"RECOGNITION AND OBSERVATION OF POTENTIAL RESCUE VICTIMS IN AN OPEN WATER ENVIRONMENT"

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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 <u>potential</u> 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 ***<u>United States Lifesaving Association Manual of Open Water Lifesaving</u>***, with some elements extracted from the first USLA training manual, ***<u>Lifesaving and Marine Safety</u>***.

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.

Swimmer Observations

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.

Drowning Presentations

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.

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, blood-borne 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.

Contact with Victims

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.

Contact with skin or saliva

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.

Risk to lifeguards. 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.

Prevention. 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.

Contact with blood

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

Risk to lifeguards. 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 life-guards 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

<u>Selected References</u>

Myint S, Manley R, Cubitt D. Viruses in bathing water. *Lancet* 25 June 1994; **343**:1640-1.

Corbett SJ, Rubin GL, Curry GK, Kleinbaum DG. The health effects of swimming at Sydney beaches. *American Journal of Public Health* December 1993; **83**:1701-6.

Phillip R, Pond K, Rees G. Litter and medical waste on bathing beaches in England and Wales. *British Medical Journal* 17 April 1993; **306**:1042.

Phillip R, Pond K, Rees G. Medical wastes found on coastline are increasing. *British Medical Journal* 13 August 1994; **309**:471.

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	*Physalia utriculus* (Bluebottle)

	stinger)	

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.