique challenges that include limited access to advanced imaging and specialty services. This “high thought, low tech” practice milieu is different from the tertiary academic medical centers where most (EM) physicians train and probably requires a unique curriculum. The early leaders of the ACEP Rural Section did not explicitly define “rural”, “rural provider”, or “rural emergency department”, nor did they debate whether their target audience was in austere settings across the world, simply agricultural or non-urban America, or both. The ACEP Rural Section received a Section Grant to develop a “Rural Emergency Medicine” textbook in 2010, which transformed into a perceptible desire for a sustained voice for rural emergency department (ED) practitioners. Following a survey of the ACEP Rural Section membership in 2013, the *Journal of Rural Emergency Medicine* (JREM) arose and published Issue 1 in June 2014. While seeking JREM support from the ACEP Board of Directors, pertinent questions arose about how the JREM Editorial Board defined “rural”, “rural provider” or “rural ED”. This essay is an attempt to answer these queries.

Layman’s definitions of “rural” sometimes denote derogatory characteristics like unsophisticated or rough. Others define “rural” as relating to or characteristic of the country, farming, or agriculture. Common synonyms for rural include rustic, pastoral, or bucolic. In the House of Medicine a “rural provider” would include any healthcare professional who delivers medical care in rural settings, including pharmacists, medical technicians, nurses, physician extenders, and physicians. A “rural ED” would be a section of a rural hospital dedicated to acute care medicine, including trauma and critical care. Some opine that rural is in the eyes of the beholder, apparent when seen, but difficult to capture in words, definitions, or objective measures. As noted in the Introduction to JREM Issue 1, at least 14 journals already exist with direct or indirect relevance to rural emergency medicine (Table).¹ Understanding how existing professional journals define

TABLE
Existing Rural or Rural Relevant Journals in 2015

The Canadian Journal of Rural Medicine
The Journal of Rural Health
Rural and Remote Health
Australian Journal of Rural Health
Journal of Neurosciences in Rural Practice
Tropical Medicine & International Health
Telemedicine and e-Health
Journal of Health Care for the Poor and Underserved
Journal of Telemedicine and Telecare
Royal Society of Tropical Medicine and Hygiene
Healthcare in Low-resource Settings
Online Journal of Rural Nursing and Health Care
Journal of Rural and Tropical Public Health
Journal of Rural Community Psychology

“rural” could provide one path to defining the same for *JREM*. ACEP President Dr. Michael Gerardi organized the second ACEP Rural Emergency Medicine Task Force in October 2014. In order to meet one of their objectives, this Task Force contacted all 14 of the rural journals noted in Table 1 seeking to understand how each journal defined “rural”. Two Task Force members sent a standardized email query to the Editor-in-Chief of each journal identified via the journal online author instructions. If no response was received, a second email query was sent two weeks later. Only 5/14 journal editors responded and agreed to either answer questions via email (2) or via telephone (3). None of these 5 journals has developed a standard definition for “rural”. One Editor-in-Chief noted that “we leave it to the submitting authors to tell us how their population or setting is rural”. Reviewing the websites of all 14 journals for definitions of “rural” identified no references, guidance, definitions, or suggested synonyms for this term to guide authors.

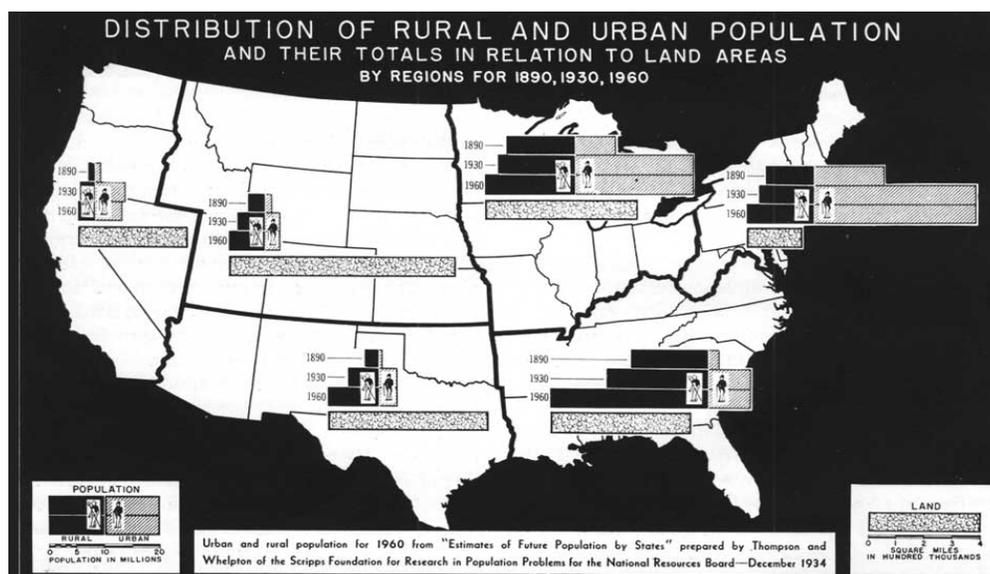
In the absence of a formal definition of “rural” among existing relevant medical journals, we looked to the federal government, which has many definitions of “rural” created by statute or by agencies for programmatic or research use, for the most appropriate definition for our purposes.² The two definitions that are most commonly used are from the Census Bureau and the Office of Management and Budget (OMB). The Census Bureau first began to designate populations as rural in the late 19th century. At that time any

town with a population over 8,000 was considered urban. The population cutoff was later changed to 2,500 and any incorporated place of 2,500 or more persons was considered urban. The rest of the United States (U.S.) land and population was considered rural. Until the 1920 Census, the majority of the U.S. population was rural. The dawn of the Industrial Revolution and the increasing availability of factory jobs led to a population shift towards predominantly urban after 1920 (Figure).³

Suburbs began to expand beyond the incorporated limits of cities following World War II and the Census Bureau changed their definition so that it no longer strictly followed the boundaries of incorporated places, but expanded urbanized areas to the point at which the population density fell to under 1,000 people per square mile.³ The current definition used by the Census Bureau no longer uses the boundaries of incorporated places. Instead, they describe two kinds of urban areas: (1) urbanized areas with a population core of at least 50,000 people and (2) urban clusters that have a population core of at least 2,500 people, but fewer than 50,000 people. Surrounding areas are included in the urban area or cluster as long as the population density remains above 500 people per square mile.

Since almost 81% of the population lived in urban areas in 2010 (nearly 250 million people), it’s surprising that less than 5% of the total land area of the U.S. is in urbanized areas or clusters. One challenge of using the Census Bureau’s definition is that because it no longer follows the boundaries of

Figure



National Park Service. *Distribution of Rural and Urban Population*. Photograph. *Census.gov*. Web. 11 April 2015

incorporated places or county borders, it is difficult to tell where urban areas end and where rural areas begin. In contrast, use of Metropolitan Statistical Areas, as designated by the White House's OMB, is simple. Whole counties are the geographical unit used to delineate the two kinds of Core-Based Statistical Areas (CBSAs): Metropolitan Statistical Areas and Micropolitan Statistical Areas. Metropolitan Statistical Areas have a core, urban area of at least 50,000 people. Micropolitan Statistical Areas have an urbanized core of at least 10,000 people, but fewer than 50,000 people.⁴ After the 2010 Census, 1167 counties were designated as Metropolitan, 641 counties were designated as Micropolitan, and the remaining 1335 were not included in CBSAs. According to this OMB definition, Metropolitan counties now contain 85% of the U.S. population within 1167 counties that make up only 28% of this country's land area. For practical purposes many agencies combine the Micropolitan counties and the non-CBSA counties together as the non-metro (or rural) areas of the U.S.

Neither the Census Bureau nor OMB actually defines "rural". By default, rural areas are what remain after the Census Bureau has designated urban areas, while the non-metro counties are all those which were not included in Metropolitan areas designated by OMB. In medical parlance, "rural" is effectively a diagnosis of exclusion, a label applied after "urban" has been ruled out.

Limitations with both the Census Bureau and the OMB definitions of rural areas are worth noting. Both are moderately complex and create some classifications that defy common sense. The Census Bureau's definition includes a large amount of suburban areas as rural because the population density falls below 500 people per square mile. For example, nearly half of Howard County Maryland, located between Baltimore and Washington, DC, is considered rural because of its low population density. At the other end of the extreme, urban counties as defined by OMB include rural or even frontier areas such as the Grand Canyon (located in Metropolitan Coconino County) and part of Death Valley National Park (located in Metropolitan San Bernardino County).

The U.S. Department of Agriculture's (USDA) Economic Research Service has created other classifications beyond the division of countries into Metropolitan, Micropolitan and

non-CBSA in order to "measure rurality in more detail and to assess the economic and social diversity of non-metro America."⁵ These classifications include Rural-Urban Continuum Codes, with a system that divides Metropolitan counties into 3 categories depending on the size of their core urban population and the non-metro counties are divided into 6 categories depending on the status of their adjacency to Metropolitan counties.⁶ Urban-Influence Codes are a 12 category classification system for counties where the Metropolitan counties are divided into 2 categories, those with total populations over 1 million and those with populations under 1 million. Micropolitan counties are divided into 3 categories by adjacency to the Metropolitan counties and non-CBSA counties are divided into 7 groups by their adjacency to Metropolitan or Micropolitan areas and whether or not they contain a town of at least 2,500 residents.⁷

While use of the USDA county based systems permits more accurate classification than simply dividing counties into Metropolitan, Micropolitan and non-CBSA categories, they still use the county as the geographical unit of measurement and counties vary widely in area and population settlement patterns. In collaboration with the Federal Office of Rural Health Policy, the Economic Research Service developed and maintains the rural-urban commuting area (RUCA) codes to classify a sub-county unit, the Census Tract, by 10 classifications ranging from the urban core to isolated rural tracts.⁸

The US Congress has been concerned with the impact of reimbursement policies on rural hospitals since the 1980s, when the implementation of the Medicare Prospective Payment System was associated with the closure of hundreds of rural hospitals. Section 1886 of the Social Security Act refers to how Centers for Medicare & Medicaid Services (CMS) designates rural hospitals. "[T]he term "urban area" means an area within a Metropolitan Statistical Area (as defined by the Office of Management and Budget) ... and the term "rural area" means any area outside such an area or similar area." Hospitals outside of Metropolitan counties are considered rural hospitals.

However the CMS definitions grow more complex, since hospitals in Metropolitan counties can also be designated as rural under section 1886(d)(8)(E): if the "hospital is located in a rural Census Tract of a metropolitan statistical area (as

determined under the most recent modification of the Goldsmith Modification, originally published in the Federal Register on February 27, 1992 [57 Fed. Reg. 6725].” The Goldsmith modification, developed by the Federal Office of Rural Health Policy, was an earlier version of the RUCA codes. The current version of the RUCAs as used by the Federal Office of Rural Health Policy, designates all Census Tracts with RUCA codes 4 to 10 in Metropolitan counties as rural, and also includes a small number of Metropolitan large, low density Tracts with RUCA codes 2 or 3 as rural. When the rural Tracts are combined with the population and area of the non-metro counties in the U.S., about 18% of the population and 82% of the U.S. landmass is classified as rural.

Hospitals can also be classified as rural if “any State law or regulation deems it to be a rural hospital or located in a rural area,” or, while it is located in a Metropolitan county, it would meet all the requirements to be classified as a Rural Referral Center (RRC) or a Sole Community Hospital (SCH).⁹ While not every hospital in a non-metro county is classified as rural for CMS payments, most hospitals that are classified as rural are either located in a non-metro county or in a rural Census Tract of a Metropolitan county.

Considering which definition makes the most sense in the context of Emergency Medicine, there is an obvious benefit to aligning with the definition used by CMS for classifying hospitals as rural. Therefore, we propose using the definition specified in the Social Security Act, which includes as “rural” all Non-metro counties and the Metropolitan County Census Tracts identified by the Federal Office of Rural Health Policy as rural. Although use of other definitions of “rural” may be appropriate for some purposes, including for the selection of papers for inclusion in a rural journal, this definition seems most valid for ACEP and organized medicine to use in defining an area as rural or not.

In conclusion, defining “rural” is surprisingly complex without a uniformly accepted descriptor, either in journals or governmental agencies. Those seeking to define an area as “rural” from a practical perspective should consider using the “Am I rural? Tool” available at <http://www.raconline.org/amirural> or the Rural Health Grants Eligibility Analyzer at <http://datawarehouse.hrsa.gov/RuralAdvisor/RuralHealthAdvisor.aspx>

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A Descriptive Study of Traumatic Brain Injury Patients and their Transfer within the State of Alaska

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Introduction

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Patients with head trauma may have traumatic brain injury (TBI) requiring rapid and decisive neurosurgical intervention. Providing definitive TBI management for the 59% of Alaskans who live outside the Anchorage metropolitan area is a challenge; many patients with head trauma must be transferred for neurosurgical specialty care hundreds of miles away in Anchorage or Seattle, Washington.¹ Transfers come at a high cost; the Medicare air ambulance rate in rural Alaska starts at a base rate of \$4753 for a fixed wing one-way transfer and \$5525 for a rotary one-way transfer. There is an additional fee of \$12.80 and \$34.80 per mile for fixed wing and rotary flights, respectively.² In addition, the

hazards of flying through rural Alaska are quite real, including limited radar coverage, unpredictable weather and rough terrain. Not surprisingly, Alaskan pilots demonstrate a work-related mortality rate of 410 per 100,000, which is nearly five times the rate of pilots in the rest of the United States.³ In 2004, in order to provide the best possible care without excessive transfers across the vast rural and remote settings of Alaska, the Alaska Trauma Systems Review Committee adopted the *Alaska State Guidelines for the Management of Acute Head Trauma in Remote and Rural Locations* henceforth referred to as “the Alaska guidelines.”⁴ These guidelines were presented at the annual State of Alaska Emergency Medical Services (EMS) Symposium in 2004. They were further distributed by being placed on the Alaska EMS website and continue to be available for free download and unlimited distribution at the Alaska Department of Health and Social Services website. The Alaska guidelines have not yet been validated in any studies.

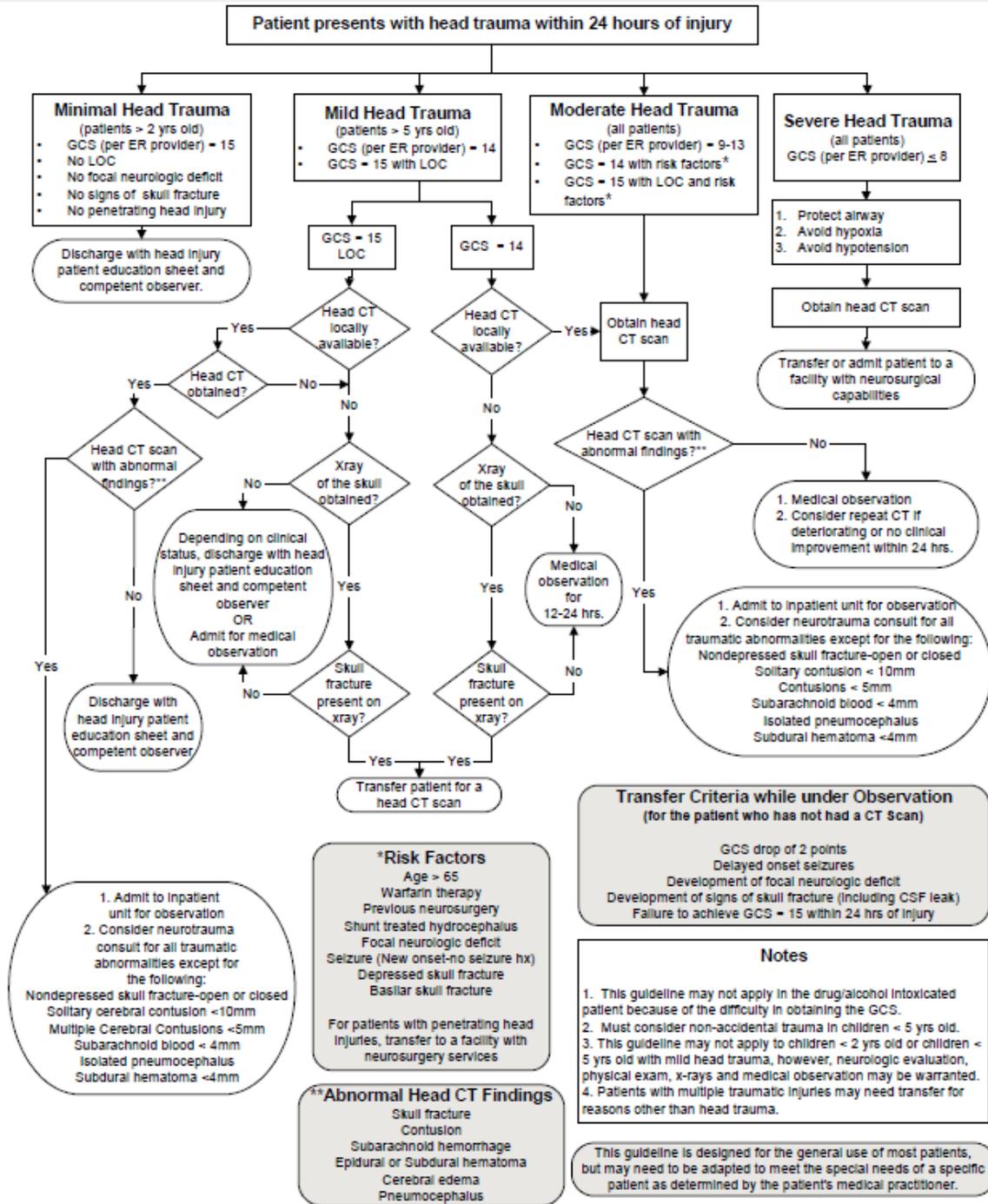
The Alaska guidelines were initially formed when the Alaska Trauma Systems Review Committee convened in 2003 to develop the recommendations. This group consisted of 18 physicians representing emergency medicine, trauma surgery, radiology, pediatrics, and neurosurgery. Each physician had many years of experience working in the unique environment provided within the state of Alaska. A literature review was done and distributed to the committee. Several previous studies were considered in the formation of

the final guidelines, including neurosurgical literature, the Canadian Computed Tomography (CT) Head Rules, the Scandinavian guidelines, and NEXUS II. A complete list of reviewed literature taken into account when formulating the guidelines can be seen in Table 1. These studies, along with the experiences and judgement of the committee members were taken into account when developing the Alaska guidelines. A detailed flowchart of the Alaska guidelines appears in Figure 1.⁴

Table 1- Literature considered in the formation of the Alaska guidelines

Committee on Trauma, American College of Surgeons. <i>Advanced Trauma Life Support for Doctors</i> . Chapter 6. "Head Trauma" 6th edition. 1997
Committee on Quality Improvement, Am. Academy of Pediatrics, Commission on Clinical Policies and Research, Am Academy of Family Physicians. The management of minor closed head injury in children. <i>Pediatrics</i> 1999 104(6) 1407-15.
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Figure 1 - Flowchart of Alaska Traumatic Brain Injury Guidelines



The Alaska guidelines define a *rural* facility as one with medical providers and a CT scanner, but no neurosurgeons, and a *remote* facility as one that has medical providers, but no CT scanner or neurosurgeons. Effectively, all medical facilities in Alaska outside of Anchorage are either rural or remote. This emphasizes how rural most of Alaska is. The largest city in the state, Anchorage, has a population of approximately 300,000. The next two largest cities, Fairbanks and Juneau each have a population slightly greater than 30,000.

Patients with minimal head trauma (see Table 2) do not need imaging. They can be discharged with head injury instructions in the care of a competent observer and do not require transfer. The guidelines for patients with mild and moderate head trauma are much more complicated and depend on Glasgow Coma Scale (GCS), level of consciousness (LOC), the availability of CT, specific CT findings, x-ray findings, neurosurgery teleradiology consultant availability and recommendations, and individual patient’s symptom progression during emergency department (ED) observation (see Figure 1). All patients with severe head trauma require head CT and should be managed facilities in with neurosurgical specialist care.

The 2002 American College of Emergency Physicians (ACEP) Clinical Policy regarding neuroimaging and disposition decision-making in adult mild TBI in the acute setting was not cited in the Alaska guidelines.⁵ The ACEP Clinical Policy does not recommend skull film radiographs in the evaluation of mild TBI. The ACEP Clinical Policy recommends a head CT scan in patients with loss of consciousness or posttraumatic amnesia *only* if one or more of the following is present: headache, vomiting, age greater than 60 years, drug or alcohol intoxication, deficits in short term memory, physical evidence of trauma above the clavicle, posttraumatic seizure, GCS score less than 15, focal neurologic deficit, or coagulopathy. Lastly, the ACEP Clinical Policy recommends that patients with no history of coagulopathy or prior neurosurgical procedures who have a negative head CT scan result are at minimal risk for developing an intracranial lesion and therefore may be safely discharged from the ED. The Alaska guidelines differ from the ACEP Clinical Policy in that they apply to all TBI, not just mild TBI. Furthermore, the Alaska guidelines account for situations in which CT scanners may not be readily available by using x-ray. Lastly, the Alaska guidelines are much less conservative allowing for observation of a range of patients, including those with

Table 2 - Alaska guidelines categorization of head trauma

Minimal	Mild	Moderate	Severe
GCS 15, no LOC, no focal neurological deficit, no signs of skull fracture, no penetrating head injury	GCS 14 or GCS 15 with LOC	GCS 9-13 or GCS 14 with risk factors* or GCS 15 with LOC and risk factors*	GCS ≤ 8
*Risk factors: age > 65, warfarin therapy, previous neurosurgery, shunt treated hydrocephalus, focal neurologic deficit, new onset seizure, depressed skull fracture, basilar skull fracture			

abnormal head CT findings. The Alaska guidelines for moderate head trauma also differs from the American College of Surgeons (ACS) Committee on Trauma Field Triage Decision Scheme to identify which patients require transport to a trauma center. The ACS recommends that all patients with GCS less than or equal to 13 be transported to the highest available trauma center.⁶ A summary of the major differences between the Alaska guidelines and the ACEP and ACS guidelines can be seen in Table 3.

They reported no in-hospital deaths and all patients were discharged with unchanged or improving head CTs and good neurologic condition.

Objectives

The Alaska head trauma guidelines have been available since 2004, but anecdotal evidence suggests that they have been applied inconsistently. The primary aim of this study is to estimate how well the transfer guidelines are being followed. The secondary aim is to report descriptive

Table 3 - Summary of the major differences between the Alaska, ACEP, and ACS guidelines

	GCS 14-15	GCS 9-13
Alaska	Consider skull xray if head CT not available	Consider inpatient observation even with abnormal CT findings
ACEP	Doesn't recommend skull xray	
Trauma Field Triage		Transfer to highest available trauma center

Our literature review suggests that the Alaska guidelines intention to avoid excessive transfers is a problem faced by many rural facilities. A 2013 study by Sorensen et al looked at the rates of secondary overtriage in a rural trauma system and reported that 56% of overtriaged transferred patients had head and neck injuries.⁷ These patients were likely transferred because of the lack of neurosurgical specialty care. Sorensen et al. recommend improved collaboration, including teleradiology, between neurosurgeons at level I trauma centers and their referring rural hospitals. In addition, Alaska is not unique in starting a non-transfer protocol for patients with head trauma and abnormal CT scans. A 2008 study by Fabbri et al reviewed 6 month outcomes for patients with abnormal post-TBI head CT's that did not require immediate neurosurgical intervention.⁸ These patient's scans were discussed with a neurosurgeon via a teleradiology consultation before deciding if they would be transferred to a higher level of care. Their research demonstrated that patients with mild to moderate TBI who were observed in a peripheral hospital and could be transferred to a higher level of care within 30-60 minutes were not exposed to extra risks. A 2013 study by Levy et al studied in hospital outcomes of non-transferred patients with small intracranial hemorrhages in a rural trauma center without neurosurgical capabilities.⁹

characteristics of patients with isolated head trauma in Alaska. Results might be useful for hospitals in Alaska and elsewhere, to improve their transfer protocols. Improved transfer protocols might improve outcomes and decrease unnecessary transfers. Unnecessary transfers not only waste limited resources, especially money and personnel, but also carry risks for EMS providers, including flight crews, and patients.

Methods

Alaska Trauma Registry (ATR) data from 2004-2010 was obtained. The ATR collects information from all 24 of Alaska's acute care hospitals. In order for a patient to be included in the ATR, the patient must be admitted to a hospital in Alaska, either as an inpatient or under observation, transferred to another acute care hospital, or declared dead in the ED within 30 days of an injury.¹⁰ Patients discharged home from the ED were not included in the study since they were not in the ATR. This is a significant limitation in the evaluation of minimal head trauma and is further addressed in the limitations section.

We identified head trauma cases based on ICD-9 codes and described demographics of patients with head trauma. We then categorized these cases retrospectively, using the Alaska guidelines, into minimal, mild, moderate, or severe

head trauma. In order to eliminate the effects of other injuries on transfer decisions, we further evaluated only patients with isolated head trauma. In the final analysis, we included only patients with minimal and severe head trauma, the two categories for which the Alaska guidelines make clear-cut recommendations. Patients with minimal head trauma should not be transferred, whereas all patients with severe head trauma seen at hospitals outside of Anchorage should be transferred for neurosurgical care. We compared survival among patients who were and were not transferred. We could not study adherence to the guidelines for patients in the mild and moderate categories because imaging results affecting transfer decisions were not available in the registry. We simplified dispositions from the ED into either “admit” or “transfer.” A single

researcher (KA) compiled all the data in a Microsoft Excel Spreadsheet. Statistical significance of changes was evaluated using two-tailed p-values, which were calculated using OpenEpi software.

Results

Demographics

From 2004 to 2010, there were 33,515 patients with trauma of whom 4,685 (14%) had head trauma (see Table 4). There were 943 patients with minimal head trauma, 1073 mild, 1939 moderate and 730 severe. Of the head trauma patients, 3059 (65%) had isolated head trauma. There were 597 patients with minimal isolated head trauma and 432 patients with severe isolated head trauma.

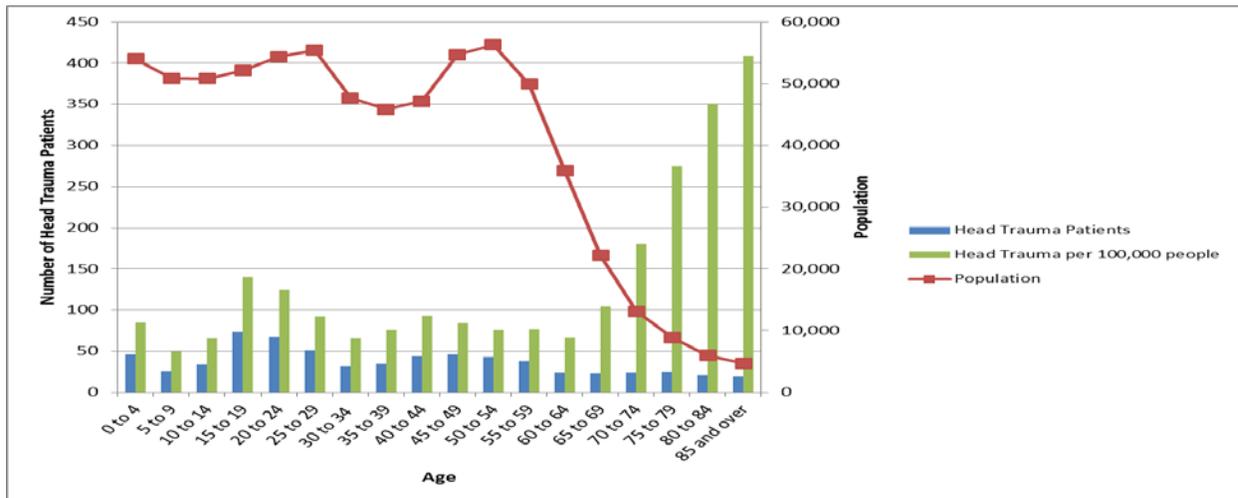
Table 4- Head Trauma Demographic Data

	Total	Average/Year	Percentage of Total Trauma
Trauma	33515	4787.9	100
Male	19151	2735.9	57
Female	14357	2051.0	43
Non-Native	21911	3130.1	65
Native	11604	1657.7	35
TBI			
	Total	Average/Year	Percentage of Total TBI
TBI	4685	669.3	100
Males	3201	457.3	68
Females	1483	211.9	32
Non-Native	3202	457.4	68
Native	1483	211.9	32
TBI by Age			
Age	Total	Average/Year	Percentage of Total TBI
0 to 4	321	46	7
5 to 9	177	25	4
10 to 14	235	34	5
15 to 19	512	73	11
20 to 24	475	68	10
25 to 29	358	51	8
30 to 34	221	32	5
35 to 39	242	35	5
40 to 44	306	44	7
45 to 49	321	46	7
50 to 54	299	43	6
55 to 59	267	38	6
60 to 64	168	24	4
65 to 69	163	23	3
70 to 74	166	24	4
75 to 79	171	24	4
80 to 84	147	21	3
85 and over	135	19	3

The age distribution of patients with head trauma is shown in Figure 2. There is a bimodal distribution of head trauma. The 15-29 year old age range experiences the greatest percentage of all head trauma; however, the greater than 65 year old population has the highest rate of head trauma per capita.

More trauma patients were male: 19,151 (57%) than female: 14,357 (43%) (see Table 4). For head trauma, the ratio was more skewed: 3,201 (68%) male and 1,483 (32%) female. According to the 2010 US census, 15% of the population are Alaska natives; but 1,483 (32%) of all head trauma patients were Alaska natives.¹¹

Figure 2 - Head Trauma incidence per 100,000 people by age

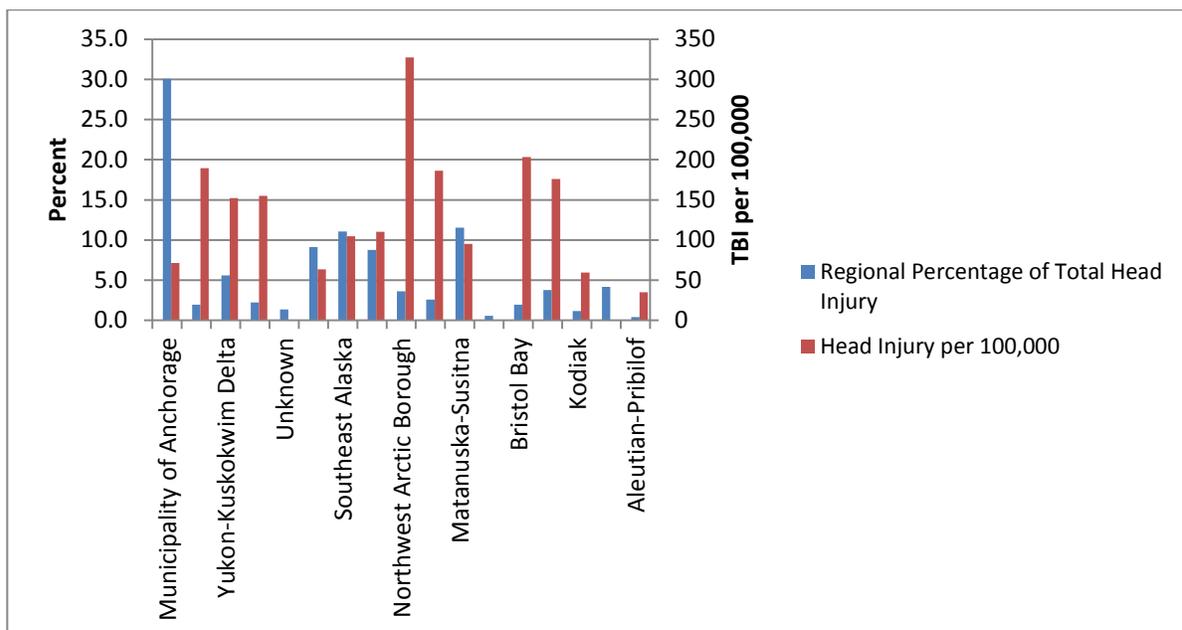


Region

The Municipality of Anchorage makes up 41% of the population of Alaska, but only 30% of Alaska’s head injuries occurred within this region (see Figure 3). The incidence of head injury within Anchorage was 72/100,000 people. This trend of lower incidence of head injury can be

seen in all of the larger population centers within the state including Fairbanks, Southeast Alaska, Kenai, and the Mat-Su Borough. Additionally, the highest incidences of head injury were seen in the rural communities across the state, with the highest incidence occurring in the Northwest Arctic Borough at 327/100,000 people.

Figure 3 - Regional percentage of total head injury and head injury per 100,000 people



Disposition

From 2004 to 2010, of 343 patients with minimal isolated head trauma outside Anchorage, 101 (29%) were transferred and 242 (71%) were not transferred. Of 227 patients with severe isolated head trauma, 81 (36%) were transferred and 146 (64%) were not transferred. Transferred versus not transferred data can be seen in Table 5. Details of the remaining ED dispositions of patients with head trauma are shown in Table 6. The final in-hospital disposition of all patients from the hospital can be seen in Table 7. For both severe and minimal head trauma patient transfer status had no statistical significance on patient mortality.

Table 5 - Minimal and Severe Head Trauma outside Anchorage Transfer Data

Not transferred vs transferred			
	Not transferred	Transferred	Total
2004-2010			
Minimal	242 (71%)	101 (29%)	343 (100%)
Severe	146 (64%)	81 (36%)	227 (100%)

Table 6 - Alaska Isolated Head Trauma Emergency Department Discharge by Category and Region

Head Trauma ED Discharge										
	Observation	AMA	Non-critical inpatient unit	Stepdown Unit	ICU	OR	Died	Transfer	N/A	Total
Alaska Isolated Head Trauma										
Minimal	88 (19%)	3 (1%)	175 (39%)	20 (4%)	49 (11%)	9 (2%)	0 (0%)	106 (23%)	5 (1%)	455 (100%)
Severe	5 (2%)	1 (0%)	19 (6%)	5 (2%)	128 (39%)	36 (11%)	50 (15%)	85 (26%)	0 (0%)	329 (100%)
Anchorage Isolated Head Trauma										
Minimal	13 (12%)	0 (0%)	52 (46%)	9 (8%)	29 (26%)	3 (3%)	0 (0%)	5 (5%)	1 (1%)	112 (100%)
Severe	0 (0%)	0 (0%)	8 (8%)	4 (4%)	51 (50%)	17 (17%)	18 (18%)	4 (4%)	0 (0%)	102 (100%)
Remainder of State Isolated Head Trauma										
Minimal	75 (22%)	3 (1%)	123 (36%)	11 (3%)	20 (6%)	6 (2%)	0 (0%)	101 (29%)	4 (1%)	343 (100%)
Severe	5 (2%)	1 (0%)	11 (5%)	1 (0%)	77 (34%)	19 (8%)	32 (14%)	81 (36%)	0 (0%)	227 (100%)

Table 7 – Final In-Hospital Dispositions

Outside Anchorage Isolated TBI Transfer Final Discharge														
	Home, No Assistance	Home, Health Care	Home, Rehab Outpt	Skilled Nursing	Intermediate Care	Inpatient Rehabilitation	Acute Care Hospital	Expired	Other	Jail/Prison	AMA	Burn Center	Mental Health	N/A
Minimal	38 (38%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	2 (2%)	57 (57%)	2 (2%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Severe	12 (15%)	0 (0%)	0 (0%)	2 (2%)	0 (0%)	8 (10%)	37 (46%)	20 (25%)	1 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Outside Anchorage Isolated TBI Stay Final Discharge														
	Home, No Assistance	Home, Health Care	Home, Rehab Outpt	Skilled Nursing	Intermediate Care	Inpatient Rehabilitation	Acute Care Hospital	Expired	Other	Jail/Prison	AMA	Burn Center	Mental Health	N/A
Minimal	222 (92%)	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	10 (4%)	0 (0%)	2 (1%)	2 (1%)	5 (2%)	0 (0%)	0 (0%)	0 (0%)
Severe	45 (31%)	0 (0%)	5 (3%)	7 (5%)	1 (1%)	15 (10%)	10 (7%)	56 (38%)	3 (2%)	2 (1%)	2 (1%)	0 (0%)	0 (0%)	0 (0%)

Discussion

Head trauma is a major problem for Alaskans. 94/100,000 people are reported to the ATR each year with head trauma, meaning they were either admitted to a hospital in Alaska, transferred to another acute care hospital, or declared dead in the ED within 30 days of an injury. This is slightly higher than the nationwide rate of head trauma hospitalizations of 91.7/100,000.¹² The actual number of patients with TBI, especially those associated with minimal head trauma, is likely much greater. Many patients with head trauma are evaluated and released from the ED or do not present at all and are therefore not included in the ATR. The difference in rates of head trauma among regions can be attributed to several factors. For examples, work, transportation access, and

recreation differ between rural and urban areas. Use of alcohol and drugs is also higher in rural areas.¹³

The Alaska guidelines recommend that patients with isolated minimal head trauma be discharged to a competent observer with head injury instructions rather than being transferred to another hospital.⁴ However from 2004 to 2010, 29% of patients with isolated minimal head trauma were transferred. The number of patients seen in Alaskan EDs with minimal head trauma is likely much larger than the number recorded in the ATR since many would be discharged from the ED without ever being admitted or meeting criteria to be included in the ATR. This would greatly increase the true denominator of patients with minimal head trauma, and decrease the percentage of patients with minimal head trauma that were transferred.

Furthermore, even though these patients presented with isolated head trauma, the fact that they were either admitted or transferred shows that there was something about the patient that made the treating physician uncomfortable about the patient's disposition.

The guidelines also recommend transfer to neurosurgical care for all patients with severe head trauma, but from 2004 to 2010 only 36% of patients outside of Anchorage with severe isolated head trauma were transferred. 56 (38%) of the patients with severe isolated head trauma who were not transferred died; however, 32 of these patients died before leaving the ED. When those patients are removed from the calculation, 24 (21%) died before their final disposition from the hospital. 20 (25%) of the patients with severe isolated head trauma who were transferred died before their final disposition from the hospital. These differences were statistically insignificant. The Alaska guidelines have a clause that states the guidelines "may need to be adapted to meet the special needs of a specific patient as determined by the patient's medical practitioner."⁴ It is impossible to know from the available data whether the non-transferred patients who died were in a futile state, or if they would have benefited from a higher level of care. Providers may choose to not transfer patients they expect to die or those in whom they anticipate severe permanent brain damage even with treatment.

One key lesson learned from this data is the difficulty in implementation of new guidelines. Passive dissemination, the main route of distribution of the Alaska guidelines, is generally ineffective.¹⁴ In order to change physician practice behavior, other techniques have seen greater success, including computerized decision support systems and interactive educational outreach visits. Using some of these techniques would likely increase adherence to the Alaska guidelines.

Limitations

This was a retrospective study. The ATR does not include patients with head trauma who were not admitted or transferred to a hospital, and therefore underestimates the number of patients with head trauma, especially minimal head trauma, by an unknown amount.

Adherence to the Alaska guidelines for patients with minimal head trauma is likely better than this data suggests.

The database, although compiled by trained trauma reviewers, may contain errors that would affect classification of head trauma, especially since it was not designed to capture the classification of head trauma. Specifically, transfer recommendations for mild and moderate head trauma may require results of CT or x-ray imaging, but these results were not available in the database. Several of the risk factors used to categorize the severity of head trauma were also not documented. These include previous neurosurgery, anticoagulant usage, and shunt-treated hydrocephalus. The lack of relevant data may have resulted in over-reporting of minimal and mild head trauma and underreporting of moderate head trauma. This would tend to skew the study towards the conclusion that minimal head trauma patients are excessively transferred, when some of these transfers may be appropriate.

We were not able to study the factors leading to the transfer of patients with isolated minimal head trauma or the reasons that many patients with isolated severe head trauma were not transferred. Patients with minimal head trauma may have had underlying medical conditions, such as syncope or seizure, that led to transfer and that may have caused the head trauma, even though the head trauma was minor. This would increase the number of apparently unnecessary transfers of patients with minimal head trauma. We also were not able to study outcomes other than death because the ATR does not collect follow-up morbidity information. This would be helpful in future studies because even mild head trauma can cause disability.

Conclusion

Based on our analysis of data from 2004–2010 in the ATR, it does not appear that medical providers were adhering to the Alaska guidelines for transfer of head trauma patients. Although patients with isolated minimal head trauma do not require urgent specialty care, 29% were transferred. All patients with severe head trauma require transfer according to the Alaska head trauma guidelines, but 64% of patients with isolated severe head trauma were not transferred.

Vast distances and limited resources will continue to provide challenges in the care of head trauma patients in Alaska. A literature review shows there are effective and safe ways to integrate imaging, observation, and neurosurgical teleradiology consultation to safely treat patients with head trauma in a rural setting.^{7,8,9} Outreach to Alaskan providers at rural and remote healthcare facilities to understand their current practice patterns, their awareness of existing guidelines, and reasons for adherence or non-adherence to the Alaska guidelines will be essential reduce unnecessary transfers to a higher level of care for patients with head trauma.

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Hosts



Gregory L. Henry, MD

Dr. Henry has reviewed in excess of 2,000 emergency medicine malpractice cases, is the editor of the ACEP text, *Emergency Medicine Risk Management: A Comprehensive Review* and has been the CEO of an emergency physicians malpractice insurance company. Dr. Henry lives to teach and this is reflected in the energy and passion he puts into each of his presentations.



W. Richard Bukata, MD

Dr. Bukata is the editor of *Emergency Medical Abstracts* and, as such, he has been summarizing the key literature of Emergency Medicine for more than 30 years. In addition to his interests in evidence-based, literature-defensible emergency care, as the director of a community hospital ED for 25 years he has the perspective of a front line emergency physician.



ED Leadership Monthly

The Monthly Audio Series Designed For Emergency Department Physician and Nurse Leaders to Optimize the Operation of Their Departments

Hosts



Shari Welch, MD

Dr. Welch is a practicing emergency physician with Utah Emergency Physicians and a research fellow at the Intermountain Health Institute for Health Care Delivery Research in Salt Lake. She has written numerous articles and three books on ED quality, safety and efficiency. She is a consultant with Quality Matters Consulting with her particular specialty being ED operations. She is a Fellow of the American College of Healthcare Executives and certified in Healthcare Management.



Kevin Klauer, DO, EJD

Dr. Klauer is the Chief Medical Officer - Emergency Medicine and Chief Risk Officer for TeamHealth as well as Executive Director of the TeamHealth Patient Safety Organization. He is an Assistant Clinical Professor at Michigan State University College of Osteopathic Medicine, Speaker of the ACEP Council and Medical Editor in Chief of *ACEP Now*. Dr. Klauer has a law degree and has authored numerous articles and book chapters on ED management.



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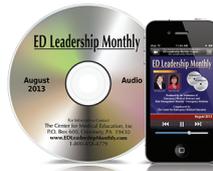
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ACEP, Open Wide the Gates

Rick Bukata, MD

The great debate over allowing non-boarded EM physicians into ACEP is a battle that doesn't make sense anymore. Here's why ACEP needs to open its doors a little wider.

There has been a longstanding debate on what credential you need to be a member of ACEP. I completed my residency in EM in 1975 – before some of you were even born. I was ABEM certified in the first year certification was available. SO I completely understand the angst associated with EM being recognized as a specialty. I have now been an ACEP member for about 35 years.

That being said, I believe that ACEP members who want to limit inclusion to only EM boarded physicians are making a huge mistake. I have heard all of the elitist arguments in favor of this model – and yes, I think the best way to learn EM is to take a residency. But there are simply too many compelling reasons why the college needs to open membership to all who practice emergency medicine.

This sense of exclusivity ignores the fact that emergency medicine is now being practiced, and will always be practiced, by well-intended, sincere physicians who are not EM-trained. At least 10,000 (probably closer to 14,000) physicians practice emergency medicine without the EM board stamp of recognition. Many of these docs practice in rural environments, covering the ED at a local hospital. It is a bit of a slap in the face to exclude them from the club even though they're showing up and doing the same work.

Then there is the fact that excluding non EM-boarded docs is hypocritical because we are readily and happily handing over EM duties to PAs and NPs, and welcoming them into the fold. Would it be better to have all EM-boarded physicians seeing every ED patient in the country? Probably. But, realistically, that's never going to occur. I know large, multicontract groups where 30% of all patients are seen by PAs or NPs. So who is kidding whom? Why relegate our non-boarded brethren to second-class status when we readily admit the vital role of advanced practice providers?

We also need ALL emergency care physicians to be involved in ACEP for the sake of EM advocacy. It is not just about educational opportunities or e-mails and news updates. It is about these physicians being needed to help carry the legislative advocacy ball. Although I don't know the percentage of ACEP dues that are allocated for legislative advocacy, it is significant. And that doesn't count the additional funds raised for the ACEP Foundation, which would also benefit from enlarging the rolls.

To look at it a different way, currently, EPs who are not ACEP members get all of the benefit of our extensive, expensive advocacy efforts without paying a dime. And the advocacy also is present on the state level. IN my state chapter in California, I'll bet that at least half of discretionary income goes to advocacy. And we, too, have a Foundation in which even more money can be spent for advocacy. Widening the net and getting more emergency medicine docs to pay dues just makes practical sense because they are benefiting from these initiatives.

I know that suggesting that all physicians who practice EM should be allowed membership in ACEP will ruffle feathers – especially at the residency level. But, honestly, the residency fight is over. Emergency medicine is recognized as a specialty; boarded EPs will get good jobs and non-boarded EPs are not going to replace boarded EPs. The fear that the American Academy of Emergency Medicine was going to siphon off all the boarded EPs if ACEP didn't also mandate boards is largely behind us – ACEP and AAEM are at least cordial now. The contract management corporations don't control ACEP, and the people on the ACEP Board are reasonable folks with no hidden agendas. It's OK to open up a bit.

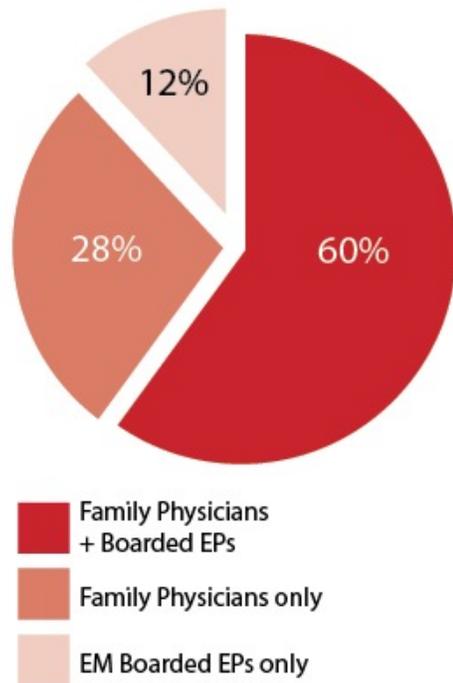
Let's follow the lead of other medical societies. The majority of specialty societies allow some sort of membership for non-boarded physicians. Non-boarded physicians who are allowed into ACEP can become "affiliate" members, or what have you. They can be counted, or not counted, when determining the number of councilors from a state for the ACEP council. (I would count them because they do provide care in settings in which EPs either are not available or choose not to practice and they have a great deal to offer the College.)

Finally, opening up the ACEP gates is the right thing to do because we need to provide more support to our colleagues working in rural areas. For decades, ACEP members who work in rural areas have bemoaned the lack of attention paid to this very important aspect of emergency care. Not every hospital has 24-hour CT scan access, ultrasound on demand, MRI capabilities and house staff and specialists available 24/7. In many ways, it is a lot harder working in the rural setting than in large hospitals. And when you look at who teaches at most conferences, you see that it's the academics, the people with virtually no experience working in a resource-limited rural setting.

Take a look at these stats: According to a recent study (see opposite column) of emergency department staffing in Iowa, only about 12% of EDs are staffed exclusively by boarded EPs. About 60% are staffed by family physicians and boarded EPs and about 28% are staffed by FPs only.

The numbers have remained steady from 2008 to 2012. A similar study is underway in Wisconsin – and I bet it will produce similar results.

PHYSICIAN MIX –
A recent study showed that in Iowa, only 12% of EDs are staffed entirely by EM boarded physicians



So, please let's have ACEP represent all of the physicians who provide emergency care. It makes practical, fiscal sense, and it's the right thing to do.

1. BOARD-CERTIFIED EMERGENCY PHYSICIANS COMPRISE A MINORITY OF THE EMERGENCY DEPARTMENT WORKFORCE IN IOWA
Groth, H., et al, West J Emerg Med 14(2):186, March 2013

BACKGROUND: It has been estimated that family physicians (FPs) provide nearly one-third of emergency care, particularly in rural areas where 42% of EDs are located. A three-fold increase has also been reported from 1993 to 2005 in the proportion of ED visits managed by PAs and NPs.

METHODS: These multicentered authors, coordinated at the University of Virginia, surveyed the administrators of all 119 Iowa hospitals with EDs in 2008 and 2012 regarding ED staffing patterns. The response rate was 100%.

RESULTS: There were no significant differences between 2008 and 2012 regarding the percentage of EDs that were staffed with board-certified emergency physicians (EPs) only (12.6% and 11.8%, respectively), a combination of EPs and FPs (63% and 60.5%), or FPs only (22.7% plus 1.7% staffed with IM residents vs. 27.7%). However, there was a significant increase in the percentage of EDs with solo staffing by PAs and NPs for at least part of the week (38.7% vs. 60.5%). In 2012, the mean population of communities supporting exclusive ED staffing by EPs was just under 85,000. Reasons for staffing with FPs most commonly included low availability of EPs, low patient census and

satisfaction with the care provided by FPs, while reasons cited for staffing with EPs included high availability of EPs and patient census, and the quality of care provided by EPs. Low salaries and low physician availability were often cited as reasons for hiring PAs and NPs for solo ED coverage.

CONCLUSIONS: Physician staffing of Iowa EDs did not change substantially between 2008 and 2012, but there was a significant increase in staffing by advanced practice providers (APPs). Without ED coverage by FPs, it would not be possible to provide emergency care for large areas of the state. 17 references (hans-house@uiowa.edu – no reprints) (PMID: 23599868)

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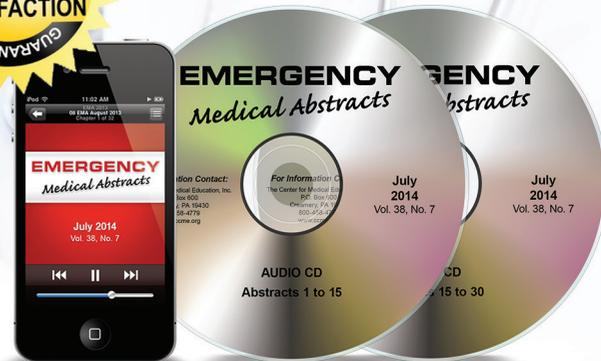
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JREM Rural Spotlight - Idaho

Ken Gramyk, MD, FACEP
 Lake Pend Oreille
 Emergency Medicine, PLLC
 Bonner General Health
 Rural EM Section-Secretary

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When you have seen one rural emergency system, you've seen one rural emergency system. With this issue, JREM introduces a new series to highlight the unique attributes of each rural system, state-by-state.

IDAHO QUICK FACTS



Idaho is the 13th largest state in the U.S. covering an area of 83,557 square miles. Idaho is bordered by Washington, Oregon, Nevada, Utah, Wyoming, Montana and Canada. 63% of Idaho is public land. Idaho's population is around 1.6 million with about 600,000 in the Boise metro area. Idaho has 3,100 miles of rivers—more than any other state. Idaho's largest cities are Boise, Nampa, Idaho Falls and Pocatello. Idaho is the number one producer of Potatoes, Trout, Austrian Winter Peas and Lentils. The population density of Idaho is only 19.5 persons per square mile.

JREM Rural Spotlight-Idaho

Idaho covers two time zones, runs from Canada to Nevada, and encompasses the western side of the continental divide of the Rocky Mountains. Rivers, mountains and farmland dominate the state's landscape. The pandhandle has emerald green hillsides, timbered mountains and pristine lakes. Central Idaho is covered with jagged peaks. The Snake River Plain, with its wide open vistas, irrigated farm lands and vibrant cities forms the character of Southern Idaho.

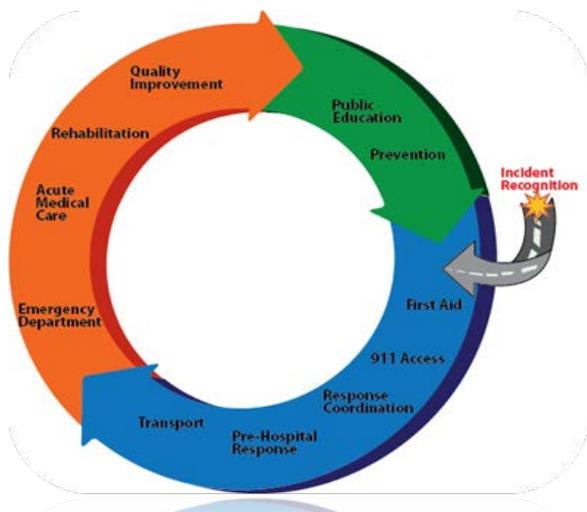


Covered from the north to south by the Rocky Mountains, Idaho contains over 114 individual mountain ranges.

Time Sensitive Emergencies Idaho

The 2014 Idaho Legislature approved and funded a plan to develop a statewide Time Sensitive Emergency (TSE) system of care that will include three of the top five causes of deaths in Idaho: trauma, stroke and heart attack. Numerous studies throughout the United States show that organized systems of care improve patient outcomes, reduce the frequency of preventable death and improve the quality of life of the patient and long-term recovery. A TSE system of evidence-based care addresses public education and prevention, 911 access, response coordination, pre-hospital response, transport, hospital emergency/acute care, rehabilitation and quality improvement. A TSE program creates a seamless transition between each level of care and integrates existing community resources to improve patient outcomes and reduce costs. It will get the patient to the right place in the right time with the right care. The following guiding principles are the foundation for the TSE system:

- Provide nationally accepted evidence based practices to TSE;
- Ensure that standards are adaptable to all providers wishing to participate;
- Ensure that designated facilities institute a practiced systematic approach to TSE;
- Reduce morbidity and mortality from TSE;
- Design inclusive systems for TSE;
- Participation is voluntary; and
- Data are collected and analyzed to measure the effectiveness of the system.



Idaho had been one of only a few states without statewide top down organized systems of care for trauma, stroke and heart attack.

Time Sensitive Emergencies



Trauma, Stroke, and Acute MI are three of the top five causes of death in Idaho, a predominately rural state.

STEMI ALERT North Idaho



Field diagnosis and EMS STEMI alert plan reduces EMS to balloon time (E2B) in a rural Idaho county.

Tele-Medicine Networks



The Boise, Idaho-based, St Alphonsus Health System has developed telemedicine that has saved the system in medical transport costs and has allowed more patients to be treated in their local communities.



Combining remote control robotics and remote presence technologies, the RP-7i® allows a remote clinician to see and interact with patients and staff just as if they were physically present on-site.

Idaho is a very rural state with many critical access hospitals that don't have access to specialists that are available in an urban center.

The legislation will enable the Idaho Department of Health and Welfare to work toward creating the framework for a statewide comprehensive system of care for TSE in Idaho. Idaho is now in the beginning stages of a continuous process for full development of this system of care. Initial efforts have established a governor-appointed TSE Council. Regional committee formation, rule promulgation, and updates to the existing trauma registry to include heart attack and stroke data are under development now.

STEMI Alert Bonner County, ID

Primary percutaneous coronary intervention (PI) has become the standard of care for the management of ST-elevation myocardial infarction (STEMI) patients when rapid door-to-balloon (D2B) times can be achieved in < 90 minutes. Rural communities have diverse challenges that may prevent the timely use of primary PCI care. Patients or family may have a reluctance to call 911 for symptoms of a heart attack. There are often wide variations in distances from the field or the rural ED hospital to the primary PCI hospital. Seasonal inclement weather may limit travel and transport options. Initial rural ED hospital evaluations and treatment times combined with receiving ED hospital times may contribute to significant delays in definitive care. Due to these factors, many rural hospitals have become primary thrombolytic sites that “drip and ship” because of the potential long times from initial STEMI diagnosis to interventional cardiology care (E2B).



Bonner County is in the northern panhandle of Idaho. Covering an area of 1920 sq. miles with a population of 40,877. Sandpoint on Lake Pend Oreille is the largest city with a population of 7,397

Bonner General Health (BGH) is a rural critical access hospital located in the North Idaho panhandle and is 50 miles from Kootenai Health (KH), the nearest PCI cath-capable facility. Bonner County (BC) is diverse geographically and covers an area of over 1,920 square miles that includes mountain ranges, lakes and rivers. A STEMI Alert plan was instituted in 2010 wherein STEMI patients are transported by ground ambulance directly from the field to KH for primary PCI. In addition, patients who present to BGH Emergency Department with STEMI are transferred directly to KH primary PCI utilizing county 911 dispatch and the existing 911 EMS personnel.

Upon initial EMS contact a cell phone photo transmission of the 12 lead EKGs is sent via a secure email group to the rural ED Medical Control Physician (MCP) at BGH and the on-call intervention cardiologist at KH confirming the diagnosis of STEMI. The MCP at BGH notifies the KH transfer center of the STEMI patient with name and date of birth for pre-registration. The MCP is connected with the interventional cardiologist and relays important clinical information. This notification results in early activation of the PCI team, and direct transport from the field to PCI facility proceeds with direct communication between the

paramedic and the accepting cardiologist. The cardiologist may order oral antiplatelet medications to be given en route. Critical care trained (CCT) paramedics following STEMI Alert care guidelines may also administer aspirin, heparin, beta-blockers, nitrates and narcotics. As a part of the pre-planning for this STEMI Alert Plan, KH has administratively agreed to accept all BC field STEMI's as well as all walk-in STEMI's to BGH ED regardless of the current bed status at KH.

For walk-in patients to BGH, the ED has implemented a STEMI tool kit that utilizes the same STEMI Alert plan and county 911 dispatch. This has resulted in much shorter ED door-to-door times (20 minute goal) for the transfer of STEMI patients from the rural ED direct to PCI cath. Upon initial STEMI recognition the ED physician activates the 911 system utilizing 911 crews for transport. A cell phone photo transmission of the 12 lead EKG is sent to the STEMI email group. The initial ED care to is limited to essential

diagnostics, IV access, monitoring, aspirin and sublingual or topical nitrates. Notification of the KH transfer center results in physician-to-physician contact with the on-call cardiologist and early activation of the PCI team.

The change in the EMS to balloon times (E2B), length of stay and mortality in 35 patients treated prior to this program, was compared to the first 15 persons managed with this program. Between 1/09 and 11/10, 35 STEMI patients were transported to KH from BC. For those requiring immediate cath (typically for failed thrombolysis) the average E2B was 198 minutes including an average time of 88 minutes at BGH before transport could be mobilized. Average length of stay for STEMI patients was 4.5 days. There was one in-hospital and one 30-day mortality. In contrast, under the new STEMI Alert plan the E2B dropped to 109 minutes, which includes a 20-minute scene time. Transport times were similar (44 vs. 47 minutes) as were D2B times once arriving at KH (24 vs. 29 minutes). Length of stay decreased to 2.8 days with no mortality to date.

Since this program was implemented, Lifelight Networks has added a base in Sandpoint (2012), which allows for additional time sensitive rotary wing transport options from areas of the county where direct ground transport would be significantly slower than a field air transport.

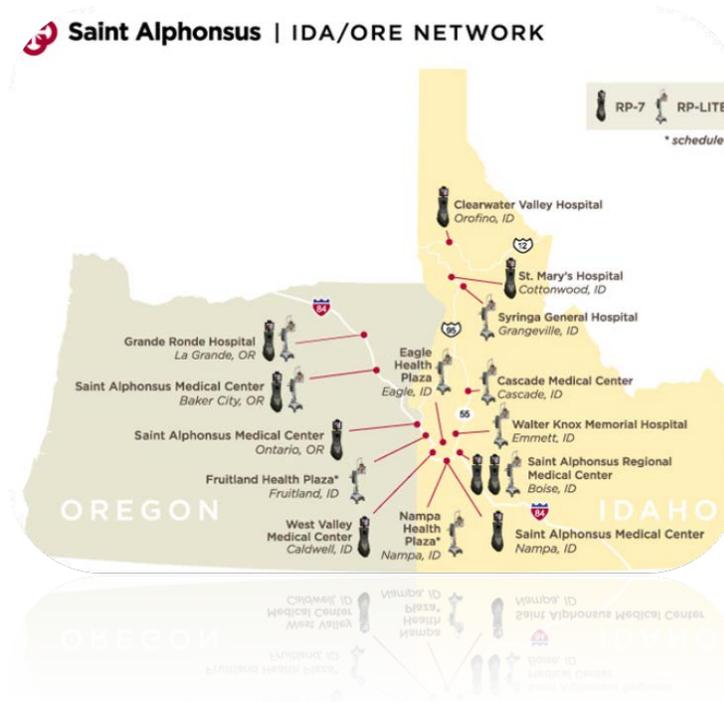
Our experience in Bonner County has shown that direct field EMS to Primary PCI for STEMI is a safe, viable option when using early 12 lead EKG transmission, early activation of the PCI team, and pre-hospital care guidelines used by paramedics in communication with a medical control physician and cardiologist.



STEMI ALERT

Bonner General Health is a critical access hospital located in Sandpoint, Idaho and staffed by ABEM physicians. It is linked with Kootenai Health in Coeur d'Alene for interventional cardiology and is a member of the Providence Spokane Tele-Stroke Network.

Tele-Medicine Networks



RURAL TELE-MEDICINE NETWORKS SAINT ALPHONSUS BOISE, IDAHO

Eastern Oregon and southwest Idaho are sparsely populated with the largest city being Boise, Idaho. In the 350-mile area around Boise, there are 2 regional referral centers, 6 community hospitals and critical access hospitals. Much of the population lives in rural underserved areas where primary care physicians and specialists are scarce.

The Saint Alphonsus tele-medicine program was developed to address these regional disparities and increase access to specialty care. The program started with the standard hub and spoke concept then developed into a network of collaborating facilities. The evolution of the network eventually allowed the expansion of services beyond the initial network providers to services from providers at multiple

locations.

Initial services included psychiatry and operating room education for rural nurses. These services have expanded to include cardiology, oncology, burns, stroke, and others. Tele-stroke allows for real time audio-video interaction with stroke specialists for time sensitive emergency management. The technology is also used for physician, nursing and patient education and support services. The use of tele-medicine for rural and community hospitals allows distant specialists to determine which patients may benefit from certain specialized procedures, medications, or in-person consultation. The use of these telemedicine services allows for the expansion of capabilities and admissions by the rural and community hospitals.

InTouch Health Inc. developed a Remote Presence (RP) technology in use at Saint Alphonsus and partnering hospitals. The system is comprised of a RP end-point (robots or cart system), Control Station, and RP Connectivity Service. The Remote Presence technology is a web-based, wireless platform that can be accessed wherever Internet service is available.

Many rural physicians are more comfortable managing patients in their local community when they have immediate access to specialists and tele-medicine. Rural hospitals may also be more successful in recruiting providers when they have access to specialists and tele-medicine.

The potential for financial savings for the patients is significant. In rural Idaho, many transfers occur via air medical transport, which has significant costs. When patients are able to remain in their local community through the use of tele-medicine support, they are able to stay with their family support system. Rural hospitals benefit through increased inpatient volume that can improve both the capabilities and financial viability of these facilities. In cases where transport is necessary, involving a specialist earlier in the patient's care can lead to improved outcomes while providing support to local physicians. For example, stroke patients can be evaluated by neurologists who can support treatment decisions in real-time.

During the first five years of operation the Saint Alphonsus, Boise based tele-medicine program has provided improved access to specialty services which has allowed more patients to be treated in their local communities.

TELEMEDICINE NETWORKS



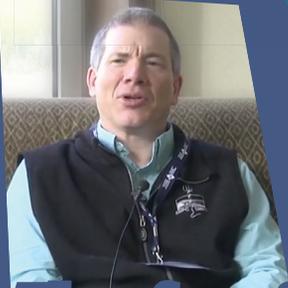
St Alphonsus Health System

The Saint Alphonsus Health System is Boise, Idaho based, and is anchored by a hospital that is certified as a Level II Trauma Center, Chest Pain Center, and Primary Stroke Center.

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