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John S. Peters, FACHE
Publisher, *Wound Care & Hyperbaric Medicine Magazine*

Note from the Editor

In this issue of *WCHM* we continue to invite leading experts in the fields of diving, hyperbaric medicine, and wound care to elucidate best practice principles and offer insight on everything from management to practice to facility safety. But aside from just asking the experts, we are also looking at individual clinics that receive top distinction from the UHMS, and how these accredited programs promote better patient outcomes with top-notch standards of care, well-trained specialists and staff, and cost-effective practice. These are real world examples of how a clinic can increase revenue and patient satisfaction, and we are excited to feature these clinics and their success stories. See the press release on page 42 to read about Hudson Valley Hospital Center's (HVHC) Institute for Wound Care and Hyperbaric Medicine, which received Re-Accreditation with Distinction by the UHMS. Congratulations to HVHC and Life Support Technologies Group for a job well done!

Of course, besides the considerations of equipment use and safety, high quality patient care, and proper document maintenance, having well-trained and credentialed staff and specialists in place is paramount. Continuing education is a key component in any medical practice, and what better way to stay on top of current industry standards than to attend a local UHMS Chapter meeting? Now through the end of October is the UHMS conference season—and if you haven't decided to attend your local meeting, now is the time to sign up! These meetings provide a forum for professional growth and development and offer CHT and CHRN exams as well as other credentialing opportunities. What better way to expand your practice and gain insight on the latest industry information than to go right to the source? Join the dialog and be sure to attend your local UHMS Chapter meeting.

I am pleased to welcome our newest contributors Drs. Worth, Zanon, Bosco, and Camporesi, who have contributed heartily to our hyperbaric section in this issue. Dr. Michael Strauss et al. continue their article series on diving stresses, addressing psychological factors that contribute to panic. I would also like to welcome back Dr. David Charash, Medical Director of Wound Care and Hyperbaric Medicine at Danbury Hospital in Danbury, Connecticut, who submitted an exciting article on his epic dive to visit Fabian Cousteau in the Aquarius habitat. As always, we are grateful for our regular contributors and all of the work they put into their submissions.

We encourage our readers to take advantage and share *WCHM* with colleagues and clients alike. In addition, if you have a clinic, be sure to add your details to our revamped Map of Wound Care and HBO Centers. Take advantage of this free resource and make your clinic easy to find for prospective clients and referral physicians.

Please join us in delivering the highest quality publication in the industry, focused on advancing the knowledge and practice of wound care, diving, and hyperbaric medicine by providing your comments, articles, industry information, press releases, and updates.

Sincerely,

Jennifer Calabro
Managing Editor, *Wound Care and Hyperbaric Medicine* Magazine

Wound Care & Hyperbaric Medicine

Are You Ready for the Stormy Season? Will Your Clinical Documentation Weather an Audit with Gale Force Winds?

By Gretchen Dixon, MBA, CCS, CPCO

When a storm is forming somewhere of some type, often we just don't heed the warnings to pay attention and prepare. Why? Maybe it is due to the hype and repetitiveness of information, where we tune out everything because the threat turns out to be empty. Other times the warning may be appropriate; however, due to past experiences we decide to ignore the facts, which may cause us to place our well-being at risk. The simple steps of preparation, if followed, can assist in avoiding catastrophic events by planning for the what-ifs. The catastrophic events within the professional realm may entail legal activities such as exclusion from Medicare program participation, civil monetary penalties, false claims cases, and corporate integrity agreements, to itemize a few. Both the Centers for Medicare & Medicaid Services (CMS) and the Office of Inspector General (OIG) have recognized the weaknesses with physician documentation. They have discovered it does not make a difference whether clinical documentation is through an electronic health record (EHR) or hand written; the clinical information frequently lacks supporting evidence of medical necessity, even though the work performed is very detailed. The term in use to describe this activity is **over-documentation**.

Preparation prior to the stormy season is vital to saving lives, just as relevant, accurate, and complete documentation is necessary for providing quality patient care. Internal as well as external compliance audits are uncovering structural incompatibilities related to work-performed patient care documentation and medical necessity. It is the aftermath of the storm where we look at what happened, what structures made it through, and the many whys.

Once again, it is vital to recognize and understand the importance of physician encounter documentation as it relates to the patient's level of acuity and the intensity of services with the complexity of care. Many issues have been identified from the Office of Inspector General, Medicare Administrative Contractors, Recovery Audit Contractors, and the plethora of external auditing agencies demonstrating the lack of supporting documentation evidence to meet medical necessity for services reported or billed. *Forget about making excuses and address these problematic areas now.* It is time to go to work and improve your documentation to avoid the storms. All healthcare settings are under the documentation microscope to ensure the quality of patient care matches what is being billed and paid. The storm of penalties is lurking and does happen to all healthcare settings including from small to large physician practices. Refer to the end of this article for excerpts from the False Claims Act and additional references.

Very Dark Storm Clouds: Why Practice Avoidance?

This article focuses on some of the general principles of medical record documentation that seem to be most problematic—*but what makes them so?* This is due to the controversy that still abounds when physicians read through Medicare's *Evaluation and Management Services Guide* (latest edition is December 2010) looking for loopholes through their interpretation of what they need to document and what they believe is not necessary to document. This observation, although faulty, is from the many retrospective documentation audits conducted for and with physicians in all types of practices.

Not Ready For The Storm?

We know there are specific principles applicable to medical record documentation in all types of healthcare settings, which are not new to the healthcare industry. The provision of services often vary based on healthcare setting due to the focus and work required by the physician; however, the general documentation principles were developed to ensure appropriate documentation in the medical record for all E/M services.

These basics have not changed and need to be periodically reviewed by all documenters as noted in the following list.

1. The medical record should be complete and legible.
1. Documentation for each patient seeking healthcare services must be relevant to the reason for the encounter or Chief Complaint documented in each of the following components:
   a) History
      - Chief complaint/reason for the encounter
      - History of present illness
      - Review of systems
      - Past family social history
   b) Physical examination findings.
   c) Prior diagnostic test results.
   d) Assessment, clinical impression, or diagnosis (supported by evidence in the first three items).
   e) Plan of care (includes physician's orders)
   f) Date with legible identity of the physician/non-physician.
2. Rationale for ordering diagnostic and other ancillary services should be easily inferred if not clearly documented.
3. Past and present diagnoses should be accessible to the treating and/or consulting physician.
4. Appropriate health risk factors should be identified.
5. Patient's progress, response to, and changes in treatment and any revision of a diagnosis should be documented.
6. All codes (ICD-9-CM and CPT codes) reported on any health insurance claim form or billing statement should be supported by the medical record.

Where is the General Weakness in Documentation? No Storm Preparation!

For the purpose of this article on documentation, the focus will be discussing only the history, physical examination, assessment or clinical impression (diagnosis), and the plan of care, which are components in the medical decision making process. It is in these components that clinical documentation is often limited, vague, or missing information linking the reason for the encounter to the services provided and reported.

The first area of information weakness begins with the reason for the encounter, otherwise titled the Chief Complaint (CC). This is the reason the patient is seeking medical attention or feels in need of care. The CC is documented in the patient's own words or from a caregiver when the patient is not able to express him or herself. However, in order for this information to count towards the level of service, the provider must document the information collected from talking with the patient or caregiver. Often the CC is noted as "follow up," a description that lacks substance and doesn't support the reason for the encounter. Instead the note should be more specific, e.g., "for follow up continuing wound care of left lateral ankle."

The second area of information weakness is relevancy of information to the reason for the encounter. It is not as simple as it seems: This may be one area where possible abuse or fraudulent documentation is considered as well as the cause of denials or reduced changes to (down coding) the level of an encounter. Often these occur as a result of retrospective audits. The cause is the preconceived idea by providers that the more they document the better the documentation will support the level of encounter and services provided. **What is missing is the medical necessity connected to all of the clinical documentation components relevant to the reason for the encounter.**

SCENARIO

The following scenario will combine the above two areas of weakness in documentation, including non-relevant documentation.

HISTORY

Chief Complaint, or reason for the encounter, is an open wound with drainage that is 3 weeks old. It is a traumatic wound of the left lateral shin area caused by hitting a broken metal gutter at the base of his house for the roof drainage system. The patient is a healthy 36-year-old male. **The physician must document these details in the CC.**

> **NOTE:** Do not limit the CC as "follow up." Add the identifying problem for the follow up.

History of Present Illness (HPI) notes should include as many of the eight elements as possible (note only three of the eight elements were documented)

1. **Location:** where on the body is the patient experiencing signs and symptoms

   ✓ Documented: left lateral shin area

2. **Quality:** a description or statement to identify the type of sign or symptom: describe the area such as area is jagged, straight, etc.
   - Include type of pain: dull, stabbing, radiating, sharp, etc.
3. **Severity:** describe the degree, intensity, and ability to endure the symptom and/or pain
   - Use terms such as mild, intense, severe
   - Pain related: have the patient rate the level of pain on a scale of 1 to 10, with 10 being the highest level of intensity or unbearable
4. **Duration:** how long has the patient experienced the sign(s) or symptom(s) or how long ago did the incident happen

   ✓ Documented: 3 weeks ago

5. **Timing:** when does the problem occur (recurrent, intermittent, continuous, seldom, etc.)
6. **Context:** circumstances, including cause, precursor, or outside factors. How did the problem happen? What was the environment, setting, interrelated conditions, etc.?
   - ✓ Documented: Hit his leg on a broken metal gutter at the base of his house roof drainage system
7. **Modifying Factors:** actions taken by the patient to alleviate the problem (in this case, promote wound healing)
8. **Associated signs and symptoms:** other problems or factors occurring with the primary complaint/problem not included in any of the other seven elements

The HPI may not accurately portray the medical condition due to the vague or limited amount of history information collected and documented by the provider or physician. Information in the HPI is gathered by asking specific and detailed questions about the medical condition of the patient, thus providing a clear picture of the occurrence and any effort the patient has taken in managing their healthcare scenario. **Physician must document these details in the HPI.**

NOTE: The HPI is a chronological story of the development of the patient's present illness, from the first sign and/or symptom or from the previous encounter, to the present.

With the implementation of the electronic medical record, it is often discovered the HPI information is copied from the initial encounter and populated into ongoing encounters without any current revisions. **This initial information may become irrelevant to ongoing encounters.**

The Review of Systems (ROS) is an inventory of body systems obtained through a series of questions seeking to identify signs and/or symptoms that the patient may be experiencing **relevant** to the CC or reason for the encounter. This information may be documented by ancillary staff.

NOTE: Document the ROS appropriate for the clinical situation, which means limiting inquires about a system to be directly related to the problem identified in the HPI.

- Thus, it may be inappropriate to conduct a comprehensive inventory of those systems not relevant to the reason for the encounter.
- If in the physician's professional judgment it is felt necessary to review a specific system apparently unrelated to the reason for the encounter, the rationale linking the system to the reason for the encounter must be clearly documented.

Physical Examination (PE) physician/provider performed
The extent of the hands on physical examination performed and documented is dependent on the clinical judgment and nature of the present problem(s). **The examination of the body systems must be related to the presenting problem.** If the physician documents an objective review of a specific system without documenting relevancy of the reason for the encounter, the system should not be counted towards a higher level of service.

NOTE: Documentation based on excessive or unnecessary information solely to meet the requirements of a high-level of service is not appropriate when the encounter scenario dictates a lower level of service to have been medically necessary.

- Documenting a system as abnormal is insufficient documentation. There needs to be specific details supporting the abnormal findings.
- If during the PE, the physician discovers a medical condition unrelated to the reason for the encounter and it appears this discovered condition requires intervention, the physician needs to accurately and thoroughly document all rationale for the finding.

Storm Concerns: Why is the Wind Whipping the Trees?

Based on the clinical findings from the patient's history, ROS, and PE, a diagnosis or signs and symptoms are usually identified. The greater the patient acuity, the more complex the diagnosis(es) and the higher the risk of complications, both of which impact the provider's choice of treatment and plan of care covered in the medical decision making process. The level of patient acuity and intensity of services with complexity of care must support the level of encounter and provided services. The discovery of a clinical documentation weakness provides auditors and reviewers an overview of how often diagnoses are documented in this area without supporting evidence in the other components—CC, HPI, ROS, or even PE.

Document all diagnoses with a level of detail to allow for diagnosis codes to be assigned with a high level of specificity. The documented diagnoses are those responsible for the encounter, discovered during the encounter and/or are medical conditions which affect the current care of the patient and require additional management. The use of unspecified codes denotes a lower level of patient acuity and may not support the intensity of service with complexity of care. A patient with a lower leg ulcer is coded in ICD-9-CM as 707.10, with the description of "ulcer of lower limb, unspecified." This code would most likely result in a rejection to a claim due to the unspecified location of the ulcer, as a more specific code could have been used had the documentation been sufficiently detailed. Documentation should have noted the ulcer to be of the heel, which would result in a specific ICD-9-CM code of 707.14, defined as "ulcer of heel and midfoot" (includes plantar surface). This is an example of documentation specificity. Documentation improvement involves specificity, which is required to support quality patient care and all provided services.

NOTE: In the outpatient setting, any diagnosis documented as possible, probable, I think it is, maybe it is, questionable, suspected, ruled out, working diagnosis, etc. cannot be coded as if the condition exists. The coder should attempt to query the provider/physician, and if no response, to then code the signs and symptoms which brought the patient into the healthcare setting.

- Only those conditions existing and require or affect the patient's treatment or management should be coded.
- The old adage "if you did not document it, it was not down" still is applicable.

NOTE: Before you certify or sign off on any documentation, read it completely to ensure the accuracy of your information. Incomplete, vague, limited, or missing information lacks supporting evidence your patient received quality care.

Trouble with EHR Templates: Storm Possibly To Change Course

With the implementation of the electronic health records, diagnoses and treatment options may be copied and pasted or cloned from previous encounters which have no or little bearing on the reason for the encounter. At other times, it is difficult to identify the response or progress of the patient from one encounter to the next due to the limited amount of new information documented for the specific date of service; however, a diagnosis and treatment regime continues.

Diagnostic testing needs to be documented in your progress notes, both the results and the ramifications. Provide details of the findings and whether there is an expected change in the Plan of Care or treatment options. No assumptions are allowed.

Forget about making excuses and address these problematic areas now. It is time to go to work and improve your documentation to avoid the storms.

Your EHR templates should allow for patient individuality within the documentation. Built-in verbiage within templates often loses patient individuality through cookie-cutter dialogue. Ensure your templates allow enough space to add patient specific value-added information for each clinical document component within the EHR for each encounter.

In Summary: The Storm Warnings Continue

Medical necessity needs to be clearly documented and not assumed. According to the *Medicare Claims Processing Manual*, Section 30.6.1 titled: Selection of Level of Evaluation and Management Services, Subsection A titled: Use of CPT codes, second paragraph states: "The volume of documentation should not be the primary influence upon which a specific level of service is billed. Documentation should support the level of service reported. The service should be documented during or as soon as practicable after it is provided in order to maintain an accurate medical record."

NOTE: The presenting problem and associated risk limit the E/M level regardless of the work performed (comprehensive ROS and PE).

- A comprehensive service may have been performed and documented; however, it is not always medically necessary and billable.

Relevancy relates to all components of your clinical documentation. Throughout CMS E*valuation and Management Services Guide* there are a variety of notes stating:

- ROS inquiries of systems are directly related to the problem identified in the HPI
- PFSH review of history areas directly related to the problem(s) identified in the HPI
- PE is based on clinical judgment, patient's history, and nature of presenting problem(s)
- Diagnosis and the Plan of Care are components of the medical decision making process, which is used to address the risk of complications, morbidity, co-morbidities, and/or mortality associated with the patient's presenting problems

Over-documentation through EHR programs Both the OIG and CMS have identified the practice of irrelevant documentation to create the appearance of support for billing higher level of services. Some EHR technologies auto-populate fields when using templates built into the system. Other systems generate extensive documentation on the basis of a single click or a checkbox that may be inaccurate without appropriate editing. Also, the information created through technology often loses the individuality of information from the patient's encounter.

NOTE: Take the time to review all information being populated from other areas of the EHR. Ensure there is an opportunity for the provider to edit all information, eliminating any conflicts and verifying it accurately reflects the condition and care of the patient for each encounter.

- Be proactive now by improving the quality of your clinical documentation and avoid the method of cloning information or over-documenting your thoughts about the patient to whom you just provided care.

False Claims Act

Pertinent information needs to be periodically reviewed. Anyone who documents, codes, and/or submits a claim for reimbursement can be held responsible for a false claim. It is important to understand and recognize it may be necessary to review your operational billing processes annually (at a minimum) to ensure the documentation and codes selected are accurately reflective of what is or has been submitted for payment. Your daily documentation, coding, and billing activities may well include the term "knowingly," which could result in an unexpected, costly storm. Be aware and be proactive professionally with your clinical documentation, coding, and billing processes. We are accountable for what we do and it is our responsibility to understand the ramifications of our actions.

In closing, below is excerpt from the False Claims Act for your information:

The False Claims Act ("FCA") provides, in pertinent part, that:

(a) Any person who (1) knowingly presents, or causes to be presented, to an officer or employee of the United States Government or a member of the Armed Forces of the United States a false or fraudulent claim for payment or approval; (2) knowingly makes, uses, or causes to be made or used, a false record or statement to get a false or fraudulent claim paid or approved by the Government; (3) conspires to defraud the Government by getting a false or fraudulent claim paid or approved by the Government; . . . or (7) knowingly makes, uses, or causes to be made or used, a false record or statement to conceal, avoid, or decrease an obligation to pay or transmit money or property to the government . . . is liable to the United States Government for a civil penalty of not less than $5,000 and not more than $10,000 plus 3 times the amount of damages which the Government sustains because of the act of that person . . .

(b) For purposes of this section, the term "knowing" and "knowingly" mean that a person, with respect to information (1) has actual knowledge of the information; (2) acts in deliberate ignorance of the truth or falsity of the information; or (3) acts in reckless disregard of the truth or falsity of the information, and no proof of specific intent to defraud is required.

31 U.S.C. § 3792. While the False Claims Act imposes liability only when the claimant acts "knowingly," it does not require that the person submitting the claim have actual knowledge that the claim is false. A person who acts in reckless disregard or in deliberate ignorance of the truth or falsity of the information, also can be found liable under the Act. 31 U.S.C. 3729(b).

In sum, the False Claims Act imposes liability on any person who submits a claim to the federal government that he or she knows (or should know) is false. An example may be a physician who submits a bill to Medicare for medical services she knows she has not provided. The False Claims Act also imposes liability on an individual who may knowingly submit a false record in order to obtain payment from the government. An example of this may include a govern-

ment contractor who submits records that he knows (or should know) is false and that indicate compliance with certain contractual or regulatory requirements. The third area of liability includes those instances in which someone may obtain money from the federal government to which he may not be entitled, and then uses false statements or records in order to retain the money. An example of this so-called "reverse false claim" may include a hospital who obtains interim payments from Medicare throughout the year, and then knowingly files a false cost report at the end of the year in order to avoid making a refund to the Medicare program.

In addition to its substantive provisions, the FCA provides that private parties may bring an action on behalf of the United States. 31 U.S.C. 3730(b). These private parties, known as "qui tam *relators," may share in a percentage of the proceeds from an FCA action or settlement.*

Section 3730(d)(1) of the FCA provides, with some exceptions, that a qui tam *relator, when the Government has intervened in the lawsuit, shall receive at least 15 percent but not more than 25 percent of the proceeds of the FCA action depending upon the extent to which the relator substantially contributed to the prosecution of the action. When the Government does not intervene, section 3730(d)(2) provides that the relator shall receive an amount that the court decides is reasonable and shall be not less than 25 percent and not more than 30 percent.*

The FCA provides protection to qui tam *relators who are discharged, demoted, suspended, threatened, harassed, or in any other manner discriminated against in the terms and conditions of their employment as a result of their furtherance of an action under the FCA. 31 U.S.C. 3730(h). Remedies include reinstatement with comparable seniority as the* qui tam *relator would have had but for the discrimination, two times the amount of any back pay, interest on any back pay, and compensation for any special damages sustained as a result of the discrimination, including litigation costs and reasonable attorneys' fees.*

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Gretchen Dixon is the owner of Professional Compliance Strategies LLC and consults on outpatient departments and physician services. She provides revenue cycle compliance reviews of services with the focus on wound care department operations for over 9 years. She holds several credentials: MBA in Healthcare Management, Registered Nurse with practicing licenses in NY and a multi-state license from Virginia, AHIMA Certified Coding Specialist (CCS), AAPC Certified Professional Compliance Officer (CPCO), and is an AHIMA Approved ICD-10-CM/PCS Trainer/Ambassador. Being a longtime internal healthcare compliance auditor, she identifies issues through audits of D, C, Bs (documentation, coding & billing) of provided services. The outcomes of each audit determines the topics of education to be provided to staff and physicians as she believes education is the KEY to having accurate, complete and consistent documentation for accurate reimbursement of billed services. If you are interested in the services offered, contact her at gmdixon@cox.net or 615 210 7476.

Wound Care & Hyperbaric Medicine

Stresses in SCUBA and Breath-Hold Diving

Part III: Psychological Stresses

By Michael B. Strauss MD, Derek Covington MD, and Stuart S. Miller MD

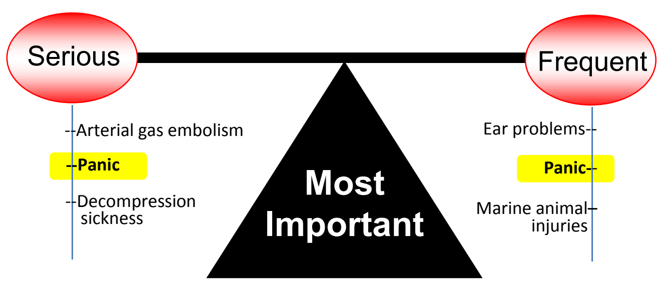
Introduction

In the two previous issues of *Wound Care & Hyperbaric Medicine* we introduced the subject of stimulus/stress—response/resolution and used this as the basis for discussing the physical and physiological stresses of diving.[1,2] In this issue we discuss the psychological stresses of diving and again use the stimulus/stress—response/resolution approach to recognition, prevention, and management of this group of diving medical disorders. Psychological stresses of diving are those that target the processing of information in the brain and/or the perception of sensations. The primary responses/resolution of the psychological stresses do not cause physical harm or directly interact with biochemical functions of the body as the physical and physiological stresses do. However, if the psychological stresses are not adequately resolved, the consequences can be harmful and even life threatening if they initiate physical and/or physiological stresses on the body. The panic syndrome is the major psychologically-related medical problem of diving. It is probably the most important of all the medical problems of diving in terms of incidence rates, seriousness, and mortality. Consequently, the majority of Part III of this series of stresses and stress resolutions of diving will deal with this medical problem. Other psychological stresses of diving involve visual, hearing, and tactile sensory systems and will also be discussed briefly.

> The psychological stresses of diving consider how our body's sensory systems interpret the stresses of the diving environment and our reactions to the interpretations. The panic syndrome is the principal psychological stress problem of diving and its initial consequences, in contrast to the physical and psychological stresses of diving, are almost exclusively a reflection of brain activity.

The diver is continuously bombarded by psychological stresses. Almost all are subliminally resolved without consequences to the diver analogous to the automatic stress-reaction, stimulus-response mechanisms previously described for the physical and physiological stresses of diving.[1,2] Other than the stress (carbon dioxide elevation) response (to breathe) cycle to maintain respiration, the psychological stresses of diving are probably the most omnipresent of all diving stresses. Furthermore, of all the diving medical disorders, the psychological stress of panic is the most important, being the most frequent of the serious problems and most serious of the frequent problems (Figure 1). Like many of the other medical problems of diving, panic associated with diving is best prevented by training, experience, and pre-dive planning. Its onset can be almost instantaneous and its resolution may require only the simplest of interventions. However, when not immediately resolved, panic in diving can lead to drowning or be the initiating factor in a variety of other medical disorders of diving, with arterial gas embolism being the most serious.

Figure 1.
Panic in Relation to the Most Serious and Most Frequent Medical Problems of Diving

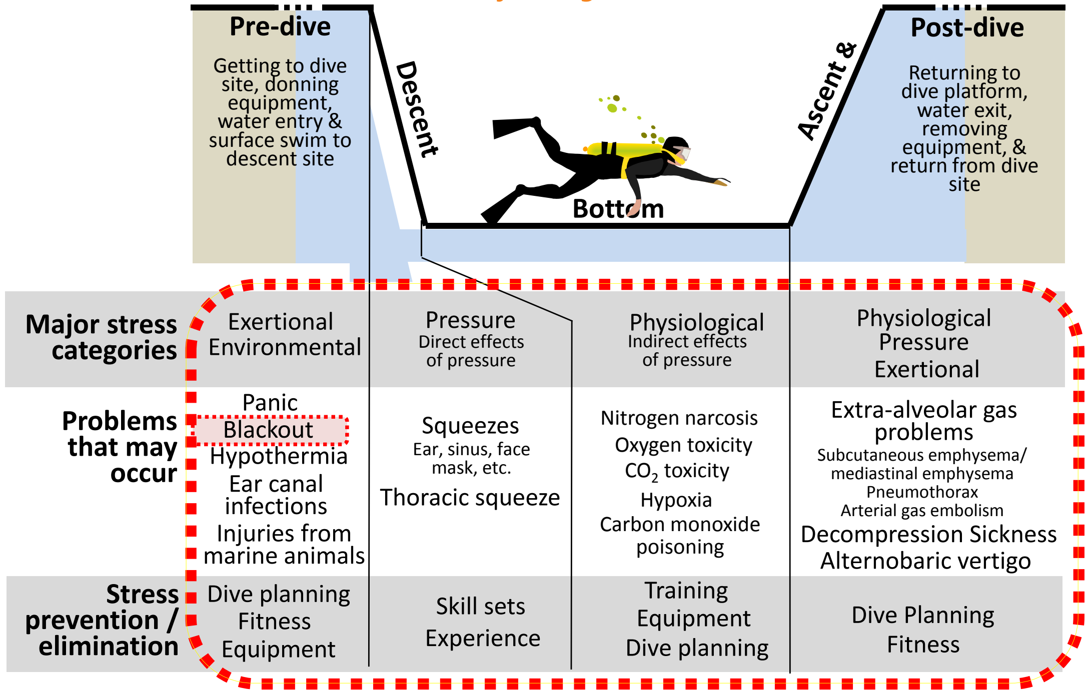


Notes: In general the most serious medical problems of diving occur infrequently , and the most frequently occurring problems are usually not serious.

Panic has the distinction of being both a serious and frequent problem in diving and because of this can be considered the most important medical problem of diving.

Unless the cause of death is diligently sought, we believe that most cases of drowning in SCUBA divers has panic as a precursor.

Figure 2.
Phases of the Dive Where Psychological Stresses Predominate



Legend: In contrast to the physical and physiological stresses of diving which predominantly occur during specific phase of a dive, the psychological stresses can occur during a specific phase of the dive.

The blackout conditions (bolded in light red) are most frequently associated with breath-hold diving and will be described in a subsequent article.

Phases of a Dive and the Psychological Stresses of Diving

When the four phases of a dive (i.e., 1. Pre-dive→surface, 2. Descent, 3. Bottom and 4. Ascent→post-dive) are considered, the psychological stresses are ubiquitous (Figure 2). That is, they can occur during any phase of the dive since our sensory systems are bombarded with stresses throughout a dive. During the pre-dive→surface phase, panic, especially in the inexperienced diver, is prone to occur. During the descent and bottom phases of a dive, orientation stresses become a challenge. Psychological stresses of ascent→post-dive phases include both orientation and panic-provoking stresses from dealing with currents, wave action, swells, hypothermia, exhaustion, and retrieval from the water.

Dive Scenario: A SCUBA diver is diving in a mid-ocean island chain. Of necessity the support craft is "free"; that is not anchored, but drops off the divers at a predetermined site and then retrieves them individually as they surface. The sea state is mild-to-moderate with 2 to 3 foot wave crests. Upon surfacing the diver becomes separated from his buddy. Due to the height of the swells he is unable to line-of sight the support craft. An ocean current is causing the diver to drift away from the island. The diver tries to buck the current and rapidly becomes exhausted as well as uses up his remaining SCUBA tank air supply. The stage for panic is set.

Comment: Disorientation from loss of line-of-sight visualization of the support craft led to initiation of irrational decisions including trying to swim against the current and failure to inflate the buoyancy compensator to conserve energy. Upon surfacing the diver should have inflated the rescue sausage (Figure 3) to improve localization of the diver by the support craft. The crew of most open water diving support craft are well versed in the above scenarios and take into consideration the ocean currents when retrieving the surfaced SCUBA diver. The lesson is to remain in place, use emergency location devices (sausage, whistle, light, etc.) and conserve energy until retrieved by the support craft.

Part III: Psychological Stresses of Diving*

*Parts I and II, Physical and Physiological Stresses of Diving were published in the two previous issues of *Wound Care & Hyperbaric Medicine.*[1,2]

Section A: The Panic Syndrome

When discussing the significance of medical problems of diving, the seriousness of the problem must be coupled with the frequency of occurrence. When these two elements are considered, panic is at the top of the list. This is because of the serious disorders, panic is the most fre-

Figure 3.
Dive Sausage as a Signaling Device

Legend: The dive sausage increases the visibility of the diver on the surface. Typically the bright orange or yellow tube, which is inflated by exhaling into its bottom opening or using the purge valve on the regulator for inflation, extends 3 to 4 feet above the water surface and the diver's head.

When uninflated and rolled-up it forms a small cylinder that is easily attached to the buoyancy compensator or stored in one of its pockets.

quent and of the frequent disorders, it is the most serious (Figure 1). The consequences of panic span a wide range, from a transient episode of anxiety which becomes a topic of a "sea story" to tell others to life-threatening exhaustion, to near-drowning, to unconsciousness, to death from drowning or cardiac arrest.

Of the estimated 5 million SCUBA divers in the United States, about 100 deaths a year are reported by the Divers Alert Network from this activity. When the causes of death are analyzed, panic is the reason for the dive fatality after other identifiable causes such as equipment failure, cardiac disease, or seizure have been excluded. Since the exclusions are relatively rare occurrences in the sport SCUBA diver population, panic in SCUBA divers achieves even more significance.

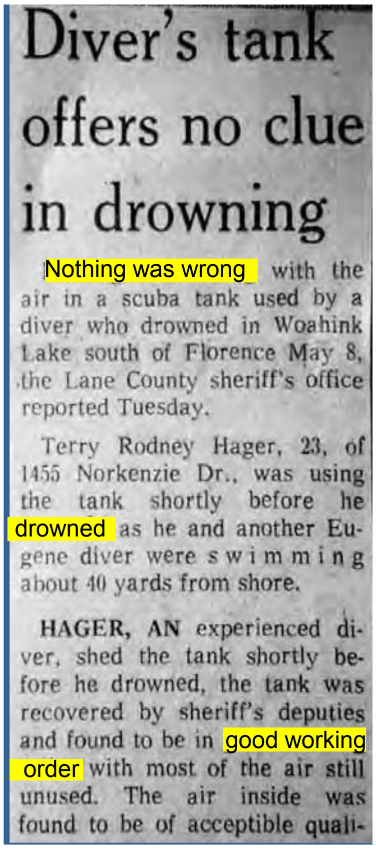
Historical Considerations Before the 1970s panic in divers was not appreciated to the extent that it is today. About this time an unusually large number of SCUBA diver deaths occurred off the coast of Southern California. In almost all situations nothing could be found that explained the cause of death such as equipment failure, lack of gas supply in the SCUBA tank, or indications that safety equipment, specifically the buoyancy compensator or a dive knife, was employed to extricate the victims from entanglement in kelp. The concerns were so great that it threatened to shut down the sport SCUBA diving industry in the Los Angeles area. Dr. Glen Egstrom, an exercise physiologist, and Dr. Art Bachrach, a psychologist, both with special expertise in exercise physiology solved the "Diver's tank offers no clues in drowning" mystery (Figure 4). They proposed that the SCUBA diver victims failed to make rational decisions, i.e., panicked after becoming entangled in kelp. This initiated a struggling response to free themselves from the entanglements and resulted in exhaustion, over-breathing the regulator, unconsciousness, and drowning. The rational decisions in such situations would have been to relax, inflate the buoyancy compensator, and use the dive knife to cut away the entanglements. From this important work by Drs. Egstrom and Bachrach, panic became a recognized predicament in SCUBA diving.

Panic is not a new concept in water-related activities. Twenty-five years before Drs. Egstrom and Bachrach's formulations on panic, the first author's father, Max Strauss, was already espousing the significance of this subject. For the record Maxie (as everyone addressed him) was "Mr. Swimming" for a small town in Western Oregon. Although he was a sole proprietor and purported furniture dealer, his true passion was to teach others to love the water. He used any excuse to lock up the furniture store, put a "gone swimming" sign on the door and transport the town kids in his furniture truck to the nearest swimming pool. This evolved to coordinating the county's Red Cross swimming programs and becoming the father of competitive swimming in the county. The "gone swimming" sign got a lot of use.

From my father I not only gained a great fondness for water-related activities, but also learned about managing panic in the water. Many of his admonitions and techniques for the management of panic in water are as valid today as when he first taught them to me in 1946. This information was the starting point for my interest in panic in diving and resulted in one of the first diving medicine publications on this subject.[3]

Definition of Panic In simple terms, panic is a loss of control. This results in failure to make rational decisions and initiate appropriate responses in perilous situations. The panic response arises from a stress that is not usually identified by the victim and is followed by a failure to take appropriated corrective actions to resolve the stress. The failure to appreciate the cause places panic in the psychology category of an anxiety. This is differentiated from a fear where the inciting cause can be identified by the victim.

Figure 4.
Headline Consistent with Panic as the Cause of Death in Scuba Fatality



Diver's tank offers no clue in drowning

Nothing was wrong with the air in a scuba tank used by a diver who drowned in Woahink Lake south of Florence May 8, the Lane County sheriff's office reported Tuesday.

Terry Rodney Hager, 23, of 1455 Norkenzie Dr., was using the tank shortly before he drowned as he and another Eugene diver were swimming about 40 yards from shore.

HAGER, AN experienced diver, shed the tank shortly before he drowned, the tank was recovered by sheriff's deputies and found to be in good working order with most of the air still unused. The air inside was found to be of acceptible quali-

Before the 1970s panic in divers was not appreciated.

Glen Egstrom and Art Bachrach solved the riddle of why divers die when nothing seemed to be wrong.

It is apparent that some people are more prone to panic than others. This was demonstrated by Nardi using hyperventilation as the stimulus to induce a stress response.[4] Hyperventilation lowers blood carbon dioxide tensions. This leads to vasoconstriction and decreased blood flow to the extremities from the vasoconstriction. One of the first responses is numbness and tingling in the fingers, a stress-inducing effect itself. In a simple test Nardi found that with 3 minutes of hyperventilation, panic occurred in 9.1 percent of normal subjects and in 69.2 percent of subjects with a previously diagnosed anxiety disorder.

Demographics of Panic in Divers A couple of studies demonstrate how commonly panic occurs in SCUBA divers. Morgan reported the incidence of panic occurrences in a survey of 254 recreational divers.[5] Panic or near panic episodes were experienced on one or more dives in 64 percent of the females and 50 percent of the males. In 2003 Colvard surveyed 12,000 recreational divers. Thirty-seven percent of females and 24 percent of males reported experiencing one or more episodes of "an intense fear of losing control or dying while diving."[6] These two studies support our hypothesis that panic experiences are the most common of the serious medical problems of diving and that they have been experienced in a substantial number of recreational SCUBA divers. Furthermore, patients with a history of anxiety attacks are more prone to experience panic, and panic occurs in a higher percentage of female divers than male divers.

Causes of Panic in Divers The encounters SCUBA divers experience that can lead to panic are so extensive that no listing would be complete. However, some causes are reported commonly (Table 1, Figure 5). All have the common denominator in that the diver becomes increasingly fearful at his/her health or life is at risk and subsequently triggers the fight or flight response. In our experiences the five most frequently observed causes of panic are wave turbulence during the water entry of a beach dive, being dragged seaward by a rip tide, entanglements, disorientation, and buoyancy control problems. A few corollaries that can be derived from our observations are that the more experienced the diver, the more ideal the diving conditions, the better the dive planning, and the safer the diving practices, the less likely panic will occur. Due to the quality of the equipment and recommended preventative maintenance, equipment failure such as regulator malfunction is almost never a cause of panic.

Pathophysiology of Panic in Divers Pathophysiology is the convergence of pathology, the effect of disease processes, with physiology, how the body functions. While panic is not a disease, it is a disorder that has pathophysiological consequences (Figure 6). The first step in the pathophysiology of the panic syndrome is contending with a stress. Typically, it is one of those previously mentioned (Table 1). As discussed in our previous articles in *Wound Care & Hyperbaric Medicine*, in almost all circumstances the stress is resolved subliminally.[1,2] In the rare situation when the stress is not resolved, the panic syndrome progresses to the loss-of-control stage. With loss of control, the victim no longer makes rational decisions about his/her management. Many times the inciting stress, such as the turbulence from a cresting wave or the rip current, is no longer present.

At maximum activity/energy output, air "hunger" occurs very rapidly. An analogy to appreciate this is the sprinter who runs the hundred yard dash at an "all out" effort. With completion of the run, the sprinter is already tired and hyperventilating even though the maximum energy output activity only lasted about 10 seconds. This analogy reflects the speed in which the loss-of-control stage can evolve to a vicious circle.

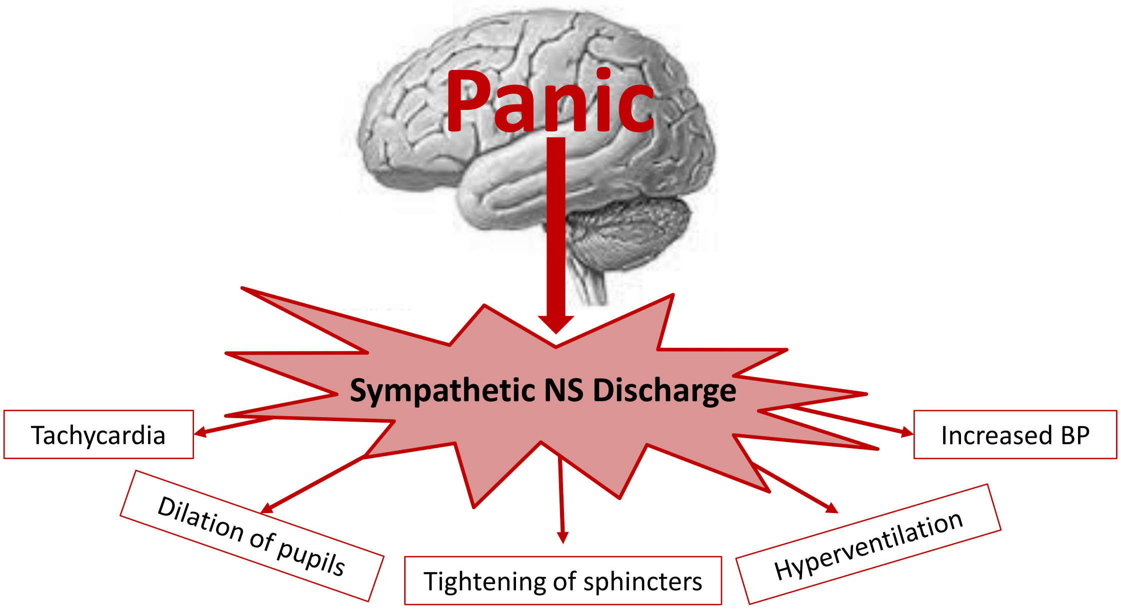
Figure 5. Some Identifiable Causes of Panic

Legend: The underwater environment is a source of many situations that can lead to the panic syndrome.

Table 1. Causes of Panic in Divers (alphabetically listed/most frequent bolded in red font)

Causes	Comments, Effects, etc.
Aspiration of water	Multiple causes including removal of mouthpiece from turbulence or willfully (nitrogen narcosis)
Being dragged by currents, tides, etc.	Swim parallel to shore or diagonal to the current
Coughing incessantly	May lead to aspiration of water & further panic
Disorientation	Loss of visual clues, nitrogen narcosis, losing sight of dive buddy
Entanglements	Analysis of deaths in kelp enhanced the understanding of panic in divers
Exhaustion, exhaustion of gas supply	Occurs rapidly with struggling; failure to gain headway against currents
Negative buoyancy	Inability to ascend leading to struggling
Regulator failure	Very infrequent problem, but hoses can be cut accidentally (wreck diving) or fail with long use
Sighting a shark or other marine animal	Usually underlying morbid fears of encounters
Turbulence; surf zone or in open water	Dislodgement of equipment, especially regulator
Vomiting	Possible aspiration of vomitus through regulator

Figure 6. The Psychological Stresses of Panic Leading to Physiological Responses in the Body



Legend: From the brain processing of the panic exciting event, a sympathetic nervous system discharge can occur. This generates the classic "fight or flight" response.

The "fight or flight" response can lead to physical and physiological stresses of diving such as breath-holding with ascent and omitted decompression.

BP = Blood pressure; **NS** = Nervous system

The loss-of-control stage rapidly progresses to a self-perpetuating vicious circle. This usually occurs within a few seconds. Components of the vicious circle include loss of breath, negative buoyancy, and struggling (Figure 7). Each component has a pathophysiological basis. Loss of breath is due to rapid, inefficient breathing. As in panting, most of the air movement with the inefficient, extremely rapid respirations is in the dead spaces of the respiratory tract. The consequences are impaired exchange of gases at the alveoli with less than adequate oxygen moving into the alveoli and carbon dioxide retention. These effects contribute to more air "hunger," anxiety, loss of control, and rapid respirations.

Negative buoyancy can result from incomplete inhalations and failure to increase the tidal volume to approximate the total lung capacity. If the panic victim is only exchanging minimal tidal volume air with each breath, the buoyancy effect of increasing the 500 cc normal tidal volume to the 5,000 cc total lung capacity is substantial. This has a potential buoyancy effect of approximately 10 pounds between the tidal volume and the total lung capacity. Additionally, negative buoyancy can occur with decreased volume of gas in the wetsuit or buoyancy compensator during descent. With negative buoyancy there is more struggling and energy output to counteract the negative buoyancy. This further self-perpetuates the vicious circle and level of anxiety.

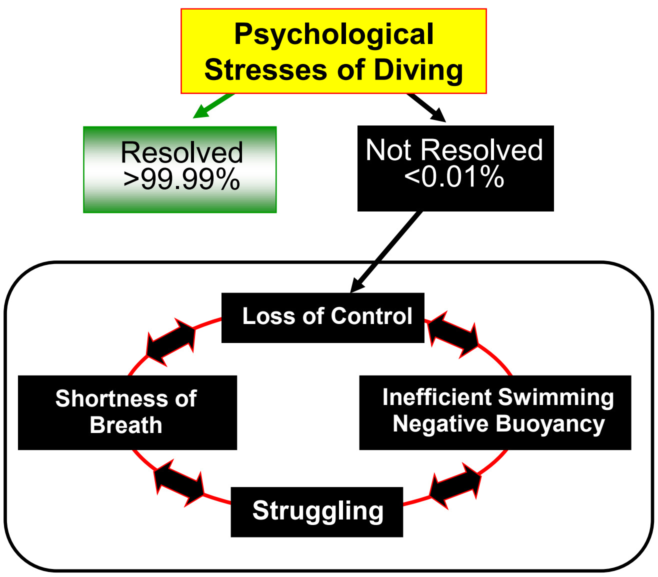
Struggling, the third component of the loss-of-control vicious circle, is a "do or die" effort to free oneself from the predicament. Struggling implies making strenuous or violent efforts using utmost exertion to "fight" the consequences of the panic-provoking situation. The results are inefficient swimming or other self-correcting/extrication movements and increasing exhaustion. This contributes to the loss of control and even more air hunger so even if the exciting event had ended the struggling and exhaustion continue.

Dive Scenario: A recently certified teenage SCUBA diver was making a confidence building "bottom drop" to 110 feet with an experienced dive buddy after a beach entry and swimming through the surf zone. He adjusted his buoyancy to be neutral on the surface. When reaching the bottom he felt "heavy." A few moments later he tried to start his ascent, but made no progress in leaving the bottom. Meanwhile his inefficient swimming movements resulted in his fins stirring up the bottom silt. Quickly he was engulfed in a cloud of silt. This intensified the diver's anxiety and caused even more struggling. His uncontrollable, rapid, inefficient breathing over-breathed the regulator and contributed to more shortness of breath.

Fortunately his dive buddy appreciated the gravity of the situation, located and released his weight belt, and lifted him off the bottom. With improved buoyancy the diver began ascending easily and reached the surface breathing normally and in no distress.

Comment This scenario illustrates a “classic” presentation of the panic syndrome. It illustrates how quickly the loss of control can occur and how the elements of the vicious circle contribute to the self-perpetuating aspects of the panic syndrome. Many things could have been done to avoid this problem. First, the diver could have adjusted his negative buoyancy due to compression of his wetsuit and air in his buoyancy compensator when he reached the bottom. With more neutral buoyancy he would not have had difficulty leaving the bottom with his own swimming movements. Second, had he started swimming in a more horizontal direction towards the shore, the lifting effect of his forward momentum would have assisted his ascent and reduced his panic by swimming out of the cloud of silt. Third, had the diver been able to adequately analyze the situation, he would have released his weight belt himself. Fortunately, his quick thinking buddy did so and avoided a possible disastrous outcome.

Figure 7. The Panic Syndrome



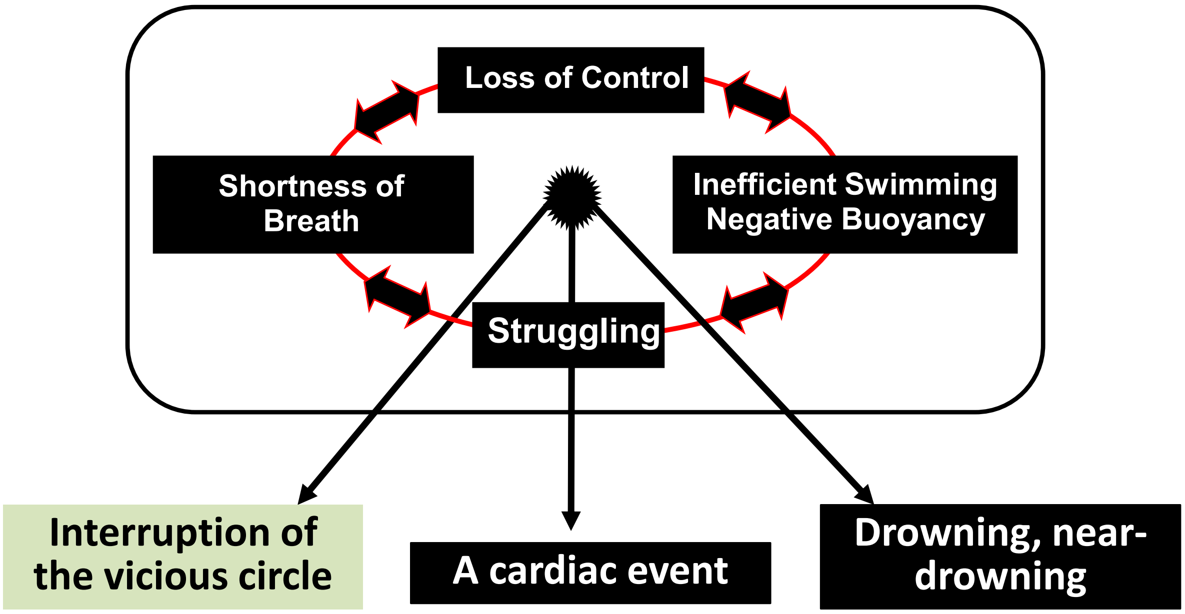
Legend: An unresolved psychological stress , although very infrequent , can progress to a self-perpetuating chain of events. Although the psychological stress may have passed, the elements of the vicious circle “feed” into each other and can result in its perpetuation even if the psychological stress that precipitated the panic syndrome is no longer present.

Outcomes of The Panic Syndrome Three outcomes can occur with the panic syndrome (Figure 8). First is the interruption of the vicious circle and survival of the diver (described in the next section). Panic prevention training is an important component of SCUBA diving training. As mentioned before, the more experienced the diver the less likely that he/she will get into a panic-provoking situation. The second is the struggling and over-exertion lead to a cardiac event such as a heart attack or arrhythmia which can be fatal for the diver. Risk factors and comorbidities such as poor fitness, obesity, smoking, and heart disease usually contribute to this possible outcome of the vicious circle. The third outcome is loss of consciousness from hypoxia (over-breathing the regulator) or aspiration of sea water. In a state of exhaustion, a moment’s interruption of oxygen supply to the brain will lead to loss of consciousness. Without careful analysis of the events leading to the death in the water, drowning will be the diagnosis given as the cause of death.

First Response Interventions for The Panic Syndrome First response interventions are crucial for managing the panic syndrome and may mean the difference between life and death for the victim. The first response interventions are directed at interrupting the components of the vicious circle. Four interventions are effective (Figure 9): ***First, realize panic is developing by recognizing the symptoms. Attempt to stay calm, and identify the inciting cause and eliminate it***; this can be as simple as transiting the surf zone or as complicated as freeing oneself from entanglements (Table 1). ***The second is controlling breathing***; this includes slowing the breathing rate and increasing the depth (i.e., tidal volume) of breathing. As the previous scenario illustrates, eliminating the inciting cause and maintaining a breathing supply may be all that is needed to interrupt the vicious circle of the panic syndrome. To improve ventilation when on the surface and the conditions warrant it (i.e., no turbulence, wave action, etc.), the buoyancy compensator should be sufficiently inflated. Then the regulator should be removed from the victim’s mouth and he/she should breathe the surface air directly. This measure improves ventilation by eliminating the dead space of the gas in the regulator, the expiratory resistance of the regulator, and the cycling time of the regulator (i.e., over-breathing the regulator).

Dive Scenario: An experienced SCUBA diver in good physical condition was checking the bottom for an ideal dive site in a kelp-laden dive area. After reporting his findings to his buddies, they decided to move on to another site. Rather than climbing back aboard the small skiff, the diver

Figure 8. Outcome Permutations of the Vicious Circle of the Panic Syndrome



Legend: There are three possible outcomes of the vicious circle of the panic syndrome. Interruption of the vicious circle may result in a "sea story" as in some of the scenarios in this article. When lethal consequences of the panic syndrome occur, panic may not be appreciated as the precursor to the cause of death and the death signed out as a drowning.

held onto a bowline with his regulator out of his mouth as the craft slowly moved forward. Almost immediately, the manifold of the diver's tank was entangled in kelp and was pulling him underwater. In a few moments the diver was using all his strength to hold onto the bowline and keep his head above water. He rapidly became exhausted. Fortunately, the dive buddies aboard the skiff recognized the predicament, stopped the boat from moving forward, freed the regulator from the kelp, and placed it in the diver's mouth.

With the air supply reestablished, the diver let go of the bowline and was pulled ten feet underwater due to the tension of the kelp. Once the tension of the kelp was relieved, the diver nonchalantly floated to the surface.

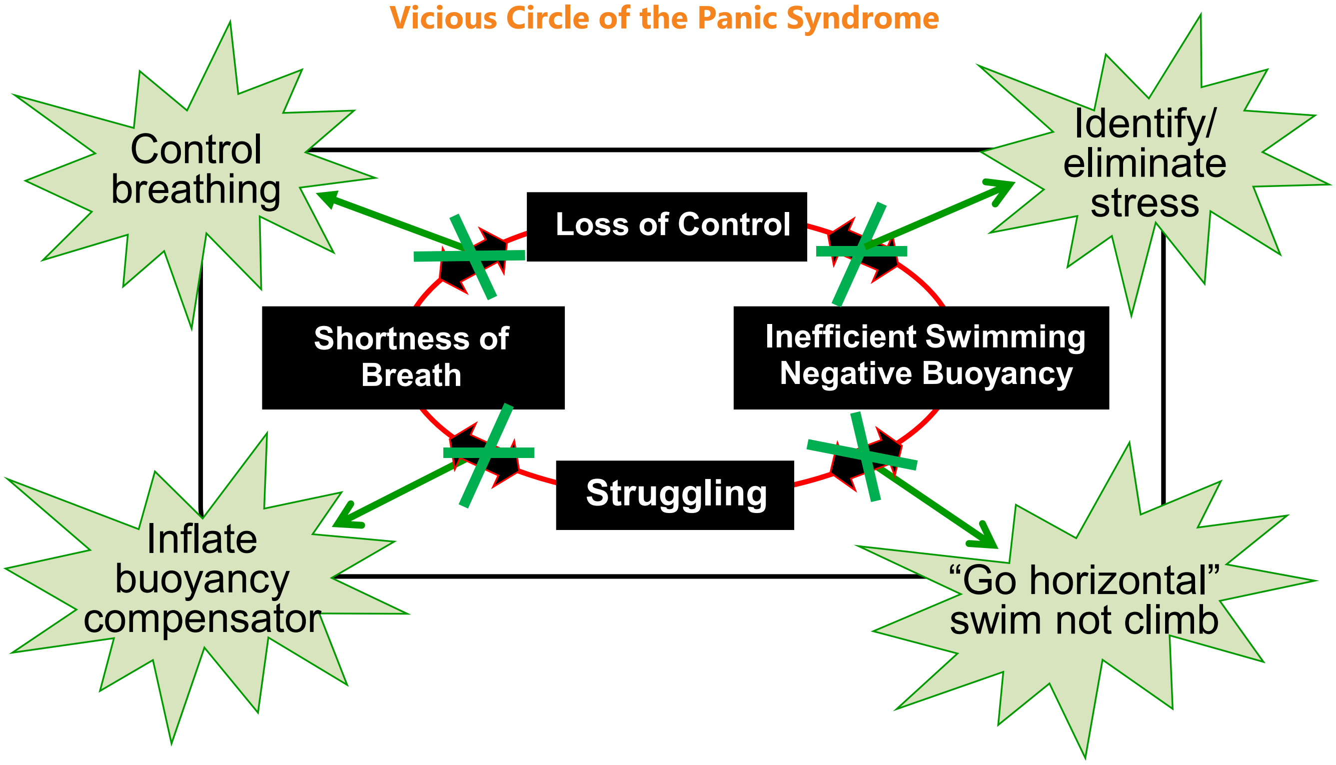
Comment :This potentially disastrous situation illustrates how rapidly exhaustion can occur with an "all out" expenditure of energy. While not a true panic situation while the diver's head was above the water, had he let go of the bowline and been pulled underwater, struggling to reach the surface would have maintained tension on the kelp and his near-exhaustion state would have resulted in an uncontrollable desire to breathe—a true panic situation. Aspiration of water and loss of consciousness would have occurred. Fortunately, the vicious circle was interrupted by re-establishing the diver's SCUBA air supply.

The third intervention is improving buoyancy; this should be initiated by adding air to the buoyancy compensator or as a last resort releasing the weight belt and/or ditching the integrated weights in the buoyancy compensator. With improved buoyancy the diver does not need to expend energy to reach the surface and when on the surface to keep his/her head above the water surface. ***The fourth intervention is improving swimming efficiency*** by slowing the kicking rate and improving the kicking efficiency. With extension of the knees (instead of trying to "climb" out of the water as the diver tried to do when engulfed in silt), forward propulsion is improved. In addition, assuming a more horizontal position in the water provides a lifting effect for the body as a diver moves forward, thereby aiding ascent.

Overzealous inflation of the buoyancy compensator can lead to an uncontrolled ascent and subject the victim to arterial gas embolism and/or decompression sickness. This situation must be avoided by inflating the BC enough to achieve positive buoyancy and then releasing gas from the BC as the gas expands in it with ascent (as described by Boyle's law) to maintain a controlled ascent.

In panic situations once on the surface and verbal communications can be re-established, the diver should be reassured that everything is OK. Decisions then need to be made whether to continue the dive or return to shore or the

Figure 9. First Response Interventions for Interrupting the Vicious Circle of the Panic Syndrome



Legend: Immediate first response interventions are crucial for interrupting the vicious circle of the panic syndrome. Usually, the immediate initiation of a first line intervention is all that is needed to interrupt the vicious circle and make a potentially disastrous situation an "interesting" sea story.

support craft—and how to do this most efficiently and with the least expenditure of energy. Considerations to resume the dive include effective first response interventions, the diver is OK, and the situation leading to the panic syndrome has passed. The decision to abort the dive should be based on whether the diver's anxieties about the event have been alleviated, the diver is fully alert and clear thinking, and there are no symptoms or signs of injury to the diver from the event. Omitted decompression with evolving decompression sickness symptoms, delayed onset pulmonary edema, traumatic injuries, and altered mental status dictate that the diver be extricated and transported to an emergency facility for further evaluation and management. Once the diver is OK an analysis of what went wrong, the corrective measures initiated, and how to prevent reoccurrence of the event should be conducted with the diver and the dive team leaders. From this information the diver needs to decide whether or not he/she wants to return to diving or requires evaluation by a physician with hyperbaric/diving medicine experience.

Definitive Management for Residuals of the Panic Syndrome Three major considerations dictate whether or not definitive management is needed for possible consequences of the panic syndrome. First if there was loss of consciousness while the diver was underwater, follow-up evaluation and management for lung injury, such as aspiration pneumonitis or delayed onset pulmonary edema, is essential. Likewise, the same should be done if a cardiac event has been observed (arrhythmia) or suspected (chest pain). Second if there was omitted decompression with or without symptoms, the diver should be evaluated by a hyperbaric medicine specialist and hyperbaric oxygen-recompression done. Finally, if arterial gas embolism with or without altered mental status is suspected because of an uncontrolled ascent, emergency evacuation should be initiated with oxygen breathing and the diver immediately transported to a hyperbaric medicine facility.

Panic Prevention The prevention of panic in divers is an important topic for all SCUBA diving training programs as well as in all pre-dive briefings. Whereas the topic might not be directly addressed, so many items that prevent panic or mitigate its occurrence are. From the training aspect, competency with using the buoyancy compensator, buddy breathing with the octopus (secondary) regulator, efficient fin propulsion, fitness, equipment selection, ascent rates, buddy diving, familiarity with the use of gauges and dive

Table 2. Diving Equipment that Prevents and/or Helps to Reduce Dive Stresses and Manage Panic

Name of Equipment	Role in Dealing with Stress Reduction/ Panic
Breathing equipment (SCUBA tanks & regulator)	Meets ventilation stresses (normally subliminally resolved); Mini air supplies provide brief backup when air supply lost
Buoyancy compensator	Reduces the stresses of energy requirements to maintain depth, to do ascents and descents, to rest completely when inflated on the surface
Compass; Reels with lines	Assists with navigation & decreases energy requirements in swimming to & from dive sites. With currents, it helps remain on course swimming against the current during the first 1/3 of the dive & returning with the current to the start pointing; Lines for bottom searches & cave diving
Dive Computer/Depth gauge	Mitigates the physiological stresses that can lead to decompression sickness; Avoids unscheduled depth excursions or ascents when visual or other clues such as descending lines not available
Dive mask	Maintains visual acuity underwater; Counteracts the differences in refractive indices between the cornea & water; Prevents eye irritation with salt water contact
Fins	Diminishes mobility & propulsion stresses in an environment almost 800 times more dense than air
Knife and/or probe	Available to cut free from entanglements; Serrations on the blade are desirable to help cut through nylon lines; Ward off & prevent injuries from encounters with marine animals
Signaling devices (sausage tube, strobe light, whistle, integrated air horn, GPS)	Improves visibility, localization and retrieval of the surfaced diver; Radio signaling devices also sometimes employed for open ocean dives
Thermal protection suits	Prevents/lessens hypothermic stresses of the water environment
Underwater light	Makes observation possible in light free situations (caves, night dives); Helps with reading gauges/orientation in diminished light conditions; Useful as signaling device for in-water retrievals/rescues

computers, and dive planning are all direct or indirect measures to prevent panic. From the pre-dive brief, diving conditions, likely marine animal encounters, dive depths and durations, and underwater communications (hand signals) should be addressed; all are stress reduction/panic prevention measures.

As discussed before, stresses lead to physical, physiological, and psychological challenges in SCUBA diving; the panic syndrome can arise from unresolved stresses from any of these three domains.[1,2] In one respect all diving equipment helps reduce stresses, thus in a sense it prevents panic (Table 2). Breathing gear (tanks and regulators) prevent panic from breathing challenges, the buoyancy compensator from uncontrolled descents and ascents, the dive knife from entanglements, the thermal protection suit from marine animal encounters and cold water, the dive "sausage" and signal mirror from separations from support crafts, the compass for navigation and orientation, fins for mobility, and dive computer for decompression requirements.

Fitness for diving is another panic prevention measure. This was discussed in the older diver in a previous issue of *Wound Care & Hyperbaric Medicine* but has applications to all divers.[7] Fitness includes exercise tolerance, mobility, and absence of (or well controlled) underlying medical problems. It is easy to appreciate how fitness helps meet the physical challenges of diving and when they are not met, a panic-producing situation is prone to arise. Diving conditions can vary from swimming pool "mild" to extremely challenging conditions that require extreme fitness, careful planning, and open water rendezvous with support craft. Consequently to prevent panic diving locations should be selected based on the fitness of the diver as well as the desirableness of the dive site.

Return to Diving After an Episode of Panic Three situations arise with respect to this topic. In some of the divers who experience panic on their first encounter, the initial episode is enough to dissuade from continuing SCUBA diving. For this group the answer is simple enough: stop diving. In a second group, the episode was resolved sufficiently and the problems that led to the panic syndrome well enough understood that they resume diving immediately without any hesitancy. The third situation is where residuals exist from complications of the panic syndrome such as neurological impairments from omitted decompression, arterial gas embolism, or near drowning. In addition, orthopaedic and cardiac conditions could have arisen from the stresses of dealing with and attempting to resolve or avoid the panic situation. In these situations an OK to return to SCUBA diving possibly with special conditions as in the above scenario should be made with recommendation of a physician knowledgeable in diving and undersea medicine.

Dive Scenario: While diving in extremely challenging conditions due to a confluence of currents and cold water that required thick neoprene wetsuits and lots of weights to counteract the buoyancy effect, the divers had to hold on to a line draped over the stern of the boat while waiting to exit the water on a rickety stern ladder. Once gripping the stern line, the diver dared not let go because of being dragged away by the currents—a real panic-provoking situation.

With the water turbulence the divers were twisted around the line while holding it with one hand and removing gear with the other. One diver complained of shoulder pain upon exiting the boat. The next morning he could hardly move his shoulder. He was wary of further diving activities in the area and did not want to be transferred to a recompression chamber for possible decompression sickness. Subsequent workup when he returned home confirmed the presence of a rotator cuff tear.

Comment A review of the dive history including the unlikelihood of decompression sickness supported the diagnosis that the traumatic shoulder injury was a residual problem from an impending panic producing situation. After this was addressed the diver restricted his diving to sites with “ideal” diving conditions.

Section B: Psychological Stresses from Altered Sensory Input in the Water

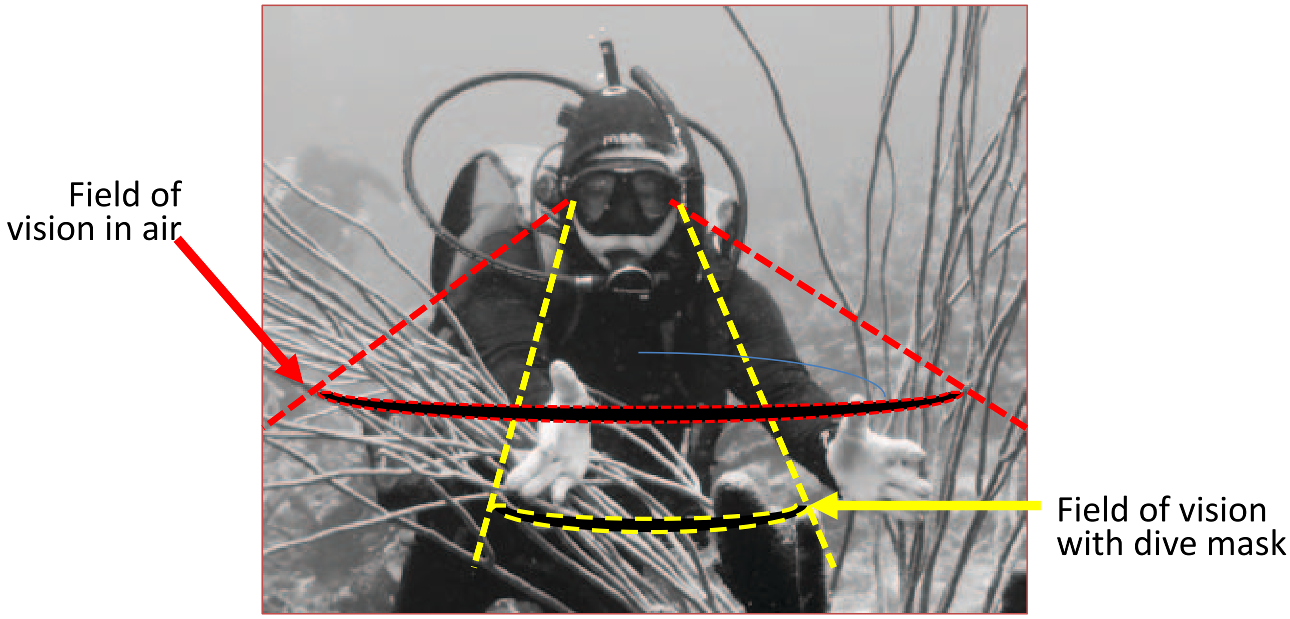
Introduction The underwater environment provides challenges to the human body unlike any found on land. Besides physical and physiological encounters, divers must contend with alterations in sensory input when in the aquatic environment. These generate psychological stresses. All five senses are either altered or significantly impaired when underwater. The visual and auditory systems are notably distorted. Tactile sensation decreases substantially secondary to the donning of gloves and the wearing of thermal protection to meet the chill of the surrounding water. For all practical purposes smell and taste sensations are inconsequential in the underwater environment. Finally, the viscosity of water hampers a diver’s ability to effectively move through the water column thereby hindering mobility and the ability to respond to sensory input.

The importance of sensory input was demonstrated in a murine immersion in water study.[8] Rats were swum to the point of exhaustion from drowning. The two arms of the study included rats with their whiskers intact and those whose whiskers had been removed. The rats with whiskers swam for much longer periods than the rats sans whiskers. Since whiskers do not aid in swimming, but are important tactile receptors, the investigators concluded that whiskers kept the rats from panicking.

Comment While this might not have direct applications to humans, the study seemed to confirm the importance of sensory input in preventing panic and certainly has analogies that can be carried over to the human SCUBA divers where the environment markedly alters human sensory perception.

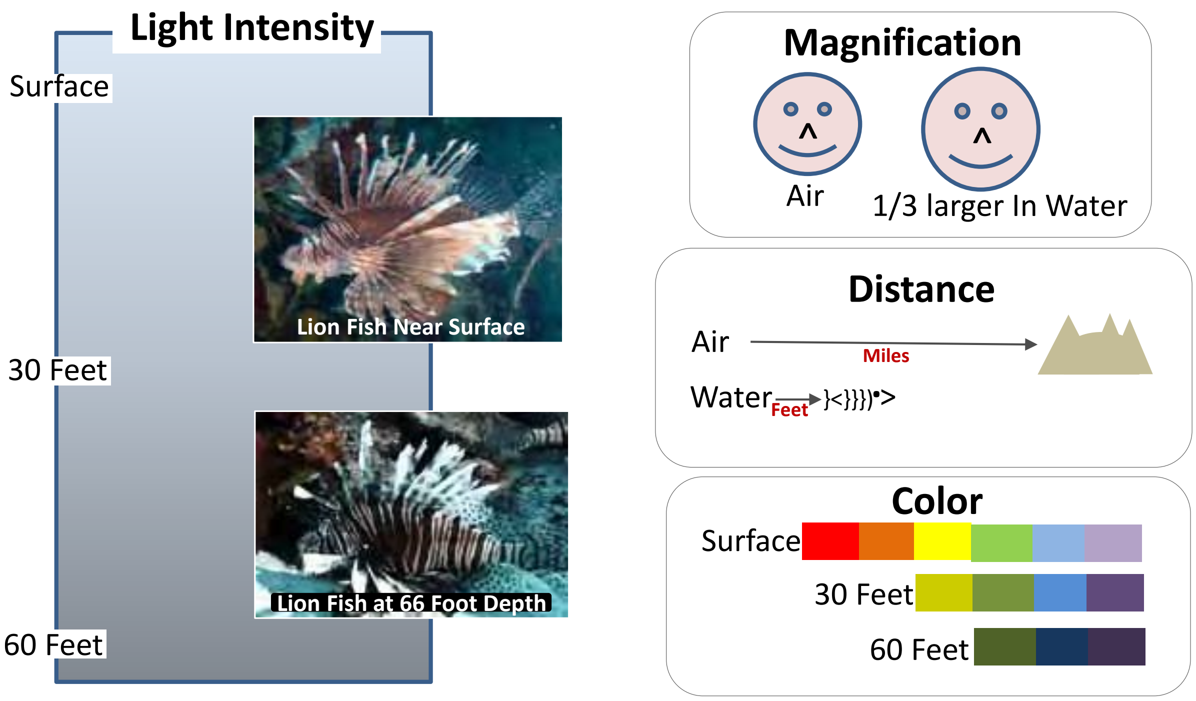
Visual System Vision is distorted underwater because of the difference in refractive indexes of the cornea and the water interface. A diving mask mitigates this distortion by interposing airspace between the two media. However, the face mask reduces the visual fields by 50% or more, depending on how close the face plate is to the eyes, which is a potential panic-provoking, claustrophobic situation (Figure 10). Further, the dive mask protects the eyes from the irritating effects of salinity (or chlorine if in a swimming pool) on the conjunctiva. Vision in water presents other challenges (Figure 11). As a result of the dive mask and faceplate-to-water interface, there is an approximately 33 percent magnification effect. For the unaccustomed diver, the magnification effect may result in misses when reaching for objects such as safety lines or game. The underwater world also limits distance vision secondary to the opacity of the water, which is a function of turbidity, depth, obliquity of the sun’s light rays, and organisms in the water column. Underwater vision measured in feet is roughly equivalent to on-land vision measured in miles. As a diver descends into deeper water, illumination and color recognition progressively diminish secondary to water filtering colors of the visible light spectrum. As shallow as 30 FSW (9.1 MSW) the color red disappears, while yellow becomes indiscernible at 75 FSW (23 MSW). Consequently the subaquatic environment appears a monotonous blue-grey. To remedy the lack of perceived color, underwater photographers utilize high lumen output flashes, or strobes, to capture the vibrant col-

Figure 10. Reduction in the Field of Vision with the Dive Mask



Legend: The dive mask substantially reduces the field of vision. (outlined yellow area). This can, in itself, lead to "closed-in" feelings that can evolve to claustrophobia and panic.

Figure 11. Visual Alterations with Immersion and Descent in Water



Legend: Visual alterations in water and with descent can be a source of stress for a diver. Besides narrowing of the visual field, four other effects (diminishing light intensity, magnification, limited distance visualization, and blunting of colors) occur with water immersion and descent. All can interfere with orientation, keeping track of dive buddies, handling of objects, and reading of monitoring equipment.

The vivid coloration of the underwater fauna is often lost due to the color and intensity decrements of descent in the water only to be fully appreciated with underwater lighting equipment.

Figure 12. Differences Between Sound Transmission in Air and in Water

Legend: Because water transmits sound 25 times faster than air, the diver underwater cannot discriminate the direction of the sound source. The fractions of a second delay of sounds reaching each ear when on land allows us to determine from where the sound arose.

This situation may interfere with trying to reconnect with a separated buddy (using a metal probe to tap on the SCUBA tank) or being aware of the direction an overhead motor boat is traveling; both are potential sources of stress for the diver.

ors of the underwater environment. Many day-time divers utilize a torch, or underwater flashlight, to appreciate the colors of the dive, while nocturnal SCUBA requires the use of torches as everything is "dark" except for the cone of light generated by the diver's underwater lantern.

Auditory System The underwater environment markedly interferes with the detection of sound direction in the auditory system (Figure 12). Water is almost 800 times denser than air and conducts sound 25 times faster than air. As a result, a diver hears sounds quite well underwater. However, the ability to localize the source of the sound is lost because the increased speed of sound transmission in water does not allow the ears to discriminate the shorter time differences for the sounds to reach each ear which determines the direction from which the sound came.

Furthermore, intelligible speech requires an air interface between the mouth and the surrounding water, and a receptive ear benefits from a similar interface. Ear problems such as barotraumas or acute otitis externa (swimmer's ear) constitute common medical conditions associated with diving and may further deteriorate sound conduction and hearing secondary to fluid collection behind the tympanic membrane or stenosis of the external auditory canal.

Divers using closed circuit rebreather (CCR) may communicate quite well secondary to the air space provided by their mouthpiece and air-filled breathing loops (Figure 13). Effective communication can also be accomplished with the use of hand-signals, rope pulls, tapping on metal objects, underwater sound generators, and via slate and pencil.

Tactile Sensations Many maneuvers required to safely conduct a dive such as retrieving a signaling device, sharing second stage regulators, or withdrawing a cutting tool from a sheath mandate excellent hand coordination. Although divers are encouraged to refrain from touching the marine environment, many choose to utilize gloves for thermal and abrasion protection. However, the thickness required to provide warmth usually necessitates a product that markedly diminishes tactile sensation and hand dexterity. This may lead to struggling in order to accomplish an otherwise simple task such as cutting free from an entanglement,

Figure 13. Voice Communications with Closed Circuit Rebreathers (CCRs)

Closed circuit rebreather with relatively large air-filled mouthpiece & breathing loops spaces

Open circuit SCUBA with negligible air-filled space in 2nd stage of the regulator

Legend: With the relatively large air space volume of the mouthpiece and the air-filled breathing loops, verbal communication is possible when diving with CCR.

Utmost caution much be exercised to maintain the watertight seal on the mouthpiece. Water entering the closed circuit will react with the soda lime carbon dioxide absorbent and generate caustic chemicals in the breathing circuit.

In addition, speech intelligibility using air or helium in the CCR may be difficult to interpret because of the "Donald Duck" quality of speech when breathing air at great depths or at all times when breathing helium .

and the consequence could be panic. As mentioned before, this could lead to serious problems like breath-holding during ascent (causing arterial gas embolism), omitted decompression (causing decompression sickness), increased respiratory rate and gas consumption (exhausting the SCUBA tank gas supply before freeing oneself from an entanglement), and interference with making appropriate decisions (to extricate oneself from an underwater predicament).

"Going blue" is a term used in SCUBA diving when visual clues for orientation from the bottom or a wall are lost and the divers feels as if he/she is suspended in mid ocean. This is often coupled with poor visibility from water turbidity. Without visual clues for orientation, the diver may misjudge depths, lose his buddy, hyperventilate, or become so disoriented that panic develops.

In such situations the diver may find himself/herself in much deeper water than expected, or when surfacing, further from shore than anticipated or not in sight of the dive boat. If separated from his/her buddy, feeling "lost in the middle of the ocean" can become a source of panic.

To mitigate this situation the divers must rely on monitors such as depth gauges, compasses, and/or dive computers to maintain orientation as well as strict buddy diving discipline—even to the point of using a buddy line to maintain connection. In "going blue" situations, especially for research and survey activities, it is desirable to have a descent line as a point of contact and to maintain a line connection to the descent line during the activity.

Disorientation Divers may quickly become disoriented underwater secondary to changes in the normal visual, vestibular, and somatosensory contributions to maintain our spatial orientation. Decreased peripheral vision, ambient light, and visibility limit our visual input, which is the dominant sensory input to maintain orientation when diving. Further, the effects of neutral buoyancy decrease the utility of the body's vestibular system, which is composed of fluid-filled canals and voltage-coupled cells with hairlike projections interacting with a viscous gel and otoconia. Topside, these intricate structures allow the body to detect linear and rotational accelerations. Underwater, the sensitivity to these accelerations is tampered. Cumbersome exposure protection, especially gloves, further acts to decrease our third input: somatosensory information.

Regardless of these formidable alterations to our senses, spatial orientation is usually maintained. This is because of the brain's ability to integrate sensory information from a variety of sources. External cues such as an ascent line, exhalational bubbles, surface light, or the presence of a visible bottom terrain also provide clues to orient a diver.

As a diver ascends, the previously equalized middle ear gas must escape through the Eustachian tubes into the environment to equilibrate pressures at more shallow depths. If the Eustachian tubes are patent, the gas easily traverses down these passages and exits the body via the oral cavity and regulator. However, the reversal of gas flow from the middle ear may be difficult if secretions have accumulated during the bottom phase of the dive. For this reason, divers should not utilize medications like pseudoephedrine to clear congestion and facilitate equalization upon descent due to a rebound hyperemia congestion effect from this medication. Failure of gas egress from the middle ear spaces during ascent may lead to reverse ear squeezes. If unilaterally it may generate alternobaric vertigo. Due to the difference between middle ear pressures; vertigo, pain, and nausea occur. Alternobaric vertigo alone causes serious disorientation problems. When coupled with challenging underwater situations such as strong currents, overhead environments, limited visibility, or extended decompression obligations, alternobaric vertigo may result in making inappropriate decisions and precipitate panic. In the event of reverse squeeze or alternobaric vertigo, a diver should descend until the pressure equalizes in the middle ears spaces of the ears. A slow, repeated attempt at ascent will give the gas additional time to escape. Forced or rapid ascent risks exacerbation of disequilibrium and potential rupture of the tympanic membrane or the round window.

Mobility Underwater activity poses challenges to the diver. Compared to air, water is substantially more viscous, which leads to difficulty moving through the medium. Strong currents can also severely impede movement or completely reverse a diver's direction if one attempts to swim directly into it. In addition, water's density and buoyancy effects must be addressed throughout a SCUBA dive. Finally, abundant, non-streamlined gear induces significant drag and restricts propulsion in the water.

If a diver utilizes efficient swimming movements while maintaining ventilation with slow deep breathing and neutral buoyancy, the diving experience may be euphoric, as if able to fly through air. When done properly, SCUBA diving requires less energy expenditure than is required at rest on land. Optimal physical conditioning provides a safety margin to a diver when circumstances call for quick or demanding efforts for emergencies. When a euphoric diving situation goes awry, panic is likely to occur and mobility impairment in the water can interfere with corrective actions.

Conclusions

The psychology-related stresses of SCUBA diving require equal attention to the physical and physiological stresses. By virtue of frequency of occurrence and potential seriousness of effects, the panic syndrome may be the most important medical problem of diving. Whereas dive briefings are instrumental in preventing physical problems of diving and adherence to dive times and depths for preventing the physiological problems, experience and the ability to think in crisis situations are the most important considerations in preventing psychological stresses that lead to medical problems of diving. In reality, almost all gear SCUBA divers use has some relationship to avoiding panic or mitigating its effects when it occurs. Whereas there is usually some opportunity to manage effectively the physical and physiological effects after the dive is completed (such as recompression treatment for decompression illness or middle ear barotrauma), management of panic invariably requires immediate on the scene interventions to avoid death or serious consequences to the diver.

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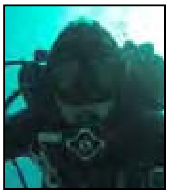
Michael B. Strauss MD, FACS, AAOS has had a long-standing and keen interest in diving and diving medicine. His formal training started with Navy Submarine and Diving Salvage Schools. This was followed by tours on a nuclear submarine, with salvage divers in the Philippines & Vietnam and as the undersea medical officer for Underwater Demolition & SEAL Teams in San Diego. Dr. Strauss's special interests in diving include panic & blackout, disordered decompression, the source of pain in decompression sickness, diving stresses (Part two in this issue), diving in older age (published in the previous edition of *WCHM*) and mammalian adaptations to diving. As Medical Director of the Long Beach [California] Memorial Medical Center Hyperbaric Medicine Program, he continues active in diving medicine having evaluated and managed nearly 500 diving medical problems, generating over 50 papers & posters on these subjects, conducting yearly worldwide diving-diving medicine programs and authoring *Diving Science*, a well-acclaimed text that describes essential physiology and medicine for divers.



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Wound Care & Hyperbaric Medicine

Preparing for that Epic Dive

By David Charash DO, FACEP, CWS, UHM

The dive of a lifetime—for some, that dive could be a historic dive off Truk Lagoon, looking at the wrecks of the Japanese Imperial Navy. For others, that dive might be a cave dive at the Eagle's Nest. My dive of a lifetime came this past June, when I was invited by Fabien Cousteau to join him on the Aquarius Reef Base during Mission 31. Fabien Cousteau, the grandson of Jacques-Yves Cousteau, carries on the family legacy as a third generation ocean explorer and filmmaker. Fabien recently led a team of scientists, divers, and technicians to complete Mission 31. I had the privilege of working with him in the recent past; he was a featured speaker at the fourth annual Dive Medicine Conference at Danbury Hospital on April 5, 2014, of which I have been the organizer.

At the conference, Cousteau presented on the upcoming Mission 31, which coincided with the 50th anniversary of Jacques Yves Cousteau's Conshelf Two Mission. In 1963, Conshelf Two was the first successful mission where six oceanauts inhabited an ocean floor habitat in the Red Sea and performed various scientific experiments for 30 days at 30 feet.

It isn't often one is invited by a Cousteau to join him for a dive, or, to dive to the Aquarius Reef Base and gain entry during an active mission.

Some fifty years later, Mission 31 began its journey with splashdown on June 2, 2014, and splash up on July 2, 2014. The goal of Mission 31 was to dive deeper at 63 feet and longer, for 31 days. The theme of Mission 31 was the human-ocean connection within the lens of exploration and discovery. There were three main objectives highlighted through Mission 31: climate change and the related challenges of ocean acidification; ocean pollution, with an emphasis on the effects of plastics; and the overconsumption of resources, with specific focus on the decline of biodiversity.

Scientists from Northeastern University, Massachusetts Institute of Technology, and Florida International University accompanied Cousteau, and carried out research related to the various themes. In addition to the above goals, use of current technology such as Internet, Skype, and state of the art videography was used to allow for public education and documentation of this historic mission. To accomplish this mission, Florida International University offered technical support, mission control training, and surface support.

Mission 31 took place at the Aquarius Reef Base nine miles off the shores of Islamorada, Florida. The Aquarius is the only habitat based solely for scientific research. The Aquarius is owned by the National Oceanic and Atmospheric Agency (NOAA) and is operated by the Florida International University (FIU). This 81-ton habitat sits 63 feet under water and is 43 x 20 x 16.5 feet in size.

I was honored to be asked to join Fabien and the crew on the 22nd day of Mission 31 on June 22, 2104. So how does one prepare for the dive of a lifetime? It isn't often one is invited by a Cousteau to join him for a dive, or, to dive to the Aquarius Reef Base and gain entry during an active mission.

Appropriate preparation for my dive required an understanding of the proposed dive plan and selection of dive equipment. Once the gear was selected, it was necessary to update and repair the gear I was to dive with. I reviewed my dive qualifications, made sure my C-cards were available, and updated my dive insurance. I then spent some time in the pool and ocean environment reviewing and practicing my dive skills. It was during this time that I tested all of the serviced equipment. I discovered that I needed to replace a battery in my dive computer and that the second stage on my regulator had a slow leak.

Aquanaut Liz Bentley Magee, Mission Scientist Northeastern, working in the reef for over five hours. Photo ©David Charash.

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Dr. Charash at the Medina Aquarius Mission Control Headquarters, completing the documents and waivers prior to his epic dive.
Photo ©David Charash.

Life support Buoy (10 metres in diameter) attached to the Aquarius.
Photo ©David Charash.

Dr. Charash and Fabien Cousteau on board the Aquarius during the interview in the kitchen. Photo credit: Mission 31.

Dr. Charash about to dive to the Aquarius to speak with Fabien Cousteau.
Photo ©David Charash.

Three inch in diameter, 42-meter unitized umbilical attached from life support buoy to Aquarius.
Photo Courtesy of History of Diving Museum, Islamorada, Florida.

RV *Sabina,* the boat that took Dr. Charash out to Reef Base Aquarius. Photo ©David Charash.

I then visited my family physician and was assured that all medical concerns were addressed. It is mandated that all aquanauts pass the watermanship fitness test, so, in advance, I set a goal to meet this physical fitness requirement.

Another consideration I had was how to capture such a dive on film, or video, or both. I own an underwater video camera, and I purchased a camera tray and lights. Once I set these up, I realized that I had not yet had the chance to test the new equipment in a real dive environment. I felt that keeping the setup simple was the way to go, as task loading can lead to an increased risk of dive or mission failure, and I did not want to compromise my safety or the safety of others. I opted for the video housing attached to my wrist with an appropriate filter, and I was able to capture the entire underwater experience on high-definition video by keeping things simple.

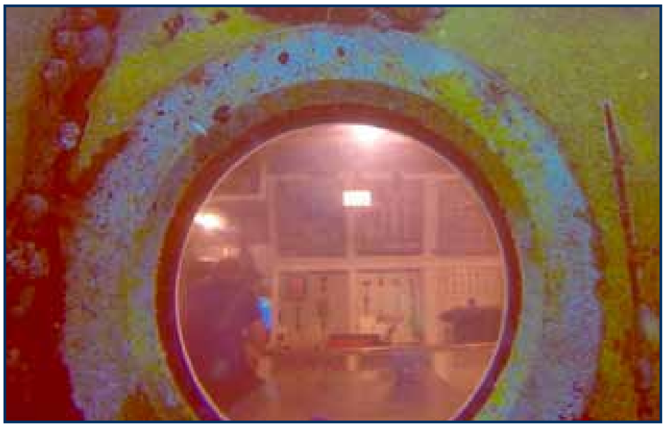
Epic dives, or dives of a lifetime, are best enjoyed like any other dive—with adequate preparation and understanding of any and all requirements related to the dive.

With all of the planning and preparation behind me, it was time to dive. I arrived the day before the dive at Mission 31 Headquarters at the Florida International University Medina Aquarius Facility on Islamorada. I met with the Director of Operations, Roger Garcia; I then reviewed the proposed dive plan and completed any necessary paperwork.

After a great dinner with friends, I decided to head in early and get plenty of rest for my morning dive. My cell phone rang at midnight. It was the mission coordinator; I was asked to arrive much earlier as the dive plan had changed—instead of a single dive, there would now be an opportunity to have a second dive. Now that was a welcome phone call!

On June 22, 2014, day 22 of Mission 31, I cast off on the RV Sabina and made my way to the Aquarius Reef Base. My first dive was a direct approach to the Aquarius: it was to 43 feet, on air, with a water temperature of 85 degrees. I entered the wet porch at 43 feet and gained entry into the habitat. I was greeted by Mission Specialist Mark Hulsbeck and given a safety briefing and review of emergency procedures.

My host Fabien Cousteau then greeted me. I had a rare and unique opportunity to sit down with him and have a 30-minute discussion. The topics ranged from Fabien's reflection on his legacy of as a third generation ocean explorer to the past record of his grandfather Jacques Yves Cousteau. We then spent the remainder of our conversation discussing various issues related to the medical effects of living on the Aquarius. It was interesting to note that the aquanauts were able to feel the various pressure changes related to tides



Porthole Outside the Aquarius looking inside the Aquarius.
Photo ©David Charash.

Dr. David Charash taking a selfie with Fabien Cousteau (right) in front of a porthole in the kitchen of the Aquarius.
Photo ©David Charash.

Dive plan.
Photo ©David Charash.

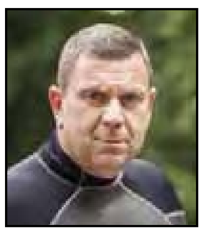
and weather, which in turn caused sinus-related issues. Also, because of the humid environment of the habitat and the bacteria-laden ocean, all aquanauts are prone to skin infections. A simple scratch can easily become infected, which can spread to other persons on board. Meticulous attention to hygiene and early recognition and treatment of infection are key to a safe mission.

At the conclusion of the discussion, my host gave me a walking tour of the living space and small workstation. Fabien and I shared some peanut M&M's, which were a very popular staple on board the Aquarius. I then presented Fabien a shirt and hat on behalf of Divers Alert Network. As my dive profile would only allow a 45-minute stay, it was now time to make my way to the surface. I exited to the wet porch, put my dive gear on, and bid Fabien and the Mission 31 crew farewell as I made my way to the surface.

After an adequate surface interval, I then was fortunate to make a second dive. This dive to 50 feet for 45 minutes was a swim around the exterior of the Aquarius and the surrounding research fields as well as the astronaut training area and mockup of the lunar surface. The sea life was very active, and the visibility was exceptionally clear. We made a 5-minute safety stop at 20 feet just above the Aquarius. This allowed a few minutes of reflection on what an incredible experience I had just had. It was a surreal moment. I then made my way back to the RV Sabina. The boat ride back to the shore in the late afternoon allowed me to reflect on what was an incredible day.

Epic dives, or dives of a lifetime, are best enjoyed like any other dive—with adequate preparation and understanding of any and all requirements related to the dive. Dive planning—the process of planning an underwater operation—can vary from a recreational dive to a very technical dive. The purpose of dive planning is to increase the probability that a dive is completed and that all objectives or goals are achieved. In the case of the scientific operation Mission 31, the Medina Aquarius Staff of the Florida International University carried out the actual dive planning. These dedicated professionals are an important part of the success of this mission.

One could easily argue that this was not a very technical dive, or in fact, a very deep dive. For me, this epic dive was a dive of a lifetime because being invited by Fabien Cousteau, and having the opportunity to sit with this third-generation ocean explorer in the Aquarius at 60 feet during Mission 31, made this a very special moment.



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Wound Care & Hyperbaric Medicine

Hyperbaric Chamber: Considerations about Panic in Extraordinary Environments

By Vincenzo Zanon MD; Gerardo Bosco MD, PhD, and Enrico M. Camporesi MD

A hyperbaric chamber is a complex medical apparatus capable of providing an environment of high pressure and special gas breathing mixtures, usually 100% oxygen, simulating a therapeutic dry dive. Most clinical chambers can provide up to 3 ATA of pressure and special gas breathing mixtures: the hyperbaric medicine sub-specialty has become the heritage and research field of the physiology of extraordinary environments.

Hyperbaric chambers are available in different configurations (mono- and multi-place), and allow treatment for all diseases that, directly or indirectly, can benefit from the temporary increase of oxygen partial pressure which is achieved inside the enclosed facility due to the increased pressurization. The biological mechanisms responsible for the beneficial effects in diverse syndromes are varied and continue to be elucidated.

Panic is a particular emotional experience defined at the other extreme of the Urbach-Wiethe scale;[1,2] this last named disease is characterized by the complete absence of fear and both extremes represent subjective emotional disorders. In a restricted group of subjects there is evidence of an underlying neurological problem involving amygdalic structures.[3]

Panic is a reaction that, while one is facing a real or imaginary danger, suddenly overwhelms the patient, taking away any capacity for rational actions, and can provoke instinctive and rash acts. Women are twice as likely to suffer from panic disorder or social phobias compared to men, with onset between 25 and 36 years.[4,5] This disturbance can affect 3.5% of the world population and has described in all cultures, while in Iceland, where population genetic can be studied due to limited cross-breeding, some anxiety disorders have been linked to an abnormal 9q chromosome.[6] In the hyperbaric environment panic could be triggered by an underlying claustrophobic trait. Claustrophobia appears to be present in about 2% of the general patient population and may cause confinement anxiety, even in a large multiplace chamber. Occasionally, mild sedation is required for such individuals to continue to receive daily HBO_2 therapy.[5]

The majority of patients are able to undergo hyperbaric therapy (about 98% in our series) despite pre-existing or concurrent clinical conditions, and usually can rationalize the acceptable cost-benefit ratio for the side effects of the procedure. However approximately 2% of patients, for various reasons, will need to shift to other treatments as they are unable to tolerate the minimum clinical safety conditions required for receiving this therapy. In this small percentage, which constitutes less than 2% of patients in our experience (over 20 plus years of practice), we include those cases of claustrophobia that cannot be modified with pharmacological control and need to be diverted to other treatment options precluding hyperbaric oxygen therapy. The dozen of cases of patient emphatically rejected the exposure to hyperbaric treatments soon after understanding the predicament of the confined space. Confinement anxiety, fear of enclosed spaces, claustrophobia induced by environment, and/or mask breathing or tent enclosure constituted the majority of the complaints.

Two different factors can affect these patients: the confinement in a limited space, often with pain and loss of control of their movements; and the fear of not being able to immediately leave the hyperbaric chamber due to the decompression requirement which might be acquired during compression, even when the patient is rationally aware of the small spaces, obligatory positioning, and safety factors. Symptoms might include palpitations, tremors, chest pain, and tightness of breathing, but also increased heart rate, shaking, choking, nausea, numbness or tingling, chills or hot flashes, feeling of dizziness and weakness, feelings of depersonalization (as estranging from one's own body), fear of going crazy, and fear of dying.

Where claustrophobic traits remain confined to a mild form, it might be sufficient to administer an anxiolytic 30 to 60 minutes prior to the scheduled time of the daily treatment session.[5] In this case, adequate patient informed consent must be obtained, including transportation arrangements for the patient due to the possible effects of the drug. Also, where permitted by the structure and the operator expertise, acupuncture has been utilized with success.[7] Not to be overlooked is the power of the medical visit itself—during the initial phase of the interview and patient history, a professional provider can open a dialog of understanding to help convince the patient to successfully undergo a hyperbaric treatment. At this stage, a trial run with a visit inside the chamber and good communication skills can strongly support the patient past any anxiety.

Hyperbaric Experience in Monoplace Chambers

Specific considerations for patients treated in monoplace chambers have been summarized recently.[7] An analysis of adverse events from a database was performed using data from all centers operating for the full two-year period of 2009–2010.

Diversified Clinical Services provides management services to 340 hospital-based outpatient wound care centers, of which 89% provide outpatient hyperbaric oxygen treatment to diagnoses limited to those listed in the *2008 UHMS Hyperbaric Oxygen Therapy Indications* (12th edition).

Adverse event data was collected concurrently in a central proprietary database. An Adverse Event Data Dictionary defined each adverse event. Entering of adverse events into the predefined categories was mandatory for all treatments. Air breaks were provided for all treatments at pressures greater than 2 ATA. The primary adverse event categories were ear pain, confinement anxiety, hypoglycemic event, shortness of breath, seizures (includes both oxygen toxicity and hypoglycemic event seizures), sinus pain, and chest pain.[9] Reporting data was reviewed from 463,293 monoplace hyperbaric oxygen treatments provided in hospital-based outpatient settings involving 17,267 patients (average of 27 treatments per patient) (Table 1).

Table 1: Monoplace chamber adverse events associated with hyperbaric oxygen treatment (tx)

	Total events in 2 years	AE per 10,000 Tx
Number of treatments	463,293	–
Complications	1,870	40
Ear pain	928	20
Confinement anxiety	407	8
Hypoglycemic event	244	5
Shortness of breath	112	2
Seizure	88	2
Sinus pain	66	1
Chest pain	25	1

The majority of these patients received hyperbaric oxygen treatment for diabetic limb salvage or radiation therapy: anxiety and panic was rarely observed, perhaps because of more personalized care possible in the monoplace chamber.

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Wound Care & Hyperbaric Medicine

Enhancement of Healing in Selected Problem Wounds

By Eugene R. Worth MD, M.Ed., FABA, FABPM-UHM

Introduction

Problem wounds of the lower extremities are the most common and vexing wounds seen in modern wound care centers. The incidence of diabetic foot ulcers is growing. If any indication from our wound care practice, the level of acuity of these patients is more severe than in the past.[1]

Foot ulcers in patients with diabetes, or DFUs, are frequently precursors to non-traumatic lower extremity amputations. More than 60% of these amputations come from this population.[2] In 2011 the American Diabetes Association estimated that 25.8 million individuals in the United States have diabetes. This represents 8.3% of the population.[3] The population at risk has more than quadrupled over the preceding 20 years. The potential economic consequences of diabetic foot ulcers can be staggering. In 1995 the attributable cost for a 40- to 65-year-old male with a new diabetic foot ulcer was $27,987 for the first two years after diagnosis.[4] When adjusted for inflation, the cost in 2013 was greater than $50,000.

Background and HBO_2 Treatment for Patients with Selected Problem Wounds

There are a number of randomized controlled trials for the use of hyperbaric oxygen in the treatment regimen of diabetic foot ulcers.[5-11] The best news is that the majority of these studies showed that hyperbaric oxygen therapy prevented major amputations of the lower extremity (below and above the knee). The bad news is that each study used a different design, different patient cohort, different inclusion/exclusion criteria, and frequently, different hyperbaric oxygen protocols. These profound differences make it difficult to analyze the effect of hyperbaric oxygen in this disease process.

Rationale for HBO_2 Treatment for Patients with Selected Problem Wounds

Diabetes mellitus causes a number of complications as the disease advances. These include peripheral vascular occlusive disease, perineural glycosylation resulting in neuropathy with muscle imbalances, and cellular dysfunction with lower nitric oxides levels. Unfortunately, these pathologic processes lead to changes in the skin and blood flow, foot deformity, and the inability to heal.

Patient Selection and Clinical Management

Most Medicare intermediaries and state Medicaids require four weeks of standard wound care for Wagner Grade 3 or higher diabetic foot ulcers. Through review of the literature and study of our own practice, we find five areas that must be addressed through the wound care avenue in order for the addition of hyperbaric oxygen to be helpful. These are **V**ascular evaluation and intervention, **O**ffloading, **I**nfection management, **D**iabetes control, and **S**urgical debridement or intervention. **VOIDS** is the key by which all future randomized controlled trials should be compared for wound care standards.

Cost Analyses

No formal cost analysis has been performed for diabetic foot ulcers. There are several studies that address cost or attempt to model cost.[12,13] Cianci and Hunt[12] reviewed 101 consecutive cases of diabetic foot ulcers with a Wagner Grade 3 or 4. Of those, initial limb salvage with aggressive medical management and hyperbaric oxygen salvaged 85% of those extremities. The durability in surviving patients was nearly 5 years. The durability in patients who died was 3.4 years. Cost for this aggressive treatment was $31,264 in 1997 dollars.

Chuck et al.[13] modeled a population cohort of 65-year-old patients with a 12-year time horizon. Cost savings for adjunctive hyperbaric oxygen was approximately $9,000 Canadian in 2008 dollars. This study concludes that 3.4 quality-adjusted-life-years (QALY) was a favorable outcome.

Our own practice (Joan Eggert, MD, personal communication) has shown that aggressive wound care with adjunctive hyperbaric oxygen is cost effective vs. lower extremity amputation and rehabilitation. We can conclude that a multidisciplinary wound care and hyperbaric medicine approach is necessary for quality outcomes in this disease population.

The 13th edition of the *Undersea and Hyperbaric Medical Society Hyperbaric Oxygen Therapy Indications* has just been released and provides additional information on this indication.

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About the Author

Eugene R. Worth is the medical director for hyperbaric medicine at Dixie Regional Medical Center in St. George, Utah. Dr. Worth is the physician lead for the Hyperbaric Development Team for Intermountain Healthcare. He is also an adjunct assistant professor of anesthesiology for the undersea and hyperbaric medicine fellowship at Duke University.

Wound Care & Hyperbaric Medicine

UHMS Northeast Chapter Meeting coming soon! October 24-26 in Quincy, MA

The NE Chapter organizers have prepared an extraordinary line up of lectures for this year's annual chapter meeting! Join us in Quincy, MA October 24-26 and hear from leading experts, practicioners, and researchers in the fields of wound care, diving and undersea medicine, and hyperbaric medicine.

Diver's Day

The 2 1/2 day meeting will kick off on Friday, October 24th at 6:00pm with a special Diver's Day program.

The first lecture will be "**JAWS Revisited: New Insights into the Ecology of the White Shark in the North Atlantic**" presented by Dr. Gregory Skomal. This presentation highlights Dr. Skomal's research from tagging 38 white sharks off the coast of Cape Cod with coded acoustic transmitters and/or satellite-based tracking tags to examine movements, habitat use, site fidelity, residency and feeding behavior along the east coast of the US as featured on Discovery Channel's Shark Week.

"Thoughts on Biodiversity and Public Health From the Front Lines of Marine Conservation" will be presented by Alex Shopov, member of the Sea Shepherd Conservation Society for over three years and in that time has taken part in Operation Infinite Patience, Operation Grindstop, and the Dam Guardian sea lion defense campaign. In addition to his time with Sea Shepherd, Alex has worked as an educator at the New England Aquarium, contributed to and published research in marine microbial ecology, and is an avid sailor and SCUBA diver. This presentation is an exploration into the relationship between human health and the large scale slaughter of wild animal populations, viewed through the lens of the dolphin drive hunts in Taiji, Japan, the killing of pilot whales in the Faroese grindadrap, and the culling of California sea lions in the Columbia River.

"SEALAB and a Forgotten Quest" will be presented by Ben Hellwarth. Author Ben Hellwarth has interviewed many surviving participants and uses archival visuals and rare audio clips in this presentation based on his well-received book SEALAB (Simon & Schuster, 2012), about the pioneering US Navy divers and scientists who set out to achieve longer and deeper dives than ever thought possible by developing "saturation diving". This year marks the 50th anniversary of the first SEALAB trial. A book signing will follow. Visit Ben at www.benhellwarth.com

"Underwater USA" will be presented by Peter Venoutsos, a certified diver since 1976 and a commercial diver since 1983. His experience includes working with private underwater engineering firms, the Federal Government and the US Navy. He is an active member of the Connecticut Underwater Archeology Committee and his interests include underwater photography, shipwrecks & cave diving. He is the founder of American Scuba Adventures a underwater video company with the goal of promoting diving in the United States and around the world. This presentation highlights the diving diversity of our country starting with the East coast down along the South and then over to the West coast. www.americanscubaadventures.com

"Prevention and Mitigation of the Dangers of Spearfishing" by Alex Post of the Massachusetts Freedivers Club, a marine biologist, fisherman and aquarist. Spearfishing, the sport of underwater hunting, is an exciting branch of the free diving and SCUBA skill set. Participants face the risks associated with either method of diving as well as risks specific to spearfishing. This presentation will focus on awareness of these dangers and ways to prevent and mitigate their effects, featuring northeast diver insights. www.massfreedivers.com

"Dive History from Leonardo da Vinci to Present Day" by Fred Barthes from the Historical Diving Society whose mission is to preserve, study, compile archive and disseminate information relating to the history of man's underwater activities and to promote public awareness of and participation in underwater activities. Fred is a diver with over 35 years experience and co-founder of the Northeast Diving Equipment Group. His presentation will include videos and displays of various pieces of equipment used in commercial diving on loan from the New Jersey Maritime Museum taken out for limited engagements only. He will also feature audience participation with instruction on how to dress a hard hat diver.

Invasive Skills and Procedures Refresher

Friday, October 24th from 7:00-10:00pm, The workshop will be conducted by Scott H. Smith EMT-P DMT and Prehospital medicine course director and Medical Information Specialist with Divers Alert Network. The refresher will provide opportunities for hands-on clinical procedures and skills you may feel rusty with. There will be skill stations with manikin task trainers, porcine tissue and simulation manikins available to practice phlebotomy, IV access, adult IO access, needle thoracostomy, chest tube thoracostomy, suturing and staples, difficult airways and intubation, blind insertion airways devices, Foley catheter insertions, myringotomies and scenarios on patient emergencies. Join Scott and his team for an evening of fun and a chance to brush up on your skills. *Additional fee.*

Hyperbaric Medicine Topics on Saturday

Director of the Undersea and Hyperbaric Medical Society, John Peters FACHE will kick off the day on Saturday, October 25th with an update on the UHMS.

- Direction of the Society, John Peters FACHE
- Hyperbaric Staff Certification; Genesis and Current Standards of the National Board of Diving & Hyperbaric Medical Technology, Dick Clarke CHT
- Northeast Hyperbaric Registry Project Update, Judy Ptak ACHRN, Jay Buckey MD
  Materials Testing Advisory Committee Project Update, Richard Barry CHT
- Challenges in Treatment: Inpatient, Outpatient and Somewhere in Between, John Kirby MD. Selected uses of both wound care methods and HBO therapy for inpatients, outpatients and essentially outpatient procedures that split the differences between inpatients and outpatients and how we can all get more done properly on the outpatient side of our practices.
- TCPO2 Testing-Why All the Confusion?, Dick Clarke CHT
- That is Not in MY chamber: Infection Control and Chamber Cleanliness, Karin Roemers-Kleven RN, CWS
- Safety Director Challenges, Kip Posey CHT
- Break-Out Session for Physicians and Associates
- Accreditation and Issues, Roy Cano CHT An overview of the UHMS accreditation program, MVP & Novitas insurance status; past, present and future initiatives.

More Hyperbaric Medicine Topics on Sunday

- Research-How To Do It in Non-Academic Settings, Funding and IRB, John Kirby MD, Academic vs Non-academic settings and the challenges of getting research accomplished, thinking outside the box for funding sources and working with your IRB or starting an IRB at your facility.
- Traumatic Brain Injury, Tom Serena MD, This presentation will review the evidence for HBOT in the treatment of
- TBI and describe an ongoing TBI study in college athletes.
- HBO for Improving Stump Salvage After AKA in Patients with Severe Unreconstructable Vascular Disease, Judy Ptak CHRN, A case series of patients who developed post-op wound complications after AKA. They received HBOT and went on to heal their wounds.
- Does Your Documentation Meet Industry Standards and CMS Requirements? Laura Josefson ACHRN
- Indocyanine Green Micro-Angiography; Assessment of the Complex Wound and Determining Candidacy for and Efficacy of Hyperbaric Oxygen Treatment, Stephen Guthrie MD
- Phase 2 Clinical Trial Using Hyperbaric Oxygen, Radiation and Chemotherapy for Glioblastoma Treatment, Scott Gorenstein MD

This is a conference not to be missed! Please join us for a great weekend of educational workshops, dynamic lectures, and thought-provoking presentations with some of the industry's best speakers.

To register, please follow the link below:

http://membership.uhms.org/event/NE14

Wound Care & Hyperbaric Medicine

Press Release

Life Support Technologies Group Guides Hudson Valley Hospital Center to Earn Top Distinction from the Undersea and Hyperbaric Medical Society

Hyperbaric chambers at the Hudson Valley Hospital Center's (HVHC) Institute for Wound Care and Hyperbaric Medicine in Cortlandt Manor, NY.

Tarrytown, NY - (July 21, 2014) – The Life Support Technologies group (LST) has guided Hudson Valley Hospital Center's (HVHC) Institute for Wound Care and Hyperbaric Medicine through a vigorous program review process that has resulted in HVHC being awarded Re-Accreditation with Distinction by the Undersea and Hyperbaric Medical Society (UHMS). LST has been contracted by HVHC since 2009 to provide hyperbaric medical services at its Institute in Cortlandt Manor, NY.

Glenn Butler, CEO of LST, remarked: "National Accreditation of Hyperbaric Medicine programs by the UHMS helps to promote safer, cost effective programs with better patient outcomes. The Life Support Technologies group and our Hudson Valley Hospital Center partner are proud to be UHMS accreditation pioneers in the Northeast."

Hudson Valley Hospital Center is the only facility in the Mid-Hudson, NY region to provide this level of service, according to the UHMS, the leading hyperbaric medicine authority in the nation. Only one other Hospital in New York State - Upstate University Hospital in Syracuse, a 400-bed teaching hospital - has earned Accreditation with Distinction from the UHMS.

In order to receive the UHMS accreditation, HVHC's Institute had to submit to an inspection by expert evaluators who rated it on commitment to staffing and training, equipment installation, operation, maintenance, facility and patient safety, and standards-of-care.

"This is an incredible honor,'' said Kathy Webster, Vice President of Patient Services at Hudson Valley Hospital Center. "It speaks to the level of care we provide at our Institute for Wound Care and Hyperbaric Medicine and that is due to our top-notch staff as well as new modalities of treatment we are using here with great success.''

In July, the UHMS' rapidly growing Clinical Hyperbaric Facilities Accreditation Program had 155 accredited hyperbaric medicine services nationally. In year 2011, Hudson Valley Hospital Center was the first in the region to receive the UHMS accreditation, which is increasingly being required by commercial insurances for patient treatment approval and reimbursement.

HVHC's Institute for Wound Care and Hyperbaric Medicine treats non-healing wounds with a combination of debridement and the use of hyperbaric medicine. The super oxygenation offered by hyperbaric treatments can help those with chronic non-healing wounds caused by diabetes, poor circulation, traumatic injury, radiation therapy and other causes. The Institute offers three oversized, private hyperbaric chambers where patients can relax, listen to music, or watch a movie. More than 5 million Americans suffer from non-healing wounds.

The advanced clinical programs of Hudson Valley's Institute include Diabetic Limb Salvage, and Breast Reconstruction as part of the Ashikari Breast Center at HVHC. The Institute also uses the LUNA Fluorescence Imaging System to provide fluorescence images for the visual assessment of blood flow in vessels and related tissue perfusion.

The Institute is now led by Medical Director Hisham Hourani, MD after Stephen Guthrie, MD, PhD, retired at the end of June. Dr. Guthrie established a solid network of physicians who refer patients to the Institute for advanced treatment. Integrated clinical support is provided by: Eileen Donatelli,

> **"The UHMS' rapidly growing Clinical Hyperbaric Facilities Accreditation Program had 155 accredited hyperbaric medicine services nationally . . . Hudson Valley Hospital Center was the first in the region to receive the UHMS accreditation, which is increasingly being required by commercial insurances for patient treatment approval and reimbursement."**

CHRN; Christine Rogers, RN; New York Group for Plastic Surgery; and, the entire HVHC Physician / clinician staff.

For more information see:

Hudson Valley Hospital Center

http://www.hvhc.org/

Undersea & Hyperbaric Medical Society (UHMS)

http://uhms.org/

About the Life Support Technologies Group (LST)

The Life Support Technologies Group (LST) is a Tarrytown, NY-based medical and life-support engineering company specializing in Advanced Wound Care and Hyperbaric Medicine Services to hospitals in the NY, NJ, CT region. LST has been in business for 20 years, currently provides services to 9 hospitals, and offers full, turn-key operations to hospitals for Wound Care and Hyperbaric units.

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Wound Care Education Partners

In Plain Sight

By Darren Mazza EMT, CHT

Outpatient hyperbaric therapy programs around the United States vary with regards to staffing, facility spatial configurations, and even their written policies for emergency procedures. One thing does stay the same despite the general differences: Emergencies do happen in the hyperbaric environment, and it is absolutely imperative that the hyperbaric safety director conducts monthly emergency training for the entire staff of both the wound care and hyperbaric departments. Everyone counts in an emergency and plays an important role which influences the overall outcome. Having experienced several emergency situations in the hyperbaric environment, I have found that conducting monthly emergency training has had a significantly positive impact on the overall outcome of every one of the emergencies the staff and I have faced in my facility. I encourage every facility to create a list of emergencies and their respective response procedures for their policy and procedure manual. Listed below are the emergency topics covered in my facility:

- OTIC BAROTRAUMA
- SINUS BAROTRAUMA
- ANXIETY
- NAUSEA / VOMITING / DIARRHEA
- HYPOGLYCEMIA/ HYPERGLYCEMIA
- UNRESPONSIVE PATIENT
- OXYGEN TOXICITY/ SEIZURE
- PNUEMOTHORAX
- GAS EMBOLISM
- LOSS OF OXYGEN PRESSURE
- POWER LOSS
- SEVERE WEATHER
- FIRE IN THE ROOM
- FIRE IN THE CHAMBER
- USE OF THE SCBA (self-contained breathing apparatus)

Every month I select a topic from this list and provide emergency response training to all staff. The type of emergency will not only dictate how the staff responds, but will define each staff member's specific role during the emergency, as per our written policy. For example, in case of a fire in the room emergency, the following protocols are in place.

CHT First Responder

- ACTIVATE RED PULL STATION
- DON SCBA
- EXTINGUISH FIRE USING FIRE EXTINGUISHER IN THE CHAMBER ROOM
- REASSURE PATIENT
- NOTIFY MD
- NOTE TIME AND DEPTH
- START ASCENT TO SURFACE
- TURN OXYGEN SHUT-OFF VALVE TO THE OFF POSITION UPON REACHING SURFACE
- NOTE TIME UPON REACHING SURFACE
- EVACUATE PATIENT
- FOLLOW DIRECTIONS OF RESPONDING FIREFIGHTERS
- NOTIFY TECHNICAL/SAFETY DIRECTOR.

Staff Member First Responder

Alternatively, the first non-CHT staff member to enter the chamber room will don the SCBA and grab the fire extinguisher, which are both located on the wall at the entrance to the chamber room, and then extinguish the fire. Both of these items are dedicated to the first responder. Additional responders will assist with evacuating patients and have been instructed to assist the CHT as directed.

Keep emergency procedures in plain sight for quick reference should they be needed.

Although staff members receive periodic training, true emergencies are extremely stressful, which makes it difficult to stay focused and on task. I find that it is extremely important to make these procedures visible for staff responding to an emergency. One example is to attach a laminated copy of the emergency procedures to the rails on the control side of each monoplace chamber so it is in plain sight. This will cue the CHT to respond appropriately for the type of emergency and make the emergency procedures more accessible for the responding staff to review, which in turn will improve the outcome in an emergency situation.

About the Author

Darren Mazza is the CHT and Safety Director at the Center for Wound Healing and Hyperbarics at Swedish/Edmonds, located in the greater Seattle area. He has 20 years of experience in healthcare, which includes 8 years as an EMT in the greater Sacramento region. Darren also worked as a preceptor trauma tech in a Sacramento hospital for several years. After leaving California and moving to Idaho in 2005, his hyperbaric career began after becoming the department head of an outpatient wound care and hyperbaric center. His hobbies include fly fishing and fly tying.

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Wound Care Education Partners

Wound Care & Hyperbaric Medicine

Credentialing: What's In it for Me?

From the Wound Care Education Partners blog, *Rx Pad*

Is it a goal of your clinic to achieve 100% staff credentialing? If not, your facility is missing a huge opportunity. Having a fully credentialed staff sends the message to referring physicians, patients, and your local community that meeting a national standard of high quality health care is your clinic's #1 priority. Being fully credentialed also sends the message that your clinic has a very competent clinical team. And when faced with making a patient referral, wouldn't you rather refer a patient to a facility that you trust to be competent and provide the highest quality of care?

Clinics Setting the Standard

We recently received very exciting news from two clinics who, after holding an onsite Introductory Course in Hyperbaric Medicine at their facility, taught by Wound Education Partners, now have a fully credentialed staff team! The Respiratory Therapy & Hyperbaric Oxygen Services at the OhioHealth MedCentral Mansfield Hospital has four RRT-CHT's plus one CHRN on staff; each person passed their respective NBDHMT CHT and CHRN test, and one individual passed with distinction! Their department opened in February 2012 with two Sechrist chambers. They have four monitoring physicians, two pulmonologists, one infectious disease and one general surgeon. All staff in the HBOT department are certified CHT and CHRN which is a condition of employment in their center. Their department is located within the hospital and they work very closely with the wound care department. They are scheduled for UHMS accreditation in Aug 2014.

Another clinic, the Center for Wound Care and Hyperbarics at Springhill Medical Center in Mobile, Alabama is one of only six facilities nationally to have earned UHMS accreditation four times, and became the only facility in Mobile, Alabama to have a fully certified staff. Their nurses took the CHRN national certification exam from the NBDHMT and all passed! Their facility is now fully credentialed!

Julio Garcia,CHT, CHRN, BSN and Program Director for the Center for Wound Care and Hyperbarics at Springhill Medical Center, shared this with us, "Thanks to Wound Care Education Partners, we have an onsite educational format that allows for quality training of clinical staff in order to achieve full credentialing for Registered Nurses and the Technicians. In addition, it has been instrumental in maintaining our credentialing with the UHMS."

The Bottom Line

The bottom line is this, it may cost your facility more money up front to get a fully credentialed staff in place, however, look at the cost benefit. If practitioners trust your facility and make more referrals, your case load increases and with it your bottom line. When your bottom line increases, your clinic doors stay open, your hospital network wants to keep your clinic up and running, and you keep your job! Also, if your staff has a higher level of knowledge, competence, and performance you will have less incidents that occur, and thus incur less overall risk.

Credentialing Standards

For more information about credentialing standards, we invite you to read the recently published UHMS Credentialing and Privileging Guidelines for Hyperbaric Medicine Physicians in the U.S.A.

The guidelines detail the essentials of credentialing standards for hyperbaric medicine physicians practicing in the U.S.A. These standards were developed by an ad hoc committee of the UHMS. As per John J. Feldmeier, DO, FACR, FUHM and President of the Undersea and Hyperbaric Medical Society (UHMS), "this document is not meant to be an all encompassing statement of credentialing and privileging for hyperbaric physicians. We plan to publish a larger document in a future edition of the Undersea and Hyperbaric Medicine Journal to address more detailed standards for

American physicians as well as standards for privileging our international UHMS members in their own countries."

Take Action Now!

Get your facility on the road to being fully credentialed. Contact Wound Care Education Partners today and schedule a training course at your facility! WCEP offers training at your facility, saving your clinic thousands of dollars in travel expenses, staff time, and overhead costs.

WCEP On-site Training Courses Include:

- Introductory Course in Hyperbaric Medicine
- Hyperbaric Safety Director Role
- Wound Care Review

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Do you have questions for the wound care experts, or want to continue your education and improve the health of your clinical practice? Follow the Wound Care Education Partners' Blog, Rx Pad today at: http://www.woundeducationpartners.com/rx-pad.html

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Press Release

A new article written by Dr. Michael Strauss et al. is available from *Wounds:*

"Foot Sensation Testing in the Patient With Diabetes: Introduction of the Quick & Easy Assessment Tool"

For Immediate Release

This article discusses the shortfalls with regard to the Semmes-Weinstein monofilament (SWM) test and reviews other techniques for sensory evaluation. In addition, the Quick & Easy system is introduced, which combines sensory assessment with guidance for anesthesia requirements during wound debridements or other surgical interventions.

Access the article at:

http://www.woundsresearch.com/article/foot-sensation-testing-patient-diabetes-introduction-quick-easy-assessment-tool

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Wound Care & Hyperbaric Medicine

Press Release:

Retrospective Analysis Finds MiMedx EpiFix® As Most Effective In Rapid Resolution Of Diabetic Foot Ulcers When Compared With Two Other Skin Substitutes

EpiFix(R) shown to have most rapid and complete wound healing, least wastage and lowest cost per patient among three advanced wound care products in retrospective analysis of data.

MARIETTA, Ga., July 22, 2014 /PRNewswire/ -- MiMedx Group, Inc. (NASDAQ: MDXG), an integrated developer, processor and marketer of patent protected regenerative biomaterials and bioimplants processed from human amniotic membrane, announced for investors today that a peer-reviewed study, "An Evaluation of Healing Metrics Associated with Commonly Used Advanced Wound Care products for the Treatment of Chronic Diabetic Foot Ulcers," was electronically published in the July 2014 edition of *Managed Care*.

The retrospective evaluation examined data for three commonly available skin substitutes: Apligraf®, Dermagraft®, and EpiFix®. Data examined included rates of complete wound closure, time to healing, number of graft applications to wound closure, durability of healed wounds, and safety data. Data for Apligraf® and Dermagraft® included peer-reviewed publications of pivotal clinical study data and physician product prescribing information, as well as other pre-market approval summary documents from the U.S. Food and Drug Administration. The EpiFix® data was from randomized controlled trials of EpiFix®.

The retrospective evaluation concluded: "Although prospective comparative effective trials are needed, the differences recorded suggest EpiFix**®** results in the most rapid improvement and resolution of diabetic foot ulcers."

The electronic publication can be found at: http://www.managedcaremag.com/archives/2014/7/evaluation-healing-metrics-associated-commonly-used-advanced-wound-care-products.

The summary comments in this press release should be read with reference to the full abstract of the study, which includes the purpose, design, methodology, results and limitations on the study analysis.

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About MiMedx

MiMedx® is an integrated developer, processor and marketer of patent protected regenerative biomaterial products and bioimplants processed from human amniotic membrane. "Innovations in Regenerative Biomaterials" is the framework behind our mission to give physicians products and tissues to help the body heal itself. Our biomaterial platform technologies include AmnioFix® and EpiFix®, our tissue technologies processed from human amniotic membrane that is derived from donated placentas. Through our donor program, mothers delivering full-term Caesarean section births can elect in advance of delivery to donate the placenta in lieu of having it discarded as medical waste. We process the human amniotic membrane utilizing our proprietary PURION® Process, to produce a safe and effective implant. MiMedx® is the leading supplier of amniotic tissue, having supplied over 250,000 allografts to date for application in the Wound Care, Surgical, Sports Medicine, Ophthalmic and Dental sectors of healthcare.

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Test your Knowledge of Wound Care

By Dr. Jayesh Shah

1. About how many hospitalized patients develop MRSA (Methicillin Resistant Staphylococcus aureus) infections each year?

   A. 5 million
   B. 1.26 million
   C. 12.6 million
   D. 126,000

2. Which one of the following is the most common reservoir for MRSA?

   A. hands
   B. foot
   C. mouth
   D. anterior nares

3. In a patient who is colonized with MRSA, all of the following are acceptable precautions for the health care provider, except . . .

   A. implement contact precautions.
   B. put her or him in private room.
   C. initiate airborne precautions.
   D. cohort patients with MRSA together in a room.

4. Which one of the following statements about MRSA contamination is a true statement?

   A. Stethoscopes do not transmit MRSA from patient to patient.
   B. Physicians' lab coats do not transmit MRSA from patient to patient.
   C. Health care workers will not contaminate their hands by touching intact skin of a patient with MRSA.
   D. Health care workers can become contaminated by touching objects near the patient.

5. In a patient who is treated for MRSA wound infections, when is it appropriate to discontinue contact precautions?

   A. After one negative culture is documented.
   B. After patient has been started on IV antibiotics for MRSA for more than 48 hours.
   C. At least 3 negative cultures have been documented on different days.
   D. Patient has been afebrile and wound is healing.

See the following page for answers.

ANSWERS to Test your Knowledge of Wound Care

By Dr. Jayesh Shah

Answers:

1. d, 2. d, 3. c, 4. d, 5. c

Answer 1. (d)

An estimated 126,000 hospitalized patients develop MRSA infections each year, and more than 5000 of them die as a result of MRSA infections.

Answer 2. (d)

Anterior nares are the most common reservoir for MRSA. The bacteria may also be carried on intact skin of the axilla, the perineum, and the hands and arms. Active surveillance cultures of the anterior nares will identify 80% of MRSA colonized adult patients.

Answer 3. (c)

Implementing contact precautions will help in preventing transmission of MRSA in health care facilities and it is preferable to put patients with MRSA infection or colonization in a private room. A private room reduces the likelihood of transmission of MRSA infection, as the health care worker is more likely to perform hand hygiene and remove gloves and gown before leaving that patient's room. If a private room is not available, then cohorting patients with MRSA together in a room is acceptable.

Answer 4. (d)

MRSA contamination can occur from a health care provider's stethoscope when used from one patient to another. A physician's lab coat has also been shown to transmit MRSA infections. MRSA is colonized on intact skin, so by touching intact skin without gloves, one can transmit MRSA. A health care worker can get contaminated by touching objects near the patient, so it is recommended that whenever possible, dedicate separate patient care equipment to a patient with MRSA or preferably use disposable equipment.

Answer 5. (c)

Contact precautions can be discontinued if there are at least 3 negative cultures on different days.

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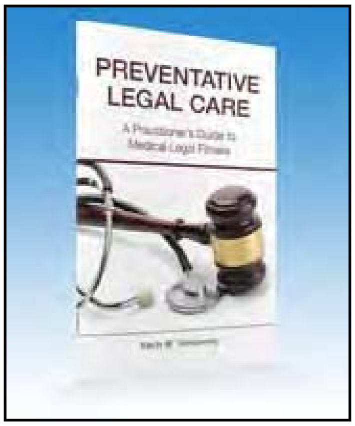
Wound Care & Hyperbaric Medicine

NEW BOOK RELEASE

A Sneak Peek at the new book *Preventative Legal Care: A Practitioner's Guide to Medical-Legal Fitness*

As a practicing healthcare attorney, Kevin W. Yankowsky has represented individual clinicians and healthcare institutions involved in legal disputes of all shapes and sizes. In his nearly 20 years as a practicing attorney he has seen providers and institutions pour money into resolving legal disputes that potentially could have been avoided. Much like the inverse pyramid that plagues the healthcare system today— the majority of resources are directed toward end-of-life acute care issues rather than preventative care—institutions focus too much of their time, effort, and financial resources on the costs of litigation defense and the expenses of settlement rather than investing time and resources on medical-legal prevention. In *Preventative Legal Care: A Practitioner's Guide to Medical-Legal Fitness* Yankowsky outlines some medical-legal risk factors unassociated with clinical care and supplies practical real-world solutions to recognize, control, and minimize, if not eliminate, those factors. It's time to turn the pyramid right side up and allow resources to work for the health of your practice rather than allocate them to preventable legal issues.



The most effective way to manage the medical-legal risks associated with clinical care is to eliminate the factors that cause them. It sounds simple enough, but how do you identify the risk factors? This handbook serves as a go-to guide for practitioners and administrators, drawing on medical-legal issues that are seen time and time again in hospitals and clinics around the country. Topics discussed include:

- Common reasons that motivate patients to seek out plaintiff's attorneys, even after successful treatments
- Patient expectation of outcome vs. actual clinical outcome—when informed consent paperwork isn't enough
- The "when" and "how" of offering appropriate apologies in the clinical setting, and why they matter
- The medical record—what documentation (or lack of) means to a plaintiff's attorney
- The potential legal consequences of improper wording in clinical policies and procedures
- Legal risks associated with electronic medical record systems
- HIPAA laws, the HITECH Act, and clinical photography
- Considerations for transparency initiatives
- Mitigating risks for criminal liability

Preventative Legal Care: A Practitioner's Guide to Medical-Legal Fitness is a timely handbook that provides workable ways to complement your practice with an effective approach to medical-legal risk management. For legal health, much like physical health, prevention is the best medicine.

About the Author

Kevin W. Yankowsky is a partner in the Life Sciences Pharmaceutical and Health Litigation Practice group of Norton Rose Fulbright. Kevin has served as lead counsel in over 30 jury trials and 12 appeals, in both State and Federal Court, the majority of which involved claimed damages at trial in excess of $1 million. Kevin's trial practice encompasses virtually all types of civil litigation facing the healthcare industry. He serves as lead counsel in professional liability claims, complex commercial suits, products liability matters, ERISA actions, premises liability suits, and EMTALA litigation and regulatory investigations. In addition to his extensive courtroom experience, Kevin advises clients on Joint Commission investigations, hospital committee, and medical peer review matters. Kevin also serves as a frequent consultant on legal, litigation, document retention and electronic management, and enterprise risk issues for health industry clients. Kevin's established reputation as both an accomplished trial lawyer and risk management consultant have also made him a frequently featured speaker at national healthcare industry conferences and professional symposiums across the country.

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