WORKSHEET for PROPOSED Evidence-Based GUIDELINE RECOMMENDATIONS

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STEP 1: STATE THE PROPOSAL. State if this is a proposed new guideline; revision to current guideline; or deletion of current guideline.

Existing guideline, practice or training activity:

Rescue the victim as quickly as possible. Treat all victims as potential spinal cord injuries and immobilize the cervical and thoracic spine. If diving, recreational equipment, or unwitnessed event was involved or if the rescuer otherwise suspects a spinal cord injury then the first responder rescuers should use their hands to stabilize the victim's neck in a neutral position and should float the victim supine onto a horizontal back support device before removing the victim from the water.

Step 1A: Refine the question; state the question as a positive (or negative) hypothesis. State proposed guideline recommendation as a specific, positive hypothesis. Use single sentence if possible. Include type of patients; setting (in- /out-of-hospital); specific interventions (dose, route); specific outcomes (ROSC vs. hospital discharge).

Any victim with a history of diving, trauma, alcohol or abnormal neurological exam is at high risk of spinal cord injury.

Step 1B: Gather the Evidence; define your search strategy. Describe search results; describe best sources for evidence.

Key words-Drowning, Near Drowning, CPR, Resuscitation, Cardiopulmonary resuscitation, Water

List electronic databases searched (at least MEDLINE (http://igm.nlm.nih.gov/) and hand searches of journals, review articles, and books.
Medline, Cochrane, Embase, AHA EndNote library, and manual reference review of the citations contained in selected manuscripts.

- State major criteria you used to limit your search; state inclusion or exclusion criteria (e.g., only human studies with control group? no animal studies? N subjects > minimal number? type of methodology? peer-reviewed manuscripts only? no abstract-only studies?)

Searched human and animal studies published in peer-reviewed literature, excluded abstract-only studies.

- Number of articles/sources meeting criteria for further review: Create a citation marker for each study (use the author initials and date or Arabic numeral, e.g., "Cummins-1"). If possible, please supply file of best references; End Note 4+ preferred as reference manager, though other reference databases acceptable.

8 relevant citations:

Kewalramani, 1977 #1 Kewalramani, L. S. and J. F. Kraus (1977). "Acute spinal-cord lesions from diving--epidemiological and clinical features." West J Med 126(5): 353-61.

Green, 1980 #2 Green, B. A., M. A. Gabrielsen, et al. (1980). "Analysis of swimming pool accidents resulting in spinal cord injury." Paraplegia 18(2): 94-100.

Good, 1980 #3 Good, R. P. and V. L. Nickel (1980). "Cervical spine injuries resulting from water sports." Spine 5(6): 502-6.

Branche, 1991 #4 Branche, C. M., J. E. Sniezek, et al. (1991). "Water recreation-related spinal injuries: risk factors in natural bodies of water." Accid Anal Prev 23(1): 13-7.

DeNicola, 1997 #5 DeNicola, L. K., J. L. Falk, et al. (1997). "Submersion injuries in children and adults." Crit Care Clin 13(3): 477-502.

Goh, 1999 #6 Goh, S. H. and B. Y. Low (1999). "Drowning and near-drowning--some lessons learnt." Ann Acad Med Singapore 28(2): 183-8.

Watson, 2001 #7 Watson, R. S., P. Cummings, et al. (2001). "Cervical spine injuries among submersion victims." J Trauma 51(4): 658-62.

Hwang, 2003 #8 Hwang, V., F. S. Shofer, et al. (2003). "Prevalence of traumatic injuries in drowning and near drowning in children and adolescents." Arch Pediatr Adolesc Med 157(1): 50-3.

STEP 2: ASSESS THE QUALITY OF EACH STUDY

Step 2A: Determine the Level of Evidence. For each article/source from step 1, assign a level of evidence—based on study design and methodology.

Level of Evidence	Definitions (See manuscript for full details)
Level 1	Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects
Level 2	Randomized clinical trials with smaller or less significant treatment effects
Level 3	Prospective, controlled, non-randomized, cohort studies
Level 4	Historic, non-randomized, cohort or case-control studies
Level 5	Case series: patients compiled in serial fashion, lacking a control group
Level 6	Animal studies or mechanical model studies
Level 7	Extrapolations from existing data collected for other purposes, theoretical analyses
Level 8	Rational conjecture (common sense); common practices accepted before evidence-based guidelines

Step 2B: Critically assess each article/source in terms of research design and methods.
Was the study well executed? Suggested criteria appear in the table below. Assess design and methods and provide an overall rating. Ratings apply within each Level; a Level 1 study can be excellent or poor as a clinical trial, just as a Level 6 study could be excellent or poor as an animal study. Where applicable, please use a superscripted code (shown below) to categorize the primary endpoint of each study. For more detailed explanations please see attached assessment form.

Component of Study and Rating	Excellent	Good	Fair	Poor	Unsatisfactory
Design	Highly appropriate sample or model, randomized, proper controls	More than adequate design; minimally biased	Adequate, design, but possibly biased	Small or clearly biased population or model	Anecdotal, no controls, off target end-points
Methods	Outstanding accuracy, precision, and data collection in its class	More than adequate in its class	Adequate under the circumstances	Weakly defensible in its class, limited data or measures	Not defensible in its class, insufficient data or measures

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint
B = Survival of event D = Intact neurological survival

Step 2C: Determine the direction of the results and the statistics: supportive? neutral? opposed?

DIRECTION of study by results & statistics:	SUPPORT the proposal	NEUTRAL	OPPOSE the proposal
Results	Outcome of proposed guideline superior, to a clinically important degree, to current approaches	Outcome of proposed guideline no different from current approach	Outcome of proposed guideline inferior to current approach

Step 2D: Cross-tabulate assessed studies by a) *level*, b) *quality* and c) *direction* (ie, supporting or neutral/ opposing)**; combine and summarize.** Exclude the *Poor* and *Unsatisfactory* studies. Sort the *Excellent, Good,* and *Fair* quality studies by both *Level and Quality of evidence,* and *Direction of support* in the summary grids below. Use citation marker (e.g. author/ date/source). In the *Neutral* or *Opposing* grid use bold font for *Opposing* studies to distinguish them from merely neutral studies. Where applicable, please use a superscripted code (shown below) to categorize the primary endpoint of each study.

Supporting Evidence

Any victim with a history of diving, trauma, alcohol or abnormal neurological exam is at high risk of spinal cord injury

Quality of Evidence	1	2	3	4	5	6	7	8
Excellent				Watson, 2001 #7				
Good				Hwang, 2003 #8	Kewalramani, 1977 #1 Green, 1980 #2 Good, 1980 #3 Branche, 1991 #4			
Fair					Goh, 1999 #6			
	Level of Evidence							

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint
B = Survival of event D = Intact neurological survival

Neutral or Opposing Evidence

Any victim with a history of diving, trauma, alcohol or abnormal neurological exam is at high risk of spinal cord injury

Quality of Evidence	1	2	3	4	5	6	7	8
Excellent								
Good								
Fair								DeNicola, 1997 #5
	Level of Evidence							

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint
B = Survival of event D = Intact neurological survival

STEP 3. DETERMINE THE CLASS OF RECOMMENDATION. Select from these summary definitions.

CLASS	CLINICAL DEFINITION	REQUIRED LEVEL OF EVIDENCE
Class I *Definitely recommended.* Definitive, **excellent** evidence provides support.	• Always acceptable, safe • Definitely useful • Proven in both efficacy & effectiveness • Must be used in the intended manner for proper clinical indications.	• One or more Level 1 studies are present (with rare exceptions) • Study results consistently positive and compelling
Class II: *Acceptable and useful*	• Safe, acceptable • Clinically useful • Not yet confirmed definitively	• Most evidence is positive • Level 1 studies are absent, or inconsistent, or lack power • No evidence of harm
• *Class IIa: Acceptable and useful* **Good** evidence provides support	• Safe, acceptable • Clinically useful • Considered treatments of choice	• Generally higher levels of evidence • Results are consistently positive
• ***Class IIb:*** *Acceptable and useful* **Fair** evidence provides support	• Safe, acceptable • Clinically useful • Considered optional or alternative treatments	• Generally lower or intermediate levels of evidence • Generally, but not consistently, positive results
Class III: *Not acceptable, not useful, may be harmful*	• Unacceptable • Not useful clinically • May be harmful.	• No positive high level data • Some studies suggest or confirm harm.
Indeterminate	• Research just getting started. • Continuing area of research • No recommendations until further research	• Minimal evidence is available • Higher studies in progress • Results inconsistent, contradictory • Results not compelling

STEP 3: DETERMINE THE CLASS OF RECOMMENDATION. State a Class of Recommendation for the Guideline Proposal. State either a) the intervention, and then the conditions under which the intervention is either Class I, Class IIA, IIB, etc.; or b) the condition, and then whether the intervention is Class I, Class IIA, IIB, etc.

Intervention: Rescue the victim as quickly as possible. Treat any victim with a history of diving, trauma, alcohol or abnormal neurological exam as a potential spinal cord injury and immobilize the cervical and thoracic spine. First responder rescuers should use their hands to stabilize the victim's neck in a neutral position and should float the victim supine onto a horizontal back support device before removing the victim from the water if it is available. Despite potential spine injury, if the patient is pulseless and apneic they should be removed from the water as quickly as possible with attention to stabilization the victim's neck and prevention of flexion and extension, even if a back support device is not available

Final Class of recommendation: Class IIb-Acceptable & useful; fair evidence

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REVIEWER'S PERSPECTIVE AND POTENTIAL CONFLICTS OF INTEREST: Briefly summarize your professional background, clinical specialty, research training, AHA experience, or other relevant personal background that define your perspective on the guideline proposal. List any potential conflicts of interest involving consulting, compensation, or equity positions related to drugs, devices, or entities impacted by the guideline proposal. Disclose any research funding from involved companies or interest groups. State any relevant philosophical, religious, or cultural beliefs or longstanding disagreements with an individual.

Assistant Professor of Emergency Medicine at University of Texas Southwestern Dallas and Parkland Hospital. No conflict of interest.

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK: Summarize your final evidence integration and the rationale for the class of recommendation. Describe any mismatches between the evidence and your final Class of Recommendation. "Mismatches" refer to selection of a class of recommendation that is heavily influenced by other factors than just the evidence. For example, the evidence is strong, but implementation is difficult or expensive; evidence weak, but future definitive evidence is unlikely to be obtained. Comment on contribution of animal or mechanical model studies to your final recommendation. Are results within animal studies homogeneous? Are animal results consistent with results from human studies? What is the frequency of adverse events? What is the possibility of harm? Describe any value or utility judgments you may have made, separate from the evidence. For example, you believe evidence-supported interventions should be limited to in-hospital use because you think proper use is too difficult for pre-hospital providers.

It is important to note that the mechanism of drowning, if known, is very important in determining the risk of potential spinal injury. In the study by Kewalramani & Kraus, 1977(#1) there were no spinal cord injuries from waterskiing, surfing, or boating. Green et al, 1980 (#2) found that the primary cause of spinal injury was diving into shallow water, with a significant number being associated with waterslides, especially with head-first entry into water < 3 feet. Good & Nickel, 1980 (#3) noted that in an oceanside

community the majority of spine injuries were sustained in the ocean, and that the highest risk activities were a running surface dive from the beach, diving through a wave, diving from a pier or rock ledge, or body surfing. Branche et al, 1991 (#4) found that high risk activities for spinal cord injuries during water recreation included diving or jumping from a pier or dock, diving into water that is unfamiliar or < 5 feet deep, and alcohol consumption. DeNicola, et al 1997 (#5) recommended spinal cord precautions for all drowning victims, and emphasized special importance of this in patients with high risk mechanisms of injury. Goh & Low, 1999 (#6) recommend that in drowning victims with any alteration in sensorium spinal immobilization should be observed.

In the largest study addressing the specific issue of spinal immobilization and extrication, Watson et al, 2001 (#7) found that only 0.5% of the 2,244 submersion victims had sustained C-spine injuries, and that all of those had submerged in open bodies of water, had clinical signs of serious injury, and had a history of a fall from height, diving, or motorized vehicle crash. No C-spine injuries were found in the low-impact submersion group.

Similar findings were also recently noted by Hwang et al, 2003 (#8), and support that there is a low prevalence of traumatic injury in the pediatric and adolescent drowning population. All but one patient with a spinal injury had a clear history of diving.

Preliminary draft/outline/bullet points of Guidelines revision: Include points you think are important for inclusion by the person assigned to write this section. Use extra pages if necessary.

Publication: ___ Chapter: ___ Pages:

Topic and subheading:
Consensus on Science:

Based on two LOE 4 studies, spinal cord injury may be predicted by the mechanism of injury. Spinal injury is unlikely in patients with low-impact submersions.

Treatment Recommendation:

Rescue the victim as quickly as possible. Treat any victim with a history of diving, fall from a height, motor vehicle trauma, alcohol or abnormal neurological exam as a potential spinal cord injury and immobilize the cervical and thoracic spine. If spinal injury is suspected, first responder rescuers should use their hands to stabilize the victim's neck in a neutral position and should float the victim supine onto a horizontal back support device before removing the victim from the water if a back support device is available. Despite potential spine injury, if the patient is pulseless and apneic they should be removed from the water as quickly as possible with attention to stabilization the victim's neck and prevention of flexion and extension, even if a back support device is not available.

While C-spine immobilization is important for drowning victims with a substantial risk for spine injury, it is unnecessary for most drowning victims and is potentially harmful. Spinal immobilization can be difficult to perform in the water, it can delay removal from the water and adequate resuscitation of the victim. Poorly applied C-collars can also lead to airway obstruction in unconscious patients. Therefore, if the mechanism of injury is clearly low impact, the victim may be removed without spinal immobilization. This will often be the situation for young children, especially in swimming pool drowning incidents without a fall from a significant height.

Citation List

Citation Marker	Full Citation*
Kewalramani, 1977 #1	Kewalramani, L. S. and J. F. Kraus (1977). "Acute spinal-cord lesions from diving--epidemiological and clinical features." West J Med 126(5): 353-61. *LOE 5, good quality, supportive*
Green, 1980 #2	Green, B. A., M. A. Gabrielsen, et al. (1980). "Analysis of swimming pool accidents resulting in spinal cord injury." Paraplegia 18(2): 94-100. This paper is a summary of a study of 72 cases of swimming-pool accidents resulting in serious injuries with the potential of permanent disability. Sixty-four of the 72 cases resulted in spinal cord injuries, 57 of which involved quadriplegic lesions. The authors observed that the majority of these injuries resulted from a lack of good judgement and common sense rather than from intoxication or pool structural deficiencies. Also of note was the lack of appropriate first-aid and extrication rendered, as well as the absence of uniform treatment and care received by the majority of the patients. *LOE 5, good, supportive*
Good, 1980 #3	Good, R. P. and V. L. Nickel (1980). "Cervical spine injuries resulting from water sports." Spine 5(6): 502-6. A retrospective review of 152 cases of cervical spine injury suffered in water sport-related accidents is presented. Water sport accidents were the second most common cause of traumatic quadriplegia among patients treated on the Spinal Injury Service at Rancho Los Amigos Hospital. The mechanics of injury in 80% of the cases involved flexion and/or axial loading forces. A fracture of the body of C5 was seen in two thirds of the cases. The ratio of complete to incomplete cord lesions was approximately 1:1, with anterior cord syndrome being the most commonly observed. Various risk factors are identified. *LOE 5, good, supportive*
Branche, 1991 #4	Branche, C. M., J. E. Sniezek, et al. (1991). "Water recreation-related spinal injuries: risk factors in natural bodies of water." Accid Anal Prev 23(1): 13-7. Spinal cord injuries are a major public health problem, and costs to society may total $6.2 billion per year. Using a case-control design, we investigated risk factors for spinal injury in male Wisconsin residents who sustained their injuries during water recreational activity. Compared with the controls, the people who sustained spinal injury were more likely to have entered the water from a pier or dock; to have dived into water; and to have used alcohol. Injury prevention programs for water recreation enthusiasts should address the topics of the hazards of combining alcohol with these activities, how to enter natural bodies of water safely, and safe water levels for diving. *LOE 5, good, supportive*
DeNicola, 1997 #5	DeNicola, L. K., J. L. Falk, et al. (1997). "Submersion injuries in children and adults." Crit Care Clin 13(3): 477-502. Drowning and near drowning remain a common cause of childhood death and disability. Toddlers aged one through four drown in private swimming pools. Submersions greater than 10 minutes and lack of CPR at the scene or the need for greater than 20 minutes of resuscitation portends a poor prognosis. Management of respiratory failure without neurologic impairment has the most successful outcome. Prevention of drowning morbidity is dependent on constant parental supervision, and immediate and expert CPR. *LOE 8, fair, opposed. This is a review article and not directly related to the hypothesis.*
Goh, 1999 #6	Goh, S. H. and B. Y. Low (1999). "Drowning and near-drowning--some lessons learnt." Ann Acad Med Singapore 28(2): 183-8. Over a period of sixteen months, 17 cases of submersion injury (encompassing victims of drowning and near-drowning) were attended to at our Accident and Emergency Department at Changi General Hospital. Most of the victims were inexperienced recreational swimmers, and in 6 of them, early bystander cardiopulmonary resuscitation enabled them to recover without severe morbidity. Non-cardiogenic pulmonary oedema with resulting chest infection was the commonest complication in survivors. Most of the episodes occurred in an urban setting in swimming pools without supervision by lifeguards. About two-thirds of the

	cases were adults over the age of fifteen years. In addition, there were patients in whom submersion injury was associated with more sinister conditions (fits, traumatic cervical spine injury, dysbarism, intoxication from alcohol or drugs), some of which were unsuspected by the doctors initially. Apart from the immediate threats of hypoxia and pulmonary injury, active search for any possible precipitating causes and associated occult injury should be made. In this study, the determinants of survival from near-drowning were early institution of cardiopulmonary resuscitation, presence of pupil reactivity, and presence of a palpable pulse and cardiac sinus rhythm. *LOE 5, fair quality, supportive*
Watson, 2001 #7	Watson, R. S., P. Cummings, et al. (2001). "Cervical spine injuries among submersion victims." J Trauma 51(4): 658-62. BACKGROUND: Submersion victims are frequently considered at high risk for cervical spine (C-spine) injury regardless of whether they sustain a traumatic injury. We hypothesized that C-spine injury is unlikely in submersion victims who do not sustain high-impact injuries. METHODS: The study was a cohort study of all people who submerged between January 1974 and July 1996 and received medical care or were seen by the medical examiner in King, Pierce, and Snohomish counties in Washington State. RESULTS: Eleven (0.5%) of 2,244 submersion victims had C-spine injuries. All 11 had submerged in open bodies of water; had clinical signs of serious injury; and had a history of diving, motorized vehicle crash, or fall from height. No C-spine injuries occurred in 880 low-impact submersions. CONCLUSION: Submersion victims are at risk for C-spine injury only if they have also sustained a traumatic injury. Routine C-spine immobilization does not appear to be warranted solely on the basis of a history of submersion. *LOE 4, excellent quality, supportive. This is a large retrospective cohort study providing the best evidence that spinal injury only occurs in association with a significant impact with the water. There were no spinal injuries in 880 low-impact submersions.*
Hwang, 2003 #8	Hwang, V., F. S. Shofer, et al. (2003). "Prevalence of traumatic injuries in drowning and near drowning in children and adolescents." Arch Pediatr Adolesc Med 157(1): 50-3. OBJECTIVE: To determine the prevalence of traumatic injuries in children involved in drowning and near-drowning accidents. DESIGN/METHODS: Ten-year retrospective medical chart review of patients at an urban tertiary care pediatric facility. Included patients had International Classification of Diseases, Ninth Revision, Clinical Modification codes for fatal/nonfatal drowning or E codes for fall into water, accidental drowning, and submersion. We recorded demographics, event characteristics, diagnostics, and outcome data. We used the chi(2) or the Fisher exact test to compare patients with and without injuries. RESULTS: One hundred forty-three patients met inclusion criteria. Of these, 95 (66.4%) were male. Median age was 3.8 years, and 30 (23.4%) of 128 had preexisting conditions. Site of drowning was the pool (70.6%), the bathtub (19.0%), or natural water (10.4%). The prevalence of traumatic injury was 4.9% (95% confidence interval, 0%-28%). The predominant mechanism of injury was diving, and all injuries were to the cervical spine. Patients with injury were more likely to be older (mean age, 13.5 vs 5.1 years; P<.001) and to have a history of diving (85.7% vs 2.2%; P<.001). The presence of injury was not associated with sex, preexisting condition, or site of drowning (P>.05). CONCLUSIONS: The prevalence of traumatic injury in drowning and near drowning is low. We identified only cervical spine injuries, and all but 1 patient had a clear history of diving. Use of specialized trauma evaluations may not be warranted for patients in drowning and near-drowning accidents without a clear history of traumatic mechanism. *LOE 4, good quality, supportive. Again, supports concept that spinal injury can be predicted by the mechanism of injury surrounding the submersion event.*