International Medical-Rescue Conference

International Life Saving Federation

Americas Region

September 1997

San Diego, California

Editor: B. Chris Brewster

World Water Safety

International Medical-Rescue Conference

Proceedings of a conference on the rescue and treatment of people in distress in and around the waters of the world.

Presented by the Americas Region

September 15 - 17, 1997 -- San Diego, California

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International Life Saving

Organized international lifesaving activities began in 1878 when the first World Congress was hosted in Marseille, France. The need for an international forum to exchange ideas was soon recognized. This led to establishment of the Federation Internationale de Sauvetage Aquatique in 1910 and World Life Saving in 1971. Both organizations were composed of national lifesaving federations from countries throughout the world.

After many years of operating separately, in 1993 representatives of FIS and WLS agreed to merge into a single organization, to represent all of the national lifesaving organizations of the world. This fusion was consummated on September 3, 1994 and the International Life Saving Federation was born.

Drowning remains one of the leading causes of accidental death in every country of the world. A drowning occurs somewhere in the world every two minutes, with more than 250,000 every year.

The objectives of ILS include the following:

- Improve aquatic life saving and resuscitation techniques
- Develop life saving education
- Exchange practical, medical, technical, and scientific experiences
- Spread aquatic life saving skills to every corner of the world
- Help prevent pollution of our waters
- Encourage uniformity in life saving equipment, safety symbols, signs, and laws
- Promote and organize life saving sports and competitions

ILS is now composed of over 120 national lifesaving federations. Patrons of ILS include His Royal Excellency King Carl XVI of Sweden and the Honorable Nelson Mandela of South Africa. ILS is recognized by several international organizations, including:

- The World Health Organization of the United Nations (WHO)
- The International Red Cross and Red Crescent (IRC)
- The International Olympic Committee (IOC)
- The International Military Sports Council (CISM)

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Foreword

Welcome to the written proceedings of the International Life Saving Federation (ILS) International Medical Rescue Conference, hosted by the Americas Region, in San Diego, California, September 1997. This text presents the formal papers submitted by each of the 32 speakers.

The speakers at this conference gave of their time unselfishly and without compensation. In many cases, they developed extensive, original works. In other cases, the papers are reprints of published medical journal articles, for which we are grateful to the original publishers. While the views of the authors do not necessarily represent those of ILS, all of these contributions are in the highest tradition of lifesaving.

A primary goal of ILS is to foster exchanges of information about the core responsibility of all lifesavers – the saving of human life. Participants in this conference came from countries throughout the world, many travelling great distances. They sought to learn the latest information on how to improve upon the services they deliver, and they departed with a vast array of knowledge to apply in their home countries.

Keep this text as a reference, share it with others, and use it to evaluate and advance lifesaving practices. By itself, it will have little impact; but with thoughtful and deliberate application by dedicated lifesavers, the ideas embodied in this text will do much to reduce untimely death and unnecessary injury throughout the world.

B. Chris Brewster
President for the Americas
International Life Saving Federation

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Dr. Hans Aström

MD at Karolinska Institute 1965
Assistant Professor in Clinical Physiology 1970
Visiting scientist at CVRI in San Francisco 1971-72
Senior doctor at Thoracic Clinic, Karolinska Hospital
Member of the Board of Swedish Lifesaving Society (since 1982)
Chairman of FIS Medical Commission 5 years until fusion to ILS
Member, ILS Medical Commission
Research in heart and lung disease, and interest in hypothermia
More than 100 publications

Treatment of Hypothermia

Medical care by the Rescuer, Transport Personnel and Hospital

Heat loss in water is increased 25-fold. Water below the temperature of 28° C (82° F) can be considered as cold. The degree of hypothermia depends on exposure time, water temperature, insulation and more.

Hypothermia is a condition in which the core body temperature falls below 35° C (95° F). The symptoms prevailing in mild hypothermia (35° - 33° C) are confusion and shivering In moderate hypothermia (33° - 30° C) shivering is replaced by muscle stiffness, the level of consciousness falls rapidly, blood pressure drops and pulse rate falls. In severe hypothermia (<30° C) the main findings are coma, absence of reflexes, and progressive depression of heart rate and respiration with deepening hypothermia.

Treatment

In treating and handling a hypothermal patient it is essential to handle the victim with utmost care and consideration as the heart is extremely susceptible to arrhythmias at subnormal temperatures.

Treatment of the conscious patient:

Patients suffering from cold who are still conscious are normally no problem to treat. Wet clothes should be removed and further heat loss prevented by wrapping the patient in insulated sheets or blankets. He can be treated at normal room temperature. The patient's body temperature rises as a result of his own heat production. If possible the patient should be kept in an intensive care unit for observation.

Treatment the unconscious patient:

The patient must not be moved around or handled unnecessarily. Leave wet clothes on and prevent further heat loss by covering him carefully. Oxygen should be given from a mask if possible. No attempt must be made to warm the patient actively or revive him at the scene of the accident. Treatment requires the resources of hospital. A hypothermic patient shall not be declared dead, unless rewarming has been attempted without success

Treatment at hospital of the mild to moderate hypothermic patient usually only requires prewarmed, humid oxygen and intravenous (IV) infusion of glucose. Severe hypothermia needs more active treatment such as peritoneal lavage or probably best if possible heart-lung machine.

Abstract by Hans Aström

Lt. Brant Bass

Lieutenant Brant Bass has been a lifeguard for the City of San Diego for 23 years. He is presently assigned the Central Area, which includes Mission Beach and Pacific Beach. His duties include beach supervision, Public Information Officer, Helicopter Liaison Officer, Medical Liaison Officer, and various special projects. He is an investigator for the County Medical Examiner, responsible for investigating all deaths related to scuba diving in San Diego County.

Lt. Bass has been a member of the San Diego Lifeguard Dive Rescue Team for 18 years and has been the team's leader for the past 9 years. He is a Scuba Instructor for the National Association of Underwater Instructors and is qualified to instruct a specialty class entitled, "Scuba for Emergency Services." Lt. Bass was an original member of the San Diego Lifeguard River Rescue Team.

A native San Diegan, Lt. Bass is a graduate of San Diego State University with a Bachelor of Arts degree in Public Administration. He is a former president of the San Diego Chapter of the United States Lifesaving Association.

Lt. Bass regularly lectures to dive clubs and councils on safe diving procedures. He also instructs a 3R's (rocks, rips, and reefs) course to local divers to demonstrate safe diving practices.

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Nearshore Search Procedures

Brant D. Bass
Marine Safety Lieutenant
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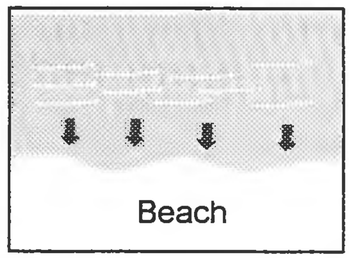
A survey of emergency training agencies across the U.S. demonstrates the obscurity of formal education in the subject of nearshore search procedures. Although individual experts are available to teach this subject, a meaningful course curriculum is hard to come by. Why? Probably because most searches take place in inland waters such as lakes and rivers. Its also probable that the physical requirements of these types of searches are so great that the client base for such training is low relative to calm water searches. With this in mind the following information is a result of many years of experimentation and sharing of information with other agencies. They are proven methods.

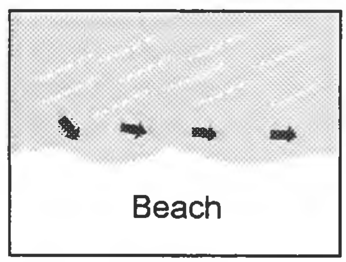
Shoreline Hydrology

A thorough knowledge of currents associated with the shallow waters of the coastline benefits the search team members greatly. Experienced dive rescue team members know that a submerged victim can move great distances rapidly or stay in exactly the same position depending on the strength and location of the currents. Anticipating the effect of these currents is an important part of the search strategy.

BBThere are two major currents that would affect the shoreline search. The first is the *longshore current*. When the oncoming waves contact the beach in a perpendicular manner, there will be very little longshore current. However, if the waves approach from an angle, the water tends to move along the shore, hence a longshore current.



Weak Longshore Current

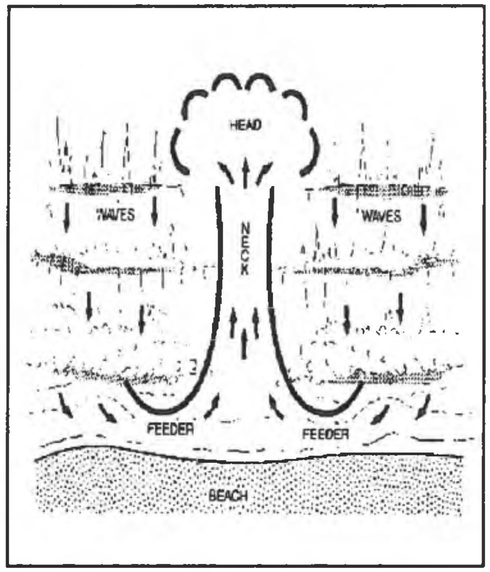


Strong Longshore Current

In many areas such as Southern California, there are predominant and sometimes predictable weather patterns. Since the waves are caused by storms that are hundreds of miles off shore, these weather patterns may mean a reversal of the longshore current depending on the time of year.

The other major current along the shoreline is the rip current. Many times this current is erroneously referred to as a "Rip Tide" or "Undertow". In actuality a rip current has very little to do with the tide and is very seldom responsible for pulling a swimmer under. Mostly, rip currents develop when a wave is cast upon the seashore. The simple effect of gravity causes the water to seek the lowest point. In doing so, the water will flow parallel to the shore for a short time and distance. This is referred to as the "feeder" of the rip. When the water reaches the lowest point along the ocean floor, the water will rush out to sea. This area, the neck of the rip, contains the water that is moving at the highest velocity and is the cause of about 80% of ocean front rescues. Typically, this current terminates as it reaches the outside of the surfline and disperses in a mild rotating manner. A rip can also develop from the effects of a longshore current described above. As the current hits a fixed object such as a rocky outcropping, it may be directed offshore causing a rip current.

As may be expected, most drownings take place in the neck of the rip current making the search effort very difficult. The initial search should be started in knee deep water and continue out the rip until the area well beyond the head of the rip is covered. Once the search team is confident the neck and head of the rip has been thoroughly covered, areas immediately downcurrent should be searched. If there are any obstructions such as kelp or rock reefs in the immediate area they must be searched in the early stages of the rescue attempt.



A Typical Rip Current

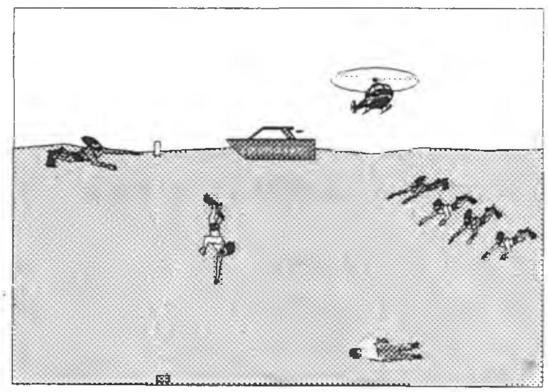
The Nature of the Emergency

A crucial part of any rescuer's decision making process, is how to determine the appropriate type of response. Particularly when a person is reported "missing" a decision must be made that applies the right amount of resources to the incident, according to information available. For instance, a woman looking for her teenage son who was last surfing with a wetsuit on in a lifeguarded area should not immediately invoke a large scale response. On the other hand, if a non swimmer, last seen in the water, cannot be located, all available resources should be called into action. And there are always the "in-between" situations that require that a search be conducted without committing significant resources. For several reasons, including consistency and protection from liability, emergency response agencies should have a written policy that determines how to respond to reports of missing persons. These policies should be available to field personnel so they can be referred to when the time comes. This policy should include the appropriate steps to take when the information clearly describes a drowning. But it should also describe instances in which emergency personnel should not be dedicated for a search. Another important aspect of a search should be determined by the time lapse since the incident. Although the first two minutes of a victim's submersion is considered the "salvageable" time, rescue crews should consider the incident a "rescue" attempt for the first full hour. Thereafter, rescuers should transition into a "recovery" mode meaning that much fewer risks will be taken in terms of rescuer safety and reduction of other services.

The Code X

Transported to San Diego by the Lifeguard Chief's previous background as a ski patrol person in Vail, Colorado, the Code X concept began as a means of searching for a person covered by an avalanche. Now this approach is spreading rapidly to lifeguard agencies as a systematic approach to searching for a submerged swimmer. The Code X was designed to trigger a long string of events once the two words are called out by a lifeguard. This code is used only for witnessed drownings because of the dangers it presents to emergency personnel. While the field personnel go through a number of steps, the dispatchers, too, pull out a list of things they have to do.

The first lifeguard on the scene of a Code X will be responsible for quickly interrogating the eyewitness, passing the information on to a dispatcher, telling the reporting party to stay where they are, and entering the water. Although it is usually a needle in a haystack experience, victims have been located and revived by the random diving of one lifeguard. The second lifeguard on the scene should further interview the witness and begin developing a "datum" which is defined as the best place to begin the search taking all available information into account. As additional staff arrives, a weighted buoy is swum out to the datum and dropped. A line sweep consisting of three to eight searchers with fins, masks, and snorkels begin searching across the datum. If a boat is available, it should be used to support a perimeter of the search area and provide a communications link between the onshore incident commander and the inwater search team. It should not be mixed in with the divers involved in the search. As the first hour progresses, more complicated search techniques are employed.

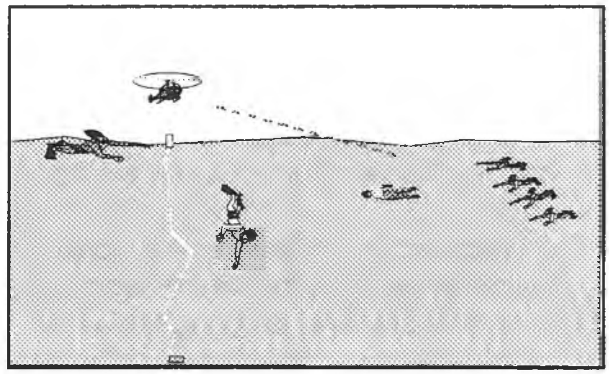

Searches Become More Complex as Resources Arrive

Meanwhile, the dispatcher should have pulled out a predesigned list of tasks to perform. They will make sure that the entire agency is aware of the incident. Supervisors are responsible for deciding how many of their resources they are capable of committing to the incident and sending them on their way. The dispatcher will then check on the availability of a helicopter, the most probable way of spotting a submerged bather. An ambulance will be summoned to standby the area and police will be asked to provide crowd control. Other communications will take place as necessary such as calling out the Dive Rescue Team.

Utilizing a Helicopter

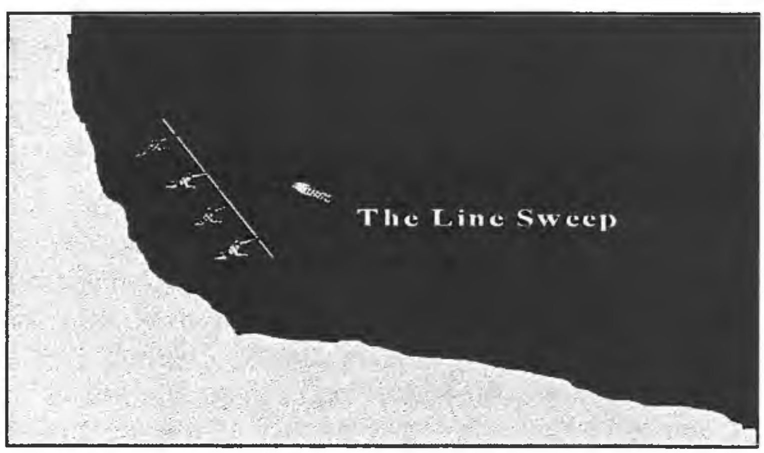
Helicopters have located more submerged victims than have Dive Rescue Teams.

They have also, at times, interfered with the search procedures. By knowing how to utilize them the chances of a successful recovery can be greatly enhanced. Most of the single engine turbine helicopters such as the MacDonnell Douglas 500D or the Bell Jet Ranger are well suited to work with water rescue teams. They are relatively quite and can isolate their search in a small area. Larger helicopters such as the United States Coast Guard's HH60 Jayhawk are better suited for searches that cover large areas when there is not an inwater search team which is dependant upon voice or radio communications.

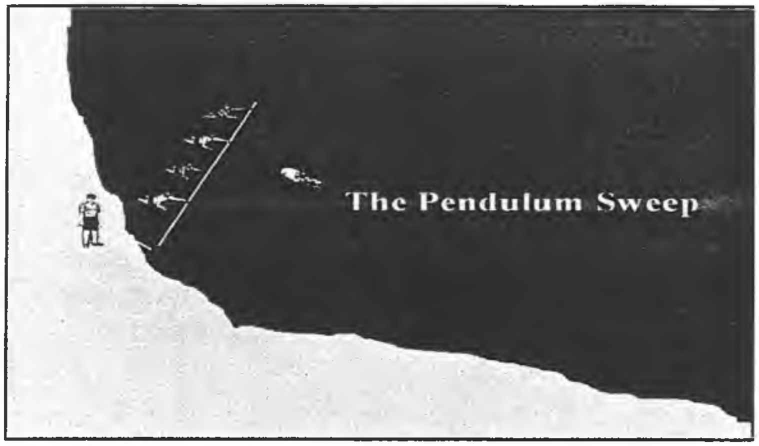

The Target Search is Used When a Helicopter spots the Victim

In San Diego, helicopter agencies have practiced with lifeguards to develop a means of communication during a search. There is an agreement that if the victim is spotted by the helicopter crew, it will flash its landing lights in rapid succession several times. They will also communicate with the Incident Commander. The search team is then expected to set up their line perpendicular to aircraft and sweep directly toward it. If the victim is passed over, the helicopter moves so that the team will sweep over the location again. This is called a "**Target Search**" since the team is focusing on the helicopter for direction,

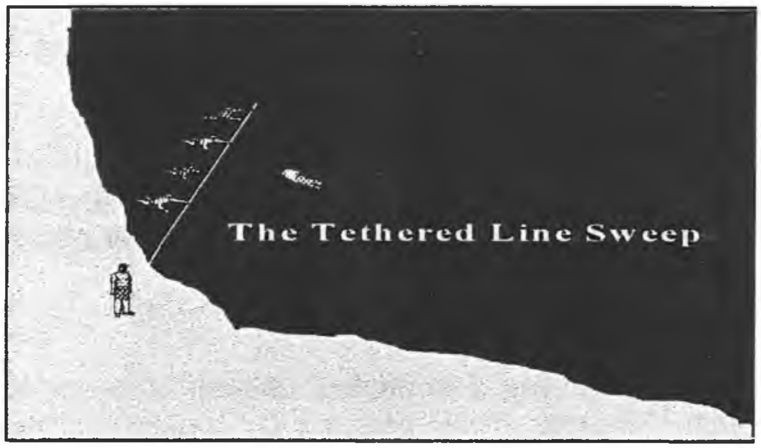
Deciding on a Search Technique



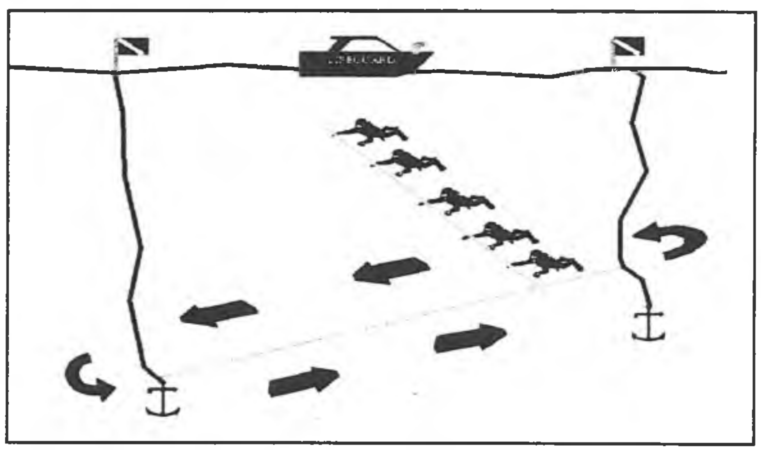
Most effective search techniques are simple in design. There is enough for the rescuers to concern themselves with during an emergency without the added pressure of remembering complex rules, signals, and procedures. The standard search technique is the ***line sweep***. Skin divers equipped with mask snorkel and fins will line up on a yellow polypropylene line. This line is used because it is highly visible and floats. The search team has a leader who will coordinate their efforts by calling out when the group is to dive. The team will stay underwater until the first member has to come up for air then they will all surface. The leader will instruct the team to move in revers a few feet to make up for the area missed during the ascent. They will continue to dive in this manner until the search area is covered or the victim is located.



In calm water, a ***pendulum sweep*** is an effective technique. It is particularly useful for small objects because it is very thorough. In this technique one rescuer is used to anchor the search team to a fixed object. As one pass is made by the team, the tender plays out additional line, the team reverses direction, and covers a new area.



A variation of this is the ***tethered line sweep*** in which the tender advances down the shoreline with the search team.



If scuba is available, an ***anchored sweep*** may by useful. It insures that a particular area is thoroughly covered. It becomes more trouble than its worth, though, unless a surface support team is available. Ideally, the surface support team would have another anchored sweep system ready to go when the Dive Rescue Team completes a pass. Due to time it takes to set this system up, it is usually used only in the recovery mode.

Equipment Considerations

A great deal of good searching can be performed with a minimum amount of equipment. The key is to have enough of the basic pieces available in order that it will be used in an emergency by the first rescuers on the scene. In San Diego this concern has been addressed by outfitting every emergency vehicle and vessel with a "Code X" bag which contains the following:

2 Masks   2 Snorkels
1 polypropylene line, 30 feet in length
1 high visibility buoy   1 weight (5-10 lbs)
1 Bailout Bottle (supervisor's vehicles only)

As more units arrive. Additional equipment is available for the search. The first line is normally combined with the weight and buoy to establish a datum. The second and third lines to arrive units are used for line sweep purposes with skin divers.

Scene Management

A very effective way of managing a search operation is by using the Incident Command System. Originally developed by a police agency, this system has been widely adopted by emergency personnel. Typically, when a Code X occurs, a senior rescuer who is not vital to the inwater search effort will establish themselves as the *Incident Commander*. They will designate another rescuer as the *Operations Commander* for the inwater search. While the Operations Commander is busy coordinating the search team, the Incident Commander is responsible for the overall scene. They will make decisions such as the boundaries of the search area and may adjust them as information develops. The Incident Commander will also coordinate the work of other agencies such as the helicopter provider or the law enforcement personnel. Any requests for additional equipment or personnel will be submitted to this person for evaluation.

Summary

Searches that begin nearshore usually restrict the flexibility of the search team. Because of strong currents and surf, basic procedures are usually the best. Someone experienced in the movements of water along the coast can be a great assistance and can provide an extra margin of safety for the rescuers. As in all drownings, the first few minutes are the most critical which makes having a plan of action and a team of rescuers who are familiar with it essential.

Dr. Stephen Bruce Beerman, Bsc, BSR, MD, CCFP

Steve Beerman received his undergraduate medical education from the University of British Columbia, graduating in 1985. Post-graduate studies in Family Practice resulted in certification in 1987. Pre-medical training included a degree and professional certification in Physiotherapy, Occupational Therapy and biochemistry. He is a Clinical Instructor, Faculty of Medicine, University of British Columbia.

Dr. Beerman has been an active Family Physician and Emergency Physician in Nanaimo, Canada for 10 years. He provides primary care in a central Vancouver Island community. This includes emergency care in water related mishaps, including near-drowning, aquatic spinal injury, hypothermia and diving injuries.

Steve Beerman has held many voluntary positions within the Lifesaving Society – Canada's Lifesaving Experts (formerly the Royal Life Saving Society Canada). He was chairperson for Aquatic Emergency Care, Medical Advisors and Vice-President, Program. Between 1991 and 1994, Steve was National President of the Lifesaving Society, and has recently completed his term as Past-President. Throughout this 20 years, Dr. Beerman has provided visionary leadership, strategic direction and dedication to our objective: to reducing drowning and water related deaths in Canada.

Dr. Beerman has had a particular interest in educating lifesavers, lifeguards, paramedical and medical personnel in the diagnosis and management of aquatic related emergencies. He has authored and published educational papers on a variety of topics in this field. He has been interested in the strategic planning for effective interventions, educational and organizational initiatives to reduce drowning and water related injuries and deaths. He has assisted with many of the publications of the Lifesaving Society – Canada's Lifesaving Experts.

Dr. Beerman has presented papers and ideas at many local, national and international medical and para-medical conferences and meetings. This has included the role of keynote speaker at several international lifesaving conferences. His experience as a lifeguard, lifeguard instructor, strategic planner, national lifesaving organizational leader, have been valuable as a medical legal expert witness in several aquatic related accident cases throughout North America.

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Aquatic Spinal Cord Injury -- Canadian Point of View

Introduction

Diving injuries account for 61 % of the "sport/recreational activity" Spinal Injuries. Most of these injuries are occurring in non-supervised settings.
The majority of the victims are male between 16 and 30 years of age.

Strategic Interventions:

Prevention:
Given high morbidity and mortality from this sudden injury, all efforts to prevent the injury need to be explored. These include: Targeted Awareness Campaigns, Adequate and standardized signage at point of risk, Supervision of risk activities, avoidance of co-risk factors -- alcohol, drugs and peer dynamics.

Management
The most important issue in the management of Acute Aquatic Spinal Injury is early awareness and suspicion for this injury. If the life saver or lifeguard suspects a possible spinal injury, they have made the most important management decision in the rescue and removal of the victim to medical care. If any technique or immobilization and stabilization is used, the victim will have adequate care. Airway management remains a high priority and having the ability to manage the upper airway is an important skill for life savers and lifeguards.

There is no strong evidence that any one roll-over technique is any better than another. There is no strong evidence that any one removal technique is any better than another.

There is benefit to having an identified small number of principles of management; and allowing specific facilities, rescuers, locations to develop specific applications of thc principles in there region, group and facility. Leaders within the lifesaving and lifeguard movements need to encourage facility and circumstantial adaptations of the principles without getting involved in debates about which of a number of techniques is better or best in all environments.

Principles of Acute Aquatic Spinal Injury Management

1. Recognize that certain injuries and victim situations may be acute spinal injury.
2. Immobilize the spinal area of injury as best you can.
3. Assess and maintain the ABC's.
4. Use the assistance of others.
5. Remove the victim from the water in a controlled manner.
6. Arrange appropriate transport to a medical assessment facility.

The Lifesaving Society advocates and supports prevention programs directed to the general public, parents and the high risk population.

The Lifesaving Society introduces the principles of Acute Spinal Cord Injury Management to lifesavers. A variety of immobilization and aquatic removal techniques are introduced as examples of the application of the principles

The Lifesaving Society teaches the principles and techniques for coordinated team approaches for the recognition, immobilization, removal from water and transportation preparation for lifeguards.

Dr. Joost J.L.M. Bierens MD PhD

Dr. Joost Bierens is trained in anesthesiology and emergency medicine. He is head of the department of Intensive Care Medicine of the Stuivenberg Hospital, a large teaching hospital in the town-centre of Antwerp (Belgium). The department also runs an E.M.S system and a Centre for Hyperbaric Medicine.

During summer vacations as a medical student, Dr. Bierens worked as a lifesaver in the Netherlands for 6 years. He is a member of several national advisory commissions and serves on boards of directors of several organizations in the field of water rescue, resuscitation and emergency medicine.

Dr. Bierens' interest in life-saving and treatment of submersion victims has resulted in about 50 publications on these items in (inter)national medical journals and textbooks. He is a regular speaker on these subjects to all persons involved, from lay persons to intensive care specialists. In 1996 he wrote the Ph.D. thesis "Drowning in the Netherlands. Pathophysiology, epidemiology and clinical studies."

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FACTS AND FIGURES ABOUT DROWNING - DATA FROM THE NETHERLANDS

Joost J.L.M. Bierens MD PhD, ILS Medical Commission Member
Head Department of Intensive Care Medicine and Centre for Hyperbaric Medicine, A.Z. Stuivenberg, Antwerp, Belgium

The origin and history of resuscitation guidelines of drowning victims

During the 17th and 18th century, the shape of the "low countries near the sea", that finally became the Netherlands, was outlined by seas, lakes and rivers. Dutch ships were omnipresent at the world's oceans. Drowning was the major cause of accidental death for the Dutch at that time. Many died from drownings during floods, sea-battles, shipwrecks, work, leisure or by accident: during one night in 1790, about 90 persons drowned in the canals of foggy Amsterdam, at that moment a city of approximately 200,000 inhabitants.

The large number of drowning victims and the absence of humanitarian aid to drowning victims motivated a group of citizens in Amsterdam to install the *Maatschappij tot Redding van Drenkelingen* (The Foundation of the Rescue of Drowned Persons) in 1767. The main aim of the organisation was to promote any activity to prevent death by drowning and to reward courageous acts by persons who had saved drowning victims. The instructions published by the *Maatschappij* were the first official resuscitation guidelines world-wide. The Amsterdam initiative was promptly followed in several cities in Europe and America (Philadelphia in 1780, Boston in 1786, New York 1794).

The absence of scientific knowledge about anatomy, physiology and medicine was an important problem at that moment. For example: the existence of oxygen in air and its essential role in life processes was only accepted by a few scientists. Terms as ventilation, hypoxia, circulation and cardiac arrest were not known or had a different meaning than nowadays.

Lack of basic medical knowledge resulted in a variety of techniques to bring the apparently dead persons back to life. In most resuscitation, several techniques were simultaneously used in the Netherlands according to annual reports of the *Maatschappij tot Redding van Drenkelingen* 1767-1813 (Gorter 1952) noted below:

74% rubbing (of the complete body or specific parts as thorax, spine, genital area or feet)
69% warming by external heat sources or natural warmth
36% rectal smoke insuflation
34% irritation of nose or mouth (with feather, smoke, gin, induction of vomiting)
20% venasection
19% rolling over barrel, hanging
13% insuflation of air through the nose
5% rectal irrigation

Mouth-to-mouth ventilation was introduced in the advices in 1790, but the technique was hardly mentioned in the reports of the *Maatschappij*. In the advices published after 1838, mouth-to-mouth ventilation was omitted. In 1877, a push-pull technique proposed by Silvester (in supine position, the arms were drawn outwards and upwards for inspiration) was introduced. After 1960, mouth-to-mouth ventilation was the single accepted technique for artificial ventilation in the Netherlands.

The decreasing number of drowning victims

General socioeconomic changes, large waterworks, laws related to water safety, education of the general public, preventive measures as compulsory swimming education to all school children and improvement of the health system decreased the annual number of drowning victims: from 25 per 100.000 inhabitants at the end of the 19th century to about 2 per 100.000 inhabitants at the end of the 20th century.

Last few decades the number of drowning fatalities has been stable at an average of 400 Dutch each year. Of these deceased victims, 44% have commited suicide by drowning, 29% are accidental drowning cases and 12% are lethal traffic accidents in which the victim landed in or under water. The remaining group drowned due to water transportation, murder or (acute) diseases such as myocardial infarction, cerebral hemorrhage and epilepsy.

Profile of the submersion victim admitted to hospital

Recently the administrative data and clinical diagnoses of 2944 submersion victims, admitted to Dutch hospitals between 1989 and 1995 have been analysed. The epidemiologic analysis demonstrated that 70% of the admitted near-drowning victims were due to accidental drowning, 14% due to suicide and 8% due to traffic accidents. Of all admitted patients 10% died. Comparison between the death statistics and hospital data showed that 90% of the deceased drowning victims were not admitted to hospital.

In the hospital admitted group, death rate was lowest in water transportation accidents (5%) and highest in traffic accidents drownings (18%). Other risk factors with a high mortality rate were epileptic seizures before or after drowning, Adult Respiratory Distress Syndrome (ARDS) and hypoxic brain damage (death rates respectively 18%, 25% and 50%).

The study also showed that 72% of the admitted near-drowning victims were uncomplicated cases and 33% of the victims could be discharged home within 48 hours. The epidemiologic study could not demonstrate a protective influence of hypothermia. Death rate, hospital stay and complication rate between the non-hypothermic group and hypothermic group did not significantly differ.

Another study, of patients admitted to the Intensive Care Unit of a university hospital showed that death rate in 46 non-hypothermic (central body temperature above 35°C) patients was lower than in the 29 hypothermic patients (16% vs 31%). It was assumed that the water temperature in the Netherlands is not cold enough to be protective. Low body temperature indicates a long submersion period which causes lethal hypoxia. Yet a few case-reports are known of children and young adults who have survived a period under water of twenty minutes or more.

Lay persons, rescue organisations, Emergency Medical Systems

During the last decade a coherent prehospital system has been established from the scene of the accident to the hospital. Also the submersion victims benefit from this.

Quality criteria of the training programs on first aid to lay persons are legally assigned to "The Royal Netherlands Orange Cross". All first-aid organisations and volunteer water rescue organisations (such as the Royal Dutch Life Saving Society - *Reddingsbrigades Nederland*) are providing the same 20-hours courses which include water-rescue procedures with and without equipment. Lay persons are instructed that each victim who has been under water for less than one hour has to be resuscitated and that each started resuscitation in a submersion victim has to be continued until arrival in a hospital. Also minor cases without evidence of harm have to be admitted to hospital for observation. There is agreement between all organisation who provide resuscitation courses that the Dutch C-A-B scheme (resuscitation is initiated with thoracic compression before a free airway is managed and ventilation is started) is not applied in case of submersion victims.

Ambulances in the Netherlands are manned by Intensive Care or Cardiac Care Nurses who have followed an additional 120 hours training in Ambulance Care. The ambulance nurses have a very high grade of independence and work with national protocols. With respect to near-drowning victims the protocols include indications and techniques for intubation, medication, defibrillation and selection criteria of the hospitals to where hypothermic victims have to be admitted. It is the intention of the government agencies to have ambulance-access within 15 minutes.

At this moment, there are no doctors involved in prehospital activities. Very recently, university hospitals have started to develop hospital based out-of-hospital emergency teams by road or helicopter. Submersion is one of the indicators to call for such a team.
Only a few hospitals have written protocols for the treatment of submersion victims. The protocols highlight passive and active rewarming techniques in hypothermic submersion victims. It can however been assumed that there is a rather uniform approach in hospitals without protocols. Dutch textbooks on resuscitation, emergency medicine, traumatology, surgery and pulmonary medicine all include the same kind information with respect to Pathophysiology, resuscitation and clinical treatment of drowning victims.

Future attention to the drowning victim

Recently the knowledge about drowning and the quality of care to drowning victims has been critically reviewed. This critical look shows that only little progress is made in the understanding of the drowning mechanism, the dying process during drowning and the influence of protective mechanisms.

From epidemiologic and clinical data it can be concluded that there are various drowning mechanisms. Interdependent and undependent variables in the drowning mechanism are immersion or submersion, hypothermia as protective or life-threatening factor, diving reflex, laryngospasm, aspiration, cardiovascular changes due to a stay in or under water, physical and emotional stress, oxygen consumption and hypoxia. The presence or absence of these variables determine the clinical course. However, this concept of looking at submersion needs further studies and if proven true will have important consequences for the design of drowning studies.

Also improved knowledge with respect to rescue, resuscitation, first aid and clinical treatment is necessary. At this moment resuscitation of submersion victims is performed according to guidelines meant for a cardiac arrest situation. The guidelines do not include aspects that are important in case of immersion or submersion. Many advices about the management of immersion or submersion victims are based on not-relevant studies or case reports (for example: importance of horizontal removal from the water, rewarming techniques, frequency of thoracic compressions in hypothermic patients). The current discussion to abandon ventilation during resuscitation, because of fear for infectious diseases, may have a dramatic impact on the survival chances of drowning victims.

At this moment the *Maatschappij tot Redding van Drenkelingen* (The Foundation of the Rescue of Drowned persons) is investigating if their is sufficient international interest to discuss drowning-related items world wide. During 1997 a survey will be undertaken among all relevant organisations, institutions and scientists to investigate the interest in a project that aims at an increase of knowledge on drowning. If there is sufficient interest, task-forces will elaborate specific items. Such items could be the establishment of standardised guidelines for rescue and resuscitation and the preparations of multicentered and multi-targetted studies to answer relevant questions with respect to the drowning mechanisms, its protective factors and treatment. Items that could be studied are: determination of risk factors and risk groups, quality criteria for training programs, guidelines for rescue and resuscitation, the influence of hypothermia during immersion or submersion in animal and human studies, data about water-related disasters. Also the usefulness and efficacy of medical equipment as ventilators, or specific techniques as intubation and semi-automatic defibrillators, can be included in these studies. The conclusions of the task-forces, notably rescue and resuscitation guidelines and proposals for relevant study objectives, are to be presented by all relevant authorities at a congress in 2002 at the site of origin of resuscitation efforts.

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Dr. Branche received her B.A. in biology from the University of Rochester in New York, and her M.S.P.H. and her Ph.D. in epidemiology from the University of North Carolina at Chapel Hill. While completing her Ph.D. studies, she worked as a Epidemiology Research Associate in the Epidemiology, Information, and Surveillance Division at Burroughs Wellcome Company, where she gained expertise in pharmaco-epidemiology. Once at the CDC, Dr. Branche has received numerous awards for her work.

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"Who Drowns in the United States?"

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Between 1988 and 1994, U.S. drowning rates have steadily declined, with 3,942 deaths (1.57 per 100,000 population) in 1994. To determine if the risk of drowning is uniform across all groups of individuals and in all recreational waters, we must examine the major risk factors for drowning--age, sex, race, and setting--and a number of behavioral risk factors. Appropriate interventions can be developed once we understand the risk factors for drowning.

BACKGROUND

Drowning is the fourth leading cause of unintentional injury death in the United States after motor vehicle crashes, poisoning, and falls. In addition to claiming thousands of lives each year, drowning contributes to enormous health care costs. Rescue, hospitalization, and rehabilitation costs associated with drownings and near-drownings totaled $2.5 billion dollars in 1985 alone.[1]

RISK FACTORS

When we take a closer look at recent drowning rates, we see that trends vary in different populations. As we examine these trends, we can begin to understand why differences occur. Let us focus on the four main covariates, or risk factors, for drowning rates: age, sex, race, and setting.

Age Drowning rates are highest mainly for two age groups: children under 5 years of age, and persons 15-24 years of age.[2-4] This trend has remained virtually unchanged for many years. High drowning rates among small children, adolescents, and young adults are the result of several different factors, which differ by age. Drownings among young children usually occur in water sources around the household, including bathtubs, buckets, toilets, large puddles, and swimming pools;[5] this is true in both rural and urban settings. Small children can drown in as little as one inch of liquid, and in only 30 seconds.[6] As is true for other types of unintentional injury and death, lapses in adult supervision caused by chores, socializing, or phone calls, for example, are implicated in most drowning incidents among children under 5 years of age.[5] The danger of drowning also increases with the number of young children present because of the difficulty of supervising several children at once.

Among adolescents and adults, drowning occurs during swimming, wading, and boating in natural bodies of water, particularly when alcohol is involved.[7,8] An estimated 40-45% of drownings in these age groups occur during swimming,[9,10] whereas 12-29% are associated with boating.[4,9] The risk factors that contribute to the role of age in drowning have been consistent over time. Such risk factors include drinking alcohol, swimming alone, and not wearing a personal flotation device while engaged in water sports or recreation.

Sex Drowning rates are almost four times greater for males than for females,[4] and this male-female difference is evident in every year from childhood through older age.[8] The increased risk for males is primarily related to alcohol consumption, a well-documented risk factor for drowning and other fatalities occurring during water recreation.[10,11] Alcohol can reduce body temperature and, through its effect on the central nervous system, can impair swimming ability. Because alcohol use affects vision, balance and movement, it is a risk factor for injury and death for swimmers, boat operators and passengers, who can fall overboard while intoxicated.[12,13]

Race Drowning rates among African Americans are about twice those among White Americans;[4,14] however, this is not true for all age groups. For example, White American children aged 1-4 years have twice the drowning rate as do African American children of these ages, largely because of drownings in residential swimming pools, which are not typically available to minority children in the United States. But for children aged 5-19 years, African Americans drown two to four times more often than White Americans.[15] Among American Indians and Alaskan Natives, drowning rates are high among young children, and those aged 15-34 years. Males experience the highest rates, seven times higher than rates for American Indian and Alaskan Native females and two times higher than for African American males.[16] American Indians and Alaskan Natives have such high drowning rates for several reasons: Common use of natural waterways for daily activities, especially in Alaska; alcohol use; and limited access to emergency rescue and trauma care services.[17]

Setting Differences in drowning rates in the United States reflect several factors that include climate; availability of beaches, lakes, and other natural and artificial water sources; as well as parks and water recreational equipment and products (e.g., personal watercraft). Overall, between one-half and three-quarters of drownings occur in lakes, ponds, rivers, and the ocean.[9,18]

Drowning rates differ by region of the country. Coastal areas and regions adjacent to the southern Mississippi River have high drowning rates.[19] Rates for drownings that do not involve boats are generally highest in southern and mountain states. Alaska, Hawaii, Louisiana, Mississippi, Montana, and Idaho were among the states with the highest drowning rates in 1994. Alaska has the highest rate (8.32 per 100,000 population), which is more than twice the drowning rate in the state with the next highest rate, Hawaii, with a rate of 3.46 per 100,000 population. A major factor in the extremely high rate in Alaska is the very low water temperature, which reduces a person's chance of survival after falling into the water.

More than 75 million people engage in recreational (noncommercial) boating annually in the United States.[20] Among enthusiasts, a variety of boating-related injuries can ensue, ranging from drownings to falls, burns, and trauma, which can precede drowning. We can expect drownings and falls overboard to be frequent outcomes.[10] Personal watercraft use is growing, and is associated with a growing number of injuries (Branche et al. in press), but less so with drowning. We should, however, monitor the number of drownings associated with personal watercraft use, as these watercraft become more popular.

Swimming pools greatly influence drowning rates in warmer climates.[21] Young children account for the largest proportion of drownings in residential swimming pools. Adults often expect small children to splash and show obvious signs of distress when they are having trouble in the water, yet drowning children rarely display such signs of distress or call for help.

PREVENTIVE STRATEGIES

Declines in drowning rates in the United States can be attributed, in part, to successful interventions and other preventive strategies. The nature of these strategies can be environmental or engineering (changing the area where water recreation occurs), educational (training water enthusiasts about dangers associated with water recreational activities), behavioral (adopting water safety practices), or legislative (adopting and enforcing policies that protect the public from unacceptable risks).

Parents need to constantly supervise their young children around all household and outdoor water sources to prevent drownings. Isolation pool fencing, which separates the residential swimming pool from the house and remaining yard, has been widely regarded as an effective barrier method of prohibiting access to the swimming pool by unsupervised children.[22] Such fencing has been recommended by the American Medical Association. Critics have recommended that pool covers, pool alarms, door alarms, and child alarms provide equally satisfactory protection for children. Additional research is needed to determine the degree of protection these various methods provide to children.

Personal flotation devices (PFDs) or life jackets are not substitutes for knowing how to swim, but they do offer a degree of protection for swimmers in rough or uncertain waters and for individuals who cannot swim or who swim poorly.[23] Personal flotation devices are recommended for all boat operators and passengers on all boating vessels on all waterways. A personal flotation device is required to be on board for each person on the vessel if the vessel is under 16 feet.

With improved emergency rescue services, improved emergency treatment modalities and the recommendation that parents, swimming pool owners, and recreational boat users learn CPR, effective conversion of near drowning victims appears to be possible more often.[24]

Over the past decade, more communities have adopted laws that prohibit people from buying, selling, possessing, and using alcoholic beverages at water recreation facilities. Laws that govern the consumption and sale of alcoholic beverages at water recreation facilities have been slowly changing. Legislation that prohibits alcohol use during boating is on the rise.

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B. Christmas Brewster is Lifeguard Chief for the City of San Diego and, concurrently, Harbormaster for Mission Bay. Agency responsibilities include water rescue of swimmers, marine firefighting, law enforcement via citation and arrest, coastal cliff rescue, swiftwater rescue (flood rescue), ocean rescue of boaters up to three miles offshore, staffing of a 24-hour dispatch center with full 9-1-1 capabilities, and public safety education programs. There are some 230 lifeguards under his supervision and an annual budget of $6.5 million. He has worked as a lifeguard since 1979.

Brewster edited *The United States Lifesaving Association Manual of Open Water Lifesaving*, which is used to training beach lifeguards throughout America. He also edited USLA's *Guidelines for Open Water Lifeguard Training and Standards*, which is used in the USLA National Lifeguard Agency Certification Program, and *Guidelines for Training and Standards of Aquatic Rescue Response Teams*.

He serves as a Vice-President of the International Life Saving Federation and President for the Americas Region. He also serves as Chair of the National Certification Committee of the United States Lifesaving Association, which sets minimum recommended standards for lifeguard training and certifies those in compliance. He is President of the California Surf Lifesaving Association.

Brewster has been widely quoted in various national media, such as The New York Times, The Los Angeles Times, ABC News 20/20, CNN, and Condé Nast Traveler, regarding open water lifesaving and boating safety. He has a Bachelor of Science in Journalism from the University of Colorado, writes extensively on lifeguard matters, and lectures regularly, both domestically and internationally.

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Lifeguard Skin Cancer Protection

An Approach to Protecting Health and Promoting Image

B. Chris Brewster, Lifeguard Chief
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Introduction

The problem of skin cancer is insidious. As a result of high levels of sun exposure, many lifeguards have sustained this disease, even at a young age. Throughout the world however, lifeguards can be seen working under the sun with little protection, wearing a minimum of clothing, even during the most severe hours of the mid-day sun.

Lifesaving is a hazardous profession. Orthopedic injuries abound, trauma injuries can occur due to wave action and other factors, and, occasionally, death can result. For this reason, in Southern California, many professional lifeguards are classified as having *high risk* jobs and are given enhanced injury and retirement benefits in recognition of that risk. The high risk designation was not conferred with skin cancer in mind, but beginning several years ago, skin cancer emerged as a significant injury source.

In the early 1980's, the San Diego Lifeguard Service realized that it had a problem. Lifeguards were contracting skin cancer at a seemingly accelerating rate, some forced to retire early. Experienced lifeguards seemed most susceptible. They had been guarding the beaches long before sunblock became commonly available and fully recognized as a valuable protectant; but even younger lifeguards were developing this disease. In fact, from 1984 to 1989, 25 San Diego lifeguards sought treatment or medical evaluation for suspected skin cancer.

In some cases, the cancer was treated and resolved, with doctors determining that the lifeguards could continue to work, using proper precautions. In other cases, the cancer was treated, but doctors determined that the lifeguards could no longer return to their customary and usual assignments. They were disabled and forced to retire – some while only in their 30's.

In either case, the results were costly, both to the physical well-being of the lifeguards and the financial well-being of their employer. California maintains employment laws that require both treatment of injured workers and certain payments to workers when they are permanently injured on the job. When they are forced to retire early, there is an additional cost borne by the employee retirement system. In the case of retirements, the employer must hire new, less experienced personnel to take the place of those departing, and incur the costs of training. Such was the case for City of San Diego.

Lifeguards and Sun Exposure

Part of problem of lifeguard skin cancer rates is founded in the very culture of lifeguarding. Persons drawn to lifeguarding are typically highly physically fit and desirous of displaying their physical fitness. Those with light skin coloring typically consider a deep, dark tan to be an essential part of their self-image and personal appearance. Meanwhile, they are sustaining accelerated damage to their skin and apparently greatly enhancing the likelihood of becoming skin cancer victims.

The fact that lifesaving disproportionately attracts the youthful only compounds the problem. Youths rarely worry about problems they might experience later in life. They are known to be higher risk takers than the general populace and they are particularly concerned with personal physical attractiveness.

To address these issues, prudent lifeguard employers need to take strong steps to ensure that their employees are adequately protected. Lifeguard employers commonly distribute sunblock to their personnel and some require its application. Lifeguard station designs should take sun protection into account, not only to reduce skin cancer problems, but also to counter the accelerated fatigue which results from over-exposure to the elements, sapping attentiveness and physical readiness. Unfortunately, the San Diego Lifeguard Service found that these steps were not enough. In consulting experts, we learned that the only true protection came from covering up the body, particularly areas of the body that are frequent skin cancer sites.

The Professional Image

Skin cancer aside, lifesaving has an image problem. Too often, lifesavers are inadequately recognized for the essential role they play. Although lifeguards probably have a greater impact on the saving of human life than any other public safety providers, they are sometimes seen as having a less important role than, for example, police or firefighters. This, in turn, has a deleterious impact on lifeguard budgets, equipment, and public recognition, all of which are inextricably intertwined.

There are many reasons for this, including the fact that lifesaving is often, literally, a day at the beach, which most people identify with recreation and relaxation. Some are jealous of the person who is able to work daily where most can only vacation occasionally. Thus lifesavers are sometimes seen as having a role that is more of a vacation itself than a serious public safety job. This is far from the truth, but it is a part of the image lifesavers must continually work to shed if they are to attract the funding and support necessary to ensure that they can adequately do their job.

There are many ways to improve image. One of the most obvious is through uniforms. Police and firefighters are almost always attired in official and readily identifiably uniforms which are clean and authoritative. They imply professionalism, whether the individual employees deserve that image or not. To the general public, these are people who, if necessary, have committed to risk their lives for the lives of others and their uniform tells this story.

Contrast this image with that of a lifeguard, perhaps slouching in an elevated chair for all to see, with only a pair of trunks on, relaxed and seemingly “catching rays.” Perhaps then one can understand a primary reason that fire and police agencies are typically better funded, equipped, and paid than lifesaving agencies. For all three, professional image is essential to ensuring public support, but in many places, lifesavers are losing the public relations battle over professional image.

Lifeguards too, wear uniforms, but often the uniform is just a pair of trunks with a small patch, and perhaps a T-shirt occasionally worn. To a degree, dressing light is necessary. Lifeguards must be ready at a moment's notice to enter the water and make a rescue. They also need to keep cool. Improvements are possible however, which do not impede a lifeguard's response.

Perhaps more important than image is the need for the beachgoer and other lifeguards to readily identify the lifeguard in a crowd or at an emergency scene. It is essential that the lost child, the distraught parent, the arriving ambulance crew, the patrolling police officer can quickly and easily find the lifeguard, but this is often a difficult task. Perhaps the lifeguards' swimsuits are of consistent color, but rarely are they of a color or design unavailable to the general public. A small patch on the suit may be the only distinction. How often is the lifeguard at an emergency scene brushed aside by other emergency workers, partly perhaps by negative stereotyping, but partly due to lack of a professional image as compared to other emergency services workers?

Uniforms are also important for proper attribution and visibility when the news media visits a rescue scene or other event. Many years ago, firefighters took to placing their names and that of their agencies on the upper back of their uniforms, probably to help identify each other while assaulting a house fire or similar calamity. Today however, one of the most photographed images in local and national news stories is the backs of firefighters prosecuting a fire or rescue, with their agency's name widely credited. On their chests too, and their helmets, their agency's name is available for all to see. And those who are inspired by the heroism of emergency workers are moved to support them all the more as a result.

In San Diego, we found that too often, news accounts of beach emergencies identified all of the emergency workers except the lifeguards. Less experienced reporters would identify a lifeguard rescue boat as belonging to the police or fire department. They might assume that a cliff rescue could not have been performed by lifeguards, so they reported that firefighters had accomplished the rescue, even if none were there. This led to great frustration on the part of lifeguards whose deeds were not recognized or, seemingly, even appreciated.

Protecting Health and Image

In the early 1980's, the San Diego Lifeguard Service decided to address both of these issues in an effort to protect it's personnel and burnish its professional image. In 1984, it adopted a standardized uniform policy including everything from wetsuits to T-shirts and the dress uniforms worn by its personnel on formal occasions. A standard logo for the shirts was chosen, which is also an educational depiction of a person in distress in the water, waving for assistance. The backs of all uniforms state *LIFEGUARD* in bold letters, and *SAN DIEGO*. The front of beach uniforms of full time employees includes a silk-screened badge, as well as the employee's name. For seasonal employees, the front of the shirt includes a smaller version of the logo on the back. The colors of the shirts too, are consistent. This logo arrangement is also used on uniform sweatshirts, jackets, wetsuits, and personal floatation devices.

For trunks, tanksuits, and dress uniforms, the San Diego Lifeguard Service retained the traditional patch. It is worn on the lower left thigh of trunks or lower left abdomen of tanksuits. It is also worn on both shoulders of Class A (dress) uniforms, which include a metal badge and nametag. The patch, which is red, white and blue, appears at left.

The policy regarding the wearing of uniforms and sunblock, both for personal protection and professional image, is perhaps the most strict of any lifeguard service. It includes:

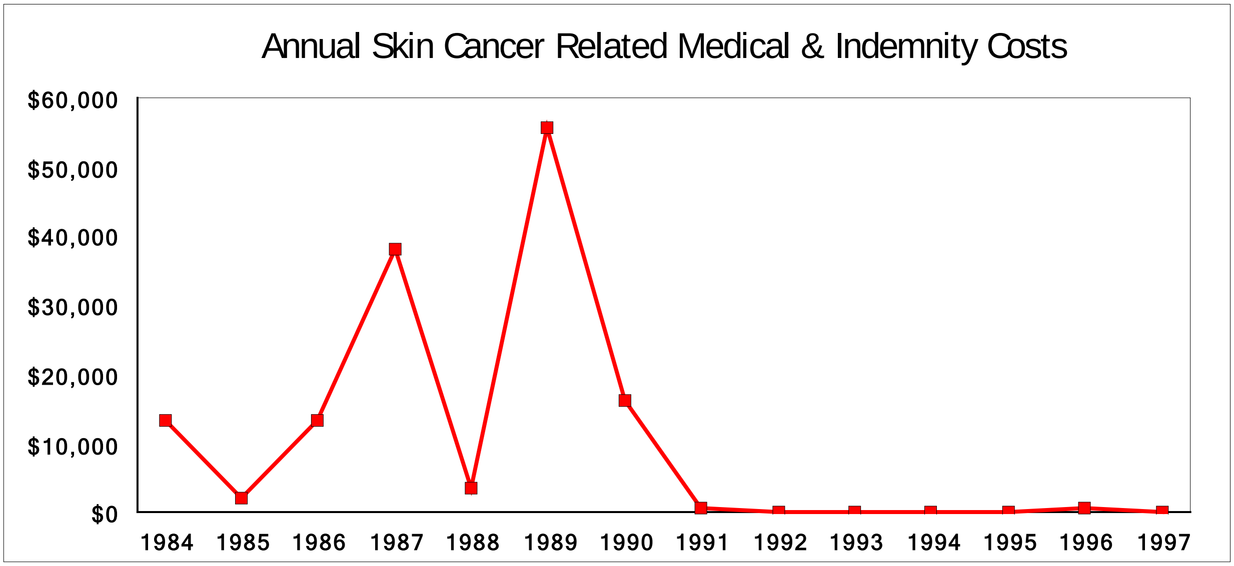
- Uniform shirts of a consistent color *must be worn at all times* unless actively involved in a water rescue.
- All upper body uniform items, including wetsuits, personal floatation devices, etc. must be emblazoned back and front with standard, identifying logos.
- Hats must be worn whenever the lifeguard will be exposed to the sun for more than 15 minutes.
- Sunscreen must be applied regularly to all exposed areas.

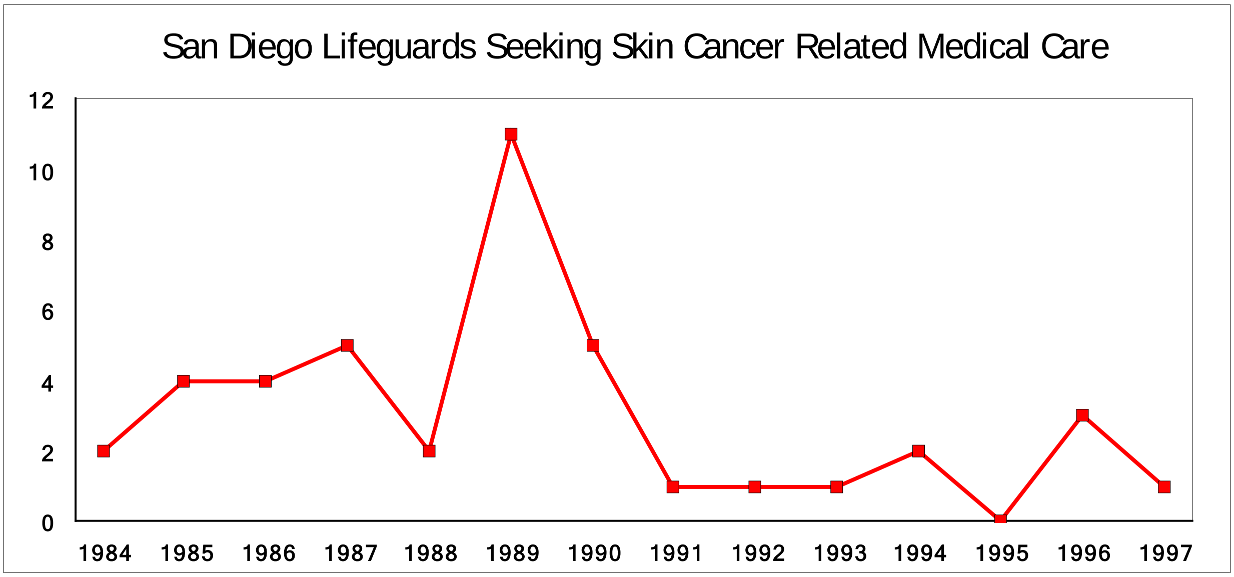
These requirements ensure that the upper bodies of lifeguards, excluding the necks and lower arms, are protected from the sun at all times, greatly reducing sun exposure of areas of the body heavily susceptible to skin cancer. They also ensure that San Diego lifeguards are immediately identifiable to the public they serve, fellow safety providers, and to persons watching news media accounts.

Initially there was great resistance to the policy. Lifeguards rejected the shirts and strong supervision was required to keep the policy in force. Today, discipline is still occasionally meted out to lifeguards who decide that tanning is more important than personal protection, public identification, and professional image; but this is the exception.

Outcome

Has San Diego's initiative accomplished its twin goals? In regard to skin cancer, it appears that there has been a significant reduction, both in severity and frequency. Obviously this has also come during a time of heightened awareness of skin cancer and the need for sunblock, and skin cancer can take many years to develop, so the full effect of this policy may take decades to fully evaluate. No one however, would dispute the fact that covering up is the most effective way to protect against the ravages of the sun. The following charts give some specific data on our history of skin cancer problems:





As for the benefits of professional image, San Diego lifeguards have progressed tremendously over the past several years. Since implementation of the uniform policy, San Diego lifeguards have developed a much stronger strong public image within and outside their community. One reason is that San Diegans watching the local news regularly see the word "lifeguard" in local news accounts of beach area emergencies, be they cliff rescues, water rescues, boat fires, river rescues, etc. Even if the reporter gets the story wrong, the video identifies the rescuers. National news accounts of major disasters in our area, such as flooding, as well as reenactment shows, have also shown San Diego lifeguards involved in rescue work. Each time, we believe that it gives the public a sense that their tax dollars are well spent on lifeguards.

Once a district within a division of the Park and Recreation Department, the San Diego Lifeguard Service was made a full division in 1988, then combined with the Fire Department to form a new organization called Fire and Life Safety Services in 1995. On July 30, 1997, a City Council committee discussed a proposal to make the San Diego Lifeguard Service an independent department.

Since1985, the annual budget of the San Diego Lifeguard Service has grown significantly, from $2.7 million to $6.5 million. The number of budgeted full time equivalent positions in the Lifeguard Service has increased from 72 to 107 during that same period. Recently, the City Council voted to increase the annual budget of the Lifeguard Service by $300,000, which translates to five additional full time lifeguard positions.

Certainly all of these improvements cannot be singularly attributed to uniforms and the professional image they bring. Professionalism, after all, goes well beyond image, but ensuring that the public we serve knows who made the rescue is very important. There is little doubt that the palpable change in public support for the San Diego Lifeguard Service and the various enhancements in pay, budget, and positions are owed to a large part to the improved image presented by the uniforms worn by its employees. Certainly each of them is better protected and better respected since this policy was implemented.

Sergeant Greg Buchanan

Greg Buchanan is a Lifeguard Sergeant for the City of San Diego. Buchanan supervises both full time and seasonal lifeguards on the ocean as well as on Mission Bay. Buchanan has worked on Mission Bay during the last 4 years where he has been responsible for emergency response and staffing of six 22' foot rescue vessels, two 32' fire suppression vessels, 2 personal watercraft, a multi-purpose response vehicle that responds to cliff, river and dive emergencies, and a 24 hour 9-1-1 dispatch center.

Buchanan's duties have included coordinating a 120 hour academy for full time San Diego Lifeguards covering topics such as boating safety and enforcement, marine firefighting, emergency dispatching, river rescue and cliff rescue. He also serves as an assistant coordinator for the San Diego Regional Lifeguard Academy, which is aimed at training entry level seasonal lifeguards. This academy is run through a local college.

Buchanan is the lead cliff rescue instructor in charge of training, equipment and rescue for the San Diego Lifeguard Service. He organizes instructor training and coordinates and instructs annual cliff rescue training for 60 full time lifeguards.

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Special Rescue Teams
Cliff Rescue

Greg Buchanan
Sergeant, San Diego Lifeguard Service

CLIFF RESCUE

History reveals that the adventurous cavers and mountaineers have largely shaped the current day world of cliff rescue approaches and techniques both in the wilderness and along the cliffs. Many years ago true pioneers first began to explore caves through a variety of techniques and equipment uses. The mountaineers developed their own style and special equipment. The development of mountaineering equipment assisted the evolution of caving techniques. When the cavers and the climbers joined forces, the techniques and equipment underwent refinement and improvements that allowed for application to rescue teams throughout the United States.

Based on increased calls for assistance and significant safety factors, EMS and rescue operations throughout the United States have been required to form coordinated rescue responses to a multitude of special emergencies. As in many urban US cities, San Diego has been forced to adapt to the many types of emergencies that they are called upon to perform.

Cliff rescues have been one such emergency that has challenged the rescuers for years which, in turn, has required the rescuers to understand and train for a variety of situations.

CLIFF RESCUES IN SAN DIEGO

When coastal cliff rescue emergencies occur during the day in the City of San Diego, the San Diego Lifeguards are called to perform the rescue. San Diego Lifeguards perform these rescues as a part of their normal job duties due to the proximity of the cliffs to the ocean coupled with the lifeguard's familiarity with the cliff and quick response time. San Diego Lifeguards perform between 50-100 cliff rescues per year.

The principle cliff areas in San Diego are those at Black's Beach in La Jolla and the seaward side of Point Loma. Both areas are composed of sandstone but each has its own particular physical characteristics.

The Black's area consists of high, unstable cliffs, cut by deep fissures and canyons. Most visitors access the beach by three precipitous and heavily traveled trails. Footing is poor and frequent landslides make the area next to the cliffs hazardous. The primary cause for cliff rescues is the dangerous, false trails. The heights of these cliffs range from 50-150 meters.

The low cliffs at the Sunset Cliffs area drop vertically to the beach. The beach below is little more that a tidepool area, composed of broken rocks and reef structures with a few sandy coves. High tide reaches the base of the cliffs, where the action of the surf is quite strong. Extrication of trapped surfers during large surf is usually a problem and may be compounded by the tidal flow.

EMERGENCY CALLS

A call for assistance on or near the cliffs can come from many different sources. Some calls are routed through the 9-1-1 system, others are reported to lifeguards working at the beach, while others are spotted by the lifeguards themselves. Strategically placed call boxes along the cliffs are another common method of notification. A cliff rescue call will usually be categorized into one of three scenarios: 1) reported non-injury or minor injury entrapment; 2) reported serious injury; 3) no details. Depending upon the report, a certain number of rescuers are sent to the scene to evaluate and size-up the situation.

RESPONSE AND SIZE-UP

When a cliff rescue call is initiated, a supervisor, with technical cliff rescue gear, responds to the call and attempts to make contact with the reporting party so that the victim's status and location can be determined as quickly as possible. Other back up units will also be responding and a proper incident command structure is set up. Obtaining pertinent and reliable information is often difficult due to the unusual nature of the emergency but is critical for a good size-up. The most difficult challenge, when responding to a cliff rescue is receiving updated information on known facts that will assist in the rescue. Vital information would include; the exact location of the victim(s); whether or not the victim is injured, whether the victim is in a stable or precarious spot and what is the best spot to access the victim to perform the most efficient rescue operation. The more reliable the information, the better the size-up which usually translates into a smooth, efficient rescue operation.

Because locating the victim is the most important step in the rescue evolution, assistance is often requested of the duty lifeguards on the beach, lifeguard vessels from the water or available helicopters that may aid in the spotting.

RESCUE

Once the victim is located, a rescue plan is devised, communicated to the on scene rescuers and executed. The standing practice in the City of San Diego is to be over the cliff in 10 minutes once the victim has been located and the rescue plan has been communicated. This objective is in place to provide the best possible patient care while maintaining safety as the top priority.

Different techniques are used all over the world when rescue personnel perform technical cliff rescue evolutions. Based on our needs and specific terrain, a lowering system is used when possible which is backed up by a separate tandem prusik belayed rope. The redundancy of two ropes is practiced to ensure rescuer and victim safety. If the victim is hauled up the cliff, a mechanical advantage system, usually a 3 to 1, is deployed along with a great deal of padding and edge protection to lessen the friction caused by the eroding cliffs.

Actual rescue operations will involve three general rescue techniques. The least difficult rescue involves a person who is trapped on the cliff in a stable position and uninjured. Other victims are trapped on the cliff but in a precarious position but still uninjured. The most difficult rescues involve victims who are injured somewhere on the cliff.

Many of the victims who are trapped but stable have put themselves in that position because they attempted to hike up or down the cliff on a trail that does not extend from the top to the bottom. These victims are stuck and unable to move up or down, hence the term "false trail." During these rescue situations, rescuers use a stake line operation, which relies on the fact that the victim is trapped but able to help themselves up the cliff using an "easy to grip" stake line while being secured in a redundant belay system.

Victims who are trapped on the cliff and in a precarious situation are in very serious danger. These victims are subject to losing their footing and falling down the rest of the cliff. These victims must first be secured to the rescuer before they are tied into the two redundant systems. The use of a "victim sit harness" has been very advantageous for these rescues.

Injured victims are placed in stretchers and given basic life support until advanced life support personnel are able to arrive on the scene. Most injured patients require additional rescuers which make the rescues more complex and time critical. Because medical care while on a cliff face is often difficult, the main objective is to extricate the victim to a waiting ambulance or helicopter for more definitive medical care.

TEAMWORK

In order to perform cliff rescues in an efficient manner, the rescuers on the scene must work toward a common goal. The on scene goal is often obvious but the specific method by which it may be accomplished is not. Scene commanders take an active role in giving detailed explanations of the rescue technique that will be used along with individual job assignments. Once this has been done, the team must work independently but with a common goal in mind. When properly trained rescuers are allowed to complete their job duty with little interference, the outcome is usually efficient and rewarding. However, this rescue style becomes drastically flawed if the rescuers are unfamiliar with the rescue technique or the rescue plan has been poorly communicated.

SPECIALTY CLIFF RESCUE TEAMS

The San Diego Lifeguard Service employs an approach toward cliff rescues that is best suited to our operation. All full time lifeguards are required to be certified as cliff rescue technicians and demonstrate appropriate cliff rescue skills. This translates into 60 highly trained cliff rescue response individuals who are capable of performing a variety of technical cliff rescues.

CLIFF RESCUE INSTRUCTORS

More than 20 years ago, the San Diego Lifeguard Service decided to utilize a unique group of lifeguards who specialized in cliff rescues. This group has attended training throughout the country so that they may stay current on the evolving cliff rescue techniques. They train together and create training curriculums for the rest of the lifeguards. They are responsible for annual training for other lifeguards and they use feedback forms to adapt and refine techniques based on input from their students.

The cliff rescue instructors respond to all cliff rescues along the coastal region. Their main purpose is to oversee the technical aspect of the rescue. They offer suggestions to the incident commander and when needed, perform the rescue themselves. The instructors are used to gauge the effectiveness of the skills being applied during the rescue. During the post rescue critique, the instructor discuss and identify efficient rescue work while offering suggestions for improvement if needed.

The cliff instructors are also responsible for equipment purchases and deployment of equipment to the five different cliff rescue trucks. They develop and present policy and procedures to the supervisor's committee and conduct testing and training in new methods and equipment.

The cliff rescue instructors are used as a hybrid between two different response modes. They do not act alone as a specialty team but they do have increased knowledge and responsibilities. Based on staffing levels and the varying locations of the cliff rescues, it is not feasible to exclusively dispatch only cliff instructors to every call. In essence, the other 60 lifeguard rescuers are deployed as the primary rescuers while the instructors manage and guide the operation.

TRAINING

Each year the Lifeguard Service conducts annual training for all full time lifeguards. This training is designed and given by the cliff instructors who arrange the classes according to skill level. The ratio of students to instructors is 6:2 and the goal is to promote efficient execution through the use of applied knowledge and teamwork.

The classes are required to meet a minimum standard for technical cliff rescues that is outlined in a field training guide. The goal of each class is to present material that reinforces their existing expertise while challenging them to learn and advance their level of understanding.

In-Service training is another component to maintaining skills and confidence. During summer months, the seasonal lifeguards request and receive cliff training from the full time lifeguards which allow the full time lifeguards to teach skills and reinforce their own knowledge.

The Lifeguard Service is currently working on a program that will allow for In-Service Assessment of cliff skills which are accompanied by specific procedures and goal times in an effort to work toward excellence.

Professor Gerald DeMers, Ph.D.

Gerald "Jerry" DeMers is a Professor and Aquatics Director for the Physical Education and Kinesiology Department at California Polytechnic State University in San Luis Obispo, California. He has been an Aquatics Director at a major university for the past 22 years and is in his 27th year of teaching.

Dr. DeMers was a member of the American Red Cross Progressive Swimming Revisions Committee and Lifeguarding Today Revisions Committee. He was also a member of the YMCA of the USA On the Guard II Revisions Committee and Progressive Swimming Revisions Committee. He has served as the Chair of the American Alliance for Health Physical Education, Recreation and Dance Aquatic Council and has been a member of numerous other national committees relating to Water Safety.

Dr. DeMers developed the Head-Splint Rescue technique for Spinal Injury Management in 1976 and has developed rescue and backboarding procedures for the American Red Cross and YMCA of the USA. His research relating to Spinal Injury Management has spanned two decades and his most recent accomplishment was the development of spinal injury in-line stabilization techniques and backboarding procedures for the surf environment.

Dr. DeMers has numerous publications relating to aquatic safety and was a primary writer for the American Red Cross texts Swimming and Diving and Head Lifeguard. He is currently working on three textbooks dealing with home swimming pool safety, aquatic facility management and swimming pool design and mechanics. He has presented at numerous State, National, and International conferences and is a legal consultant for a variety of aquatic safety issues.

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SPINAL INJURY MANAGEMENT IN SURF:
IS THERE A BETTER WAY?

By Gerald DeMers, Ph.D.

Spinal injury management in surf presents a variety of problems for the rescuer. Methods for in-line stabilization must be adaptable to environmental factors, size of the victim, and location of the victim. Current methods for handling spinal injuries in surf are adaptable in some instances but are they safe? Unfortunately, very little research has been completed to validate the techniques being taught to surf lifeguards. The objective in completing an effective spinal injury rescue is to maintain in-line stabilization in order to prevent further injury to the spinal column. A critical aspect of any in-line stabilization technique is to prevent the head and neck from moving. Do the current methods being used in surf significantly restrict head and neck movement? As professionals we need to address the question, "Is there a better way for handling spinal injuries in surf?"

Let's take a look at a common method which is being taught to surf lifeguards around the world. This method is referred to by a variety of names, including the Vice-Grip, Hawaiian Method, and Full Nelson. For the purposes of this manuscript the term Underarm Spinal Stabilization Technique (USST), as used by the United States Life-saving Association, 1995, will be utilized. To employ this technique, the lifeguard places both arms under the victim's armpits then, bending the elbows, places the hands, palms in, on opposite sides of the victim's head. The hands maintain the head in a neutral position while the arms stabilize the victim's shoulders against the lifeguard's chest (Brewster, 1995). This can be applied to a victim who is in a prone or supine position.

An in-depth analysis of this technique raises a multitude of questions. Can this method be performed in a variety of conditions? Is it adaptable to shallow water rescues? Can the victim be transported easily to shore? Is there an easy transition from in-line stabilization to backboarding the victim? Is it adaptable to victims weighing 275 to 300 pounds? Does it really provide a safe and effective method for maintaining in-line stabilization?

In order to answer these questions, we must first understand who is at risk and where the injuries occur. In a study analyzing data from 314 spinal injuries over a 22 year period, DeMers and Richardson (1997) established a profile of a likely surf spinal cord injury victim and environmental conditions in which spinal injuries are likely to occur. The following information from this research identifies some important characteristics of spinal injuries in surf:

The Victim

- 82% were male
- Age ranged from 4 years to 66 years
- Height ranged from 4 feet to 6 feet 5 inches
- Weight ranged from 60 to 339 pounds
- Activity at time of injury included: body boarding (18%), Bodysurfing (42%), surf-boarding (10%), other activities (30%)

The Environment

- Depth of water ranged from 0 to 8 feet
- Tide was ebbing
- Water visibility at the site of injury was less than 2 feet
- Surf size ranged from 1 to 8 feet
- Depth of water where victim was located ranged from 0 to 8 feet

The research by DeMers and Richardson (1997) included very detailed data relating to spinal injuries at Huntington Beach, California from 1975-1996. The information above allows us to determine the efficacy of spinal injury management techniques under conditions which are likely to occur.

Can the USST method be administered in a variety of conditions? The location of the victim in water shallower than two feet makes it impossible to perform this method. It is questionable if this technique can be performed effectively in water shallower than four feet. According to DeMers and Richardson (1997) a majority (more than 59%) of spinal injuries in surf occur in water shallower than four feet. The USST method is also difficult to perform in deeper water (6 ft or deeper). The lifeguard must swim with the victim tightly against them while trying to maintain in-line stabilization. Surf action can cause movement of the victim's lower body, adding further complications to the rescue. Any flaw in technique could potentially cause the head or neck to move. This method is best suited for a depth ranging from four to five feet. It is easier for the rescuer to position him-or herself effectively with fewer risks of head/neck movement on the victim.

Can the victim be transported easily to shore? A minimum of two lifeguards must be available in order to transport the victim to shore. Even with two lifeguards, the method leaves much to be desired. An unconscious victim or victim with spinal cord damage will be very limp. The rescuer in control of the victim's head must be able to squeeze their elbows against the victim's ribs with enough force to maintain the weight of the victim during the lift and walk to the beach. One cannot assume the arms of a limp-bodied victim will stay over the rescuer's arms during transport from water to shore. This potential problem will cause the rescuer to place unacceptable pressure on the victim's head and result in traction on the neck. Another consideration is the fact that the victim may have lotion on which will make it even more difficult for the lifeguard to maintain adequate pressure on the victim during the lift. Is there an easy transition from in-line stabilization to backboarding the victim?

The transition from in-line stabilization to backboarding is complicated and places the victim in potentially hazardous positions. During the transition from the carry to the beach and placing the victim on a backboard, the rescuers must kneel down with the victim, move their arms and hands out from under the victim's armpits and legs, lay the victim down on the board, and continue to provide support to the victim's head and neck with as little movement as possible. There are many opportunities for error in this transition.

Is it adaptable to victims weighing 275 to 300 pounds? Here is a major problem for any technique but especially the USST. One difficulty is the lifeguard's ability to reach under the arms and stabilize the victim's head. If the lifeguard's arms happen to be long enough to do so, the next question is, can the lifeguard lift that much weight? It is highly unlikely. The USST is ineffective with large victims.

Does it really provide a safe and effective method for maintaining in-line stabilization? This is a question that cannot be answered. Even if conditions were perfect for the rescuer, the amount of head/neck movement which takes place during the USST rescue technique is unknown. Unfortunately, many of the rescue procedures developed for surf and swimming pools have been handed down from generation to generation. Often, no research took place to substantiate the use of these techniques. We blindly follow historical processes which may be defective and dangerous.

So, **Is there a better way?** The answer to this question is an unequivocal, yes! In 1976, this author developed the Head-Splint rescue for suspected spinal injuries in a swimming pool environment. The technique was published in the Journal of Physical Education, Recreation and Dance, (1983). Since that time, the technique has been adopted and published by the American Red Cross (1990, 1995) and YMCA of the USA (1994). A variation of this technique is also published in the United States Life-saving Association Manual of Open Water Lifesaving, (Brewster, 1995).

In the summer of 1995, Head-Splint methods were developed for extreme shallow water in-line stabilization techniques and backboarding procedures in surf. There was a definite need for a viable method for providing in-line stabilization for victims located in water zero to three feet in depth. Additional methods for deeper water were also developed for extrication on a backboard and without a backboard. These new methods can be performed by one, two or three rescuers in a variety of surf conditions.

The Head-Splint technique consists of the rescuer trapping the victim's head between the victim's arms (splinting) and maintaining this position throughout the rescue until the victim is secured to the backboard. At this point, let us once again examine the same questions as posed for the USST.

Can the Head-Splint method be administered in a variety of conditions? The Head-Splint technique is adaptable to deep water as well as extremely shallow water. In-line stabilization may be performed on a victim discovered in a prone or supine position. In deeper water, since the victim is not trapped against the rescuer the rescuer has freedom of movement while swimming the victim to shallow water. Once in shallow water, the rescuer has the option of backboarding and carrying the victim out of calm water or towing the victim to shore in surf. There are a number of options for this technique which will be addressed later in this paper.

Can the victim be transported easily to shore? If the water is fairly calm, the victim may be towed onto a backboard located in the water. This can be accomplished in any depth in which it is comfortable for the lifeguards to stand. Other rescuers may lift the backboard and victim while the primary rescuer continues to apply the Head-Splint. With the victim on the backboard, rescuers may walk the victim to shore and lay the board on the beach in preparation for securing the victim to the backboard.

If there are surf conditions, it is advisable to remove the victim from the water as quickly as possible. This can be accomplished by the primary rescuer maintaining in-line stabilization and a secondary rescuer providing support to the victim's hips and legs. The victim is then transported to shore and out of the surf or placed onto a backboard and walked to shore.

Is there an easy transition from in-line stabilization to backboarding the victim? There are several options for backboarding the victim. The technique applied is dependent upon the conditions of the water and the location of the victim. In any situation, the primary rescuer maintains the Head-Splint while placing the victim on the backboard.

Is it adaptable to victims weighing 275 to 300 pounds? The size of the victim does not affect the effectiveness of the Head-Splint technique. Even a small rescuer can comfortably maintain the Head-Splint technique regardless of the size of the victim. Since the buoyancy of the water may be utilized while towing the victim to shore, the only time the lifeguards need to be concerned is when the victim is backboarded in the water and carried to shore. Even then, the victim can be kept low in the water until it is necessary to lift and carry the victim to the beach.

Does it really provide a safe and effective method for maintaining in-line stabilization? Measuring neck movement in an aquatic environment presents many complicated problems. In 1985, this author developed an instrument which measured head/neck movement during spinal injury rescue procedures. The research that followed the development of this instrument compared the Head-Splint rescue with the Head and Chin Support rescue. The Head-Splint proved to be much more effective in stabilizing the head/neck during in-line stabilization than the Head and Chin support method. Two separate studies confirmed that there was less flexion/extension and less lateral movement of the head/neck utilizing the Head-Splint as compared to the Head/Chin support, $p<.01$ (DeMers, 1985 and Johnson, 1989). Further research needs to be completed comparing the newly developed Head-Splint procedures for surf and the Underarm Spinal Stabilization Technique.

An In-depth Look At The Head-Splint Procedures

Victim In Prone Position

In all depths, approach the victim from the side and face the victim's head. Grasp the victim's upper arms (humerus bone) near the elbows. This will give you better leverage for applying pressure to the victim's arms and head. The rescuer's right hand grasps the victim's right arm and the left hand grasps the left arm. Move the arms laterally and trap the victim's head between his/her arms. In depths greater than four feet, roll the victim toward you until the victim is in a supine position. While rolling the victim over, the rescuer should submerge so that the water is at shoulder level. The victim's arms will end up next to the rescuer's neck and over the rescuer's shoulder. The rescuer will end up in a position where he or she will be looking toward the victim's feet with his or her head next to the victim's head. This places the rescuer in a good position for checking breathing and viewing surf conditions.

In **extremely shallow water** (less than 2 feet), as the victim is rolled, the rescuer maneuvers into a position above and to the rear of the victim's head. The rescuer's hand position must change somewhat during this process but arm pressure against the victim's head should be maintained.

If a backboard is readily available, the victim can be rolled directly onto the backboard. In order to complete this maneuver, a second rescuer places the backboard adjacent to the victim. As the primary rescuer begins to roll the victim, the secondary rescuer, located to the side of the victim, angles the board beneath the victim and assists the primary rescuer in turning the victim by grasping the victim's hip and rolling him or her onto the board.

Once the victim is backboarded, there are a some options for the rescuers. If it is necessary to remove the victim from the surf, the primary rescuer moves to one side of the backboard while maintaining the Head-Splint. The secondary rescuer grasps the head of the board and drags the board and victim out of the surf. The primary rescuer walks to the side of the backboard. If other rescuers are available, the primary rescuer stays at the head of the backboard and maintains the Head-Splint while secondary rescuers lift the board and transport the victim out of the surf.

If only one rescuer is available and it is a necessity to remove the victim from the surf-line as quickly as possible, once the victim is turned to a supine position, the primary rescuer could drag the victim onto the beach. It is extremely important that the rescuer continue to maintain pressure on the victim's arms and trap the head during the drag. Keep the victim's arms as low to the water and sand as possible. This will reduce the possibility of causing flexion of the head and neck during transport.

There are several options In **water deeper than 2 feet**, depending on the number of rescuers available and the surf conditions. The victim may be towed out of the surf or backboarded and carried out of the surf. If the victim is backboarded and carried onto the beach, a minimum of three rescuers are needed. One rescuer maintains the Head-Splint while the other two locate on each side of the backboard. The two secondary rescuers lift the backboard and the primary rescuer maintains in-line stabilization.

In any spinal injury rescue in surf, control of the victim's lower body is also an important aspect of an effective rescue. If the victim's legs are angled toward the surf, surf action has a tendency to cause the legs to wash laterally and turn the victim. To avoid this, the primary rescuer should position his or her back to the waves and the secondary rescuer should stabilize the victim's hips and legs. This is not a lift, it is a means of guiding the victim to shore in a feet-first direction. By positioning his or her back to the waves, the primary rescuer can help reduce the action of the waves breaking over the victim's face and have better control of the victim for transporting to shore.

There are other variations for using the Head-Splint technique in surf. The main factor in all of the Head-Splint techniques is that the victim's head is always trapped between his or her arms until cervical collar and strapping processes begin. This technique can be used in deep water, shallow water, and in extreme shallow water. A victim can be extricated from the water by one or more rescuers in a safe and effective manner. Though no method has, as yet, been scientifically tested in surf, the Head-Splint has been proven to be the most effective in-line stabilization technique for calm water. In practice, the Head-Splint technique and backboarding procedures work well in surf. It is now necessary to collect data comparing these new techniques with other methods being utilized at surf beaches.

Because of the ever-changing conditions during a surf rescue, no method of spinal injury management is completely fail-safe. It is important that lifeguards be trained in a variety of techniques so that intelligent choices can be made relating to the method utilized for the condition at hand. The Head-Splint provides another viable choice and most certainly meets a need for shallow water extrication.

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James G. Dobbins

James G. Dobbins is a senior epidemiologist at the US Centers for Disease Control and Prevention. Most of his research deals with viral diseases. He received his doctoral degree at the University of California, Berkeley.

He has a long connection with lifesaving, having been trained originally as a pool guard in San Francisco and then working for a number of years in open water lifesaving in Galveston, Texas while he was also a professor of epidemiology at the University of Texas Medical Branch.

From 1990 to 1994 he served as the science advisor to the United States Lifesaving Association. As part of his USLA work, he conducted studies of viral infections and of neck injuries among lifeguards, and provided expert testimony before the US Occupational Health and Safety Administration recommending that lifeguards be included in proposed regulations to reduce exposure to bloodborne pathogens in emergency medical personnel.

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Communicable Disease Avoidance for Lifeguards

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Summary

Lifeguards may be exposed to infectious agents while in the water, on the beach, or in contact with the victim's skin, saliva, or blood. Water-borne infections from polluted water are possible even when fecal coliform counts are low. In general, the risk of infection for lifeguards is high for water-borne infections, moderate to low for infections caused by microbes found in sand, and extremely low for potentially severe, bloodborne infections. Simple preventive steps include avoiding swallowing water while swimming, wearing sandals or shoes while walking on the beach, using pocket masks for resuscitation, avoiding contact with victims' blood, and vaccination for hepatitis B for those guards who do come into contact with blood.

Introduction

In the normal function of their duties, lifeguards are frequently at increased risk of contact with infectious agents. While in the water, they are repeatedly exposed to water-borne infectious agents. Walking on the beach, they are exposed to other infectious agents as well as to the threat of contact with medical wastes. Finally and most importantly, while in contact with a victim, they are often exposed to infectious agents. These agents may be present on the victim's skin or in their saliva, or they may be present in the blood of the victim.

Perhaps the most common type of exposure occurs in the water, while exposure to blood is certainly the most serious infectious disease threat to the guard's health. Fortunately, much can be done to reduce the risk from each type of exposure.

Contact with Water

A wide range of infectious organisms can be found in swimming pools, rivers, lakes, and near oceans beaches, especially those beaches adjacent to rivers or sewers. Some examples of these agents are hepatitis A virus, enteroviruses, salmonella, *Cryptosporidium*, *Vibrio vulnificus*, and leptospira. Most of these pathogens enter the water in inadequately treated human sewage, while others come from domestic and wild animals living near rivers and lakes.

A number of studies of human illness associated with recreational exposure to contaminated water have been done in various countries (for example, Australia, Canada, Costa Rica, Denmark, Egypt, France, Germany, Great Britain, Israel, Poland, and the U.S.A.), but research on this problem is extremely difficult to conduct. In the next presentation at this meeting, you will hear a description of one of these studies and understand better the problems of connecting exposure to swimming water with illnesses that may develop days or weeks after that exposure. Furthermore, even though most of these pathogens are usually associated with diarrheal diseases, exposure in the water can commonly result in lung, eye, and ear infections (Corbett, *et al*., 1993).

Standards for safe water are traditionally based on the presence or absence of fecal coliform bacteria, but recent published and unpublished studies have repeatedly shown that these standards are inadequate (see, for example, Myint, *et al*., 1994). While it is true that high fecal coliform levels indicate a high risk to swimmers, low or undetectable levels do not mean that there is no risk of infection from other agents.

Risk to lifeguards. Based on the results of a British study of persons with long-term exposure to ocean water, we can estimate that the virtually all ocean lifeguards will experience some illness from these water-borne pathogens (Myint, *et al*., 1994). Furthermore, both the British study and an Australian study found that the risk of illness among persons with prolonged exposure to ocean water is approximately 4 times greater than that of persons who do not swim in the ocean.

Prevention. Individual lifeguards can take a number of steps to avoid contact with water-borne pathogens. The most obvious of these is to avoid swallowing water while swimming. A new Hepatitis A vaccine is available for previously unexposed guards working in areas where hepatitis A is prevalent. In addition, because some pathogens enter the human body through the skin, guards with cuts and abrasions should avoid water contact. Lastly, shellfish that have collected at the water line should also be avoided, since a puncture wound can lead to infection with *Vibrio vulnificus*.

Long-term prevention, of course, involves stopping the discharge of inadequately treated sewage into bathing areas. One way of encouraging this change is to maintain records on water quality and to initiate or collaborate in studies on illnesses among lifeguards and visitors to beaches.

Contact with Sand

Some infections, especially those caused by various types of worms, can be contracted by walking on sand beaches. Recent studies of this type of infection have been conducted in England, France, the Netherlands, and Poland. In tropical areas, the most common type of infection, and perhaps the least studied, is helminthal infections from worms deposited in dog and cat feces (*larva migrans*). In developed areas, a second hazard on the beach is contaminated medical waste. Studies in Great Britain indicate that this problem is continuing to increase in spite of new control measures that may have been taken since the advent of the AIDS epidemic (Phillip, *et al*., 1993; 1994).

Risk to lifeguards. Evidence of human contact with medical waste on beaches suggest that infection is certainly possible. For example, Phillip and colleagues (1994) report that between 1988 and 1991, 40 needlestick injuries on British beaches were reported to public health authorities. In Palm Beach, Florida, 3 needlestick injuries to lifeguards have been reported in a 10-year period (J. Fletemeyer, personal communication).

Prevention. Contact with both of these hazards can be prevented by wearing sandals or shoes while walking on the beach. Surveying the beach for medical waste each morning, along with the use of containers to collect and dispose of sharp objects, will also help to reduce the chance of infection from needlesticks. Exclusion of pets from popular bathing areas is also helpful, but regulatory and logistic support for such efforts is usually lacking.

<u>Contact with Victims</u>

Direct contact with injured or drowning victims is unavoidable, yet these people can present a rich mixture of pathogens to a lifeguard. I will comment separately on the risk from contact that occurs in administering cardiopulmonary resuscitation (CPR) and the more serious risk from general contact with blood and other blood-contaminated bodily fluids.

<u>Contact with skin or saliva</u>

A number of viruses can be transmitted through direct contact when a guard is attempting to resuscitate a victim. Some viruses, such as herpes simplex virus type 1 (HSV-1), the cause of oral herpes, are present on the mucosal surface, while others, such as cytomegalovirus (CMV) and Epstein-Barr virus (EBV), are present in saliva.

> *<u>Risk to lifeguards</u>*. The risk of infection caused by these agents is probably relatively low. An unpublished study conducted at the US Centers for Disease Control (CDC) and Prevention (J. Stewart, personal communication) found that some of these viruses can persist on the surface of mannequins used for training in CPR. However, these viruses are fairly common, with 50-95% of lifeguards having already been exposed to them, and therefore it is only the previously unexposed guards who are at risk for new infection.
>
> *<u>Prevention</u>*. The use of pocket masks while administering CPR to victims should significantly reduce the risk of this type of infection, and wiping the mouth areas of mannequins with alcohol will prevent transmission of viruses during CPR training.

<u>Contact with blood</u>

The two major bloodborne viruses are hepatitis B virus and human immunodeficiency virus (HIV).

> *<u>Risk to lifeguards</u>*. The risk of occupationally acquired infection from these viruses in lifeguards is extremely small. In 1990, CDC conducted a collaborative study of the risk for hepatitis B virus infection among lifeguards at an ocean beach in the state of New York. The beach is heavily used in the summer, with many visitors coming from New York City. Serum specimens collected from over 100 guards were tested for antibody to hepatitis B virus

and all were negative, indicating that none of the guards had been exposed to hepatitis B virus at any time in the past. (Guards who reported high-risk sexual behavior, injection drug use, and tattoos were excluded from the study so that the results would apply only to occupationally acquired infection).

Prevention. All blood and all bodily fluids should be assumed to be contaminated with these viruses, and steps should be taken to avoid contact with these fluids. Protective devices, such as gloves and pocket masks or disposable mouthpieces, should be routinely available for all first aid. Specialized first aid kits should also contain barrier masks and gowns. Special containers should be provided for the disposal of blood-contaminated sharp objects, and special water-proof bags should be available for the disposal of other blood-contaminated waste. A mixture of 10% bleach and water should also be available for cleaning blood-contaminated surfaces.

All lifeguard services should provide hepatitis B vaccination in advance to those guards who are regularly exposed to blood as part of their duties. In addition, detailed plans should be developed to be followed once a guard has actually been exposed to blood. This plan should include vaccination against hepatitis B for guards who have not been previously vaccinated, an evaluation of the risk of HIV infection in the victim and the probability of transmission to the guard, and counseling of the guard concerning procedures that may be followed for treatment for HIV.

Conclusions

Lifeguards are, by the nature of their work, routinely exposed to communicable diseases. The major steps to avoid these infections include:

contact in the water

- avoid swallowing water while swimming, even when coliform counts are low
- guards with cuts and abrasions should avoid swimming in polluted water
  avoid puncture wounds from shellfish

contact on the sand

! clean all types of waste, especially medical waste, from the beach

! wear sandals or shoes while walking on the beach

contact during CPR

! use pocket mask or other barrier over victim's mouth

! wipe practice mannequins' mouth area clean with alcohol

contact with blood

! avoid all contact with blood

! assume that all blood is contaminated

! have gloves, masks, gowns, "sharps" containers, water-proof bags, and disinfectant available for all first aid

! obtain hepatitis B vaccination if exposed to blood

! develop a plan for evaluation, counseling, and treatment following exposure to blood

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Mr. Dovenbarger has worked at Duke University Medical Center as a registered nurse since 1977 and with Divers Alert Network since 1985. He received his associate's degree in nursing from Ohio University at Zanesville and his bachelor's degree in nursing from The University of North Carolina at Chapel Hill. His duties include supervising DAN's 24-hour international emergency telephone assistance line and daily information line provided by DAN for recreational scuba divers. He is also the editor of the national Report on Recreational Scuba Injuries and Fatalities. He has regular columns in DAN's bimonthly magazine, Alert Diver, and is a frequent contributor and reviewer for other diving related publications.

Mr. Dovenbarger is the 1996 recipient of the Craig T. Hoffman Memorial Award given by the Undersea and Hyperbaric Medical Society. This international award is given to physicians and researchers who make significant contributions to the field of diving safety and medicine. In addition, he has been recognized by the Flying Doctors of America for his volunteer work as a teamleader for the medical mercy mission to the Dominican Republic.

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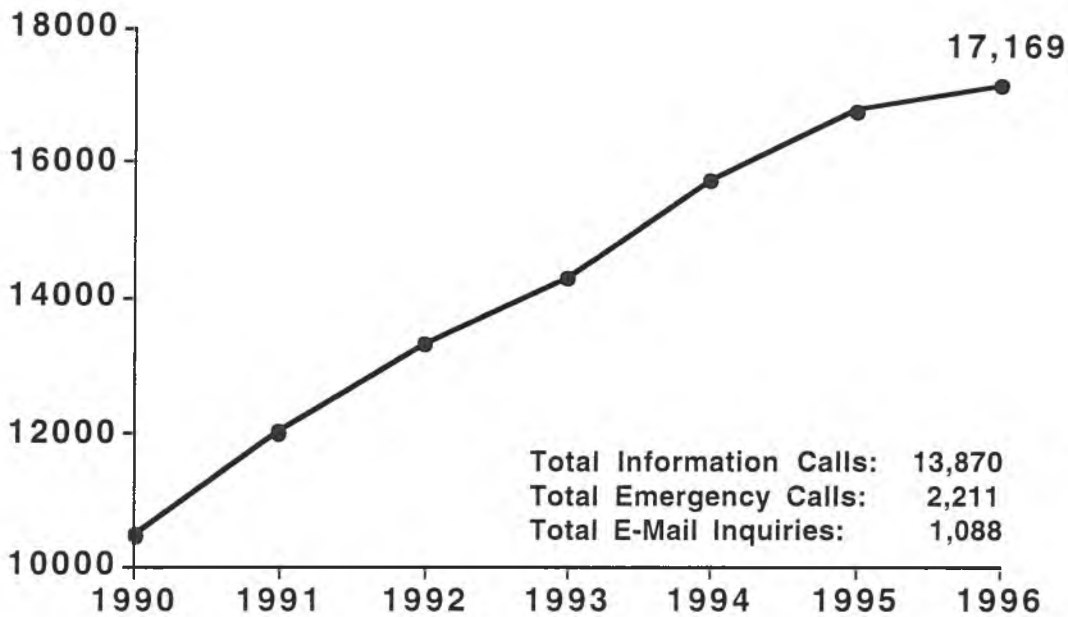
Recreational Diving Accidents
Physiology and Statistical Indicators

Joel Dovenbarger, BSN
Director of Medical Services - Divers Alert Network

The Divers Alert Network (DAN) is a 501(c)(3) not-for-profit organization dedicated to scuba diving safety and education. It is funded through a membership association that allows DAN to act as a safety resource for recreational scuba divers. DAN is located in Durham, North Carolina and associated with Duke University Medical Center. DAN also responds to over 16,000 requests for information and assistance each year. This includes over 2,000 emergency assistance calls, almost 14,000 dive safety and medical information requests and over 1,000 e-mail inquiries.

DAN Total Call Volume



There are approximately 1,000 treated cases of decompression illness reported to DAN each year among U.S. citizens. These cases are reported from treatment facilities around the world. The actual number of cases could be higher since all divers with decompression illness may not seek treatment. There has also been between 67 and 104 recreational scuba fatalities annually since 1990.

Decompression illness (DCI) includes both decompression sickness (DCS) and arterial gas embolism (AGE). DCI was introduced because the clinical signs and symptoms of DCS and AGE are similar and difficult to differentiate, even for a physician trained in diving medicine. Decompression sickness is primarily a disease of exposure to high partial pressures of nitrogen. Exposure means depth and time breathing compressed gas, and can be cumulative, such as the number of dives made per day and number of days diving. Arterial gas embolism is usually the result of pulmonary overpressurization which occurs during ascent to the surface. This overpressurization can produce tiny tears in lung tissue which allows air to enter lung tissue and the pulmonary vasculature and ultimately produce stroke-like cerebral signs and symptoms.

The expansion and compression of a gas volume in the lung can be explained by Boyle's Law. Boyle's Law states "If temperature remains constant, the volume of a gas is inversely proportional to its pressure." This is the principal mechanism of injury resulting in AGE. It is the excess of nitrogen that can produce bubbles in tissue leading to DCS symptoms. Henry's Law of partial pressure states, "The amount of gas that will dissolve into a liquid is directly proportional to the partial pressure of that gas." In other words, the diving force for the absorption of the inert gas nitrogen is the pressure gradient created by the increase partial pressure of nitrogen in compressed gas.

There is no single presentation which is classic for decompression illness. Nitrogen will be absorbed by all body tissues and fluids. Symptoms, therefore, may present in any area of the body. A physical and neurological examination will be necessary to diagnose decompression illness. There is rarely any outward sign of injury that would indicate severe or even mild symptoms. There are no lab tests or x-rays that can be performed to detect decompression illness. In the emergency care setting, it is important to begin an accurate record of symptoms and symptom onset in order to establish baseline information on the injury and the evolution of symptoms. A diagnosis does not need to be made prior to arriving in the emergency department. Because decompression illness requires treatment in a hyperbaric chamber, the rescuer should verify the recent history of breathing compressed gas while under water (scuba diving). Emergency care, including 100% oxygen, should not be withheld when DCI is suspected.

Approximately 54% of all symptoms of DCI will occur in the first 30 minutes following the scuba dive. About 68% will occur within the first two hours of the dive and 95% will have developed within 24 hours. Divers may present with both acute severe symptoms, and mild to moderate neurological symptoms hours after diving. There are seven symptoms considered the most frequent symptoms of DCI.[1]

Symptom Frequencies

	First Symptom	Total Occurrence
Numbness	21.9	61.7
Pain	34.4	57.8
Weakness	6.4	25.4
Headache	5.9	24.7
Dizziness	7.5	22.7
Extreme Fatigue	4.2	21.0
Nausea	4.2	14.7

Although unconsciousness, paralysis, semi-consciousness and difficulty walking tend to get more immediate attention, they are less likely to occur. Emergency caregivers are often surprised when paralysis and loss of consciousness is reversed with only positioning and 100% oxygen by demand valve or nonrebreather mask. This is not unusual in gas bubble disease. Dalton's Law will not allow inert gas to remain in a high concentration in a solution or tissue once high partial pressures of oxygen are delivered to that tissue. Nitrogen off gassing creates a reverse pressure gradient which encourages nitrogen to leave the bubble, reducing it's size. The reduction in bubble size can reduce or eliminate symptoms.

Emergency department evaluation is still required in suspected DCI cases. A detailed neurological exam may reveal reflex changes, small areas of paresthesias or other focal neurological signs, the diver is unable to report or is unaware of. Even though symptoms may completely resolve, hypoxic tissue damage and secondary edema may produce a recurrence of symptoms.

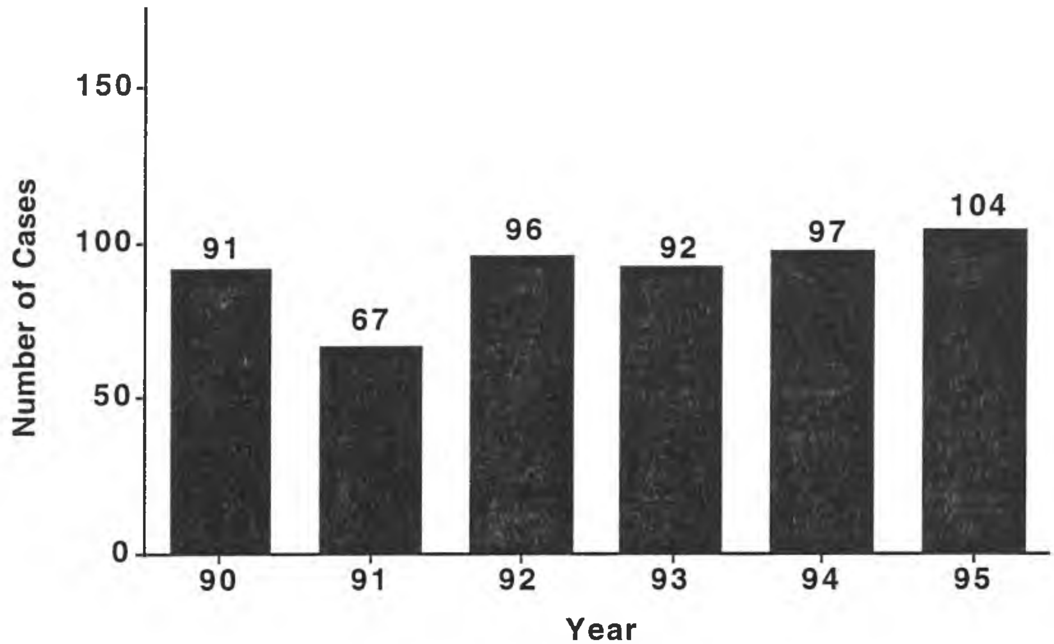
Comparison of Dives That Resulted in AGE and DCS

Attribute	DCS	AGE
No Decompression	85.1	91.3
≥ 80 fsw	72.1	58.7
Multilevel	62.5	52.2
Repeat Dive	61.2	17.4
Single Day	49.4	47.8
Single Dive	38.8	82.6
Square	36.8	47.8
< 2 yr. Experience	33.8	45.7
Rapid Ascent	27.5	45.7
Buoyancy	14.1	28.3

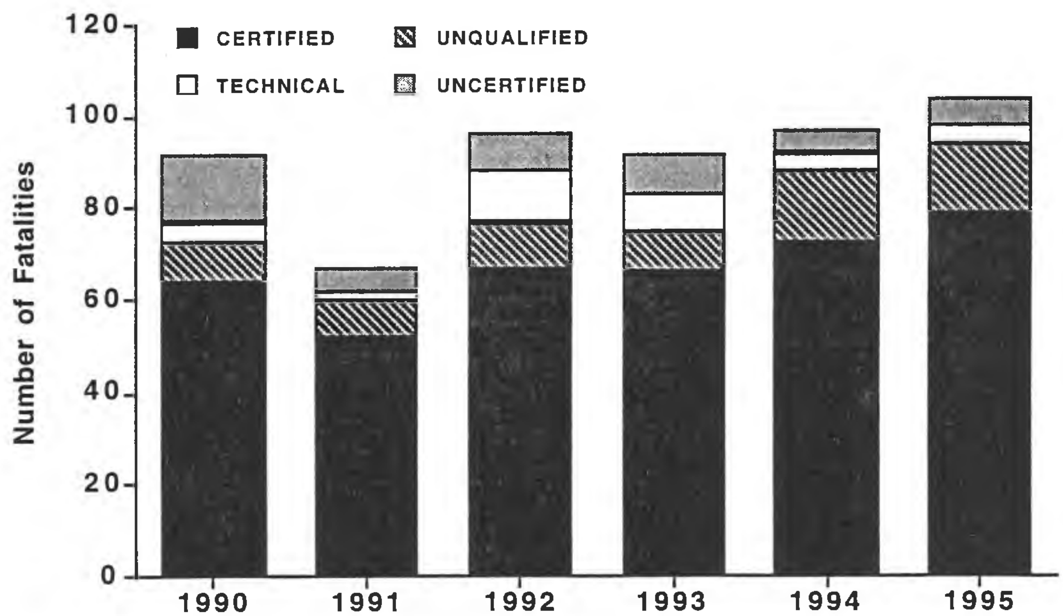
Scuba Fatalities

DAN also collects and reports on recreational scuba fatalities each year. It is not possible to determine a mortality rate for scuba divers since the exact number of active divers each year is not known. There are numerous contributing factors in scuba related deaths.

U.S. Yearly Recreational Diving Fatalities 1990 - 1995

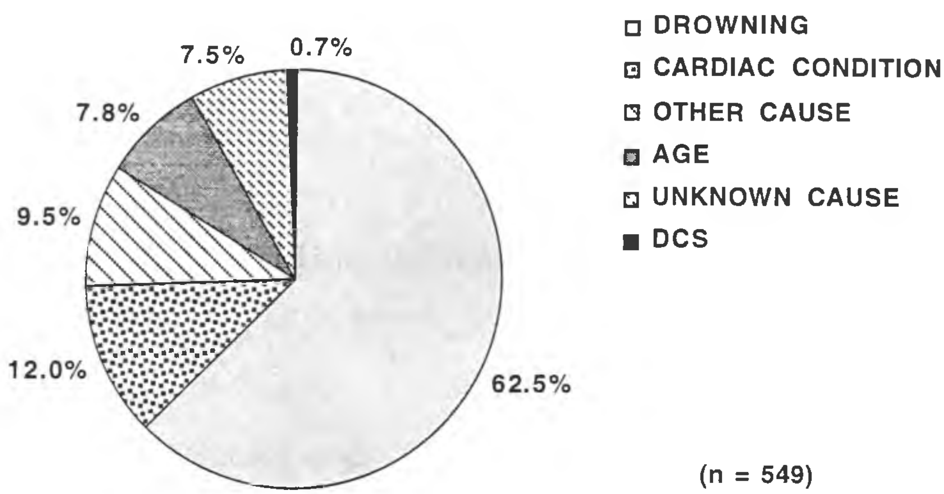


Breakdown of Scuba Fatalities



Scuba diving is not without risk. Risk increases when safety guidelines and precautions are not followed. This can result in death. There are deaths each year among individuals who attempt scuba without proper certification or who lack the appropriate knowledge and training, experience or levels of skill. These factors contribute to the cause of death in scuba divers.

Primary Cause of Death



Another unique contributing factor to cardiovascular related deaths is the shunting of blood centrally to the heart and lungs. In the general, healthy population, this increase in central blood volume will produce an immersion diuresis. In the individual with preexisting cardiovascular disease, the added blood volume can produce sufficient cardiovascular stress that may result in a vessel spasm or infarct.

Major Contributing Factors Leading to the Primary Cause of Death

CAUSE	TOTALS	PERCENTAGE (%)
Insufficient Air	69	18.9
Entrapment	36	9.8
Arterial Gas Embolism	28	7.7
Cardiac Conditions	22	6.0
Struck by Boat	3	0.9
Other Causes	204	55.7

In addition, human error can also play a role. Not only the lack of skill and experience, but the failure to properly monitor personal breathing supply or diving alone with little chance of assistance or rescue when diver problems occur.

Conclusions

While the water rescue specialists, life guard or medic, first responder is not likely to encounter a scuba related injury working near recreational water resources, they need to understand the unique physiological changes which contribute to diver injuries.

It is necessary to initiate basic care in every suspected diver injury incident, starting with the ABC's. Additionally, symptomatic divers require the administration of 100% emergency oxygen and transfer to the nearest medical facility for evaluation.

[1] Dovenbarger JD. Report on Decompression Illness and Diving Fatalities: 1997 Edition. Divers Alert Network: Durham, NC. 1996.

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He has been the Marine Stinger Officer for Surf Life Saving Queensland for the past 12 years, and is adviser to WHO, Australian Medical Association and the Queensland Government. He has lectured world-wide and is the author of many published articles, several book chapters and the simplified Marine Stinger Guide. He his an author and coeditor of Venomous and Poisonous Marine Animals: a medical and biological handbook and has just completed his MD Thesis on world jellyfish medical problems.

In his spare time he works as a private General Practitioner in Mackay, north Queensland, having qualified at the Royal London Hospital in 1970 and emigrated to Australia in 1975. His favourite relaxation after Surf Life Saving is riding his Harley Davidson.

Awareness, Prevention and Treatment of world-wide marine stings and bites

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Abstract

The most common world-wide first aid treatment used by the average lifesaver/lifeguard is the treatment of marine envenomation, especially the treatment of jellyfish stings.

It is important to use the correct first aid treatment for each type of envenomation. This study provides a simplified protocol for: -

1. Awareness of the geographical distribution and possibilities of envenomation enabling: -
2. Preventative strategies to reduce morbidity and mortality from marine envenomation
3. First aid treatment of marine envenomation by jellyfish or other marine animals

This discussion is based on protocols developed for Surf Life Saving Australia and other first aid providers in Australia over the past ten years. Their success has been proven by a 30% reduction in the number of stings over the past 10 years (statistics from the author's records).

Information for this article has been taken from: -

1. Venomous and poisonous marine animals: a medical and biological handbook produced by Surf Life Saving Queensland
2. The global problem of cnidarian stinging. MD Thesis by the author for the University of London.

Introduction

The global problem of marine envenomation is not fully appreciated. Each year hundreds of deaths occur from poisoning (by ingestion or eating) or by envenomation (stinging by jellyfish, or biting by venomous marine animals).

The morbidity is even greater with jellyfish stings world-wide being numbered in their millions. Each summer it is estimated that up to half a million stings occur on the east coast of the United States from the Portuguese man-o'-war (*Physalia physalis*). Large numbers of stings also occur on the east and west coasts of both South Africa and Australia, where the author's records suggest some 20,000+ stings occur each year from both the similar, but smaller, *Physalia utriculus* (bluebottle), which has just one tentacle, and the smaller multi-tentacled Pacific man-o'-war (*Physalia physalis*).

There is usually little need to identify most species of jellyfish, as they simply cause skin pain. This pain varies from a very mild irritation through to the severe, unbearable pain of a multi-tentacled box jellyfish. However, this skin pain can be treated simply, using first aid protocols suggested below.

Some jellyfish envenomations may cause systemic symptoms – i.e. they may cause generalised muscle pains, painful breathing, breathing difficulty or breathlessness, anxiety, sweating, high blood pressure, heart failure and even death (see below). These symptoms usually occur after a time interval, which may be a few minutes or may be delayed for up to an hour. This syndrome occurs after envenomation by a tiny carybdeid (see below) in tropical Australian waters in summer months, which is called the “Irukandji syndrome”.

Other jellyfish world-wide may cause a similar syndrome and it is referred to as an Irukandji-type syndrome. Investigation into Irukandji envenomation and the developed treatment should also be effective in similar syndromes caused by other jellyfish species. These include a tiny hydroid (jellyfish), *Gonionemus* present in the Japan Sea, and other large carybdeid species world-wide, *Stomolophus nomurai* (the sand jellyfish) in the China Sea and *Physalia physalis* (Portuguese/Pacific man-o’-war) world-wide. Rarely, other jellyfish may cause spasm of the arteries causing local gangrene. As stings are often on the limbs this may be a severe complication. For the average lifesaver/lifeguard, these are symptoms that are impossible to treat and need urgent referral to medical aid.

Most jellyfish have tentacles that arise from all round the bell. One group of jellyfish called cubozoans, or Box-jellyfish. They have a box-shaped bell with tentacles arising from each corner.

There are two main types of box jellyfish: -

1. Chirodropids, which have more than one, and up to 15 tentacles arising from the corner of each bell. The bell may be up to 300mm in diameter and the tentacles may reach up to 3 metres in length.

   Box jellyfish cause many deaths each year, mainly in the tropical Indo-Pacific region, although one death has occurred at Galveston Island, Texas in the United States.

   There are approximately 6 types of chirodropid worldwide. However, they all appear to cause similar, if not identical symptoms. Thus the first aid and medical treatments suggested should prove effective for all chirodropid envenomations regardless of geographical location (see below).

2. Carybdeids, which have just one tentacle in the corner of each bell. They come in sizes ranging from a few millimeters to 500mm bell height. They cause varying symptoms from mild skin irritation to the severe systemic symptoms mentioned above; neither the size of the jellyfish, nor the size of the sting has any relation to the severity of the symptoms.

Methods that are suggested in this article promoting awareness and prevention have contributed to the reduction of mortality from chirodropid envenomation in Australia by 30% over the past ten years, and should prove effective elsewhere. However continued seasonal promotion is essential.

Other venomous creatures, including sea snakes, spiny fish, cone shells and blue-ringed octopus also cause severe systemic (generalised) symptoms that may cause fatalities. However, these are less common and for the lifesaver the most important early treatment is the immediate and correct first aid treatment. This provides most victims of envenomation with the best chance of a successful outcome, however severe the envenomation may be.

AWARENESS

The problem of world marine envenomation

Work by the author and his colleagues has enlarged the knowledge on the world-wide problem of marine envenomation and suggested methods to promote awareness and prevention of the problem. Further research has also suggested simplified first aid treatments for the lifesaver, in addition to medical treatments for hospital-based care.

Marine envenomation, especially jellyfish envenomation, emerges as a significant global problem. Despite this, research remains vestigial with both undergraduate and post-graduate medical teaching conspicuous by its absence.

Promotion of awareness

Information on Australia jellyfish is now distributed via information pamphlets, illustrated charts on identification and treatment, teaching videos, a simple book on identification and treatment and, more recently, by a major textbook on International marine envenomation by the author and his colleagues.

Most of the information contained in this article is derived from a newly published major textbook named “Venomous Marine Animals: a Medical and Biological Handbook”, co-edited and co-authored by the author, which has been released by Surf Life Saving Queensland. It contains the latest first aid and medical information on jellyfish and all aspects of marine envenomation on a global basis.

Mortality rates from chirodropid envenomation in Australia have previously averaged about one per year; morbidity was even higher. However, a significant reduction has been achieved in reducing this average in the past ten years. The author in his role as “Marine Stinger Officer” for Surf Life Saving Queensland has made this a principal aim, producing a simplified book called “The Marine Stinger Guide”, distributed by Surf Life Saving Queensland, to provide simplified information on identification and treatment of jellyfish stings to the average surf lifesaver. He has also produced jellyfish identification and treatment charts jellyfish and marine envenomation videos, and jellyfish brochures described in this article.

Other measures to bring the problem to the attention of the general population who live in risk areas in tropical Australia, or for people who visit these places, include talk-back radio shows, newspaper articles and interviews and all other forms of media education. These initiatives, through Surf Life Saving Queensland have also been adopted by State Governments in Queensland, the Northern Territory and Western Australia.

Similar strategies are suggested to tackle the global problem of jellyfish stings causing mortality and morbidity. Current geographical locations of human death from jellyfish and other marine animal envenomation are shown in the Tables below: -

Table 1 - Geographical locations of deaths from non-box jellyfish

Human fatalities from non-chirodropid envenomation
China (east coast) – *Stomolophus nomurai* United States of America – *Physalia physalis*

Table 2 - Geographical locations of deaths from box jellyfish

Human fatalities from chirodropid envenomation
Australia Brunei Borneo Indonesia (Kalimatan) Japan Labuan Malaysia (Penang & Langkawi Is.) Papua New Guinea Philippines Sabah Sarawak Solomon (Bougainvillea) Is. Kalimatan Papua New Guinea United States of America

Table 3 - Geographical locations of other marine envenomations

Animal	Distribution	Fatalities
Pufferfish	Worldwide	110 deaths (1975-1992) - currently 10% mortality of the total poisoning
Paralytic Shellfish Poisoning	Europe, North America, Venezuala, Indo-Pacific (Including Japan)	Brunei, Sabah, PNG, Philippines, Thailand, USA, Venezuala
Chirodropids (Box jellyfish)	Tropical waters of:- Pacific – west coast Indian – east/west coasts Atlantic – east/west coasts	Australia, "Borneo", Japan, Malaysia, Solomon Is, Philippines, PNG, USA Some 30-50/year at present
Physalia physalis	Worldwide	USA - 3 deaths (total)
Stomolophus nomurai	China Sea- around Qindao	8 deaths
Sea Snake	Tropical Indian & Pacific Oceans	Burma, China, India, Indonesia, Malaysia, Thailand, Vietnam.
Cone Shell	Tropical Indian & Pacific Oceans	Australia, Fiji, Japan (Okinawa), New Caledonia, India, Vanuatu.
Spiny fish (exc. Stingray) Weeverfish Stonefish Zebrafish Catfish	Worldwide	 Europe, West Africa. Seychelles, Mozambique, Okinawa, Thursday Is (?) Philippines USA (septicaemia – in a diabetic)
Stingray	Worldwide temperate Waters	Australia, Colombia +++, New Zealand, Fiji, Surinam, USA (Ca, NC, Texas)
Blue Ringed Octopus	Australia, central Indo West Pacific Region (Inc. South Japan and New Zealand)	Singapore, Australia.

PREVENTION

Educational Policy: prevention of jellyfish envenomation

Facts derived from stings investigated by the author and his colleagues, together with early work conducted by Dr Jack Barnes for Surf Life Saving Queensland, assisted in the development of an educational policy on the prevention of stings from dangerous jellyfish in tropical Australian waters. This policy was then accepted as the standard by Surf Life Saving Australia in their Training Manual. With its success in simplicity and effectiveness it was then presented, and accepted for teaching in schools in tropical Queensland (see below). The most important points are awareness of the problem (as discussed above) and prevention of envenomation. The treatment is then presented – in case: -

Prevention of envenomation

Knowing some of the habits of dangerous box jellyfish such as *Chironex* or the Atlantic *Physalia,* which causes severe or even fatal stings, it is possible to use strategies to prevent envenomation, rather than the need to treat it. The thread tubes of the stinging nematocysts are just long enough to penetrate the dermis. Consequently, any clothing worn on the outside of the skin will prevent penetration of the integument, and prevent envenomation: -

<u>Protective clothing/ slow entry into the water</u>

`Stinger suits' in Australia are made of lycra, which covers the body and limbs, but not the head, hands or feet. Most stings occur on the lower limbs, with less than 5% occurring on the face. If people to do dive head first into the sea, they will not be stung on the face. If they walk slowly into the sea, box jellyfish such as *Chironex* will invariably swim away, and the large floats of *Physalia* may be seen, hopefully before envenomation. With stinger suits, if the victim should be unfortunate enough to sustain a sting on the feet whilst walking slowly into the water, the area stung, although being acutely painful, will not allow a sting of sufficient size as to cause systemic, or potential fatal effects.

Prior to the introduction of stinger suits in Townsville in 1985, lifesavers and people entering the sea used to wear ladies pantyhose! One pair was worn on the legs, as usual, although the feet were cut out and the ends were taped to the ankles. The other pair was worn upside down with a hole cut in the crutch for the head to go through, with the arms in the leg holes, and with hand holes cut out with the ends taped to the wrists.

Any clothing covering these major areas of the body is sufficient for protection, however, normal "street clothing" carries with it the danger of the weight when waterlogged, and may present a problem if immersion may occur accidentally, or if victims suddenly find themselves in deep water where swimming is necessary. For this reason it cannot be recommended that `street clothes' as such, be worn.

<u>`Stinger resistant enclosures'</u>

Originally conceived by the late Professor Stark of James Cook University of North Queensland, enclosures are large, netted safer areas in the sea that effectively exclude larger, lethal box jellyfish such as *Chironex*. The area consists of nets, hanging from a floating pontoon that extends 50-100 meters out into the sea, a similar distance along the beach and then back to shore. The pontoon is held in position by strong anchors and the net hangs down from the pontoon, secured by weights to keep it on the bottom. These nets were designed by the Engineering Dept. of the James Cook University to prevent *Chironex* of a lethal size entering the enclosed area. This they do exceptionally well as *Chironex* only becomes lethal at a certain size when it has grown sufficient tentacles to be able to cause a fatal envenomation on a child (approximately 7cms diameter across the bell [Hartwick 1987]).

These enclosures are NOT effective against smaller jellyfish such as the Irukandji (Fenner et al 1986) as they are small enough to swim through the mesh net, which is about a13mm size.

Swim on a patrolled beach

Surf lifesavers and lifeguards are both taught and made aware how to recognise times and places when dangerous jellyfish may be present in the sea. They also have on hand, first aid treatments, and the knowledge necessary to treat jellyfish stings.

All surf lifesavers are well taught in resuscitation and first aid techniques for marine envenomation, and many have oxygen on hand if necessary.

TREATMENT

Developing policies for first aid

Many years of watching and discussing sting treatments whilst on surf patrol have confirmed the author’s view that first aid treatment had to be simple, and easy to remember. Initially treatments were designed around each different jellyfish species - thus needing prior, positive identification of the animal. Most people, even the trained lifesavers who have access to the charts, videos and publications prepared for them, find it practically impossible to positively identify different jellyfish. The policies suggested (see below) have been simplified as much as possible for treatment `groups’ of jellyfish (and other marine animals causing envenomation) so that they are easily remembered.

Table 3 - Vinegar – effects on jellyfish stinging cells (nematocysts)

Total nematocyst inhibition	Causes nematocyst Discharge	No nematocyst discharge
All multi-tentacled box jellyfish (chirodropids) All single-tentacled box jellyfish (carybdeids) - Tested to date	*Physalia physalis* – Portuguese man-o’-war) –some specimens, not all! *Cyanea* (Blubber) *Stomolophus nomurai* (in China) *Pelagia noctiluca* (the mauve stinger)	*Physalia utriculus* (Bluebottle)

Summary of Marine envenomation treatment

VINEGAR

For major jellyfish stings (see below), apply compression bandage - first, **directly over the stung area**, then cover the full limb starting from the furthest point, bandaging towards the body; then immobilise the limb in a splint.

Vinegar: -

* Is usually ineffective for the skin pain of a jellyfish sting
* Does NOT reverse the effects of venom already injected
* Vinegar PREVENTS FURTHER STINGING on any tentacles that may remain on the skin after a Box-jellyfish (especially *Chironex fleckeri*) sting.
* Vinegar may prevent further discharge of stinging cells after an Irukandji sting, or Portuguese man-o'-war sting

Vinegar should not be used without first testing a small area of the sting for adverse effects. It may cause further discharge of stinging cells, increasing skin pain or systemic envenomation effects.

COLD PACKS

Ice or cold packs stop the majority of SKIN PAIN in jellyfish stings tested to date. It does NOT prevent further stinging. However, major Chironex box-jellyfish stings should first be treated in the usual way with vinegar, compression bandaging and antivenom.

NOTE: Recent evidence shows that fresh water will cause discharge of stinging cells, and may make the sting worse; sea water should be used to wash off tentacles and ice wrapped up to keep the area dry.

1. IF there are remaining tentacles on the skin, wash them off with sea water, or pick them off with the pads of your fingers.
2. Apply a cold pack or ice, wrapped in a thin cloth, to the stung area for 5-15 minutes.
3. Re-apply the cold pack or ice if skin pain remains, or returns.
4. Send for medical aid for other symptoms, or skin pain remains despite the two applications of cold packs.

Treatment of multiple stings when cold/ice packs are not available

At times there are so many bathers with stings at one time that lifeguards or lifesavers may not have enough ice to treat them effectively. Policies to overcome this and use alternative treatments that were more readily available were developed, using the principle of "first do no harm". They use the power of suggestion to overcome any discomfort caused by jellyfish sting. Such treatments are ineffective for more serious stings and all first aid policies call for trained help if simple treatments do not help, or the patient's condition causes concern. The simple `alternate' suggested, that will cause no further harm, and so may help the trauma of envenomation in such mass cases, is simply to spray the area with sea water from a hand-held spray with a fine nozzle. This is applied with `plenty of reassurance from the treating lifesaver' that is will often be effective in relieving symptoms. Close monitoring in needed to ensure the patient does not deteriorate and need medical follow-up.

HEAT (for penetrating injuries such as fish spines/spikes etc)

E.g. stonefish, stingray, bullrout, sea urchin envenomation, other spiky fish envenomations.

1. Place the area (usually a limb) in hot water:

NOTE: First test the temperature of the water yourself to prevent scalding the patient!!

2. Further `top-ups' of hot water may be necessary, but the water MUST be tested each time to prevent scalding the victim.

COMPRESSION / IMMOBILISATION bandages

Compression/immobilisation bandaging is used for envenomations where a large amount of venom is placed in one area - e.g.:

a) Snake bite (land or sea)
b) Cone shell envenomation
c) Blue-ringed octopus envenomation
d) Major box-jellyfish stings

Major box-jellyfish stings are those that: -

a) affect the conscious state (the victim is difficult to rouse)
b) affect breathing (shallow, weak breathing - or absence of breathing, needing expired air resuscitation)
c) affect the circulation (pulse may be weak, fast or possibly slow or irregular - or absent, needing external cardiac compression).
d) covers a large area - more than 1/2 the area of 1 limb).

Compression immobilisation bandaging is NOT used on any injury from penetrating spines (e.g. stonefish, stingray - see above) as it causes increased pain.

The bandage is first applied, **directly over the envenomated area**, then extended to cover the full limb starting at the furthest point from the body; the limb is then immobilised in a splint.

Table 5 -Current First Aid Treatments of Jellyfish Envenomation

First Aid Treatment of most jellyfish stings (including Portuguese man-o'-war)
1. When a jellyfish stings a person the victim usually suffers from skin pain, which may be severe. They may also have more serious reactions, such as muscle pains and cramps, difficulty breathing or even collapse. 2. If the symptoms are severe or if they are not controlled by the simple first aid measures described here, send for medical assistance or take the victim to advanced medical care. 3. To reduce pain from the sting, remove any tentacles still adhering to the skin of the victim by flushing the area with seawater. Do not use fresh water and do not rub the area, as this can increase stinging and pain. If necessary the tentacles may be picked off the skin with the fingers, preferably while wearing gloves. (If gloves are not available the finger pads will receive only a harmless `prickling'). 4. The next step to reduce pain is to apply cold packs or ice to the area. If ice is used, wrap it in a material that will keep the skin dry. Reapply cold packs or ice as necessary until the pain subsides. 5. The major problem with these stings is that they can continue to cause pain and increase any systemic envenomation effects if any portion of the tentacles remains on the skin. Numerous solutions have been advocated throughout the world to stop further stinging. These include lemon juice, papaya, ammonia, meat tenderizer, sodium bicarbonate, and boric acid. <u>None of these has proven scientifically, to be effective</u>. Vinegar however, has shown an ability to prevent further stinging in some cases, particularly for box jellyfish, although it may worsen some other stings. If vinegar is available, it is suggested that it is tested on a small area of the wound to see if there is a negative reaction. If not, it may be applied with caution to the remainder of the wound. 6. Even if a victim appears to be recovering from a jellyfish sting, the patient's condition should be monitored closely. Victims who do not respond to the simple first aid measures suggested and those with extensive stings or stings to the face (particularly children), should also be transported or referred to a hospital – "do not dive into the water"

Table 6

First Aid Treatment of <u>Chirodropid envenomation</u>
1. Retrieve the victim from the water and restrain them, if necessary. 2. If other helpers are available, immediately send them for ambulance / medical help (emphasise that the sting is from a Box jellyfish as the Ambulance may have antivenom available). 3. Assess the victim's airway, breathing and circulation (ABC). Treat with mouth-to-mouth resuscitation (EAR), or heart massage (CPR), if necessary. 4. If others are available to help, or if resuscitation is not needed, pour vinegar over the stung area for a minimum of 30 seconds to inactivate remaining stinging cells on any adherent tentacles left on the skin. 5. AFTER vinegar application, apply compression bandages directly over major stings, i.e. those: a) covering an area more than half of one limb b) causing impairment of consciousness c) causing impairment of breathing d) causing impairment of circulation If vinegar is unavailable, the rescuer should pull tentacles off using their fingers (only a faint, harmless prickling will be felt) - before applying the compression bandages 6. If available, use *Chironex* antivenom for all major cases (see above). Three ampoules each containing 20, 000 units may be given intramuscularly, above the bandages, if there is a trained health professional on the beach. Medical personnel may give one ampoule intravenously. 7. Cold packs may be used (15 minutes and repeated when necessary) to help ease the skin pain in conscious victims. 8. In severe envenomation, use oxygen if available to assist with any breathing difficulty; Inhaled analgesia (i.e. entonox or penthrane) can be administered for unremitting pain in conscious, breathing, cooperative patients; its use should be discontinued if the patient's condition worsens.

CONCLUSION

Jellyfish envenomation has emerged as a major medical problem in both modern and third world Countries. Despite this knowledge, research remains vestigial with both undergraduate and post-graduate medical teaching remaining conspicuous by its absence.

Surgeon Rear Admiral Frank Golden (Ret.)

Frank Golden graduated in Medicine at the University of Cork, Ireland in 1960. Following his hospital internships he joined the Royal Navy as a Surgeon Lieutenant and retied on completion of a full time career as Surgeon Rear Admiral. During his Naval career his interest in immersion, drowning, hypothermia, cold injury, and survival at sea started in the mid-1960s when posted to the Royal Naval Air Station in Cornwall on the southwestern tip of England. A subsequent posting to the Institute of Naval Medicine enabled him to follow that interest and undertake applied research, both in the laboratory and in the field, into various aspects of the subject.

Golden was awarded his Ph.D. from the University of Leeds in 1979. He served on many National and International Committees and Working Groups, both civil and military, advising on various aspects of survival, and has published over 40 papers or Chapters in textbooks on aspects of the above topics.

He is now Chairman of the Royal National Lifeboat Institution's Medical and Survival Committee and does some part time consultancy work with the Human & Applied Physiology Department of the Robens Institute, University of Surrey, UK.

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HOW LONG SHOULD THE SEARCH FOR IMMERSION VICTIMS CONTINUE?

Surgeon Rear Admiral Frank Golden, Royal Navy (retd)

INTRODUCTION

One of the most difficult decisions confronting a rescuer or Search and Rescue (SAR) coordinator is how long to continue the search for victims. The possibility that there may be an outside chance of a survivor still just hanging on to the last vestige of life is a powerful emotional drive to continue the search operation, even though those conducting the rescue search may be approaching their limits of safe endurance. Conversely, the potential danger, to tired rescue crews operating in adverse conditions, of unnecessarily continuing the search long after there is any realistic hope of survival through fear of adverse litigation must also be considered. Regrettably, no precise mathematical formula exists to predict survival times with any certainty. Some crude guidelines have been published over the years giving predicted survival curves but how reliable is such information? This paper will examine some such survival times and discuss their limitations.

PREDICTED SURVIVAL TIMES - AN HISTORICAL PERSPECTIVE

The limiting effect of water temperature on survival time has been recognised for many centuries ever since Herodotus, in Histories Book Six, first described the demise of the crews from the Persian Battle Fleet which foundered on the Athos promontory in 400 BC. The first scientifically documented reference was made almost two centuries ago by James Currie [1], a Liverpool physician, who conducted some cold water immersion experiments after observing sailors from an American cargo ship apparently suffering hypothermia and drowning at the entrance to Liverpool harbour in 1798. The first attempt to quantify the precise relationship, between water temperature and survival time, was made by George Molnar in 1946 [2]. He performed a retrospective analysis of US Navy records of ship sinkings and aircraft ditchings during the WWII; by including data only from those incidents for which precise information of sea-water temperature and time of immersion was available, he compiled a graph of survival time against water temperature which displayed a curve above the highest recorded survival times which "represents a limit of tolerance which probably few men can exceed and many cannot even approach". The result was relatively crude in so far as it provided guidance to the nearest couple of hours, but it did identify, for the first time, that survival times in water below 15C (50°F) was relatively short and thereafter it increased reasonably quickly.

More precise information relating to the lower water temperatures (circa 5°C (40°F)) became available after the war when the data obtained by the Nazi researchers at Dachau was revealed [3]. Concerns over the ethical and scientific accuracy of this data cast doubt on its precise veracity, however, from the available data, when taken together with anecdotal accounts from many different sources of individual immersion fatalities during the WWII and since, it can be concluded that most of the reported

Dachau data is reasonable accurate. From it we learned that the lethal body temperature for people immersed in cold water was in the region of 24-26°C (77°F) although ventricular fibrillation was frequently encountered below 28°C (82°F). Death was from a cardiac rather than a respiratory cause. Insulation provided by clothing delayed body cooling and prolonged survival time provided the head was kept clear of the water. However, the value of such information in answering the question relating to search duration is limited, as the body insulation of the unfortunate Nazi victims is unknown and the immersions were conducted under laboratory conditions. This is the recurring potential error in the majority of the predicted survival curves which have been subsequently published in the open literature.

In 1962, Barnett [4] published an empirical predicted survival graph based on Molnar's original. His expanded 6 hour time axis made his curve more user friendly, while to overcome the uncertainty of the grey area on the border of Molnar's original curve, he substituted two curves: one delineating a relative "safe" zone, the other an "lethal; 100% expectancy of death" zone, with a large area between these two curves labeled "marginal; 50% expectancy of unconsciousness which will probably result in drowning". While the graph served its purpose in emphasising to military aircrew the need to wear specialised protective clothing when flying over cold water, it did not resolve the demise of the SAR coordinator on how long he should continue to search for survivors.

In 1975, Hayward et al. [5], produced a mathematical formula to calculate survival times for cold water immersion victims. The formula was derived from an analysis of the cooling rates encountered in 15 relatively young, fit, volunteer subjects immersed in cold water (5° - 18°C (40 -64°F)) and only lightly clad. Their cooling rates were mathematically extrapolated to a temperature at which it was considered death would inevitably occur (30°C / 86°F). By implication, if rescue was not effected before that time, survival would be unlikely. Again the prediction was flawed in that the assumption made was that the only factor to consider when estimating survival time is rate of body cooling. Conditions in open water are frequently much different from those encountered under controlled experimental conditions; a fact acknowledged by the authors in the final paragraph of their paper. Finally, as the formula was based on the cooling rates of a relatively small sample of young fit volunteer subjects, it would be unlikely to apply to the population as a whole and thus yet again fulfils little useful function to the SAR coordinator.

Based on both experimental data and case histories of shipwreck and aircraft survivors reported in the literature and some which were personally investigated, Golden (1976) [6], produced a curve showing the estimated 50% survival times in cold water, i.e. the survival time of the "average" individual. Again the curve would be of little help to the SAR coordinator as it provides no indication as to how long the search should continue for those who may be above average and thus in the surviving 50% group at a specific time for any given water temperature. The great diversity in human responses to cold water immersion may be partially explained by variations in some or all of the following: body mass/surface area ratio; insulation; health and fitness; physical behaviour and body posture in the water; presence or absence of cold habituation; availability and effectiveness of buoyant support; etc. Thus, in open water, some may die in minutes, while others may survive for several hours, thereby making predicted survival times extremely difficult.

Subsequently, those with an interest in mathematical computer and thermal manikin modelling have attempted to resolve the problem [7,8]. Regrettably, the mathematical models were largely based on laboratory derived data and therefore subject to the same errors, described above, when applied to open water scenarios. However, when data from some maritime disasters are superimposed on cooling curves produced by the model, it would appear that a more realistic deep body temperature at time of death in such scenarios may be in the region of 35°C (95°F). One of the major criticisms of extrapolating data to humans from manikens -- which were originally designed to evaluate insulation of garments to a given environmental stress, and not to emulate human physiological responses to immersion -- is that the manikin model does not allow for regional alterations in body insulation caused by vasoconstriction and thus heat flow from body core to the surface.

The most recent contribution to this controversial area comes from the UK National Immersion Incident Survey (UKNISS) [9]. The UKNISS is a voluntary reporting scheme, which commenced in 1990 with the object of validating the various predictive survival curves described above. Information relating to persons rescued, predominantly from the sea, were forwarded to the authors by some of the various organisations involved in such rescues. Regrettably, as the survey was mainly directed towards live "survivors", of whom 834 were recorded, compared to 66 fatalities, in the six years covered by the report, it is impossible to discover what the survival rate was of the total numbers immersed. As the UK Royal Society for the Prevention of Accidents statistics reveal, the annual maritime immersion death rate runs at approximately 100 per annum, this survey, therefore, missed about 89% of the fatal incidents during the six years of study. Likewise as it cannot be guaranteed that all immersion cases were reported, the statistical value of the information is of dubious value overall with regard to the primary question of validating the existing survival curves. Nevertheless, the authors again fall into the trap of producing a mathematical formula to predict survival times, based on the data available to them, which by its nature is heavily biased by those who survived. It is however noteworthy, from their study, that there were very few reports of successful rescue following immersion times exceeding 4 hours in water at any temperature: a total of 14 of whom 7 died (water temperatures were not reported). This could be a reflection of the generally cold sea temperature surrounding the British Isles even in summer, when the average maximum rarely exceeds 17°C (63°F) and for the majority of the year rarely exceeds 11°C (52°F). It must be assumed that the majority of those immersed for times exceeding 4 hours died and were thus not recorded in the survey; yet from their mathematical formula they predict a 50% survival time in water at 5°C (40°F0) as being 17 hours. To support their mathematical conclusion they cite their survey finding (7 survivors from 14 immersed > 4 hours) as validation. In the absence of data relating to all those that died it is difficult to see how this prediction can be supported.

WEAKNESSES OF EXISTING PREDICTIVE CURVES

From the preceding historical review it is apparent that all the existing predictive survival cures do little other than remind the reader that survival time in cold water is time limited. Secondly, because of the tremendous variation in individual response to cold water immersion, some may die in minutes from drowning as a consequence of incapacitation from "cold shock" [10], while those who are cold habituated will be untroubled from this effect. Insulation, either from body fat or clothing, will significantly reduce the rate of body cooling and thus may prolong survival time. While in the absence of an effective buoyancy aid, long term survival is difficult, especially in cold water [11].

But perhaps the single most important omission from these predictive equations is the variability due to sea state. Laboratory derived data ignores the dangers associated with the intermittent submersion of the airway from "wave splash". To a fully conscious individual with voluntary control of respiration, wave splash represents little more than a minor irritation. Alternatively, to someone experiencing uncontrollable hyperventilation from cold shock, wave splash is a life threatening phenomenon during which a lethal dose of water may be aspirated in the first few minutes of immersion. Should the individual survive those first few critical minutes, people who are not habituated to cold may find it difficult to swim relatively short distances to a safe refuge 12. In both these examples, death from drowning will occur long before deep body temperature starts to fall, even in ice water. Thus predictive survival curves based on whole body cooling may be totally misleading.

Even if the individual is wearing an effective lifejacket or buoyancy aid, in a seaway with white cresting waves, or in an estuary when wind and tide are opposed, the resulting wave splash will usually encourage the individual to turn his back to the wave. To remain floating in that position will require a physical effort; however once deep body temperature falls to about 34 -35°C (93-95°F), peripheral muscle temperatures will usually have fallen to around 28°C (82°F) when muscular effort becomes significantly impaired. With the cessation of arm movement, the upper more buoyant part of the body will be turned by the wave motion to face the on coming wave forcing the victim to synchronise his breathing with the wave movement to avoid aspiration. With the onset of the loss of useful consciousness occurring about this time, drowning will result, again well in advance of body temperature falling to the lethal range [11]. In the UKNISS study there were 153 victims (16%) wearing an effective/ inflated lifejacket, and a further 117 (13%) wearing a buoyancy aid of some description. Death occurred in 5 (3%) of those wearing lifejackets, 1 (1%) of those wearing a buoyancy aid, and 45 (10%) of those wearing neither. The incomplete data relating to deaths detract from the usefulness of these figures other than illustrating that death does occur in those wearing a lifejacket.

The expected insulation provided by specialised protective "Dry Suits" derived from laboratory based experimentation can be as much as 33 -100% in error when worn in open turbulent water [13,14]. Thus the point of loss of useful consciousness may occur much earlier than anticipated even in those wearing specialised garments. Finally, even if it is known that there is specialised protective clothing available to the victim, how can the rescue coordinator be confident that the victim is wearing that clothing?

ICE-WATER SUBMERSIONS

One specific type of incident is worthy of special mention in a paper on duration of search times for immersed victims and that relates to those submerged in very cold or ice- water, in particular children. This was the subject of an excellent review by Orlowski [15] and little further detail is required here other than to say that the current record for successful resuscitation for someone submerged in ice cold water has been described by Bolte et al in 1988 [16]. That account relates to a 2½ girl in Salt Lake City who was rescued in apparent cardiac arrest following a 66 minute immersion in fresh water at 5°C (40°F). On admission she was asystolic, cyanotic, flaccid with fixed dilated pupils and a Glasgow Coma Score of 3. Cardiopulmonary resuscitation was maintained for more than two hours before the initiation of extracorporeal rewarming, at which point core temperature had fallen to 19°C (66°F). On rewarming she converted spontaneously to normal sinus rhythm. She was eventually discharged after eight weeks with some relatively minor neurological damage. One year later she was functioning at her age level although still displaying a fine tremor.

The case illustrates the importance of continuing the search for such victims in these special circumstances, although for every success, such as that quoted above there will be many who, if successfully resuscitated, will be left with debilitating neurological damage and many more who cannot be resuscitated.. It is perhaps worth noting that it would appear that these remarkable survival incidents relate to fresh water submersions only.

CONCLUSIONS

Predicting survival times in immersion victims is not a precise science; there is no magic mathematical formula to determine how long a rescue search should continue. Guidelines based on historical analysis of accidents, together with laboratory based experimental evidence, shows a clear correlation between water temperature, body cooling and survival times. Regrettably, because of the wide variation in physiological responses to immersion between individuals, these guidelines tend to be over optimistic for the majority while failing to allow adequately for the 95 percentile group. As a consequence, the SAR coordinator must make some unenviable decisions based on the best information available and a number of assumptions. To cover himself he must extend the search times beyond that which he can reasonably expect anyone to survive. Occasionally he will get it wrong and then, in the event of litigation, it will be up to the law courts to make a judgement on the definition of "reasonable expectation". But as a general rule of thumb it is considered prudent for the recommended search times to be in the region of at least six times the predicted 50% survival times.

Thus in water at 5°C (40°F), the 50% survival time for a clothed individual is estimated to be in the region of 1 hour with a recommended search time of 6 hours; the corresponding times for 10°C (50°F) are 2 hours and 12 hours; while in 15°C (60°F) the 50% survival time is in the region of 6 hours with the recommended search time at 18 hours. Between 20°C and 30°C (68-86°F) search times exceeding 24 hours should be considered and for several days above 30° C (86°F).

Near naked swimmers would be at the lower ranges of these times, unless they have the body morphology and cold acclimatisation of a long distance "Channel Swimmer". In calm water there may be an exceptional individual (someone who is very fat) who will exceed these times; therefore for such people consideration should be given to exceptionally extending the search times 10 fold.

For inshore accidents, survival times may be less because of higher expectation of breaking water and adverse currents. However, consideration must be given to the possibility that the inshore survivor managed to get ashore; consequently the limiting effects of cold water cooling will no longer be the only consideration and the search must be continued until such time as the shore adjoining the coast line, allowing for tidal drift, has also been thoroughly searched.

Offshore there is likely to be an increased expectancy of survivors being better equipped to survive by having appropriate protective clothing, lifejackets and possibly liferafts available to them. Consequently search times for them should be at the upper limits of those expected, unless in obviously adverse conditions.

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Ralph S. Goto

Ralph S. Goto is administrator of the Ocean Safety and Lifeguard Services Division, Department of Parks and Recreation, City and County of Honolulu, Hawaii.

In this capacity, he is responsible for the professional ocean lifeguard service on the Hawaiian island of Oahu. The Division employs two hundred water safety officers with an annual budget of $4 million.

A graduate of the University of Hawaii at Manoa, Goto has been with the City and County of Honolulu since 1981 and acts as the primary water safety resource for legislature, community, and statewide matters. He serves on numerous committees, coalitions and boards in Honolulu, including the State of Hawaii Injury Prevention Advisory Committee, the State Emergency Medical Services Advisory Committee, and as an advisor to the Board of Directors of the Hawaiian Lifeguard Association.

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BEACH SIGNAGE:
A PERSPECTIVE FROM PARADISE

Hawaii is internationally known for the natural beauty of its magnificent beaches and surrounding ocean waters.

The Pacific Ocean in these latitudes is clear, warm, and inviting.

A myriad of recreational activities take place in, on, and beneath the waters around our island paradise.

These activities include: surfing, swimming, snorkeling, boating, fishing, windsurfing, SCUBA diving, sunbathing, and ... surfing.

Each year, Hawaii is the vacation destination for six million visitors. These visitors arrive from all over the world, and account for 16-18 million beach visits annually.

With a resident population of almost one million, we estimate that beach attendance for the island of Oahu is conservatively 15-17 million every year.

Married to this estimate is the assumption that the more interactions that take place between human beings and the ocean, the more opportunities exist for mishaps. Statistically, this assumption has been supported by the number of rescues and preventive interventions recorded annually by Honolulu City and County lifeguard personnel since 1990.

Since the mid-1980's, the City and County of Honolulu's Water Safety Division (since 1995, the Ocean Safety and Lifeguard Services Division) has pursued an aggressive strategy of prevention and intervention as an integral part of its mission. In addition to the constant state of readiness needed by a lifeguard service to react and respond to aquatic emergencies, a conscious effort to prevent these incidents from occurring is now included in all operational procedures and training opportunities.

Key division personnel have received formal training in the areas of Risk Management and Injury Prevention, the former through collaborative efforts with the US Army Safety Center in Ft. Rucker, Alabama, and the latter through association with the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, and the State of the Hawaii Injury Prevention and Control Program.

By applying fundamental principles of these established areas of study to the unique environmental and professional challenges of lifeguarding , we believe that a more formalized approach to our profession has begun.

Injury Prevention and Control involves a systematic, scientific approach to the implementation of strategies to reduce, in our case, drownings, near drownings, and injuries that occur in and around the open water environment. After identifying the problem, i.e., a significant number of hospitalizations from a particular beach area, the next step is to collect data from lifeguard/EMS/Fire incident reports, and to analyze the data to determine target groups, at risk populations, high risk beaches, etc. Once the analysis is completed, intervention strategies are developed and implemented to reduce the number of incidents. The final and, perhaps most important step in the process is a thorough evaluation. This evaluation must be done objectively and repeatedly in order for the intervention to be considered effective.

Similarly, risk management principles used by U.S. military forces to reduce casualties can also be applied to lifeguarding. A thorough assessment of environmental and demographic risk factors at any given beach area can be performed by trained lifeguard personnel. Some areas to consider would include surf heights, currents, water temperature and turbidity, as well as demographic characteristics of beach patrons, i.e., residents v. visitors, level of aquatics skills, age, sex, experience, etc.

Reducing these risk factors would then include the deployment of lifeguard personnel and equipment, prevention and education efforts such as signage and other warning (public address, one on one contact, etc.), and, once again, evaluating the effectiveness by sound data collection and analysis.

I have been involved in the field of aquatic safety in the State of Hawaii for thirty years, as a lifeguard, swim coach, aquatics director, college lecturer, and since 1981, as the Water Safety Director for the City and County of Honolulu. I have been a member of and/or associated with the United States Lifesaving Association since 1982, when I attended my first national championships and board meeting in Daytona Beach. I have served as national advisor, member of the certification and competition committees, and now chair the National Signage Standards Committee of the United States Lifesaving Association. Fifteen years later, I find myself in San Diego delivering this paper at the ILS Medical Conference. I have come to the realization that our profession has come to an important juncture in its development. We have heard about the importance of prevention in lifeguarding. Two years ago, USLA President William Richardson delivered a very strong appeal for all regions to maintain accurate records and statistics, important tools are justifying budgets, jobs, and our very existence.

I believe that we need to apply some fundamental principles of scientific rigor and research to confirm the intuitions we have come to believe as a result of our collective lifeguarding and water safety experiences.

We know, or think we know, how people behave in certain aquatic situations. We also know, better than any other group of people, the dynamic nature of the ocean in the nearshore environment, and what it can do to people, including death and serious injury. What we do not know with any degree of certainty, is what we need to do to modify human behavior to reduce the incidence of drownings, near drownings and injuries that occur in this environment. I would suggest that we apply that we know about injury prevention and risk management principles, combine this knowledge with our collective lifesaving experience, and design sound strategies for implementation and measurement to reduce drownings and near drownings.

SIGNAGE

One of the areas where we have reached our intuitive pinnacle is in beach warning signs.

Ten years ago, our organization was fortunate to work with a public service group comprised of young people from the marketing, advertising and public relations industry in Honolulu.

A three-pronged public education initiative was designed by the group after consultation with the Lifeguard Association regarding problems that beach lifeguards commonly dealt with.

As a result, three projects were completed: 1) the development of standardized graphic symbols for beach warning signs, 2) the printing of 100,000 beach safety brochures, and 3) the production of a public service video.

Graphic symbols were developed to address the need for multi-lingual signage to communicate with tourists from all parts of the world.

We took the figure in the crosswalk and turned him upside down in a wave at Sandy Beach in an attempt to depict the shorebreak conditions and possible injury that could occur as a result of going “over the falls”.

Other symbols included graphic depictions of high surf, sharp coral, dangerous shorebreak, strong currents, man-o-war/jellyfish, and prohibited activities, i.e., no swimming, no diving, and no boardsurfing.

Similarly, symbols that were similar to highway safety signs (black figures, yellow background to indicate caution) were developed to depict conditions in the ocean environment. A set of twelve symbols was developed and copyrighted in 1986 to protect the Lifeguard Association from commercial exploitation.

“These signs are wonderful,” we declared. “The new signs are great!” people said. But how did we know they were actually modifying behavior to keep people out of harm’s way?

In 1988-90, a three year study was conducted at Hanauma Bay, a popular visitor destination on Oahu that is a designated Marine Life Conservation District. Over 3 million people go to the bay during the course of a year to scuba dive and snorkel to observe the abundant marine life protected by conservation statutes. Funded by the Centers for Disease Control and Prevention in Atlanta, through an Injury Prevention grant, the three year study showed a significant reduction of drownings, near drownings, and rescues performed by City and County lifeguards after certain signage was put in place. The study also revealed the importance of educating the beach going public before arrival at the beach, through print, video, and other media forms.

A strong motivating factor for the development of standardized warning signs for the beach environment in Hawaii was the proliferation of legal claims brought against local and state government agencies and owners of beachfront properties, specifically, resort hotels and condominiums.

In 1981, (Kazmarczyk v. City and County of Honolulu) the Supreme Court of the State of Hawaii established the "duty to warn" of extremely dangerous conditions in the ocean fronting beach parks and similar areas used by the public. This "duty to warn" dictated the actions of landowners and those charged with overseeing public, government owned or controlled areas.

A handful of high profile lawsuits with multi-million dollar judgements against government agencies and in one case, a five star beachfront resort hotel, prompted the municipalities and the visitor industry to seek relief at the Hawaii State Legislature.

Unlike most coastal states, Hawaii does not have what is known as Natural Condition Immunity, whereby government enjoys immunity from legal claims involving injuries sustained in the natural environment, such as the ocean, beach, or mountains.

Numerous attempts to secure governmental immunity by the four counties in the State of Hawaii have been thwarted by a very powerful and politically articulate plaintiff's attorney lobbying organization.

As a compromise, the State Legislature in 1996 passed Act 190, Relating to Public Land Liability Immunity, which essentially provides protection if the "properly designed and properly placed" signage is posted at a beach when and where an injury occurs. The law is restrictive and by no means all encompassing, however, it does provide some degree of protection to the counties.

Our experience in these legal proceedings has led us to the following conclusions about signage:

1) Simple, universally understood and interpreted signage is necessary to warn beach users of risks and hazards.

2) Signage symbols should conform to the national and international standards.

3) Signage is an essential component of a comprehensive ocean safety program.

4) Signage augments, but is never a substitute for, properly trained, equipped, and deployed lifeguard personnel.

Lt. Col. Paulo Roberto Moreira Goulart

Rio de Janeiro Military Fireman Corporation

Present Activities

- **Maritime Groupment General Commander**
- **Aerial Operation General Coordination Helicopter Pilot**

Courses

- **All of Fireman Officer Career**
- **Helicopter Pilot**
- **Flight Safety Investigator**
- **Underwater Operations**
- **Civil Engineer**
- **Enterprise Administration Course**

Specialization

- **Military Fireman Superior Course**
- **Technical visitation and internship in Spain, France, Italy, England, Germany, United States, Canada and Portugal**

Published Works

- **Basics Safety Concepts**
- **Civil Defense Helicopter Employment**
- **Helicopter Employment Handbook**
- **Rio de Janeiro Fireman Corporation Aerial Groupment**
- **Rio de Janeiro Fireman Corporation Firefight Vessel**
- **Ultralight Aircraft Search and Rescue Employment Scheme**

Helicopter Sea Rescue in Rio de Janeiro

Lt. Col. Paulo Roberto Moreira Goulart

- **Commander of Rio de Janeiro Maritime Groupment**
- **Helicopter Pilot of Rio de Janeiro Fire Department**

Summary

This paper will present the several methods of helicopter-based water rescue techniques developed by Aerial Operations General Coordination-CGOA of Rio de Janeiro, which is responsible for many successful rescues each year.

We will follow the sequence below:

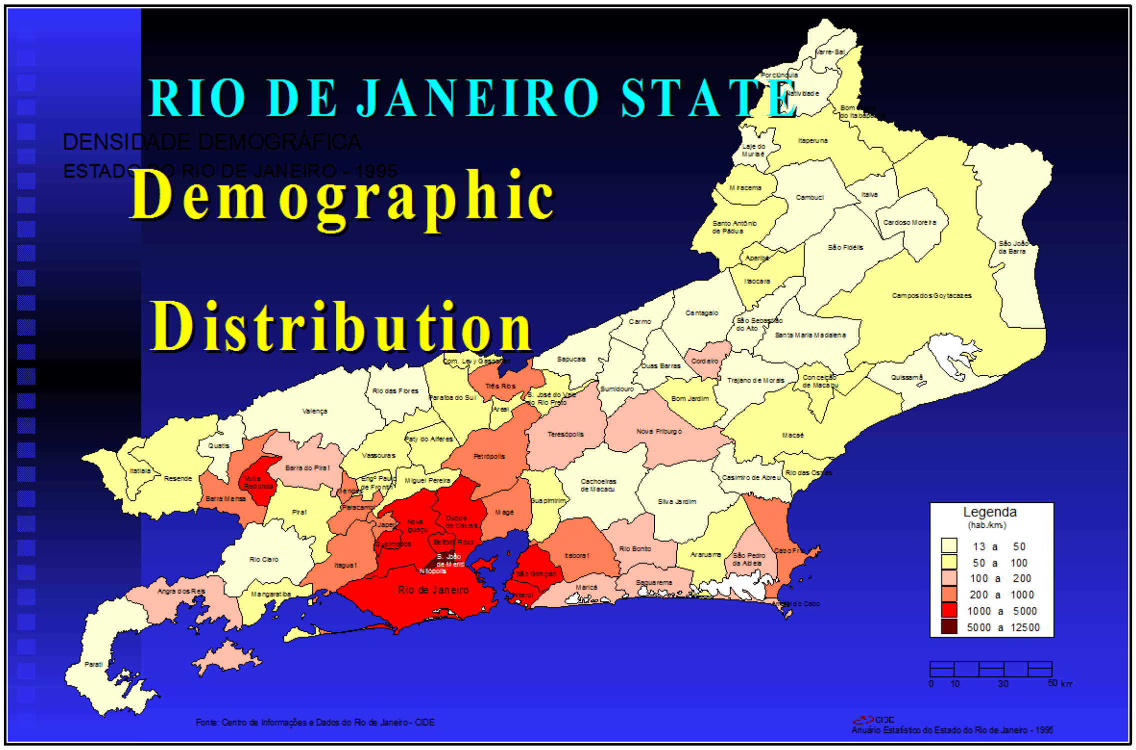
- The Maritime Groupment of the Fire Department
- Rio de Janeiro State characteristics
- Drowning profile in Rio de Janeiro
- The Aerial Operation General Coordination -- CGOA
- The helicopter rescue method used in Rio de Janeiro
- A brief statistic of this method of rescue in the other fields developed by the CGOA.

Maritime Groupment of Rio de Janeiro Military Fire Department

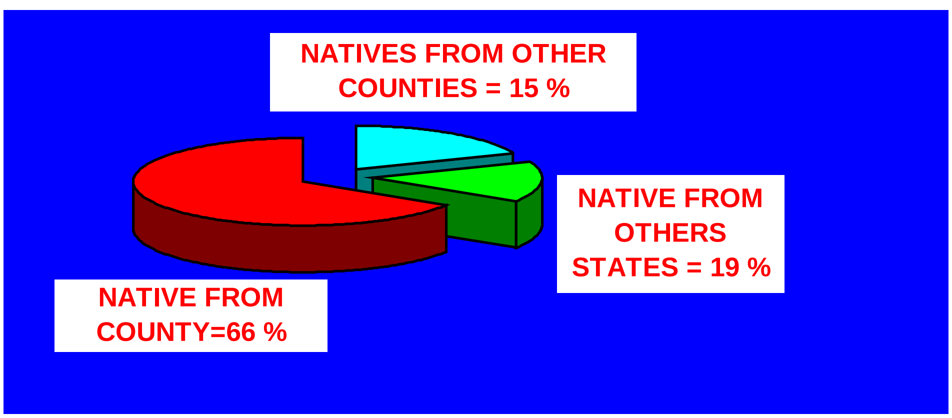
The Maritime Groupment is the operational unit of the Fire Department specializing in ocean lifesaving. Its headquarter is in Botafogo, south zone of Rio de Janeiro City, where the vehicles and naval workshop are located. In addition to this, there are two Drowned Recuperation Centers, located in Barra da Tijuca Beach and Copacabana Beach. It is one of the most efficient life saving organizations in the world, with a low relation between death and saving cases (about 0,3%).

Population Distribution of Rio de Janeiro

The State of Rio de Janeiro has a fixed population of about 5.700.000 inhabitants, 80% of them in Rio de Janeiro City, as shown in the following illustration. In Rio, which has about 132 km of coastline, this contingent is more than 4.500.000 people. The many thousands of national and foreign tourists who visit our beaches, together with our natives, are the most important reason for the number of sea rescues done by the Maritime Groupment. Last year, we saved 9073 people with 24 deaths.



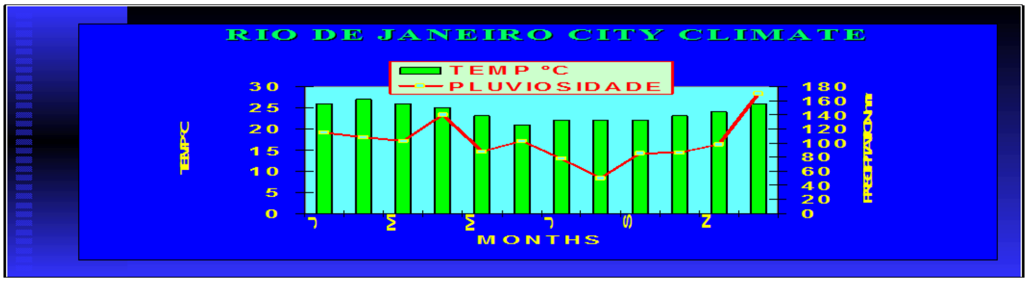
Resident People by Nativiness



Rio de Janeiro and São Paulo are the Brazilian states to which people from the North and Northeast Region immigrate most, due to the employment opportunities. The graphic above shows the average distribution of this contingent in the state, with a great influence in our beach population.

Rio de Janeiro City Climate

In Rio, the average annual rain is about 102 mm and the average annual temperature is about 24º C. This warm climate encourages a beach-going culture in all seasons, which directly influences the number of ocean rescues.

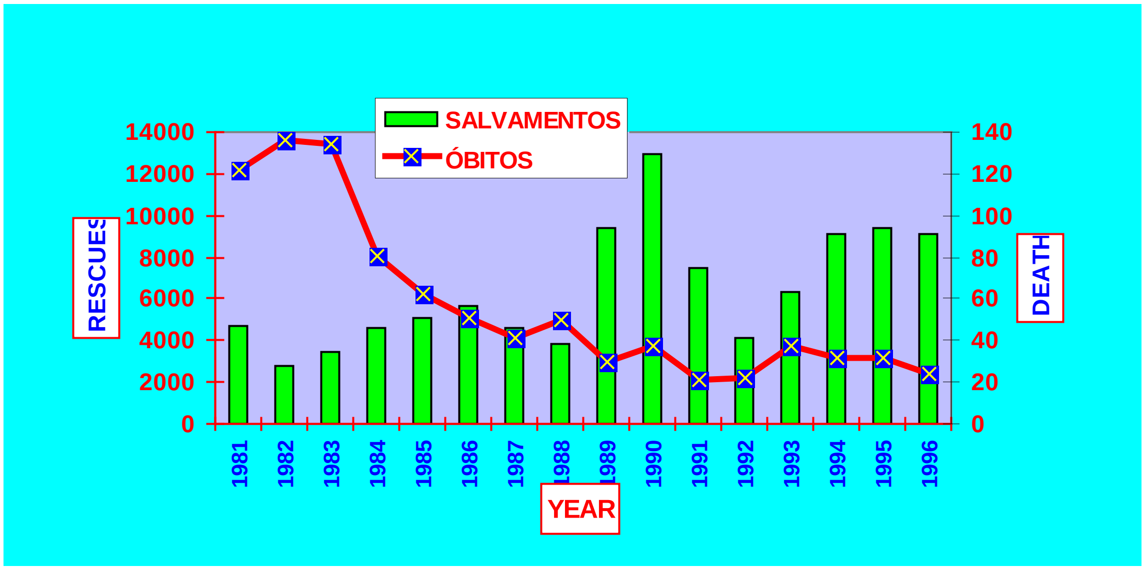


Operation Area

The Maritime Groupment is a state organization, so it has under its responsibility all of Rio de Janeiro's coastline, about 960 km, with 160 lifeguard posts, including Rio de Janeiro City, with 100 lifeguard posts distributed over 132 Km, including Guanabara Bay.

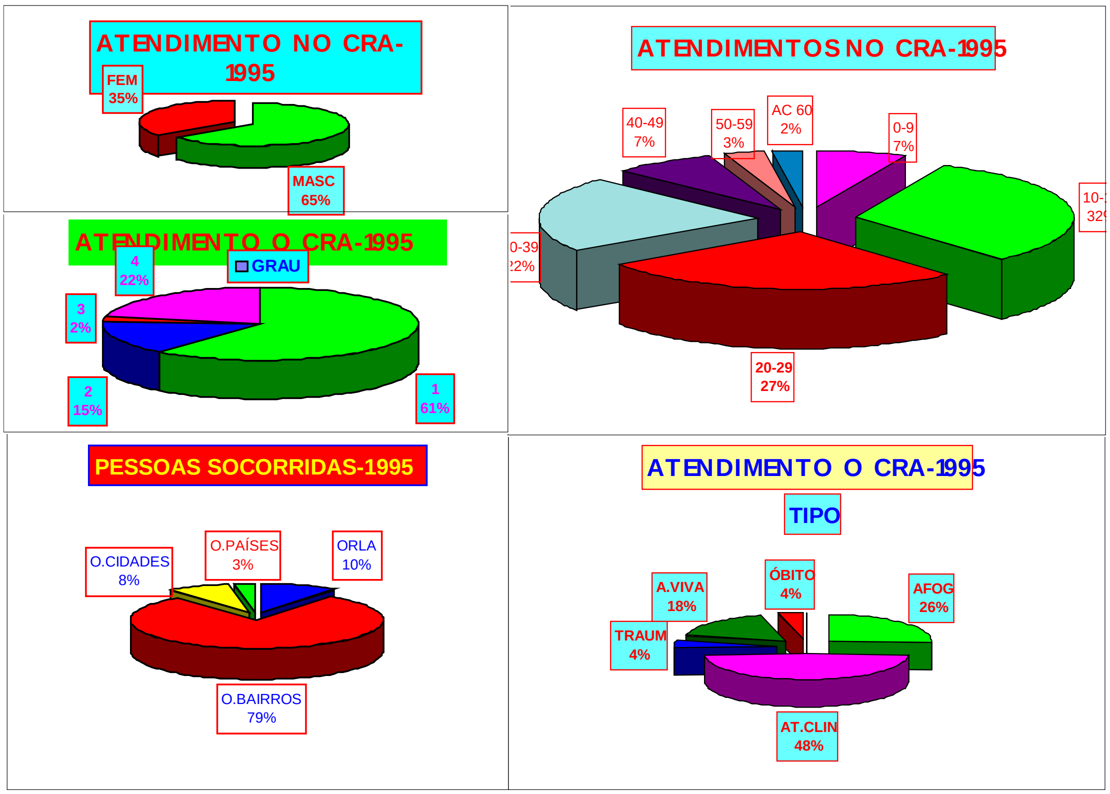
In other counties, the rescue operation is made under the administration of the Fire Department where beaches are located. The Maritime Groupment gives them special training, logistic support, doctrine and statistic controller. During its existence, about 800 lifeguards were trained. For search missions, it has 13 boats, 2 ultralights and 10 Jetskis.

Rescue Statistics 1981 - 1996



This graphic shows the total of sea rescues and deaths year by year. Notice that despite the increase of rescues, death cases are decreasing and the Maritime Groupment has one of the lowest death and rescue ratios in the world (about 0,3%).

RIO DE JANEIRO DROWNING PROFILE



The drowning profile in Rio shown in the graphics is based on an analysis over more than 12 years of sea rescues. Notice that, in general, they are bachelors, from 20 to 25, who live far from the beach. The drowned classification is often “grade 1” (tired, nervous, increased heart rate, breathless, which require only a few minutes to get normal).

Operational Employment Diagram

The aid solicitation begins on the beach, after the victim is located. Complementary means of aids such as boats, helicopters, Jetskis or others may be requested, if necessary, under Maritime Groupment Operation Center coordination.

After the rescue, the victim will be taken, if necessary, to one of the Drowning Treatment Centers, aboard an ambulance, helicopter or boat.

General Coordination Aerial Operation - CGOA

In Rio, all the government helicopters are administrated by CGOA, whose base is located near Rodrigo de Freitas Lagoon. Although the Fire Department has a helicopter, its configuration is for Medical Evacuation only, so rescue missions are not possible. To perform those kinds of missions, a Eurocopter "Esquire" general purpose helicopter is used, which operates in the following situations:

- When there are many rescues due to a significant trough located near the beach, and there are not enough lifeguards on the beach to conduct the rescues without assistance.
- When sea conditions seem unusually dangerous, and drowning cases may occur.
- When the drowning cases in a particular location suggest the aid of a helicopter;
- In major aquatic events, like swimming competitions, processions, boat races, etc.

Aid Solicitation Answering

The helicopter takes off:

- In case of a lifeguard request, whose own rescue possibilities have expired and it is not possible to complete the rescue plus his localization or the sea condition demonstrates that another way than the helicopter will be insufficient.
- May be requested to search for lost boats or that its passengers are with severe injuries or illnesses
- Any other case where the versatility of the helicopter is the best way of a fast and effective solution

Equipment

The Rio de Janeiro general purpose helicopters use the standard equipment of this kind of aircraft, except for the Puçá (like a fish basket), built under CGOA's design and development. The main reason for Its use is the capacity to rescue many people at the same time (5 in exceptional cases) and the method adopted in CGOA, as we'll see in the sequence.

The "sling" used with the hoist is limited by the number of liftings and the total people each time (2 maximum). For this reason, it is used only to lift people from boats and re-lift the lifeguard after each sea rescue operation.

Crew

Unlike several other aerial organizations, in CGOA only a pilot flies all missions. The co-pilot is replaced by the observer, only a lifeguard flies each time and a policeman is the hoist operator.

Accosting

Once the victim is located, the helicopter approaches it in low height and speed, getting to a hover in vertical position above the victim. After the pilot's "roger," the lifeguard jumps into the water, near the victim, who will have been prepared to be lifted. The helicopter goes away to the right side, approaching the wind, decreasing the whirlwind and noise over them, so it's possible to understand one another.

During the side flight, the pilot loses sight of the victim, but the observer reports to him about the victim's location. In a few seconds, they can be seen abeam the helicopter, on the left side. At this point, the fish basket is launched onto the water, in a vertical position, at a height of about 5 meters. The basket is anchored in the hook device with an untwister and a guide cable attached to a ring on the helicopter floor.

The Drowning Gather up

With the victim under the pilot's visual range, the helicopter begins a left side slow flight, with the pilot doing a cross-check of its own position, just to pick the victim up. After crossing the victim's vertical position, the pilot waits for his appearance in the right abeam, when correct your relative position.

His corrective action, in association with the lifeguard's position, allows him to gather up both victim and lifeguard easily. After this, the pilot substitutes the horizontal displace by a soft vertical displace, increasing collective pitch and pulling back the basket.

In all operations, the aircraft will be above the curve of the "height x speed diagram" (death man curve), so the pilot has to pay attention on the speed and direction of the wind, to minimize the application of power, and special attention to the big waves, that may reach the tail rotor.

Attention should be paid to the proximity of the breaker, which may hurt seriously the victim in the basket, once he has fainted, and has no possibility of self-defense.

Drowned Transportation

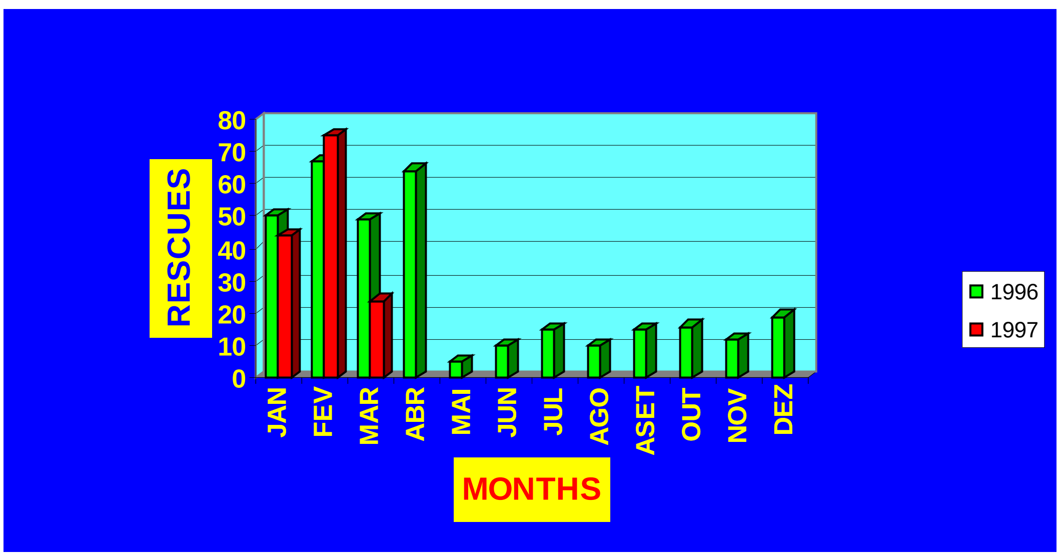
Out of the sea, according to his condition, the victim may be taken directly to the beach, where he will be expected by the other lifeguard to do CPR, if necessary. Otherwise, the victim may be to taken to an ambulance-boat or an EMS helicopter, where there is a medical team ready to dedicate all their attention.

Sometimes, in case of hard injuries, while the rescue operation is in course, the EMS helicopter will be requested to the necessary medical support and transportation to a public hospital.

During the transitional flight, with people in the basket, special attention should be dedicated to steering, taking care with height and speed over the water, turn and balance, so that it may be quickly corrected. The basket descending must be extremely soft, to avoid traumatic accidents that will aggravate the drowned injuries.

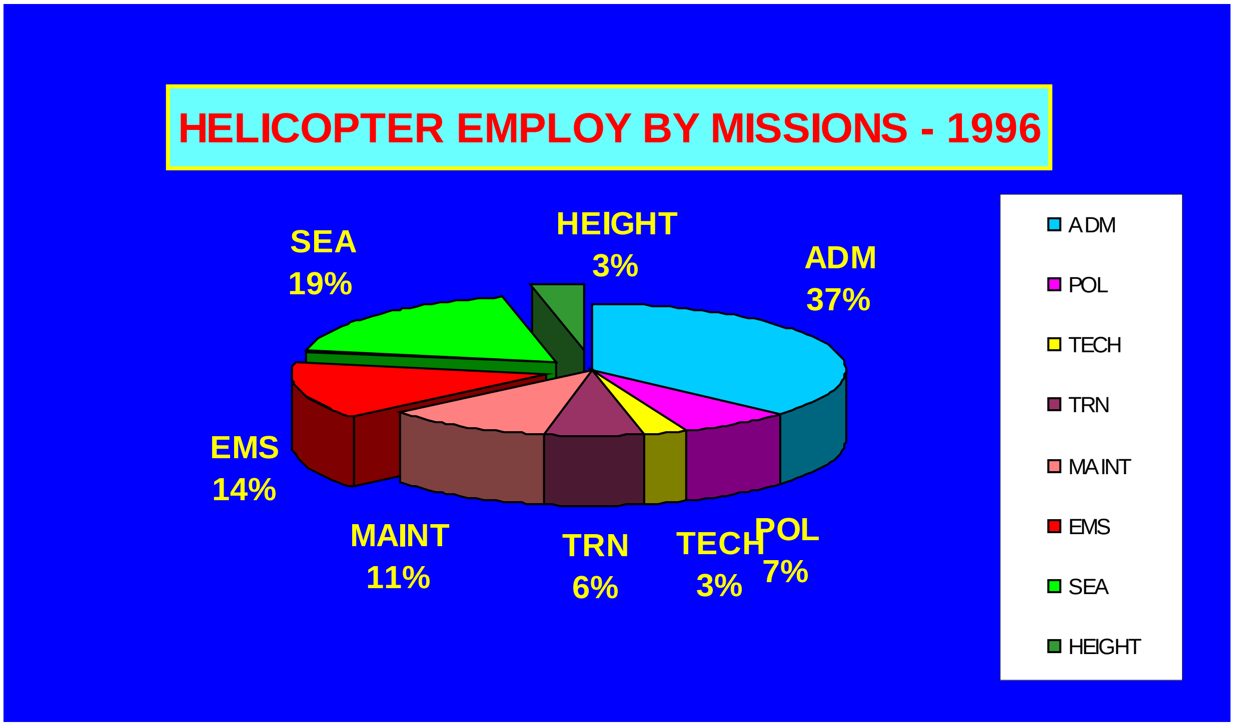
Statistic Charts

The graphic shows the absolute number of drowning victim rescues by helicopter last year and this one. Notice the increase during the summer period (November, December, January and February) and the mid-year school vacation. It is important to emphasize that the number of take-offs is not the equal number of people saved, due to the saving of several people at the same time.



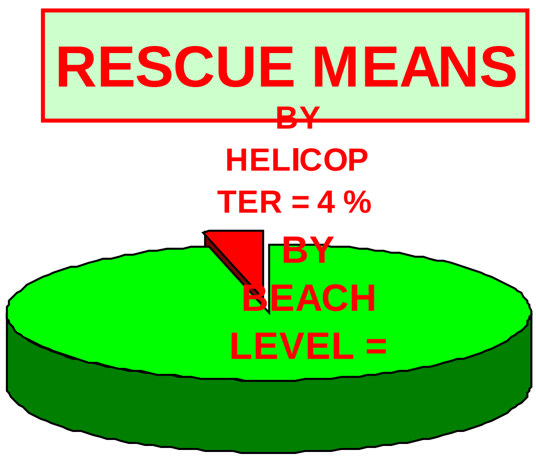
Statistic of CGOA Employ

The following graphic compares sea rescue missions to the total of general missions performed by CGOA. Notice the relation among the mountainous ledge rescues, hazardous place rescues and EMS missions, all are specialties of the Firemen Corporation.



Rescue Types

The graphic presents the total of sea rescues in Rio, the two main types: by lifeguard at sea level and by lifeguards aboard helicopters. Although the total helicopter rescue percentage seems small, it is representative of our best results in lifesaving.



Sgt. John R. Greenhalgh

Sgt. John Greenhalgh has been a lifeguard for 22 years, 17 of them for the City of San Diego. He is currently assigned to the Southern District, supervising Ocean Beach and Mission Bay stations.

Sgt. Greenhalgh is a Master Swiftwater Rescue Instructor I and II, and training coordinator for the San Diego Lifeguard River Rescue Team. He has served as lead Sergeant for the team for 7 years. In addition, he is Team Manager for the Aquatic Rescue contingent of the San Diego Urban Search and Rescue Team. In January 1997, Sgt. Greenhalgh developed a River Rescue Awareness program which was provided to over 1,100 firefighters throughout San Diego County.

During the time that Sgt. Greenhalgh has served as a supervisor of the River Rescue Team they have received numerous local and national awards. They have also been featured on several national and international television shows and documentaries.

In addition to river rescue duties, Sgt. Greenhalgh recently served as Assistant Coordinator for the San Diego Regional Lifeguard Academy, the first of its kind in the nation. He is the coordinator of the State of California, Department of Boating and Waterways, Marine Firefighting course.

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Special Rescue Teams
Flood/River Rescue

Sgt. John R. Greenhalgh
San Diego Lifeguard Service

Facts about flooding in America:

- 70% of major disasters declared by the President are caused by floods.
- More Americans die in floods than in fires.
- Floods kill more Americans and cause greater property loss each year than all other natural catastrophes combined.
- On average, three rescuers (generally untrained) die in moving water each year.

INTRODUCTION

Water rescue is a broad field encompassing numerous disciplines, including swiftwater, surf and offshore rescue, ice rescue, underwater rescue, and many more. Aquatic rescuers often assume that their expertise in one water rescue field makes them an expert in all. As we have learned in San Diego, river and flood rescue is unique. It requires specialized training, preparation, equipment, and a strong team approach. Nevertheless, persons with a strong background in open water rescue are likely to have great success when they properly prepare for flood rescue.

THE SAN DIEGO LIFEGUARD RIVER RESCUE TEAM – A HISTORY

San Diego has a semi-arid climate. Average annual rainfall is 10 inches, but wide swings occur from year to year. In many years, there is no measurable rainfall at all in summer months and little the rest of the year. When it does rain however, usually in winter, the rainfall can be concentrated in torrential downpours that cause very serious flooding.

The popular 1956 Hollywood movie, *The Rainmaker*, which starred Burt Lancaster and Katharine Hepburn, was based on an actual event in San Diego in 1915. Amidst a crushing drought that was seriously impacting the town, city leaders called upon a man who proclaimed himself a "Moisture Accelerator." Following his incantations and other efforts, there was a deluge of 38 inches of rain in one month, which drowned 20 people.

Many years later, in 1978, a man and woman drowned after their car was trapped in floodwaters when they tried to cross a flooded road. With more flooding imminent, the City of

San Diego turned to its professional lifeguards, as experts in water rescue, to organize and prepare for flood rescues.

The San Diego Lifeguard River Rescue Team was initially comprised of six senior lifeguards who had experience in cliff and SCUBA rescues. At first, none of the lifeguards were trained in swiftwater rescue, presuming that the river environment would be easily tackled with their ocean rescue techniques. When two lifeguards were injured and nearly killed however, they quickly learned that the swiftwater environment required additional skills. Even so, these intrepid lifeguards made 23 river rescues in the floods of 1978, without formal river rescue training, repeatedly placing themselves in grave danger.

Their first specialized training came from a private citizen who had whitewater rafting experience. He accompanied them to the Colorado River, where they attempted to adapt their ocean rescue equipment and skills to river rescue. They learned many things, including how little they really knew; but they also formed a plan to further develop their team.

While some communities have chosen to train a large number of safety personnel at a basic level of flood rescue skills, San Diego elected to train a small cadre of rescuers at the highest possible level. While this limited the number of trained providers available to respond, it ensured that upon arrival at-scene, they were able to quickly and safely accomplish the rescue.

During the 1980s the team grew to include 11 highly trained members. Each year, the team traveled to a swiftwater river somewhere in the United States to hone their skills in this specialized environment. During this period, flood rescue teams were also being developed in other parts of the United States. Members of the San Diego team, including the current team leader, Lt. Marshall Parks, attended special courses throughout the nation. Equipment improved and innovations were made.

In some years, there were no rescues whatsoever, due to lack of rainfall. In other years though, the rescues came one after another during the winter rainy season. In heavy rains, the River Rescue Team began to be called throughout the County of San Diego to multiple rescues up to 50 miles apart. The team never declined a request for help from a neighboring city.

The success of the team drew interest from other emergency workers, some of whom felt that perhaps lifeguards should not handle this responsibility. Occasionally conflicts arose at rescue scenes over who would take command of the incident. To resolve this question, in 1984 the San Diego City Manager issued a policy that defined a river rescue as, "… any rescue of persons or property threatened, surrounded or entrapped by stationary or moving water" and declared that, "To safely perform [river] rescues requires specialized training and equipment … it is important that where possible all river rescues be performed by the Lifeguard Service's River Rescue Team." Thereafter, authority of the team was rarely questioned.

Effective communications has been a hallmark of the team. They equipped themselves with two-way radios that could be used to directly communicate with police, firefighters, California Highway Patrol, and US Border Patrol Agents throughout San Diego County. As a result, they became able to monitor and immediately respond to reports of persons in distress, broadcast by other public safety units in the field. During periods of flooding, one regularly hears police units stating, “We need the River Rescue Team,” and members of the team immediately responding on the police frequency.

In January and February of 1993, San Diego was hit by a series of storms which produced floods of great proportions. During a three week period the team, augmented by other lifeguards with basic swiftwater skills, effected 195 swiftwater rescues, assisted in the evacuation of several hundred citizens trapped by flood waters, and helped save numerous livestock. They worked day and night for several weeks, often bivouacked in hotels near the Mexican border where many of the rescues took place. Later, they received several awards and commendations for their actions.

One of the original dreams of the San Diego Lifeguard Service was to arrange a national flood rescue mutual aid system that would allow the team to be deployed wherever it might be needed. A number of contacts were made over the years in an effort to accomplish this, but little progress was made until a separate, but similar system was developed for other types of disasters.

Primarily at the urging of firefighters, the United States Government’s Federal Emergency Management Administration began to develop a national mutual aid system for major national disasters, like earthquakes. This system, which came to be known as Urban Search and Rescue (USAR), relies on local rescue teams throughout the United States. In a disaster, teams from unaffected areas are sent via military transport and other means to assist emergency workers in the disaster area. The system has capitalized on the idea that it is less expensive and more efficient to harness the resources of local rescue crews than to maintain large federal forces in anticipation of infrequent, major disasters. It has been very successfully employed in a number of disasters, including the Oklahoma City bombing case.

In 1996, at the urging of a number of swiftwater rescue teams, including San Diego’s, California was given the go-ahead to develop a swiftwater rescue component of its USAR teams. One of these was in San Diego and came to include lifeguards from the River Rescue Team, along with firefighters with swiftwater rescue training.

Minimum certifications for this team include Swiftwater Rescue Technician I & II, heavy rescue techniques, Emergency Medical Technician, Vertical/Cliff Rescue, SCUBA, Operator of Personal Watercraft and Inflatable Rescue Vessels, Advanced Incident Command Operations, Helicopter Rescue, and a minimum swim requirement.

Shortly after its creation, in February 1997, the team was deployed to a major flood disaster in Northern California. They were flown to the disaster site in military transport planes with lifeguard vehicles, personal watercraft, inflatable rescue boats, and other equipment aboard the aircraft. They spent five days evacuating and rescuing people and livestock. Later, rescuers involved in this deployment, including the River Rescue Team, received the Higgins and Langley Memorial Award for outstanding achievement in the field of swiftwater rescue by the National Association for Search and Rescue.

When the San Diego Lifeguard Service replaced a special cliff rescue vehicle in 1993, it was specially designed to be used for swiftwater rescue as well. This required each lifeguard on the team to acquire special driver licenses due to the weight and complexity of the vehicle.

River rescue is one of the most dangerous emergencies to which lifeguards respond. It is the only discipline in which a San Diego lifeguard has died. All team members now receive hazardous duty compensation.

RIVER RESCUES IN SAN DIEGO

In the San Diego urban environment a number of the roads that cross rivers were designed to allow the river to overflow them so that property would not be damaged during excessive rainfall. Many of the rescues made are of individuals who attempt to drive their vehicles through flooded roads and become trapped in their vehicles or swept downstream.

The Tijuana River, which separates Mexico from the United States and San Diego, is another common rescue site. During periods of heavy rain many people attempt to cross the border unlawfully to gain access to the U.S., while trying to elude United States Border Patrol agents. They feel that these agents will not enter the water, making their entry into the U.S easier. This creates a special rescue situation.

In attempting to slip into the United States while eluding the Border Patrol, some become stranded on small islands or washed downstream. Others drown and are found many days later in a heavily decomposed state. Ironically, many of the calls to assist people in this distress come from Border Patrol agents themselves, who are concerned for the safety of persons they would otherwise pursue. While river rescue team members are attempting to rescue these individuals, they sometimes move or attempt to flee. Once rescued, lifeguards turn them over to the Border Patrol and they are deported.

Within San Diego's urban environment, there are also a number of drainage culverts. When filled with rainwater some flow at speeds up to 40 m.p.h. The River Rescue Team has responded to numerous calls of children being swept away while playing in or near these culverts.

One especially challenging rescue was of a young boy who was playing in a drainage culvert with a Boogie Board. He was swept downstream into a series of culverts that ran underground. He found a culvert that led up and out to the street above, but became trapped in a narrow passageway under the street. Citizens heard his cries for help coming from a storm drain. The River Rescue Team responded and located the child. Water flowing into the storm drain from heavy rain had to be stopped with sandbags before it drowned the child. Once stopped the child had to be removed from the storm drain using heavy rescue equipment to open up the sidewalk above him.

OPERATING PROCEDURES

The primary river rescue season in San Diego lasts from November through March, but rescue activity varies greatly from year to year depending on the amount of rainfall. The River Rescue Team operates under guidelines of the San Diego Lifeguard Service's Manual of Policies and Procedures. This policy specifies the selection, training, deployment, and supervision of the team. It also specifies levels of alert for the team.

Most San Diego lifeguards work eight hour shifts, five days a week. To ensure around the clock response to emergencies on San Diego beaches, there are always at least two lifeguards assigned to 24-hour shifts, similar to those of firefighters. During the river rescue season, River Rescue Team members are often assigned to this shift, but team members who are not on duty must also be prepared to respond to river rescues from home. The Lifeguard Service has established an alert system involving three levels. When predicted rainfall heightens the possibility of an emergency response, members of the team are placed on alert.

In determining the level of alert, a hydrologic criteria has been created. Using predicted 24 hour precipitation amounts as measured in inches related to the coast, foothills, and mountains, various alert status levels are created. Existing conditions are also taken into consideration. The precipitation forecast is provided by the National Weather Service. The team leader is responsible for determining the various alert level status levels and ensuring that all appropriate measures are taken.

Team Alert Status Levels:

Alert I

During any alert, team members are required to carry pagers and personal river rescue equipment at all times, as well as refrain from consuming alcohol. At Alert I or II, while off-duty, they must stay within 20 miles of Lifeguard Headquarters. Designated vehicles are equipped with river rescue gear. Weather is constantly monitored, and the team leader is notified of any changes in weather predictions.

Alert II

Same as Alert I, however all off-duty team members are placed on paid stand-by. Designated equipped vehicles are taken home by various members of the team. Lifeguard Communications, which is always staffed 24-hours a day, is given details of team operation plans. Appropriate public safety agencies throughout San Diego County are advised of the team's status.

Alert III

> The team is fully activated as a unit and all members strategically deployed throughout San Diego in historically known past river rescue locations with an action plan in place. During this status the team is broken up into three to four member squads with a Sergeant as squad leader. The Lieutenant is the overall leader.

Emergency Response:

When Lifeguard Communications receives a report of a river rescue emergency, they advise the ranking River Rescue Team member (generally a Lifeguard Lieutenant or Sergeant). The duty supervisor evaluates the call and determines the appropriate level of response.

Often, this response will include other emergency agencies, such as firefighters, paramedics, and police. A police helicopter is commonly summoned, since aerial evacuation may be the best alternative and the helicopter can be valuable for spotting victims, communicating with them, and lighting at night. Once on scene the ranking team member assumes command of the incident and makes use of all appropriate resources to effect the rescue.

Environmental Safeguards:

Many rivers in the urban environment have been found to contain contaminates which may be harmful to humans. For example, sewage is often present in floodwaters. In an effort to reduce exposure, all team members are issued dry suits and are required to wear them while actively involved in swiftwater incidents. After each swiftwater incident, team members are decontaminated and receive appropriate inoculations.

TEAM TRAINING

All team members are required to attend 40 hours of swiftwater training annually. This training takes place in the fall prior to the river rescue season. Since San Diego lacks swiftwater training sites in the dry fall season, the team must travel to various parts of the nation for a suitable swiftwater environment. Most recently, they have utilized the Potomac River, just outside Washington, D.C.

Generally, the team will meet with a local agency that provides swiftwater rescue for the training site. This also allows them to share various rescue techniques. Many times the San Diego team has provided enhanced training to these agencies. Team members are assigned training topics and are required to instruct their fellow team members.

During this training the team will cover everything from the basic rescue to highly technical rescue scenarios, including night rescue operations. All team members are encouraged to provide research and development of any new ideas or techniques to their fellow team members.

CONCLUSION

Today the San Diego River Rescue Team is recognized as one of the nation's elite teams and has received national acclaim. This team and the way it operates has been used as a model by other teams throughout the nation. Team members have received commendations from the San Diego City Council, San Diego Board of Supervisors, and the Governor of California. They have twice been awarded the Higgins and Langley Memorial Award for Outstanding Achievement in the Field of Swiftwater Rescue. In fact, they are the only two time recipients of this award.

Experts in the field of aquatic rescue consider swiftwater rescue one of the most dangerous water emergencies. Even with their strong aquatic background, San Diego lifeguards learned that significant specialized training and equipment were needed to safely and effectively perform these rescues. Nonetheless, their extensive aquatic skills as a basis helped greatly in developing what has become a nationally recognized team that has been regularly lauded for its successes. In our view, when considering the development of a specialty team to respond to these types of emergencies, lifeguards are the natural choice.

Glen Hagemann, M.D.

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Hagemann obtained his medical degree from the University of Cape Town, graduating in 1988. He subsequently spent three years travelling and working in various countries around the world. In 1994 he accompanied a group of Canadians and New Zealanders to the Everest region of Nepal on an environmental clean-up operation where they ascended to an altitude of 6000m. In 1996 he was employed by the Auckland Regional Rescue Helicopter Trust where he was also involved in domestic and international air ambulance transfers.

Hagemann has a Diploma in Anaesthetics and is currently completing a masters degree in Sports Medicine. For his thesis, he is determining by means of magnetic resonance imaging the patho-anatomical changes that occur in the shoulders of endurance kayakers and surfski paddlers.

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Rescue and Resuscitation in the South African Surf Zone.
Efficacy of the South African Lifesaver and Current Challenges.

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OBJECTIVES

To determine the efficacy of cardiopulmonary resuscitation (CPR) as performed by South African Surf Lifesavers, as well as the predisposing and contributing factors leading to drowning and near-drowning in surf conditions, in order to facilitate primary prevention and enhance the efficacy of this community-orientated service.

METHODS

The resuscitation records were examined for the period March 1978 - February 1995 (17 years) of 52 lifesaving clubs that oversee coastal beaches in South Africa. Demographic, clinical and rescue details and outcome were the broad categories of data recorded. Outcome measures included success of resuscitation, alcohol detection on the breath of the victim and corroborative subjective enquiry from club committees.

RESULTS

There were 75 males and 24 females with an age range of 15 months to 84 years with a skew to the younger age groups. Immersion in the surf was the most common single cause necessitating resuscitation (65%). In 63 (64%) victims, resuscitation was commenced within 5 minutes. In 68% the duration of resuscitation was under 30 minutes. The pulse was absent in 56 victims, present in 40. Overall, resuscitation was successful in 52 victims (53%), unsuccessful in 41 (41%) and undetermined in 6 (6%). If a pulse was absent, the relative risk of unsuccessful outcome was a high 26.7. Alcohol noted on the breath was unrelated to success of resuscitation. If the incident and rescue occurred between bathing beacons, the likelihood of successful resuscitation was significantly increased.

DISCUSSION

The causes of drowning and requirements for resuscitation as experienced in the surf zone of South Africa are heterogenous. Clearly many different people from all walks of life and with widely differing surf knowledge and ability are prone to immersion and rescue by lifesavers. The competent free diver getting into trouble from over-breathing to the non-swimmer, alcohol abuser and infant are examples of the extremes of this spectrum. Although initially diagnosed as the direct cause of collapse in only one person, alcohol was noted on the breath of 34 / 99 victims (which includes children). If the figures are analysed for the age groups ∃ 21 years of age the percentage consuming alcohol becomes 54%. Although this was shown not to affect resuscitation outcome per se, it may be reasonably concluded that despite being frequently detected, it is probably severely under detected bearing in mind the crude subjective diagnostic method and that it may be a very common cause of people getting into trouble in the water. Apart from underestimating their swimming capabilities if under the influence, alcohol use may also precipitate cardiac arrhythmias, cardiac arrest, seizures and errors in judgement, all of which may necessitate a rescue effort. Alcohol has been aptly named the Aubiquitous catalyst in predisposing people to submersion and drowning≅ and has been implicated as a major factor in the many secondary causes of drowning. Our own data, both from resuscitation instances (in about half the adult cases) as well as from public behaviour on the beach witnessed by lifeguards (75% of the surveyed clubs) underscores this concept.

Interestingly the presence of alcohol on the breath did not influence the outcome of resuscitation. A comparison with a recent Australian study is appropriate here. Their incidence of alcohol on breath was 21% (compared to our local figure of 33%) which also did not affect resuscitation outcome. Very similar findings were noted by the Canadian Lifesaving Society in their 1996 edition of the National Drowning Report wherein alcohol beverages were involved in 36% of all preventable water-related deaths in Canada.

The second major message of the data involves the bathing between appropriately demarcated zones. Of the resuscitations performed between the lifesavers= beacons, 76% were successful, whereas of those performed outside these areas only 35% were successful. Speculation would yield a number of possibilities such as distance from the lifesavers (in the role as first aiders with emergency equipment) being a factor, more dangerous surf conditions and longer time lapse until victim=s plight was recognised. Almost identical findings were found by Fenner et al in their study from Queensland, Australia.

The study also provides crude data on an unselected out of hospital population requiring CPR and initial survival statistics. The 52% is in sharp contradistinction to the less than 10% survival rate after in-hospital cardiac arrest with resuscitation. The hospital environment is where most medical practitioners have had experience with CPR and it is important not to compare the relatively dismal outcome in the Aailing≅ in-hospital patient with the people requiring resuscitation in a recreational circumstance such as in the surf zone.

As a very important early prognostic indicator, the presence of a pulse at the time of initial assessment was a powerful predictor of outcome. The absence of a pulse equated to a relative risk of 26.7 of unfavourable outcome.

The message from the analysis is clear. Young age, alcohol consumption and bathing in non-demarcated areas are the primary prevention targets readily amenable to public health education. The very strong relative risk ratio of no pulse at time of CPR initiation may indirectly reflect delay in getting to the victim in many cases. As Atime is brain,≅ the necessity for promoting bathing between beacons becomes all the more important.

The mailed questionnaire response from the club executive committees shows remarkable concurrence with what the incident forms have found over the 17 year period. The number one problem in terms of magnitude but not in terms of gravity, are marine stingers - colloquially named Ablue bottle≅ stings. Although many agents have been purported to be effective, the lifesaving fraternity remains relatively helpless at times of blue bottle invasions and again prevention and adequate public education must receive attention for this distressing, albeit rarely dangerous or fatal, condition. The other important conditions identified by lifesavers were alcohol abuse in the beach environment and immersion either due to extrinsic (surf conditions) or intrinsic (poor judgement) factors. These priority issues are largely amenable to primary prevention.

In conclusion, the statistics tell a tale of efficient resuscitation with a success rate that is comparable to that of a similar study done in Australia, a first world country with a very different demographic profile. Not only can significant further improvement in outcome be gleaned from improving the skills and equipment of the rescuer, but also from the education of the Arescued≅. Appropriate adaptation to change for a successful organisation demands urgent public education regarding the dangers of non-adherence to bathing guidelines and the abuse of alcohol in a potentially hostile environment, such as water.

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RESUSCITATION

Single rescuer adult basic life support

An Advisory Statement from the Basic Life Support Working Group of the International Liaison Committee on Resuscitation (ILCOR)[1]

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1. Introduction

This document presents the consensus view of the Basic Life Support (BLS) Working Group of the International Liaison Committee on Resuscitation (ILCOR), which represents the world's major resuscitation organisations (including the American Heart Association, Australian Resuscitation Council, European Resuscitation Council, Heart and Stroke Foundation of Canada, and Resuscitation Council of Southern Africa). These 'advisory statements' have evolved during ten meetings of ILCOR from 1991 to the present.

The scientific basis for the treatment of cardiac arrest has an active international literature [1]. The purpose of creating these advisory statements is to take full advantage of international perspectives and experience in the basic management of cardiac arrest. It is hoped that the 'Sequence of Action' can be used as a template by individual national resuscitation organisations. This template should not, however, be considered as a rigid standard. It is intended primarily to remove the many minor international differences in BLS education that have developed over the last thirty years, often without any basis in science. For example, if the current BLS guidelines of the European Resuscitation Council (ERC) and the American Heart Association (AHA) are compared, most of the differences that exist are without any particular rationale and are based simply on quirks of historical practice. It is hoped that by removing these, BLS training can become as uniform as possible throughout the world.

The process for the development of the advisory statements involved:

1. Identification of major and minor differences between existing BLS guidelines [2,3]. Minor differences mostly involved the use of words, rather than any real differences of opinion about scientific content. They were resolved by arriving at a consensus.
2. Presentation of formal position papers on areas of major difference, with an emphasis on available scientific evidence. The Group attempted to reach consensus on items of controversy, but sometimes the resulting statements reflect a majority opinion.
3. Presentation of the newly developed guidelines to the ILCOR Advanced Life Support and Paediatric Working Groups with incorporation of the comments received.
4. Feedback from the individual BLS Committees of the member resuscitation organizations.
5. Preparation of the final Sequence of Action which follows.

2. Sequence of Action

Note: In the following descriptions, the masculine includes the feminine

1. Ensure safety of rescuer and victim
2. Check the victim and see if he responds:
   - [1] Gently shake his shoulders and ask loudly: "Are you all right?"
3. If he responds by answering or moving:
   - Leave him in the position in which you find him (provided he is not in further danger), check his condition and get help if needed
   - Reassess him regularly

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4. If he does not respond:
   - Shout for help, send someone for help or, if you are on your own, consider leaving the victim and going yourself for help
   - Open his airway by tilting his head and lifting his chin:
     If possible with the victim in the position in which you find him, place your hand on his forehead and gently tilt his head back keeping your thumb and index finger free to close his nose if rescue breathing is required
     At the same time, with your fingertip(s) under the point of the victim's chin, lift the chin to open the airway
     If you have any difficulty, turn the victim on to his back and then open the airway as described

   Avoid head tilt if trauma (injury) to the neck is suspected
5. Keeping the airway open, look, listen, and feel for breathing (more than an occasional gasp):
   - Look for chest movements
   - Listen at the victim's mouth for breath sounds
   - Feel for air on your cheek
   - Look, listen, and feel for *up to 10 seconds* before deciding that breathing is absent
6. If he *is* breathing (other than an occasional gasp):
   - Turn him into the recovery position
   - Check for continued breathing
7. If he is *not* breathing:
   - If you have not already done so, send someone for help or, if you are on your own, leave the victim and go for help; return and start rescue breathing as below
   - Turn the victim onto his back if he is not already in this position
   - Remove any visible obstruction from the victim's mouth, including dislodged dentures, but leave well fitting dentures in place
   - Give 2 *effective* rescue breaths, each of which makes the chest rise and fall
     Ensure head tilt and chin lift
     Pinch the soft part of his nose closed with the index finger and thumb of your hand on his forehead
     Open his mouth a little, but maintain chin lift
     Take a breath and place your lips around his mouth, making sure that you have a good seal
     Blow steadily into his mouth over about 1.5–2 seconds watching for his chest to rise
     Maintaining head tilt and chin lift, take your mouth away from the victim and watch for his chest to fall as air comes out
   - Take another breath and repeat the sequence as above to give 2 effective rescue breaths in all
   - If you have difficulty achieving an effective breath:
     Recheck the victim's mouth and remove any obstruction
     Recheck that there is adequate head tilt and chin lift
     Make up to 5 attempts in all to achieve 2 effective breaths
     Even if unsuccessful, move on to assessment of circulation
8. Assess the victim for signs of a circulation.
   - This includes:
     Looking for any movement, including swallowing or breathing (more than an occasional gasp)
     Checking if the carotid pulse is present
   - Take *no more than 10 seconds* to do this
9. If you are *confident* that you can detect signs of a circulation within 10 seconds:
   - Continue rescue breathing, if necessary, until the victim starts breathing on his own
   - About every minute recheck for signs of a circulation; take no more than 10 s each time
   - If the victim starts to breathe on his own but remains unconscious, turn him into the recovery position. Check his condition and be ready to turn him onto his back and re-start rescue breathing if he stops breathing
10. If there are *no* signs of a circulation, or you are at all unsure:
    - Start chest compression:
      Locate the lower half of the sternum and place the heel of one hand there, with the other hand on top of the first
      Interlock the fingers of both hands and lift them to ensure that pressure is not applied over the victim's ribs. Do not apply any pressure over the upper abdomen or bottom tip of the sternum
      Position yourself vertically above the victim's chest and, with your arms straight, press down on the sternum to depress it between 4–5 cms (1.5–2 inches)
      Release the pressure, then repeat at a rate of about 100 times a minute (a little less than 2 compressions a second). Compression and release should take an equal amount of time
    - Combine rescue breathing and compression:
      After 15 compressions tilt the head, lift the chin and give 2 effective breaths
      Return your hands immediately to the correct position on the sternum and give 15 further compressions, continuing compressions and breaths in a ratio of 15:2
11. Continue resuscitation until:
    - The victim shows signs of life;

- Qualified help arrives;
- You become exhausted

3. Modification of the ILCOR BLS Sequence of Action

This BLS Sequence of Action is not intended to restrict national resuscitation organizations or prevent them from making modifications when valid concerns (or future studies) support these. It is fully anticipated that the significant differences in culture and emergency facilities that exist between communities will result in modification of these statements by national resuscitation organisations in order to meet specific local or regional needs. For example, decisions on when to call for help or whether to perform a pulse check may vary depending on local epidemiology, EMS technology, or public CPR education. Therefore this template should be used as a basic resource from which to develop appropriate local BLS guidelines.

4. Lay rescuer training

Readers familiar with CPR guidelines from other sources will note that there are some differences between these statements and previous publications. A central concern has been to ensure that the guidelines are as simple as possible. The reason for a 'movement towards simplicity' comes from a critical examination of the successes and failures of public sector CPR education. There is no question that CPR saves lives, yet after 30 years of attempts at public CPR education most communities still do not train a sufficiently high proportion of the public to perform basic CPR; rates of community CPR in the USA and Europe have not increased significantly since the 1970s. Paradoxically, in some higher risk populations the rate of bystander CPR is particularly poor [4,5]. Therefore, the ILCOR BLS Working Group recognize that a redoubling of efforts to teach CPR to the public is a vital priority for nearly all communities.

There are many possible obstacles to lay person CPR training, the reasons for which are multifactorial. It has been noted by some investigators that the psychomotor skills required to perform CPR are relatively difficult for the lay public. Moreover, even when they are taught to professionals their retention by people who do not use them regularly has been disappointing [6–8]. In addition, in some communities there is a reluctance to perform rescue breathing on a 'stranger' due to a concern over disease transmission, for example a fear of contracting HIV [9,10].

There is scientific uncertainty within the literature regarding how 'good' CPR has to be in order to save a life [11]. Do victims who receive perfectly performed compressions and rescue breathing (so called 'good CPR') fare better than victims who get less effective CPR? A definitive answer is still awaited, but the clear conclusion from many studies is that the lowest survival rates occur when there is no attempt at CPR [12]. Any CPR is better than no CPR. Therefore a simple, basic, approach that can be taught effectively to the largest number of people should help to increase the pool of individuals willing to attempt basic life support.

It is possible to imagine a wide spectrum of BLS instruction from simple to very complex. For example, some have suggested that CPR instruction for lay persons be as simple as 'pump and blow'. By contrast, far more complicated protocols than those currently available could be developed and recommended for public education by the addition of more medical assessment steps to the various manoeuvres. The recipe for the most 'simple CPR', while maintaining effectiveness for survival, has not been adequately addressed.

5. Circulatory assessment

It has been traditional when checking for cardiac arrest in a non responsive (unconscious) adult victim to palpate the carotid artery. To date, all resuscitation councils world-wide require this single determination of carotid pulselessness as the diagnostic step which immediately leads to the initiation of chest compression. The time allowed to feel for the existence of a pulse differs between resuscitation councils [2,3,13] but no council advocates more than 10 seconds for a normothermic victim as time is critical when initiating CPR.

Should the 'carotid pulse check' still be taught to lay persons as the sole criterion for the initiation of chest compression?

Many emergency medical service despatch centres now offer telephonic CPR instruction to callers reporting victims who have collapsed. The criteria for the initiation of CPR are normally a combination of unresponsiveness and lack of breathing [14]. It is not normal practice for the dispatcher to ask for a carotid pulse check prior to advising chest compression, mainly because of the perceived difficulty in describing the technique over the telephone. Is the carotid pulse check in fact difficult, particularly for lay persons?

Recent studies [15–19] have strongly suggested that the time needed to diagnose with confidence the presence or absence of a carotid pulse is far greater than the 5–10 seconds normally recommended, with times in excess of 30 seconds being needed to achieve a diagnostic accuracy of 95%. Even with prolonged palpation, 45% of carotid pulses may be pronounced absent when in fact they are present [19]. It should also be borne in mind that most of the studies were undertaken using normotensive volunteers, a situation far different from finding a collapsed and cyanosed victim in the street who is likely to be hypotensive, vasoconstricted, or worse.

As a result of these studies, the BLS Group consider that the carotid pulse check should be 'de-emphasized' and that other criteria should be used to determine the need for chest compression in an unresponsive, apnoeic, adult patient. It was decided to use the expression: 'Look for signs of a circulation' which includes looking for movement as well as checking the carotid pulse. The rescuer should limit the time taken for this check to no more than 10 seconds. Therefore, the absence of any obvious signs of life, not necessarily the absence of the carotid pulse, should be sufficient indication to initiate chest compression.

It should be emphasized that this departure from current teaching is aimed, at least for now, only at the lay rescuer; checking for a pulse remains an important part of advanced life support and the algorithm for use of automatic external defibrillators.

6. Volume and rate of ventilation

Rescue breathing (expired air ventilation; mouth to mouth ventilation) has been a well accepted technique of airway management in BLS since the early 1960s [20]. The volume of air required for each inflation is normally quoted as 800–1200 cc, with each breath taking 1–1.5 seconds. The BLS Group questioned the validity of these figures.

Artificial ventilation without airway protection (such as tracheal intubation) carries a high risk of gastric inflation, regurgitation, and pulmonary aspiration [2]. The risk of gastric inflation depends upon: (a) the proximal airway pressure, which is determined by tidal volume and inflation rate; (b) the alignment of the head and neck, and degree of patency of the airway; and (c) the opening pressure of the lower oesophageal sphincter (approximately 20 cm H_2O) [22].

It has recently been shown that a tidal volume of 400–500 cc is sufficient to give adequate ventilation in adult basic life support because CO_2 delivery during cardiac arrest is very low [21]. This recommendation overrules earlier guidelines and makes it necessary to recalibrate adult training manikins [22]. It is, however, consistent with the accepted teaching that the tidal volume should be that which causes the chest to rise as in normal spontaneous breathing.

During combined rescue breathing and chest compression the rate of ventilation is dependent both on the ventilation volume and the compression rate. An inflation time of 1.5–2 seconds diminishes the risk of exceeding the oesophageal opening pressure [22] and results in an inflation–exhalation cycle of about 3 seconds. To obtain optimum perfusion of vital organs a chest compression rate of about 100 per minute is recommended. It therefore takes 12 seconds to perform 15 cardiac compressions. Allowing 6 seconds for the 2 rescue breaths, single rescuer CPR should result in 8 breaths and 60 chest compressions per minute.

7. Call first—call fast

The first link in the 'Chain of Survival' [23] is to gain access to the emergency medical services. Advice as to the optimum time during a resuscitation attempt at which to leave the victim to go for help will depend on several factors: whether the rescuer is alone; whether the victim has a primary respiratory or primary cardiac arrest; the distance to the nearest point of aid (for example a telephone); and the facilities offered by the emergency services.

The importance of early defibrillation in the treatment of sudden cardiac death is now accepted, and major initiatives are moving forward in the world to deliver a defibrillator and the first shock at the earliest possible moment [24]. The 1992 AHA Guidelines [2] emphasized that the rescuer should, if no other help is available, leave an adult victim immediately after establishing unresponsiveness in order to call an ambulance or emergency medical service system ('phone first'). The ERC Guidelines [3] advise that a shout for assistance should be made as soon as the victim is found to be unconscious, but that the lone rescuer should not leave to go for help until cardiac arrest is diagnosed by means of a pulse check ('phone fast'). Both the AHA and the ERC Guidelines seek to ensure that a defibrillator reaches the victim at the earliest appropriate opportunity. Both agree that if the victim is a child, the rescuer should provide rescue support (ventilatory or circulatory or both) for about 1 minute before leaving the victim and calling the rescue team [25].

The rationale for phoning first (rather than fast) is based on several factors [26]. Clearly defibrillation is the key to survival from sudden cardiac death. However, it has been documented that rescuers finding unconscious victims frequently encounter psychological blocks that prevent them starting CPR or even calling for help. Valuable minutes are lost because of this inactivity, resulting in less chance of survival for the victim. Other rescuers can become so consumed with providing CPR that they persist far too long before summoning the EMS system.

In children the aetiology of cardiopulmonary arrest is different from that of the adult [27]. Respiratory arrest is far more common than cardiac arrest which, if it occurs, is usually secondary to respiratory arrest. The outcome of attempts at resuscitation from cardiac arrest in children is dismal at best, with a high chance of poor neurological status afterwards [28]. Survival following cardiopulmonary arrest in children is dependant mainly upon the immediate provision of effective rescue breathing [29], hence the recommendation of 1 minute rescue support before leaving and phoning for help.

There has recently been interesting data to suggest that ventricular fibrillation is relatively rare in individuals up to the age of 30 years [30,31] and that perhaps a similar strategy to that of the management of childhood cardiac arrest would be prudent up until this age.

The EMS system in the USA responds in a way that uses the AHA Guidelines, but also considers other causes of collapse with separate protocols to manage them. It is recognized that the result of the 'call first versus call fast' debate will vary in different parts of the world because of the different ways in which EMS systems are composed and staffed, as well as their different approaches to first aid. For this reason the Sequence of Action includes two alternative points in time when the lone rescuer may consider leaving the victim to get help—after unresponsiveness is established, or after the airway has been opened and breathing has been found to be absent.

In order to try and identify cases of primary respiratory arrest, 'one minute of resuscitation' is advised when dealing with children and victims of trauma and near drowning. The following advisory statement embodies the discussions above:

7.1. *When to get help*

It is vital for rescuers to get help as quickly as possible.

- When more than one rescuer is available, one should start resuscitation while another rescuer goes for help
- A lone rescuer will have to decide whether to start resuscitation or to go for help first. In these circumstances, if the likely cause of unconsciousness is:
  trauma (injury);
  drowning;
  or if the victim is an infant or a child

the rescuer should perform resuscitation for about 1 minute before going for help.

If the victim is an adult, and the cause of unconsciousness is *NOT* trauma (injury) or drowning, the rescuer should assume that the victim has a heart problem and go for help immediately unresponsiveness is established or after establishing unresponsiveness and the absence of breathing.

8. Action for choking

Action for choking, in particular the abdominal thrust manoeuvre, is included in most BLS guidelines. However, the incidence of an impacted foreign body in the airway is extremely low compared with the incidence of cardiac arrest from other causes. Indeed, most medical practitioners will never have encountered foreign matter in the airway that has caused death or even near death. Most cases of impacted food occur when the victim is eating, frequently whilst in the presence of other people. The event is therefore commonly witnessed. It also usually results in a progressively worsening situation of aphonia, cyanosis, and loss of consciousness, rather than sudden collapse; sharply contrasting with most cases of primary cardiac arrest.

The BLS Group decided, therefore, not to include the abdominal thrust manoeuvre as part of BLS, not only because it will be rarely needed, but because the technique carries significant added risks including gastric aspiration and damage to abdominal organs. Chest compression applied for cardiac arrest produces significant increase in intrathoracic pressure and, in the unlikely event of there being impacted material, may well be sufficient to clear the airway.

By eliminating the abdominal thrust from the teaching of basic life support there is the additional benefit that one less skill has to be learnt, which should benefit long term skill retention.

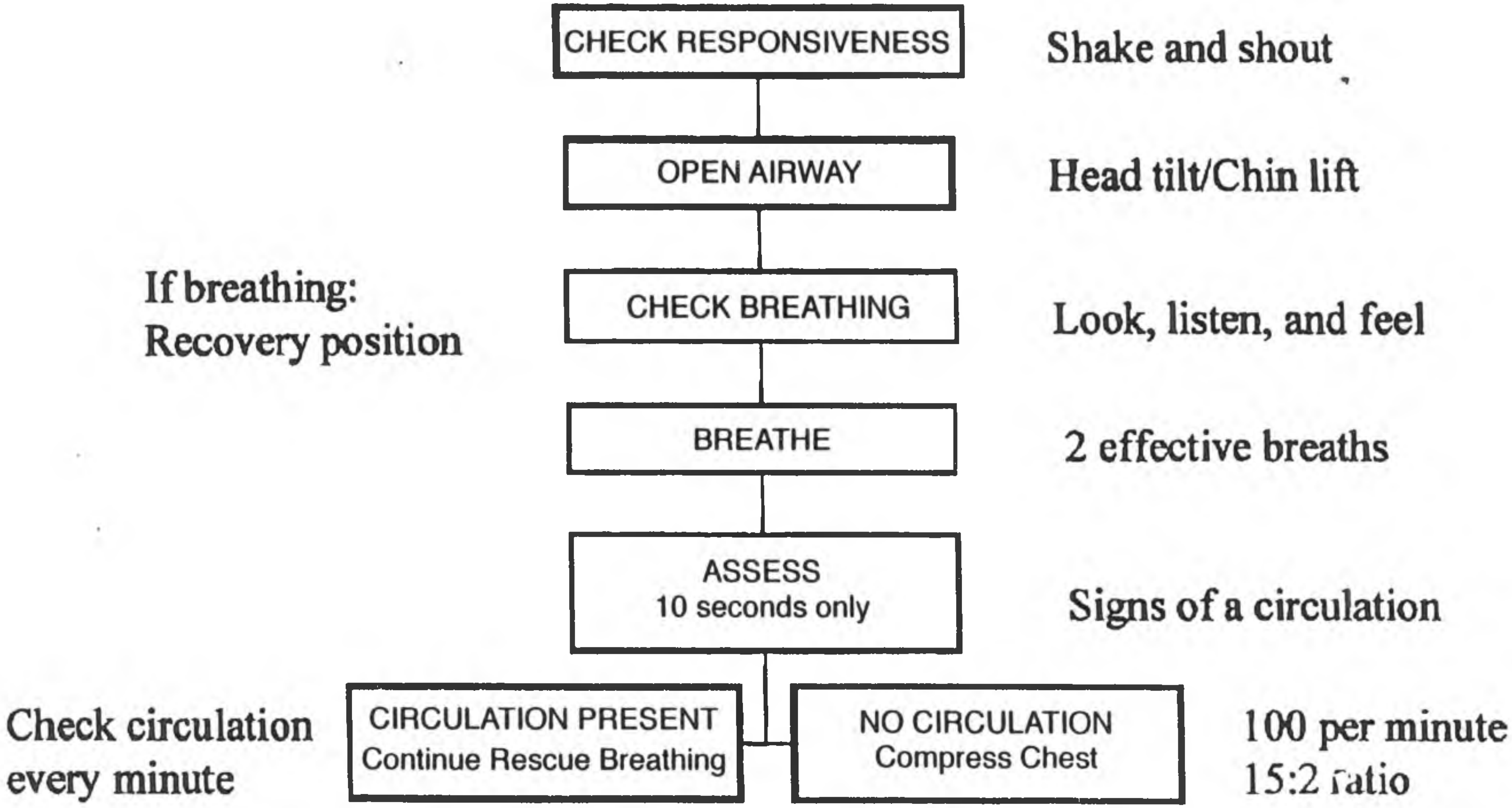
9. Recovery position

The airway of an unconscious victim who is breathing spontaneously is at risk of obstruction by the tongue and from inhalation of mucus and vomit. Placing the victim on the side helps to prevent these problems, and allows fluid to drain easily from the mouth. This lateral, coma, side, or recovery position has been advocated in anaesthesia for over a hundred years [32] and is still standard practice today. It is surprising, therefore, that its introduction into first aid practice was within the last 50 years [33]. Perhaps even more surprising is that in 1992 there was no mention of any recovery position in the AHA Guidelines [2].

Some compromise is needed when positioning the victim; a true lateral posture tends to be unstable, involves excessive lateral flexion of the cervical spine, and results in less free drainage from the mouth. A near-prone position, on the other hand, can result in under-ventilation because of splinting of the diaphragm and reduction in pulmonary and thoracic compliance [34].

Potential injury to the victim has also to be considered [35]. There have been a number of recent reports of potential interference with upper limb blood flow association with the recovery position advocated by the ERC [36,37]. This involves the lowermost arm being brought into a ventral position with the uppermost arm crossing it and producing a pressure effect on the blood

ADULT BASIC LIFE SUPPORT



Send or go for help as soon as possible according to guidelines

vessels and, possibly, the nerve supply. Placing the lowermost arm in a dorsal position may not necessarily be the answer, as this involves movement that could, at least theoretically, injure the shoulder joint. There is inadequate published evidence to come to definite conclusions but the recognition of the potential for harm as well as for benefit from placing the victim on the side has been highlighted.

Many different versions of the recovery position exist, each with its own advocates. The BLS Group concluded that it was unable to recommend one specific position, but instead agreed on six principles that should be followed when managing the unconscious, spontaneously breathing victim:

1. The victim should be in as near a true lateral position as possible with the head dependent to allow free drainage of fluid.
2. The position should be stable.
3. Any pressure on the chest that impairs breathing should be avoided.
4. It should be possible to turn the victim onto the side and return to the back easily and safely, having particular regard to the possibility of cervical spine injury.
5. Good observation of and access to the airway should be possible.
6. The position itself should not give rise to any injury to the victim.

10. Health care providers

Health care providers and emergency personnel are likely to possess extended resuscitation skills, and the situations in which they are called upon to use them may require more complicated BLS guidelines. These requirements have not been addressed in the current advisory statements, which are aimed predominately at lay persons. They are, however, planned as the subject of a future ILCOR publication.

11. Automated external defibrillators

The use of an automated external defibrillator (AED) is now considered to be within the domain of BLS [38]. In fact, learning to use an AED may be easier than learning the skills required to perform CPR. Most investigators believe that these devices should be distributed as widely as possible. Over the last five years the use of AEDs has been extended to include EMTs, fire fighters, police, airline personnel, hospital personnel and lay citizens [39]. The AHA statement on 'Public Access Defibrillation' lays down scientific evidence for the widest practical distribution of these devices throughout all communities [38]. However, there is not yet sufficient world-wide experience, nor is there sufficient world-wide availability of AEDs to warrant inclusion of training in their use in the current BLS Sequence of Action. Nevertheless, it should be noted that many resuscitation organisations are already adding training in the use of an AED to their BLS programmes in the hope of saving more lives.

Early CPR coupled with early defibrillation is a very powerful combination that improves survival from cardiac arrest. The expansion of early defibrillation into BLS is expected to continue in the future. Resuscitation organisations would do well to consider this when customizing the ILCOR BLS template to serve the particular needs of their region.

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RESUSCITATION

Editorial

The ILCOR advisory statements

This issue of *Resuscitation* contains the Advisory Statements of the International Liaison Committee on Resuscitation (ILCOR). To ensure a wide exposure of these most important documents, the statements are being published concurrently in *Resuscitation* and *Circulation* and are likely to be re-printed and quoted extensively in the future. Plans are underway for early publication in Australia and Southern Africa.

This simultaneous publication reflects the co-operation and goodwill which has been generated across continents in the world by members of ILCOR representing the European Resuscitation Council (ERC), the American Heart Association (AHA), the Australian Resuscitation Council (ARC), the Resuscitation Council of Southern Africa (RCSA) and the Heart and Stroke Foundation of Canada (HSFC) and most recently by the Consejo Latinoamericano de Resuscitacion (CLAR).

Perhaps in no other branch of medicine could colleagues representing such wide and varied specialties and regions of the globe work together with harmony and trust to seek a mutually beneficial common end and purpose for the good of those we serve—our communities.

Resuscitation has but one aim world wide—to prevent or reverse premature death in patients with severely compromised or arrested respiration and circulation. The basic principles of resuscitation have been recognised and accepted by all in the field but there remain regional variations that are related to culture, tradition, availability of local facilities and emergency medical systems, and local interpretation of (sometimes scanty and equivocal) scientific data. These variations have the potential to create confusion in a world in which resuscitation should know no boundaries. Without flexibility matters are perceived starkly as either right or wrong.

Resuscitation is a branch of medicine in which success depends on the motivation and performance of lay people and professional rescuers as well as by doctors. All of these groups benefit from guidelines as to what is best to do in the ultimate emergency when there is no time to consult a friend of colleague. All would wish that those guidelines were so secure in the light of current knowledge that they could have world wide acceptance.

It was with that goal in view that the members of ILCOR have met twice yearly since 1992 to hammer out a consensus view which was based on seeking out our similarities, not our differences and building up agreement whilst progressively paring away disagreement.

The result has been to produce Advisory Statements with accompanying simple core templates which represent a consensus view of all of the ILCOR representatives. Each continental, regional and national body of authority on resuscitation can now build on these templates and design detailed resuscitation guidelines to suit their own particular circumstances and resources.

The ILCOR advisory statements are based on painstaking evaluation of the current published scientific evidence, and represent probably the best consensus interpretation available at the present time. In many of its aspects however resuscitation is not a precise science and it is not possible to produce hard and fast guidelines. The Advisory Statements acknowledge this and in producing the templates have allowed for flexibility and variation in putting the flesh on the skeleton.

The Advisory Statements will be presented and debated in April 1997 at the 'CPR '97—Towards a Common Goal' conference in Brighton, UK. After that time the proposals and templates contained in the Statements will be considered for adoption or modification by continental and national authoritative bodies, some of which may delay a final decision until the Statements and Templates have themselves been subject to evaluation in regard to efficacy, efficiency, and the relative ease or difficulty with which the programme can be taught, be learned, and the knowledge and skill be retained.

The Advisory Statements cover Basic Life Support, Advanced Life Support, and Paediatric (including Neonatal) Life Support. There is an additional section covering resuscitation in specific conditions which may call for modification of the normal resuscitation procedures or techniques.

The highly acclaimed Utstein system for reporting cases out-of-hospital cardiac arrest is now partnered by

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an in-hospital reporting system which is also published in *Resuscitation* and concurrently in *Circulation*. The in-hospital document is also the work of representatives for the same organisations as ILCOR.

The new Utstein is likely to enhance greatly the reporting standards of in-hospital resuscitation experience and will enable us to be presented with data that can be scientifically and soundly assessed, so paving the way for improved guidelines and practice in the future.

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Emergency Oxygen Use By Lifeguards: Making a Case

Gary Horewitz, J.D., NREMT-P

In 1995, there were an estimated four thousand five-hundred (4500) drowning deaths in the United States. Of these, one thousand seven-hundred (1700) are estimated to have occurred during swimming activities. The pediatric population represented the greatest number of drowning victims per 100,000 people.[1] Estimates of near-drowning, defined as a submersion incident with a survival period of greater than twenty-four hours, are extrapolated from drowning statistics, since many near-drowning events go unreported. The incidence of near-drowning is estimated to be two to twenty-fold greater than drowning incidences, meaning that near-drowning involving swimming is estimated between three thousand four-hundred (3400) to thirty-four thousand (34,000) incidents in the representative year. ([2],[3])

Since 1914, the American Red Cross has been a part of the effort to address this serious problem. Largely due to the early ground-breaking work of Commodore Wilbert E. Longfellow, The American Red Cross is one of the leading training organization for lifeguard instruction in the United States, in 1996 training over one hundred eighty thousand lifeguard rescuers in lifeguarding skills, First aid and CPR. In addition, The American Red Cross also trains the public in water safety issues.

One of the courses offered by the American Red Cross catalogue is Oxygen Administration. When a lifeguard is certified in Oxygen Administration it stands as a sign of the growing professional capabilities of today=s lifeguard. Yet, at this time, not all lifeguards are being trained in the use of oxygen most facilities do not have oxygen as part of their medical equipment. This presents several questions. Why is oxygen important in the early care for submersion victims? Should more lifeguards be trained in the use of supplemental emergency oxygen? What are the barriers to training more lifeguards in oxygen administration? What are the barriers to oxygen delivery capabilities at aquatic facilities? What steps are being taken and can be taken to address these issues?

The importance of supplemental oxygen in the early care for submersion victims

In reviewing the literature, study and debate continues as to the definition of terms for submersion incidents.[4] Study continues on the care for victims of submersion injuries as well. Research continues for good outcome predictors for those involved in a submersion incident, whether to monitor their Intra Cranial Pressure, the application of Positive End Expiratory Pressure (PEEP), and whether or not to administer corticosteroids. [3]

However, there is no question as to the greatest issue in the near-drowning incident. ABy consensus, the most clinically important consequence of near drowning is hypoxemia.≅ Gonzalez et al. [3] AThe most important consequence of submersion is hypoxemia and its effect on the brain.≅ Kyriacou et al.[5] AThe one most devastating aspect of the drowning is hypoxemia...≅ Levin et al.[6] A...the single most important consequence of near-drowning is hypoxaemia.≅ Mackie and Manolios[7]

Pathophysiology of hyoxemia during drowning

Drowning and near-drowning can be either Adry≅ or Awet,≅ depending on whether the victim aspirates fluid or not. While laryngospasm prevents aspiration of fluid in 10-15percent of drowning incidences and near-drowning incidences, most victims have some aspiration of fluid. AWet≅ drowning and near-drowning hypoxemia pathophysiology depends on the water type the victim aspirates. Fresh water aspiration dilutes the pulmonary surfucant, altering alveolar surface tension, resulting in alveolar collapse and atelectasis. Hypoxemia in fresh water aspiration is secondary to the pulmonary shunting and ventilation-perfusion mismatch.[8]

Sea water aspiration causes attraction of intravascular fluid into the alveoli, resulting in shunting as the alveoli, already filled with sea water, continue to be perfused, resulting in secondary pulmonary edema. In both fresh water and sea water aspiration, proteinaceous fluid may enter the alveoli, resulting in acute respiratory distress syndrome, (ARDS) further impairing oxygenation. [8]

Results of hypoxemia

The pulmonary involvement and hypoxemia from submersion incidents are significant. Hypoxemia, along with hypothermia, often results in cerebral hypoxia and edema, cardiac dysrhythmias such as atrial fibrillation and bradycardia, and respiratory acidosis. Hypoxia and respiratory and metabolic acidosis are now considered the best explanations for several primary and secondary problems associated with near-drowning, including, renal failure, nervous system dysfunction and myocardial dysfunction, which was previously thought to be caused by electrolyte imbalances. ([3,4,6,8,9])

Pulmonary involvement from submersion incident was found as a significant clinical issue in a study of 91 drowning and near-drowning victims by Modell, et. al. More than 50 percent of drowning and near-drowning victims suffer from respiratory and metabolic acidosis In the initial arterial blood gas collected, more than 50 percent of the subjects had an acidemia of <7.30, which was both respiratory and metabolic in nature. Only 22 percent of the 91 patients studied had normal x-rays, while the x-rays of 14 percent showed atelectasis, 8 percent showed evidence of pneumothorax, 26 percent showed pulmonary edema and 30 percent showed some type of aspiration. Thirty percent of the subjects patients had PaO2/FiO2 ratios of less than 200. [9] Low PaO2/FiO2 ratios were found to correlate with a poor prognosis by an outcome study of 49 near-drowned patients conducted by Kaukien.[10]

Early resuscitative efforts make a difference in submersion victim outcomes.

In the pediatric near-drowning victim, early resuscitative efforts, in the first ten minutes after a rescue, has been shown to be Athe single most important factor in influencing survival.≅ [11] Yet, the efforts of paramedical personnel are often delayed. One study, in what many regard as a community that is proactive in its efforts in resuscitation education, found that paramedical care response was greater than 10 minutes in 91 percent of the victims.[12]

Fields emphasizes the points of prevention, early rescue and resuscitative efforts to reduce the time the organs are hypoxic,

> Near-drowning is a global hypoxic-ischemic insult that causes multi system organ dysfunction that correlates in magnitude to the severity and time of hypoxia and ischemia. Although several organ dysfunctions can be treated in the intensive care setting, the die is usually cast for the neurologic outcome before the patient reaches the hospital...The primary determinant of the ultimate prognosis of the vic-tim of a submersion incident is the duration of the hypoxic-ischemic insult. [4(124-125)]

The importance of the use of supplemental oxygen in drowning and near drowning victims

Rottenberg, et al. wrote generally about the benefit of supplemental oxygen in all early resuscitative efforts.

> Use of supplemental oxygen during the ventilation phase of resuscitative efforts has been shown to increase the amount of oxygen a rescuer can deliver to the victim, thus potentially enabling there to be a greater percentage of oxygen delivered to the tissues by chest compressions.[13]

Further, all of the articles reviewed outlining treatment for the near-drowning victim included prompt application of supplemental oxygen as soon as possible.

> ΑHigh flow oxygen (O_2) should be provided to the victim.≅[8(464)]

> Appropriate treatment for respiratory insufficiency associated with near-drowning includes using either supplemental oxygen or oxygen along with mechanical ventilation and positive-pressure breathing.[3(474)]

> Once trained personnel arrive, bag valve mask ventilation, with proper positioning of the tongue, use of supplemental oxygen, and on occasion, tracheal intubation may be needed...All patients must be given oxygen...even to awake patients... until it is proved that they no longer need it...[6(332)]

> ΑOxygen should be administered as soon as possible.≅ [4(120)]

The Case for Emergency Oxygen Use by Lifeguards

There have been direct statements of support in the literature. Mackie and Manolios note that after a successful rescue, a victim is at high risk for respiratory and cardiac arrest. They attribute this phenomenon, not to electrolyte or water shifts in the body, but by progressive hypoxia and acidosis as the more likely causes. This explains the emphasis of Australian lifesavers= training in applying supplemental oxygen after an apparently successful rescue. [7(170)] Rottenberg, et al. make a more emphatic statement.

> Supplemental oxygen for CPR may be particularly effective for pediatric drowning and near-drowning victims, for whom supplemental oxygen is recommended as soon as possible. Most pediatric drowning and near-drowning occur in residential swimming pools, locations where it would be realistic to have an emergency oxygen supply on hand. [13(1030)] See note:[1]

At the same time, there has not yet been a prospective or randomized study looking at early use of oxygen by lifeguards on the outcome of those involved in submersion incidents. Yet, the logical model can be built, by examining what has been previously demonstrated.

1) Hypoxia is the most critical issue in the submersion victim, leading to a number of critical care concerns.
2) Early resuscitative efforts make a difference to the outcome of the submersion victim.
3) Emergency medical services system providers, particularly advanced life support personnel, can be delayed in arriving beyond a critical time-frame.
4) Oxygen is an accepted and important first-line care for the submersion victim that should be applied as soon as possible.
5) Lifeguards can be trained to deliver needed oxygen.

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[1] Rottenberg, et al. also cite, Fields AI. Near-drowning in the pediatric population. Critical Care Clinics 1992; 8(1):113-114, and Levin DL, Morriss FC, Luis TO. et al., Drowning and near-drowning. Pediatric Clinics of North America 1993; 40(2):332

Thus, it can be proposed, that by incorporating supplemental oxygen administration into a lifeguard=s early resuscitative efforts, submersion incident victims will have a better outcome.

Another benefit of emergency oxygen delivery capabilities is probably more valuable than this note here. Aquatic facilities are public venues, and there are a number of non-submersion events where oxygen administration is appropriate. Early use of supplemental oxygen is a well-documented benefit to the treatment of acute cardiac event, asthma and many traumatic injuries. These events occur at all public venues and preparation is most beneficial.

Barriers to increasing training and preparation for use

Unfortunately, one cannot merely decide that oxygen administration training and preparation is good idea for lifeguards, declare it so, and magically all lifeguards are trained and facilities are prepared. There are challenges to be addressed and overcome.

Institutional challenges at the American Red Cross to greater training delivery

In 1993, the American Red Cross released its Emergency Response (ER) program, the course designed specifically for those with a duty to respond. At the same time, the American Red Cross released a modular program with information from Emergency Response, entitled Oxygen Administration. Emergency Response instructors were authorized to teach the Oxygen Administration module separately. The Emergency Response program is an extensive course, requiring significant time and equipment commitments from American Red Cross instructors, chapters and stations, the service delivery units by which the American Red Cross organizes. This affected the ability of chapters and stations to get instructors in Emergency Response, and made it even more difficult to add the burden of Oxygen Administration training to these instructors.

By 1997, when the Emergency Response course was revised, there were almost three times as many chapters and stations offering instruction in lifeguarding programs than chapters offering Emergency Response. There was almost six times as many lifeguard instructors as there were Emergency Response instructors. Finally, there were almost 10 times as many instructor trainers in the lifeguard program as the Emergency Response program. In short, there were just not enough Emergency Response instructors to deliver the Oxygen Administration program to all lifeguards trained by the American Red Cross.

Concerns of facilities in adopting an oxygen administration program & capability

It would seem obvious that cost would be the first issue that presents a barrier to greater training and preparation for use of emergency oxygen by lifeguards. Cost is a factor, from equipment acquisition and maintenance, to increased training times. However, the initial materials acquisition cost should be minimal in the overall budget of a facility, as little as $200.00 U.S. It is more difficult to assess the degree that increased training time poses a barrier to more widespread use, but the time to teach the Oxygen Administration course is less than four or five hours, if added on to existing knowledge.

The second issue is liability exposure. Some facility administrators may feel that by adding emergency oxygen delivery capability, there may be liability exposure if the equipment is not used properly and thus it is better not to have the equipment at all. It is true that this potential exposure exists, but a significant, if not greater exposure to legal consequences, is failing to have the equipment, especially if others do have the equipment and training. Thus, this barrier is more one of education and balance than reality.

One of the most significant barriers to adoption of oxygen training is facility administrator concern over regulatory issues to use and training in the use of emergency oxygen. In the United States, the U.S. Food and Drug Administration (FDA) regulates medical devices and medications. The FDA, through its regulatory powers granted it by Federal law, has the power to require medical authorization (prescription) to use a particular drug. The FDA does require a prescription for long-term therapeutic application of oxygen. However, on September 19, 1996, the FDA made clear that no prescription is required for the emergency application of oxygen. It now require the following labeling on oxygen devices, Afor emergency use only when administered by properly trained personnel for oxygen deficiency and resuscitation. For all other medical applications, Caution: Federal law prohibits dispensing without a prescription.≅

The September 1996 clarification was in response to the Compressed Gas Association making a formal request for a clarification by the FDA to a proposed rulemaking published in 1972. Prior to this clarification, the national regulatory status of emergency oxygen use was left to states, interpretation of a≅proposed rulemaking≅ and ignorant speculation. States were left free to regulate emergency oxygen use, and some have. Each state has an emergency medical system that is administered by a state regulatory body that dictates the scope of practice, including oxygen training and use, for members of the emergency medical services system.

While the U.S. Department of Transportation distributes generic guidelines for the training of each level of EMS responders, each state, and sometimes municipalities, are free to create its own layers of responders. The accompanying scope of practice levels vary as well, from first responder to emergency medical technician-basic to emergency medical technician- intermediate, to emergency medical technician-paramedic. Not all states recognize a formal first responder certification. States also vary the degree of medical authorization required to practice for each level.

Where lifeguards are trained and certified under one of these formal levels, training and use of emergency oxygen may be a function of medical authorization, following state and local dictates. However, in most states, there is no clear definition as to the use of the emergency oxygen beyond these well-defined actors. Does including oxygen as part of the scope of practice for emergency medical technicians exclude others? Is the FDA ruling sufficient and definitive? If no specific prohibition about the use of oxygen and training exists, can authorization be presumed, or is the use of oxygen practicing medicine without a license. A dearth of clear guidance or enforcement history left a void, and some aquatic facility administrators have been previously reluctant to venture forth.

How the barriers to training and implementation are being addressed

First, there are changes that can help allay the concerns of facility administrators to adopting an oxygen administration program. The regulatory picture for the future looks brighter. Now, if states do not specifically add specific regulation on the use of emergency oxygen administration, FDA position may offer needed comfort to previously reluctant facility administrators. The key factor will be education and awareness. Furthermore, some states may be open to following the federal lead and specifically enact rules and laws that encourage appropriately trained individuals to be prepared to administer emergency oxygen.

As to the challenges of greater delivery capabilities, the American Red Cross is revising its Oxygen Administration program and taking steps to allow not only lifeguard instructors to teach the program, but community level CPR instructors may also be prepared to deliver the course. This will enable thousands of potential instructors to learn the material and deliver the course.

Conclusion

Oxygen plays a vital role in the care of victims of submersion incidents. Study must continue to assess the exact costs and benefits of preparing lifeguards to deliver emergency oxygen when needed. It would seem apparent though, that by having lifeguards prepared to address hypoxia, the greatest threat in a submersion incident, there is potential to improve the outcome of so many, who would otherwise suffer tragic results.

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Mr. Leahy spent eight years in the Victoria Police Service where he reached the rank of Senior Detective. He left the Police Service in 1991 to work with Surf Life Saving Australia as a National Development Officer. Based in the state of Queensland, he managed the professional lifeguard services and the "Westpac Life Saver" Rescue Helicopters.

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Spinal Injuries Extrication - The Australian Perspective

by Stephen Leahy CertALEP
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With nearly 86% of the Australian population living along the 37,000 kilometres of beautiful coastline, it is no wonder that ocean and aquatic sports are a favourite Australian pastime. Surf Life Saving Australia is one of the largest volunteer aquatic rescue organisations in the world, with 22,000 active surf lifesavers (total membership of 80,000) patrolling 300 aquatic locations around the country.

Apart from immersion, one of the most traumatic incidents that a surf lifesaver will encounter is a spinal cord injury (SCI) in the surf zone.

Every year, about 420 Australians suffer a spinal cord injury. While spinal cord injuries can happen to anyone, most patients who suffer SCI are aged between 15 and 29. For every injured female there are five injured males. Alcohol is a common factor.

Spinal cord injuries as a result of water sports make up 20% of all spinal cord injuries. It follows motor vehicle injury and falls from a height as a cause of permanent spinal injury.

This cause of spinal injury has been neglected to date and has been overshadowed by motor vehicle injury in spinal awareness campaigns in Australia. Unfortunately there is a general lack of public education and health promotions in regards to overall water safety. Considering most victims of water sports related spinal cord injury are young people of normally healthy lifestyle, I suggest that this group warrant special attention as the patients live longer and require greater resources and rehabilitation.

Research programs conducted by State Governments and Surf Life Saving Australia estimate that it costs the community AU$625,000 for each drowning. One can expect that this figure would rise for each permanent spinal cord injury.

The major damage in a surf related incident is to the C5 and C6 vertebrae. Two separate studies, (Griffiths, 1980 and Hall & Burke, 1978) are both supportive of this and suggest that males make up 95% of victims. It would be fair to say that most spinal cord injuries could be prevented.

Rescue from the water must be effected early as the patient is usually face down and therefore suffocates within minutes. The lucky ones are able to walk from the water, simply complaining of severe neck pain. The unlucky ones will remain permanently quadriplegic.

Water rescue organisations round the world continue to grapple with the issue of how best to conduct preventive programs and how best to handle the patient once the injury has occurred.

The International Life Saving Federation Medical Commission discussed rescue techniques in Cardiff in 1994 and conducted trials with the assistance of the director of the spinal unit in that city.

Directors of spinal units in Australia, as well as rescue and medical experts from international aquatic organisations, have been consulted in the formulation of SLSA's techniques. The technique has been developed over a period of more than 10 years and has been extensively trialed both in Australia and overseas.

RECOGNITION

Aquatic neck injuries may occur in a variety of ways, so all lifesavers and persons involved in water safety must have a high index of suspicion.

a) The most common presentation is the person **who leaves the water and immediately or very soon afterwards complains of a painful neck**. In these circumstances, the assumption of spinal injury must be made and the neck immobilised immediately by the most experienced persons on the spot using whatever means are available. There may also be limb symptoms such as pins and needles or weakness.

b) Less frequent is **the witnessed event** in which the patient is seen to dive into shallow water or be dumped in the surf.

c) Third is the non-witnessed but highly suspicious circumstance where a person is found floating face down in or near shallow water.

d) Least suspicious, but still possible is any person found floating face down in deep water. Each of these must be managed as a potential spinal injury victim.

Spinal injury may involve only the bones, ligaments, etc, or, less frequently and more seriously, the delicate spinal cord itself, producing varying degrees of damage to nerve tissue. However, all spinal injuries must be managed by lifesavers and first aiders according to the same basic rules.

POLICY

Principles of Rescue and Treatment

1. First priority is to remove the person's face from the water while at the same time stabilising the neck in the neutral position. Removal of the patient's face from

the water is clearly the first step in creating a clear airway which must then be maintained at all times.

2. **Breathing must be assessed as quickly as possible** and this is done in the usual way. In practice, the presence or absence of breathing will usually be very obvious when the patient's face is no longer covered by water.

3. **If breathing is absent**, rescue should proceed as a normal rescue and resuscitation, taking as much care of the neck as possible. **Resuscitation is much more important than a suspected neck injury when the patient is not breathing**. The principles of Airway, Breathing and Circulation always take precedence over any suspected injury.

4. **If breathing is present**, the rescuers can usually be unhurried in their rescue. Wave conditions, the possibility of hypothermia, rocks, etc may dictate the need to expidite the rescue but the lifesavers present will assess all of these factors.

   At all times during rescue, the neck must be kept in the neutral position and the whole of the spine kept in normal alignment. If attempts to place the neck in the neutral position produce or aggravate pain in the conscious person, the neck should be immobilised in the position of comfort for that person. The neck should never be forced into the neutral position, but, if resistance is met, it should be immobilised as is.

5. Recruitment of assistance is especially important in the unsupervised environment. Not all spinal injuries occur at patrolled beaches or in guarded pools. Removal of a spinal injury person from the water is very difficult unless there are adequate numbers of persons available to help. The most experienced lifesaver present should assume responsibility.

6. Without equipment, removal from the water requires a maximum number of assistants, care and lack of speed to ensure that the neck and the remainder of the spine are kept in position as described above.

7. In the surf, removal from the water is described in the SLSA Surf Lifesaving Training Manual, 1995, 30th edition. This Manual, the basis of all surf lifesaver training is currently being revised and rewritten. The latest procedure is reproduced here for you:

SPINAL INJURY CARRY

In cases where spinal injury occurs in dumping surf, the patient is usually floating face down in shallow water. There is often a dumping surf or an inshore gutter. To carry a patient with a suspected spinal injury safely:

- *The first rescuer should come alongside the patient and place both arms quickly under the patient's armpits, with hands on either side of the patient's head, over the ears. Because of the action of the waves and the movement of the water, the first rescuer and the patient's head may be facing the on-coming waves.*

- *Holding the neck still and stable, the whole of the victims upper body is lifted so that the patient's face is lifted clear of the water, which will allow breathing, the patient's hips will sink into the water. This is not difficult, even with a heavy patient, because of the buoyancy of the water.*

- *The neck should be maintained in the neutral position* ****** *from this point on until the completion of the rescue.*

  ** The neutral position is when the head, neck and spine are in a position that, when standing straight, the eyes face directly towards the horizon.*

- *If breathing is present, subsequent movements can be unhurried. However, if breathing is absent, the need for EAR is urgent and the patient must be moved to the beach as quickly as possible, with maximum care to the neck region.*

- *More members of the patrol will be required to assist in lifting the patient. The exact number of patrol members needed will be determined by the size of the patient, the number of rescuers available and the surf conditions. It may be necessary to enlist members of the public if a full patrol is not available. The most senior lifesaver present should assume control and give clear directions on all movements involving the patient.*

  - *One person should hold the patient's head and take responsibility for neck stability. Ideally, this should be the most senior person present; however, unnecessary changing of the patient's position is not recommended.*

  - *As soon as enough rescuers are present, the patient should be moved carefully to the beach.*

  - *At least one member must observe and report on approaching waves and other surf conditions.*

  - *Movement must be slow and careful, taking into account the sand conditions underfoot.*

  - ***Depending on beach and surf conditions, the patient may be moved from the water feet first, or head first****. Conditions of the day will dictate, and the decision made by the most senior lifesaver present.*

- *When the rescue team reaches reasonably level dry sand, above the water line, rescuers should position themselves to lower the patient to lie across the beach, facing the water.*

- *Lowering of the patient must be very careful - speed is not important if breathing is present.*

- *The patient's lower arm should be moved across to allow correct positioning. At this stage, if a qualified, experienced member is present, application of a neck brace improves neck stability.*

  The patient is placed in the lateral position with the neck supported, the airway cleared, if necessary and breathing reassessed. If a suitably qualified, experienced operator is present and a neck brace has been applied, this is left in position with the head and neck supported in the neutral position. Complete immobilisation of the head with sand, or any other means is totally acceptable. The application of a neck brace by a non-expert person is NOT recommended.

- *The conscious patient who is breathing should be carefully laid on their back, using at least two operators. The patient should be turned gently, with the head and neck continuously supported. At all times, the whole spine should be kept in line, without bending or twisting.*

- *The unconscious person should always be nursed in the lateral position with the head in the neutral position. This can be achieved by using a neck brace, hands, towels or sandbags.*

Most patients will be conscious and able to talk at this stage. If they are not vomiting (or feeling sick) they can be nursed on their backs. If this means the patient has to be turned, it should be done gently. Oxygen therapy may be very helpful at this stage. The patient should be covered with towels or blankets, depending on weather conditions, and may need to be protected from the hot sun. At this stage, most patients will be able to talk, and it is often possible to obtain from them an idea of what led to the incident. This will be of help to the ambulance staff when they arrive. Reassure the patient and the relatives. Keep crowds away.

All persons with suspected spinal injury should be transferred by ambulance to hospital for expert assessment."

8. **All patrolling lifesavers must practise the drill for spinal injuries frequently**.

9. At the earliest opportunity, medical retrieval must be arranged.

10. The cervical collar (neck brace) was introduced into the management of aquatic neck injuries in Australia in the summer 1992-93 and teaching has proceeded systematically since that time, being restricted to holders of the Advanced Resuscitation Certificate. The cervical collar has been used by overseas lifeguards for a lot longer on the recommendation of their medical advisers.

It is therefore the policy of Surf Life Saving Australia that cervical collars are appropriate adjuncts to the management of aquatic neck injuries provided their use is restricted to those who have been specifically trained in their use.

The cervical collar is always used as an adjunct to and not a substitute for correct management of immobilisation, airway management and transport. It should not be used in a patient who requires respiratory or cardiac resuscitation.

Full details of the use of the cervical collar are published in the SLSA Surf Lifesaving Training Manual No 1, 1995, 30th Edition.

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Dr. Mackie's primary interest in lifesaving lay in the area of lifeguard education. From 1973 for 9 years he was National Education Officer to Surf Life Saving Australia and then became National Medical Adviser. From 1976 to 1986 he was Chairman of the World Life Saving Medical Panel and on the formation of ILS became its first Medical Commission Chairman.

Since the advent of multi discipline endurance events Ian Mackie has produced prolific publications on safety aspects of competition in addition to his many publications on aspects of death in the water and near drowning. Since 1982 Ian has been National Medical Adviser to the Royal Life Saving Society Australia.

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THE THERAPEUTIC USE OF OXYGEN BY AUSTRALIAN LIFESAVERS 1997

Because drowning and near drowning are hypoxic episodes, the use of oxygen early in the near drowning process was considered a priority at much the same time as Expired Air Resuscitation was introduced into community teaching in 1960.

Traditionally manuals of instruction for life saving organisations within Australia were updated every five years but the rapid acceleration of research in the areas of resuscitation and oxygen use in the late 50's and early 60's required much more frequent revision. CPR was described in detail in 1961 and oxygen enrichment with the Ambu bag was first described for lifesavers in 1961. The 1964 manual showed photographs of the use of an air bag and oxygen but detailed descriptions were lacking. The 1969 manual took this further but a detailed program of instruction in the use of oxygen did not eventuate until 1973 when the National Medical Panel recommended the use of a single device to be used on a national basis. This was a manually held, trigger operated, pressure device which delivered 60 litres of oxygen per minute for adults and 30 litres per minute for children. In addition the same machine known as an Oxy Viva provided therapy at a fixed flow of 8 litres per minute and suction by a Venturi system. The Oxy Viva box was specified to contain 2 oxygen therapy masks and 2 anaesthetic masks.

Oxygen therapy for the patient with spontaneous breathing was taught at Bronze Medallion age (minimum age 15 years) and a detailed curriculum was written. This basic curriculum remains essentially unchanged in 1997 and at least 100,000 lifesavers in both Surf and Royal Life Saving organisations have been trained to this level.

Mouth to mask resuscitation was also introduced in 1973 together with the description of supplementary oxygen with the therapy tube either through the nozzle of the mask or under the rubber coping of the mask. Basic oxygen usage and the Advanced Award required extensive training sessions so that Instructors and Examiners were created on a nationwide basis. At that stage retraining was set at every 2 years but this is currently set at every year. The use of the manually triggered positive pressure head was restricted initially to lifesavers who were at least 18 years of age but this age is now set at 16 years.

Over the next 10 years Resuscitation Report forms were completed by lifesavers around the country to provide feedback on the use of oxygen and Coroners' Reports were read on all drowning victims. No problems were reported.

In 1981 the Australian Standards Association brought down findings which required aquatic organisations to change to equipment which met new standards. Unfortunately the earlier manually triggered device did not meet the standard and so after detailed research and trials the Medical Panel recommended a return to bag valve mask leaving oxygen therapy and mouth-to-mask resuscitation with oxygen unchanged.

The old Oxy Viva was phased out over 6 years and the air bag reintroduced with detailed description in training manuals. By August 1987 the change over was complete.

Since then reports on the use of resuscitators have been universally satisfactory and no serious problems have ever arisen. Currently the most frequently used regulator has a choice of 8 litres per minute for oxygen therapy or 15 litres per minute with the use of the air bag.

It is a policy of both Surf Life Saving Australia and the Royal Life Saving Society Australia that where possible all lifesavers using aquatic facilities whether they be out-door or indoor, surf or stillwater should be trained in the use of oxygen. The criteria for training and retraining are specified in great detail and regular followup is regarded as being an item of being the utmost importance.

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Fred Mael is a Research Scientist at the American Institutes for Research, a research and consulting organization in Washington, DC, and an adjunct professor in the psychology and management departments at Loyola College in Baltimore, MD. He previously spent eight years as a Senior Research Psychologist at the Army Research Institute for Social Sciences in Alexandria, VA. Mael has a Ph.D. in Industrial/Organizational Psychology from Wayne State University, as well as a Masters in Counseling psychology. His areas of research expertise include personnel selection methods such as biographical data, invasion of privacy in selection, individual commitment to work and other organizations, and minority representation in aquatics.

Mael is the author of over three dozen journal articles, book chapters, and conference presentations, and has made invited addresses at the International Swimming Hall of Fame and various universities. He also serves on the editorial board of Personnel Psychology and reviews papers for six other journal as well.

Mael has conducted research into reasons for lack of minority participation in aquatics, and reasons for differences between minorities, which has appeared in the Journal of Applied Psychology. This research was an outgrowth of his work with the U.S. Army Special forces and the U.S. Military Institute at West Point. His research on this topic has also been featured in Athletic Monthly Magazine, the Washington Post, Monitor Radio, and the St. Petersburg Times. He is continuing to work on issues in aquatics with the American Red Cross and other organizations.

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Staying Afloat: Within-Group Swimming Proficiency for Whites and Blacks

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Generally, Blacks are less likely than Whites to be proficient at swimming. Blacks also have higher rates of drowning and are underrepresented in competitive swimming and in occupations requiring swimming or water safety skill. In this study, physiological, demographic, and biodata measures were used with military academy cadets to determine the individual factors contributing to within-group swimming proficiency among Blacks as well as Whites. The best predictor of swimming skill was the age at which the cadets had learned to swim. Other items pointed to fitness, sociocultural, and learned or dispositional differences between better and poorer swimmers. Implications for increasing swimming proficiency among Blacks and for future research are discussed.

Swimming is a popular form of strenuous exercise that alternately serves as a recreational activity, a competitive sport, and a survival skill. The inability to swim not only deprives people of swimming's health benefits and pleasures but may also jeopardize their lives. The Centers for Disease Control and the National Safety Council reported 4,600 drownings in the United States in 1989. Although the number of drownings has declined since 1980 (7,257) and 1986 (5,596), drowning is still the third most common cause of unintentional injury death for all ages and ranks second for ages 5–44 years (S. P. Baker, O'Neill, Ginsburg, & Li, 1992).

At every level of swimming, from minimal competency to representation in world-class competition, there are stark differences in the performance or participation of American Blacks relative to American Whites (Allinder, 1989; Hoose, 1990; Teplitzky, 1992). This discrepancy has negative implications for Blacks, ranging from increased drowning risk to underrepresentation in occupations and sports requiring swimming skill. However, because the various reasons advanced for poorer swimming by Blacks have not been studied simultaneously, competing and potentially stereotypic reasons that ignore other potential sources of variance have been advanced. In addition, until the true reasons for Black–White discrepancies are known, correct solutions cannot be advocated. Moreover, the reasons why some Blacks are more likely to be swimmers than others have not been examined. I address these issues in this article. Because Black–White swimming differences have been well established, the primary focus of this article is on differences in swimming proficiency among Blacks. Replication of findings of Black–White differences, focusing on possible reasons for these differences, is a secondary purpose of this article. To accomplish both purposes, I identified background characteristics and experiences related to swimming proficiency and learning how to swim. The results may suggest directions for upgrading Blacks' involvement in swimming. First, evidence for Black–White swimming differences is reviewed, and possible reasons for poor swimming proficiency, some of which may be especially applicable to Blacks, are discussed.

Group Differences in Swimming and Water Safety Proficiency

In the United States, the rate of drowning among Blacks is 2–3 times as high as that among Whites (S. P. Baker et al., 1992; Campbell, 1991; Dietz & Baker, 1974; Kizer, 1983; Palinkas, 1985). Differences have also been seen in a study of lifeguard rescues at 150 water parks servicing almost 24 million guests (Ellis & Associates, 1991). Out of 16,333 rescues, 33% of all rescuees were Black, and 43% of all rescuees were White, although Blacks make up only 13% of the U.S. population, with state percentages ranging from 36% (Mississippi) to less than 1% (Montana).

There are also significant differences in minimal swim-

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ming proficiency that could affect employment opportunities. Allinder (1989) found attrition at all three Navy Recruit Training Centers because of failed swimming requirements was much higher for Blacks (6%) than for Whites (1%). At one center, although Blacks comprised only 15% of all trainees, they accounted for 75%–78% of all swimming failures during 1987–1989. Similar discrepancies were found with the 50-yard (45.72-m) swimming requirement of the U.S. Army's Special Forces Assessment and Selection (SFAS) course. During Fiscal Year 1991, 15% of Blacks failed the pre-SFAS swim test, compared with 3% of Whites and 5% of Hispanics (cf. Teplitzky, 1992). Inability to swim can also endanger the nonswimmer's life or limit his or her chances for employment and promotions in other military and civilian occupations and careers, such as maritime commerce and engineering, fishing, marine research, lifeguarding, and offshore oil exploration and drilling. Finally, Blacks are underrepresented in competitive swimming, and no Black swimmer has ever been on a U.S. Olympic team (Burfoot, 1992; Hoose, 1989).

Reasons Advanced for Group and Individual Differences

Physiological Differences

A wide array of physiological characteristics are advantageous for excelling at various sports, including swimming (Arnot & Gaines, 1986). However, using those characteristics to explain racial differences in performance is liable to generate controversy and charges of racism (Burfoot, 1992; L. R. Cohen, 1994). Nevertheless, Burfoot cited extensive research showing physical qualities that purport to explain Blacks' running superiority and speculated that similar physiological factors could conversely hamper Blacks' ability to swim.

Numerous researchers have demonstrated that Black Americans as a group have less subcutaneous fat and are less buoyant than Whites (P. T. Baker & Newman, 1957; Burdeshaw, 1968; Campbell, 1991; Lane & Mitchum, 1964; Malina, 1972). Blacks as a group have denser bones, resulting in denser lean body mass (Malina, 1972; Schutte et al., 1984). (Subcutaneous fat is adipose tissue directly beneath the skin surface, as opposed to fat surrounding organ and muscle tissue. Lean body mass refers to all nonfat body mass, such as muscle, bone, and organs.) Burdeshaw found that Black female college students had a harder time learning strokes demanding or aided by buoyancy (i.e., sidestroke and elementary backstroke) than did fellow White students with equivalent training. In addition to aiding buoyancy, which facilitates learning to swim (Page, 1975), body fat acts as insulation to preserve body heat and reduces the energy needed to maintain one's body on a water surface (Costill, Maglischo, & Richardson, 1992). Thus, Campbell (1991) noted that lack of body fat might lead to greater discomfort in cold water, which might hamper relaxation and concentration on learning. These effects may vary, however, depending on the strokes and the distances involved. For example, Campbell (1967) found that although buoyancy affected ability to learn individual components of the crawl stroke, it did not do so when the skills were coordinated as a whole. Whereas additional body fat and buoyancy are advantageous for distance swimming, muscle power can usually compensate in sprints and 200–400-m races (Arnot & Gaines, 1986). Finally, "previous studies suggest that swimming success is dependent more on the swimmer's skill than on muscular strength and endurance" (Costill et al., 1992, p. 26).

Moreover, even if physiological differences explained the paucity of Black swimming champions in the United States, they would not be sufficient to explain differences in minimal swimming capability. Added buoyancy would favor women over men and endomorphs over ectomorphs; yet, slim White men do not comprise a large class of nonswimmers. Thus, in the current study, I examined physiological differences as one possible contributor to individual differences in swimming ability.

Social Differences

Sociocultural factors have generally been viewed as more important reasons than physiological differences for poorer swimming among Blacks (Allinder, 1989; Campbell, 1974; cf. Jackson, 1993). Campbell (1991) and Hoose (1989) have described the lack of quality swimming facilities for inner-city youth. Like golf and tennis, in which Blacks are underrepresented (Potter, 1992), swimming requires facilities that may be too expensive for or inaccessible to some Blacks.

Unfortunately, this perspective tends to treat race and lower socioeconomic status as being synonymous, with the concomitant, untested assumption that rates of swimming among middle-class Blacks are similar to those among Whites. Therefore, in this study, I examined some correlates of socioeconomic status that relate directly to differences in childhood experiences and upbringing, especially those that covary with opportunities to learn how to swim. These differences are best understood from a sociological perspective. One advantage children of the middle and upper-middle classes are said to have over their lower-class counterparts is their *sponsored independence* (Farber, 1964). Their parents seek to control their external and recreational environment, exposing them to various enriching or valued pastimes and skills. Children from higher socioeconomic strata are more likely to belong to the Boy or Girl Scouts, hobby groups, or other extracurricular organizations. In addition, "children go away to summer camp, and, during the school year, may take lessons in music, dancing, swimming, skiing, or tennis" (Elkin & Handel, 1989, p. 89). In contrast, children of lower socioeconomic classes are more likely to lead lives of *unsponsored independence* (Farber, 1964), in which, outside of school and family responsibilities, they are much more on their own. Like their parents, who serve as their role models, they are less likely to join communal organizations or to engage in enrichment and skill-developing opportunities that are not strictly utilitarian. Their scope of interests is narrower, and they are less likely to discuss national or international current events with their families. Although no direct data on socioeconomic status could be gathered for this research, it was expected that both Blacks and Whites coming from more middle-class and upper-middle-class homes, in which children have greater exposure to extracurricular enrichment, would be more likely to swim at an earlier age and to be more capable swimmers.

Individual Differences

Another source of variance in swimming may be individual differences. One realm of individual differences relates to physical fitness and activity level, which are related to swimming ability (Behrman, 1967). In this research, I therefore hypothesized that persons who were more physically fit and more physically active and who had a preference for individual-type sports would be more attracted to swimming and hence would be more proficient swimmers. This should be true for both Blacks and Whites.

A second realm of individual differences is dispositions and learned tendencies to be fearful, tentative, or risk-aversive. Fear of water is often invoked by nonswimmers as a primary reason for not having learned to swim (Behrman, 1967; Whiting & Stembridge, 1965). As learning to swim involves some degree of self-confidence and absence of risk-aversiveness, I hypothesized that youth who by disposition or upbringing were more introverted or sheltered would be somewhat slower to learn how to swim and therefore less proficient than more outgoing and adventurous youth. Although specific fear of water and swimming need not be dispositional, the hypothesis that generalized tendencies will affect learning how to swim has some empirical support. In a study of 204 college students, Behrman found that nonswimmers tended to be more restrained, serious, shy, submissive, and reclusive and less aggressive and sociable than swimmers. A subset of the nonswimmers, who failed to learn to swim in spite of training, were more tense and high-strung than others in addition to being unathletic and relatively uncoordinated. In a study of 11–12-year-old boys, Whiting and Stembridge found nonswimmers to be more neurotic and introverted. Also, Page (1975) found that extroverted boys learned to swim more quickly and that physical buoyancy was more crucial for the introverted youth attempting to learn to swim. These individual differences would likely apply to both Whites and Blacks.

In summary, a disparity exists between Black and White Americans regarding swimming participation, with implications for access to occupational and fitness opportunities. In this article, I used variables that capture Black–White differences to explore why some Blacks are better swimmers than other Blacks. I hypothesized that differences in physiology, physical-fitness levels and proclivities, sociocultural experiences and opportunities, and individual swimming aversiveness based on personal tendencies, background experiences, or both would contribute to differences in swimming proficiency, especially within the Black community. As part of the study, I evaluated individual differences among Whites as well.

Method

Sample

The incoming cadets of the U.S. Military Academy (USMA) at West Point, New York, classes of 1994 and 1995, participated in the research during their first few days at the USMA (1990 and 1991, respectively). Of the 2,549 cadets, 157 (6%) were Black, and 2,099 (82%) were White, with all others designated as belonging to other racial categories. Cadet race was self-defined. Of the Black cadets, 29 (18%) were female, and 128 (82%) were male. Of the White cadets, 236 (11%) were female, and 1,863 (89%) were male.

The cadets were selected into the USMA on the basis of their scores on a weighted composite called the whole candidate score, 60% of which is based on an applicant's standardized test scores (i.e., Scholastic Aptitude Test and American College Test) and graduating rank in high school; 30% of which is based on the Leadership Potential Score, which is derived from an evaluation form filled out by high school instructors, and a checklist of extracurricular activities and varsity sports; and 10% of which is based on scores on a physical aptitude examination, which is described later in the *Physical condition and exercise propensity* section. On the one hand, because cadets are chosen on the basis of stringent standards, there is the possibility of restriction of range on many of the predictors described below; on the other hand, the sample assures that even Blacks and Whites who are athletically and academically elite will be represented in the research.

Biodata Questionnaire

Items from a biodata questionnaire, which was developed for admissions and selection purposes (Mael & Hirsch, 1993), were used for this research. The items that were used were all historical and objective (Mael, 1991) and as such were less likely to be tainted with socially desirable responding, compared with typical, subjective self-report measures (Becker & Colquitt, 1992; Mael & Hirsch, 1993).

The method used to key the biodata items was a modified form of empirical keying, in that only keys that could be justified theoretically were used, even if more idiosyncratic ones may have appeared to provide initially higher validities. By using this more conservative approach, the probability of shrinkage can be reduced, and the relationships revealed by the biodata can contribute to substantive knowledge about the predictor–criterion relationship (Mael, 1994). A hypothetical example of this form of empirical keying is provided below.

Suppose that for the item "How many years did you play varsity pinball in college" and a criterion measure of manual dexterity, means on the criterion for each response choice were 2.7 (not play at all), 3.1 (1 year), 3.1 (2 years), 3.5 (3 years), and 3.9 (4 years). One might assign a 0 to "not at all," a 1 to "1–2 years," a 2 to "3 years," and a 3 to "4 years." However, if the mean for 2 years had been 3.5 and the mean for 3 years had been 3.35, then rather than postulating the unlikely thesis that 3 years was somehow less predictive of dexterity than was 2 years, one would take the more conservative approach and assign a single value for 2–3 years. Additional guidelines for this so-called "rainforest empiricism" approach, guidelines which were drawn almost wholly from the expertise of longtime biodata practitioners, are discussed in Mael and Hirsch (1993).

After reviewing the aforementioned literature for potential biodata precursors or correlates of swimming proficiency, I evaluated items from the biodata instrument and other USMA admissions measures for their ability to adequately test the hypothesized relationships. On the basis of this evaluation, I selected 20 items for the research, and I grouped them according to the aforementioned categories as follows.

Physical condition and exercise propensity (4 items). Biodata items measuring weekly hours devoted to sports and exercise, and preference for individual versus team-oriented sports were used. Also included were scores on the USMA Physical Aptitude Exam, which is a weighted composite of various fitness indicators (i.e., pull-ups [or flexed arm hang for women], standing long jump, basketball throw, and 300-yard [274.32-m] shuttle run). Understandably, physical-fitness scores at USMA suffer from range restriction, because almost all cadets are varsity high school athletes. Another item was a measure of experience with three rugged, outdoors types of physical activities consisting of three items about hiking, wilderness exploration, and mountain climbing (with a combined alpha of .63).

Physiology (2 items). To assess the hypothesis that lower body fat and reduced buoyancy is related to lower swimming proficiency, I obtained height and weight measurements for the cadets. I used these measurements to derive scores on the Quetelet index, known more popularly as the body mass index (BMI), which is defined as weight in kilograms divided by height in meters squared (Hamilton, Whitney, & Sizer, 1988; Heyward, 1991). BMI is often used as a measure of a person's percentage of body fat, which may lead to greater buoyancy. Although the BMI is a somewhat coarse measure of body fat because it is also sensitive to the weight of lean muscle mass, the BMI is moderately to strongly correlated with more sophisticated skin-fold measures of body fat (Davis, Shapiro, Elliot, & Dionne, 1993; Laws, King, Haskell, & Reaven, 1993; Neggers, Stitt, & Roseman, 1989; Roche, Siervogel, Chumlea, & Webb, 1981; Ross & Mirowsky, 1983). I also included weight as a separate variable.

Swimming and sociocultural opportunity (5 items). A single biodata item measuring the age at which the cadet had learned to swim was included. Those cadets who had never learned to swim were excluded from the item to avoid inflating correlations with the swimming criterion. Four items relating to differential experiences or preferences of more middle- or upper-middle-class youth were included: (a) having been a Boy or Girl Scout, (b) watching less television daily, (c) having taken music lessons, having learned to play a musical instrument, or both and (d) preference of social studies as a favorite high school subject (compared with math, English, or physical science).

Tendencies to avoid swimming (8 items). Eight items were included that were indicative of persons whose behavioral styles, through parenting, disposition, or both, might make them less likely to learn to swim well. I hypothesized that very studious and rule-oriented youth (ranked high in their high school class, spent more nights at home per week, spent more time on homework, and more frequently attended religious services) would be poorer swimmers. Similarly, I predicted that those cadets who were less outgoing (preferred socializing with fewer people), less independent (entered later into part-time work and spent less summers working), and more typically risk-aversive (such as firstborns; Nisbett, 1968; Yiannakis, 1976) would be poorer swimmers.

Gender. A final item on gender was included in the study, as I hypothesized that the genders might differ on the stress put on their mastery of swimming, compared with achievement in other athletic and nonathletic endeavors.

Additional items, such as parental socioeconomic status or the number of parents at home, may have proved useful. However, because the instrument was developed for selection purposes, those questions might have been perceived as invasive and hence were omitted.

USMA Swimming Test

USMA regularly administers a swimming test to all cadets shortly after their arrival at USMA. The cadets are categorized according to the distance that they are capable of swimming. A cadet who cannot swim 50 yards (45.72 m) is classified as a nonswimmer. Those who can swim 51–160 yards (46.63–146.30 m) are categorized as beginners. Low intermediates are those who can swim 161–200 yards (147.22–182.88 m) within a 5-min period. High intermediates and advanced swimmers can swim 201–260 yards (183.79–237.74 m) and 261+ yards (238.66+ m), respectively, within 5 min. Thus, the criterion is coded as 1 = nonswimmer, 2 = beginner, 3 = low intermediate, 4 = high intermediate, and 5 = advanced.

For the classes of 1994–1995, 3% of Whites were classified as nonswimmers. In contrast, 29% of Blacks were classified as nonswimmers, and another 44% of Blacks were categorized as beginners. At the other extreme, 12% of White cadets were coded as advanced swimmers compared with less than 2% of Black cadets. Thus, Blacks, who made up 6% of these classes, accounted for 37% of the nonswimmers and only 2% of the advanced swimmers. The Black–White differences were statistically significant, $\chi^2(5, N = 2{,}256) = 336, p < .001$.

Each of the biodata items was correlated with the swimming test. I used moderated regression (Evans, 1991; Stone & Hollenbeck, 1984) to determine if an item's relationship with swimming outcomes was moderated by race. I used multiple regression with backward selection (J. Cohen & P. Cohen, 1983; Dillon & Goldstein, 1984) to determine which subset of items accounted for unique variance within each group. Because the main focus was within-group differences, I performed separate regressions for both the Black and White cadet populations. Nevertheless, the differences in statistical power made direct comparisons of Black–White regression coefficients problematic and decreased the likelihood of detecting true predictors of Black swimming proficiency. Thus, in instances when a comparable predictor–criterion correlation was significant for the White subsample and was not significant for the Black subsample, one cannot conclude that the true correlation among Blacks was zero or significantly different from the correlation among Whites. A final combined regression was conducted to determine if race accounted for additional variance over and above the other variables.

Results

Descriptive statistics and intercorrelations for the 20 predictor items and swimming proficiency for Whites and Blacks together and for each group separately appear in Table 1. It became apparent that the best predictor of current swimming capability was the age at which the cadet learned to swim, with earlier learning being positively correlated with swimming proficiency. The correlation was .43 for Blacks and .32 for Whites. Because of this strong relationship, age of learning was treated as an additional intermediate criterion, although perhaps it served as a mediator between swimming ability and some of the other variables. When age of learning was used as a criterion, however, never having learned to swim was also included as a response option.

The results of the moderated regression analyses, shown in Table 2, demonstrated that race moderated the predictor–criterion relationships in four cases with the swimming proficiency criterion and in eight cases with the age of learning criterion.

Black–White Differences

The groups differed not only in swimming ability but also in age of learning. Over 90% of Whites had learned to swim by age 9 compared with 58% of Blacks. Conversely, whereas only 1% of Whites had never learned to swim, 16% of Blacks had not. The fact that Blacks in the sample tended to learn to swim at a later age might help to explain a curious finding: Although the drowning rate among Blacks is more than twice that among Whites for all ages, the rate for White children ages 1–4 years is double that of Blacks (S. P. Baker et al., 1992). If White children were generally exposed to swimming at a much earlier age, the result would be not only earlier learning but also more exposure to drowning risks.

Furthermore, Blacks were also less proficient swimmers than were Whites who learned to swim at the same age. Among Blacks, 64% of those who learned to swim by age 5 were coded as low intermediates or higher. For those who learned between 6 and 9 years of age, that number dropped to 30%. Less than 7% of those learning after age 9 were low intermediates or higher. Among Whites, the equivalent rates of swimming proficiency were 90% (by age 5), 70% (between ages 6 and 9), and 35% (over age 10).

Correlates of Swimming Proficiency

Physical condition and exercise. Hours of exercise and scores on the Physical Aptitude Exam were significant correlates of swimming proficiency and earlier swimming for Blacks and Whites. Also, those who preferred individually oriented sports and who were involved in rugged, outdoors activities were more capable swimmers, with significant correlations for Whites and correlations of equivalent magnitude for Blacks. Race did not moderate the relationships between these variables and the criteria.

Physiological differences. Unlike previous research, albeit with less select samples, Blacks' and Whites' scores on the BMI were not different (23.51 and 23.59, respectively). In addition, BMI scores were unrelated to either swimming ability or age of learning for both groups. However, heavier cadets were both better swimmers and earlier learners, with significant correlations for Whites and equivalent correlations for Blacks.

Swimming and sociocultural opportunity. As mentioned above, age of learning was the strongest predictor of current swimming proficiency for both Blacks and Whites. Three items were significant indicators for Blacks only. Those cadets who watched less television than others and those who favored social studies over other core high school courses were better swimmers. Those cadets were also more likely to have learned to swim at an earlier age, as were those who had been Boy Scouts or Girl Scouts. Conversely, music lessons were a significant correlate of age of learning among Whites. Race did moderate a number of these relationships, as indicated in Table 2.

Tendencies to avoid swimming. Among both Blacks and Whites, cadets who were more studious and better academic performers were poorer swimmers. Among Blacks, those who more frequently attended religious services were significantly poorer swimmers, whereas

Table 1
Means, Standard Deviations, and Intercorrelations for Total, White, and Black Samples

Biodata item	*M*	*SD*	1	2	3	4	5	6	7
1. Hours of exercise									
Total	0.99	0.47	—						
White	1.00	0.47	—						
Black	0.98	0.52	—						
2. Prefers individually oriented sports									
Total	0.38	0.62	.07*	—					
White	0.39	0.62	.07*	—					
Black	0.23	0.47	−.01	—					
3. Physical Aptitude Exam									
Total	564	81	−.19*	−.10*	—				
White	561	79	−.19*	−.09*	—				
Black	607	93	−.20*	−.13	—				
4. Rugged, outdoors activities									
Total	0.99	0.63	−.04	.07*	.01	—			
White	1.01	0.63	−.03	.06*	.04*	—			
Black	0.67	0.61	−.08	.09	−.08	—			
5. Body mass index									
Total	23.59	2.80	−.08*	−.11*	.01	−.01	—		
White	23.59	2.77	−.08*	−.10*	.01	−.01	—		
Black	23.51	3.26	−.16*	−.26*	.03	−.09	—		
6. Higher body weight									
Total	1.54	0.84	−.13*	−.14*	.10*	.03	.31*	—	
White	1.54	0.84	−.12*	−.14*	.09*	.03	.29*	—	
Black	1.54	0.85	−.27*	−.19	.21*	.01	.50*	—	
7. Age at which learned to swim									
Total	1.66	0.44	.13*	−.01	.03	.13*	.00	.07*	—
White	1.70	0.40	.14*	−.04	.06*	.10*	−.01	.07*	—
Black	1.18	0.67	.18*	.05	.13	.03	.03	.07	—
8. Boy or Girl Scout									
Total	1.12	0.99	−.02	.05*	−.06*	.15*	−.05*	−.03	.06*
White	1.13	0.99	−.03	.05*	−.06*	.15*	−.04	−.03	.04
Black	1.01	1.00	−.04	−.01	.01	.09	−.10	−.01	.16*
9. Watches less television daily									
Total	1.65	0.61	−.03	.02	−.02	.07*	−.03	−.01	.05*
White	1.67	0.60	−.04*	.01	−.01	.05*	−.03	−.01	.00
Black	1.41	0.73	.04	.15	.00	.17*	−.03	.00	.15
10. Music lessions									
Total	1.50	0.87	.01	.03	−.02	.05*	−.03	−.01	.09*
White	1.50	0.87	−.00	.03	−.02	.05*	−.04	−.01	.10*
Black	1.51	0.86	.05	.03	−.01	.06	−.03	−.04	.05
11. Social studies favorite subject									
Total	0.62	0.93	−.02	.01	−.02	.02	.02	−.05*	.00
White	0.64	0.93	−.01	.00	−.01	.01	.02	−.06*	.04
Black	0.44	0.83	−.11	.13	.03	.10	.07	.08	.16*
12. High school rank (R)									
Total	0.96	0.88	−.10*	.02	.09*	.08*	.09*	.12*	.07*
White	0.95	0.88	−.11*	−.02	.08*	.08*	.10*	.13*	.08*
Black	1.11	0.87	.01	.19*	.15	.23*	−.04	−.08	.15*
13. Nights spent at home per week (R)									
Total	1.44	0.73	−.09*	−.04*	.03	.03	−.05*	.01	.08*
White	1.45	0.73	−.09*	−.05*	.05*	.01	−.07*	.01	.08*
Black	1.32	0.78	−.10	.06	−.08	.15	.13	.06	.06
14. Weekly hours spent doing homework (R)									
Total	0.93	0.78	.07*	.00	.05*	−.04*	.07*	.03	.01
White	0.94	0.78	.07*	−.01	.06*	−.05*	.07*	.03	−.03
Black	0.79	0.77	−.04	.12	.05	.00	.13	.05	.00
15. Religious attendance (R)									
Total	0.63	0.93	.03	.06*	.04	.03	.00	−.01	.00
White	0.64	0.93	.04	.05*	.05*	.02	.01	.00	−.03
Black	0.55	0.90	−.08	.12	.00	.05	−.13	−.10	.16*
16. Preferred number of friends for socializing									
Total	0.90	0.74	−.08*	−.04	.00	.02	.00	−.02	.05*
White	0.91	0.74	−.08*	−.05*	.00	.02	.01	−.01	.04*
Black	0.78	0.74	−.03	−.02	.03	.01	−.09	−.05	−.06
17. Earlier part-time work									
Total	1.66	0.75	.02	−.02	.02	.06*	.02	.04	.07*
White	1.67	0.74	.02	−.02	.02	.05*	.02	.03	.06*
Black	1.55	0.84	−.01	.01	.08	.10	.05	.06	.09
18. More summers worked									
Total	1.28	0.96	−.02	−.03	.04	.09*	.00	.04	.04
White	1.29	0.96	−.02	−.02	.05*	.08*	.00	.04	.05*
Black	1.19	0.99	.00	−.08	.02	.22*	.00	.00	−.10
19. Birth order									
Total	0.94	0.73	.01	−.01	.03	−.02	.00	−.04	.00
White	0.93	0.73	.00	.00	.02	−.01	−.01	−.04	−.01
Black	1.04	0.74	.15	−.08	.07	−.03	.03	−.05	.20*
20. Gender									
Total			.04*	.08*	−.16*	−.13*	−.15*	−.09*	.00
White			.04	.08*	−.17*	−.12*	−.15*	−.08*	.05*
Black			.13	.03	−.16*	−.10	−.17*	−.17*	−.21*
21. Swimming proficiency									
Total	3.05	1.14	.12*	.07*	.08*	.13*	−.03	.08*	.36*
White	3.13	1.12	.13*	.05*	.12*	.10*	−.04	.08*	.32*
Black	2.02	0.98	.13	.09	.17*	.11	−.02	.09	.43*

Note For the total sample, $N = 2{,}257$. For the White sample, $n = 2{,}099$. For the Black sample, $n = 158$. R = reverse scored.
*$p < .05$.

8	9	10	11	12	13	14	15	16	17	18	19	20	21
— — —													
.02 .02 .00	— — —												
.06* .06* −.01	.05* .05* .04	— — —											
.02 .02 .01	−.02 −.03 .04	−.05* −.05* −.09	— — —										
.02 .03 −.09	−.04* −.05* .12	.00 .01 −.04	.07* .07* .12	— — —									
.00 −.01 .05	.00 −.01 −.04	.01 .01 .03	.02 .02 −.02	.04 .04 .06	— — —								
−.03 −.02 −.17*	−.11* −.13* −.04	−.04 −.04 −.06	.02 .01 .20*	.10* .11* .10	−.02 −.03 .10	— — —							
.01 .01 −.09	−.06* −.07* .08	−.04* −.04 −.07	.02 .02 .05	.04* .03 .26*	−.03 −.03 −.02	.01 .01 .02	— — —						
−.01 .00 −.14	−.01 −.02 .03	.00 −.01 .07	.00 −.01 .12	.10* .10* .10	.07* .07* .05	−.01 −.02 −.01	.04* .04 .03	— — —					
.05* .05* .13	.01 .00 .05	.00 .01 .03	.00 −.01 .10	.07* .08* .07	.04 .03 .07	.02 .02 .05	−.02 −.03 .03	.01 .01 .08	— — —				
.00 .00 .07	.01 .01 .02	.01 .02 .05	.01 .00 .07	.10* .10* .12	.04 .04 .01	.00 .00 .01	−.01 −.01 −.03	.00 −.01 .08	.35* .35* .35*	— — —			
.00 .00 .02	.02 .02 .05	.03 .04 −.03	−.01 −.01 .10	.03 .03 .09	−.05* −.05* −.06	.00 −.01 .20*	−.03 −.04 .04	.00 .00 −.03	.02 .02 .01	.03 .02 .07	— — —		
.05* .05* .02	.06* .07* .11	.10* .11* .04	−.08* −.08* −.05	−.10* −.10* −.11	−.03 −.02 −.12	−.12* −.13* −.08	−.02 −.02 .01	.03 .03 .10	−.06* −.06* .02	−.04 −.04 −.01	.04* .03 .20*	— — —	
.05* .04 .15	.03 .01 .26*	.03 .03 .10	.00 −.02 .20*	.10* .10* .23*	.08* .07* −.03	−.02 −.05* .14	−.01 −.03 .18*	.09* .08* −.05	.06* .05* .16*	.04* .05* −.08	.03 .03 .18*	−.01 .01 −.11	— — —

Table 2
Moderated Regression Analyses for Swimming Ability and Age of Learning: Standardized Betas and Incremental Validities

	Swimming ability				Age of learning			
Biodata item	Item	Race	Item × Race	Incremental R^2	Item	Race	Item × Race	Incremental R^2
Hours of exercise	.15	.23*	.03	.000	.01	.39*	.16	.001
Prefers individually oriented sports	.03	.27*	.05	.000	.16	.37*	.17	.000
Physical Aptitude Exam	.11	.28*	.02	.000	.05	.53*	.27	.001
Rugged, outdoors activities	.08	.27*	.01	.000	.13	.28*	.04	.000
Body mass index	.06	.30*	.06	.000	.06	.41*	.12	.000
Higher body weight	.08	.24*	.00	.001	.03	.32*	.05	.000
Age at which learned to swim	.37*	.11	.05	.000				
Boy or Girl Scout	.05	.27*	.10	.000	.17*	.35*	.23*	.002*
Watches less television daily	.21*	.36*	.24*	.003*	.19*	.41*	.24*	.003*
Music lessons	.03	.27*	.07	.000	.10	.29*	.01	.000
Social studies favorite subject	.23*	.39*	.26*	.002*	.33*	.50*	.37*	.004*
High school rank (R)	.00	.28*	.11	.000	.09	.35*	.19*	.002*
Nights spent at home per week (R)	.17*	.21*	.12	.000	.05	.30*	.02	.000
Weekly hours spent doing homework (R)	.21*	.18*	.20*	.001*	.05	.29*	.03	.000
Religious attendance (R)	.20*	.28*	.20*	.002*	.30*	.34*	.31*	.005*
Preferred number of friends for socializing	.21*	.22*	.14	.000	.16	.26*	.14	.000
Earlier part-time work	.03	.29*	.10	.000	.02	.33*	.08	.000
More summers worked	.15	.21*	.12	.000	.23*	.24*	.21*	.002*
Birth order	.09	.29*	.14	.000	.32*	.41*	.36*	.006*
Gender	.10	.17	.14	.000	.36*	.01	.47*	.009*

Note. $N = 2{,}257$. R = reverse scored.
* $p < .05$.

among Whites, cadets with more extroverted styles, as expressed in a preference for socializing in larger groups, tended to be better and earlier swimmers. Both Blacks and Whites who had earlier part-time work experiences were better swimmers. Having worked more summers during high school was a significant positive correlate of swimming ability among Whites, whereas for Blacks, the correlation, albeit not statistically significant, was larger and in the opposite direction. Finally, birth order was a significant swimming correlate for Blacks: Oldest and only children learned to swim later and swam more poorly than later-born siblings.

Gender. This variable alone had statistically significant correlations in opposite directions for Blacks versus Whites. Black men were significantly more likely than Black women to have learned to swim at an earlier age, whereas among Whites, the reverse was true.

Multiple Regression Analyses

Multiple regression analyses, with standardized regression weights for both races and both criteria, appear in Table 3. Among Blacks, the best predictor of swimming ability was the age of learning. Other variables with significant beta weights seemed indicative of more active, less homebound lifestyles. Regarding age of learning, the primary contributors of unique variance were either demographics or variables with both sociocultural and active lifestyle implications.

Among Whites, age of learning also accounted for the most unique variance in swimming proficiency. Among Blacks, physical conditioning and physiological variables made significant contributions to both multiple regressions, whereas sociocultural variables contributed little. Individual differences, such as birth order and extroverted socializing preferences, contributed to prediction of swimming ability.

As a final step, all variables were regressed simultaneously on swimming ability for the whole sample, with race entered on a second step. Race added significant incremental variance to the multiple correlation squared (incremental $R^2 = .02$, $p < .001$) and had the second largest beta weight (.16), after age of learning (.30). The multiple correlation rose from .41 to .44 when race was included. Thus, the combined effects of the other variables did not account for all variance in Black–White differences.

Discussion

Statistical Issues in Data Interpretation

In this study, a number of hypothesized variables accounted for variance in both swimming ability and age of

Table 3
Multiple Regression Analyses for Swimming Ability and Age of Learning

Biodata item	Swimming ability (β)		Age of learning (β)	
	Blacks	Whites	Blacks	Whites
Physical condition and exercise				
Hours of exercise		.05	.21	.12
Prefers individually oriented sports		.08		
Physical Aptitude Exam		.04		.04
Rugged, outdoors activities		.04		.09
Physiology				
Body mass index		.06		
Higher body weight		.07		.06
Swimming and sociocultural opportunity				
Age at which learned to swim	.34	.30		
Boy or Girl Scout			.18	
Watches less television daily	.15		.15	
Music lessons				.09
Social studies favorite subject				
Tendencies to avoid swimming				
High school rank (R)		.08	.08	.04
Nights spent at home per week (R)				.07
Weekly hours spent doing homework (R)	.14	.07		
Religious attendance (R)		.04		
Preferred number of friends for socializing		.05		
Earlier part-time work	.16			.05
More summers worked			.15	
Birth order		.04	.29	
Gender			.20	.10
R	.52	.38	.47	.25
Adjusted R^2	.23	.14	.14	.06

Note. $n = 158$ for Blacks; $n = 2{,}099$ for Whites. All standardized beta weight values are significant at $p < .05$. Adjusted R^2 was computed using the Stein formula (Kennedy, 1988). R = reverse scored.

learning for both Blacks and Whites, with the primary focus being within-group differences. Two issues need to be noted when interpreting statistical differences in correlations for each group. First, although fewer variables accounted for statistically significant variance in the Black sample, as a group they accounted for more variance in the criteria, as evidenced in Table 3. However, it should be noted that the variance on the age of learning variable among Blacks was much higher, increasing the possibility for substantial relationships with predictors. In addition, in the Black sample, most of the within-group variance on swimming ability differentiated between swimmers and nonswimmers, whereas most Whites in the sample were functional swimmers, and variance among them was at the high end, in terms of gradations in swimming endurance and ability (i.e., how many laps could one swim quickly in the USMA swimming test). Both of these differences could be reflected in differing patterns of relationships within the regressions for these two subsamples.

Second, when statistical relationships for both the Black and White subsamples are being discussed, it is important to reiterate that differences in sample size may have led to statistically significant differences in effect size when the correlation coefficient for the Black sample was equivalent to or even higher than that for the White sample; yet, only the latter was statistically significant. An example is the correlation of preference for individually oriented sports to swimming ability, which was .05 ($p < .05$) for Whites and .09 (*ns*) for Blacks. It would be incorrect to interpret this finding as evidence that there was no relationship between sport preference and swimming proficiency among Blacks, as .09 was the best estimate of the true population correlation between the variables and would have been statistically significant if the sample size had been larger. Thus, differences in statistical significance must be interpreted with caution, and replication with a larger Black sample is highly desirable.

Factors in Swimming Experience and Proficiency

A number of potential factors that differentiated between cadets who did and did not achieve proficiency in swimming prior to entering USMA were discerned. Possible explanations and supporting findings are discussed below.

Age of learning. Clearly, learning to swim at an early age best predicts swimming proficiency. Perhaps older nonswimmers are more likely to develop a fear of the water. Moreover, once children reach adolescence, the shame of seeking instruction as a beginner while others of both genders swim in the deep end of the same pool can be a serious deterrent.

Physical condition and exercise. The current finding that greater physical fitness increased the likelihood of learning to swim and swimming proficiently is consistent with data from the aforementioned SFAS course. Successful completion of the SFAS swimming test was significantly related to all three components of a concurrent physical-fitness test (push-ups, sit-ups, and a timed run). The relationship between hours of exercise and learning to swim at an earlier age may also be indicative of a personal or parent-mandated active lifestyle.

Physiology. This research did not support the premise that Blacks have less body fat, contributing to lower buoyancy and poorer swimming ability. Also, no within-group links between BMI and swimming proficiency were found, although in the regression for Whites, those with lower BMI scores were somewhat better swimmers. Perhaps the detrimental effects of higher BMI, indicating overweight or less athletic tendencies, negate or override any potential positive gains from greater buoyancy (cf. Costill et al., 1992).

However, BMI is an imperfect measure of body fat, which is itself not the optimal measure of buoyancy (Page, 1975). This may be especially relevant in a restricted sample of athletic cadets. Thus, one cannot assert unequivocally from this research that buoyancy is a nonfactor in the swimming ability of the general Black population.

Sociocultural opportunity. Items indicating sociocultural differences in upbringing made a significant contribution to explaining variance in swimming proficiency among Blacks, consistent with the concept of sponsored independence (Elkin & Handel, 1989; Farber, 1964) described earlier in the *Social Differences* section, in which middle- and upper-middle-class children are provided with more enriched extracurricular experiences and are encouraged to obtain nonacademic skills (music, crafts, or swimming), to join communal organizations, and to spend less time watching television. Because pools are more ubiquitous in primarily White schools and neighborhoods and because more White parents would themselves be capable swimmers, class-related differences among Whites may be less relevant to swimming.

Tendencies to avoid swimming. The hypothesis that more academically accomplished and more studious youth would be later learners and poorer swimmers was supported among both Blacks and Whites. Especially among Blacks, those with a more active, outgoing lifestyle were more likely to master swimming. Although earlier and more extensive work experience was generally related to swimming ability, among Blacks more summers worked during high school was negatively associated with learning to swim, as indicated by the moderated regression in Table 2 and the beta weight in Table 3. One could speculate that this is a function of within-group sociocultural differences as well, in that less affluent youth who worked more had less time for summer enrichment and swimming. Those who preferred extroverted socializing, but nevertheless preferred individual (vs. team-oriented) sports, were most likely to excel at swimming. Birth order was a major differentiator among Blacks, although the hypothesized reason, that firstborns are more risk-aversive and thus less likely to swim (Nisbett, 1968; Yiannakis, 1976), should logically apply among Whites as well. Once again, an interaction of individual and societal factors may be involved. In the White community, most children may be pushed to swim, whereas in the Black community, with more nonswimming parents, self-selection may be a more important factor in learning and mastering swimming. Thus, the findings regarding birth order cannot be clearly attributed to underlying dispositional differences without additional research.

Gender. The biggest difference between Blacks and Whites was in the role of gender in learning to swim. White women were more likely to learn to swim at an earlier age; perhaps their male counterparts were being diverted to competitive team sports at that stage of their lives. The reverse significant difference among Blacks is more puzzling. However, numerous Black female social scientists, swimming professionals, and college students who were interviewed as part of this research stated that hair care was a social deterrent to swimming. This has also been stated by Dr. Wilburn Campbell, an educator and athletic director with over 30 years of experience in teaching and studying Black aquatics. The texture of Blacks' hair requires more styling care after swimming, so that even recreational swimming demands greater time commitment, making swimming less attractive to Black women (Campbell, 1991; Wessel, 1994; Woodham, 1994). While especially relevant to female adults and adolescents, this could partially explain why young Black girls are introduced to swimming at a slower rate as well.

Another explanation may be that as noted above, more sheltered and obedient youth of both sexes were generally less likely to learn how to swim. Thus, Black men who learned to swim at an earlier age may have done so through their own initiative, whereas Black women were more sheltered by their parents. In the White community, in which swimming is more actively stressed by parents, this would not apply.

Summary

As a group, Blacks are less accomplished than Whites in swimming. This has a number of negative consequences, ranging from lost recreational and employment opportunities to increased risk of drowning. In this study, a number of reasons for between-groups and within-group differences were presented, although the additional unexplained variance relating to Black–White swimming differences requires further study. However, the experience of Blacks at USMA is encouraging. Each USMA cadet is required to achieve some swimming proficiency before graduation, and the USMA swimming coach affirmed that during his 30-year tenure, no cadet of any ethnic group has failed to learn to swim by graduation. With proper instruction, it appears that virtually all Blacks, at least in age and fitness cohorts like this sample, could become functional swimmers. However, the intensive swimming training at USMA is not available to other members of the army, not to mention the civilian population at large. Thus, one solution may lie in more swimming pools and instruction in Black communities. However, another important avenue may be education and marketing. Swimming needs to be reestablished in the public consciousness as not only a sport and a form of recreation but also as a survival skill.

Moreover, there are signs of change. New urban pools and swim clubs are introducing more young Blacks to aquatics and successful competitive swimming (Hoose, 1989, 1990). A recent national swim meet, showcasing over 600 primarily Black members of urban swim teams, underscores this trend (Backover, 1993). The consensus is that given sufficient opportunity, the rate of swimming among Blacks will increase, and the Black–White gap will be narrowed. It is desirable to hasten that process.

More research is clearly needed, beginning with replication of this research encompassing a wider cross-section of Blacks. It is also possible that in other countries or societies, the scope and the sources of between-groups and within-group variance would also differ. Optimally, studies that could also incorporate explicit measures of socioeconomic status, parental involvement in swimming, parental and personal fears about swimming (cf. Behrman, 1967), and other physiological measures of buoyancy could clarify many of the hypotheses spawned by this study. In addition, the line of research should eventually be expanded to other minorities, such as Hispanics and Asian Americans, as well.

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The Drowning Process and Lifeguard Intervention
Jerome H. Modell, M.D.

For at least the past two centuries, various persons have speculated on and conducted research regarding the drowning process. One of the first descriptions of the procedures used in attempting to resuscitate the drowning victim was described in a monograph written by Herholdt & Rafn in 1796 (1). The contents of this monograph are fascinating since the very crude methods of pushing or blowing air into the victims lungs and pushing on their chest to remove the air are remarkably similar to the modern techniques of mouth-to-mouth ventilation and closed cardiac massage, which were described in detail in the late 1950's (2) and early 1960's (3).

The Drowning Process

One of the more fascinating descriptions of the drowning process was written by Lowson in 1903. He described what occurred to himself when he became submerged after a shipwreck (4). His experience was most stressful and frightening before he lost consciousness. Those of us that have had the opportunity to participate in rescue and treatment of drowning and near drowning victims are keenly aware that there is no universal common history as to how the individual became submerged or what conscious experience they recall subsequent to recovery (5). Some individuals are observed to struggle in the water or even cry out for help before disappearing below the surface. In my experience, however, this seems to be the exception rather than the rule. Others will suffer head or neck trauma from diving in shallow water or hitting their head on the side of the pool, which leads to unconsciousness or a cervical spinal cord injury that renders them unable to control their arms and legs. Some will deliberately swim under water and lose consciousness before they surface. This is particularly true for persons that hyperventilate prior to entering the water; in which case, they significantly drop their arterial carbon dioxide tension so that they prolong the time before the normal stimulus of carbon dioxide to breathe takes over (6). By that time, their arterial oxygen tension has decreased to a level that is incompatible with consciousness and they begin to breathe water. Others consume alcohol or drugs, which interferes with their ability to save themselves when they get into trouble in the water (7). Others may become exhausted, particularly while swimming in open water, and cannot sustain the muscle activity necessary to keep their head above water. Some will swim in cold water and develop total body hypothermia. Although hypothermia may protect them from the effects of cerebral hypoxia for a longer period of time, when their temperature falls below 30°C they are more susceptible to lethal cardiac arrhythmias. Still others suffer some other medical event such as profound hypotension and syncope, cardiac arrhythmia, or a convulsive disorder, which renders them unable to keep from becoming totally submerged. In this case, the drowning episode is secondary rather than the primary process. Still other individuals will be dead of other causes prior to entering the water. They are found in the water and, therefore, because of that circumstance, they may be signed off as a "drowning" by a coroner who either did not perform an autopsy or the autopsy did not show evidence of water aspiration.

From interviews of persons I have treated, I have found substantial variation in their recollection of the events preceding and during the drowning process. Recollections vary from no memory of the events in victims who likely lose consciousness very early in the process, such as occurs after hyperventilation and underwater blackout; to the victim who realizes they are in trouble and struggles to survive. These persons report fear, despair, a struggle to keep from being submerged, a blockage of their throat, and a crushing feeling of their chest or burning substernal pain prior to losing consciousness.

Physiology

Ten percent of persons found in the water who are thought to have drowned do not have evidence of water aspiration in their lungs. This was first reported by Cot in 1931 (8) and was an observation that he had made at autopsy. Modell, et al, (9) reported a similar percentage of near drowned patients (12%) that had arterial oxygen tensions upon arrival at the hospital of 80 mmHg or above, which they interpreted to be compatible with the data of Cot. They thought that these individuals either had not aspirated water or had aspirated an insignificant amount. This suggests that these victims underwent laryngospasm while submerged to the point of developing sufficient hypoxia for them to lose consciousness and/or suffer cardiac arrest, but without actually actively breathing in water. It is important to point out that there are no controlled scientific studies to verify that about 10% of drowning and near drowning victims do not aspirate water. Particularly in those victims who are found dead in the water, one must remember that if evidence of water aspiration is not present, then an equally likely conclusion is that the individual was not alive when they entered the water or at least was not breathing at that point.

This leaves at least 88-90% of drowning and near drowning victims that do aspirate water. When that occurs with fresh water, the water is absorbed very rapidly into the circulation and, depending on the volume, there may be a very transient hypervolemia. This fluid is redistributed rapidly, however, and significant persistent changes in serum electrolyte concentrations are rare (10). The water does, however, lead to significant ventilation-to-perfusion mismatch in the lungs and intrapulmonary shunting (11). The physiologic mechanism by which this likely occurs is the alteration of the surface tension properties of pulmonary surfactant. This, in turn, leads to alveolar hypoventilation and collapse (12). Thus, there is no opportunity for the blood to become re-oxygenated as it perfuses such alveoli. Because sea water is hypertonic, after sea water aspiration there is movement of fluid from the vascular space into the lungs (13). This, produces fluid-filled, but perfused alveoli, which similarly result in alteration of ventilation-to-perfusion ratios and intrapulmonary shunting. In either case, severe hypoxemia occurs, and if not treated very rapidly, will lead to permanent neurologic damage or death.

Length of Submersion and Survival

I frequently am asked how long after one becomes submerged can they be resuscitated back to normal health. Obviously, no ethical researcher would preform controlled experiments to determine this with precision. Factors that obviously will effect the length of time from submersion to successful resuscitation and conversely to permanent neurologic damage or death, include whether the victim entered the water with their lungs maximally deflated as opposed to maximally inflated, whether the victim had concurrent pre-existing disease that would limit resuscitability, the temperature of the water to which the victim was exposed, whether the victim was impaired in any way either mentally or physically, whether the submersion episode was observed in which case an accurate time-line could be constructed, or whether the victim was merely found in the water without witnesses as to the preceding events. Based on having participated in the treatment of over 120 near-drowning victims (14), I believe that, unless there was a pre-existing medical event that lead to the drowning episode, individuals in whom effective ventilation and circulation are restored within three minutes of the submersion episode will have an excellent chance for normal survival. With a submersion time of three to five minutes, survival may still be likely, however, the longer the time period from onset of submersion until effective ventilation and circulation is re-established, the more likely permanent neurological damage will occur. With submersion times of at least five minutes, normal recovery is uncommon. This should not discourage one from resuscitating such victims, however. I have personally treated a victim who was known to be submerged in a warm water pool for ten minutes by the clock and awakened to be able to communicate appropriately with others even though her lung damage was so extensive that she died (7).

If the submersion episode occurs in cold water, then the time course is prolonged before irreversible cerebral hypoxia occurs because hypothermia decreases the requirement for oxygen, thereby, prolonging the interval between cassation of ventilation and circulation and permanent brain damage (15). It is unknown exactly how long the brain can be without oxygen under hypothermic condition and still recover complete function. To a great extent, it depends on how rapidly the hypothermia occurs prior to the cessation of circulation. In 1963, Kvittingten and Naess (16) reported on a child who was submerged under a frozen body of water in Norway for a substantial length of time before being retrieved and resuscitated. This child had a long recovery period, but did recover to a point where he could return to his class in school. Some techniques of performing extensive open heart surgery on infants require that the infant first be cooled to very low temperatures with a cardiopulmonary bypass machine. When extremely low temperatures are achieved, the machine is stopped in order to obtain a bloodless field, the cardiac lesion is repaired, the pump is restarted and the infant is then warmed. In this situation, it is thought that if the patient is sufficiently hypothermic, the cessation of circulation for an hour is safe (17). It must be remembered, however, that in this controlled situation oxygen deprivation does not occur until after the brain is hypothermic. During drowning, oxygen deprivation begins to occur before maximum hypothermia is achieved.

Retrieval and Intervention

Since the likelihood of irreversible brain damage increases as the time without effective ventilation and circulation increases, it is paramount to emphasize the importance of rescuing the victim and beginning artificial resuscitation as rapidly as possible. Personally, I have emphasized that whenever possible, mouth-to-mouth ventilation should begin in the water if the rescuer can perform this without compromising themself. During the drowning process, respiration commonly ceases before the heart stops. Also, victims may become very vasoconstricted and develop severe bradycardia, which leaves the rescuer to believe that their heart is stopped when actually it is still beating. In these cases, if artificial ventilation is preformed, thereby improving oxygenation while the victim's heart is still beating, this oxygen will be distributed throughout the body and the victim may recover. Obviously, it is important that if the rescuer does not find evidence of cardiac activity that closed chest cardiac massage be added as soon as possible. However, it is virtually impossible for this to be performed effectively unless the victim is on a firm surface.

Since irrespective of whether one aspirates fresh water or sea water or what volume of water is actually aspirated, it is hypoxia that permanently damages the brain or kills the victim, restoration of ventilation and circulation and provision of supplemental oxygen must be paramount in the minds of the lifeguard who is responsible for the interventional process. Heimlich has suggested that application of an abdominal thrust until no more water is expelled is preferential to standard cardiopulmonary resuscitation techniques (18). I disagree with this recommendation and recommend the American Heart Association Standards and Guidelines of using CPR (19), which have been upheld by a special committee of the Institute of Medicine (20). After fresh water aspiration, the water is very rapidly absorbed in the circulation and water blocking the alveoli or conducting airway in the lung is not likely to be present (10). Werner, et al, have also shown in an animal model of sea water aspiration that the abdominal thrust maneuver does not result in increased resuscitability and survival over standard techniques of CPR (21). On the other hand, many drowning and near drowning victims do swallow significant quantities of water, making it highly likely that with the abdominal thrust maneuvers, it is water from the stomach, not from the lungs, that is expelled (22). If the victim takes a gasp at this point in time, they will aspirate this fluid, thus compounding the injury to their lung and making resuscitation more difficult or even impossible (23). Also, using the abdominal thrust technique in preference to artificial ventilation and circulation further delays the length of time from submersion until effective ventilation and circulation occurs, thereby, increasing the chance of permanent neurologic damage or death.

Every lifeguard should be certified in and adept at administering basic cardio-pulmonary resuscitation (CPR). Certification in Advanced Cardiac Life Support is also desired, but not required. If the lifeguard is certified in Advanced Cardiac Life Support, they should treat the victim, as appropriate, using these techniques even prior to the arrival of the Emergency Medical Services team. Several appliances to facilitate establishing a patent airway and applying artificial ventilation and circulation have been introduced. These appliances must not be used by the rescuer unless they are specifically trained in their use and know, not only the indications for use, but also the complications they may cause and the treatment of the complications.

How long should the lifeguard persist in applying CPR to the drowning victim?

I believe that CPR should be continued until the victim can be evaluated by medical personnel who have the equipment and expertise necessary to predict whether the victim is viable with continued resuscitation. We all know of stories about persons who were thought to be unsalvageable who subsequently did survive. There is always a danger, however, that if you persist with resuscitation, a survivor with brain damage so severe that they cannot handle their own bodily functions will result and, thus, may be a burden to their loved ones. Since the lifeguard at the scene cannot and should not make the determination as to who should live and who should die, I believe that the lifeguard must apply cardiopulmonary resuscitation to their maximum ability until they are relieved of this responsibility by medically trained personnel (24). In the final analysis, it is extremely difficult, even for members of the medical profession, to make value judgements on quality of life issues that one might speculate will occur subsequent to the resuscitation effort. This becomes more of a moral and economic issue and I do not believe that the responsibility for these should be thrust upon the treating lifeguard or, for that matter, on the subsequent treating physician. Participation by the patient's family in making such determinations is critical. However, few family members are, in my experience, prepared for such decisions and they undergo tremendous psychological stress regardless of their ultimate conclusions. From a lifeguard perspective, I believe the best approach is to assume that your responsibility is to attempt to resuscitate the victim as promptly as possible, while leaving the ultimate decision as to when the resuscitation process should be terminated to the medical personnel who will subsequently tend to the victim and the family who ultimately must care for them and be financially responsible.

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Bernard Q. Nietschmann

Bernard Nietschmann is Professor of Geography at the University of California, Berkeley and Member of the National Geographic Society's Committee for Research and Exploration. He specializes in research and teaching on ocean geography – the interaction of people and ocean environments and biota, and on mapping coastal ocean environments and related human activities. His courses include, "The Ocean World," "Islands and Oceans," "Coasts and Ocean," and "Geography and Ecology of Tropical Coasts."

In 1989, while living in Costa Rica, he helped form the "Foundation for Livesaving and Coastal Protection" to assist the governments and local communities develop a professional lifeguard response to the problem of widespread and frequent beach drownings. Along with colleagues and students at UC Berkeley, he formed "Ocean Initiative" in 1993 to train and assist coastal-ocean communities do their own research; "GeoMap" in 1996 for community-based mapping; and "Surf Rescue Research" in 1997 to train student lifeguards in surf-zone research methods.

In addition to his continuing work mapping the world's dangerous beaches, Bernard Nietschmann is assisting the National Geographic Society compile a map on "Coral Reefs of the World," a map on "Threats to Coral Reefs of the Western Caribbean," and, along with Francis J. Smith, a map on "California Rip Currents." Supported by a University of California grant, Bernard Nietschmann and Francis J. Smith have begun work to help transfer lifesaving knowledge and training from Pacific Rim and Basin areas with high expertise to areas with low or no expertise.

Nietschmann has a Ph.D. from the University of Wisconsin. He has received awards from the Ford, Guggenheim, MacArthur and Pew foundations, and the National Geographic Society.

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INTERNATIONAL LIFE SAVING FEDERATION

INTERNATIONAL MEDICAL RESCUE CONFERENCE

San Diego, California, September 15-17, 1997

WORLDWIDE DANGEROUS BEACHES SURVEY

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THE DANGEROUS BEACHES SURVEY

Wind-driven waves acting on sand, rock and coral coasts create and maintain ocean beaches. Dotting the world's some 600,000 kms (375,000 mi) of coastline are many hundreds of thousands of beaches (Roeland Hillen 1993; Schwartz 1982). Depending on beach geography and geology, swell direction, wave characteristics, tides, marine life, time of year, weather, winds, and many more variables, many of these beaches may present a low risk to human safety, others may be high risk, and a small percentage may be outright dangerous.

People are drawn to beaches that have high surf, sand, rivers, cliffs, rocks and reefs, and marine life--characteristics that make beaches scenic, recreational, and, sometimes dangerous.

Part of UC Berkeley's OCEAN Initiative, the Surf Rescue Research group[1] is mapping the world's dangerous beaches--beaches that have persistent, hazardous safety conditions. These hazards include rip currents and high surf; pollution from industrial, agricultural and urban sources; geological hazards such as cliffs, and submerged rocks and reefs; and hazardous marine organisms such as jellyfish, stingrays and sharks.

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[1] Surf Rescue Research studies the human and physical geography of the beach surf zone. Its "Worldwide Dangerous Beach Survey and Map" project began in a University of California, Berkeley, seminar, Geog. 266, Oceans and Coasts, Spring 1996. James Scarborough, now a graduate student in Landscape Architecture, UC Berkeley, began construction of the computer database and map projection. Anders Flodmark, an exchange student from Sweden at UC Berkeley, improved the map design and map symbols, and created a Website for the project during January-May, 1997. Francis J. Smith, now a graduate student in the Department of Geography, UCB, is the sparkplug behind the project. He oversaw work on the database and map, designed the four beach hazard symbols and beach safety signs, and directed student researchers. In addition, the following UC Berkeley students gathered information on dangerous beaches: Lindsey Dinn, Thomas Ellrott, Susan Galla, Ken Greenberg, Heather Gurewitz, Mike Gridley, Tina Lichens, Mike Schafler, Perry Tkachuk, and Erik Wilhousky. UC Integrative Biology student Courtney Gallagher did the word processing for the present report.

The project has six stages, the first three of which have been completed:
1) compile a rough database to begin mapping;
2) design a map and symbols that best display the data;
3) convert the data and map to a computer mapping system;
4) transfer the computer map files to a Geographic Information System (GIS) to streamline data entry and retrieval;
5) create an interactive Website for the map and project to acquire more complete and representative information (i.e. on South America, Africa and South Asia); and
6) analyze and communicate the information to appropriate groups such as the ILS and USLA.

The data used to compile the Dangerous Beaches map (Fig. 1) are derived from a wide range of sources, including surfers (who probably have more first-hand knowledge of national and international beaches than any other group), the monthly Surf Report, questionnaires sent to lifesaving services in various countries, DAN (Divers Alert Network), e-mail and Web queries, shark attack files[2], newspaper articles and reports on beach drownings, accidents, pollution, and sharks and marine stingers, and newspapers, articles and first-hand accounts of hazardous coastal geomorphology.

The initial mapping of 250 dangerous beaches (of an estimated 1000) indicates how uneven the information is spatially (a lot on California, but very little on Africa), and categorically (some on surf and rip currents, but little on pollution or geological and marine hazards). At the same time, the mapping process has shown that in developed countries with professional lifeguard services, pollution is an increasingly common beach hazard, while in developing countries--almost all without lifeguards--surf and rip currents are the major beach hazard. This is significant because internationally, beach tourism and recreation are fast-growing, money-producing global activities that encourage beach-rich but economically-poor countries to make once isolated--often dangerous--beaches accessible by building new roads and facilities, far in advance of providing for public safety with professional lifeguards and first aid stations.

THE DANGEROUS BEACHES MAP

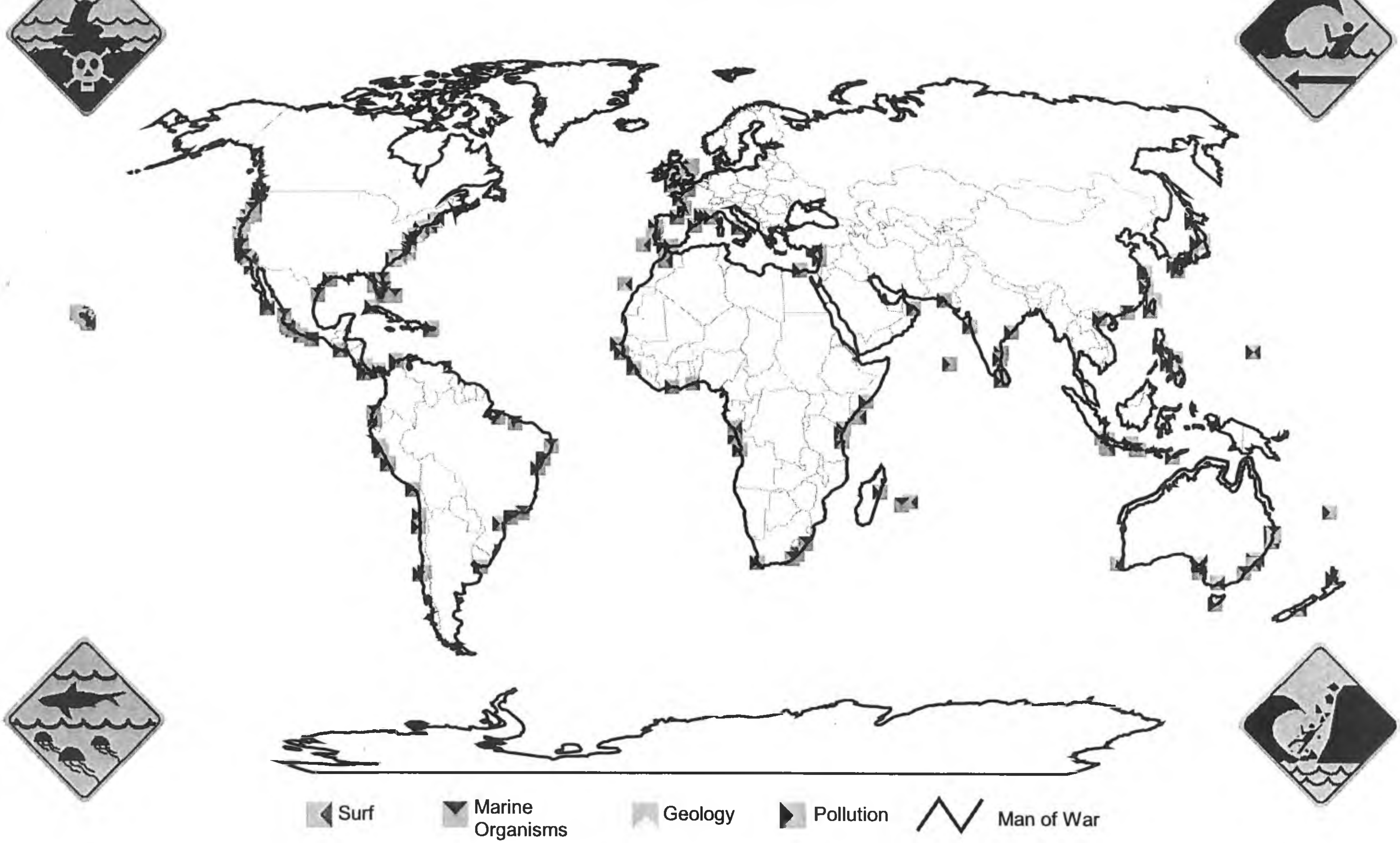
The paper map is 90 X 120 cm (3 X 4 ft) and locates 250 dangerous beaches and has text to explain the four categories of dangerous beaches (surf and rips, geological hazards, hazardous marine life, and pollution). The Dangerous Beach database has much more information and can be accessed at the OCEAN Initiative homepage (http://www.server.edu/OCEAN). The map included with this report (Fig. 1) is too small to do more than provide a snapshot of the dangerous beaches.

[2] Shark attack files are maintained by G. Burgess, Museum of Natural History, University of Florida, Gainesville; John McCosker, Steinhart Aquarium, Golden Gate Park, San Francisco, California; and Surf Rescue Research, Department of Geography, University of California, Berkeley.

Fig 1

DANGEROUS BEACHES OF THE WORLD

By the Surf-Rescue Research group of OCEAN Initiative
In cooperation with the AEGIS-lab, UCB



Scale:
Robinson projection

http://server.berkeley.edu/OCEAN
aflodmar@ced.berkeley.edu

DANGEROUS BEACHES

All beaches pose a safety risk to people. The severity of that risk--from very low to extremely high, from a reasonably safe to a really dangerous beach--depends on three interacting factors:

1) the prevalence and severity of hazards;
2) the surf beach knowledge and experience of beach users; and
3) the presence or absence of professional lifeguards.

A generally safe beach would be one that has full-time lifeguards, low wave energy, no rip currents, no rocks, reefs or cliffs, no discharge of pollutants, no hazardous marine organisms, and has visitors who can swim, know about tides, waves and rips, have good common sense, and who are cautious (probably no such beach exists, but Carpinteria, California, comes close). A very dangerous beach would be one that has no lifeguards, high wave energy, frequent rip currents, rocks or reefs and cliffs, a river or pipe discharge of pollutants, hazardous marine organisms, and has visitors who are poor or non-swimmers, who know little or nothing about tides, waves and rips, and who are impulsive (Baker Beach, California).

The "Worldwide Dangerous Beaches Survey and Map" focuses on the beaches themselves, the physical, biological and geological characteristics that produce extreme risk, even to experienced beach users.

A dangerous beach is one that has frequent, persistent or permanent hazardous conditions that endanger people's safety by placing them at extreme risk. Most of the hazards are natural Earth phenomena such as rip currents, eroding cliffs, and poisonous, venomous, biting and stinging marine organisms. Pollution is a human-created hazard. Dangerous beaches have histories of high numbers of rescues by lifeguards, and major injuries and deaths on beaches without lifeguards. On many beaches in California, Hawaii, New Zealand, and Australia, among others, lifeguards greatly reduce the safety risk from high surf, rip currents, high cliffs, submerged rocks and so on, by education and intervention, and their presence and actions strongly reduce risk and increase safety (Short 1994, and Short, Williamson and Hogan 1993). At the same time, on beaches without lifeguards, risks increase, especially for high-wave energy, rip current beaches, where the absence of a surf rescue lifeguard can often result in a drowning (Nietschmann 1994, 1995).

Lifeguards have been very supportive working with us in identifying beaches and specific places on beaches that have hazardous physical conditions. Many lifeguards we visited with in San Diego, Orange, Los Angeles and Ventura counties, California, have considerable knowledge about beach hazards and the conditions that produce them. This very valuable knowledge can't be found in books by oceanographers, coastal geomorphologists, or coastal hydrologists.

Others we talked with about dangerous beaches often were not too helpful. People involved with promoting beach development and tourism rarely agreed that a beach should be categorized as a "dangerous beach: (or a "hazardous beach" or a "high-risk beach"), even though it was a high-energy, big-wave, strong-rip beach and had a history of frequent rescues or drownings. Similar to the movie "Jaws" where the mayor of the small summer tourist town does not want to admit the presence of a large Great White shark because the news would drive away business, a beach labeled as dangerous on a map could pose a potential threat to commerce. While we don't shy away from labeling a beach dangerous if it is, we have to strive to be accurate and to have reliable information (saves, injuries, and deaths).

We used these criteria to designate a "dangerous beach":

1) It has one or more conditions that pose a high risk to human safety.
2) These high-risk conditions are persistent and part of physical and biological geography of the beach in the case of rip currents, high surf, marine life, cliffs, rocks and reefs, or are recurrent and part of human-created hazards such as waste dumping and sewage overflow.
3) Reliable documentation or first-person information exists on the hazardous, high-risk conditions, such as rescues and interventions by lifeguards; reports of injuries and deaths in the water or from cliffs, and high levels of pollution.
4) If a beach is dangerous seasonally--for example Waimea Bay on Oahu, Hawaii, during the winter high surf months, we consider it to be dangerous year around, because otherwise the map and database would be too complicated and qualified.

BEACH HAZARDS THAT MAKE BEACHES DANGEROUS

We condensed beach hazards that create dangerous beaches into four categories: Surf and Rips, Geology, Marine Organisms, and Pollution.

Surf and Rips

> Lome, in Togo, breaks with the same force as the Wedge, and locals are terrified of swimming there. Apparently, the last time they went looking for a missing swimmer they found 13 bodies. (The Surf Report, Vol. 6, No. 12, p.10, 1993.)

Beaches are built and maintained by surf. High-surf beaches, such as the Wedge, Newport Beach, (and outside reef breaks such as Mavericks, California, and tow-in breaks off North Shore, Hawaii) are hazardous because of the huge mass of water in a breaking wave that can hold a person underwater for long periods or tumble them against rock and reef bottoms, or hurl them against a sand bottom in shorebreak. Generally, however, only experienced surfers and bodysurfers venture out into big-surf beaches.

The primary beach hazard is caused by rip currents. The United States Lifesaving Association estimates that 80 percent of surf rescues are due to rip currents (Brewster, ed. 1995:40). Rip currents are fast, seaward-moving gravity currents caused by waves that push water up the slope of a beach above mean sea level, build up a mass of water, and then with the first lull in the wave sets, the wave-caused damming effect stops, and, pulled by gravity, the water rushes seaward through a trough in the sand or along a jetty, groin or pier (Brewster 1995: 40-41). Many types of rip currents exist. Rip currents may be so strong that they carry even expert swimmers out for distances up to several hundred yards, usually just beyond the surf line where the current dissipates with greater depth. "Rip currents are sometimes referred to as *the drowning machine* because of their almost mechanical ability to tire swimmers to the point of fatigue, and, ultimately, death" (Brewster, ed. 1995:40).

Pacific Rips

The Pacific is the world's main region for rip currents and rip current-caused fatalities. This is because rip currents are caused primarily by breaking waves which are formed by winds blowing across water to create swells that travel over long distances to break as surf on distant beaches. As the largest ocean and with frequent winds and storms, the Pacific generates more surf, which causes more rip currents over a wider area, than any other ocean. Rip currents are not unique to the Pacific, but their concentration, strength, frequency and death toll in the Pacific make them much more hazardous and life-threatening than elsewhere.

In terms of loss of life rip currents are one of the major coastal hazards along much of the tropical and temperate Pacific Rim. Rip currents are a leading coastal killer in the Pacific, probably second only to hurricanes. Playa Escondido in Mexico annually averages 80 rip current fatalities. Three beaches in Nicaragua form the notorious "Red Triangle" and annually account for 125 deaths. In Costa Rica, an estimated 200 people per year drown at beaches from rip currents. To put this is perspective, 200 annual fatalities from but one country are more than ten times the annual reported fatalities from shark attacks for the world (100 attacks and 20 fatalities per year average), one and one-half times more than reported U.S. combat fatalities in the Gulf War, and equal two-thirds of California's 10-year total of 303 reported fatalities from natural hazards such as floods, fires, and earthquakes (San Francisco Chronicle, January 7, 1997:1). Though hurricanes and earthquakes pose extreme threats because of property damage, on an annual basis rip currents probably claim almost as many--perhaps more--lives. In Florida, the National Weather Service issued an advisory notice in 1996 that rip currents kill more people annually than do hurricanes, tornadoes and lightning combined (U.S. National Weather Service 1996).

In many countries, rip currents are not commonly understood as prevalent natural hazards requiring beach safety programs, but are seen as either a lurking danger that is impossible to overcome (in Costa Rica, the belief is they are violent whirlpools -- *remolinos*), or that a drowning is the fault of the victim due to supposed inebriation, bad luck, or lack of swimming skills. Elsewhere, rip currents are called "rip tides" or "undertows" which shows lack of critical understanding of how and where they form and function. It is important to dispel the many inaccurate descriptions and myths about rip currents (rip tides, undertow, whirlpools, etc.). In Australia, though swim training and beach safety are mandatory in schools, and popular beaches are guarded, new beach development is attracting foreign tourists who don't have beach safety training and knowledge. In early 1996 an alarming 400 percent rise in surf rescues occurred on Queensland beaches, mostly of tourists from South East Asia and Japan who are inexperienced about Gold Coast beach conditions and rip currents. As a result, Surf Life Saving Queensland has begun a new beach safety program aimed at tourists, especially those from Asia (The Sunday-Mail, (Brisbane) February 18, 1996:36). Because most Pacific beaches have high rates of foreign tourism, no beach safety program aimed at residents can cover what may be weekly new arrivals from other countries.

Geologic Hazards

Shallow coral, rock or lava reefs off some beaches form surf from swells which attracts surfers and body surfers. This can be hazardous as a wipeout can lead to being hurled against sharp reef surface resulting in lacerations, severe cuts, or strong, bone-breaking blows.

Cliffs are the major geological hazard along emergent coasts such as the West Coast of the United States (in contrast to the U.S.'s East Coast which is submergent, with few cliffs). Cliffs are dangerous because they are fundamentally a retreating feature due to cliff face collapse from seismic shaking in tectonically active regions, wave impact -- especially storm waves -- at the cliff base that compresses water and air to cut out rocks and dirt -- a process called "quarrying", and by cliff-face erosion caused by marine, subaerial and chemical weathering, groundwater seepage, and disintegration along bedding planes, joints, faults, and tree roots. The combination of these processes produces unstable cliff faces subject to landslides and giving way under people attempting to take a short cut to or from the beach. Along the California coast, many people have been injured or killed falling from beach cliffs along the Mendocino Headlands, Santa Barbara and Santa Monica cliffs, and Black's Beach (San Diego).

Marine Wildlife

Some beaches have concentrations of marine organisms hazardous or dangerous to people. People do become sick from eating shellfish in red tide regions and fish in ciguatoxic areas, and painful punctures may result from stepping on sea urchins, or a stingray (unusual concentrations have been along many California beaches during the 1995, 1996, and 1997 seasons), or infected lacerations from touching fire coral or stinging hydroids.

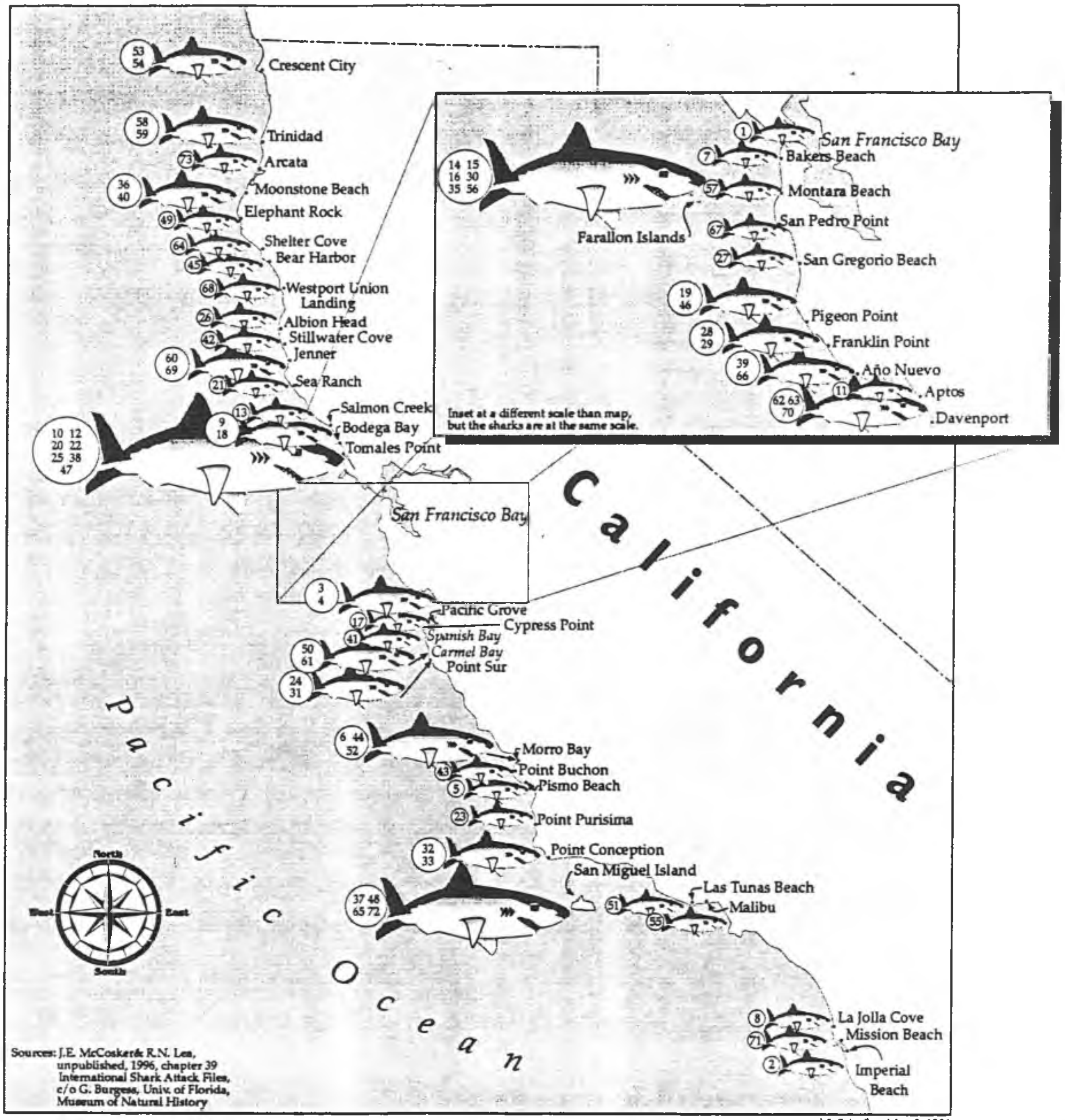
Some species of tropical fishes (8 families), sea snakes (50 species), octopi (spotted and blue-ringed), and mollusks (the cone shells, Conus geograficus) are known to have killed people, but their low concentrations and offshore water and coral reef habitats are in general different and distant from large number of people on beaches. An exception is the stonefish, Scvnanceia horrida, that lies buried in sandy, muddy and coral rubble bottoms, sometimes along Indo-Pacific beaches, such as those of northern Queensland, Australia. This fish has three venomous spines forward of its dorsal fin which inject deadly venom into humans should one be stepped on. The venom causes excruciating pain in everyone injected, sometimes death.

More serious hazards and dangers are posed by other marine life such as sharks and some species of jellyfish. The compass jellyfish, the sea wasp, and the lion's man jellyfish have non-lethal stinging cells (nematocysts) similar to a bee or wasp sting. Saturday, July 26, 1997 in the Waikiki area of Oahu, Hawaii, an estimated 800 people were stung by jellyfish in one hour. These were not serious stings and for the most part the victims quickly recovered after being treated with applications of vinegar. The Portuguese Man-of-War causes more serious stings as its surface-floating gas bag supports tentacles sometimes 100 feet long, containing up to 750,000 nematocysts which can incapacitate a swimmer.

The most serious jellyfish and the one that makes several beaches dangerous in Queensland and across the top end of Australia in general, is the sea wasp or box jellyfish (Chronex fleckeri) whose sting can cause rapid circulatory or respiratory failure. Some beaches in Queensland are screened off to protect bathers from box jellyfish; other bathers protect themselves by wearing lycra or thin wetsuits (the box jellyfish's nematocysts are short and can't penetrate far).

Shark attacks may be the most feared danger on beaches but the fear far outstrips the statistics. At least 100 times more people die every year from rip currents than sharks. People attacks on sharks have drastically lowered and endanger shark populations in many world regions. Nevertheless, some species of sharks--Great White, bull, tiger, whitetip, and gray reef--do attack people at beaches often enough so that those beaches may be considered dangerous (e.g., Davenport and Dillon beaches, northern California; Winchester Bay, Oregon; Stuart and Daytona, Florida; Aticama, Mexico; Leblon, Rio de Janeiro, and Pernambuca, Brazil; The Spot and Green Point, Durban, South Africa; Ballina, Dee Why Point and Minamurra, New South Wales, Australia; Las Tunas, Ecuador; among many others. Shark attacks often are concentrated to particular beaches or offshore locations and to particular human activities such as surfing and spearfishing. The geography of Great White attacks in California is shown in Fig. 2.

Great White Shark Attacks in California



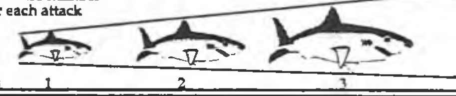
M. Schafler May 8, 1996

Great White Shark Attacks in California

#	Name	Date	Activity	Result
1	Norman Peixotto	July 8, 1926	Swimming	Serious Injuries
2	R. Campbell	Oct. 8, 1956	Swimming	Bitten on leg
3	Barry Wilson	Dec. 7, 1952	Swimming	Fatal
4	James Jacobs	Feb. 6, 1955	Skindiving	Minor
5	Douglas Clarke	Aug. 14, 1956	Swimming	Bitten on thigh, sides, hand
6	Peter Savino	Apr. 28, 1959	Swimming	Body not recovered
7	Albert Kogler, Jr.	May 7, 1959	Swimming	Fatal
8	Robert Pamperin	Jun. 14, 1959	Skindiving	Body not recovered
9	James Hay	Oct. 4 1959	Skindiving	Bitten on swimfin
10	Frank Gilbert	Apr. 24, 1960	Skindiving	Major
11	Suzanne Theriot	May 19, 1960	Swimming	Bitten on leg
12	Rodney Orr	May 21, 1961	Skindiving	Uninjured
13	David Vogensen	Aug. 20, 1961	Swimming	Bitten on foot
14	Floyd Pair, Jr.	Jan. 14, 1962	Spearfishing	Major leg wound
15	Leroy French	Nov. 11, 1962	Spearfishing	Major bites to leg and thigh
16	Jack Rochette	Jan. 11, 1964	Spearfishing	Major bites to thigh and leg
17	Donald Barthman	Jan. 22, 1966	Skindiving	Bitten on arm and thigh
18	Frank Logan	July 27, 1968	Skindiving	Major bites to mid-body
19	R. Colby	July. 20, 1969	Skindiving	Bitten on foot
20	Donald Joslin	Sept. 6, 1969	Skindiving	Major bites on leg
21	Calvin Ward	Oct. 2, 1971	Scuba Diving	Bitten on legs
22	Helmut Himmrich	May 28, 1972	Skindiving	Bitten on legs and buttocks
23	Kenneth Gray	July 19, 1972	Hookah Diving	Major
24	Hans Kreschmer	Sep. 9, 1972	Surfing	Major
25	Leroy Hancock	May 26, 1974	Skindiving	Bitten on leg
26	Robert Kehl	July 26, 1974	Skindiving	Minor bite on foot
27	R. Sanders	Aug. 5, 1974	Surfing	Bites to hand and board
28	Dale Webster	Sep. 2, 1974	Scuba Diving	Minor bite on foot
29	Jack Greenlaw	Sep. 2, 1974	Scuba Diving	Minor bite on hand
30	Jon Holcomb	Sep 14, 1974	Hooka Diving	Major
31	Kirk Johnston	Sep. 28, 1974	Surfing	MAjor injuries to abdomen
32	Gary Johnson	July 19, 1975	Hooka Diving	Swimfin bitten
33	Robert Rebstock	July 23, 1975	Scuba Diving	Major
34	Gilbert Brown	Aug. 9, 1975	Skindiving	Major bite on arm
35	Robin Buckley	Dec. 6, 1975	Spearfishing	Bitten on leg
36	Willaim Kennedy	Oct. 18, 1976	Scuba Diving	Bitten on leg
37	Jack Worrell	Dec. 18, 1976	Hooka Diving	Bitten on buttocks
38	Glen Friedman	Aug. 14, 1977	Skindiving	Major injuries to lower body
39	Calvin Sloan	May 11, 1979	Scuba Diving	Bitten on swimfin
40	Curt Vikan	Oct. 17, 1980	Surfing	Uninjured
41	Lewis Boren	Dec. 19, 1981	Surfing	Fatal
42	D. Harvey Smith	Feb. 7, 1982	Scuba Diving	Bitten on calf
43	Casimir Pulaski	July 24, 1982	Paddleboarding	Uninjured
44	John Buchanon	Aug. 29, 1982	Surfing	Uninjured
45	Michael Herder	Sep. 19, 1982	Skindiving	Bitten on thigh
46	Omar Conger	Sep. 14, 1984	Skindiving	Fatal
47	Paul Parsons	Sep. 30, 1984	Skindiving	Major bites on legs
48	Chris Massahos	Feb. 18, 1985	Scuba Diving	Minor bruises
49	Rolf Ridge	Sep. 28, 1985	Skindiving	Uninjured
50	Frank Gallo	Dec. 6, 1986	Skindiving	Major neck wounds
51	Craig Rogers	Aug. 15, 1987	Surfing	Bitten on hand
52	Mark Rudy	Apr. 24, 1988	Surfing	Uninjured
53	Carl Lafazio	Aug. 11, 1988	Surfing	Bitten on thigh
54	Tamara McAllister	Jan. 26, 1989	Kayaking	Fatal
55	Roy Stoddard	Jan. 26, 1989	Kayaking	Body not recovered
56	Mark Tisserand	Sep. 9, 1989	Hooka Diving	Wounds to leg
57	Sean Sullivan	Jan. 12, 1990	Surfing	Uninjured
58	Rodney Swan	Aug. 28, 1990	Surfing	Minor
59	Matt Hinton	Sep. 5, 1990	Kayaking	Uninjured
60	Rodney Orr	Sep. 8, 1990	Skindiving	Minor bites
61	Eloise Tavares	Nov. 3, 1990	Scuba Diving	Major bite on leg
62	Eric Larsen	July 1, 1991	Surfing	Bitten on legs, arms
63	John Ferreira	Oct. 5, 1991	Surfing	Bitten on legs, arms
64	David Abernathy	Dec. 4, 1991	Hooka Diving	Minor
65	Andy Schupe	Oct. 29, 1992	Hooka Diving	Bitten on foot
66	Ken Kelton	Nov. 14, 1992	Kayaking	Kayak bitten
67	Don Berry	March 12, 1993	Skindiving	Bitten on swimfin
68	David Miles	Aug. 11, 1993	Skindiving	Major bites to head
69	Rosemary Johnson	Oct. 10, 1993	Kayaking	Kayak bitten
70	Mike Sullivan	Sep. 29, 1995	Sailboarding	Minor bites
71	Brian Cramer	Sep. 17, 1984	Swimming	Bitten on arm
72	James Robinson	Dec. 9, 1994	Skindiving	Fatal
73	Robert Williams	Oct. 31, 1993	Surfing	Major bites to leg

Legend

(1) = reference number for each attack



Pollution

> Water pollution has become an increasing problem in Guam, according to our correspondent; worst of all is the Agana Boat Basin, a continuing major health hazard to surfers who report seeing used condoms, tampons and human feces in the water. Many have reported illnesses and open, festering wounds as a result of surfing the best wave in Guam. (The Surf Report, Vol. 15, No. 8, p.10, 1994.)

It used to be that lifeguards pulled people out of the water to save them, but now because of pollution lifeguards often must prevent people from entering the water to save them. Pollution has become on many beaches the number one hazard to people. The U.S. Environmental Protection Agency considers three categories of pollution to be of direct concern to humans in coastal waters and beaches: human pathogens--bacteria and viruses that are transferred through human and animal fecal matter caused by overflow, discharge and runoff of sewage; heavy metals--from industrial and agricultural wastes, boat and automobile fuels, and hazardous waste spills; and toxins--organic (red tides) and synthetic (industrial, agricultural, and urban spills, runoff and dumping).

In 1994, California had 40 percent (910) of the U.S.'s 2,279 beach closings. San Diego and San Francisco county beaches together had 60 percent of the state total, mainly due to sanitary sewer overflow, rain and storm-water runoff (Natural Resources Defense Council, 1995: 40-43). Surfers report skin and sinus problems from polluted waters at Malibu Point and Manhattan.

Elsewhere, beaches considered to be hazardous due to pollution, include Ipanema, Leblon, and Guaruja, Brazil; 13th Street, Victoria, and Sewer Pipe, Queensland, Australia; Ponce, Puerto Rico; Lisbon beaches, Portugal; Kuta, Bali, Indonesia; and Cornwall, England; among many others.

CLASSIFYING DANGEROUS BEACHES

Our Surf Rescue Research group is working on classifying dangerous beaches in an effort to communicate the types and magnitude of the various beach hazards and risks. The 1-6 Dangerous Beach Scale is modeled on the 1-6 scaling system used to classify whitewater rivers for canoeing, kayaking and rafting, and is similar to the various scaling systems used to classify the magnitude of geohazards such earthquakes (Richter Scale), hurricanes (Saffir-Simpson Scale) and tornadoes and winds (Fujita Scale) (Coch 1995).

We used a 1-6 scale to classify the magnitude of each of the four beach hazard groups (Fig. 3). These were then combined to produce a single beach classification, again using the 1-6 scale, from minimal to extreme hazards (Fig. 4).

As the Worldwide Dangerous Beach Survey progresses, we will work describe beaches not only in terms of physical hazards, but also in terms of the human response to those hazards which may reduce or increase the dangers.

Some investigators doing research on geohazards such as flood, hurricanes, tsunamis, earthquakes and tornadoes, emphasize that the degree to which a natural physical event is hazardous depends not only on the magnitude of the event, but also the degree of preparedness and response to manage the hazard -- current or potential. For physically dangerous beaches, hazard preparedness and response involves 1) having the authority and willingness to warn actual and potential beach users of the dangers by means of education, media, beach signs and flags, and lifeguards; 2) having a team of surf-rescue professionals on the beach to warn, intervene and rescue as necessary; 3) having sufficient funding, training and political commitment from local, regional and national governments.

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Fig. 5-4

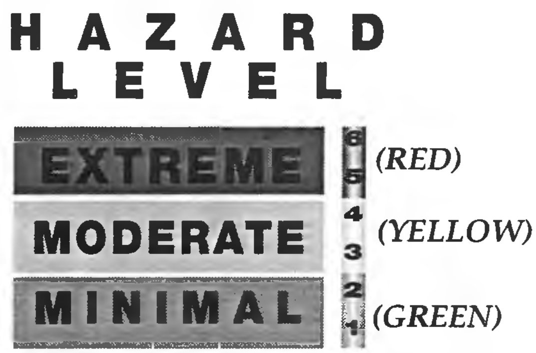
BEACH HAZARD CLASSIFICATION

The task was to formulate a system of classifying beaches so that people who visit them would have a general idea of the prevalent conditions that occur on the given stretch of coast. The classifications are a precautionary measure to keep beach users out of harm's way.

The sign had to display a vast amount of scientific information but be simple, so that it can be easily understood by a person strolling by from the parking lot to the beach. We had to come up with a way of informing people that the beach they were visiting was potentially hazardous, but in an informative manner that took into consideration all the prevalent beach conditions. There are four major factors that normally occur on all beaches that can be classification hazardous: Pollution, Geological Hazards, Surf and Rip Currents, and Marine Wildlife.

Finally, the classification also contains a small symbol that indicates whether or not the beach is patrolled by lifeguards.

The sign consists of a diamond shaped object that is divided into four separate sections. Each of the four sections are then classified by three separate colors, Red, Yellow, and Green.



In the center of the sign is a number. This *number* prescribes the level of danger that any one beach may have that is posted with a "Beach Hazard Classification". The criteria set for the numbering of the hazard levels are; from 1 (minimal hazard) to 6 (extreme hazard).*The colors signify the levels of caution that are prescribed by the criteria that is detailed in this paper.*

The Numbering System works as follows for the Four Section Diamond Dangerous Beach Sign:

Level 1 Beach Consists of all sections of the diamond being designated as *Green.*

Level 2 Beach Consists of *Three Green* sections and *One Yellow* section.

Level 3 Beach Consists of *Two Yellow* sections and *Two Green* sections only.

Level 4 Beach Consists of *Three Yellow* sections and One Green section or Four Yellow sections but *No Red* sections.

Level 5 Beach Consists of any sign with at least *One Red* section.

Level 6 Beach Consists of any sign with at least *Two Red* sections.

GEOLOGICAL HAZARDS

*** Green Coded Beaches ***

Class "1 Beach"

easily accessible to the general public. Even sandy beach with no geological outcrops.

Class "2 Beach"

•Generally safe with small areas that require some caution due to slippery rocks, sand over hard surfaces, and uneven surfaces. Beach has course-grained sand with pebbles and small rock outcrops.

*** Yellow Coded Beaches ***

Class "3 Beach"

•Accessible to the general public with caution. May have areas of unstable surfaces, steep inclines without rails, or lacking stairs, but is generally accessible to able-bodied individuals. Uneven beach with berms and larger rock outcrops.

Class "4 Beach"

•Accessible to able-bodied individuals, but may require some physical exertion. Accessibility requires great caution and may contain trails adjacent to sheer cliffs without guard-rails, steep inclines and periodic rock and landslides. Very uneven beach with rock outcrops and associated small reefs.

*** Red Coded Beaches ***

Class "5 Beach"

•Beach access requires physical agility and strength. Access may require climbing ropes (repelling), using unstable stairways and trails which have no guard-rails. Some areas may require climbing cliffs with no marked trails. Rock and landslides occur often and are a constant hazard. Extremely uneven beach with numerous rock outcrops and large reefs.

Class "6 Beach"

•Unaccessible to the general public due to a lack of safe trails. The existence of sheer and very unstable cliffs with a high tendency for rock and landslides also makes these areas extremely dangerous. Little or no sandy beach , mostly reef associated with sheer cliffs.

MARINE WILDLIFE

*** Green Coded Beach ***
No traumatogenic animals, venomous invertebrates, venomous vertebrates

Class "1 Beach"
•Only harmless marine wildlife present. Sand dollars, Non stinging jellyfishes.

Class "2 Beach"
•Non-life threatening wounds or illnesses requiring self-treatment. Such as the cut from a mussel shell.

*** Yellow Coded Beach ***
Non fatal but serious injuries possible form traumatogenic animals, venomous invertebrates, venomous vertebrates

Class "3 Beach"
•Non-life threatening but serious wounds or illnesses requiring minor medical attention. Such as injection of spines from the red sea urchin.

Class "4 Beach"
•Possible life threatening wounds or illnesses requiring major medical attention. Such as a sting from the California butterfly ray.

*** Red-Coded Beach ***
Fatal injuries possible from traumatogenic animals, venomous invertebrates, venomous vertebrates

Class 5
•Near fatal wounds or illnesses requiring major medical attention and resulting in possible permanent physical or neurological damage. Such as a great white shark attack or stonefish sting.

Class 6
•Fatal or permanently disabling wounds or illnesses. Such as a bite from The blue ring octopus or sting from the box jellyfish.

SURF
RIP CURRENTS

*** Green Coded Beaches ***

Class 1

•Gradual slope, no rip currents, small waves (under 1 ft.), low use, no seasonal danger, minimal potential hazard.

Class 2

•Gradual slope, wave heights (1-2 ft.), low use, no seasonal danger, minimal potential hazards whether guarded or not.

*** Yellow Coded Beaches ***

Class 3

•Medium slope, no sudden drop off, medium rip currents (1 mph) wave heights (3-4 ft), medium use, mild seasonal fluctuations in conditions, moderate potential hazards.

Class 4

•Steeper slope, no sudden drop off, strong rip currents (2 mph), wave heights (5-6 ft), medium use, mild seasonal fluctuations in conditions, moderate potential hazards even when guarded.

Red Coded Beaches

Class 5

•Steep slope, sudden drop off, strong undertow, strong rip currents (3 mph), wave heights (6-8 ft), heavy use, seasonal fluctuations in conditions, unsafe even when guarded.

Class 6

•Steep slope, sudden drop off, strong undertow, strong unpredictable rip currents (over 4 mph), wave heights (over 10 ft), heavy use, seasonal fluctuations in conditions, **do not swim**.

POLLUTION

*** Green Coded Beach ***

In order for a beach to be a "**green**" level 1 beach it *shall not* be closed by the proper authorities more than 3 times in a thirty day period due to Total Fecal Coliform Levels exceeding 1,000 per 100 ml of sea water. Nor shall it be closed for Total Fecal Coliform Levels more than 1 time in a thirty day period exceeding levels of 10,000 per 100 ml.

*** Yellow Coded Beaches ***

A beach shall be a "**yellow**" if it is closed by the proper authorities more than 3 but less than 6 times in a thirty day period due to Total Fecal Coliform Levels exceeding 1,000 per 100 ml of sea water. Nor shall it be closed for Total Fecal Coliform Levels more than 2 times in a thirty day period exceeding levels of 10,000 per 100 ml.

*** Red Coded Beaches ***

A beach shall be a "**red**" if it is closed by the proper authorities more than 6 times in a thirty day period due to Total Fecal Coliform Levels exceeding 1,000 per 100 ml of sea water. Nor shall it be closed for Total Fecal Coliform Levels more than 3 times in a thirty day period exceeding levels of 10,000 per 100 ml.
These levels are the only documented data that are applicable to pollution and tested levels. All beaches that are within 1/2 mile of an industrial discharge pipe, sewage treatment outflow point, or agricultural stockyard shall be rated as "**Red**".

Dr. James Orlowski

Dr. James Orlowski is Director of the Pediatric Intensive Care Unit at University Community Hospital in Tampa, Florida where he serves as Chair of the Ethics Committee and Institutional Review Board. He previously served as Director of the Cleveland Clinic Pediatric Intensive Care Unit for seven years and was Assistant Director of the Cleveland Clinic Adult Surgical Intensive Care Unit for 14 years. He is board certified in Pediatrics and Critical Care Medicine.

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Note: The article, *Drowning, Near Drowning, and Ice Water Submersion* is reprinted with kind permission of *Intensive Care* and the W.B. Saunders Company.

Near-Drowning

Background

Effective resuscitation at the scene is paramount in determining long-term survival and its quality. Prevention of immersion incidents is of utmost importance in decreasing the frequency of near-drowning.

BLS Modifications During Arrest

- No Modification of standard BLS in necessary.
- In-water resuscitation requires flotation devices and training in their use. External chest compression cannot be performed in the water.
- Suspect spinal injuries in diving injuries and in the surf.
- Do not attempt to drain water from the lungs.
- Remove foreign bodies in the airway, eg., seaweed, sand, or mud.
- Vomiting and regurgitation are very common:
  - 86% in cases with chest compression
  - 68% in cases with expired air resuscitation
- All immersion victims who require resuscitation should be transported to the hospital.

ALS Modifications During Arrest

- No modification of standard ALS is necessary, although care should be taken to dry the patient before defibrillation.

Early tracheal intubation is indicated for:

- Improved intermittent positive pressure ventilation and reduction in $PaCO_2$.
- Removal of foreign material from the tracheobronchial tree
- Application of continuous positive airway pressure (CPAP) or positive end-expiratory pressure (PEEP)

Recovery after long immersion and resuscitation times may occur, especially after cold water immersion.

Modifications Immediately After Arrest

- No modification of standard therapy is necessary.
- Techniques that do not improve outcomes:
  - Barbiturate coma
  - Intracranial pressure monitoring
  - Corticosteroids

Prognostic Features

•No predictors of outcome are reliable in an individual case.
•Patients reaching the hospital with a spontaneous circulation and breathing have good outcomes.

Hypothermia

Background

Hypothermia increases the tolerance time for cardiac arrest and reduced blood flow during resuscitation, probably due to reduced metabolism and inhibition of deleterious effects of hypoxia such as free radical reactions, excitoxicity, and changes in membrane permeability. Severe hypothermia causes, bradycardia and a slow ventilatory rate.

Key Interventions to Prevent Arrest

•Prevent further heat loss due to evaporation from wet garments, cold environments, and wind.
•Cautiously transport the patient to the hospital, avoid rough movement and excess activity, which can precipitate VF. Urgently indicated procedures such as intubation or the introduction of intravascular catheters or a pacemaker should not be delayed.
•Patients with core temperature <34°C can be rewarmed passively or by internal active rewarming (extracorporeal rewarming, esophageal rewarming tubes, peritoneal lavage, 42° to 44°C IV saline, 42° to 46° C humid ventilation gas).
•Active external rewarming to truncal areas only.

BLS Modifications During Arrest

•Prevent further heat loss due to evaporation from wet garments, cold environments, and wind.
•Take up to 30 to 45 seconds to confirm cessation of ventilation and pulselessness.
•Do not attempt external rewarming. Avoid rough movement and excess activity.
•In cardiac arrest secondary to hypothermia, BLS efforts should normally not be stopped until the patient is rewarmed.
•Successful resuscitation without neurological sequelae has been reported after 70 minutes of cardiac arrest followed by 2 hours of BLS before active rewarming was started by cardiopulmonary bypass.
•If the patient is hypothermic secondary to the arrest, resuscitation should not be attempted.

ALS Modifications During Arrest

•The hypothermic heart may have a reduced response to pacemaker stimulation, defibrillation, and cardioactive drugs that might accumulate to toxic levels.
•If the core temperature is <30°C, give a maximum of three shocks for VF/VT until core temperature is increased, and give intravenous medications at longer than standard intervals.

- Needle electrodes are preferred for electrocardiographic monitoring.
- Active internal rewarming can be started in the field but must not delay transport to the hospital, where more advanced rewarming techniques are available, such as extracorporeal bypass. This is the preferred method as it also ensures adequate oxygenation and circulation.
- Patients who have been hypothermic for hours may require large amounts of fluids during rewarming and full cardiovascular monitoring is important.
- Cachectic, malnourished, or alcoholic patients should receive thiamine 100 mg IV early during rewarming.
- In the hospital, physicians should (as with other patients) use their clinical judgment to decide when resuscitative efforts should cease.

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Drowning, Near-Drowning, and Ice-Water Submersions

*James P. Orlowski, MD**

Drownings and near-drownings are the two entities composing submersion accident.

Drowning is defined as death by suffocation after submersion in a liquid, whereas near-drowning is survival or at least temporary survival following asphyxia secondary to a submersion episode. Most clinicians term the death a drowning if the victim dies within 24 hours as a consequence of a submersion accident, and a near-drowning accident if the victim survives beyond 24 hours. If the patient subsequently dies of complications of the submersion accident, the cause of death is designated the primary cause (e.g., superimposed infection, pulmonary injury, or renal failure) secondary to or as a consequence of a near-drowning accident. The latter, namely, delayed death from drowning due to complications such as pulmonary alveolar inflammation, has been referred to as secondary drowning in the literature.[34] The term secondary drowning only adds more confusion to an already confusing terminology and is best abandoned.

An important new subgroup of submersion accidents which has far-reaching implications for resuscitation, therapy, and outcome is the ice-water drowning or near-drowning.

EPIDEMIOLOGY

Drowning is now the second most common cause of accidental death in children, exceeded only by motor vehicle accidents[1] (Table 1). In fact, drowning is the third leading cause of death from all causes for children between the ages of 1 and 14 years, with only motor vehicle accidents and cancer being responsible for more pediatric deaths (Table 2). The two pediatric age-groups which are most likely to be at risk for drowning and near-drowning accidents are teenage boys, both swimmers and nonswimmers, and toddlers. Teenage boys usually get into trouble on a dare when

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Table 1. *Accidental Deaths According to Cause in the United States, 1972–1973*

	AVERAGE ANNUAL DEATH RATE PER 100,000 CHILDREN					
	≤1 year		*1–4 years*		*5–14 years*	
TYPE OF ACCIDENT	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Motor vehicle	10.0	9.5	13.6	10.2	13.3	7.9
Pedestrian	—	—	6.5	3.3	5.2	3.3
Drowning	2.5	1.8	8.3	3.6	5.6	1.5
Fires and flame	4.8	4.7	5.6	4.6	1.5	1.5
Falls	4.2	2.2	1.5	1.2	0.6	0.2
Poisoning	—	—	1.6	1.1	—	—
Inhalation and ingestion of food or other objects	19.2	12.7	1.8	1.4	—	—

their ability to swim is exceeded, or when they are under the influence of drugs or alcohol, whether they are swimmers or nonswimmers. The most important risk group for submersion accidents is the unsupervised toddler. Forty to 50 per cent of all drownings and near-drownings occur in the age group between 0 and 4 years with the highest rate among children ages 1 to 2.

Private swimming pools and natural bodies of water close to home present the greatest risk to young children. In 1981 an estimated 300 children under 5 years of age drowned in residential pools, and in 1983 approximately 2,000 children under age 5 were treated in hospital emergency rooms as a result of near-drowning accidents.[50] Two out of every three swimming pool drowning victims were under 3 years of age, and 75 per cent of near-drowning accidents were serious enough to require hospitalization. The anoxic encephalopathy from near-drowning accidents is an important contributor to mild through severe neurologic or brain damage in children.

Available data suggests that the vast majority of children who drown in swimming pools do so in the backyards of their own homes. The peak times for submersion accidents are on weekends in the warm, summer months between 4 and 6 P.M.[1]

In the 1 to 4 year old age group, about 85 per cent of drownings result from falling into swimming pools or natural bodies of water. Bath tubs and water receptacles around the home (wash tubs, toilets, etc.) account for about 5 per cent of drowning deaths each[31] (Table 3).

Table 2. *Leading Causes of All Deaths in Children Ages 1 to 14 Years (National Safety Council, 1980)*

CAUSE	NO. OF DEATHS	PERCENT OF ALL DEATHS (20886)
Motor vehicle accident	4,361	20.9%
Cancer	2,364	11.3%
Drowning	1,760	8.4%
Congenital anomalies	1,742	8.3%
Fires, burns	1,158	5.5%
Accidental falls	243	1.2%
Accidental poisoning	210	1.0%

Table 3. *Relative Contribution of Various Submersion Media to Drowning Accidents*

Salt Water		1–2%
Fresh Water		98%
Swimming pools: private	50%	
public	3%	
Lakes, rivers, streams, storm drains	20%	
Bathtubs	15%	
Buckets of water	4%	
Fish tanks or ponds	4%	
Toilets	1%	
Washing machines	1%	

As with most other accidental deaths, males predominate in drownings, with male to female ratios of 12:1 for boat-related drownings and 5:1 for non–boat-related drownings.[1] Male drowning rates peak at age 2 years, decline until age 10, and then sharply rise to a maximum at age 18 (Fig. 1).[1] Among females, the death rate is highest at age 1, then decreases sharply and does not rise again. The peak for female and male drownings at age 1 to 2 years is consistent with the known propensity of toddlers for accidents, especially poisonings, falls, pedestrian–motor vehicle accidents, and drownings, in all of which males predominate. The sharp contrast between male and female drowning rates after age 10 is characteristic of most accidental deaths and probably reflects differences between the sexes in exposure, drug and alcohol use, sociocultural expectations, biologic

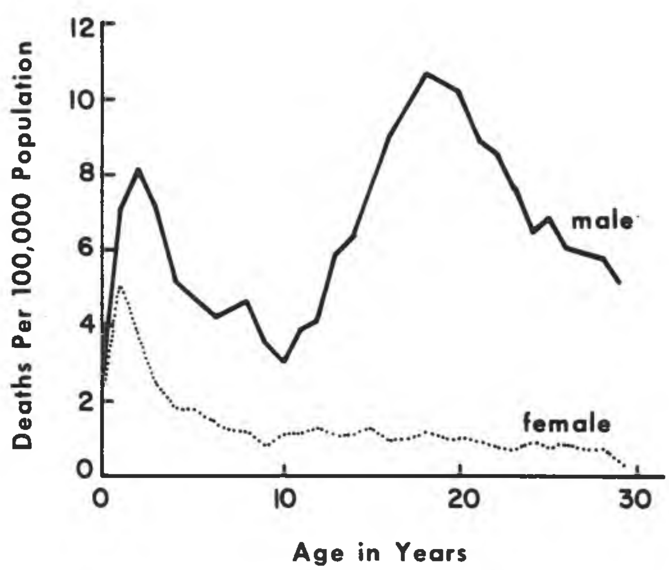

Figure 1. Male and female death rates from drowning. Male drowning rates peak at age 2 years, decline until age 10, and then sharply rise to a maximum at age 18. Female drownings are highest in number at age 1, and then sharply decline and do not rise again.

make-up, and other factors influencing death rates from potentially hazardous activities.

Other interesting epidemiologic factors in drowning and near-drowning accidents include the fact that drowning rates are highest for Native Americans, and the drowning rates for Blacks of all ages are nearly twice the rate for Whites, except in children ages 1 to 4 where the rate for Whites is almost twice the rate for Blacks. Drowning rates are highest among residents of rural areas and are inversely proportional to per capita income. Rates for drownings are generally highest in the southern and western states except that Alaska has the highest rate (10 per 100,000), which is double the rate in the next highest state, Louisiana. The very low water temperature and occupational exposure such as fishing are believed to play roles in the high rate in Alaska, whereas the rates in warm climates reflect the prevalence of swimming pools and the amount of swimming in hazardous places.[1]

There are over 8000 drowning deaths per year in the United States, and the worldwide drowning death rate approximates 3.5 deaths per 100,000 of the population.

Despite the proximity to bodies of salt water and the popularity of boating in states along the coasts, salt water drownings are very uncommon even in states bordering large bodies of salt water. The vast majority of drownings in these states still occur in swimming pools and bodies of fresh water. The rapid increase in home swimming pools to an estimated four million in 1977 plays an obvious role in drowning and near-drowning accidents and is an important area of emphasis for drowning prevention strategies.

About 90 per cent of recreational boating deaths result from drowning. In 1980, approximately 1200 drownings involved recreational boats, and alcohol use was a prominent factor in many of the teen and adult drownings. Almost 60 per cent of the boats were less than 16 feet long and the majority were open motor boats. Capsizing or falling overboard caused almost two thirds of the deaths. In 20 per cent of all deaths, the boats had too few or no personal flotation devices.[1]

It is estimated that there are 700 to 800 diving injuries per year. Most of the victims are 18 to 31 year old males and have had little or no formal training in diving. In 40 to 50 per cent of cases, consumption of alcoholic beverages, mostly beer, had occurred. The victim usually was unfamiliar with the area or pool where he made his dive and the fateful dive was usually his first attempt. Death or quadriplegia are the most serious injuries sustained in diving accidents and in most cases the diver is removed from the pool by friends who are unaware of the spine injury and have not used a spine board.[50]

Entrapment injuries and deaths are another hazard of swimming pools and spas. Body part entrapment and hair entanglement in pool and spa drains with suction fittings are the most common causes of these accidents.

Drowning is the leading cause of death in sport scuba divers. An important cause of loss of consciousness and near-drowning or drowning in scuba divers is cerebral arterial air embolism, due to pulmonary overinflation. Another cause of drowning or near-drowning specific to scuba divers is decompression sickness, more commonly known as "the bends."[53]

Another important risk group for pediatric drowning and near-drowning accidents in addition to the toddlers and teenage boys are patients with seizure disorders. Recent studies have revealed a four to five times increased risk of both drowning and near-drowning accidents in patients with known epilepsy. At greatest risk are patients with epilepsy who are poorly controlled on anticonvulsant medications, have had recent changes in their antiepileptic drugs, or who are mentally subnormal.[32]

Restriction of swimming is a difficult limitation for any child to accept, whether imposed by recurrent ear infections or seizures; it not only removes a valuable source of fun and exercise, but also stigmatizes the child as different or abnormal. For these reasons most experts feel that the data on increased risk for patients with epilepsy should not be extrapolated to restrictions on swimming, but instead to increased vigilance and care around water.

PATHOPHYSIOLOGY

The presence of chlorine in the water does not affect the outcome of drowning or near-drowning. It is neither detrimental nor helpful for drowning victims to have been submerged in chlorinated water. The complications of drowning are directly related to anoxia and to the volume and composition of water that is aspirated.[13] Salt water is approximately 3 per cent sodium chloride and therefore is slightly more than three times the tonicity or osmolality of normal extracellular body fluids. Both fresh and salt water damage alveoli, destroy surfactant, and result in pulmonary edema of the noncardiogenic or respiratory distress syndrome variety. Neither fresh nor salt water is any more or less likely to produce pulmonary edema in a particular individual who has been submerged.

Animal studies have elaborated on a number of differences between fresh and salt water drowning. Fresh water, because of its low tonicity, tends to move quickly through the alveoli, across the alveolar-capillary basement membrane and into the intravascular space. As a result, animal studies have reported hemodilution, hypervolemia, hemolysis, and hyponatremia.[13] The latter occurs both dilutionally because of water moving into the intravascular space and also because of the movement of sodium from the intravascular space into the alveolus in response to the hypotonicity and hyponatremia of fresh water. But it is important to remember that despite these volume and electrolyte changes which we see in experimental fresh water drowning, one of the most important aspects is that fresh water is very damaging to the surfactant that lines the alveoli and very damaging to the alveolar basement membrane and results in pulmonary edema with alveolitis and transudation of proteinaceous material into the alveolar spaces. In contrast, salt water is very hypertonic; it is more than three times the body fluid osmolalities and when salt water enters into an alveolar space it destroys surfactant, damages the alveolar basement membrane, and produces alveolitis, but because of the hypertonicity of salt water, water moves from the intravascular space into the alveolus. Because the concentrations of various electrolytes are much higher in sea water than they are in normal body solutions, sodium, chloride, and magnesium move into the intravascular space.[13] The damage to the alveolar basement membrane allows transudation of proteinaceous material and fluid into the alveolar space. In experimental salt water drowning, we occasionally see hypovolemia severe enough to produce hypovolemic shock, in addition to hypoproteinemia, hypernatremia, and hemoconcentration (Fig. 2). It is important to emphasize that these are the pathophysiologic changes that have been observed in experimental animal studies of drowning.

If we look at the pathophysiologic changes in human cases of drowning and near-drowning, the differences are not quite as pronounced as they have been in the animal studies. One sees hypoxemia in both fresh and salt water drownings with right to left intrapulmonic shunts.[25] Metabolic acidosis occurs in both entities secondary to anoxia, but one finds only minimal changes in electrolytes and hemoglobin in either fresh or salt water drownings.[25] The electrolyte and hemoglobin alterations in fresh and salt water drownings are minimal and of no real clinical significance. In fresh water drowning a transient increase in intravascular volume does occur. This can be measured and ascertained for only a few hours after the victim has been submerged, and then the body rapidly corrects for the increased volume by redistribution and diuresis. In salt water drowning one may see a transient intravascular volume decrease, but here also the body usually compensates adequately in a relatively brief period of time.[26]

The human response to unexpected submersion in a liquid medium has been broken down into various stages (Fig. 3). In Stage I, beginning with the unexpected submersion into the water, the victim aspirates a small

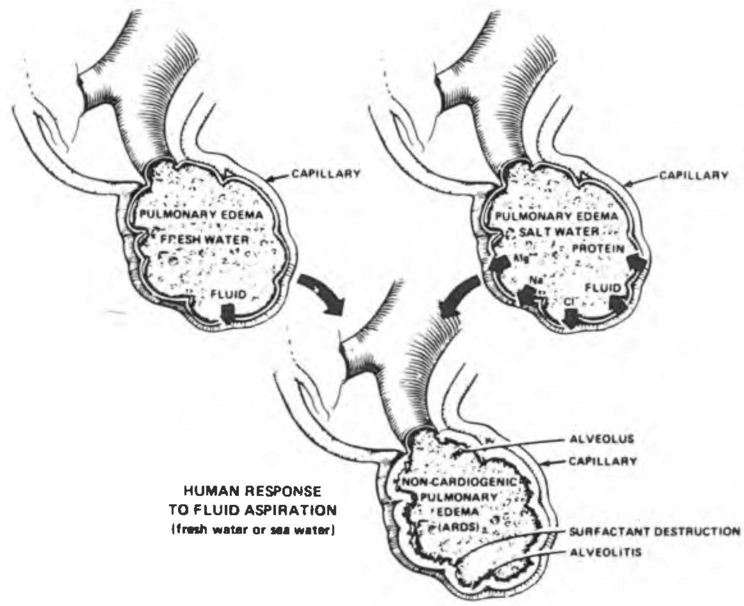

Figure 2. Pathophysiologic changes observed in fresh water and sea water experimental animal studies of drowning are shown in the top two illustrations and the final common pathway for both fresh and sea water submersion accidents in humans in the lower illustration. In human submersion accidents, one sees hypoxemia and right to left intrapulmonic shunts secondary to surfactant destruction and respiratory distress syndrome. An alveolitis results in noncardiogenic pulmonary edema.

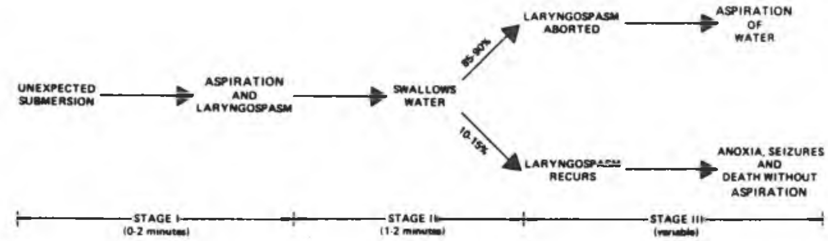

Figure 3. The human response to unexpected submersion. Unexpected submersion into water results in the victim's aspirating a small amount of water and going into laryngospasm. With increasing hypoxia and panic, the victim swallows water into the stomach. When anoxia progresses sufficiently, one of two courses occurs—in 85 per cent to 90 per cent of victims the laryngospasm is ablated and the victim aspirates water. In the remaining 10 per cent to 15 per cent of cases the laryngospasm relaxes, the victim again aspirates a small amount of water, and the laryngospasm recurs and persists to convulsions and death.

amount of water which leads immediately to laryngospasm which lasts for as long as two minutes of submersion time. In Stage II, because of the increasing hypoxia and panic, the victim may begin to swallow water into the stomach. In Stage III, one of two courses occurs. Ten to 15 per cent of victims experience what we call dry drowning. They again aspirate a small amount of water, severe laryngospasm recurs, and this time the laryngospasm persists to severe hypoxia, convulsions and death.[35] The remaining 85 to 90 per cent of drowning and near-drowning victims experience what we call wet drowning, wherein the laryngospasm relaxes secondary to hypoxia and they then aspirate large volumes of water. The 10 to 15 per cent of near-drowning victims who experience dry drowning aspirate little or no water. They either have no pulmonary damage on the basis of aspiration of water, or if they develop pulmonary edema, it may be on the basis of hypoxia and not secondary to aspiration of water.

Another important classification of human drowning and near-drowning accidents is the differentiation of "classic white cases" from "classic blue cases" of submersion accident victims.[32] In the "classic white case" the victim has lost consciousness before the submersion as opposed to the more typical immersion-asphyxia referred to as the "classic blue case." In immersion-asphyxia drowning the victim struggles to remain on the surface and to get air and aspirates water actively into the lungs. A pronounced catecholamine release is associated with the panic. In the case of drowning associated with syncope or loss of consciousness for other reasons (e.g., seizures or central nervous system injury), the victims usually do not struggle but instead sink rapidly even if they are good swimmers and there is no massive sympathetic discharge associated with panic. Here again, the distinction between these types of drownings is more theoretical than practical, although they may play a role in the pathophysiology of ice-water submersions, as will be discussed later.

In addition to the pulmonary insults from aspiration of water and hypoxia, a frequent contributor to additional pulmonary injury in near-drowning victims is vomiting and the aspiration of acidic gastric contents.

Animal studies of experimental drowning have not only contributed much to our knowledge of the pathophysiology of drowning but also substantially to the treatment of near-drowning victims. Animal studies have not only elucidated the role of anoxia in the cerebral injury and paved the way for potential cerebral resuscitation measures, but have also clarified the role of positive pressure ventilation, positive end-expiratory pressure, and volume resuscitation in submersion accident victims.[47]

TREATMENT

The single most important step in the treatment of submersion accident victims is the immediate institution of resuscitative measures at the earliest possible opportunity. This means that for the apneic victim, mouth-to-mouth resuscitation is begun as soon as the rescuer reaches the victim. For a victim who is away from shore or the side of a pool, mouth-to-mouth resuscitation must be instituted as soon as the victim is reached and assessed to be apneic, instead of rushing the victim to shore before assessment and rescue breathing. Unfortunately, external cardiac compressions cannot be effectively performed in the water, and so assessment for pulses and performance of external cardiac massage must be delayed until the victim is out of the water.

There is no logic to attempting to drain water from the lungs in fresh water drowning, since the water has rapidly moved out of the lungs and into the vascular system. The airway should be assessed and cleared of any debris or vomitus that may be obstructing the airway or in the mouth before rescue breathing is begun. The finger sweep maneuver to clear the oropharynx is especially important in submersion accident victims in whom debris from the water or vomitus may be in the oropharynx. If the victim cannot be ventilated, obstructed airway maneuvers are indicated to clear the airway.[16] I have grave reservations about the use of the abdominal thrust Heimlich maneuver in submersion accident victims because of its propensity to induce vomiting.[33] Emesis and aspiration of gastric contents are major problems in submersion accident victims and the emesis also interferes with technical and esthetic aspects of performing mouth-to-mouth resuscitation.

Pulmonary edema and decreased pulmonary compliance are also major problems in resuscitating submersion accident victims. They make effective ventilation difficult, and at times the pulmonary edema may be severe enough to interfere with attempted mouth-to-mouth resuscitation. Maneuvers to relieve airway obstruction may improve the ability to ventilate the victim, but it is important to remember that the patient can and should be ventilated even when pulmonary edema is present and copious. Cricoid pressure during mouth-to-mouth or bag and mask ventilation may reduce the risk of gastric aspiration by preventing regurgitation and reducing further abdominal distention during ventilation.

In salt water submersion accidents, there may be some logic to attempting to drain water and pulmonary edema fluid from the lungs if their presence is interfering with effective ventilation. Airway obstruction maneuvers may also have a role.[16] However, a lot of time should not be wasted in attempting to drain fluid from the lungs in the apneic victim since the single most important step is the immediate institution of resuscitation.

CPR should be continued for as long as needed during transport to an emergency facility. Oxygen at the highest concentration attainable should be provided to the victim as soon as available.

Any near-drowning victim who was submerged for more than a minute, was cyanotic or apneic, or required mouth-to-mouth resuscitation, should be hospitalized or observed in an emergency holding area for a minimum of 24 hours, no matter how good or normal they appear on arrival at the hospital or emergency facility. There are a number of cases in the literature of near-drowning accident victims who appeared normal on assessment in a emergency department, and even had a normal chest x-ray, who developed fulminant pulmonary edema as long as 12 hours after the near-drowning accident. It is unclear whether this late-onset pulmonary edema is delayed respiratory distress syndrome or neurogenic pulmonary edema secondary to anoxia. Late-onset neurologic deterioration secondary to cerebral edema has also been described. Both require careful observation and assessment for at least 24 hours after the submersion accident to prevent a fatal outcome.[29]

Decision making in the emergency department about admission to an ICU or hospital bed versus observation in an emergency department holding area or discharge home should include thorough history of the accident and previous illnesses, a physical examination with emphasis on pulmonary and central nervous system function, and a minimum number of diagnostic studies to include a chest x-ray, arterial blood gas, electrolytes, BUN, creatinine, and hemoglobin. In some cases a toxicologic screen for suspected alcohol or drug ingestion may also be warranted.

Patients who have required cardiopulmonary resuscitation or ventilatory support, or have abnormal chest x-rays or arterial blood gases on arrival at the emergency department should be admitted to an intensive care unit for close observation and therapy.

Serial arterial blood gases play an indispensable role in the management of the victim of a life-threatening submersion accident with respiratory, cerebral, or other vital organ compromise. An arterial line would provide minimally invasive monitoring of these patients in the ICU. Electrolytes, BUN, creatinine, and hemoglobin should also be assessed serially although as stated earlier, perturbations in these laboratory tests are unusual in human submersion accidents.[40, 43]

Oxygen therapy with or without ventilatory support is the first line of therapy for near-drowning victims. The apneic victim obviously requires mechanical ventilatory support. In the spontaneously breathing near-drowning victim, oxygen therapy alone (by mask or nasal cannula) may suffice if a $PaO_2 \geq 90$ can be maintained with an FiO_2 of $\leq .50$.[13] A patient with a PaO_2/FiO_2 ratio of ≤ 300 or a (shunt) $QS/QT \geq .15$ needs positive airway pressure in addition to oxygen. In most cases this will necessitate intubation of the patient and provision of the positive airway pressure by either CPAP or PEEP. With CPAP the patient breathes entirely on his own. In PEEP, ventilatory support is provided to varying degrees by a mechanical ventilator. In select cases CPAP can be provided by mask (e.g., in very cooperative adolescents) or nasal cannula (in infants who are obligate nasal breathers). In most near-drowning victims, positive airway pressure is optimally provided via a nasal-tracheal or oral-tracheal tube. Intubation not only insures the adequate and continuous provision of the needed positive airway pressure, but also enables good bronchial-pulmonary hygiene and removal of secretions.[43] Positive airway pressure should be initiated at a level of 5 cm H_2O and then increased by 2 to 3 cm H_2O increments until the desired $QS/QT \leq 20$ per cent or $PaO_2/FiO_2 \geq 300$ is achieved. As soon as possible, and definitely within 24 hours, the FiO_2 should be reduced to $\leq .50$ in order to avoid adding oxygen toxicity to the pulmonary injury. Once the desired oxygenation is achieved at a level of positive airway pressure, that level of PEEP or CPAP should be maintained unchanged for 24 to 48 hours before attempting to decrease it, in order to permit adequate surfactant regeneration.

Mechanical ventilation in addition to positive airway pressure is indicated whenever the victim's spontaneous ventilation is inadequate as assessed either by $PaCO_2 \geq 35$ mm Hg or an abnormally high respiratory rate (usually greater than 50 breaths per minute) to maintain adequate arterial blood gases, such that the patient is consuming large amounts of energy breathing and is likely to tire.[43]

In patients who are hemodynamically unstable or have serious pulmonary dysfunction, pulmonary artery catheterization improves the ability to assess and treat the victim. Pulmonary artery catheterization enables one to monitor cardiac function (cardiac output and right and left heart pressures), pulmonary function (QS/QT, pulmonary artery pressures), and tissue adequacy of oxygenation and perfusion (a-v DO_2, O_2 delivery and extraction) and to assess the response of these parameters to various therapies.

Prophylactic antibiotics are of doubtful value in the intensive care management of the near-drowning victim, and tend to only select out more resistant and more aggressive organisms. A preferred approach is daily or twice daily monitoring of tracheal aspirates with Gram's stain, culture, and sensitivity. At the first sign of pulmonary infection as gauged by fever, leukocytosis, pulmonary infiltrates, and white cell response in the tracheal aspirate to a predominant organism, antibiotic therapy is selected on the basis of predominant organism sensitivities or predominant organisms on Gram stain, pending culture and sensitivity studies. Likewise, corticosteroids for pulmonary injury are, at best, of doubtful value and probably should not be used.

Other important supportive measures for the near-drowning victim in the ICU include a nasogastric tube to prevent further aspiration and a Foley catheter to monitor urine output. Renal insufficiency or renal failure is rare in near-drowning victims but can occur secondary to anoxia, shock, or hemoglobinuria. One needs to be aware of and constantly vigilant for potential complications of therapy and underlying pulmonary injury, namely barotrauma.[23] Spontaneous pneumothoraces are common secondary to positive pressure therapy and local areas of hyperinflation. Any sudden change in hemodynamic stability is a pneumothorax or other barotrauma until proven otherwise. Another common problem is infection, and vigilance not only for pulmonary but also for other septic complications is important.

The most significant and important complication of near-drowning accidents in addition to pulmonary injury is the anoxic-ischemic cerebral insult.[2] Most of the late deaths and long-term sequelae of near-drowning accidents are neurologic in origin.[38, 39] Every effort in the early stages after rescue of a near-drowning victim should be directed at resuscitating the brain and preventing further neurologic damage. These steps include provision of adequate oxygenation and perfusion and careful monitoring for development of cerebral edema. Cerebral edema is a common occurrence after significant anoxic-ischemic insult secondary to a submersion accident.

Any victim who remains comatose and unresponsive after successful cardiopulmonary resuscitation or deteriorates neurologically should probably have continuous intracranial pressure monitoring.[8] One should also be cognizant of possible head or spine trauma or drug intoxication contributing to the submersion accident, but these are not common in childhood submersion accidents. They are, however, common in adolescent submersion accidents. If intracranial pressure (ICP) monitoring shows significant cerebral edema (ICP $\geq$ 20 mm Hg or cerebral perfusion pressure [CPP] $\leq$ 60 mm Hg) therapy should be directed at reducing ICP. These measures include hyperventilation (Pa_{CO_2} 28 to 32 mm Hg) and mannitol (0.25 to 0.50 gm per kg per dose) to reduce ICP to $\leq$ 20 mm Hg. Hyperpyrexia can occur secondary to the cerebral insult and the maintenance of normothermia with external cooling can simplify management. In select cases, induction of moderate hypothermia to 30 to 31° C and/or induction of barbiturate coma can control cerebral edema and intracranial hypertension when other therapies are unsuccessful.[6] Dexamethasone also may help in controlling cerebral edema over the long run but is of no value for acute episodes.

Unfortunately, the studies which have evaluated the results of cerebral resuscitation measures in submersion accident victims have failed to demonstrate that therapies directed at controlling intracranial hypertension and maintaining cerebral perfusion pressure improve outcome.[5, 11, 28] These studies have shown poor outcomes (death or moderate to profound neurologic sequelae) when ICP $\geq$ 20 and CPP $\leq$ 60 mm Hg have occurred, even when therapies are directed at controlling and improving these pressures. Further research and improvements in cerebral resuscitation will be needed.

Various prognostic scoring systems have been developed to predict which pediatric patients will do well after a submersion accident with standard therapy and which patients are likely to have significant cerebral anoxic encephalopathy and will require aggressive measures to resuscitate and protect the brain. One scoring system delineated five unfavorable prognostic factors, including age $\leq$ 3 years, estimated submersion longer than 5 minutes, no attempts at resuscitation for 10 minutes after rescue, coma on admission to the emergency department, and severe acidosis with an arterial blood gas pH $\leq$ 7.10.[31] Patients with two or fewer poor prognostic factors had a 90 per cent chance of good recovery with standard therapy, whereas patients with three or more poor prognostic factors had only a 5 per cent chance of good recovery. Additional studies by other authors have confirmed the utility of this scoring system.[7, 10, 11]

Neurologic classification of pediatric near-drowning victims based on level of consciousness as assessed by the Glasgow Coma Score (GCS) has also been used for prognostic purposes and to triage patients to various treatment protocols.[7] Good correlation between GCS and the prognostic scoring system of Orlowski have been demonstrated, and both are fairly accurate in predicting final outcome.[7, 11] The failure of intracranial pressure monitoring, barbiturate coma, induced hypothermia, and neuromuscular blockade to improve the outcome of severely comatose near-drowning victims with predetermined poor prognoses has, however, produced some new and potentially important prognostic data. Because of the typical delay of 2 to 6 hours between rescue and transfer from an outlying emergency facility to a pediatric intensive care unit, many patients with severe anoxic-ischemic cerebral insults and coma have had multiple determinations of neurologic status and level of consciousness before definitive therapy is begun. Recent data suggests that patients who remain profoundly comatose (decorticate, decerebrate, or flaccid) 2 to 6 hours after the submersion accident will do poorly—they will either be brain dead or suffer moderate to severe neurologic impairment. Patients who are improving but remain unresponsive have a 50 : 50 chance of doing well. Patients who are definitely improving and are alert or are stuporous or obtunded but respond to stimuli 2 to 6 hours after the accident will generally do well and most will have normal or near-normal neurologic outcomes.[49] These prognostic variables are important in counselling family members of submersion accident victims in the early stages after the accident as well as deciding which patients are likely to do well with standard supportive therapy and which victims should be candidates for experimental cerebral resuscitation therapies[5] (Table 4).

ICE-WATER SUBMERSION ACCIDENTS

An important group of submersion accident victims who have seemed to defy predictions for outcome after profound anoxic-ischemic insults are the victims of ice-water submersion accidents or cold-water drownings. The designation "cold-water drowning" has caused some confusion because no one has defined "cold-water."

The most famous of the ice-water submersion accidents was a 5-year-old boy who was documented to have been submerged for 40 minutes in ice-cold fresh water after he broke through the ice on a partially frozen river in Norway. Attempts by peers and police to locate the boy under the ice were unsuccessful, and frogmen found the boy at the bottom of the river, 2.5 to 3 meters below the surface of the water. There were no signs of air pockets between the water and the ice. Mouth-to-mouth ventilation was started immediately after rescue and external cardiac compression was commenced in the ambulance. On admission to the emergency department the boy was apneic and asystolic, and his rectal temperature was 24° C. External rewarming with warm-water bags was attempted and a palpable pulse and blood pressure were finally obtained 1 hour after arrival at the hospital and 1 hour and 45 minutes after submersion. He was discharged from the ICU after 3 days and home on the eighth day. Neuropsychometric testing was reportedly normal.[46]

Table 4. *Prognostic Factors in Submersion Accidents*

ORLOWSKI SCORE	GCS (GLASCOW COMA SCALE)
5 Unfavorable Prognostic Factors	*Eye Opening*
1. Age ≤3 years	1. None
2. Estimated maximum submersion time longer than 5 minutes	2. To pain 3. To speech
3. No attempts at resuscitation (MTM or CPR) for at least 10 minutes after rescue	4. Spontaneous *Best Verbal Response*
4. Patient in coma on admission to emergency department	1. None 2. Incomprehensible
5. Arterial blood gas pH ≤7.10	3. Inappropriate 4. Confused 5. Oriented *Best Motor Response* 1. None 2. Extension (decerebrate) 3. Flexion (decorticate) 4. Localizes pain 5. Obeys commands
Score ≤2 = 90% chance of recovery Score ≥3 = 5% chance of recovery	Score ≤5 = 80% risk of poor outcome (death or permanent neurologic sequelae)

NEUROLOGIC PROGNOSIS FOR NEAR-DROWNING VICTIMS

Initial Assessment	*Assessment 5–8 Hours Later*	*Prognosis*	*Chance of Good Neurologic Recovery (%)*
Alert (10)	Alert (9.5)	Excellent	≥95
Disoriented (9)	Disoriented (8)	Very good	75–85
Stupor (7)	Stupor (6)	Good	40–60
Coma with intact brainstem reflexes (5)	Coma with intact brainstem reflexes (3)	Fair	10–30
Coma with absent brainstem reflexes (2)	Coma with absent brainstem reflexes (1)	Poor	≤5

A thorough review of the world's literature on prolonged submersions with good outcomes was undertaken by the author. Prolonged submersion in water was arbitrarily defined as an estimated submersion of 15 minutes or more and a good outcome was defined as minimal or no neurologic deficit. Seventeen reported cases of prolonged submersions with good outcomes were found (Table 5). All but two of the victims were males and 13 of 17 were less than 19 years of age. All of the pediatric victims were male. Twelve were 7 years of age or younger, with a mean age of 10 years. Of the recorded water temperatures, all were 10° C or less. In 10 cases water was ice-covered. Core body temperatures varied from 21° C to 32° C and did not correlate with water temperature, submersion time, or body surface area. The duration of resuscitation varied from 0 minutes in two patients who had spontaneous heart rates when rescued to 160 minutes before spontaneous pulse and blood pressure were documented. Methods of rewarming varied considerably and did not seem to correlate with rapidity or ease of resuscitation. Some authors feel that core rewarming with warmed gases and intravenous fluids, peritoneal dialysis, or even

Table 5. *Reported Cases of Prolonged Submersion with Good Outcome*

REFERENCE	AGE/SEX	ESTIMATED SUBMERSION TIME	WATER TEMPERATURE	BODY CORE TEMPERATURE	DURATION OF RESUSCITATION	OUTCOME	COMMENTS
Haukebo[14] 1960	38 y.o. M	15 min	−4 to −5°C	?	Open-chest massage, 5–10 min	Good	Had been drinking on dock prior to falling into sea
Kvittinger[22] 1963	5 y.o. M	22 min	ice	24°C @ 4½ hr	160 min	Good	Complete heart block with HR 30 but no pulse @ 70 min CPR
Ohlsson[30] 1964	3 y.o. M	20 min	Stream in Nov. in Sweden	27°C @ 80 min	35 min (10 min ECC)	Good to fair	IQ 76
King[20] 1964	21 y.o. M	17 min	April in Melbourne	32°C @ 4 hr	No ECC	Good	Audible heart beat on admission—cardiac arrest when intubated
DeVillota[9] 1973	$1\frac{1}{12}$ y.o. M 12	20 min	Swimming pool in Feb. in Madrid; Air temp.: 11°C high, 0.6°C low	27.8°C @ 2 hr	50 min	Good	
Hunt[17] 1974	5 y.o. M	30 min	ice	27°C	No ECC	Good	HR 5–10 when rescued
Siebke[46] 1975	5 y.o. M	40 min	ice	24°C	67 min	Good	Longest documented submersion
Imbach[18] 1975	2 y.o. M	20 min	5–7°C	32.5°C @ 4 hr	1 hr	Good	
Klarskov[21] 1976	6 y.o. M	15–20 min	2–3°C	21°C	80 min (21 min ECC)	Good	V-fib → defibrillation with 100 watt. sec. → asystole—therapy with peritoneal dialysis
Theilade[48] 1977	6 y.o. M	25 min	4°C	31.8°C	40 min	Good	
Scientific American	18 y.o. M	38 min	ice	?	2 hr	Good	
Jessen[19] 1978	6 y.o. M	15–20 min	2–3°C	21°C	15 min	Good	
Sekar[45] 1980	23 y.o. F	25 min	ice	28.8°C	45 min	Good	
Young[52] 1980	7 y.o. M	15 min	ice	27°C	2¼ hr	Good	
Nugent[27] 1980	$3\frac{10}{12}$ y.o. M 12	12–15 min	Swimming pool in Dec. in Maryland (prob. ice)	23°C	60 min	Good to fair	Mild hypertonicity of 3 extremities and cognitive delay
Genoni[12] 1982	29 y.o. F	20 min	10°C	28°C	25 min	Good	
Newsweek[3] 1984	4 y.o. M	20 min	ice	29°C	60 min	Good	

cardiopulmonary bypass is indicated for theoretical reasons, but the literature shows as many successful cases where no active rewarming or only external rewarming was employed. The currently recommended treatment of hypothermia is based on a consensus of opinion of a number of experts.[24] An important dictum is that patients who appear dead after prolonged exposure to cold temperatures should not be considered dead until they are near normal core temperature and are still unresponsive to CPR. Unfortunately, patients who are brain dead are poikilothermic and therefore extremely difficult to warm.

A full minute or even longer may be required to detect a single heart beat or breath in a severely hypothermic patient. Victims whose hearts are beating and who are breathing, no matter how slowly, should be handled gently and not subjected to unnecessary resuscitation procedures. The cold and bradycardic heart is very irritable and fibrillation is easily induced. Victims in true cardiopulmonary arrest require CPR, but the hypothermic heart is relatively unresponsive to pharmacotherapy and electrical stimulation. If ventricular fibrillation occurs, a single attempt at countershock should be made if the core body temperature is greater than 29.5° C. If this is unsuccessful, intravenous bretylium may restore normal sinus rhythm. Intensive monitoring during rewarming is critical.

Patients with core or rectal temperatures below 29.5° C are at high risk for ventricular arrhythmias and should be rewarmed rapidly using techniques such as immersion in a tub of warm water (32 to 41° C), wrapping in heated blankets or warming blankets, gastric lavage with warmed fluids, warmed intravenous fluids, and heated, humidified oxygen. Core rewarming with peritoneal dialysis may also be indicated, especially if there is cardiovascular instability. More extreme measures such as extracorporeal blood rewarming with a heat exchanger or thoracotomy with mediastinal lavage should probably be reserved for patients with persistent, refractory ventricular fibrillation.

Patients with core or rectal temperatures between 29.5° C and 32° C and stable cardiovascular function can be rewarmed slowly but actively with heating blankets, warmed intravenous fluids, and heated, humidified oxygen.

Victims with rectal temperatures above 32° C generally have stable hemodynamics and can safely be rewarmed slowly (1° C per hour) with warm blankets.

These cases of prolonged submersion with good outcome must be balanced against the few cases of ice-water submersion with poor outcome reported in the literature. Obviously, most cases with poor outcome are probably not reported, whereas cases of prolonged submersion with good outcome are likely to be published. Three cases with poor outcomes are worth mentioning because they emphasize that none of the prognostic factors can guarantee a good outcome with 100 per cent accuracy. Two boys, one 12 years old and the other 2 years old, were submerged in ice water for 10 and 20 minutes, respectively.[52] The twelve year-old's initial core temperature was 27° C and the two year old had an initial core temperature of 32° C. Both died 3 days after the accident. In another case, a 1½-year-old boy was submerged for 7 minutes in 8° C water.[51] His initial core temperature was 35° C and he died at 14 hours after rescue.

Analysis of these published cases reveals some interesting patterns. Young boys under the age of 7 are at the greatest risk for cold water and ice water submersion accidents. As shown previously with warm-water submersion accidents, very young children under the age of 3 years do not fare as well as older children.[31] In two out of four published cases of ice-water drownings under the age of 3 years, the victims died. In 17 cases of prolonged submersion with good outcomes, all cases occurred in water 10° C or colder. Thirteen of the seventeen cases occurred in documented or probable ice-water or water that was no warmer than 2 to 3° C.

The factors which determine good and poor outcomes in ice-water submersion accidents have yet to be determined. Recent data suggests that the "dive-reflex" is not active in humans and therefore is probably not responsible for protecting the victim.[15] The physiologic changes which occur in seals during diving clearly do not occur in humans. Hypothermia under controlled circumstances is known to protect the brain and other organs from anoxia.[41] Accidental hypothermia, however, is very different from induced, controlled hypothermia. It may be that only in select cases in which the physiologic changes of accidental hypothermia mimic therapeutic hypothermia are the outcomes good. For example, falling into ice-water where rapid cooling occurs without struggle and panic (because of hypothermia induced muscle rigidity and areflexia) may be protective, whereas water warmer than 5 to 10° C or panic-induced catecholamine release with resultant ventricular fibrillation may provide no additional protection against anoxia. A heart which gradually slows to asystole or profound bradycardia in the presence of ice-water hypothermia may afford protection to the brain from anoxia, whereas ventricular fibrillation or tachycardia would result in energy and oxygen depletion and negate any beneficial effects of hypothermia.

There is a substantial body of literature documenting that arterial blood gases do not need to be temperature corrected in the presence of hypothermia.[41, 42]

PREVENTION

Probably more important than the treatment of submersion accident victims is the prevention of drowning accidents. An effective childhood safety barrier around swimming pools needs to be only 1.4 meters high to exclude virtually all children aged 4 years and younger.[36] It has been estimated that properly fenced-in swimming pools would decrease swimming-pool drownings in children aged 0 to 14 years by 80 per cent.[37]

Drowning deaths are difficult to prevent. Complete fencing-in of swimming pools would be an appropriate passive-prevention measure, but would reduce overall drowning fatalities by only 20 per cent. Adult supervision is obviously a critically important factor, particularly in children younger than 5 years of age. Unfortunately, the need for adequate supervision appears to be difficult to teach and impossible to legislate. Bystander CPR would probably reduce the number of drowning deaths, although no data are available to measure its effectiveness. An important approach to drowning prevention is victim modification by water-safety training and swimming instruction. Infants cannot be truly taught to swim, but can be made water-safe.[4] Any family who lives near water hazards or has a swimming pool should make sure that their toddlers are water-safe, and that older children can swim. Life jackets should be worn at all times by children and poor swimmers or nonswimmers while they are on boats.

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Pia produced and directed *On Drowning*, a lifeguard training film which contains film footage of actual near drownings and rescues, *Drowning: Facts & Myths*, and *The Reasons People Drown*, general audience films which examine the causes and solutions of drowning fatalities.

Mr. Pia conducted a two year research study into the causes of swimming related drowning fatalities in the United States from 1910 to 1980 in areas where lifeguards were on duty, and developed the RID Factor. He authored, *Observations on the Drowning of Nonswimmers*, *The Rid Factor as a Cause of Drowning*, *Reducing Swimming Related Drownings* and *Proposing a New Safety Collaboration*. For the last 27 years he has lectured throughout the U.S. and Canada on drowning prevention and served on two American Red Cross national advisory committees on lifeguard training.

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Reflections On Element #1 of Effective Surveillance: Water Crisis Recognition Training:

by

Frank Pia, MA, MS & Advanced Clinical Certificate in Psychology

Introduction

While it is clear the best way to prevent drownings is through the combined application of the four elements of effective surveillance: 1) water crisis recognition training, 2) scanning, 3) proper placement of lifeguards, and 4) properly designed areas of responsibility, the focus of this article will be on the first element of surveillance, water crisis recognition training for lifeguards.This information will set the foundation for the presentation *A Psychophysiological Analysis of Lifeguard Scanning Strategies* . The major points that will be covered in this paper will be the research that led to the formulation of the distress vs drowning categorization, the formulation of the Instinctive Drowning Response, and the difference between behavior centered and trait centered surveillance.

Statement of the Problem

Lifeguarding seems to be in a state of ferment and change. In attempting to reduce drowning and diving related spinal injuries through the training of new lifeguards and the retraining of experienced lifeguards, individuals are continually proposing new perspectives, ideas, terms, concepts, and training programs.

Amidst these new initiatives there is consensus among public health officials, lifeguard training agencies, and experts in the field of lifeguarding that the topic of drowning person recognition is one of the critical skills lifeguards must develop. The failure to develop these skills has been shown to be a cause of active drownings in areas where lifeguards were on duty. The other two factors shown to be causal elements in these drownings, intrusion and distraction can be found in the article "The RID Factor as a Cause of Drowning."(1)

One study by the New York State Health Department into the causes of drowning while lifeguards were on duty, clearly noted instances where drowning persons evidenced the behavior of the Instinctive Drowning Response. However, because of inadequate training, the lifeguards on duty failed to recognize the signs of drowning and dismissed the drowning person's behavior as "... someone merely playing in the water."(2) A statement by The Service National Des Saveteurs to a coroner's inquest in Montreal also noted the need to train lifeguards in distress swimmer and drowning person recognition skills and cited the role of the RID Factor in drownings(3)

The aim of this article is to provide the reader with an understanding of contemporary water crisis recognition theory. This article is needed because in trying to establish patron surveillance programs, the aquatic professional often feels that he is "drowning" in what sometimes feels to be a flood of confusing terminology and behavioral descriptions. To assist the reader in evaluating patron surveillance programs a historical review and critical analysis of the terms distress and drowning and behavior vs. trait centered recognition concepts will be undertaken.(4)

This historical method will provide an organizing scheme for both student and professional alike since many of the current " big questions" about water crisis recognition training programs for lifeguards were asked decades ago. This method will help the reader to trace the evolution of this type of training over the past forty years.

This article will not use the traditional lifeguarding term "victim" when referring to either a distressed swimmer or a drowning person. Epidemiologists believe that this term carries a negative connotation and have recommended that the term not be used to describe an injured person.

Different uses of the terms *distress* and *drowning* in lifeguard training textbooks have caused unclear references to the behavior that lifeguards should be trained to both notice and respond to. A critical training issue emerges when we frame recognition and rescue objectives for the lifeguard. If there is neither a theoretical difference (both terms mean the same thing) nor a behavioral difference (both behaviors are the same), then only one term should be used, and only one rescue technique taught. Since a dictionary helps systematize the way words or concepts are used in everyday life, this will be the starting point of the analysis.

The following are slightly edited definitions of distress from Webster's Ninth Collegiate dictionary.(5) Distress implies a external and often temporary cause of great physical or mental strain and stress. Hence the attachment of the prefix di (double) to the root word stress implying double stress. Other definitions include "to subject to great strain or difficulties or to cause to worry or to be troubled." Thus the common themes that runs through the various definitions of distress are physical or mental strain or trouble.

Using the same dictionary to define drowning, a sharp distinction between drowning and distress emerges. While the term drown is defined as "to become drowned", the behavioral definition "to suffocate by submersion especially in water", helps us by noting a crucial difference between the two terms. Research by the author has revealed that the actual or perceived feelings of suffocation in the water trigger universal unlearned behavior - the Instinctive Drowning Response (IDR) - that lifeguards must be trained to detect.

In distress situations the rescuer is looking for an individual experiencing great physical or mental stress or strain in the water. In drowning situations, the lifeguard is scanning for an individual who is suffocating in the water.

Were the differences between distress and drowning merely semantical, the author would not be investing his energy in writing this article or wasting the reader's time in reading this article because of a trivial terminology dispute. However, lying beneath these two terms distress and drowning, lies the primary question in scanning : What behavioral signs are the lifeguards looking for ?

Review of Literature

The first published account of the behavioral differences between distress and drowning were contained in the lifeguard training film On Drowning.(6) This 16mm documentary style film made at Orchard Beach, Bronx, NY during the 1970 bathing season recorded the movements of people actually drowning and being rescued. A detailed explanation of the differences between distress and drowning were contained in the 1974 article "Observations on the Drowning of Nonswimmers" in the YMCA publication *Journal of Physical Education.*(7)

Beginning in 1974 reference to the original research regarding the difference between distress and drowning has been incorporated in the following lifeguard textbooks and manuals; Alert: the lifeguard training manual of the Royal Lifesaving Society of Canada (8) Lifeguard Training: The American National Red Cross, (9), Modern Concepts in Lifeguarding A.L.T. International (10) On the Guard II the YMCA Society of North America (11) Lifeguarding in the Waterparks. Huint's definitive textbook on the subject,(12) and the Manual of Open Water Lifesaving by the U.S. Lifesaving Association (13) These textbooks point out that distressed individuals were not yet drowning and because of a swimming or floating skill were able to summon help by waving or calling out. Generally, these publications are in agreement that drowning persons are neither able to call out for help because they were suffocating in the water, nor are they able to wave for help because at their moment of peril they lack a swimming or floating skill.

Behavior Centered Surveillance

These concepts of distress and drowning form one of the foundations behavior centered surveillance.The basic premise of behavior centered surveillance is that a lifeguard's determination of a person's difficulty in the water must always be based on a person's behavior, not on physical characteristics such as age, weight, ethnic or racial background. Implicit in this approach is the belief that scanning is a task that requires constant observation and evaluation of the behavior of all bathers.

The most efficient way for lifeguards to maintain surveillance over people at their facility is to understand the behavior that indicates that a person is in distress or drowning and to evaluate patron's movements against four target behaviors. The four target behaviors that a lifeguard looks for while scanning a bathing area are breathing, arm and leg motions, body position, and movement in the water. The reader is encouraged to read table 5-1 in Lifeguarding Today which compares the movements of swimmers, distressed swimmers, active and passive drowning persons. (14)

Distress

Lifeguards can recognize distressed swimmers by the way they support themselves in the water and their voluntary actions. Because of the distressed person's swimming or floating skills, he or she has enough control of their arms and legs to keep their mouth above the surface of the water. Even though the distressed swimmer is using inefficient swimming strokes, and might be unable to move toward safety, he is able to continue breathing, and may call for help.

Another characteristic that differentiates the distressed swimmer from a drowning person is that the distressed swimmer has voluntary control over their movements. Movements such as attempting to but not making any progress toward safety, trying to use another patron for support, or waving or calling out for help, all signal the lifeguard, and in many instances other patrons, that assistance is needed.

While it has been documented that in times of acute stress, the autonomic nervous system (ANS) causes an increase in pulse rate, respiration, and blood pressure, these phenomenon most often are not observable to the lifeguard while he or she is scanning a bathing area. It is only when internal ANS functioning leads to voluntary behavior that it is observable to the lifeguard such as waving and calling out for help, the inability to swim or move to safety, or grabbing another patron, does the lifeguard have the behavior that triggers his rescue response.

As conditions such as fatigue, becoming chilled, the progress of a sudden illness or a rip current continue to effect the distressed swimmer, he or she is less able to support himself or herself in the water. It is estimated by the USLA that rip currents at surf beaches account for more than 80% of rescues at these facilities.

The most comprehensive list of distress indicators can be found in the 1995 edition of the USLA publication Manual of Open Water Lifesaving. (15) Under the heading Swimmer Observation, this publication contains thirteen distress behaviors that range from a person anxiously glancing toward shore to individuals clinging to fixed objects. As these conditions cause the person's mouth to come closer to the surface of the water, anxiety increases. If a distressed swimmer is not rescued, he or she will become a drowning person .

This description of distressed swimmer behavior does not mean there is always a transition from distress to drowning behavior. To the contrary, data indicates that most drowning persons do not pass through the distress stage, but almost immediately go from a position of safety into Instinctive Drowning Response behavior.

Drowning Behavior

As mentioned earlier an active drowning person struggles on the surface of the water in a highly predictable, patterned, and to the trained eye, recognizable way. The Instinctive Drowning Response represents a person's attempts to avoid the actual or perceived suffocation in the water. The key concept in understanding a drowning person's behavior is to keep in mind that suffocation in water triggers a constellation of autonomic nervous system responses that result in external, unlearned, instinctive drowning movements. Research has shown that this response is present when drownings occur in pools, lakes, beaches, rivers, and waterparks.While the term has been used retrospectively to establish the cause of death or to mange the course of treatment of a patient who has suffered a near drowning episode, I believe that it is the actual or perceived suffocation in water that is the stimulus for the Instinctive Drowning Response

The reader must keep in mind that the drowning process starts at the point when a person is no longer able to keep his or her mouth above the surface of the water. The aspiration of water which leads to a wet or dry drowning occurs at a later point in the drowning process. It is therefore both inaccurate and misleading to tell lifeguards that distress covers all behavior up to the aspiration of water and drowning all behavior after that point.

Characteristics of the Instinctive Drowning Response (IDR)

The following information describes the movements of the IDR, explains why certain behaviors are or are not occurring, and offers insights into what physiological processes are prompting the drowning person's movements. The IDR is a group of signs and symptoms that collectively indicate an active drowning is occurring and differentiate it from the characteristics of distress.

The first characteristic of Instinctive Drowning Response is the person is most often physiologically unable to call out for help. The respiratory system was designed for breathing; speech is the secondary or overlaid function (16). This means the primary function breathing must be satisfied first, before the secondary function speech can occur.

The second reason a drowning person cannot call out for help is his mouth is alternately sinking below and reappearing above the surface of the water. The drowning person's mouth is not above the surface of the water long enough for him to exhale, inhale, and call out for help.

When the drowning person's mouth is above the surface, he exhales and quickly inhales as his mouth starts to sink below the surface of the water. While his mouth is below the surface of the water the drowning person keeps it tightly closed to avoid swallowing water.

The second characteristic of the Instinctive Drowning Response is that the person is unable to wave for help. Immediately after a drowning person begins gasping for air, he is instinctively forced to extend his arms laterally and begins to press down on the surface of the water with his arms and hands. This response over which the drowning person has no voluntary control, renders him unable to wave for help.

The drowning person's arm movements are designed to keep his head above water so he can continue to breathe. By pressing down on the surface of the water, he can lift his mouth out of the water to breathe.

The third characteristic of the Instinctive Drowning Response is that the drowning person has arm movements that he cannot control. Physiologically, a drowning person who is struggling on the surface of the water cannot stop drowning and perform voluntary movements like waving for help, moving toward a rescuer, or reaching out for a piece of rescue equipment. All of these actions require a swimming or floating skill which by using the definition of the term drowning, the drowning person does not have.

When a drowning person grabs a rescuer, it is because the rescuer did not give the drowning person enough support to stop the IDR. Rather the rescuer only gave the drowning person enough support to use either the rescuer or the rescue tube as a base of support to grab the lifeguard. Further, the lifeguard did not give the drowning person enough support to convince him he was no longer suffocating.

The fourth characteristic of the Instinctive Drowning Response is that the drowning person's body is perpendicular in the water. There is no evidence of a supporting kick.

The fifth characteristic of the Instinctive Drowning Response is that the drowning person struggles on the surface of the water from 20 to 60 seconds. This data was obtained and validated over a 21 year period at Orchard Beach, Bronx , New York where approximately 40,000 rescues, an average of 2,000 per summer occurred.(17)

Training officers must help their lifeguards to conceptually understand that all of the drowning person's behavior is designed to prevent suffocation in the water.
Research at Orchard Beach also revealed that the drowning person was often surrounded by patrons who did not realize that a drowning was occurring next to them. It is therefore imperative that new lifeguards be trained to rely on the signs of drowning to begin their rescue, and not wait for patrons or more experienced to tell them that a person is drowning.

Because manipulation of variables in my observational drowning studies at Orchard Beach were neither ethically nor morally possible, the only way to obtain this data was direct observation of drowning persons during rescues. This methodology conformed to the qualitative research methods suggested by Patton (18) and others in which the researcher observes, describes, interprets, self reflects, and then critically analyzes.

This behavior, originally studied at Orchard Beach in the 1950's and 1960's, and then written about in the 1970's has been shown to exist in other areas. The data for this conclusion consists of letters and telephone calls from lifeguards, parents, camp counselors, and park employees who noted that drowning person recognition concepts contained in On Drowning,(19) Drowning: Facts & Myths (20), and The Reasons People Drown (21) enabled them to identify a drowning person that was surrounded by bathers who did not recognize the Instinctive Drowning Response.

Further validation of the existence of the Instinctive Drowning Response can be found in the Binghamton Tape.(21) This videotape tape showed a fire fighter being caught in a hydraulic at the base of a low head dam. Even though the fire fighter was fully clothed , and was being alternatively pulled below and recirculated above the surface of the water, the Instinctive Drowning Response was still in evidence when he struggled to stay afloat on the surface of the water.

Another piece of dramatic footage which illustrated the Instinctive Drowning Response was the rescue of an airline passenger that occurred in cold water near Dulles International Airport, in Washington, DC. The arm movements of the person being rescued clearly illustrated the presence of the Instinctive Drowning Response in cold water.

The final support for the existence of Instinctive Drowning Response can be found in the instructional tape In Too Deep (23). Using the documentary style of On Drowning, footage of near drownings and rescues at Dorney Park were obtained.

Having defined Behavior Centered Surveillance, and clearly established the existence of the Instinctive Drowning Response, with characteristics that differentiate it from distressed swimmers, the next section of this paper will examine the ways distress and drowning are used in other lifeguard training programs. In addition, trait centered surveillance, the method of using external characteristics to predict people's behavior, and then designate them as "high risk" guests, will be discussed during the presentation

In 1983, Ellis and Associates offered a new definition of the term distress. Two events, the expansion during the past few years of this program from the waterpark environment into pools and still water areas, and the listing of ten characteristics of distress, has led to confusion regarding what water crisis recognition concepts lifeguard training agencies should use. The confusion is most evident when a lifeguard service has supervisors or staff members whose training backgrounds cause them to use different definitions of distress and drowning.

In the National Pool and Waterpark Lifeguard/CPR textbook, distress is used to describe any individual experiencing difficulty in the water. People in distress are given characteristics, categorized as conscious or unconscious, and then located on the surface, just below the surface within arms reach, or below the surface beyond arms reach.

The biggest source of confusion has been this organization's listing of certain Instinctive Drowning Response characteristics under the category of distress This confusion is then compounded by listing certain behaviors that the person may be experiencing, but are not observable to the lifeguard.

Space limitations prohibit a detailed analysis of Trait Centered Surveillance concepts. This analysis will occur during the presentation *A Psychophysiological Analysis of Lifeguards' Scanning Strategies*.

The objectives of this presentation will be to:
Compare and contrast the scanning strategies taught by all the major lifeguard training agencies in Canada and the United States,
Explain the proper use of peripheral and frontal vision in scanning,
Examine the extent to which the perception of form and movement of bathers by lifeguards is a physiological or cognitive function
Theorize how lifeguards process visual data so training objects for quickly detecting swimmers in distress and drowning persons can be made
Discuss whether geometric scanning grids facilitatae or impede lifeguard scanning
Propose a guide for evaluating Behavior Centered and Trait Centered Surveillance

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Captain Bill Richardson (ret.)

Bill Richardson is retired from the City of Huntington Beach where he was the Marine Safety Captain for ten and one half years. As the city's highest ranking Marine Safety Officer his agency responsibilities included management of the Marine Safety Division, control over operation of 3.5 miles of beach, 110 marine safety employees and an annual budget of just over $3 million dollars. He progressed to the Captain position, attaining every rank in the department from Recurrent Ocean Lifeguard in 1962 to Marine Safety Captain in 1984 until his retirement in 1994.

Richardson was a member of the department's Search and Recovery and Environmental Dive Team for over twenty years and accrued over 800 hours in diving operations. He served as the departments Training Officer from 1972 to1984 and has participated as an instructor in over 25 national and international educational seminars and training schools.

Richardson is the current President of the United States Lifesaving Association, a position he has held for six years. He is also Secretary of the California Surf Lifesaving Association. He has been a member of the Board of Directors for both the USLA and CSLSA since 1983. A Charter Member of the national organization since it's development in 1964, Richardson is a Life Member of Huntington Beach SLSA, CSLSA and USLA.

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“RECOGNITION AND OBSERVATION OF POTENTIAL RESCUE VICTIMS IN AN OPEN WATER ENVIRONMENT”

International Life Saving Federation
International Medical Rescue Conference

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Presented by:

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INTRODUCTION

The following presentation will focus on the first of five basic premises related to one of the primary lifeguard responsibilities, that of rescue response.

The five premises of rescue response are:

- Know how to recognize trouble
- Know how to get to the victim
- Know what to do with the victim in the water
- Know how to get back with the victim
- Know what to do with the victim once back on shore

While rescue is one of the primary responsibilities of lifeguards, the most important responsibility must be prevention. Because time is the most critical of all factors, the recognition of potential victims is key to the preventative lifesaving model. Lifeguards must be well trained in the observation of swimmers for signs of distress certainly, but they must also be trained to observe beach clientele for indications of their swimming ability and *rescue potential* even before they enter the water.

In order to provide the essential elements of preventative lifeguarding this report considers all factors including the environment, beach topography, dry land observations and specific observations relative to individuals presentations in the water as a vital part of scanning the surf for potential rescues.

The information presented here comes from the ***United States Lifesaving Association Manual of Open Water Lifesaving***, with some elements extracted from the first USLA training manual, ***Lifesaving and Marine Safety***.

ENVIRONMENTAL CONSIDERATIONS

Surf

Without providing a whole seminar on waves and their formation, suffice to say that waves are generated by wind with few exceptions. The exceptions being seismic activity and tides. The energy of a wave, often travels great distances with the strength of the waves based upon:

- The velocity of the wind,
- The distance over which the wind has effect and
- The duration of the winds effect.

The experienced lifeguard knows that waves can cause visible changes in beaches depending upon the size and type of wave and the composition of the bottom. Waves are categorized into three primary forms:

- *Spilling waves*
- *Plunging waves (also known as shorebreak)*
- *Surging Plunging waves*

Plunging Waves generally have the most impact on beach conditions and may aid the most in the formation of Rip Currents. They are also responsible for more injuries in the surf environment than the other two types combined. Such injuries include bodysurfing, bodyboarding and surfing neck and back injuries created when the swimmer or surfer is thrown against the bottom.

However, any of the three types of waves may be responsible for increased longshore or lateral currents. The danger to swimmers from longshore currents is that they may be carried laterally along the beach to the area where a Rip Current pulls them seaward and small children can be carried into inshore holes where the depth of the water could easily be overhead.

Backwash

Backwash is most notable on steeply inclined beaches and particularly around high tide and during increased surf activity. Because the returning water often knocks peoples feet out from under them, this phenomenon is particularly hazardous to smaller children and older people.

Shorebreak

Plunging waves often break on or very near to shore and sometimes in little or no water. Such waves are said to break on the shore and are extremely hazardous to bodysurfers, bodyboarders and surfers who are thrown against the bottom creating severe injuries including cervical-spinal trauma.

Lateral Current

Lateral currents are also known as longshore currents or lateral drifts. These currents are created when waves coming from an angle to the beach push water along the beach as the waves break. These currents may be so strong that a swimmer is unable to retain their position relative to shore. Those who do not pay attention can be swept sideways into a Rip Current and then beyond the breakers.

Sand Bars

Sand bars and troughs are found in areas where consistent lateral currents have cut a channel in the sand bottom near the beach. The size, depth and shape of these channels can vary greatly depending upon the type and consistency of the sand and the strength of the current.

Sand bars may attract unsuspecting waders into an area adjacent deeper water, only to have them swept off by the lateral current and into the channel or trough. Often the lateral currents that create these sand bars feed Rip Currents. Swimmers often fail to recognize that the depth of the water is greatly varied and upon diving head first into the water without checking first often find the back side of an inshore hole or a sand bar with their head, causing severe cervical-spinal injuries.

Inshore Holes

Inshore holes are depressions in the sand caused by erosion of the sand and is fairly localized. These areas can be extremely hazardous to small children. Inshore holes can also be a serious hazard to lifeguards who can sprain or fracture an ankle or knee during response to surf rescues.

Because inshore holes, sandbars and troughs are often close to shore, it is essential that lifeguards be taught to scan both shallow and deep water.

Rip Currents

Rip Currents occur when waves spilling over sandbars into troughs on the shoreward side pile up and subsequently exit quickly through any break in the wall of sand that traps them. Similarly, lateral currents push up against inshore holes, or immovable objects such as promontory points, jetties, groins or piers, forcing the water seaward and creating what has been described as “rivers in the surf” which pull seaward.

Based upon USLA National Statistics, **Rip Currents account for more than 80% of all surf beach rescues**. Statistically, spring and early summer are the most hazardous times because of the unstable condition of the bottom created primarily by winter storms. These conditions are further aggravated by colder water temperatures which effect both swimmers and lifeguards alike.

Rip Current Characteristics

- Rough
- Choppy
- Suspended particles (sand, debris and kelp particles)
- Foam
- Usually pull the hardest with ebbing tide and during lulls between sets of waves

Rip Currents can be defined in four types:

- *Fixed or Stationary Rips*
- *Permanent Rips*
- *Flash Rips*
- *Traveling or Transient Rips*

Beach Topography

In addition to the previously mentioned problems which exist in the water and which are generally related to waves or surf, there exist another set of problems associated with physical structures that often occur on our beaches. Steep berms, rock outcroppings, cliffs and man made structures such as groins, jetties and piers, all create their own unique physical hazards to swimmers and must be observed and be controlled as to access by the swimming public.

Weather

Storms of all nature, fog, lightening and waterspouts all carry their own particular problems which lifeguards must deal with. Specific emergency action plans should be developed to deal with each type of hazard. Lifeguards must be attuned to these environmental hazards and be prepared to deal with the results.

Similarly temperature and sun exposure is a continual problem for beach attendees. Lifeguards should be aware of the impact of the sun, its harmful rays and how adverse temperature, both high and low, can effect the beach populace.

RECOGNITION AND ASSESSMENT

In the USLA's manual the chapter on Water Surveillance is introduced with the following statement:

> *"In emergency medicine there is often reference made to a golden hour -- the period of time after a traumatic injury during which effective medical intervention is essential to the saving of life. In open water lifesaving, such a time frame is an unheard of luxury. Lifeguards measure the opportunity for successful intervention not in minutes, but in moments."*

In order to effectively prevent injuries and successfully intervene before a drowning occurs, one of the primary skills a lifeguard must learn is the recognition and assessment of potential rescue victims, often before the victims themselves are aware they are in danger. Experienced lifeguards can frequently predict which persons will need assistance long before an emergency arises and sometimes even before they leave the parking lot. This is possible by observing visual clues as defined in this portion of this paper. While some of the information may appear to contain bias, the information is based on statistical evidence based upon years of evaluating rescue records and accounts of seasoned lifeguards.

Dry Land Observations

The observation of patrons as they arrive and "set-up" at the beach front will many times provide specific clues as to the possible aquatic abilities or beach sense of various individuals.

- ***Age*** -- Very old or very young individuals should be watched carefully. They may lack the physical ability or strength to fight an unexpected current or to quickly move away from a dangerous situation. These individuals usually incur injuries very near the shoreline requiring quick recognition and immediate response.

- ***Body Weight*** -- Persons who are overweight or extremely underweight each have their own specific problems in an aquatic environment, but both may be out of shape an not capable of struggling for longer periods of time as compared to individuals who have stayed in some physically inclined condition.

Overweight persons may become easily exhausted and are hampered in their ability to move quickly to avoid danger while those who are underweight can be adversely effected even by moderately cold water.

- ***Pale or Extremely White Complexion or Extreme Sunburn*** -- Individuals who look as though they just stepped out of a mayonnaise jar often are making their first visit to the beach this season, or for that matter their first trip ever. These person should be watched carefully to ascertain their swimming ability once they enter the water. They should also be contacted about the hazards of the sun.

  Extremely sunburned individuals may simply be the ones who were here yesterday that came back to fill in their "tan". Guards should continue to key on these persons for the same reasons as those who are milk white.

- ***Intoxication*** -- Alcohol and water don't mix. Most beach facilities do not allow alcoholic beverages, and for good reason. Statistics indicate a high degree of drowning incidents in the United States are related to alcohol consumption. Individuals are impacted in two general ways that will contribute to the probability of their getting into trouble in the water.

  1. The impairment of their normal physical abilities.
  2. The impairment of their ability to act responsibly.

- ***Improper Equipment & Flotation Devices*** -- Some individuals who have limited swimming skills often rely on flotation devices to bolster their ability to access deeper water. Many times these devices become separated from the swimmer by wave action, or the apparatus simply deflates because of a leak, leaving the swimmer to their own basic ability. Many individuals get the "right kind of gear" but fail to follow simple safety rules like using leashes and swim fins with bodyboards.

- ***Improper Attire*** -- Persons entering the water wearing clothes, other than those meant for swimming are also at risk. The weight and the restrictive nature of wet clothing can cause a person to tire more quickly. Similarly, not using wet suits when they should be used or using them when they are not needed are also keys.

- ***Disabilities & Ethnicity*** -- While persons with physical impairments generally know their limitations and often use swimming as a means of exercise, the addition of currents, waves, variable water temperatures and other environmentally driven factors, may cause them great difficulty. They should be watched carefully and warned of these types of hazards.

  There have been studies that identify significant differences in the drowning rates of various racial and ethnic groups. However these statistical trends vary somewhat on a regional basis and there appears to be an association with socioeconomic factors. However varied, lifeguard agencies should evaluate their own statistics to identify at-risk populations in their own areas of operation.

<u>Swimmer Observations</u>

Once the above visitors enter the water, additional clues will aid the guard in evaluating their condition. The pre-entry clues simply allow the guard to key on individuals who **MAY** be a problem. When they hit the water, either the suspicions are confirmed or negated. A number of signs and symptoms in the water are the essential clues the guard must watch for .

Facing Toward Shore -- Swimmers, generally face toward shore when they are concerned about how to get there. Body surfers and bodyboarders usually face the waves to prevent them from being pummeled and to catch waves. The less experienced individuals are looking toward shore as their haven of safety.

- ***Head Low in the Water*** -- Competent swimmers remaining in a stationary position usually hold their head high. They tread water, breastroke, swim on their back, but generally they keep their chins well out of the water.

- ***Low or Erratic Stroke*** -- This key usually accompanies the subjects head being low in the water. The swimmer may display erratic stroke with the elbows dragging.

- ***Lack of Kick*** -- Under normal circumstance the weaker swimmer displays little or no kick. Stronger swimmers will often propel themselves solely with their legs and feet and usually use fins to add to their abilities.

- ***Waves Breaking Over the Head*** -- Most people who are competent swimmers will dive under waves to prevent themselves from being pummeled.

- ***Hair in the Eyes*** -- The natural instinct for most people in control of themselves in the water is to sweep the hair out of their eyes.

- ***Glassy, Empty or Anxious Eyes*** -- It is said that the eyes are a window to our emotions. Depending on the distance and the quality of optical equipment, the lifeguard can read fear, anxiety and fatigue in the eyes of a distressed swimmer.

- ***Heads Together*** -- Swimmers who suddenly converge and remain together may be attempting to assist one another. Persons who congregate together in the water for no other apparent reason may be attempting to assist another person who is in difficulty.

- ***Hand Waving --*** Self explanatory. The guard must be alert to it as an indictor.

- ***Being Swept Along By or Fighting the Current*** -- The first sign of distress for a swimmer caught in a current is that they are being swept laterally or being pulled offshore by the current.

- ***Erratic or Unusual Behavior*** -- Watch for hyper-active motions, such as flailing or for total immobility in the water..

- ***Clinging to Fixed Objects*** -- Individuals hanging onto pier pilings or other solid structures or those attempting to climb on to jetties or groins during surf activity.

<u>Drowning Presentations</u>

Classic, obvious signs that a person has gone beyond being in distress to the imminent danger of drowning are:

- ***Double Arm Grasping*** -- Which resembles an in-effective butterfly stroke when the individual slaps as the water with both arms simultaneously.

- ***Climbing the Ladder* --** Simply stated, the victim looks as though they are climbing an imaginary ladder in the water and further looks as though they are attempting to crawl up out of the water.

EFFECTIVE WATER OBSERVATION

Observation Techniques

Visual Scanning

Several basic and key observation techniques must be employed to enable the lifeguard to adequately observe all the people in their area of responsibility.

Visual scanning requires the guard to sweep their area of responsibility continually, looking from side to side, checking each person or group of persons briefly to ascertain any of the previously defined indications of difficulty of distress.

Watch swimmers close to shore as well as those offshore. The guard begins to put their visual scanning effort together with the keys described earlier in this paper to determine who needs assistance and who doesn’t.

Watch all classifications of bathers, *waders, fanny dippers and swimmers* with equal intensity to locate trouble.

Use of Optical Equipment

Guards absolutely **must** wear good sunglasses, for the protection of their eyes but also to aid them in seeing the water and swimmers, particularly when glare is a problem. Sunglasses will also aid in preventing eye fatigue due to long periods of exposure to the sun. Good quality Polaroid lenses will almost completely eliminate glare and make scanning the water much easier.

Quality binoculars are also important. Be careful not to use binoculars with too tight a field of vision as they are extremely limiting. Never rely totally on binoculars when scanning as they generally limit your field of view and cause “tunnel vision”. Use them to verify your initial instincts and to key on those clues that require much closer scrutiny, such as, hair in the eyes or the eyes themselves, to check for swim fins on a swimmer or to establish why two people are close together in the water.

Overlapping Responsibility

Beaches with multiple towers or stands need to keep them close enough together to allow overlapping of vision to avoid creation of blind spots or areas without coverage between guards. In this situation there is no clear boundary between the stations and guards must overlap their visual scanning effort and eliminate the potential for one guard thinking that a potential victim is in someone else’s water.

Cross Checking

Because glare and other natural conditions may obscure portions of an area, guards must cross check with each other to insure that all areas are covered completely. Communications becomes an important tool for lifeguards in these situations. Radios or telephones are the best methods to properly communicate in these circumstances.

AREAS OF RESPONSIBILITY

Lifeguards must consider all areas of the water, the beach and related facilities as part of their responsibility and potentially an area where they must respond.

These areas include the Primary, Secondary and Tertiary Zones.

- ***Primary Zone*** -- The water is the lifeguards top priority. The Primary Zone for each lifeguard is the water area for which they are responsible. This zone automatically increases when lifeguards in adjacent towers are on a response or the tower is closed.

- ***Secondary Zone*** -- Usually this area includes adjacent water, including the Primary Zone of other lifeguards, the beach, immediately adjacent park areas, the sky and the water to the horizon. Less frequent scanning of this zone is required, but the lifeguard should check this zone regularly.

- ***Tertiary Zone*** -- Generally, the Tertiary Zone includes all other areas within sight of the lifeguard. It could include adjacent streets and parking lots for example. These areas should also be quickly scanned, but far less frequently than the Primary and Secondary Zones. Guards may not necessarily respond to these areas themselves, but may observe an incident that requires a response by a supervisory unit or another entity such as police and/or fire personnel.

CONCLUSION

Emergency personnel are all expected to respond quickly and efficiently once an emergency arises. This is the case even with lifeguards. However, lifesaving on open water beaches must be preventive rather than just reactionary. Using the known concerns of the environment, topographical and other possibly non-aquatic keys, lifeguards can initiate contacts with the public to prevent accidents before they happen.

Using good scanning skills and keying in on Dry Land and Swimmer Observations as a means of recognizing potential rescues also allows the guard to make contact before the incident progresses to a drowning scenario.

Preventative Lifeguarding is the key to success in the elimination of drowning. Pre-recognition and observation skills are essential elements in that process.

Professor Andrew D Short

Professor Andrew D. Short is a coastal geomorphologist with the University of Sydney where, beside lecturing on coastal topics, he directs the Marine Studies Centre and the Coastal Studies Unit. Since 1990 he has also been National Coordinator of the Australian Beach Safety and Management Program (ABSAMP), a cooperative project with Surf Life Saving Australia.

Short, who has degrees from Sydney, Hawaii and Louisiana State has been involved in coastal (beach) research throughout Australia, the Americas and parts of Europe. His major research interests are in the nature, evolution and dynamics of the coast, particularly the beach and surf zone. This information has been utilized in ABSAMP to develop a beach hazard rating system, which is in the process of being applied to all Australian beaches.

Short is the author of more than 120 scientific papers and 5 books. He serves on the editorial board of Marine Geology (The Netherlands), Coastal, Estuarine & Shelf Research (UK) and the Journal of Coastal Research (USA).

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AUSTRALIAN BEACH SAFETY & MANAGEMENT PROGRAM

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1. AUSTRALIAN BEACH SAFETY & MANAGEMENT PROGRAM

The Australian Beach Safety and Management Program (ABSAMP) was established in 1990 as a joint program between Surf Life Saving Australia (SLSA) and the Coastal Studies Unit, University of Sydney. The aims of the program are to:

- develop a comprehensive, standardised and scientific **information base** on all Australian beaches with regard to their location, physical characteristics, access, facilities, usage, rescues, physical and biological hazards, and level of public risk under various wave, tide and weather conditions.
- collate a complete **services profile** including rescue personnel and equipment provided by SLSA Australia wide.
- compile related information on associated beach **rescue and emergency services**.

This information is now being used in a wide range of applications in beach safety training and management, in public beach safety education, and in local, state and federal coastal policy and management. The ultimate aim is to expand and improve the management and safety on all Australian beaches, and to assist other countries to develop similar programs. This paper provides a brief overview of the program and some of its applications.

2. DATABASE

The database is the core of the program and when complete will contain information on every one of Australia's 8 000 plus beaches. The database is maintained in two software packages. Mapinfo is used to maintain the location of every beach, while Microsoft Access is used for data entry, management and analysis. The data are arranged in five classes, which contain a total of 19 tables which in turn contain up to 352 data fields (**Fig. 1**).

2.1 Data acquisition

Data on each beach is acquired from a range of interrelated sources.

2.1.1 Maps and aerial photographs

Large scale *maps* show the location of most but not all beaches, and provide a measure of beach dimensions. *Vertical aerial photographs* are used to clearly identify the location, access points, facilities and various physical characteristics of each beach, including beach type and location of bars, rips and other hazards. Where numerous photos exist, a measure of the variation in beach conditions can be obtained.

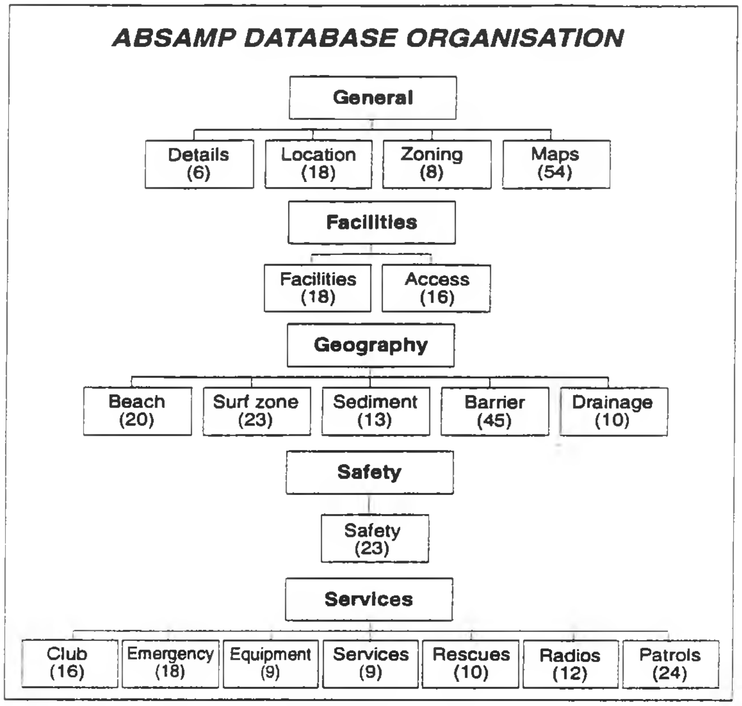

Figure 1. The Australian Beach Safety and Management Program contains five data classes which are further subdivided into 19 tables, which in turn contain 352 fields.

2.1.2 Aerial and ground field inspections

All beaches are photographed during low altitude *aerial* inspections, followed by *ground* inspections using either vehicle or boat. The aim is to obtain information not available from the above sources. This includes aerial oblique and ground photographs, beach slope, sediment samples, facilities, parking and other physical details.

2.1.3 Beach conditions

Beach and surf conditions under variable wave, tide and weather conditions are required to obtain a representative overview of each beach. To achieve this, volunteer lifesavers and professional lifeguards on Australia's 350 patrolled beaches are supplied with base maps of their beach. They use these maps each patrol day to note the prevailing wave and weather conditions, beach usage, and sketch the configuration of the beach and surf zone including any bars, rips and channels. These maps have produced a time series of changing wave and beach conditions for all patrolled beaches.

2.1.4 Published data

A bibliography, and where possible a hard copy, of all material published on each beach or coastal region is maintained. These range from scientific papers, to council reports to tourist brochures.

All information is filed as a hard copy, and all appropriate information then extracted for entry into the database (Fig. 1).

3. BEACH SAFETY MANAGEMENT

Beach safety management is the successful and safe development of public beach usage. It requires information on beach types and hazards, beach safety education, appropriate coastal policies and the provision of beach safety resources. SLSA is working to improve beach safety through input at all these levels, specifically in quantification of beach hazards and public risk (3.1), implementation of beach management plans (3.2), through improved and expanded beach safety services, training, education and information (3.3), input to coastal policy and management (3.4) and through international applications (3.5).

3.1 Beach hazard rating

Beach hazards are elements of the beach environment that expose the public to danger or harm, specifically the natural beach and surf zone processes and morphology that can place swimmers at risk by moving them involuntarily seaward of the surf zone or causing them injury or death. *Beach safety* refers to recognition of beach hazards and the mechanisms required to mitigate against such hazards. Its aim is to secure the public from danger or injury at the beach. *Beach hazard rating* refers to the scaling of a beach according to the associated hazards (**Fig. 2**) including any local hazards (**Table 1**). The rating ranges from a low rating of 1 (safest) to a high rating of 10 (extremely hazardous). *Public beach risk* is a product of the beach hazard rating and the level of beach usage.

Table 1. *Typical coastal hazards*

Permanent hazards	**Variable hazards**
Cliffs	Beach and surf zone topography
Shore platforms	* variable water depth
Rocks	* bars, troughs and channels
Reefs	Breaking waves and bores
Inlets	Wave set up and set down
Water depth	Surf zone currents (esp. rips)
Shoreline structures	Tides & tidal currents (esp. inlets)
Permanent rips	Strong winds

In order to address public risk on beaches we need to know both the nature of the hazards and the type and level of usage. The above database provides accurate information on the nature and level of beach hazards. The level of public usage, while more difficult to accurately gauge, can be assessed using daily beach patrol reports for patrolled beaches, and an assessment of the location and level of access, parking, accommodation and facilities, all contained in the database, to gauge likely seasonal usage.

The beach hazard rating was developed to provide a simple, yet effective method of scientifically rating both the average and prevailing hazards on each beach, for all beach conditions. **Figure 2** illustrates the average rating for wave dominated beaches in areas of low tide range. Modifications to this rating are required for beaches exposed to higher tide ranges and/or lower wave environments.

WAVE DOMINATED BEACH TYPES

KEY

- Bar
- Beach
- Rip head
- Pulsating current (1 - 2 minutes)
- Persistent current
- Rip current
- Plunging waves or shore break

PLEASE NOTE:

This model represents average wave conditions on these beach types in micro tidal (< 2 m tide range) regions of southern Australia (south Queensland, NSW, Victoria, Tasmania, South Australia and southern Western Australia).

BEACH SAFETY IS INFLUENCED BY:

HEADLANDS - rips usually occur and intensify adjacent to headlands, reefs and rocky outcrops.

OBLIQUE WAVES - stronger longshore currents, skewed and migratory waves.

HIGH TIDE - deeper water and in some cases stronger rips.

LOW TIDE - rips more visible but normally more intensified due to restricted channel.

RISING SEAS - eroding bars, stronger currents, strong shifting rips, greater set up and set down.

HIGH TIDE AND RISING SEAS - more difficult to distinguish bars and troughs.

STRONG ONSHORE AND ALONGSHORE WINDS - reinforced downwind currents.

MEGARIPPLES - large migratory sand ripples common in rip troughs can produce unstable footing.

CHANGING WAVE CONDITIONS - (rising, falling, change in direction or length) - produce a predictable change in beach topography and type; the reason why beaches are always changing.

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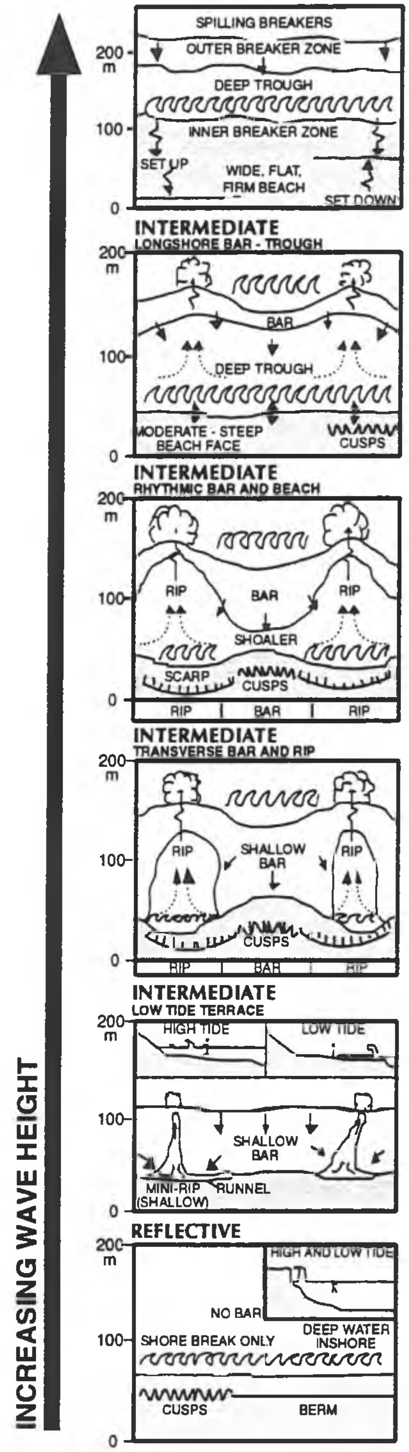

DISSIPATIVE

CHARACTERISTICS
dissipative - waves dissipate energy over a wide surf zone, 2 - 3 m breakers, straight bars, trough and beach

HAZARDS
high waves and wide surf zone restrict most bathers to the swash zone; safest bathing is in the swash zone with care of the set up and set down

BEACH HAZARD RATING AND HINTS
8/10 (stay close to shore, do not bathe in outer breaker zone)

INTERMEDIATE
LONGSHORE BAR - TROUGH

CHARACTERISTICS
consists of shore parallel bar and trough, 1.5 - 2.0 m breakers, moderate rip currents and straight beach

HAZARDS
deep trough and distance to outer bar restrict most bathers to the swash zone and inner trough, safest bathing is in the swash zone and in the trough away from rips

BEACH HAZARD RATING AND HINTS
7/10 (stay close to shore and avoid deep troughs and rips)

INTERMEDIATE
RHYTHMIC BAR AND BEACH

CHARACTERISTICS
consists of rhythmic (undulating) bar trough, and beach, 1.5 m breakers, distinct rip troughs separated by detached bars

HAZARDS
pronounced changes in depth and current between bars and rips, safest bathing is on or behind the bars during lower waves, hazardous during high waves and high tide

BEACH HAZARD RATING AND HINTS
6/10 (wade or swim to shoaler bars, avoid deep troughs and rips)

INTERMEDIATE
TRANSVERSE BAR AND RIP

CHARACTERISTICS
consists of attached bars, rip troughs and undulating beach, 1.0 - 1.5m breakers, distinct rip troughs separated by attached bars every 150 - 300 m

HAZARDS
pronounced changes in depth and current between bars and rips, safest bathing is on the bars

BEACH HAZARD RATING AND HINTS
5/10 (bathe on shallow bars adjacent to rips, however bathers can be washed off the bars into rips, inexperienced bathers may unknowingly enter rips)

INTERMEDIATE
LOW TIDE TERRACE

CHARACTERISTICS
shallow bar or terrace often exposed at low tide, 0.5 - 1.0 m breakers

HAZARDS
safest bathing - safe at low tide, deeper water and weak rips at high tide

BEACH HAZARD RATING AND HINTS
3/10 (watch for plunging waves at low tide)

REFLECTIVE

CHARACTERISTICS
reflective - waves tend to reflect back off the beach, 0 - 1 m breakers, only occur on very low wave beaches and on harbour beaches

HAZARDS
safest bathing - safe apart from deep water close inshore and from shorebreak during higher waves, steep beach and abrupt drop off to deeper water can make access difficult for elderly and children

BEACH HAZARD RATING AND HINTS
2/10

Figure 2. Beach type, physical characteristics, hazards and rating for wave dominated beaches in areas of low tide range (< 2 m).

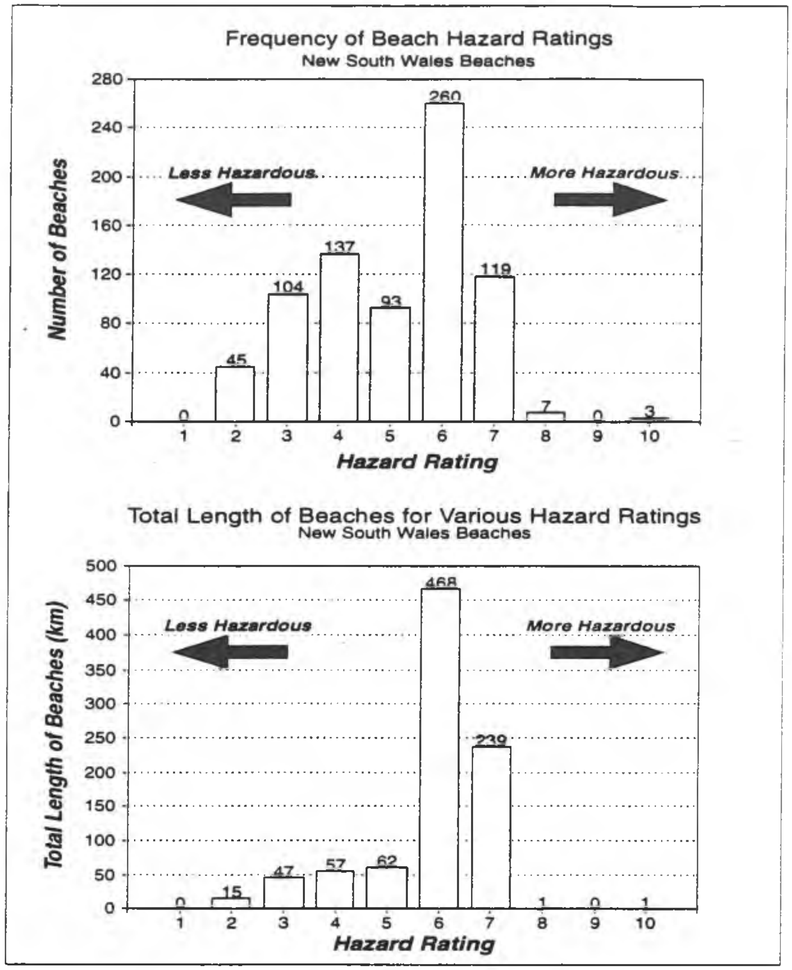

Figure 3. *Beach hazard ratings for all 721 NSW beaches. Note that based on number, most beaches in NSW (54 %) have a moderate to high rating (>5), while based on beach length 80 % rate at this level. This is because the longer, more exposed beaches have more hazardous conditions, compared to the shorter, often more protected beaches.*

Using the average rating system **Figure 3** applies the rating to all 721 New South Wales (NSW) beaches, based on beach number and beach length. **Figure 4** provides an example of typical beach conditions and the average hazard rating for beaches in the Byron Bay region of northern NSW.

3.2 Beach management plans

In order to implement the beach hazard rating at a local level and at the same time to enable lifesavers to make wider use of the beach information, SLSA developed the Beach Management Plan manual in 1996 (Leahy, et al., 1996). This manual provides a simple, yet effective way for determining both the average and prevailing beach hazard level on any beach. Based on the average hazard level and beach usage it then provides an estimate of minimum beach safety resources required for a particular beach, while based on the prevailing hazard level and actual beach usage at the time, it provides an assessment of the safety resources required for those particular conditions.

Using the plan, surf lifesaving clubs can assess their overall level of beach risk and the minimum resources required to mitigate those risks. In this way they are able to optimise their resources to match the risk levels, as well as identifying any resource deficiencies. At an operational level they can also assess the resources required on a day to day, even hour to hour basis as conditions change, so that resources can be modified and/or relocated to take account of the prevailing hazards and changing levels of public risk (**Fig. 5**).

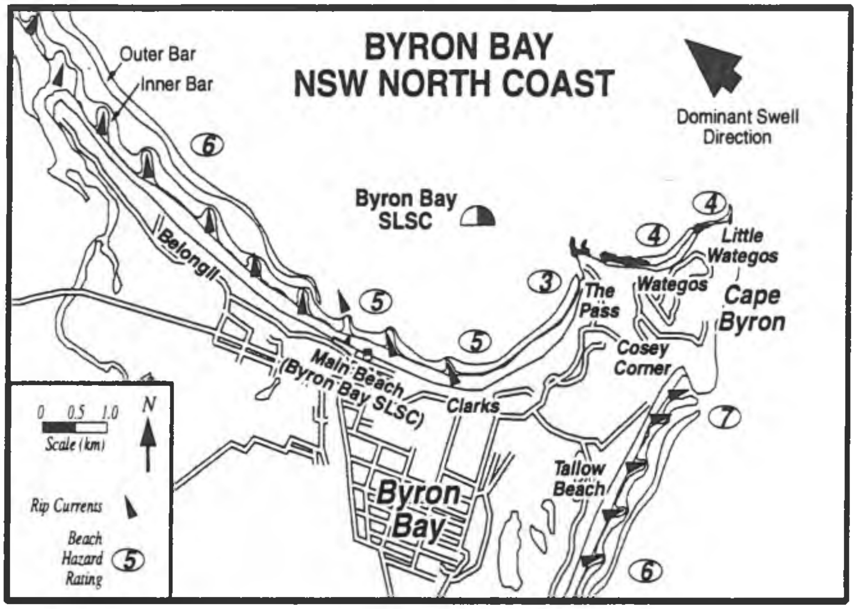

Figure 4. A plot of beaches, bars and rips at Byron Bay on the NSW north coast. Wave height averages 1.6 m at Tallow Beach and 1.4 m at Belongil where it maintains a rip dominated double bar system. Wave height decreases toward Clarks Beach and The Pass, resulting in a single bar usually free of rips. The modal beach hazard rating varies accordingly from a relatively high 6 on exposed Tallow and Belongil beaches, to a lower 3 and 4 at The Pass and on the Watego beaches.

3.3 Beach safety training, education & information

The ABSAMP recognised that there is a wide range of beach users, and consequently a range of educational programs and delivery methods (**Table 2**) are required to reach these users. The following points list some of the major initiatives developed by the program to achieve this goal.

- *Surf Life Saving Training Manual* (1995, 30th edition), new section on Surf Awareness.
- *Beach Management Plan* manual, (see 3.2 above) for use at a local and regional level.
- *Surf Ed* program, a curriculum based beach safety education program for Australian primary and secondary school children
- *Coastcare* signage program is a cooperative program with the federal government aimed at providing standardised beach safety signage on all popular beaches.
- *Posters:* Three beach safety and hazards posters have been published since 1988.
- *Videos*: Two beach safety videos, one for school children and a second for visiting tourists to Australian beaches were produced in 1995.

- *Publications*: The program has published several scientific papers, made numerous conference and seminar presentations, produced more than 30 reports, and written books on the beaches of New South Wales (Short, 1993), Victoria including Port Phillip Bay (Short, 1996), Queensland (Short, in prep.), with South Australia scheduled for 1998 and Western Australia for 1999.
- *Media*: The program has a very high media profile and regularly contributes to feature articles and programs on beach safety.
- *Electronic access:* The program is presently preparing the information base for release on the internet. This will provide online access for the public to information on all Australian beaches.

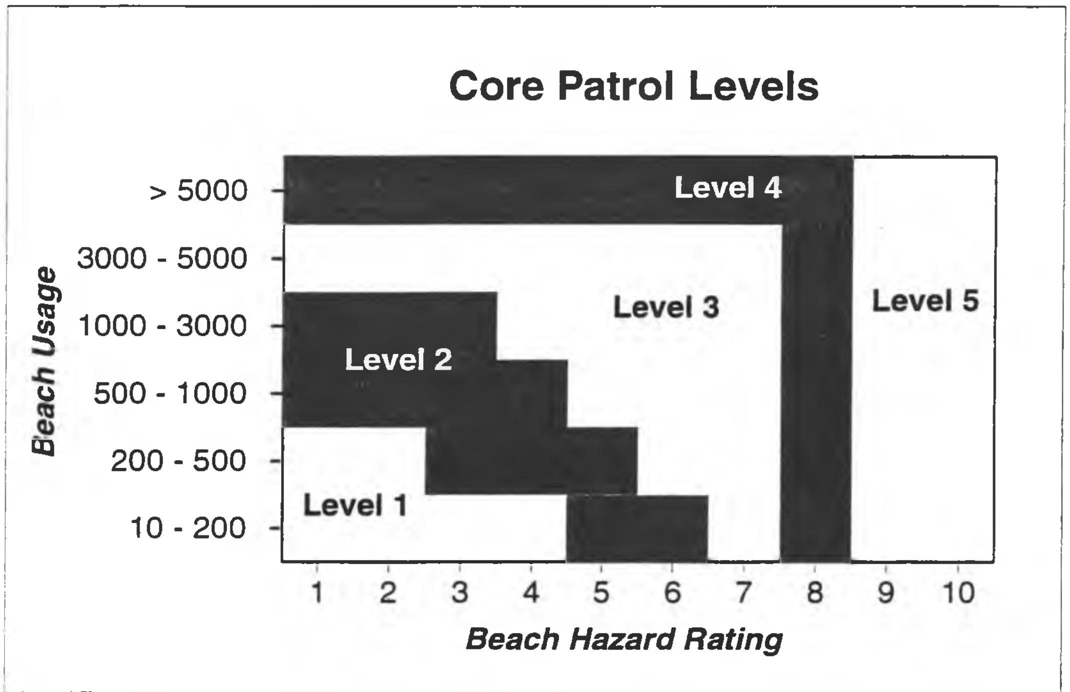

***Figure** 5. Core patrol levels are based on the beach hazard rating (Fig. 2) and level of beach usage. They range from a low level of patrol requirements (level 1) to the high risk level 5, requiring maximum patrol requirements.*

Table 2. *Australian beach/water safety education for target users*

Beach user	Risk level	Education program	Location
Primary school children	very high	swimming school syllabus	school, pool, beach
Secondary school children	high	school syllabus	school, pool, beach
General public	low to high	TV, brochures. books	media
Australian tourists	mod - high	TV, brochures, video	media, airline, hotel
Overseas tourists	high	TV, brochures, signs, video (multi-lingual)	airline, airport. hotel, beach

3.4 Coastal, policy and planning

The program has been highly successfully in Australia in lobbying local, state and federal government to incorporate beach safety in elements of their new coastal policies.

At a local level the Department of Local Governments issued a *Beach Safety* Practice Note in 1995 that outlines the local governments responsibilities with regard to beach safety.
At a state level the revised Coastal Policy for New South Wales (1994) included the following principles

- *Human safety is a prime consideration when planning access to the coast*
- *To minimise risks to human safety from the use of coastal resources.*

The state is presently revising the operational Coastal Management Manual to incorporate these principles.

Finally, the (Australian) Commonwealth Coastal Policy (1995) states (p.21) that *when development in the coastal zone results in increased tourism and recreational use, it is necessary to assess hazards that might affect users and to develop facilities for managing increased use.*

With these policies in place, consideration of beach safety will increasingly become a mandatory component of existing and all new coastal development. At the same time the ABSAMP will provide the information base to ensure that the necessary resources are allocated in order to increasingly mitigate public risk on Australian beaches.

3.5 International applications

At an international level, rights to the Australian program have been acquired by Surf Life Saving New Zealand in 1996 and the New Zealand information base is presently underway. In Brazil, Klein and Hoefel (1996) incorporated elements of the program in a study of beach rescues (Hoefel and Klein, in press) and the publication of a beach safety brochure (Hoefel and Klein, 1996).

4. SUMMARY

The ABSAMP is based on integration of a scientific understanding of beaches, their hazards and usage, together with the expertise in beach safety management and resources of SLSA, utilising the latest technology for data management, analysis and dissemination. The program has already had wide application and impact on the management and information on Australian beach systems, and will play an increasing role in their management into the next century, particularly as growing coastal development, population and tourism all demand accessible, yet safe, beaches for pubic recreation and tourism.

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Lt. John Stonier

John Stonier is Supervising Rescue Boat Lieutenant/Paramedic for the Los Angles County Fire Department, Lifeguard Division. He is currently assigned on Santa Catalina Island and supervises the Baywatch Avalon and Baywatch Isthmus lifeguard/paramedic operations. The 24 hour operations are responsible for all emergency marine and medical calls on and around the Island. Both operations respond to sea with two 32' rescue boats equipped with marine fire fighting equipment, paramedic and SCUBA rescue gear. They also have 4X4 rescue squads equipped with mountain rescue and SAR equipment for emergencies in the 75 square mile interior of the island.

Stonier has been an ocean lifeguard for 37 years, a hyperbaric chamber operator and diving treatment supervisor 23 years and a paramedic for 21 years. He was a member of the Cousteau underwater filming expedition team with Philippe Cousteau during 1974 - 1976. He is a member of the Los Angeles County Sheriff Catalina mountain rescue team and was captain for three years. Also, he has competed with L.A. County in several USLSA National Lifeguard competitions and holds eight National Veterans Titles and he also won two world titles in the 1993 World Master Championships in New Zealand.

Stonier received his SLSA International Training Officer certificate in 1975 and has lectured classes on First Aid and CPR to primary and recertification classes for lifeguard rookie and recheck classes. He has also lectured on pre-chamber treatment of SCUBA-Diving emergencies to local EMS systems and area hospital emergency rooms and has written articles on SCUBA diving emergencies for the Undersea Medical Society publication, the Journal of Emergency Medicine and Skin Diver Magazine.

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SCUBA DIVING ILLNESS

TREATMENT AND TRANSPORT

BY THE LIFEGUARD

BY

JOHN C. STONIER

SUPERVISING RESCUE BOAT LIEUTENANT

LOS ANGELES COUNTY FIRE DEPT. / LIFEGUARD DIVISION

SANTA CATALINA ISLAND, CALIFORNIA, USA

1997

INTRODUCTION

Santa Catalina Island is just 26 miles off the Southern California coast and provides the SCUBA diving enthusiast with 52 miles of a variety of coastline diving conditions. Throughout most of the year the water is calm and clear, moderate in temperature and abounds with a variety of sea life. These conditions and a large population of SCUBA divers, just a short boat trip away, makes Catalina Island one of the most heavily utilized recreational dive areas in the country. Because of this volume of divers, SCUBA accidents happen and with regularity.

BACKGROUND

In 1970 the City of Avalon on Santa Catalina Island, entered into an agreement with Los Angeles County to provide lifeguard services for the city beaches. Also provided in the agreement was a Baywatch rescue boat to handle marine emergencies in and around Catalina Island. Shortly after the arrival of the service, it came apparent that the distance around the Island was too much for one rescue boat to handle. Since most of the SCUBA diving emergencies were happening near the west end of the Island, it was decided in 1972 to add another rescue boat (Baywatch Isthmus) at the community of Two Harbors at the Isthmus, twelve miles west of Avalon. In 1974, a large multi place hyperbaric (recompression) chamber was installed at the U.S.C. Catalina Marine Science Center, now renamed Wrigley Institute for Marine and Coastal Studies at Big Fishermans Cove, just a mile east of the Isthmus. Because the Isthmus lifeguards were on 24 hour call and readily available, they were trained as chamber technicians and later as treatment supervisors when they gained treatment experience. To date the lifeguards have treated or helped in more than 700 chamber treatments of stricken divers. In 1976, to further the training of the lifeguards assigned to the Island, the Baywatch Isthmus lifeguards (Lt. Roger Smith and Lt. John Stonier) were trained as paramedics (the first lifeguards ever to receive ACLS training). Since then all eight lifeguards assigned to the island and twelve mainland-based relief lifeguards have been trained as paramedics. They now man two, 24-hour, lifeguard/ paramedic rescue boats and inland response units. Other training includes under water rescue and recovery, marine firefighting, mountain SAR and helitac rescue training.

It is estimated, by several SCUBA diving publications, that there is approximately 12 million dives being done on Catalina Island yearly by a combination of sport and commercial divers. With this number of dives being done even the relative high incident of accidents that happen is extremely small to the amount of dives being done. However, because of the enormous number of dives, accidents happen. Since the lifeguards are the closest EMS responders in the area, they see them all. Placing a yearly average to SCUBA diving accidents is difficult, but over the past 10 years, on Catalina, the lifeguards have responded to 392 diving accidents in the field. Out of that, 119 were treated for Decompression Sickness (DCS), 130 treated for Cerebral Air embolism (CAE), 68 were Submersion cases (with or without a combination of CAE), and 51 were non-hyperbaric in nature. Additionally, 36 of this total were fatalities that were either submersions or CAE or a combination and treated with ACLS until pronounced by a physician. The treatment now rendered to stricken SCUBA divers, by lifeguards aboard the Catalina-based Baywatch rescue boats, has changed very little over the years. This is because the treatment is simple to apply and to sustain and data of more than 400 cases in a 20-year period shows it is successful at keeping patients stable until recompression.

DISCUSSION

At Catalina Island, SCUBA accidents fall under four major categories, Decompression sickness (DCS), Cerebral Air embolism (CAE), Submersions (Drowning/Near-drowning) and non-hyperbaric medical or trauma problems. Non-hyperbaric problems are only mentioned because the diver was using SCUBA at the time of the incident. It is emphasized that a hyperbaric injury must be ruled out because of its life threatening potential. If it is, the non-hyperbaric problem is treated normally.

DCS simply defined, is nitrogen bubbles in the venous blood stream and is caused by violating the decompression tables while SCUBA diving. The signs and symptoms of DCS usually appear gradually after surfacing, starting around ten minutes to as late as twenty-four hours after surfacing. The signs and symptoms include joint pain, skin hypersensitivity and redness, paresthesias, abnormal exhaustion, extremity weakness, paralysis and shortness of breath.

CAE is air bubbles in the arterial blood stream, primarily in the brain and is caused by breath holding, while on SCUBA, when ascending rapidly to the surface. The symptoms of CAE appear rapidly upon surfacing and are dramatic. The signs and symptoms include severe headache, visual disturbances, hearing loss, altered level of consciousness, aphasia, hemiparesis, and chest pain to name a few. If there is anything consistent about the signs and symptoms of both DCS and CAE, it is the inconsistency in the way the two presents.

After the basic assessment has been done, which includes ABCs, signs and symptoms (chief complaint), two questions must be answered when assessing a SCUBA diving accident. First, is this case a hyperbaric medical problem? If so, is it DCS or CAE? Because the two are treated differently, both in transport and in the hyperbaric chamber. Next, if the diver was on SCUBA, did he take an excursion underwater? If so, how soon did signs and symptoms develop after surfacing? Were they immediate upon surfacing, after a rapid assent and combined with a possibility of breath holding? If so, CAE should be suspected. If they came on gradually, some time after surfacing and a possibility of a decompression tables violation, DCS is suspected. It is also emphasized that if there was a period of altered level of consciousness in the water, submersion (near-drowning) must be suspected and special attention to the airway is essential.

If DCS is suspected, the patient is treated supine and given oxygen as close to 100% as possible with a demand valve or non-rebreathing mask O2 delivery system. Furthermore the patient should be kept quiet and warm, as strenuous muscle activity and hyperthermia have shown to hasten bubble production.

If CAE is suspected, the patient is put on 100% oxygen and placed supine and if unconscious turned on their side. The left side is preferred because of the anatomy of the stomach. If the lifeguard arrives on scene within Aa short time@ of the initial call for help and the transport to the chamber is quick, the head down or Trendelenburg position is considered. This position has been readily accomplished by placing the diver on a Aflat@ or a rigid backboard with the feet raised above the head approximately 15 - 20 degrees. The use of the Trendelenburg position is controversial. Nevertheless, at Catalina Island where transport times are comparatively short, we have found it very successful at stabilizing CAE patients. The patient=s symptoms have either improved or remained the same, but have never worsened with its use. In this position care must be given to watch the airway, as the patient has a tendency to slide down and flex the neck, obstructing the airway. If this happens, the feet are lowered, the patient repositioned and placed back in Trendelenburg. If both response and transport times are prolonged then the patient is treated supine without the feet elevated.

If paramedics are on scene, in either case, an intravenous infusion (IV) of normal saline is started and infused at 250 ml./hour. This is done because divers have been found mildly dehydrated, which can cause blood coagulation around bubbles and induce sludging, acerbating the problem. Also, a cardiac monitor and pulse oximeter can be used to monitor the patient while in transport to the chamber.

In both DCS and CAE, rapid transport to a hyperbaric chamber facility is imperative. DCS and CAE, even presenting with so called Aminor@ symptoms, can progress rapidly to a debilitating and sometimes fatal end. Understanding that the two can only be treated successfully in a hyperbaric chamber is important and nothing should delay the transport of a stricken diver to a hyperbaric chamber. The only exceptions are if the rescuer has to slow or divert to attempt to stabilize the patient with an airway management problem or other immediate, life threatening complications. Also, unless the reason is to await transportation by a helicopter or other means of rapid transport to the chamber, transporting the patient to a hospital first, before attempting to go directly to a hyperbaric chamber, is contraindicated. Finally, if a helicopter is to transport a DCS or CAE patient the flight, if possible, should not exceed 1000 ft. above sea level.

SUMMARY

Quick assessment, proper treatment and **rapid** transport of a stricken diver with DCS or CAE to a hyperbaric chamber cannot be over emphasized. These injuries are true emergencies and must be handled with expediency. Both conditions deal with nerve tissue and their blood supply. When the supply is blocked by bubbles the cells can be injured and will die if the problem is not corrected rapidly. In both cases **only a HYPERBARIC CHAMBER can remedy the problem.**

Dr. David Szpilman, M.D.

Dr David Szpilman is President and founder of the Brazilian Life Saving Society (SOBRASA). As a medical doctor he has been attached to the Rio de Janeiro Fire Department, working in a specialized center called the "Near Drowning Recuperation Center (NDRC)," since 1970. He is responsible for attendance at all near-drownings and drownings on Rio de Janeiro beaches. He has also worked as an attending physician in the intensive care unit at Rio de Janeiro County Hospital since 1990.

Over the years, Dr. Szpilman has conducted drowning research based on 2,304 cases, following them until discharge or death. His article on triage of near-drowning victims is being published simultaneously here and in the medical journal "Chest."

As the first Brazilian Lifesaving organization, SOBRASA has the responsibility to spread knowledge to each of the 26 states of Brazil in an effort to reduce the 8,000 deaths which occur each year. SOBRASA has been working on many preventive programs as "Junior Lifeguard" (junior working with a professional lifeguard on the beach), Lifesaving School (all year around on the weekends, all age including adults), "Rescue Surf" (teaching the surfer how to rescue), Manual of First Aid on Drowning (edited), Manual of First Aid (edited), Internet lifesaving home page information, sticker campaign of lifesaving, National Life Saving Championship" and many others.

The history of his involvement in lifesaving is probably quite similar to many of his friends other lifesaving organizations. He loves to surf, dive, swim and engage in other aquatic activities and wants all children to enjoy the same activities.

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Note: Dr. Szpilman's article is reprinted here with kind permission of the medical journal "Chest."

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Triage of Near-Drowning Victims

David Szpilman, MD

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SUMMARY

To establish an updated classification for near-drowning and drowning(ND/D) according to severity and based on mortality rate of subgroups, we reviewed 41,279 cases of predominantly sea water rescues from the coastal area of Rio de Janeiro City, Brazil, from 1972 to 1991. Of this total, 2,304 cases (5.5%) were referred to the Near-Drowning Recuperation Center. At the accident site the following *clinical parameters* were recorded: *presence of breathing, arterial pulse, pulmonary auscultation, and arterial blood pressure*. From 2,304 cases in the data base, 1,831 cases presented all clinical parameters recorded and were selected for classification in 6 subgroups: 1,189(65%) presented *normal pulmonary auscultation with coughing* and were classified as **Grade 1** (mortality = 0%); 338(18.4%) presented *abnormal pulmonary auscultation with rales in some pulmonary fields* and were classified as **Grade 2** (mortality = 0.6%)*;* 58(3.2%) presented *pulmonary auscultation of acute pulmonary edema without arterial hypotension*, and were classified as **Grade 3** (mortality = 5.2%); 36(2%) presented *pulmonary auscultation of acute pulmonary edema with arterial hypotension* and were classified as **Grade 4** (mortality = 19.4%); 25(1.4%) presented *Isolated respiratory arrest* and were classified as **Grade 5** (mortality = 44%); and 185(10%) presented *Cardiopulmonary Arrest(CPA) and were classified* as **Grade 6** (mortality = 93%)($P<0.000001$).

***Conclusion**:* The study revealed that it is possible to establish 6 subgroups based on mortality rate by applying clinical criteria obtained from first-aid observations. These subgroups constitute the basis of a new classification.

INTRODUCTION

Brazil has the longest coastal strip in South America(7,408 km [4,445 mile]). Its warm climate encourages a beach-going culture year round. In 1990 the Brazilian population reached 150 million people, of whom 7,111($4.7/10^5$ population) died due to drowning. Rio de Janeiro city has a rescue service responsible for safety along 96 km of beaches, with 2 lifeguards every 500 m. and specialized medical teams in 3 different care centers called Near-Drowning Recuperation Centers (NDRC). The duty of the NDRCs is to render specialized medical assistance to ND/D patients, brought in promptly from accident sites. The patients stays on NDRC until clinical stabilization is achieved, allowing their release, further observation, or referral to a hospital. There has been difficulties in predicting the prognosis of such patients, because a classification system was lacking. In 1972, Menezes and Costa proposed a classification dividing the cases of ND/D into 4 grades of severity: Grade I showed normal pulmonary auscultation; Grade II showed rales in both pulmonary bases; Grade III showed acute pulmonary edema; and Grade IV were cases of CPA. The mortality rate was, Grade I = 0.0%, Grade II = 0.6%, Grade III = 10.6% and Grade IV = 87.1%.

This study was implemented with the purpose of re-evaluating the Menezes and Costa classification and updating it with other clinical parameters to evaluate the severity of the ND/D.

MATERIAL and METHODS

Area and Population Researched

We retrospectively reviewed 41,279 cases of predominantly sea water rescues, utilizing rescue bulletins recorded by lifeguards on the beach, from January 1972 to December 1991. These cases were observed in a restricted sample area of 22 km which falls under the authority of the Rio de Janeiro rescue service, and which constitutes 23% of the total coastal area of Rio de Janeiro City. From this population, 2,304 cases (5.5%) were referred to the NDRC during the study period because they had been diagnosed as ND/D requiring medical attention. The remaining 38,975 cases did not require further medical care and were released directly from the site of the accident after lifeguards had filled out a beach rescue bulletin. The medical aid bulletin filled out at the NDRC describes the occurrences prior to the physician's arrival based on a detailed report compiled by the lifeguard responsible for first aid, as well as the subsequent medical treatment; data were compiled until the patient was discharged from the NDRC or died. In addition, those patients requiring transfer to a hospital had their hospital records reviewed.

One water characteristic were considered important to final analysis: Sea water temperature throughout the year in the study area varies from 15ºC to 25ºC, with an average of 20ºC(68^{0}F).

Initial Management of the Near-Drowning and Drowning(ND/D)

A case was considered a *rescue case* (without near-drowning diagnosis) when the bather presented normal pulmonary auscultation without coughing. Any case of rescue involving altered pulmonary auscultatory findings and/or coughing was considered as water aspiration (*near-drowning*), and received immediate medical care on the beach. A physician with experience in this type of accident was always present during first aid on the beach in near-drowning cases and was in charge of filling out the medical bulletins of the NDRC. The physician was contacted by the lifeguard via radio immediately after the water rescue had taken place and near-drowning was diagnosed. In our system, lifeguards are responsible for initial evaluation of the presence of breathing and arterial pulse, as well as applying, if necessary, basic cardio-pulmonary resuscitation until the medical team arrives. The medical team responds via an ambulance equipped with ECG monitor, defibrillator, and medication and ventilation equipment. Medical examination at the scene of the accident covers presence of breathing and arterial pulse, pulmonary auscultatory findings, measurement of blood pressure and heart rate, determination of the level of consciousness, the need for respiratory assistance, and the type of respiratory assistance required. This medical examination and treatment are continuously reassessed and changed, as necessary, during transportation to the NDRC.

Clinical Parameters Evaluated

Pulmonary auscultation was classified into 3 types:

1. Normal pulmonary auscultation with coughing.
2. Abnormal pulmonary auscultation with rales in some pulmonary fields.
3. Abnormal pulmonary auscultation with rales in all pulmonary fields (acute pulmonary edema).

Blood pressure was used to classify the ND/D as normotensive or hypotensive. In infants and children less than or equal to 9 years of age, hypotension was defined as systolic blood pressure(SBP) less than the minimum systolic pressure calculated by the following formula: 70 + (2 x age in years). Individuals older than 9 years of age were considered similar to adults, and thus hypotensive when the systolic blood pressure was less than 90 mmHg, or the mean arterial pressure (MAP) less than 60 mmHg calculated by the following formula:

$$\frac{2 \text{ x diastolic blood pressure} + \text{SBP}}{3}$$

Isolated Respiratory Arrest (Apnea) was considered present when spontaneous breathing or pulmonary ventilation was absent, but arterial pulse present.

Cardio-Pulmonary Arrest (CPA) was defined as the absence of carotid arterial pulse and spontaneous pulmonary ventilation.

We excluded from the study the ND/D cases for which clinical parameters had not been recorded in the bulletins upon first examination, as well as cardio-pulmonary arrest cases in which no Cardio-Pulmonary Resuscitation (CPR) attempts were performed (generally in cases where the submersion time had been longer than 1 hour), and ND/D cases secondary to other pathologies(secondary ND/D). The use of alcohol was considered a major factor in causing secondary ND/D, when ethanol ingestion was reported by the family or friends in sufficient quantities to alter the judgment in situations of danger, or when the estimated ingestion had been over [56 grams] on the day of the accident.

In addition to the above mentioned clinical data, respiratory assistance needs and level of consciousness were analyzed. The *Respiratory Assistance Need was* classified in 3 different subgroups, as follows: 1. Absence *of Respiratory Assistance* need(ARA); 2. *Non-Invasive Respiratory Assistance* need(NIRA) using oxygen catheter or mask; 3. *Invasive Respiratory Assistance* need(IRA) using mechanical ventilation. The *Respiratory Assistance Need* was based upon clinical judgment and influenced by respiratory effort and respiratory rate. *Level of consciousness* was divided into 4 categories: 1. *Lucid* when the individual was awake, capable of correctly communicating what had happened to her/him; 2. *Confused State*, when the individual was awake but not capable of communicating correctly about the accident; 3. *Stupor* in cases of extreme drowsiness with little or no spontaneous activity, and response only to strong verbal or painful stimulation; and 4. *Coma* in which the most intense stimulation does not produce verbal or awakening responses and the victim remains unconscious. The Glasgow Coma Scale was not used because some data were unavailable resultant to the retrospective nature of this study.

For the purposes of stratifying the patients into different risk subgroups, the following classification was used, taking into account initially obtained data concerning cardio-pulmonary conditions, pulmonary auscultation, and arterial blood pressure:

GRADE 1 - *Normal pulmonary auscultation with coughing.*

GRADE 2 - *Abnormal pulmonary auscultation with rales in some pulmonary fields.*

GRADE 3 - *Abnormal pulmonary auscultation with rales in all pulmonary fields (acute pulmonary edema)* ***without*** *arterial hypotension.*

GRADE 4 - *Abnormal pulmonary auscultation with rales in all pulmonary fields (acute pulmonary edema)* ***with*** *arterial hypotension.*

GRADE 5 - *Respiratory Arrest (Apnea) without cardiac arrest.*

GRADE 6 - *Cardio-Pulmonary Arrest* (CPA).

RESULTS

Population surveyed

From 2,304 cases of ND/D referred to the NDRC because they required medical assistance, 92.6%(2,134 cases) were rescued from water by lifeguards and 7.4%(170 cases) by bathers present at the accident site (including all fresh water cases). All cases attended on the beach by an ambulance with the medical team, had an average response time of 12.3 +/-5.8 minutes. Of those sea water ND/D patients(2,274 cases), 90% were brought by ambulance and the rest (10%) were taken to the NDRC by citizens in private cars, or helicopter. Although lifeguards were not present at all rescues, they were always present during subsequent first aid, except fresh water cases. The mortality rate of 2,274 sea water cases was 12.3%, while the 30 fresh water cases had a mortality of 16.7% (P = NS). The demographics of the 2,304 ND/D patients covered by this study are shown in Table 1.

DEMOGRAPHICS OF THE 2,304 CASES

Average age was 22.7 +/- 11.5 years(*)

	Percent (%)
Men	74.2
Unmarried	87.4
Reportedly knew how to swim	46.6
Lived far from sea-side	71.4
Alcohol ingestion	14.6
Ate 3 hours prior to the accident	83.5

TABLE 1 - Demographics; **(*) 5.1% were children less than 9 years.**

In none of 2,304 cases were specific therapeutic measures implemented concerning brain protection or brain resuscitation. There was hypothermia (body temperature <35ºC or <95ºF) in all of the 532 cases in which the axillary temperature was recorded in the medical assistance bulletins.

Secondary ND/D (associated with another pathology) that might have triggered or precipitated the accident were observed in 276 cases of 2,126 ND/D cases in which this parameter was documented. The mortality of this group was 13.4%. The most frequent cause of secondary ND/D was the use of drugs (36.2%), most frequently alcohol, followed by seizures (18.1%), trauma (16.3%), cardio-pulmonary disease (14.1%), subaquatic activities(3.7%) and others (11.6%).

Of 2,304 cases surveyed, 473 were excluded: 162 due to the lack of one or more recorded clinical parameters (no deaths and 19 were cases of secondary ND/D), 65 CPA cases without resuscitation attempts (all were considered dead {11 secondary drowning}), and 246 cases of secondary drowning (26 deaths).

The remaining 1,831 cases constitute the population analyzed for our classification system.

Classification

The classification being proposed is based upon the l,831 selected cases which demonstrated different mortalities among each ND/D grade evaluated (X^2=1529.20, P<0.00001)(Table 2).

CLASSIFICATION AND MORTALITY (n = 1831)

GRADE	NUMBER(n)	Mortality
1	1189	0 (0.0%)
2	338	2 (0.6%)
3	58	3 (5.2%)
4	36	7 (19.4%)
5	25	11 (44%)
6	185	172 (93%)
	P	< 0.0001

Table 2 - Number of drowning cases(n) and its mortality. Overall mortality was 10.6%.

Follow-up evaluation from the accident site to hospital discharge or death

All 1,831 cases were at least initially treated at the NDRC, but 187 patients required transfer to a hospital (Table 3). Mortality for the entire group was 10.6% (195 cases, of which 166 died at NDRC and 29 in the hospital).

NEED OF HOSPITALIZATION AND MORTALITY (n=187)

GRADE	Hospital(%)	Mortality
1	35(2.9%)	0(0.0%)
2	50(14.8%)	2(4.0%)
3	26(44.8%)	3(11.5%)
4	32(88.9%)	7(19.4%)
5	21(84%)(*)	7(33.3%)
6	23(12.4%)(*)	10(43.5%)
Total	**187 (10.2%)**	**29(15.5%)**

Table 3 - Need of hospitalization (10.2%) in Near Drowning/Drowning cases in association with the grade and mortality. Mortality in the hospital was 15.5%; (*)Four patients grade 5 and 162 grade 6, out of this table, were pronounced dead and thus taken directly to the morgue.

Other clinical parameters

The need for respiratory assistance was documented in 1,828 cases. Analyzing the different types of respiratory assistance we observed that Grade 1 is characterized by ARA in 86.3% of cases, and in Grade 2 the need for NIRA prevailed (93.2%)(X^2=793.54, $P<0.00001$). Grade 3 patients used either IRA(72.4%) or NIRA(27.6%), and grades 4, 5 and 6 used IRA in 100% of cases.

The level of consciousness was recorded in 1,662 cases showing different mortality rates ($P<0.00001$). However, when we evaluated the ND/D grades with different levels of consciousness (Table 4), only Grade 2 showed greater mortality rate(10%), and this occurred when stupor was present (X^2=9.20, $P<0.003$).

CONSCIOUSNESS LEVEL AND MORTALITY (n=1662)

GRADE	LUCID (Mort.)	CONFUSION (Mort.)	TORPOR (Mort.)	COMA (Mort.)
1 (1085)	970 (0)	115 (0)	0 (0)	-----
2 (322)	220 (0)	92 (0)	10 (1)	-----
3 (51)	7 (0)	29 (1)	15 (1)	-----
4 (26)	1 (0)	3 (1)	7 (3)	15 (2)
5 (17)	-----	-----	-----	17 (10)
6 (161)	-----	-----	-----	161 (126)
TOTAL	1198 (0)	239 (2)	32 (5)	193 (138)

Table 4 - Initial consciousness level in all ND/D grades and their mortality. (MORT)Mortality.

DISCUSSION

The idea of updating the classification we previously used derived from the observation of cases in which some clinical parameters - acute pulmonary edema with hypotension and apnea without cardiac arrest - seemed to stratify into subgroups with different mortality rates. These observations were the impetus for a retrospective survey that demonstrated the validity of analyzing each clinical parameter, dividing cases of ND/D into 6 different grades of severity according to an initial examination.

From the total of 2,304 cases evaluated, the new classification was based on 1,831 cases that presented a mortality rate of 10.6% (195 cases).

Considering those six clinical parameters mentioned above we suggest a new classification for ND/D.

Grade 1 - patients who aspirate a small amount of water, sufficient to provoke irritation of the upper airways causing *Normal pulmonary auscultation with coughing*. The amount of water penetrating the airways is not sufficient to cause alteration in alveolo-capillary gas exchange requiring medical intervention.

Grade 2 - patients who aspirate a moderate amount of water, sufficient to alter pulmonary alveolo-capillary gas exchange causing *Abnormal pulmonary auscultation with rales in some pulmonary fields.* Generally these patients require NIRA (93.2%).

Grades 3 and 4 aspirated an amount of water sufficient to cause a significant alveolo-capillary gas exchange alteration as well as a high degree of pulmonary arterial-venous shunt that generally indicates IRA with early mechanical ventilation and positive end expiratory pressure (PEEP).*Pulmonary auscultation is that of an acute pulmonary edema with rales in all pulmonary fields*, in addition to presenting frequently with pinkish foam in the mouth and nose. They are differentiated from each other(grade 3 from 4) by the hypoxemic period and are therefore subdivided:

Grade 3 - patients with *acute pulmonary edema by auscultation without arterial hypotension*.

Grade 4 - presents with the same pulmonary auscultation as Grade 3 but is associated with *arterial hypotension.* These cases always require IRA and usually remain for a longer period with mechanical ventilatory support. When the patient is not evaluated at the accident scene, oxygen administration may ameliorate the arterial hypotension, leading to an erroneous interpretation with respect to the grade of ND/D. However, as there is no rapid improvement in the level of consciousness with the treatment, the state of coma usually persists. The initial arterial hypotension that occurs in Grade 4 seems to be caused by myocardial depression deriving from hypoxia, rather than by the transudation of liquid into the lung. The presence of coma may be secondary to a reduction in cerebral blood flow resultant from the hypotension and hypoxia.

Grade 5 - is characterized by the presence of *Respiratory Arrest (Apnea) without cardiac arrest.* Cardiac arrest can, however, occur quickly, in this situation, varying from seconds to 2 or 3 minutes, a phenomenon seen by those working at the accident site. Situations, for example, of "black-out" (which occurs in divers that hyperventilate prior to submerging), are generally reverted very easily, if rescue occurs immediately after the loss of consciousness, as water has not yet been aspirated.

Grade 6 - These are cases with cardio-pulmonary arrest(CPA), independent of the submersion time. In this study, these CPA cases were diagnosed at the accident site. In general, resuscitation is carried out in all CPA cases when the exact duration of the submersion is not known, or when such time is certainly less than 1 hour. This procedure proved successful in the summer of 1994, when 4 patients were resuscitated after more than 10 minutes water submersion at a temperature above 15ºC(59 ^{0}F) (2 died 6 hours later and 2 survived, one with severe neurological sequelae and the other without sequelae).

The recommended new classification algorithm is presented in Figure 1.

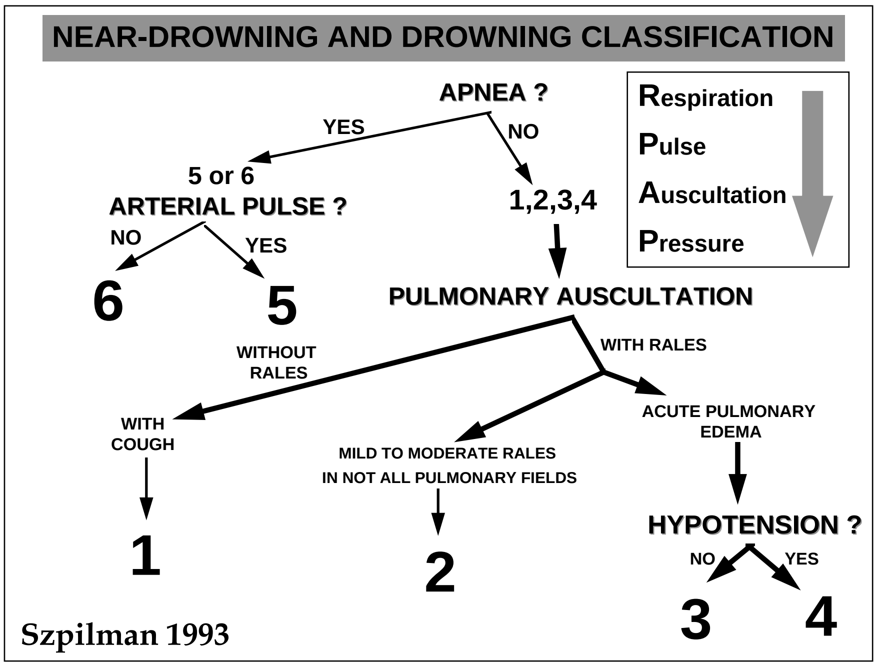

Figure 1 - **Algorithm -** Classification of ND/D (Szpilman 1993). The initials **RPAP** (**R**espiration ⇒ arterial **P**ulse ⇒ pulmonary **A**uscultation ⇒ blood **P**ressure) help memorizing the sequence to follow in assessing the classification.

Once the classification of a particular case has been determined, it should not be changed during the recovery period or hospitalization. According to Conn and Modell, mortality rate of ND/D can be predicted from the level of consciousness upon first assessment in the hospital emergency room. We consider their data to be of major importance, inasmuch as it shows the degree of anoxic encephalopathy. In our study, 73% of the patients who were in coma at the accident site died. Although this mortality rate is higher than reported in the literature, we must remember that our work differs from other studies in that it included assistance and evaluation at the accident site. Among conscious, confused, or stuporous patients (1,473 cases) the mortality rate was 0.5%.

Some authors describe greater severity of pulmonary injury in fresh water ND/D. Our fresh water cases did not show a greater mortality than those in sea water, although the group studied was too small to draw any firm conclusions.

CONCLUSION: A new ND/D Classification is suggested, taking into consideration 20 years of NDRC activity, accumulating a total of 1,831 cases for which four clinical parameters (breathing, pulse, pulmonary auscultation, and blood pressure) were reported. These parameters were statistically significant in defining the classification of six different grades($P<0.00001$). If this classification becomes universally accepted, multicenter studies to evaluate the several therapies proposed in the literature, but still controversial, could be performed.

The use of NDRC demonstrates that the number of cases requiring hospital referral may be reduced. Although efforts to improve assistance to the near-drowned patient are great, major successes are due to the preventive work of lifeguards at the beaches(early intervention). Brewster quotes the occurrence of 2% to 3% of victim deaths during rescue. In 20 years of observation, the victim mortality rate(0.7%) on Rio de Janeiro beaches has been very low as evidence that prevention is indeed the best strategy for this type of accident.

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Health Risks Associated with Swimming in Beach Areas Contaminated by Urban Runoff

Dr. Guang-yu Wang[1]

This presentation discusses the possible health risks associated with swimming in beach areas contaminated by urban runoff, based on the results of an epidemiological study conducted in Santa Monica Bay during the summer of 1995. The study was conducted in response to wide public perception and evidence about such health risks.

Over the years, there have been a number of studies of human illness associated with recreational exposures to contaminated waters. However, most of these studies focused on areas impacted by direct sewage discharge. The possible health impacts of urban runoff carried through a city' storm drain system have generally been overlooked by public health professionals. In Southern California, because sewer and storm drain systems are completely seperate, most people tend to believe that urban runoff does not contain human sewage and therefore should not impose health risks.

In recent years, new evidence have shown that there may be health effects associated with recreational exposures to urban runoff. In the Santa Monica Bay area, there have been anecdotal reports of illness caused by swimming near storm drain outlets on beaches. High levels of bacterial indicators were frequently observed in beach areas near flowing storm drains. In several investigations conducted by the Santa Monica Bay Restoration Project in the early 1990s (SMBRP, 1992, 1991, 1990), human pathogens were detected in summer runoff. People also realized that there are possible sources of pathogens contamination into the storm drain system. These sources include illegal sewer connections, leaking sewer lines, malfunctioning septic systems, illegal dumping from recreational vehicles, or direct human sources such as campers or transients. These circumstances provided the motivation to conduct a large-scale epidemiological study of the possible health effects of swimming in runoff contaminated waters.

Study Overview

During the course of the study (June to September 1995), 15,492 beachgoers who swam at three Santa Monica Bay beaches located near flowing storm drain outlets were interviewed. Nine to 14 days after the beach interviews, 13,278 follow-up telephone interviews were conducted to ascertain the occurrence of 16 symptoms (including fever, chills, eye discharge, earache, ear discharge, skin rash, infected cut, nausea, vomiting, diarrhea, diarrhea with blood, stomach pain, coughing, coughing with phlegm, nasal congestion, sore throat), and a

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group of symptoms indicative of "highly credible gastrointestinal illness" (HCGI)[2] and significant respiratory disease" (SRD)[3].

Water samples were collected daily in ankle depth at various distances from the drains (0, 100 yards north and south, and at 400 yards[4]) and analyzed for total and fecal coliforms, enterococci, and *E. coli*. In addition, water samples were collected at storm drain sites every Friday, Saturday, and Sunday and analyzed for enteric viruses.

Persons who bathed and immersed their heads in the ocean water were potential subjects for this study. There were no restrictions based on age, sex or race. Persons who had bathed at the study beaches within seven days of the survey date (before and after) were excluded, as were subjects who bathed on multiple days. Since a primary research question was whether the risk of illness was associated with levels of particular indicator organisms in the water (which could vary from day to day), it would have been impossible to link subjects' experiences with specific counts on a given day if they were in the water on numerous days.

<u>Summary of Findings</u>[5]

Fifty-five percent of the subjects surveyed were male, 45 percent female. Forty-eight percent of the subjects were children (under 12 years of age); 13-to-25 year-olds comprised 26 percent of the survey population and the remaining 26 percent were aged 26 and over. The ethnicity of the survey population was 45 percent white, 43 percent Latino, 3 percent black, 3 percent Asian, 3 percent multi-ethnic, and 2 percent "other." Children and Latino subjects tended to swim closer to the drain. Sixty-three percent of subjects swimming at the drain were children under 12. Eighty-eight percent of the surveyed subjects were residents of California.

The analyses conducted in this study addressed two questions: a) What are the risks of illness relative to the distance one swims from a flowing storm drain? and b) Are the risks of illness associated with measures of water quality? The major findings resulting from these analyses are as follows:

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[2]Two definitions of HCGI were used in this study and grouped as HCGI-1 (vomiting, diarrhea and fever, stomach pain and fever) or HCGI-2 (vomiting and fever).

[3] Symptoms including fever and nasal congestion, fever and sore throat, and cough with sputum.

[4] Previous studies have showed that indicator bacteria levels at 400 yards are generally low, therefore comparisons could be made between rates of illness in swimmers at this distance and at 0 yards.

[5] See SMBRP 1996 for detailed summary.

1. **There is an increased risk of illness associated with swimming near flowing storm drain outlets in Santa Monica Bay.** Statistically significant increases in risks for a broad range of adverse health effects were found for subjects that swam in front of storm drains in comparison to those who swam over 400 yards away (Table 1). These increases in risk appeared to be limited to the 0 yard distance, as a significant drop-off effect was observed at other distances from the drain (Figure 1).

The estimated number of excess cases of illness attributable to swimming at the drain reached into the 100's per 10,000 exposed subjects (greater than 1 percent, Table 1) suggesting that significant numbers of beachgoers swimming near storm drain outlets are subject to increased health risks.

Table 1. Comparative health outcomes for swimming in front of drains versus 400+ yards away.

Health Outcome	**Relative Risk (0 vs. 400+ Yds)**	**Estimated No. of Excess Cases per 10,000 Persons**
Fever	57%	259
Chills	58%	138
Ear Discharge	127%	88
Vomiting	61%	115
Coughing w/ Phlegm	59%	175
Any of the above symptoms	44%	373
HCGI-2	111%	95
SRD	66%	303
HCGI-2 or SRD	53%	314

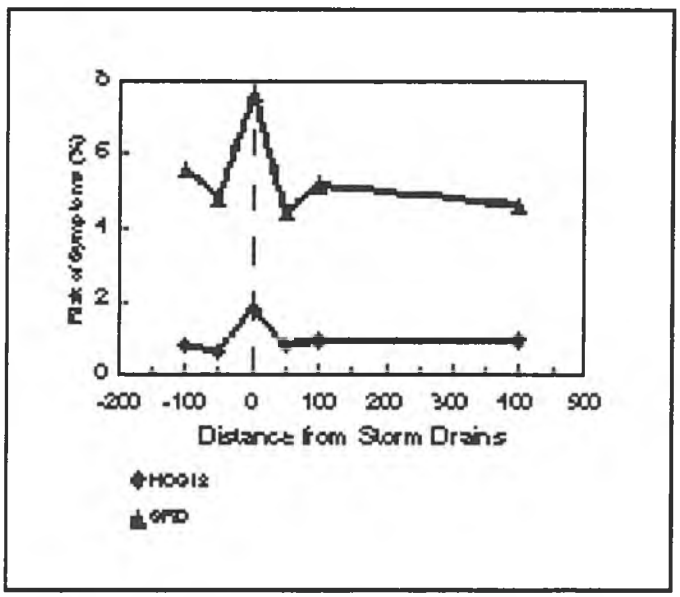

Figure 1. Reports of HCGI-2 and SRD relative to distance from drains.

The results did not change when adjusted for age, beach, gender, race, California versus out-of-state resident, socioeconomic status, or worry about potential health hazards at the beach. Distance results also did not change substantially when controlled for each bacterial indicator.

2. **There is an increased risk of illness associated with swimming in areas with high densities of bacterial indicators.** "Cutoff points" were used to determine whether there were differences in the incidence of illness for those who swam in waters with bacterial densities "greater than" versus "less than" certain cutoff levels. Symptoms were found to be associated with swimming in areas where bacterial indicator counts were greater than the cutoff points that are used as part of federal and state water quality standards (Table 2). However, effects were noted for only few symptoms for the three bacterial indicators analyzed in this study.

Table 2. Health outcomes associated with swimming in areas with high bacterial indicator counts.

Indicator (cutoff)	Health Outcomes	Increased Risk
E. coli (>320 cfu)	Earache Nasal congestion	46% 24%
Enterococcus (>106 cfu)	Diarrhea w/ blood HCGI-1	323% 44%
Total coliform (>10,000 cfu)	Skin rash	200%
Fecal coliform (>400 cfu)	Skin rash	88%

cfu: colony forming unit.

3. **The total coliform to fecal coliform ratio was found to be one of the better indicators for predicting health risks.** When analyses were restricted to time when total coliforms exceeded 1,000 cfu, significant associations were observed, with incidence of illness generally increasing as the ratio of densities of total coliforms to fecal coliforms decreased (Figure 2). The strongest effects were generally observed when the total-to-fecal coliform ratio of 2:1 was used for comparison.

None of the bacterial results changed when adjusted for age, beach, gender, race, California versus out-of-state resident, socioeconomic status or worry about potential health hazards at the beach.

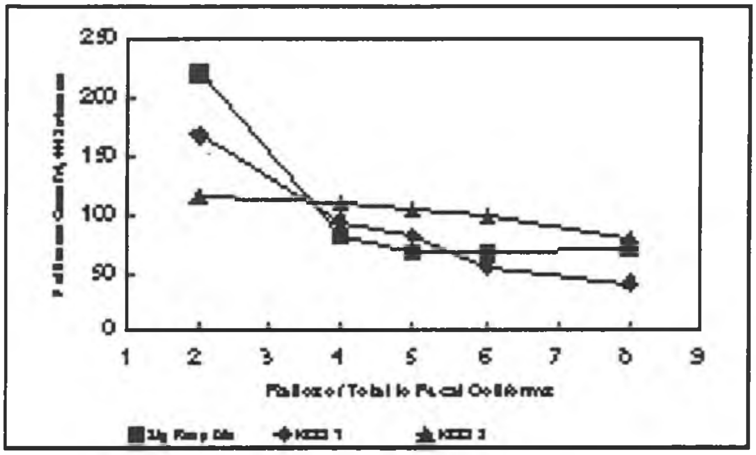

Figure 2. Relationship of excess cases of illness and total-to-fecal coliform ratios (when total coliform exceeded 1,000 cfu).

4. **Illnesses were reported more often on days when the samples were positive for enteric viruses.** Seventeen samples were positive for enteric viruses. Although based on small numbers, a comparison of subjects who were swimming within 50 yards of the drain on days when samples were tested for viruses indicates that a number of outcomes were reported more often on days when the samples were positive for viruses versus days when samples were negative. Symptoms for which increased risks were noted include: fever (53% increase), vomiting (89% increase), HCGI-1 (74% increase), and HCGI-2 (126% increase). Results remained essentially unchanged when adjusted for covariates or for each bacterial indicator.

5. **High densities of bacterial indicators were measured on a significant number of survey days, particularly in front of drains.** A great deal of day-to-day variability in bacterial indicator counts was recorded, however, high bacterial densities in water samples were detected most frequently directly in front of drains (at 0 yards). High densities of *E. coli*, fecal coliforms, and enterococcus occurred on over 25 percent of survey days. Total coliform levels were exceeded less frequently (8.6 percent of days). Total-to-fecal coliform ratios of less than 5 occurred on 12 percent of survey days.

Avoidance Measures

Based on the results of this epidemiological study, several measures aimed at reducing the health risks associated with swimming have been implemented in the Santa Monica Bay area. In general, these measures should be applicable and effective in other beach areas with similar runoff situation. These avoidance measures include:

1). Avoid swimming near flowing storm drains on beaches.
2). Post warning or "no swimming" signs on beaches near all flowing storm drain outlets to inform the public about the potential health risks.
3). Conduct routine (daily, if possible) bacterial indicator monitoring in swimming areas near all flowing storm drains. Post warning signs or close the beaches if the bacterial indicator counts consistently exceed the levels of concern. The levels of concern should be defined using the total coliform to fecal coliform ratio.
4). If possible, divert the storm drain flow or treat the flow before discharge.
5). Educate the city residents about the health risks associated with urban runoff contamination and about measures to eliminate the sources of urban runoff pollution (e.g., correct mulfunctioning septic tanks, report illegal dumping, etc.)

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Peter G. Wernicki, M.D.

Dr. Peter Wernicki is an orthopedic surgeon in private practice in Vero Beach, Florida, where he serves as Director of Vero Beach Sports Medicine center. He is Chief of orthopedic surgery at Indian River Memorial Hospital and on the Board of Directors at Health South Indian River Surgery Center.

Dr. Wernicki is a member of the International Life Saving Federation Medical Commission. He has served as Medical Advisor to the United States Lifesaving Association (USLA) for many years. He has 10 years experience as a surf lifeguard, including tenure as a chief lifeguard.

Several medical journals have published Dr. Wernicki's works, including The Physician and Sports Medicine and The American Journal of Radiology. He has authored numerous books and chapters including Sports Medicine for Coaches and Athletes: Swimming, The Mature Athlete, and The Encyclopedia of Sports Medicine. Dr. Wernicki was a contributor to The United States Lifesaving Association Manual of Open Water Lifesaving.

Dr. Wernicki has a Bachelor of Arts from the University of Virginia and earned his medical Doctorate at Rutger's University. His orthopedic surgery residency was conducted at John's Hopkins and Union Memorial Hospital where he was chief resident in orthopedic surgery. He then went on to complete fellowships in sports medicine and arthroscopy at Washington Adventist Hospital and Union Memorial Hospital.

Dr. Wernicki has cared for amateur and professional athletes, including members of the Baltimore Orioles and Los Angeles Dodgers baseball teams, and the Pennsylvania State football team. He is a clinic advisor to the American Running and Fitness Association and a certified Medical Race Director. He has directed medical care at numerous athletic events, including the Hawaiian Ironman Triathlon and USLA national lifeguard tournaments.

Dr. Wernicki is an avid runner, triathlete, kayaker and scuba diver. He has qualified and competed in the US Triathlon Championships and various marathons including the Boston Marathon.

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Lifeguarding: The Sport, the Profession, the Hazards

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Peter G. Wernicki, MD
John Glorioso

In brief **Lifeguarding is a special combination of several athletic activities and a grueling test of physical fitness. The very nature of rescuing—the "cold starts," the running on soft sand, the stress on back and shoulders, and other characteristics—may make lifeguards more vulnerable to injury than other athletes. Since lifeguarding combines aspects of several sports, lifeguards sustain common but unrelated sports injuries such as "swimmer's shoulder" and shin splints. Lifeguards can also suffer from injuries peculiar to lifeguarding, such as foot lacerations. Proper conditioning and protection can be the keys to reducing incidence of injuries among lifeguard athletes.**

Perhaps no more interesting mélange of sport and occupation exists today than lifeguarding. A rigorous melding of all the physical challenges associated with swimming, rowing, surfing, and running, it also demands many of the fitness requirements associated with military service and firefighting.

Dr Wernicki, an orthopedic surgeon specializing in sports medicine, is in private practice in Vero Beach, Florida. Once a lifeguard himself, Dr Wernicki is now the medical adviser for the US Lifesaving Association. He writes a monthly column called "The Lifeguard Athlete" for *American Lifeguard* (Chicago). Mr Glorioso is a third-year medical student at the University of Maryland Medical School in Baltimore and is also a lifeguard.

Intense professional competition, with events on the beach and in the water, has become as much a part of lifeguarding as saving lives.

Table 1. Comparison of Rescue Operations Occurring During 1-Year Periods at Three Beaches Affiliated With the US Lifesaving Association[2-4]

	California 1987*	Chicago 1988†	Maryland 1988‡
Beach Length (miles)	450	29	10
Attendance (millions)	119.8	24.2	4.3
Rescues	29,056	7,521	2,023
Medical Aids	25,090	8,151	1,677
Preventive Actions	814,553	31,075	—§

* Statistics from the beaches extending from Santa Cruz, California, to the Mexican border.
† Statistics from 16 Chicago-area beaches.
‡ Statistics from the beaches of Ocean City, Maryland.
§ No statistics available.

Traditionally, the purpose of the lifeguarding profession has been to save lives. In doing so, lifeguards test their abilities as they compete against their own physical limits, the forces of nature, and the struggles of victims. But over time, lifeguarding has developed into a true sport as well. Lifeguards have come to enter a new realm of contest as professional athletes, vying against other guards and teams in formal competition. Lifeguards are thus vulnerable to injury during training and competition as well as during rescue activity on the job. With more than 12,000 professional open-water lifeguards registered in the US Lifesaving Association (USLA)[1]—and thousands more unregistered or trained by organizations such as the Red Cross to work at pools—it's reasonable to assume that many sports medicine physicians will at some time be called upon to treat lifeguards' injuries.

USLA-registered lifeguards must maintain high skill and endurance levels through constant on-the-job training and workouts.

The Hazards of Lifeguarding

To be employed as an open-water lifeguard, male and female lifeguards of all ages must meet the same requirements for strength, speed, skill, and endurance in a number of athletic activities. They are periodically tested to ensure that their skills and fitness remain high. In many year-round organizations, lifeguards undergo constant training as part of their job duties, and they are tested biannually in a 1,000-m open-water swim, as well as in emergency care procedures.

However, most lifeguards work only seasonally, and they are often injured as a result of inadequate preseason conditioning followed by a sudden increase in physical activity once the summer season begins. For these open-water lifeguards, training is sporadic in the off-season, but during the season, they usually undergo 3 months of intense daily training and physical activity; many of them are on duty 6 or 7 days a week. (See table 1 for the number of rescue operations performed as part of lifeguards' workloads at both year-round and summer beaches.[2-4])

The manner in which lifeguards perform their duties also predisposes them to injury. For example, when guards must jump off the stand (where they may have been sitting for hours) and then sprint to the water to rescue victims, they do not have time to stretch or warm up as they can do during organized competition. But lifeguards are also injured while competing.

Swimmer's Shoulder. Compared with other swimmers, the force and demand that lifeguards exert on their shoulders increases their risk of rotator cuff tendinitis/bursitis, also known as "swimmer's shoulder."[5] The greater incidence of this overuse syndrome also arises because lifeguards generally use only one swimming stroke, freestyle. In addition, an open-water lifeguard must swim against waves and currents and with the added weight of the victim. Training often involves swimming back and forth through breaking waves, "rescuing" other guards.

In formal competition, other shoulder injuries, such as bicipital tendinitis or acromioclavicular joint sprain, can occur during the "land line" event. The land line is a rope that is secured on the beach and then stretched by the rescuer from the beach to the victim; two guards on the beach pull both rescuer and victim to shore. The speed and force the guards use in this repetitive pulling action can cause shoulder injuries.

Lifeguard's Calf. Lifeguards coined the term *lifeguard's calf* to describe a common complaint of gastrocnemius and Achilles tendon pain usually caused by running barefoot over soft sand. The degree of dorsiflexion and plantar flexion required to run barefoot on soft sand leads to increased stress on, and inflammation of, the dorsiflexors and plantar flexors of the foot. Soft sand running also leads to a greater incidence of plantar fasciitis among lifeguards than among other runners. (For tips on treating plantar fascitis, see related article on page 129.)

Surfer's Syndromes. Lifeguards sustain injuries when using the 10- to 12-ft-long rescue board, which is similar to a surfboard. As surfers do, lifeguards paddle rescue boards in either kneeling or prone positions. However, lifeguards are actually at greater risk of developing certain "surfing syndromes" than are surfers, because rescue boards are larger and heavier than surfboards and are often paddled greater distances—sometimes with the added weight of a victim.[6-8] Although also intended for use in rescue operations, the rescue board is used primarily in competition.

Isometric hyperextension of the back and neck while paddling the rescue board can lead to strains and sprains.[6] "Surfer's shoulder" (rotator cuff tendinitis) can be caused by excessive internal rotation of the rotator cuff. Other common af-

Table 2. Causes and Relative Frequency of Lifeguards' Foot Injuries From Stepping on Foreign Objects. Reported by 56 Lifeguards of the South Florida Beach Patrols, 1989.[9]

Object	Percent
Glass	31.0
Rock	15.5
Needle	15.5
Shell	15.5
Wood	7.8
Nail/Metal	6.5
Other*	6.5

* includes barnacles, fish spines, plastic forks, fish hooks, etc.

flictions include "surfer's elbow" (lateral epicondylitis) and "surfer's knots" or "knobbies"—growths of subcutaneous connective tissue over bony prominences often occurring over the tibial tubercles, ribs, and anterior superior iliac spines.

Foot Trauma. Lacerations and puncture wounds are risks of running barefoot. In a survey of 56 lifeguards from southeast Florida, 44 (79%) had suffered foot trauma while on duty (table 2).[9]

Rowing and Back Pain. Chronic low back pain and acute muscle strain are by far the most common injuries lifeguards suffer as a result of rowing. In a study[10] of 800 lifeguard rowers, 44% had sustained such injuries, and 20% of these injuries were severe enough to warrant cessation of rowing for the remainder of the season.

While rowing, lifeguards sit on a fixed seat instead of the sliding mount scullers use. Because of this, lifeguard rowers injure their patellofemoral joints less frequently than do scullers, who concentrate the power of the stroke in their legs. However, lifeguards' concentration of power in the torso and upper body while rowing increases the incidence of injury to those areas.[10] Lifeguards' common back injuries develop because of the inherent biomechanical disadvantage of the back muscles during rowing, especially when the back is hyperextended.

Skin Conditions. Overexposure to the sun places lifeguards at high risk for developing certain skin conditions, especially on the most exposed areas: the nose, lips, shoulders, upper back, and tops of the ears. Problems include keratoses, basal and squamous cell cancers, and malignant melanomas.

Using the fixed seat in a lifeguard rowboat can cause an annoying rash because of the friction over the coccyx.[10]

Eye Irritation, Eye Injury. As with surfers, the drying effects of the wind, injuries from dust and sand, and overexposure to salt water and sun increase lifeguards' risk of developing certain ocular conditions such as pingueculae, pterygia, and ocular sunburn.[8] Overexposure to the sun also places lifeguards at increased risk of developing cataracts.[11]

Other Injuries. Lifeguards suffer many other injuries as well during their various athletic activities. For example, using the 14-ft-long surf ski, which resembles a narrow surfboard, can result in injuries typical of those sustained in kayaking. The surf ski is primarily used during competitive events, but is increasingly being incorporated into rescue operations. The lifeguard sits on top of the surf ski, paddling kayak-style and steering with a foot-controlled rudder. Surf skiing can result in blisters, muscle sprains, extensor tenosynovitis of the forearm, and tendinitis of the shoulder, wrist,

The Organization of Lifeguarding

When the city of Santa Cruz, California, hosted the 1989 national championships of the US Lifesaving Association (USLA), the competition alone netted an estimated $250,000[1] for the city and captured media attention nationwide. In fact, lifeguard competitions are popular on many beaches around the country.

The USLA is the national professional alliance of open-water lifeguards, dedicated to improving lifeguarding conditions and water safety techniques. The organization is grouped in 7 regions and now has 271 chapters nationwide. In addition to its 12,000 professional members, the USLA has an equal number of nonvoting members, including associates, alumni, and junior lifeguards.[2]

Lifeguarding involves athletes of all ages. Many youths begin training as lifeguards through the USLA's Junior Lifeguard Program. The average age of most part-time guards is 19. But in Los Angeles County, 75% of the 103 full-time guards are older than 35.[3]

The main sporting events of the USLA are surf lifesaving competitions, ranging from intersquad and regional tournaments to national and international championships. Each competition involves a number of athletic events, and major competitive events are presided over by a group of officials similar to umpires and referees. To compete successfully, lifeguards must train beyond the requirements of the job, practicing specific events against the clock and often with a coach. (See table for descriptions of competitive lifeguarding events.)

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Table. Competitive Events of the US Lifesaving Association National Championships

Event	Description
3-km Beach Run	Individual 3-km run on wet sand.
Ironman	Individual 300-m swim, 300-m rescue board paddle, 300-m surf ski race, with 100-m run between events.
American Ironman	Same as Ironman, but substitutes 300-m dory row for surf ski race.
Dory	Two-rower teams row three 1,000-m laps through surf course. Between laps, one rower from each team runs to beach flag, around it, then returns to dory.
Two-Person Rescue	Rescuer and victim team event: Rescuer runs to water, swims 150 m to victim, pulls victim to shore. Both cross finish line.
1,000-m Swim	Competitor runs to water, swims out 500 m around buoy, back to shore.
Surf Ski	Individual 1,000-m surf ski race.
Land line	Teams of four: Rescuer in harness swims to victim, grabs victim. Two line pullers haul victim and rescuer to beach. All four cross finish line.
Run-Swim-Run	Competitor runs 400 m, swims out 150 m around buoy and back to shore, runs 400 m to finish line.
Rescue Board	Competitor sprints to water with rescue board, paddles out 500 m and back, sprints to finish line.
Beach Flags	Individual event won by process of elimination: Competitors lie face down in soft sand, 20 m facing away from flag line. Number of flags is one fewer than the number of competitors. On start, competitors rise, turn, and race for flags. Competitor who doesn't retrieve a flag is eliminated. Those who retrieve flags go on to successive rounds until all but one competitor is eliminated.

or elbow.[12] Surf skiing also aggravates existing problems of back strain and shoulder bursitis or tendinitis, as does kayaking.[13]

Wrist tenosynovitis and tenosynovitis on the flexor side of the forearm or the thumb can result from rowing.[10] Among nonlifeguard rowers, forearm extensor tenosynovitis may be caused by the repetitive feathering (rotational motion) used to control the oars. Among lifeguards who do not often use the feathering technique, forearm flexor tendinitis results from their need to powerfully grasp the oars.

Lifeguards also sustain trauma while rowing in open water, where dangers such as turbulence can cause bruises, lacerations, fractures, and head, neck, and other injuries.

"Jumper's knee" and patellar tendinitis can be caused by repeated jumps from the guard stand to the sand. Some common conditions often caused by running, such as shin splints, stress fractures, and iliotibial band syndrome, can also result from lifeguards' activities.

Keys to Injury Prevention

Unlike other multisport activities such as triathlons, each lifeguarding activity uses similar, if not identical, muscle groups. The shoulders and back are especially stressed and frequently injured during swimming, paddling, rowing, and line pulling. Furthermore, an injury that occurs during one lifeguarding activity will often lead to performance problems in other activities, which may then compound the injury.

However, many injuries caused by overuse and misuse can be prevented if the lifeguards take simple precautions suggested by their physicians:

- Stretch and warm up thoroughly before exercising, and avoid overuse of vulnerable areas during training. Structure workouts to include gradual early season increases. Many strains, sprains, and other overuse and misuse problems can be avoided with proper conditioning.

- Maintain proper form while exercising. Performing lifeguarding activities with incorrect techniques can result in many of the injuries described in this article. An experienced coach or senior guard should monitor technique in all lifeguarding activities.
- Use a sunscreen and wear protective clothing. Waterproof sunblocks with an SPF factor of at least 15 can help safeguard at-risk areas against damaging ultraviolet rays. Wide-brimmed hats provide added protection for exposed skin.
- Wear sunglasses that provide 100% ultraviolet filtration and are coated to reduce glare to help prevent eye problems.
- Wear protective footwear. The USLA is evaluating the use of protective footwear such as Aquasocks (Nike, Beaverton, Oregon) as a means of preventing common foot injuries among lifeguards.[9]

Physicians can also be watchful for a variety of conditions during routine evaluations:

- Anticipate and monitor conditions such as degenerative changes and shoulder impingement, particularly among older guards who may be more vulnerable to injury.
- Watch for signs and symptoms of skin problems. Rashes, abnormal pigmentation, or new, changing, or nonhealing lesions are just a few indications of more serious skin problems. Thorough monthly examinations of the skin for these and other warning signs can catch many problems while they can still be effectively treated.
- Keep patients up-to-date on tetanus vaccination, and consider administering hepatitis vaccination.

Other specific preventive measures, such as changes in the length of oars and in the style of seat in rowboats, are more specific and cannot be adequately considered here.

If injuries do occur, standard sports medicine treatment and rehabilitation procedures usually apply, such as decreased use of the affected area, application of hot or cold packs, administration of anti-inflammatory medications, and stretching, conditioning, and technique monitoring. During rehabilitation and recovery, injured guards may not be effective in performing rescue operations and may be better placed in positions requiring lighter duty.

Staying Well to Save Lives

Many of the injuries sustained by lifeguards are also common among swimmers, runners, surfers, and rowers. But lifeguards are actually more vulnerable than other athletes to some of these injuries. Understanding both these vulnerabilities and the extensive training and competition of lifeguarding will allow the excellent healthcare needed to help lifeguards stay healthy and compete—and will help keep lifeguards ready to save lives. PSM

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Guarding the Guards

Those of us who have seen a skilled lifeguard in action understand the degree of training and depth of knowledge these unsung heroes of the beach reflect. Not only must they be accomplished swimmers, runners, rowers, and surfers, they must have the vision and perception of Superman to spot trouble obscured in waves full of people.

No question about it: Lounging in the sun is not the lifeguard's lot. Lifeguards are *athletes*. And like all athletes, they are subject to injury—but with a difference. Because of the wide range of physical demands placed upon them, as well as circumstances that may require cold starts, these athletes are particularly vulnerable to certain kinds of injuries. But with proper care, conditioning, and caution, they can guard their own well-being as they guard the nation's swimmers. (See "Lifeguarding: The Sport, the Profession, the Hazards," by Peter G. Wernicki, MD, and John Glorioso on page 84.)

Another group of swimming athletes is discovering a way to have fun and stay fit afloat. Growing numbers of swimmers across the country are getting involved in the fast-paced team sport of water polo. Despite the sport's reputation for rough play, its participants are emerging from the pool little more than wet. (See "Water Polo's Benefits Surface" on page 118.)

Physicians often are faced with peculiar medical presentations, and part of the art of medicine is piecing together clues and hunches to arrive at a diagnosis. In "Rheumatic Fever Is Back—Don't Miss It" on page 75, L. Tyler Wadsworth, MD, discusses a case in which a common complaint of joint pain led to a surprising diagnosis.

Elsewhere in this issue, "Sweat: Up Close and Personal" offers advice on what to tell your patients who complain of excessive sweating (page 103). And don't miss "When Does an Athlete Need Iron?" by George B. Selby, MD, on page 96.

R. H.

Cordially,

R. H. Strauss

Richard H. Strauss, MD
Editor-in-Chief

Ian Wienburg

Ian Wienburg, 46 years old, is the Chief Executive Officer of the National Sea Rescue Institute of South Africa (NSRI) and as such, represents South Africa on the International Lifeboat Federation (ILF).

The NSRI is a thirty year old non-profit organisation with the responsibility of providing an effecient sea rescue service along the entire South African coast for a distance of approximately fifty nautical miles offshore.

The NSRI has 600 volunteer crewmen, operating from 26 stations. Ian was a volunteer crewman on one of these stations for 22 years before taking the helm on a full time basis. This has been invaluble in his handling of the mamoth task. The annual running expense budget, without replacement of craft is 6 million South African Rand, with a further approximately 1 million for capex.

Ian is spearheading an education drive to make the previously disadvantaged people of the country "water wise". A statistic that he hopes to reduce in time is that there are more drownings on inland waters (farm, dams, etc.) than at sea.

As a member of South African Search and Rescue (S.A.S.A.R.) he has delivered papers at, amongst others, the International Maritime Organisation Western Indian Ocean, Persian Gulf and Red Sea Conference on Search and Rescue.

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National Sea Rescue Institute

Offshore RescueProcedures

By

Chief Executive Officer Mr Ian Wienburg
National Sea Rescue Institute of South Africa

1. INTRODUCTION.

The National Sea Rescue Institute has provided a rescue service around the coast of South Africa for 30 years. It is recognised as an effective and efficient sea rescue service by similar International Organisations.

The Institute is committed to provide the quality and standard of a sea rescue service as required under International Agreements.

2. HISTORY.

The National Sea Rescue Institute is 30 years old this year, having been brought into existence in 1967, known originally as South African Inshore Rescue Service.

The first rescue craft was an inflatable boat 4.7 metres long powered by a 25hp outboard motor, manned by two crew members.

From these humble beginnings the Institute has grown, to today, where there are more than 45 rescue craft, at some 26 stations around the coast and on inland waters, manned by some 600 dedicated, highly trained and skilled volunteer men and women.

The fleet today comprises rescue craft ranging in size from 4 metre inflatables up to 13 metres all weather deep sea rescue boats. The inshore rescue craft, range in size from 4 to 7 metres, designed for rapid response and work relatively close to the shore.
The larger craft, 10 to 13 metres, can work up to 50 nautical miles off shore, and can remain there on station, searching or standing by for up to 24 hours.

3. THE SOUTH AFRICAN COASTLINE.

The South African coastline stretches from the border with Namibia at the Orange River, in the west to the border of Mozambique in the east. The length of this coastline is some 3000 plus kilometres.
This coastline is known to be one of the most dangerous and treacherous in the world with many a ship wreck dotted along it with the loss of many lives.

4. SOUTH AFRICAN SEARCH AND RESCUE ORGANISATION. (SASAR)

SASAR was established in 1979 as South Africa was signatory to the International Civil Aviation Organisation (ICAO), International Convention for the Safety of Lives at Sea (SOLAS) and The International Maritime Organisation (I.M.O.).

The primary function of SASAR is to coordinate search and rescue operations in Southern African Area to search for, to assist and if necessary, rescue,
- survivors of aircraft, accidents or forced landings
- vessels in distress, and survivors of maritime accidents.

It is also charged with the coordination of various government departments, volunteer organisations, and private aircraft and shipping companies, in the field of search and rescues and formulating policy.

There are two sub committees of SASAR namely the Aviation and the Maritime sub committees.

The NSRI is a member of the Maritime Sub Committee.

The control of the NSRI Units is normally exercised by our own coordinator but the control will be assumed by the Port Captains if required.

The Port Captain's Office is a Rescue Sub Coordination Centre, and an NSRI base is then a Secondary Rescue Sub Coordination Centre.

National Sea Rescue Institute as member of Member of SASAR is responsible for:

- ensuring that NSRI bases carry out the duties of alerting posts and the secondary Rescue Sub Centres(NSRI Base) within the scope and capability of the base;

- making NSRI communication channels available when required during a Search and Rescue and Medevac operation;

- providing vessels with crews and vehicles when required during a Search and Rescue and Medevac operation;

- carrying the costs involving NSRI staff, i.e. subsistence and transport allowances, salaries and allowances of a special nature that are related to a Search and Rescue and Medevac;

- carrying the costs from the use of NSRI vehicles, vessels and communication systems incurred during a Search and Rescue and Medevac operation.

- training on how the SASAR organisation works and the role played by the NSRI within it has been carried out at station level by Senior Staff Officers of SASAR Maritime Rescue Coordination Centre.
To provide all of the above it goes without saying that highly skilled, dedicated and well-trained crews are required by the NSRI.

5. THE CALL OUT PROCEDURE.

The procedure to initiate a rescue call out is as follows:

A member of the public, calls the local Port Captain's Office, having seen a distress flare fired, they report the approximate position, the Duty Officer in Port Control then activates a paging system alerting the duty Coxswain/Station Commander of the nearest NSRI Rescue Station to contact Port Control.
Upon being contacted, if the Coxswain in consulation with the Duty Officer, decides to launch a rescue craft, he requests Port Control to call out the Duty Crew, this is done again via a single button being pressed in the Port Control and the message received on all pagers is "RESCUE 2 REPORT TO THE BASE FOR A CALL OUT". The duty crew now responds to the base, upon

being briefed, the boat or boats are launched and proceed to the last known or given position. Contact with the vessel in distress is attempted by radio if possible. If no response, a search pattern will be set up in the area of the last known position, taking into account prevailing winds, sea currents etc., using all available means to attempt to plot the distress vessel's last known position using GPS, RDF, etc.

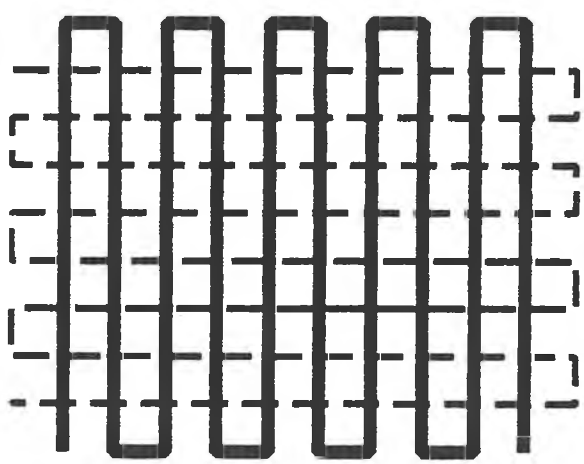
The call out could also be initiated by a distress call being broadcast on channel 16 (marine VHF) or on 2182 MHZ and this is then monitored by the Port Control or the nearest Coastal Radio Station. If this was the case, the call out would be shortened by the Port Control, activating the single button being pressed, requesting all crew to report to the base.

6. THE SEARCH PATTERN

When the search area is reached, the coxswain of the rescue craft will most likely set up a grid search. Because of the rough sea conditions in most rescues, there will always be a backup via the Shore Base where in more friendly conditions, a shore controller will assist in plotting the boats' positions on a regular basis.
The shore controller will in most cases be backed up by the presence of a senior coxswain to assist in making decisions and predications.

If there is only one rescue craft available, the grid search will be conducted as follows: the rescue boat will start at a point, do first a horizontal sweep back and forth, followed by a second sweep doing the vertical legs up and down.

If there are two rescue craft available, one rescue boat will do the horizontal sweep back and forth, while the second craft does the vertical sweep up and down.



In the above drawing the first rescue boat is represented by the dotted line doing the horizontal search, the solid line represents the single or second craft doing the vertical search of the grid pattern.

With the advent of modern plotting devises such "Chart Nav" and GPS plotters the area covered can easily be seen on the screen and no plotting as such is required to be done on charts on the boat itself. It goes without saying that if the last known position was plotted, effects of sea currents and wind will be taken into consideration and the grid search moved to take this into account.

If the position of the craft or distress flares, that have been fired, has been given by a member of the public, crew members based landside would go to the position from which the sightings had been made and will attempt to give a relative bearing or cross reference for the boat to head to. These days with the greater usage of cellular communications, the boat will often have direct contact with the member of the public who reported the sighting. All the NSRI's large rescue craft have cellular telephones on board.
This method of having direct communication with the reporter has enabled the Rescue Service to have a far better chance of finding those in distress, as they can now be directed by reporter to exact position of the sighting.

8. THE "HI LINE" METHOD OF RESCUE.

The purpose of the "HI-LINE" is to assist in the transfer of people, stretchers or light equipment between a helicopter and a vessel or vice versa.

This method of rescues was perfected by the NSRI, and Court Helicopters, a local helicopter ship servicing company, who have also worked extensively with the NSRI.

The "HI -LINE" enables a person on the deck of a vessel to control the load or person being winched up or down from a helicopter in such a way as to keep them clear of the ships' rigging or other obstructions and to guide them to and from a fixed point on the vessel's deck.

This method makes use of a second line other than the winch cable being lowered to the rescue craft or vessel with the injured person on board. This line is a braided cord approximately 25 mm in diameter, and 100 metres in length. The end that is lowered to the craft is weighted, and the other end is attached to the helicopter near the winch, with a weak link with breaking strain of approximately 200 kgs. The winch cable hook is attached to the "HI- LINE" by means of a carabiner which is free to run on the "HI-LINE".

The "HI-LINE" is dropped to the craft by the helicopter and the boat crew are instructed not to attach this to the vessel, but to ensure that there is sufficient of it flaked into a bucket, one or two crew members wearing gloves must control this line. Tension must be maintained on the line but it must be free to run as the helicopter and vessel move relative to each other.
When the stretcher or "paramedic" is lowered down, as he approaches the deck, he or the stretcher must be pulled in. The crewman must not engage in a "tug of war" with the helicopter, but ensure that there is sufficient tension on the line to keep the "paramedic" or stretcher clear of the rigging or other obstructions.

When the transfer is complete, the "HI-LINE" is paid out slowly as it is pulled into the helicopter, ensuring that it does not catch onto any part of the vessel.
The benefit of this method is two fold, one it allows the pilot of the helicopter to stand off from the vessel, clear of any aerials, or superstructure, and to have the vessel visible, instead of

hovering over the vessel. Secondly, it allows for the smooth transfer of the stretcher, "paramedic" or injured person to and from the helicopter, by preventing any swinging around.

This method has been used many times in both calm and very rough sea conditions, to transfer both injured crew and others from various vessels or craft, ranging from life rafts and yachts to fishing vessels and large container ships.

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