

## Diving Medicine Online



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# Diving in Polluted Waters

## *Water Pollution*

As our rivers, lakes and shorelines become more heavily populated, our diving population has to become more aware of the potentially hazardous presence of pollution in the water. Collectively, our waterways and the sea have been traditional dumping grounds for pollutants of many types and degrees of danger. In 1991, a Los Angeles Times article indicated that 2000 U.S. beaches were closed due to sewage spills. California, as always, a leader had 745 closures with 588 occurring just in southern California. This was quite probably only a fraction of the closures that would have occurred if consistent and regular monitoring was being done across the board. The lack of any standardized program for monitoring our waterways is clearly a problem.

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## *Flush Areas?*

Areas of special concern are harbors and similar areas which do not "flush" well; rivers, especially those with high levels of industry on the shores; sewage outfalls which go out to sea but are often overloaded and areas which have their deposits of soft, silty materials dropped as the currents reduce their velocities

in dispersal areas. Heavy metal contamination, for example, has caused a major problem with the dredging of a large marina entrance due to the fact that hazardous levels of contaminants including heavy metals, have been identified in the silt and the material cannot be pumped or dumped deeper into the sea as is commonly done. It has been estimated that there are on the order of 15,000 chemical spills that enter our water areas each year in the U.S. alone. The contaminated areas are growing and now include many recreational diving areas as well as scientific study sites and search and rescue operations.

The health consequences of the water pollution have not been quantified by careful study but many local health professionals are concerned with infectious and immunosuppressed patients who are ocean swimmers, lifeguards and divers. Until adequate epidemiologic data is available the recourse would appear to be logically focused upon conservative practices in selecting dive sites and conditions.

This increase in areas of pollution is a worldwide problem and has effected many diving operations. Diving in polluted water requires additional precautions and, in many instances, sophisticated equipment and procedures. Avoiding diving in areas with high potential for pollution, particularly after heavy rains is fundamental in urban or industrialized areas.

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### ***Microbial and Chemical Hazards***

The problem centers around the fact that microbial and chemical hazards can affect the human body by skin contact, entry through orifices and invasion through the skin. The number of specific hazards and their relative severity is beyond the scope of this presentation. The following list was produced in the NOAA Manual and the details were obtained from the medical literature.

Vibrio - 34 species of this family of bacteria are known and cholera and El Tor vibriones are among those known to be pathogenic to man. Cholera vibriones have recently been found in Santa Monica Bay in California and have

raised concerns although it is not known to have produced any disease. Other vibrios may be anaerobic and produce disease states such as purulent otitis, mastoiditis, and pulmonary gangrene. *V. Proteus* found in human fecal material is a common cause of diarrheal disease. *V. Vulnificus* is found in sea water.

#### Enterobacteria

*Escherichia* - found widely in nature, occasionally pathogenic to man, produces carotenoid pigments and can often be recognized by the orangish pus. *E. coli*, which has some pathogenic strains is often found in fecal material, and can produce urinary tract infection and epidemic diarrheal disease.

*Shigella* - produces dysentery

*Salmonella* - 1000 serotypes, ingestion can produce gastroenteritis including food poisoning, typhoid and paratyphoid.

*Klebsiella* - can produce pneumonia, rhinitis, respiratory infection.

*Legionella*, - causes Legionnaires disease and Potomac fever. Perhaps inhibited in salt water.

*Actinomycetes* - causes a "ray fungus" actinomycosis an infectious disease in man which inflames lymph nodes, develops abscesses, can drain into the mouth causing damage to the peritoneum, liver and lungs.

*Pseudomonas* - pathogenic to man, "blue pus" formed by some *pseudomonas* infections can lead to a wide variety of infections including wound sepsis, endocarditis, pneumonia, meningitis. It is known to flourish in dark, warm, damp places, i.e. inside hoses, bladder compartments and similar places that are not cleansed after being infiltrated by contaminants.

Viruses - infectious agents which can result in fevers (frequently severe), mononucleosis, and a wide range of disease states.

There are seven currently recognized hepatic viruses:

Type of virus	Route of Transmission	Comments
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A	Fecal-oral	Common, no chronic component
B	Blood-borne	DNA virus, 5-10% chronic
C	Blood-borne	RNA virus, 50-80% chronic
D	Blood-borne	RNA, needs prior Hep B to exist
E	Fecal-oral	Asian, rare USA
F	Fecal-oral	Existence debated
G	Blood-borne	Being evaluated clinically

Parasites - many types with all manner of effects, all bad, can be found in polluted water. Cercaria, shistosomes are examples.

Chemicals- There are over 15,000 chemical spills in the U.S. waterways each year and many of these are releasing chemicals that are incompatible with man and the equipment that is worn.

As detailed information becomes available on this issue the divers will become sensitized to the need for preventive measures before, during and after diving. At present the scientific and public safety diving communities are developing techniques for isolating the diver from the potential problems and decontaminating all exposed elements of the diving equipment. It appears eminent that the recreational community will feel the need to

exert greater care in the future.

It is becoming increasingly important to develop an understanding of the variations in the local conditions to which individuals expose themselves. Some areas become particularly hazardous following heavy rains, hot weather and windstorms. Local health authorities can usually be called for advice regarding any tests that have been performed and the results. They should also be able to identify areas of high concentrations of pollutants that should be avoided.

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### ***What Measures can be taken?***

When diving in areas where pollution is suspected or expected the following issues are worthy of evaluation.

1. The individual diver should consider the need for appropriate vaccinations and inoculations. Many of the diseases can be avoided if the individual has taken the appropriate "shots". Some that should be considered are:

Hepatitis A, B and C. (There is no vaccine currently available for Hepatitis C).

Cholera,

Polio

Tetanus.

Typhoid, Smallpox and Diphtheria

2. Pollution and filth are often associated. If the water contains obvious trash and garbage it is quite probably an unhealthy diving environment and another location should be selected. If the water looks nasty it probably is nasty!!

3. Many diseases have an incubation period before they exhibit symptoms. Medical advice is as close as the phone and early diagnosis and treatment can sometimes be improved if the Doctor understands that an individual may have been submerged in polluted water.

4. Information on chemical spills can be obtained from the Chemical Transportation Emergency Center (1 800 424 9300 US).

5. "When in doubt- Check about"

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## ***What does NOAA recommend?***

A basic procedure if one has to dive in high risk water involves reducing the exposure of the diver. NOAA has pioneered a sophisticated SOS (suit over suit) system that will virtually isolate the diver from any contact with the water. This system is somewhat complex inasmuch as it requires complete system integrity from the times the diver dresses out until the system has been decontaminated following the dive. Strict procedures are followed to ensure that the divers body does not contact the fluid in which it is immersed.

Previously, many public safety divers wore a single dry suit and a full face mask during their dives. However, Stephen Barsky now states that "Full-face masks only provide minimal protection and should only be used in environments where the pollutants are known, and do not pose a threat of death or permanent disability. In environments where the pollutants are not known, or where they lead to death or permanent disability, a helmet should be worn connected to a mating dry suit with mating dry gloves. This is considered the standard today." (See Reference below)

If good seals are involved and the diver is effectively rinsed, scrubbed down and rinsed again prior to breaking any existing seals, the probability of exposure to the pollutants can be minimized. Special care must be taken to clear hoses and fittings that interface with the life support system. A failure to rinse bladders and hoses which may later be linked to the divers mouth or lungs could provide a path to the host days after the dive. The use of snorkels, alternate air sources, oral inflation devices and hose connections should all be given careful attention since they can carry contaminants directly into the mouth. Positive pressure, "self bailing" breathing systems have definite advantages in that they resist flooding.

Recreational divers maybe well advised to place their regulator in their mouth and their mask over their nose before entering suspect water and keeping it there until they have safely exited the water where they can remove the regulator without needing to replace it.

Polluted water is a fact of our lives. The degree of pollution can only be mitigated through education and the "upstream" elimination of the sources of the contaminants. The attitude that careful rinsing of diving gear is a waste of time "cuz its just going to get wet again next time it is used" should probably be replaced with the attitude that one should begin every dive with clean gear.

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Adapted from Glen Egstrom, Ph.D  
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