

1993

Report on  
Diving Accidents  
& Fatalities



# Divers Alert Network

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Direct financial support for this report was provided by the  
National Oceanic and Atmospheric Administration  
(NOAA Grant NA26RU0449-01) and the Diving Equipment and  
Marketing Association (DEMA).

The majority of the funding that makes this report possible is  
from individual DAN member donations. DAN also wishes to  
recognize the dive clubs, stores, and instructors who support  
DAN and diving safety.

Copies of this report may be purchased for \$20 plus postage.  
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contacting the DAN Membership Department at the address  
given below.



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*1993 Report on Diving Accidents and Fatalities*  
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# Acknowledgments

Data for the *1993 Report on Diving Accidents and Fatalities* were collected and assembled by DAN employees and staff. These contributions ranged from accident follow-up calls, data entry, editing, proofreading, and compiling the final report. DAN wishes to recognize the following people for their important contributions:

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<i>Jim Chimiak, M.D.</i>	<i>Dan Orr, M.S.</i>
<i>Guy de L. Dear, M.B., FRCA</i>	<i>John Rorem</i>
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*Joel Dovenbarger, BSN, Director of Medical Services — Editor*  
*Karen Corson, MPH — Diving Epidemiologist*  
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*Jeffery Hodson, EMT-D — Fatality Research*  
*Renée Duncan Westerfield, B.A. — Layout*

DAN wishes to thank the many hyperbaric physicians, DAN on-call staff, nurses and technicians from the national network of chambers who fill out DAN reporting forms and send them in for follow-up. DAN also wishes to thank the local sheriff, police, and emergency medical personnel, the U.S. Coast Guard, medical examiners and coroners who submitted information on scuba fatalities. John J. McAniff of the University of Rhode Island joined with DAN in 1990 to assist with recreational and commercial diving fatalities.

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# Table of Contents

<i>Page</i>	<i>Section</i>
6	What Is DAN?
10	Introduction to Scuba Accidents
21	Injured Diver Characteristics
31	Accident Dive Profile
40	Symptoms
44	Treatment
50	Scuba Fatalities — Introduction
53	Methods of Fatality Data Collection
58	Fatality Dive Profile
62	Dive Fatalities Among Certified Divers
65	Appendix A — Fatality Case Reports
99	Appendix B — Diving DCI Reporting Form
103	Appendix C — Diving Fatality Reporting Form
107	Appendix D — Fatality Location Tables
110	Appendix E — Diving Incident Report Form
113	Appendix F — ICD-9-CM Codes
117	Appendix G — Diving Definitions

# What is DAN?

*DAN's mission is to enhance diving safety for recreational divers by helping them to avoid injury and provide assistance when injuries occur.*

Divers Alert Network (DAN) is a 501(c)(3) nonprofit membership association that is affiliated with and originated at Duke University Medical Center.

DAN is dedicated to the safety of recreational scuba diving. The membership association includes individual divers, sponsoring dive clubs, retail scuba operators, equipment manufacturers, scuba certification agencies, and special individuals who donate their services, time and money to support diving safety and research. DAN safety services and DAN scuba diving research are financially supported by its membership.

DAN's mission is to enhance diving safety for recreational divers by helping them to avoid injury and provide assistance when injuries occur. DAN supports this mission by the following:

**First:** *Providing information on health/safety issues in scuba diving to divers, the general public and physicians.*

**Second:** *Providing emergency assistance for the evaluation, transportation and treatment of injured divers.*

**Third:** *Collecting, analyzing and publishing data on diving accidents and fatalities.*

DAN is the largest diving safety organization in the world, with more than 100,000 individual and family members. In 1991 DAN organized the first international federation of diving safety organizations (IDAN). The goals are to provide worldwide assistance for medical and safety information, air evacuation, and acceptance of dive accident insurance programs. Organizations now exist under IDAN for: DAN Europe; DAN Japan; and DAN Australia, in cooperation with the existing Divers Emergency Service (DES) system of Australia.

Divers Alert Network is well known in the diving community for its medical emergency and advisory telephone services to recreational divers and physicians.

## Safety Services

### 24-Hour Medical Emergency Hotline — (919) 684-8111

DAN maintains a 24-hour emergency service 365 days a year to provide injured divers with medical consultations and referrals.

### Non-Emergency Advisory Line — (919) 684-2948

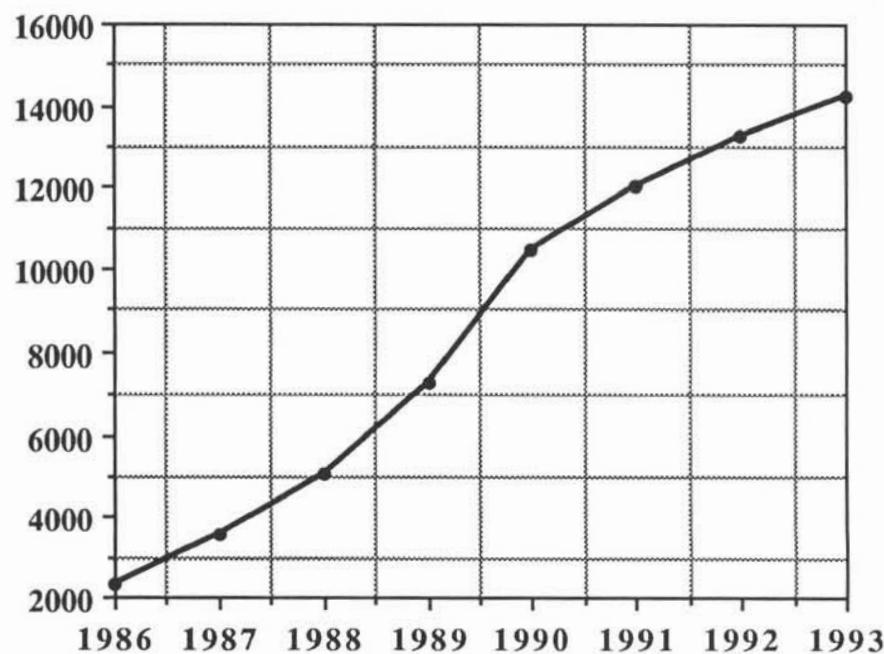
DAN maintains an information hotline to provide answers to commonly asked questions about scuba diving medicine and safety. Calls are answered 9 a.m. to 5 p.m., Eastern Time, Monday through Friday, except holidays.

*These telephone services are supported totally by membership dollars and are provided to anyone needing assistance.*

The combined telephone services now receive over 14,000 calls annually.

*Divers Alert Network is well known in the diving community for its medical emergency and advisory telephone services to recreational divers and physicians.*

## DAN Emergency and Information Services Combined Telephone Call Volume



**DAN has now trained over 30,000 Oxygen Providers, over 2,500 Instructors, and 300 Instructor-Trainers worldwide.**

### **Diving Safety Courses**

DAN provides courses for divers, instructors, and physicians who wish to increase their awareness and understanding of scuba diving injuries and treatment. Several hundred divers attend DAN's one-day courses, and over 1,500 physicians have been introduced to dive medicine through DAN's one-week seminars.

The DAN *Oxygen First Aid in Dive Accidents* program trained 6,700 Oxygen Providers and 700 Instructors in 1993. DAN has now trained over 30,000 Oxygen Providers, over 2,500 Instructors, and 300 Instructor-Trainers worldwide.

### **Membership Services**

Divers Alert Network is supported primarily by its membership, with over 80 percent of its operating funds coming from member dues. Small grants, donations and limited product sales help make up the other 20 percent. The membership department provides several services in return for the nominal dues paid, including the following:

#### **New Member Packet**

This contains DAN's *Underwater Diving Accident Manual*, decals and a membership card sent to every new member.

#### **Alert Diver**

This is DAN's bimonthly publication that serves as a forum for ideas and information relating to diving safety, education and practice.

#### **DAN TravelAssist<sup>SM</sup> Medical Emergency Evacuation**

DAN members can access a global emergency evacuation service by calling the Alarm Center number found on their DAN membership card. A DAN member traveling more than 100 miles from home on nonbusiness travel, whether insured or not, can be evacuated from anywhere in the world to an appropriate medical facility in the event of an accident or illness — even if the medical problem is not diving related.

#### **Accident Insurance**

DAN pioneered and implemented the first diving injury insurance for recreational divers in the United States. For those who choose this benefit, payment for emergency treatment of covered injuries is assured. DAN members are protected anywhere in the world for all covered in-water injuries.

## DAN Research

### ***Annual Report on Scuba Diving Accidents***

DAN collects the details of recreational dive injuries and fatalities. This data is analyzed for common injury trends and divided into descriptive population statistics.

### **Diver Safety Surveys**

Surveys have been done to study the possible risk factors of diseases which might make diving contraindicated. In this way it may be possible to quantify the risk of diving with these conditions.

### **Research Projects**

DAN's current research projects include the Flying After Diving (FAD) study and the dive profile database study known as Project Dive Safety.

For the FAD study, volunteer test subjects are exposed to depth followed by altitude in order to investigate the risk associated with flying after diving. The Project Dive Safety study is designed to collect information on dive profiles creating the largest database of its kind. Currently, final modifications are being made for pilot studies in the spring and summer of 1995.

# Introduction to Scuba Accidents

*Arterial gas embolism can result from breathing compressed gas and voluntary breathholding or be the result of a pathological condition which would trap air in the lungs while ascending to the surface.*

The 1993 *Report on Diving Accidents and Fatalities* is the seventh annual report published by Divers Alert Network.

The first section of this report focuses on decompression illness injuries. Each year DAN surveys the hyperbaric recompression facilities that treat injured divers worldwide to determine the number of treated decompression illness cases. The yearly totals reported in Figure 1.3 and the 1993 totals reported in Figure 1.4 are the results of these annual surveys.

Although there may be some non-U.S. citizens reported treated at U.S. facilities, the number of treated cases for any given year primarily refers to U.S. citizens who are treated in the U.S. or overseas chambers. There are likely to be additional cases which never receive treatment for numerous reasons. Symptoms of decompression illness, for example, are often similar to those of other illnesses and diseases and a diagnosis of decompression illness may never be made. Some individuals may view symptoms as simply a negative event and not seek assistance or perhaps not recognize the symptoms of decompression sickness and therefore not seek evaluation and treatment.

Decompression illness (DCI) is a general term referring to a broad spectrum of symptoms and severity of injury. Decompression sickness (DCS) and arterial gas embolism (AGE) are the conventional terms used to describe two different and specific injuries which are grouped under the category of DCI.

Arterial gas embolism can result from breathing compressed gas and voluntary breathholding or be the result of a pathological condition which would trap air in the lungs while ascending to the surface. Symptoms of AGE are usually immediate in onset and commonly involve paralysis, change in level of consciousness or other cerebral symptoms.

Decompression sickness usually results from exposure to breathing compressed gas in depths of greater than 30 feet. Symptoms generally occur more gradually in DCS and frequently consist of pain, numbness, tingling and other central nervous system symptoms.

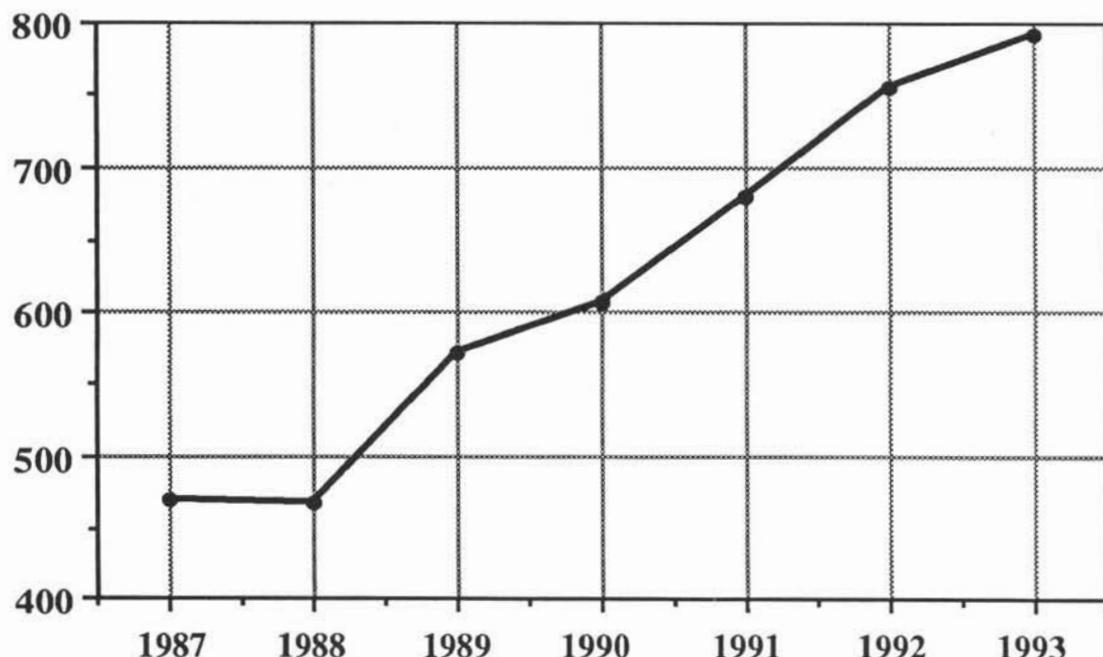
The purpose of accident data collection is to obtain details of how decompression sickness and arterial gas embolism occur. It is also valuable in determining changes or trends in types of diving injuries. This information then can be used to inform and educate the diving community. Until 1991 DAN employed a severity coding system to categorize decompression illness. DAN stopped using the 1-6 severity code because decompression illness proved to be too complex for this system. Tables used in the 1993 report have averaged results from previous years in three-year groups. This is meant to make for easier reading, references and comparison of results.

The total number of cases treated annually has been slowly increasing each year. The sharpest increase has occurred within the United States. Figure 1.1 shows the number of cases reported treated in the U.S. only. The largest increase in decompression illness is in cases of central nervous system DCS. Surprisingly, the number of reported cases of AGE has never been higher than 118 cases and usually less than 100 per year.

An accurate study to determine the risk of diving has not been performed and no incidence of injury can be drawn from data contained in this report. Studies have never reported the exact number of active divers annually or the number of dives made per year. Without some idea of the exposure to diving, an incidence of injury is not possible.

*The number of reported cases of AGE has never been higher than 118 cases and usually less than 100 per year.*

**Figure 1.1 Reported Cases Treated in the United States**



**The number of treated injuries reported to DAN increased by 8.3 percent in 1993. The overall increase in combined calls to DAN was 6.9 percent.**

## Case Collection

Divers Alert Network utilizes a network of hyperbaric chambers around the world to report decompression illness (DCI) injuries. The network is divided into seven regions, each overseen by a regional coordinator. Regional coordinators remain in contact with the hyperbaric treatment centers in their areas and help collect the dive accident reports which are sent into DAN.

Regional coordinators also assist in directing injured divers to area medical centers for evaluation and treatment. The increased and improved collection efforts by DAN are due to the cooperation of the many hyperbaric facilities in the referral network and the regional coordinators.

DAN receives most of its *Diving Accident Reporting Forms* directly from participating chambers. Some hyperbaric chambers rely on the patients to fill out the form and send it to DAN, while a few do not participate in the reporting process. Thus, the number of actual cases received at DAN is less than the total number of cases treated annually.

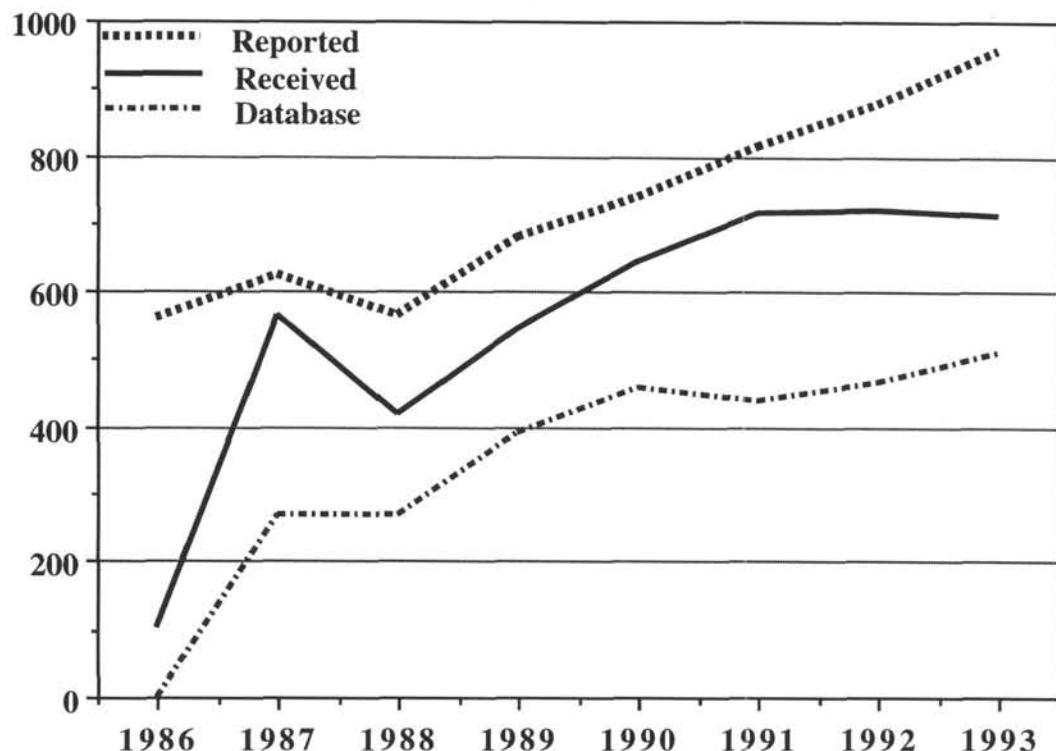
Each year more direct referrals are made through the telephone services of DAN to hyperbaric facilities. The increased number of emergency and information calls recorded each year are mirrored by the increasing number of treated accidents. The number of treated injuries reported to DAN increased by 8.3 percent in 1993. The overall increase in combined calls to DAN was 6.9 percent.

Figure 1.2 shows dive accident reporting and accident and collection trends since 1986. The top dotted line indicates the total number of cases treated yearly (958 in 1993). The middle solid line represents the total number of cases sent to DAN for review (712). The bottom dashed line represents the total number of cases which were completed, verified and entered into the 1993 DAN accident database (508 in 1993).

There was an increase of 7.8 percent in 1993 of cases treated in hyperbaric chambers, as well as an increase of 8.5 percent in the number of cases reported and completed by DAN. This represents the highest number of cases treated since 1987. Since the first annual report in 1987, DAN has reported on 43 to 62 percent of all divers treated. The 1993 report represents 47 percent of the total number of divers treated.

The number of referrals and follow-up calls by DAN's medical staff has led to more individuals with symptoms of DCI being

**Figure 1.2 Total Number of Cases Reported Received and Completed by DAN**



referred for evaluation and treatment. This system of referral has proved to be effective in assisting injured divers and collecting accident forms for review each year.

By Sept. 1, 1994, DAN had received 712 DAN *Diving Accident Reporting Forms*. Divers who were treated at more than one hyperbaric facility were counted once unless there was a separate second episode of DCI in the same calendar year.

Of the 712 forms received, 508 were completed and included in the DAN computer database. Two hundred and four (204) cases were excluded because they were commercial divers, other than SCUBA instructors providing instruction (57), or not enough information was collected about the case or follow-up was not possible (27). Also excluded from the database were any reports involving cases where DCI was not considered (i.e. ear barotrauma, pulled muscles, marine life envenomation); involved a non-USA citizen; patient did not have relief with treatment; no treatment was done; diver was using mixed gas, surface-supplied gas or breath-hold diving; or the case was in litigation (120).

***The number of referrals and follow-up calls by DAN's medical staff has led to more individuals with symptoms of DCI being referred for evaluation and treatment.***

***Five hundred and eight (508) cases diagnosed as DCI were included in the DAN database for 1993. These represent the cases which were complete and verified by a DAN medical information specialist.***

Once a case is received at DAN it is logged into the computer database. If the case involves recreational scuba, is decompression-related, and/or has missing or incongruent information, the person is contacted by a DAN medical information specialist.

If injured divers have residual symptoms, DAN will contact them by telephone for up to three months or until they no longer have residual symptoms. The names and identifying personal information are confidential and are not available to anyone outside of the DAN research and medical staff. Accident data cannot be used to imply individual fault or blame in determining the cause of scuba accidents. The number of individuals with decompression illness (DCI) who did not seek medical attention, or who were not referred for treatment is unknown.

Five hundred and eight (508) cases diagnosed as DCI were included in the DAN database for 1993. These represent the cases which were complete and verified by a DAN medical information specialist. A case was considered complete if most of its fields held a response. In the case where a question is blank, the table holds a frequency missing = "x", where "x" is the number of cases in the database that did not respond to that question. In other places where there is no frequency missing listed, there is an "n" followed by a number. This represents the population size or the number of people in that table or graph.

Percentages were rounded to the nearest tenth or hundredth. Many tables have categories which include very few responses resulting in a small number (number of respondents replying yes) divided by a large number (total number of respondents). This leads to occasional rounding errors and percentages totaling less than or more than 100 percent. A copy of the DAN Diving Decompression Illness Reporting Form which is used to gather the information present in this report is presented in Appendix C.

Figure 1.3 shows a breakdown of decompression illness by conventional diagnosis. These diagnoses are as follows: Type I decompression sickness (DCS-I), which refers to skin bends, fatigue or pain only. Type II decompression sickness (DCS-II), which includes neurological and cardiorespiratory bends, and arterial gas embolism (AGE), which represents arterialized gas bubbles primarily associated with immediate cerebral symptoms. These diagnoses were primarily based upon the diagnoses of the treating physician.

Figure 1.3 shows the total cases treated in 1993 by DAN region and the state where the treatment was received. The Caribbean basin area is included in the Southeast totals in Figure 1.3.

Figure 1.4 represents the total number of cases reported to DAN in 1993; the Caribbean basin is represented separately.

Figures 1.5 and 1.6 show a second breakdown of dive location by country and state for the 508 injury cases used for analysis in this report.

These tables do not necessarily indicate treatment location.

### **Figure 1.3 Total Reported Cases by Year and Region**

1993	US Military *	SW	NW	MW	GU	PA	NE	SE**	TOTALS
DCS-I	3	33	12	9	22	10	37	92	218
DCS-II	4	90	42	33	75	66	40	292	642
AGE	1	13	10	2	1	13	4	44	88
No case breakdown						3		7	10
<b>TOTALS</b>	<b>8</b>	<b>136</b>	<b>64</b>	<b>44</b>	<b>98</b>	<b>92</b>	<b>81</b>	<b>435</b>	<b>958</b>

\*These cases involved active duty military personnel who were diving recreationally and treated in military chambers.

1992	SW	NW	MW	GU	PA	NE	SE**	TOTALS
DCS-I	25	17	20	24	21	43	82	232
DCS-II	59	47	27	59	63†	24	276	555
AGE	11	6	4	10		6	39	76
No case breakdown							13	13
<b>TOTALS</b>	<b>95</b>	<b>70</b>	<b>51</b>	<b>93</b>	<b>84</b>	<b>73</b>	<b>410</b>	<b>876*</b>

1991	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
DCS-I	34	12	6	32	*	40	109	233
DCS-II	83	21	21	22	1	49	240	437
AGE	26	2	8	9	*	6	36	87
No DX reported					57			57
No Treatment++	1				1		4	6
<b>TOTALS</b>	<b>144</b>	<b>35</b>	<b>35</b>	<b>63</b>	<b>59</b>	<b>95</b>	<b>389</b>	<b>820*</b>

1990	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
DCS-I	31	8	17	31		28	111	226
DCS-II	60	8	10	37		34	193	342
AGE	13	1	2	7		15	58	96
No DX reported					31			31
<b>TOTALS</b>	<b>104</b>	<b>17</b>	<b>29</b>	<b>75</b>	<b>31</b>	<b>77</b>	<b>362</b>	<b>695*</b>

**Figure 1.3 (Continued) Total Reported Cases by Year and Region**

<b>1989</b>	<b>SW</b>	<b>NW</b>	<b>MW</b>	<b>GU</b>	<b>PA+</b>	<b>NE</b>	<b>SE**</b>	<b>TOTALS</b>
DCS-I	48	12	18	11		14	78	181
DCS-II	64	15	17	29		47	156	328
AGE	35	3	3	1		4	65	111
No DX reported					58			58
<b>TOTALS</b>	<b>147</b>	<b>30</b>	<b>38</b>	<b>41</b>	<b>58</b>	<b>65</b>	<b>299</b>	<b>678*</b>

<b>1988</b>	<b>SW</b>	<b>NW</b>	<b>MW</b>	<b>GU</b>	<b>PA+</b>	<b>NE</b>	<b>SE**</b>	<b>TOTALS</b>
DCS-I	14	9	11	13		22	68	137
DCS-II	43	27	10	25		32	151	288
AGE	25	6	2	1		10	38	82
DCS-AGE combined	1			4			5	10
No DX reported					36			36
No Treatment++		3		1	1	2	5	12
<b>TOTALS</b>	<b>83</b>	<b>45</b>	<b>23</b>	<b>44</b>	<b>37</b>	<b>66</b>	<b>267</b>	<b>565*</b>

<b>1987</b>	<b>SW</b>	<b>NW</b>	<b>MW</b>	<b>GU</b>	<b>PA+</b>	<b>NE</b>	<b>SE**</b>	<b>TOTALS</b>
DCS-I	15	4	2	15		30	61	127
DCS-II	58*	25	12	20		26	199	340*
AGE	20	4	2	6		6	59	97
No DX reported					38			38
No Treatment++	2					3	17	22
<b>TOTALS</b>	<b>95</b>	<b>33</b>	<b>16</b>	<b>41</b>	<b>38</b>	<b>65</b>	<b>336</b>	<b>624*</b>

<b>1986</b>	<b>SW</b>	<b>NW</b>	<b>MW</b>	<b>GU</b>	<b>PA+</b>	<b>NE</b>	<b>SE**</b>	<b>TOTALS</b>
DCS-I		6	2	1			68	77
DCS-II	69*	11	13	8	7	33	133	274*
AGE	28	2				10	41	81
No DX reported					25		97	122
No Treatment++	3					1	4	8
<b>TOTALS</b>	<b>100</b>	<b>19</b>	<b>15</b>	<b>9</b>	<b>32</b>	<b>44</b>	<b>343</b>	<b>562*</b>

\* Represents DCS Types I and II cases combined.

\*\* SE includes Caribbean basin.

† Represents DCS Type II and AGE cases combined.

+ Hawaii only reports number of cases treated.

++ No Treatment represents cases with no treatment, refused treatment, or spontaneous resolution.

### Figure 1.4 Total Cases Treated & Reported in 1993 by Region

Southwest Region	DCS-I	DCS-II	AGE	TOTALS
Arizona	0	5	0	5
California	33	77	13	123
Utah	0	8	0	8
<b>TOTALS</b>	<b>33</b>	<b>90*</b>	<b>13</b>	<b>136</b>

\*52 of these cases were combined DCS I and II.

Northwest Region	DCS-I	DCS-II	AGE	TOTALS
Alaska	1	1	1	3
Montana	0	1	1	2
Oregon	2	9	2	13
Washington	9	31	6	46
<b>TOTALS</b>	<b>12</b>	<b>42</b>	<b>10</b>	<b>64</b>

Midwest Region	DCS-I	DCS-II	AGE	TOTALS
Illinois	1	13	0	14
Indiana	0	3	1	4
Michigan	4	2	0	6
Minnesota	2	6	0	8
Nebraska	0	1	0	1
Ohio	1	7	1	9
Wisconsin	1	1	0	2
<b>TOTALS</b>	<b>9</b>	<b>33*</b>	<b>2</b>	<b>44</b>

\*Specific DCS I and II diagnoses were not provided for 4 cases.

Gulf Region	DCS-I	DCS-II	AGE	TOTALS
Arkansas	0	1	0	1
Colorado	5	9	0	14
Kansas	0	2	0	2
Louisiana	7	11	0	18
Mississippi	0	1	0	1
New Mexico	0	5	0	5
Texas	10	46	1	57
<b>TOTALS</b>	<b>22</b>	<b>75*</b>	<b>1</b>	<b>98</b>

\*Specific DCS I and II diagnoses were not provided for 21 cases.

Pacific Region	DCS-I	DCS-II	AGE	TOTALS
Hawaii	10	52	13	75
Australia	0	14	0	14
Fiji				3*
<b>TOTALS</b>	<b>10</b>	<b>66</b>	<b>13</b>	<b>92</b>

\*Specific diagnoses were not provided.

**Figure 1.4 (Continued) Total Cases Treated & Reported in 1993 by Region**

<b>Northeast Region</b>	<b>DCS-I</b>	<b>DCS-II</b>	<b>AGE</b>	<b>TOTALS</b>
Connecticut	8	3	1	12
Maine	0	8	0	8
Maryland	7	2	1	10
New Jersey	2	3	0	5
New York	9	7	2	18
Pennsylvania	11	12	0	23
Virginia		5	0	5
<b>TOTALS</b>	<b>37</b>	<b>40*</b>	<b>4</b>	<b>81</b>

\*Specific DCS I and II diagnoses were not provided for 7 cases.

<b>Southeast Region</b>	<b>DCS-I</b>	<b>DCS-II</b>	<b>AGE</b>	<b>TOTALS</b>
Alabama	4	4	0	8
Florida	63	151	24	238
Georgia	6	1	0	7
North Carolina	8	20	2	30
South Carolina		7*	1	8
Tennessee	1	2	0	3
<b>TOTALS</b>	<b>82</b>	<b>185*</b>	<b>27</b>	<b>294</b>

\*Specific DCS I and II diagnoses were not provided for 91 cases.

<b>Caribbean Basin</b>	<b>DCS-I</b>	<b>DCS-II</b>	<b>AGE</b>	<b>TOTALS</b>
Bahamas-	0	2	0	2
Barbados	1	1	1	3
Belize	0	7	1	8
Bermuda	0	1	0	1
Bonaire				7*
Cabo San Lucas	0	1	1	2
Cayman		12	4	16
Cozumel	2	35	3	40
Honduras	3	18	1	22
Jamaica	2	1	3	6
Panama (Canal Zone)	0	1	0	1
Puerto Rico	0	3	2	5
Saba	1	8	0	9
St. Thomas	1	9	1	11
Turks & Caicos	0	8	0	8
<b>TOTALS</b>	<b>10</b>	<b>107**</b>	<b>17</b>	<b>141</b>

\* Specific diagnoses were not provided.

\*\* Specific DCS I and II diagnoses were not provided for 12 cases.

**Figure 1.5 Accidents by Country & U.S. Territories**

Country	Frequency	Percentage
Barbados	1	0.2
Grenada	1	0.2
Indonesia	1	0.2
Micronesia	1	0.2
New Guinea	1	0.2
Japan	2	0.4
Canada	2	0.4
Truk	2	0.4
Jamaica	3	0.6
Bonaire	3	0.6
West Indies	4	0.8
British Virgin Islands	4	0.8
Australia	4	0.8
Other	4	0.8
Turks & Caicos	6	1.2
Antilles	8	1.6
Honduras	12	2.4
Belize	13	2.6
US Territories	16	3.1
Cayman Islands	17	3.3
Bahamas	24	4.7
Mexico	63	12.4
USA	316	62.2
<b>TOTAL</b>	<b>508</b>	<b>100.1</b>

**Figure 1.6 Accidents by U.S. States & Territories**

State	Frequency	Percent
Alabama	1	0.3
Colorado	1	0.3
Illinois	1	0.3
Maine	1	0.3
Nevada	1	0.3
Ohio	1	0.3
Oklahoma	1	0.3
South Carolina	1	0.3
Virginia	1	0.3
Wisconsin	1	0.3
Wyoming	1	0.3
Massachusetts	2	0.6
Oregon	2	0.6
Pennsylvania	2	0.6
Rhode Island	2	0.6
Delaware	3	0.9
Minnesota	3	0.9
Missouri	3	0.9
New Mexico	3	0.9
Utah	3	0.9
Louisiana	4	1.2
Michigan	4	1.2
New York	7	2.1
Texas	10	3.0
New Jersey	11	3.3
North Carolina	15	4.5
US Territories	16	4.8
Hawaii	20	6.0
California	32	9.6
Washington	33	9.9
Florida	146	44.0
<b>TOTALS</b>	<b>332</b>	<b>99.8</b>

# Injured Diver Characteristics

This section reports on some characteristics in injured divers. These characteristics are associated with injuries but have not necessarily caused an injury to occur. The 508 cases completed for this report is the largest number of recreational injuries ever reported on for one year. Over the years, there have been many small changes in the relationship between particular characteristics and injuries. This could be a function of the increasing number of accidents reported on each year.

The age distribution for injured divers is shown in Figure 2.1. Approximately 70 to 75 percent of all injuries has occurred between the ages of 25 and 44 years of age since 1987. Approximately 80 percent of scuba injuries occur each year in the 25- to 49-year-old age range. The 22- to 24-year-old age range consistently averages nine percent of all decompression illness cases annually. The small number of injuries in individuals 19 and younger or 50 and older may represent a smaller number of divers with less exposure to diving. These divers also may have different styles or patterns of diving for their respective age groups.

**Figure 2.1 Age Distribution of Accident Cases**

Age	1993 Percent	1992-1990 Percent	1989-1987 Percent
10-14	.8	.6	.5
15-19	2.2	2.9	2.8
20-24	8.9	9.0	9.4
25-29	15.4	18.4	22.4
30-34	23.2	23.0	22.9
35-39	20.5	21.2	16.8
40-44	11.4	12.8	12.4
45-49	8.3	6.8	6.4
50-54	4.7	2.9	3.3
55-59	3.0	1.1	1.7
60-64	1.2	1.1	1.4
>=65	0.6	.2	
<b>TOTALS</b>	<b>100.2</b>	<b>100.0</b>	<b>100.0</b>

*The 508 cases completed for this report is the largest number of recreational injuries ever reported on for one year.*

*Twenty-three percent of injuries occurring in male divers happened in the first 20 dives and 28 percent of all injuries occurred prior to the second year of diving.*

**Figure 2.2 Sex of 1987-1992 Accident Cases**

Sex	1993 Percent	1992-1990 Percent	1989-1987 Percent
Female	31.1	27.0	24.2
Male	68.9	73.0	75.8
<b>TOTAL</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Figure 2.2 shows that 31.1 percent of the injured population were female divers in 1993. This is the highest percentage of injured females ever recorded in the accident population. This record follows the previous record set in 1992 of 29.2 percent among the injured population. An increasing number of active female participants may account for this slightly higher percentage of injuries.

Figure 2.3 compares the diving experience of male and female divers by total lifetime dives and years diving. There is a different distribution of injuries for males and females by both years diving and total number of dives. Twenty-three percent of injuries occurring in male divers happened in the first 20 dives and 28 percent of all injuries occurred prior to the second year of diving. By comparison, 44 percent of all female injuries occurred during the first 20 dives or prior to the second year of diving. Additionally, only 18 percent of the female divers had logged more than 100 dives compared to 48 percent of the male divers.

There are a number of differences in the years of diving prior to the time of injury. Figure 2.4 has the years of experience separated into smaller groups. Fifty-two percent of the injuries among male divers occurred within the first five years of diving. This compares to 80 percent of the injuries among female divers during the same time period. The mean number of dives and inexperience in the male divers was also higher than those of the females. The mean number of lifetime dives for males was 76 (median 25), with a range of one to 770 dives. Twenty-one percent (39 divers) in the male group had made more than 100 dives in five years. In the female group, only 10 percent (13 divers) had made more than 100 dives in five years and the mean number of dives per female diver was 42 dives (median 18).

**Figure 2.3 1992 Diver Experience**

<b>Male</b>	<b>Total Lifetime Dives</b>							
<b>Years Diving</b>	0-20	21-40	41-60	61-80	81-100	101-120	121+	<b>TOTAL</b>
0-1	66	18	8	2	2	1	2	99
2-3	11	11	7	3	2	3	15	52
4-5	2	6	3	3	3	1	15	33
6-7	1	0	4	2	0	1	15	23
8-9	0	2	4	1	0	1	15	23
10-11	2	2	2	1	2	1	17	27
12-13	0	0	0	1	1	0	19	21
14-15	0	1	2	0	0	1	14	18
16-17	0	0	1	0	1	0	11	13
18-19	0	0	1	0	0	0	5	6
20-21	0	0	1	2	1	0	31	35
<b>TOTALS</b>	<b>82</b>	<b>40</b>	<b>33</b>	<b>15</b>	<b>12</b>	<b>9</b>	<b>159</b>	<b>350</b>

<b>Female</b>	<b>Total Lifetime Dives</b>							
<b>Years Diving</b>	0-20	21-40	41-60	61-80	81-100	101-120	121+	<b>TOTAL</b>
0-1	58	9	1	2	0	0	1	71
2-3	9	11	5	1	6	0	0	32
4-5	2	3	3	3	1	1	11	24
6-7	1	1	0	2	1	0	4	9
8-9	0	0	1	0	2	0	1	4
10-11	0	1	0	1	2	1	3	8
12-13	0	0	0	1	0	0	4	5
14-15	0	0	0	0	0	0	1	1
16-17	0	0	1	0	0	0	1	2
18-19	0	0	0	0	0	0	0	0
20-21	0	0	1	0	1	0	0	2
<b>TOTALS</b>	<b>70</b>	<b>25</b>	<b>12</b>	<b>10</b>	<b>13</b>	<b>2</b>	<b>26</b>	<b>158</b>

The difference in experience between males and females is even greater when the two groups are examined by two years or less of diving experience. The mean number of dives for the male group with two years or less of experience was 45 (median 17) with a range of one to 700 dives. Eleven percent (14 divers) had made over 100 dives in the male group. The mean number of lifetime dives reported in the female group was 20 (median 10) with a range of one to 150 dives. Only one of the female divers representing 0.9 percent of this group had dived more than 100 times. The female divers represented in the injury statistics have less overall experience than their male counterparts, both in years diving and total lifetime dives.

**Figure 2.4 Number of Divers by Years of Diving Experience**

<b>Years Diving</b>	<b>Sex</b>	<b>1993 Percent</b>	<b>1992-1990 Percent</b>	<b>1989-1987 Percent</b>
<2 Years	Male	28.3	26.5	19.2
	Female	44.9	46.8	39.0
2 to 5 Years	Male	24.3	31.6	28.1
	Female	35.4	32.9	32.8
6 to 9 Years	Male	13.1	12.7	15.6
	Female	8.2	9.9	18.2
≥ 10 Years	Male	34.3	29.2	37.1
	Female	11.4	10.4	9.9

**Figure 2.5 Certification Level of 1988-1992 Accident Cases**

<b>Certification</b>	<b>Male</b>	<b>Female</b>	<b>Totals</b>	<b>1993 Percent</b>	<b>1992-1990 Percent</b>	<b>1989-1987 Percent</b>
Student	10	13	23	4.5	1.9	1.3
Basic	34	9	43	8.5	7.2	11.6
Open Water	125	73	198	39.0	42.5	38.1
Advanced	84	46	130	25.6	25.4	25.9
Divemaster	34	5	39	7.7	8.0	5.6
Instructor	55	8	63	12.4	10.4	10.9
Commercial	0	0	0	0	.3	1.3
Other	8	3	11	2.2	2.9	1.8
None	0	1	1	0.2	1.3	1.2
Unknown					.2	2.3
<b>TOTALS</b>	<b>350</b>	<b>158</b>	<b>508</b>	<b>100.1</b>	<b>100.1</b>	<b>100.0</b>

Figure 2.5 shows the certification level for divers. The percentage of certified divers with a basic or open-water certification was 47.5 percent of the total population and is consistent with the average from previous years. Divers with a second or advanced certification also remained constant at 25 percent. The most important increase in the 1993 certifications was in the number of students injured during training.

The total of 23 student injuries is the highest number of cases reported in the annual report. In both 1991 and 1989, the previous record of 13 cases was reported among student divers. The total number of instructors who were injured (63) while diving is also a record. A total of 51 instructors were reported treated in 1991 which was the previous record for instructors. The number of female instructors treated in 1993 is the lowest number of female instructors since 1987-1988 when less than 300 cases were 26 reported.

### **Figure 2.6 New Diver Profile Traits**

Traits	1993 Percent	1992-1990 Percent	1989-1988 Percent
≤20 Dives	78.4	72.0	73.4
Square Dives	63.3	50.9	55.2
Repeat Dive	62.1	61.6	55.2
Diving ≥ 80 fsw	53.0	60.8	52.1
Rapid Ascent	32.3	35.6	42.2
Last Dive ≥ 80 fsw	24.0	30.3*	
Outside Limits	18.6	22.6	23.4

\* from 1992 only

n=198

n=528

n=192

*Fewer new divers dived outside their recreational table or computer limits.*

The new diver profile traits are shown in Figure 2.6. This category may include new divers with less than two years of diving experience or those divers who have not logged more than 20 dives. The new diver category made up only 34 percent of all divers in 1993. This is slightly lower than the 38 to 40 percent of the injured population typically made up of new divers. Fewer new divers dived outside their recreational table or computer limits, and the percentage of rapid ascents also showed a small decrease. There was a decrease in the percentage of new divers who dived to 80 feet during the dive series prior to injury in 1993.

The category of diving to 80 feet or greater on the last dive prior to having symptoms was added in 1992. The 6 percent decrease in 1993 from 1992 is not a significant change because there are only two years of data. It appears that more new divers are doing square dive profiles. Fourteen percent (34 divers) of the new divers were using a computer to dive with, of which six were outside their computer limits. The percentage of divers making repetitive dives is similar to the repetitive dive trait among injured divers diagnosed with decompression sickness.

**Figure 2.7 Current Medical History of Decompression Illness Cases for the Years 1993-1988**

Problem	1993	1992-1990	1989-1988
None	396	994	462
Other	55	125	87
GI/Abdomen	15	37	13
Spine/Back	13	51	29
Muscl/Skel System	7	54	23
Chest-lung	7	37	13
Asthma	5	21	11
Cir/Blood	5	12	9
Mental/Emotion	4	27	12
Neuro/Nerv System	4	17	4
Chest-Heart	4	12	10
Eye	4	6	5
Limb/joint DCS	1	16	5
Brain	1	2	-
No Response	1	1	
<b>TOTALS</b>	<b>522</b>	<b>1412</b>	<b>683</b>

Figures 2.7 and 2.9 show that a number of individuals dived with a current or previous medical condition. The body system that was affected by the medical condition or disease is shown in Figures 2.7 and 2.9. Many divers listed more than one health problem. Figures 2.8 and 2.10 show that 78 percent of all divers were diving without a current health problem in 1993 and less than half of all divers dived without some type of past health problem.

**Figure 2.8 Percentage of Divers Without Current Health Problems**

Current	1993	1992-1990	1989-1987
Frequency	396	994	636
Percent	78.0	75	68.5

**Figure 2.9 Previous Illness and Diseases of Decompression Illness Cases for the Years 1993-1988**

Problem	1993	1992-1990	1989-1988
None	250	664	313
Other	81	203	108
Muscl/Skel System	59	169	83
Spine/Back	44	130	58
GI/Abdomen	43	129	69
Limb/joint DCS	24	101	25
Asthma	18	49	30
Chest-Heart	15	34	17
Chest-lung	13	57	28
Eye	12	25	11
Mental/Emotion	7	22	5
Neuro/Nerv System	6	33	8
Brain	6	12	5
Cir/Blood	5	17	10
No Response	2	1	
<b>TOTALS</b>	<b>585</b>	<b>1646</b>	<b>770</b>

**Figure 2.10 Percentage of Divers Without Past Health Problems**

Current	1993	1992-1990	1989-1987
Frequency	250	664	444
Percent	49.2	46	47.8

Figure 2.11 shows the percentage of individuals who reported being physically fit prior to their dive injury. Many of these divers also report a regular exercise program. Although this is a subjective quality, both male and female divers consistently rated themselves as being physically fit. Lack of physical fitness has been shown to be a potentially predisposing factor for decompression illness. Physical fitness in this group of divers does not seem to offer any protection from decompression illness.

**Figure 2.11 Reported Physical Fitness in Injured Divers**

	1993	1992-1990	1989-1988
Sex	Percent	Percent	Percent
Male	92.9	91.2	91
Female	91.8	88.3	87
<b>TOTAL</b>	<b>92.5</b>	<b>90.4</b>	<b>90</b>

***Prescription  
medication use was  
down from last year's  
high of 31 percent  
of all divers.***

Figure 2.12 shows that 26.4 percent of all divers reporting were using prescription medications and 17.4 percent were using non-prescription medications. The non-prescription medication use is about what it has been in previous years. Prescription medication use was down from last year's high of 31 percent of all divers. Nineteen percent of all prescription medications involved birth control and 12 percent involved hormone replacement supplements. Decongestants, antihistamines and nasal steroid sprays accounted for 17 percent of the prescription medications. This was followed by pain and muscle relaxant medication at 13 percent, cardiovascular and hypertensive drugs at 15 percent, and anti-anxiety or anti-depression medication at 8 percent. Antibiotics accounted for 7 percent, anti-seasickness medication for 4 percent and miscellaneous needs accounted for the remainder of the prescription medications. There were only three types of medication involved in the non-prescription drug category. Forty-two percent involved decongestants. Popular over-the-counter pain relief and non-steroidal, anti-inflammatory medications accounted for 32 percent and antihistamines were involved in 13 percent of the cases.

### **Figure 2.12 Medication Use in Accident Cases**

<b>1993 Prescription Use</b>		<b>Nonprescription Use</b>	
Frequency	Percent	Frequency	Percent
129	26.4	71	17.4

<b>1992-1990 Prescription Use</b>		<b>Nonprescription Use</b>	
Frequency	Percent	Frequency	Percent
372	28.03	234	19.95

<b>1989-1988 Prescription Use</b>		<b>Nonprescription Use</b>	
Frequency	Percent	Frequency	Percent
151	23.6	96	16.3

Figure 2.13 shows that at least half of all divers abstained from any alcohol intake during their diving. The majority of alcohol use occurred the night before diving. At least one alcoholic beverage was consumed by the diver in 41.9 percent of all cases in 1993. Although this number is slightly higher than in the previous three years, it is a minimal increase. There was also a small increase in the number of divers who consumed alcohol post dive prior to symptom onset. Most divers refrained from drinking pre-dive or between dives.

**Figure 2.13 Percentage of Alcohol Use in 1988-1993 Accident Cases**

Time of Use	1993	1992-1990	1989-1988
Night before	41.9	38.1	41.8
Pre-dive	1.4	1.4	1.7
Between dives	1.2	1.5	2.3
Post-dive	15.7	14.5	13.5
None	50.8	55.2	49.7

\* Some divers engage in drinking in more than one category.

*At least half of all divers abstained from any alcohol intake during their diving. The majority of alcohol use occurred the night before diving.*

Figure 2.14 shows the number of drinks consumed up to 12 hours before diving by those divers who drank prior to their last day of diving. This group represents the 41.9 percent shown in Figure 2.13. Fifty-four percent of all those who drank had one or two drinks. Thirty-five percent had three to five drinks and 11 percent had six or more drinks the night before scuba diving.

**Figure 2.14 Percentage of Alcohol Use in 1988-1993 Accident Cases**

Year	Number of Drinks							Total
	1	2	3	4	5	6	7	
1993	59	56	39	26	10	8	15	213
1992	47	59	16	23	6	13	13	177
1991	32	53	30	16	11	9	12	163
1990	43	64	19	20	7	10	16	182
1989	39	49	24	23	6	13	10	164
1988								120

Few divers are ever reported to be intoxicated when they dived. However, the principle concerns with diving after drinking are centered more around the secondary effects of alcohol. The fatigue that divers experience after heavy drinking can impair the physical performance of an individual when diving. Mental performance, such as decision making may also be effected by fatigue, lack of sleep and the effects of alcohol. Alcohol is also a contributing factor to the dehydration divers normally experience. Although dehydration may not cause decompression sickness, the lack of adequate hydration may influence the micro circulation responsible for removing nitrogen from body tissues.

**Figure 2.15 1993 Nausea, Hangover, Diarrhea and Recreational Drug Use**

Sex	Nausea	Hangover	Diarrhea	Drug Use
Male	12	9	12	2
Female	6	0	3	0
<b>Totals</b>	<b>18</b>	<b>9</b>	<b>15</b>	<b>2</b>

*A record number of divers reported nausea on the day their diving injury occurred.*

Figure 2.15 shows that a record number of divers reported nausea on the day their diving injury occurred. The number of people experiencing diarrhea, another dehydrating factor, also increased over last year. Nine divers reported diving with a hangover and only two listed recreational drug use. Individually, these conditions may not produce any injury, but all of these conditions may impair an individual's ability to perform and place them at risk for injury. With pre-existing fatigue, strenuous exercise during the dive, dehydration or all of these factors combined, an injury can result.

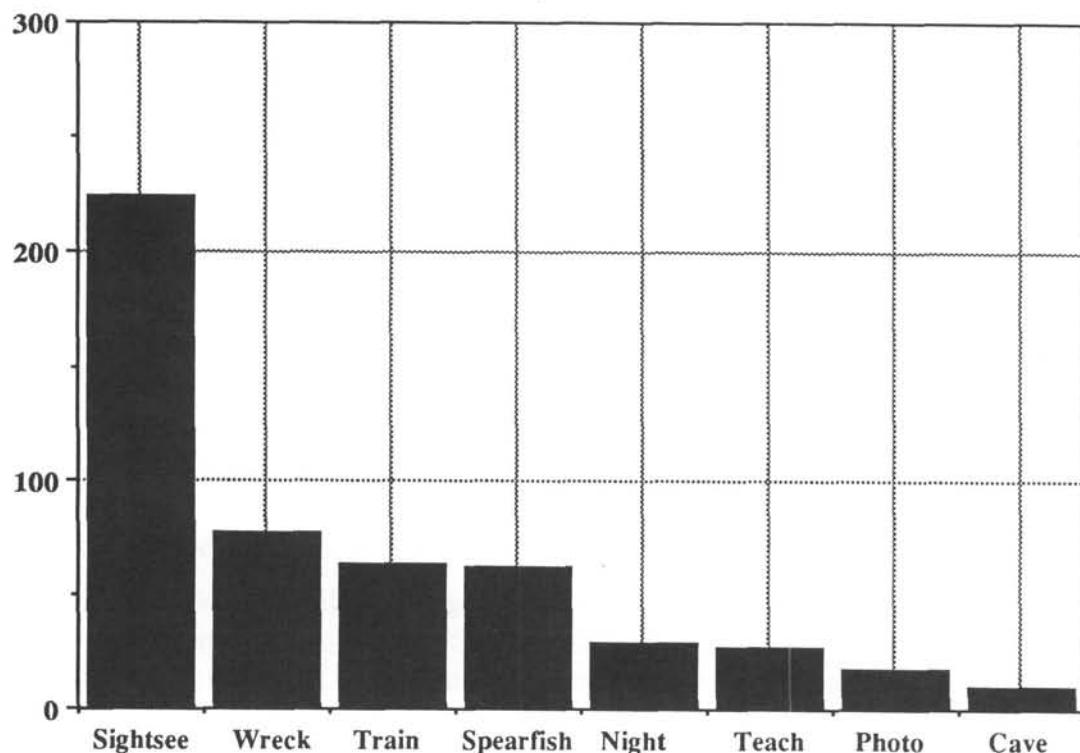
# Accident Dive Profile

The dive profile section is composed of tables and charts which demonstrate the type of underwater activity being performed, as well as various attributes of the dives when a diving injury occurred. Data from previous years has been averaged and is presented in many of the tables to indicate trends. The actual dive profile information is limited and should only be considered in relation to the various attributes of dives recorded by DAN.

The vast majority of divers suffer their injuries while sightseeing. Wreck diving, those under instruction and spearfishing were the next most common activities of those in reported cases (Figure 3.1). Wreck diving was also considered an important aspect as a secondary activity in 20 percent of the divers.

*The vast majority of divers suffer their injuries while sightseeing.*

**Figure 3.1 Primary Dive Activity**

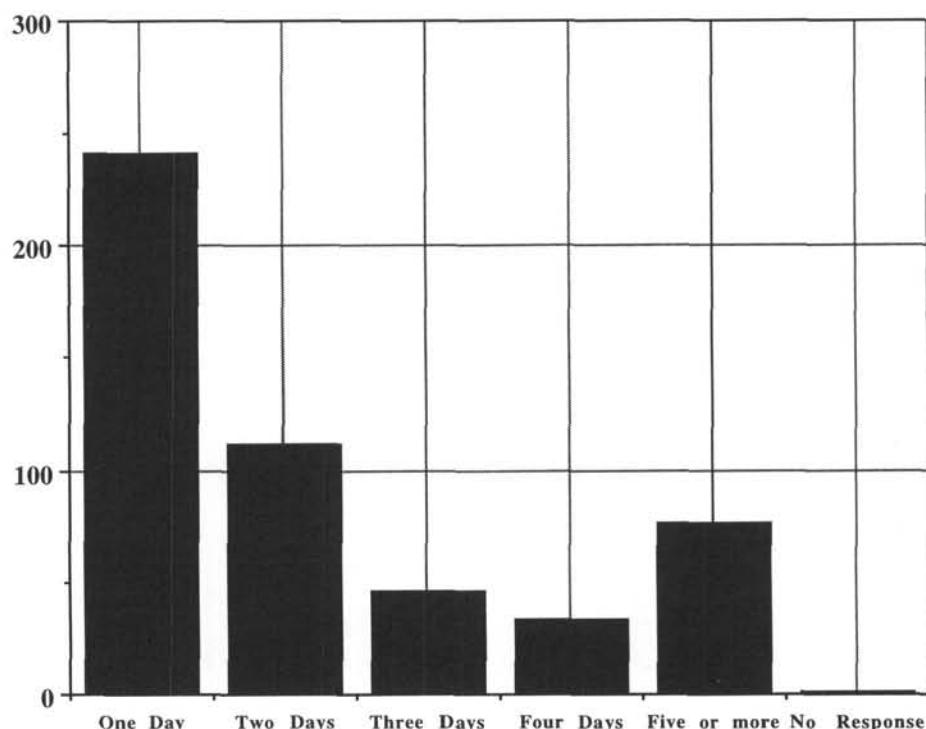


***Forty-seven percent of all divers were injured on a single-day program.***

The majority of injuries (61 percent) occurred within a month of the last safe dive made by the particular diver. This would seem to indicate that most divers in the accident database dive fairly often. There were, however, a large number of divers in whom the accident dive was the first dive in over a month. The majority of these accidents were in more experienced divers.

Figure 3.2 shows that 47 percent of all divers in the database were injured on a single-day program. The remaining 53 percent were injured after two or more days of diving.

**Figure 3.2 Number of Days of Continuous Diving**

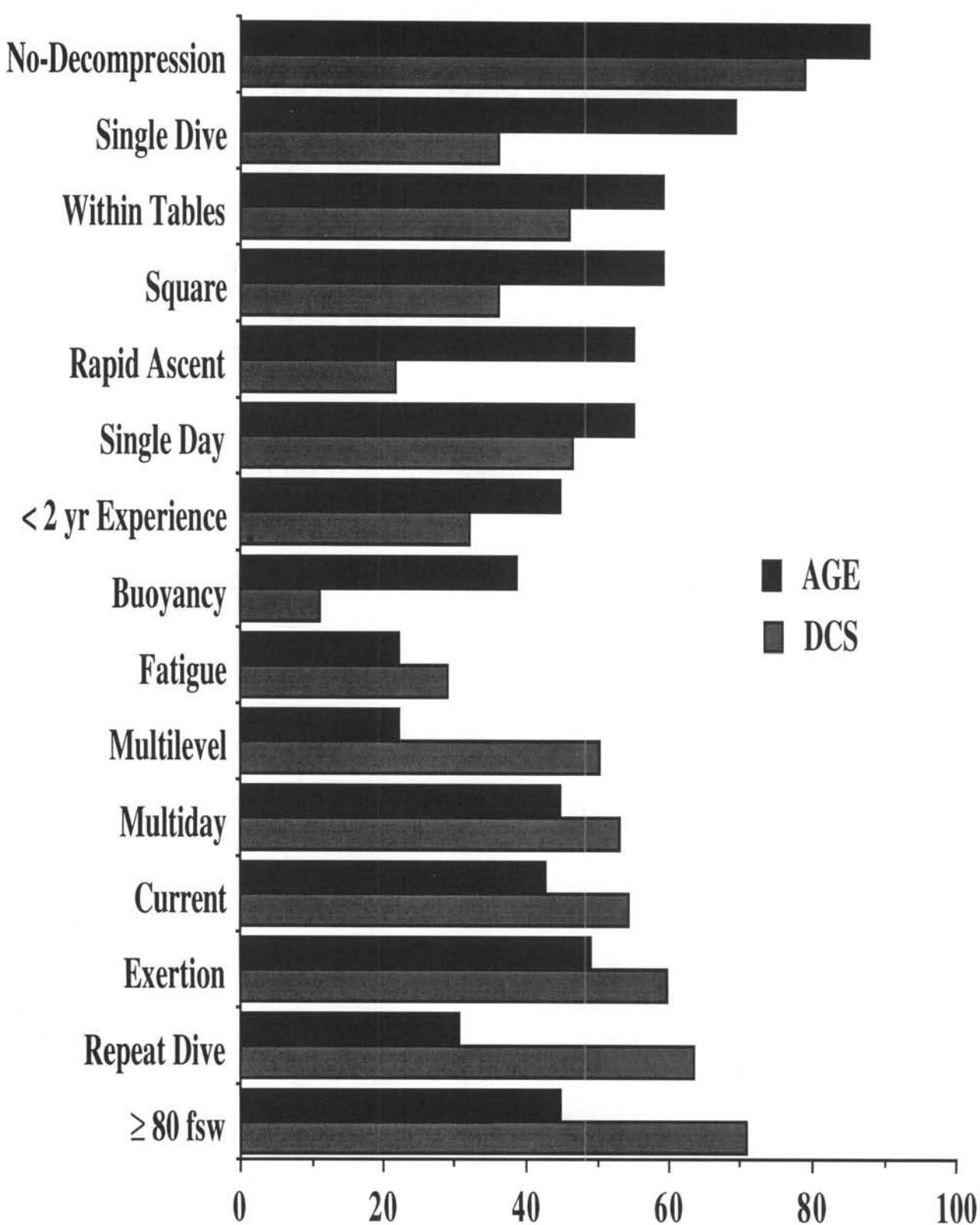


### **Dive Characteristics**

The characteristics of dives which resulted in both types of decompression illness (DCI), decompression sickness (DCS), and arterial gas embolism (AGE), were similar (Figure 3.3). The differences between the two diagnoses are displayed because these diagnoses are still used by the treating facility as a reference point. There is some disagreement about this nomenclature.

Rapid ascent is a risk factor for gas embolism and probably also for decompression sickness. DCS usually results from the duration of exposure at a depth of around 30 feet or greater. Both conditions cause bubble formation, which can produce signs and symptoms in the individual affected.

**Figure 3.3 Percentage of DCS and AGE Dive Characteristics**



*A typical AGE incident occurs with no-decompression shallow diving, within dive table limits, or during the first dive of the first day.*

The data of the two types of DCI are reported separately because the proposed mechanism of injury is different. The characteristics of the dives which produce each injury are similar, but the frequency of occurrence is different. There are many more reported cases of DCS (459 in 1993) than AGE (49 in 1993). The characteristics of each diagnosis from previous years also are presented to demonstrate yearly trends.

A typical AGE incident occurs with no-decompression shallow diving, within dive table limits, or during the first dive of the first day. Around 55 percent of divers claim to have made a rapid ascent, which is usually recognized as being the predominant cause of AGE. The characteristics of the dives which resulted in AGE have been consistent over the last five years. Figure 3.4 shows the comparative yearly data. Time and depth exposures are not

**Figure 3.4 Characteristics of Dives that Resulted in AGE**

Attribute	1993 Percent	1992-1990 Percent	1989-1987 Percent
No Decompression	87.8	68.1	92.3*
Single Dive	61.0	70.1	67.3*
Within Tables	59.2	90.4	80.0
Square	59.2	58.3	55.8*
Single Day	55.1	67.9	48.6
Rapid Ascent	55.1	56.3	52.0
Exertion	49.0	41.9	19.3
≥ 80 fsw	44.9	49.4	46.2*
< 2 yr. Experience	44.9	35.7	49.3
Multi Day	44.9	32.1	46.2*
Current	42.9	45.5	32.6
Buoyancy	38.8	28.6	21.3
Repeat Dive	30.6	29.9	29.3
Multilevel	22.4	41.7	36.5*
Fatigue	22.4	13.1	29.3

\* These percentages are from 1989 only.

considered to be major contributing factors to AGE, and this is reflected in the characteristics presented here. Only 45 percent of divers went deeper than 80 feet, and 59 percent were within the no decompression limits. However, the diagnoses, AGE and DCS, may in part have been assigned using dive profile information; thus there may be some differences apparent in these data due to this influence.

A comparison of Figure 3.4 and 3.5 will show various dive characteristics in both AGE and DCS. For example, in 1993 a rapid ascent occurred in 55.1 percent of AGE cases but only 21.8 percent of DCS cases. The characteristics of reported DCS cases are different from those who reported AGE. DCS was associated with deep dives (80 feet or greater), repetitive diving within the tables and with multilevel profiles.

***DCS was associated with deep dives (80 feet or greater), repetitive diving within the tables and with multilevel profiles.***

**Figure 3.5 Characteristics of Dives that Resulted in DCS**

Attribute	1993 Percent	1992-1990 Percent	1989-1987 Percent
No Decompression	78.9	80.0	78.5*
≥ 80 fsw	70.8	64.5	74.6*
Repeat Dive	63.6	68.2	52.9
Exertion	59.7	49.3	29.8
Current	54.5	50.5	40.7
Multi Day	53.2	48.7	51.0*
Multilevel	50.5	64.1	51.9*
Single Day	46.6	51.3	53.3
Within Tables	46.0	65.4	56.5
Square	36.2	35.8	42.8*
Single Dive	36.2	32.6	32.7*
< 2 yr. Experience	32.2	30.9	26.1
Fatigue	29.0	34.5	34.1
Rapid Ascent	21.8	21.9	24.3
Buoyancy	11.1	11.6	13.6

\*These percentages are from 1989 only.

## Dive Computer Use

*Twenty-two percent of computer divers had pain-only DCS, while only 18.6 percent of table divers suffered a similar illness.*

The dive computer credits the diver for spending time at shallow depths and assumes that nitrogen offgassing occurs at that time. Typically, this means that computer users can extend their dive time longer than table users and shorten their surface intervals. When making multilevel dives, computer users may go deeper during their repetitive dives using the computer algorithm for guidance. In 1993 just over 50 percent of divers with a diagnosis of DCI were using computers on their dive. The incidence of a neurological DCI in both computer divers and table divers was approximately equal. However, 27 percent of computer divers had pain-only DCS, while only 18.6 percent of table divers suffered a similar illness.

In 1993, the trend in the percentage and number of divers using tables who suffered AGE remained the same as in previous years. Arterial gas embolism was approximately twice as great in frequency in table users than computer users (13.6 percent vs. 6.0 percent). Computer users in the DAN database were more experienced divers who had been diving both more often and for a greater number of years than table users. This may indicate that table users were more likely to miscalculate time and run out of air. Nearly three-fourths of all injured divers with DCI had neurological signs, which is important because it may indicate a serious injury.

**Figure 3.6 Decompression Illness in Computer and Table Divers**

	Computer Users						
	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
<b>DCS I</b>	27.1	22.3	20.1	28.1	31.0	31.0	26.8
<b>DCS II</b>	66.9	71.4	73.4	64.0	62.7	60.7	61.0
<b>AGE</b>	6.0	6.3	6.5	7.9	6.3	8.3	12.2
<b>TOTAL</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
	<i>n = 266</i>	<i>n = 224</i>	<i>n = 199</i>	<i>n = 203</i>	<i>n = 126</i>	<i>n = 84</i>	<i>n = 41</i>

	Table Users						
	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
<b>DCS I</b>	18.6	12.9	16.0	17.2	18.5	18.5	15.8
<b>DCS II</b>	67.8	75.1	66.8	61.3	64.9	60.3	63.6
<b>AGE</b>	13.6	12.0	17.2	21.5	16.6	21.2	20.6
<b>TOTAL</b>	<b>100.0</b>						
	<i>n = 242</i>	<i>n = 241</i>	<i>n = 238</i>	<i>n = 256</i>	<i>n = 256</i>	<i>n = 184</i>	<i>n = 228</i>

**Figure 3.7 Attributes of Computer Divers  
From 1987-1993**

Attribute	1993 Percent	1992-1990 Percent	1989-1987 Percent
Repeat Dive	82.1	69.0	63.7
≥ 80 fsw	79.1	73.1	86.5
Multilevel	77.7	78.8	71.4
Within Tables	64.9	59.1	32.7
Exertion	61.5	48.4	29.9
Current	54.9	48.9	43.8
Multi Day	51.7	48.6	53.2*
Single Day	48.3	51.2	50.6
Outside Tables	35.1	40.9	39.4
Fatigue	28.3	32.5	31.0
Decompression	24.3	24.5	32.7

\*These percentages are from 1989 only.

*Arterial gas embolism  
was approximately  
twice greater in  
frequency in table  
users than  
computer users.*

**Figure 3.8 Attributes of Table Divers  
From 1987-1993**

Attribute	1993 Percent	1992-1990 Percent	1989-1987 Percent
Repeat Dive	78.5	58.8	51.0
Within Tables	73.1	74.4	70.5
≥ 80 fsw	57.0	53.7	63.4*
Exertion	57.0	49.7	27.4
Multi Day	53.3	44.7	49.1*
Current	52.1	50.5	37.8
Single Day	46.7	54.6	53.2
Fatigue	29.8	31.4	34.2
Multilevel	28.1	45.9	45.3*
Outside Tables	17.8	25.6	28.7
Decompression	11.2	13.2	20.2

\*These percentages are from 1989 only.

*Only 17.8 percent of table users felt they were outside standard tables (see Figures 3.7 and 3.8), whereas 35 percent of computer users stated a similar occurrence.*

Comparison of the trends in those divers who have used standard decompression tables or dive computers can be made using Figures 3.7 and 3.8. The use of computers supposedly enables divers to make repetitive dives more safely. However, while using computers, nearly 80 percent of the divers with DCI in 1993 made multilevel, repetitive dives or dives at depths greater than 80 feet.

Other factors may have contributed to this difference, such as rate-of-ascent alarms in decompression computers. Only 17.8 percent of table users felt they were outside standard tables (see Figures 3.7 and 3.8), whereas 35 percent of computer users stated a similar occurrence. Formal staged decompression has further decreased recently in computer users, presumably as the computer often indicates there is no need for decompression at the end of the dive schedule.

### ***Equipment***

Scuba diving is an activity that requires knowledge of the equipment used, as well as adequate maintenance. The correct functioning of the equipment and the knowledge of how to use it are essential to diver safety. Of the 1993 cases in this report, 14.3 percent involved equipment problems. The low number of equipment problems has remained fairly stable.

**Figure 3.9 1993 Equipment Problems**

<b>Equipment</b>	<b>Frequency</b>	<b>DCS</b>	<b>AGE</b>
BC Vest	16	10	6
Other	15	14	1
Unfamiliar Equipment	11	10	1
Regulator	8	7	1
DC Computer	8	7	1
Inflator Hose	7	3	4
Weight Belt	5	4	1
Dry Suit	2	2	0
Contaminated Air	1	1	0
<b>TOTALS</b>	<b>73</b>	<b>58</b>	<b>15</b>

The fact that equipment problems were reported does not necessarily mean that the equipment failed or malfunctioned. Another possible cause for making a report is unfamiliarity with the diving equipment.

These problems could have been a contributing factor to the development of DCI and, in the cases of divers suffering AGE, may have indeed caused the injury. The number of divers reporting equipment problems with AGE, however, was so low that no real conclusions can be drawn from the data. Those divers with DCI who reported an equipment problem were equally likely to have had a problem with their regulator, dive computer or buoyancy control.

# Symptoms

*The most frequent initial symptom was pain, observed in 31.7 percent of cases.*

Figure 4.1 shows the distribution of symptoms as a first symptom or the total distribution or occurrence of symptoms in the injured diver. Symptoms have been classified as Neurological, Cardio-respiratory, Pain/Skin/Nonspecific or Other. Otic (relating to hearing) symptoms were classified as Ambiguous, since they may be attributable to barotrauma or decompression illness. Symptoms were arbitrarily classified by severity based on the divers' description of the symptoms. The subtotals for severe and mild neurological, cardiorespiratory and pain/skin/non-specific represent the number of times these symptoms appeared exclusively of one another. The other category shows the breakdown of non-specific symptoms but are not exclusive of neurological, cardiorespiratory or pain/skin/non-specific.

The most frequent initial symptom was pain, observed in 32.3 percent of cases. However, neurological symptoms predominated, encompassing 46.4 percent of initial symptoms. Severe neurological symptoms were present as initial symptoms in 5.3 percent of cases. A total of 429 of the 508 cases (84.4 percent) ultimately developed neurological symptoms. Forty-three divers (8.5 percent) developed cardiorespiratory symptoms. Difficulty breathing was almost always associated with neurological symptoms. This symptom alone was experienced by only one diver. The most severe neurological symptoms (see Figure 4.1) were experienced by 131 divers (25.8 percent).

Whether the apparent increase in incidence of neurological symptoms from 1992 to 1993 represents a change in the pattern of diving or merely altered reporting is unknown. The preponderance of neurological symptoms in recreational divers continues, contrary to the experience in military or commercial divers in whom pain-only bends predominate. In the latter populations rapid treatment of decompression illness is likely to prevent progression from pain-only to other more serious symptoms which might otherwise occur. While only 46.4 percent of divers reported to DAN had an initial neurological symptom, 84.4 percent ultimately experienced neurological symptoms, supporting the notion of progression in these recreational divers, who rarely if ever dive with a chamber in the immediate vicinity.

**Figure 4.1 1993 Most Frequent Symptoms of Decompression Illness**

			First Symptom		Total Distribution		
			N	Percent	N	Percent	
Neurological	Severe	Unconsciousness	8	1.6	20	3.9	
		Paralysis	6	1.2	28	5.5	
		Visual Disturbance	6	1.2	41	8.1	
		Difficulty Walking	3	0.5	59	11.6	
		Semi-Consciousness	2	0.4	12	2.4	
		Bowel Problem	1	0.2	3	0.6	
		Speech Disturbance	1	0.2	14	2.8	
		Bladder Problem	0	0.0	10	2.0	
		Convulsions	0	0.0	7	1.4	
<b>Total Severe Symptoms</b>			<b>27</b>	<b>5.3</b>	<b>131</b>	<b>25.8</b>	
	Mild	Numbness	132	26.0	299	58.9	
		Dizziness	50	9.8	139	27.4	
		Decreased Skin Sensation	4	0.8	49	9.6	
		Personality Change	1	0.2	17	3.3	
		Reflex Change	1	0.2	11	2.2	
		Weakness	21	4.1	117	23.0	
<b>Total Mild Symptoms</b>			<b>209</b>	<b>41.1</b>	<b>298</b>	<b>58.7</b>	
<b>Total Neurological Symptoms</b>			<b>236</b>	<b>46.4</b>	<b>429</b>	<b>84.4</b>	
Cardiorespiratory		Difficulty Breathing	8	1.6	43	8.5	
Pain/skin/nonspecific		Pain	164	32.3	280	55.1	
		Extreme Fatigue	32	6.3	129	25.4	
		Headache	30	5.9	123	24.2	
		Nausea	12	2.4	71	14.0	
		Itching	9	1.8	37	7.3	
		Rash	4	0.8	24	4.7	
		Restlessness	3	0.5	39	7.7	
		Muscle Twitch	1	0.2	29	5.7	
		Hemoptysis	1	0.2	4	0.8	
<b>Total Pain/Skin/Nonspecific Symptoms</b>			<b>256</b>	<b>50.4</b>	<b>62</b>	<b>12.2</b>	
Ambiguous		Hearing Loss	1	0.2	6	1.2	
		Ringing in Ears	1	0.2	5	1.0	
Other		Stiffness	1	0.2	3	0.6	
		Hot/cold Flashes	1	0.2	1	0.2	
		Chills	1	0.2	1	0.2	
		Swelling	0	0.0	1	0.2	
		Tightness in Arms	0	0.0	1	0.2	
		Water Cold/Hot During Dive	1	0.2	2	0.4	
		Increased Skin Sensation	1	0.2	1	0.2	
		Muscle Ache/Soreness	1	0.2	4	0.8	
		Pressure in Neck	0	0.0	1	0.2	
		Discoloration of Skin	0	0.0	2	0.4	
<b>Total Other Symptoms</b>			<b>6</b>	<b>1.2</b>	<b>17</b>	<b>3.4</b>	
<b>Total</b>			<b>508</b>	<b>100.0</b>			

**Buoyancy problems were observed in 39 percent of those who were diagnosed as having AGE.**

Another possible reason for the lower prevalence of neurological symptoms in commercial divers may be a reluctance to admit to such symptoms and more supervised and regulated diving procedures. The occurrence of neurological decompression illness in a commercial diver can prevent or disqualify him from working, while recreational divers suffer no financial "penalty" for reporting neurological symptoms. Another possibility is different depth-time exposures and ascent rates. Buoyancy problems, rapid ascent and diving outside decompression tables were reported in 11 percent, 22 percent and 54 percent, respectively, of divers who suffered decompression sickness in 1993, respectively. Buoyancy problems were observed in 39 percent of those who were diagnosed as having AGE and rapid ascent was experienced by 55 percent of these divers. These dive patterns (risk factors) are probably less likely in the professional population.

**Figure 4.2 Conventional Disease Diagnosis**

Final Diagnosis	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
DCS I	23.0	17.4	17.8	22.0	22.5	22.4	17.4
DCS II	67.3	73.3	69.8	62.5	64.5	60.4	63.3
Air Embolism	9.6	9.2	12.4	15.5	13.0	17.2	19.3
<b>TOTAL</b>	<b>99.9</b>	<b>99.9</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Figure 4.2 indicates that the breakdown of diagnosis into the conventional classifications is very similar to previous years. The percentage of divers with air embolism, which has gradually decreased since 1987, remains at approximately the same level as 1992. The analysis in Figure 4.1 suggests that Type II DCS is more frequently observed than the 67.3 percent reported in Figure 4.2. This may indicate that some divers do not report neurological symptoms to their treating physician. Alternatively, treating physicians may apply the classification inconsistently.

**Figure 4.3 Decompression Illness Symptoms Prior to Last Dive**

<b>Sex</b>	<b>1993 Percent</b>	<b>1992 Percent</b>	<b>1991 Percent</b>	<b>1990 Percent</b>	<b>1989 Percent</b>	<b>1988 Percent</b>
Male	17.7	20.1	16.8	13.9	12.4	14.8
Female	26.6	22.1	24.5	19.0	25.3	26.6
<b>TOTAL</b>	<b>20.5</b>	<b>20.7</b>	<b>18.8</b>	<b>15.2</b>	<b>15.7</b>	<b>17.5</b>

*n=508                  n=465                  n=437                  n=459                  n=381                  n=268*

Figure 4.3 indicates that 20 percent of divers with decompression illness reported to DAN in 1993 had symptoms prior to their last dive. This percentage has remained fairly constant in the last six years, perhaps indicating lack of concern by divers regarding minor symptoms or possibly lack of knowledge.

**Figure 4.4 Percentage of Divers Who Suffered Previous Decompression Illness**

<b>Sex</b>	<b>1993 Percent</b>	<b>1992 Percent</b>	<b>1991 Percent</b>	<b>1990 Percent</b>	<b>1989 Percent</b>	<b>1988 Percent</b>
Male	7.88	10.33	15.9	12.7	15.1	12.4
Female	2.17	4.4	3.6	10.7	11.8	8.6
Total Population	10.04	8.6	12.8	12.2	14.1	11.6

*n=508                  n=465                  n=436                  n=459                  n=391                  n=268*

Figure 4.4 demonstrates, as in previous years, that around 10 percent of divers who reported decompression illness in 1993 had experienced previous episodes. In view of the low reported incidence of decompression illness in other recreational diving populations (1/10,000 to 1/30,000) these data suggest that individuals who suffer decompression illness may be a select group with particular risk factors. These may include physiological predisposing factors or high risk dive patterns.

*Around 10 percent of divers who reported decompression illness in 1993 had experienced previous episodes.*

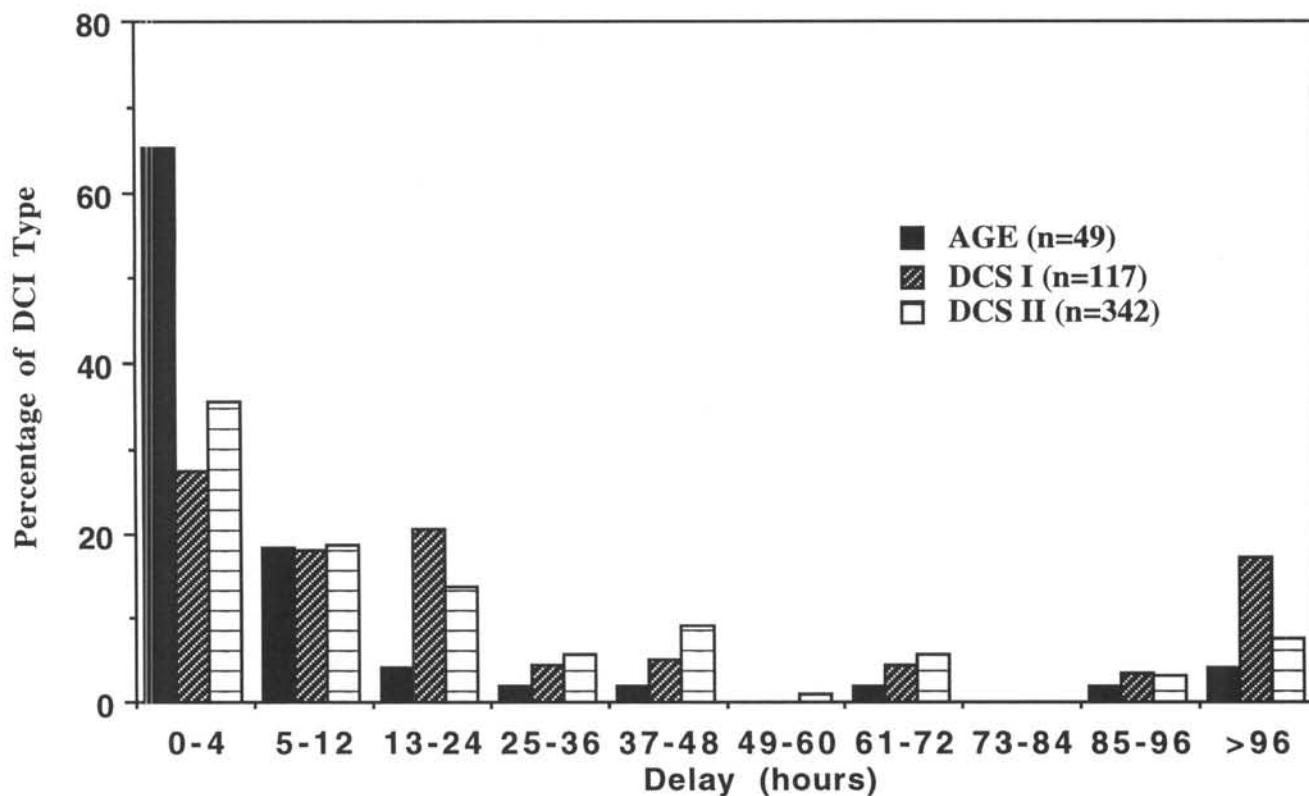
# Treatment

*Sixty-five percent of all AGE cases reported to DAN requested assistance in less than four hours of onset of symptoms.*

Prompt diagnosis and appropriate treatment are important factors in determining the ultimate resolution of symptoms of decompression illness. The following data summarizes the treatment information reported to DAN for diving accidents in 1993. Of the 508 cases, 49 (9.6 percent) were attributed to AGE, 117 (23.0 percent) were due to DCS-I, and 342 (67.3 percent) were classified as DCS-II.

Figure 5.1 demonstrates that 65 percent of all AGE cases reported to DAN requested assistance in less than four hours of onset of symptoms (32 out of 49). In contrast, only 34 percent of all DCS cases (DCS-I, n=32 and DCS-II, n=122 out of 459 total DCS) reporting to DAN did so in the first four hours. Considerable delay and variability in time from symptom onset to the time of request for medical assistance is noted for these data on DCS. Nearly 10 percent of all DCI (AGE, DCS-I, DCS-II) requested assistance after 96 hours from symptom onset time.

**Figure 5.1 Delay From Onset of Symptoms to Calling for Assistance**



Sixty-nine percent of all reported DCI cases initially contacted either DAN, a M.D., or a local hospital emergency department for assistance (Figure 5.2). The “other” category includes initial contacts to divemasters, hyperbaric chamber staff, dive club management, highway patrol, certifying agencies, friends or dive buddies.

**Figure 5.2 First Contact for Assistance**

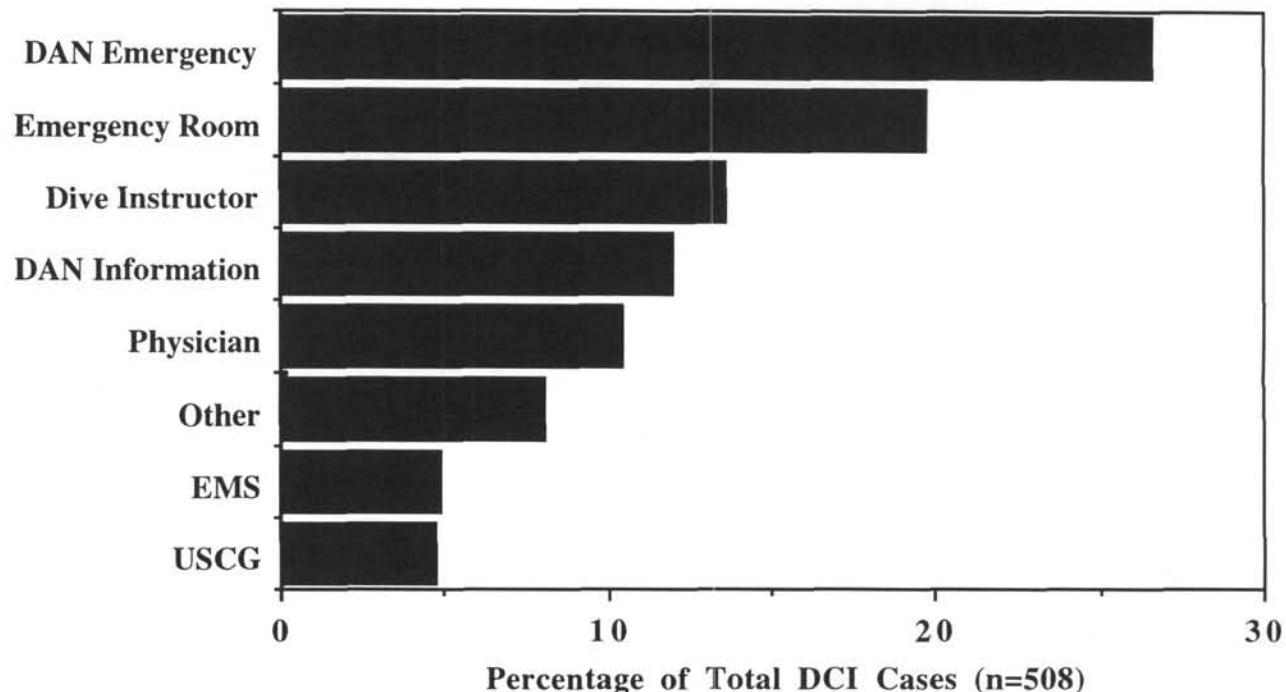
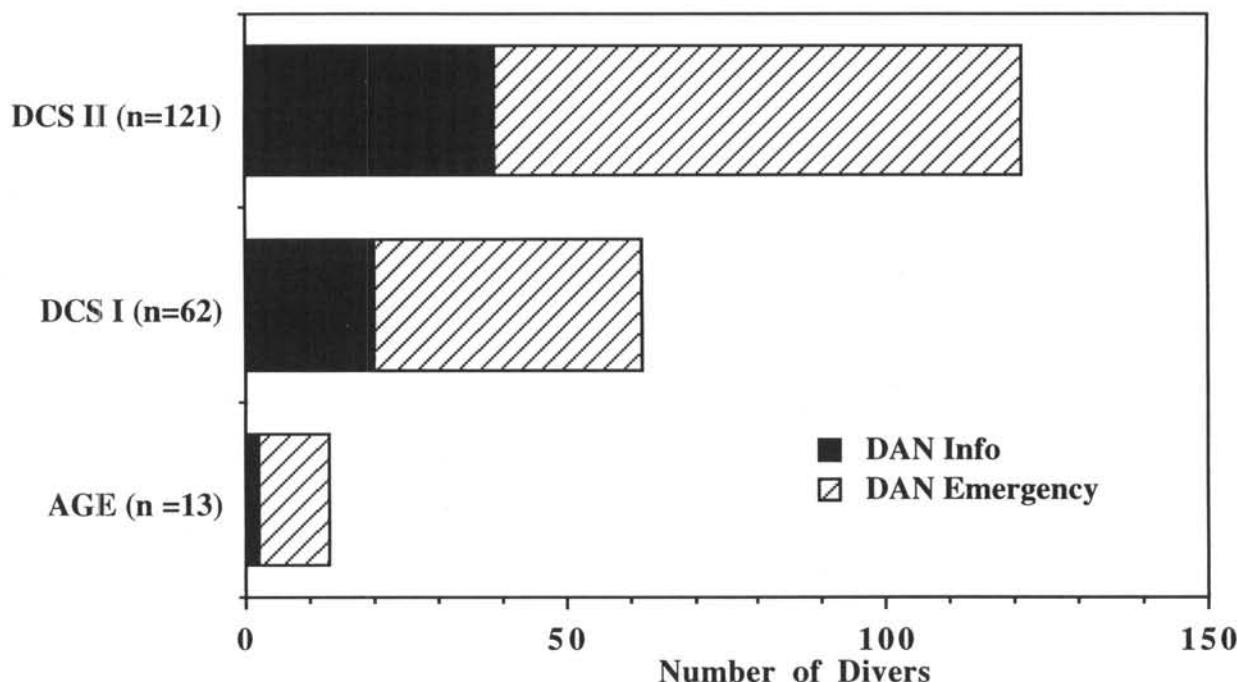


Figure 5.3 shows that 183 of the 196 divers who initially called DAN for assistance were related to either DCS-I ( $n=62$ ) or DCS-II ( $n=121$ ). In spite of the importance of prompt medical treatment in neurological DCS (Type II), 32 percent ( $n=39$ ) of these calls were made through the information line and not the emergency number. Very few emergency AGE cases ( $n=13$ ) utilized DAN as the initial contact for assistance. Of these, however, 85 percent ( $n=11$ ) utilized the emergency line for assistance. This may be due to the immediate nature and severity of AGE symptoms.

*Of the 196 divers  
who initially called  
DAN for assistance,  
183 were related  
to either DCS-I or  
DCS-II.*

**Figure 5.3 Initial Call to DAN by DCI Type**

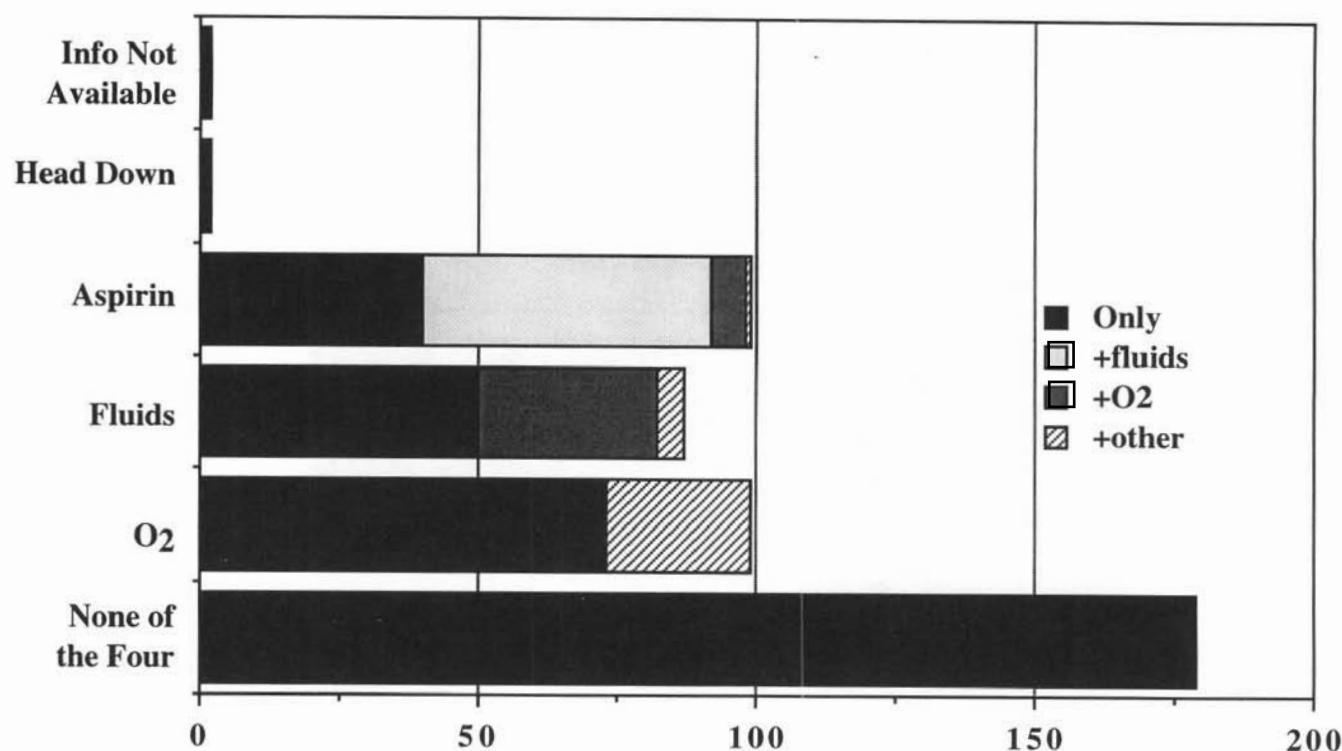


***Seventy-eight percent of the 49 AGE cases were treated initially within 12 hours of symptom onset.***

Twenty one percent (n=105) of the 508 DCI cases reported to DAN used oxygen alone or in combination with other treatments (not including fluid) for first aid (Figure 5.4). One hundred and seven, or 21 percent of the total DCI cases, used fluid alone or in combination with other interventions (not including oxygen). Thirty-two, or 6 percent, used both fluids and oxygen as first aid. Two hundred twenty-two, or 43 percent of cases reported to DAN, did not utilize either oxygen or fluids.

The time delay from onset of symptoms to beginning recompression therapy is variable (Figure 5.5). Forty-one percent (n=20) of the AGE cases reported to DAN received hyperbaric therapy within four hours of symptom onset, and 78 percent (n=38) of the 49 AGE cases were treated initially within 12 hours of symptom onset. Delay to treatment for DCS Type I and II cases reported to DAN was greater, with only 30 percent and 38 percent (n=35 out of 117 and 130 out of 342) being treated within the first 12 hours of symptom onset. The causes of the delay to treatment are numerous and include denial of symptoms, failure to correlate symptoms with DCI, and remote dive locations with subsequent difficulty in evacuation.

**Figure 5.4 First Aid Used**



**Figure 5.5 Delay from Symptom Onset to Recompression Therapy**

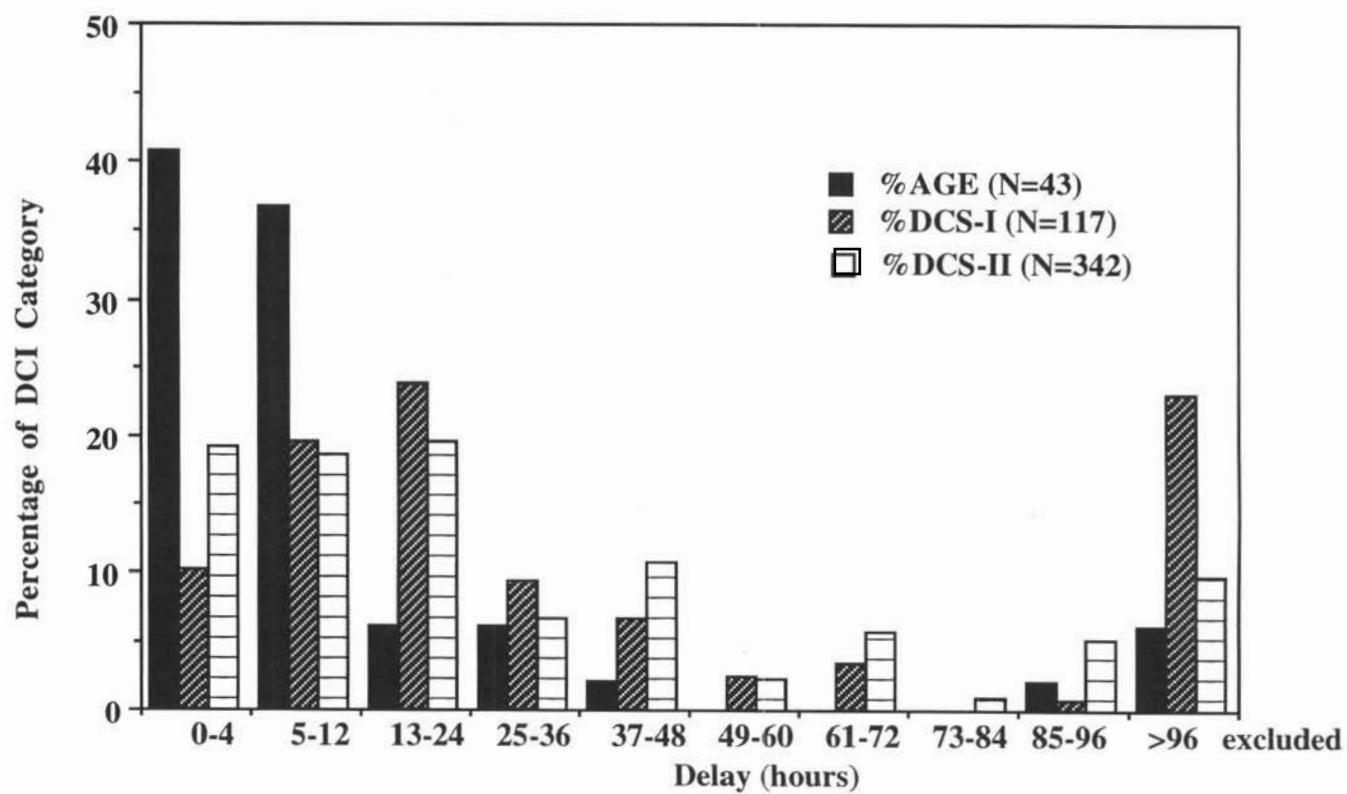
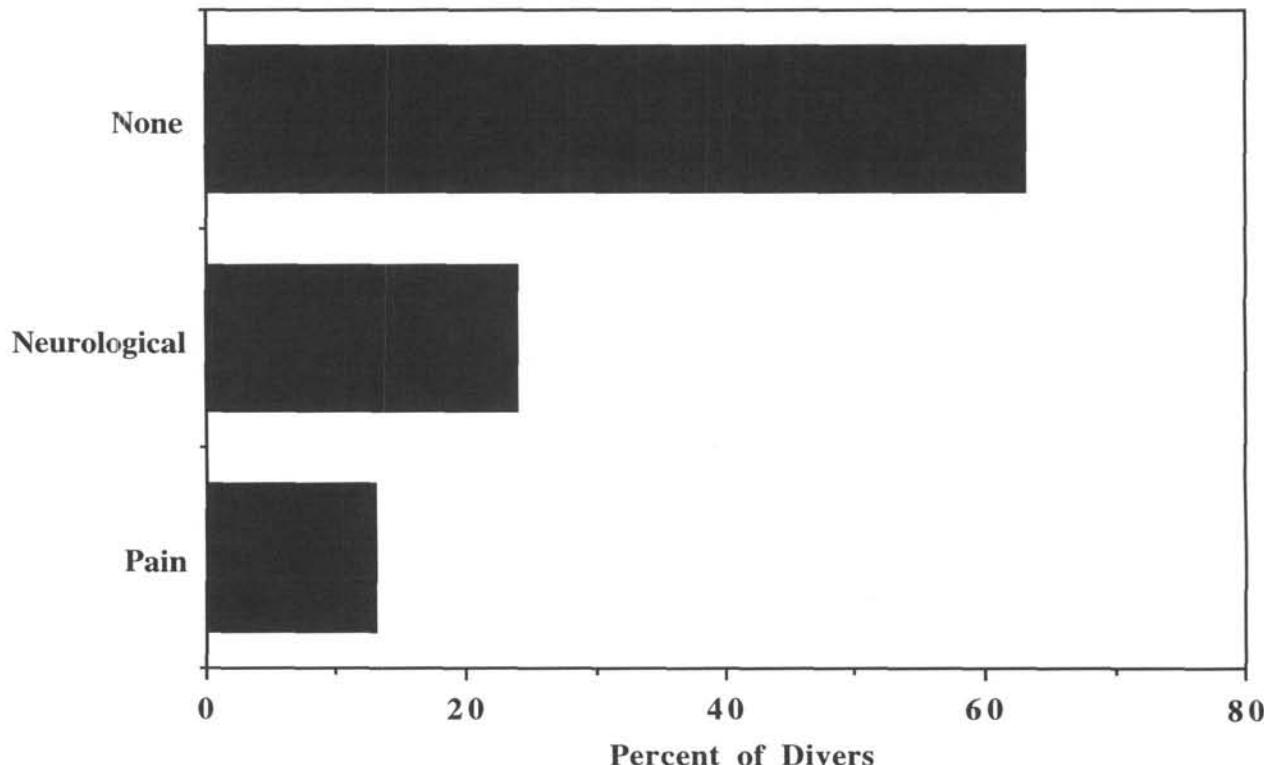


Figure 5.6 shows that hyperbaric oxygen therapy for DCI cases reported to DAN resulted in complete resolution of symptoms 63 percent of the time (321 of 508 cases). Of the 187 divers who had residual symptoms following hyperbaric therapy, 36 percent had residual pain symptoms and 64 percent had residual neurological symptoms.

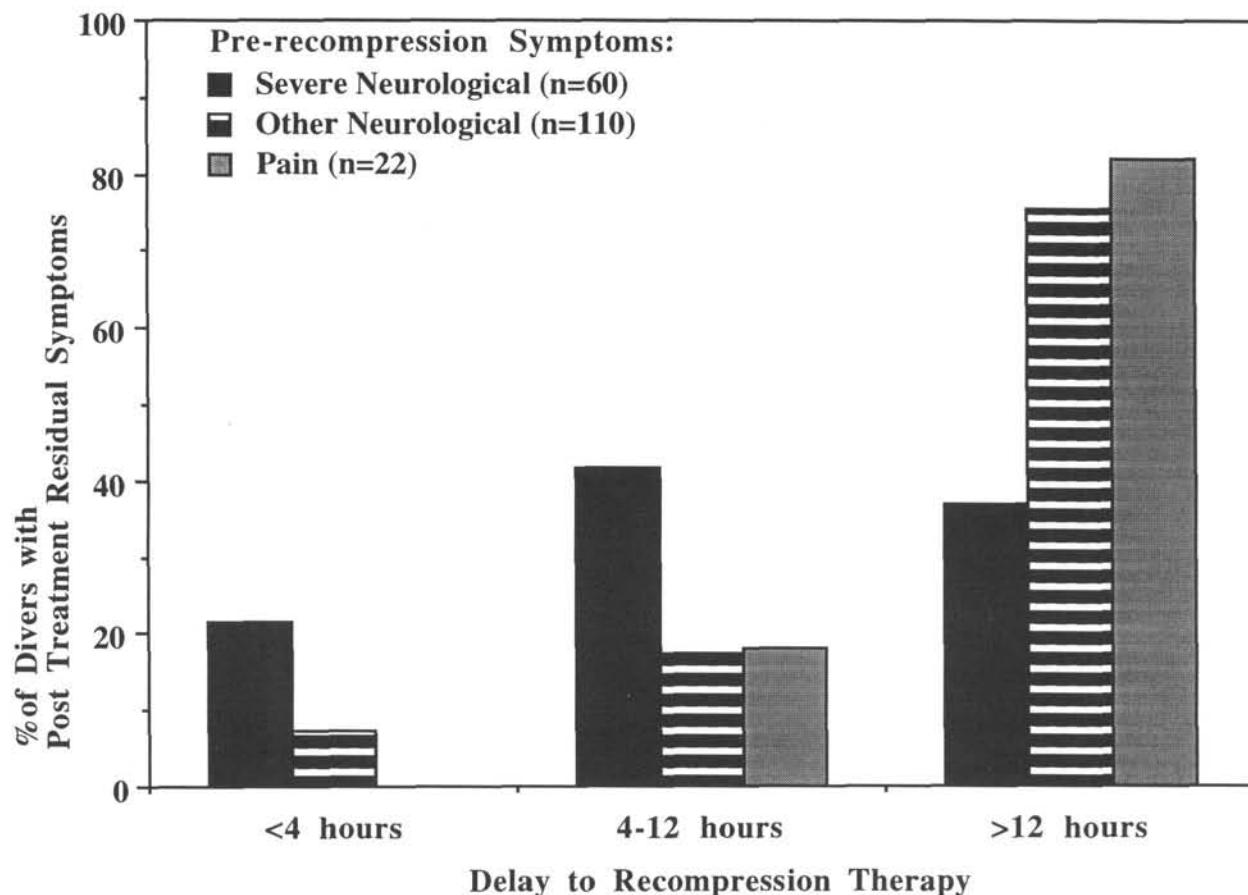
**Figure 5.6 Post-Treatment Residuals**



*Increasing delays  
result in incomplete  
resolution of symptoms  
for all types and  
severity of DCI.*

The ability to reduce the severity of symptoms or to totally resolve the symptoms with recompression is directly correlated with the promptness with which hyperbaric therapy is started. Increasing delays result in incomplete resolution of symptoms for all types and severity of DCI. These results are shown in Figure 5.7.

**Figure 5.7 Percent Divers with Post-Recompression Residual Symptoms as a Function of Percentage of Divers with Pre-Recompression Symptoms and Delay to Recompression Therapy**



One can only speculate that mild or confusing symptoms may delay the reporting of DCI symptoms by the diver. Also, the onset of symptoms occurring away from the dive site where diving is the center of attention and experienced divers are present may lessen the attention given to DCI symptoms. The curious finding that initial calls for assistance occurred two days after symptom onset and correlated with the end of a weekend is suspiciously coincidental. Both increased education of each diver as well as the education of the initial responder is essential to rapid recognition and diagnosis of decompression illness.

*The onset of symptoms occurring away from the dive site where diving is the center of attention and experienced divers are present may lessen the attention given to DCI symptoms.*

# Scuba Fatalities — Introduction

*Over the past 24 years, there has been a total of 2,485 recreational scuba deaths reported among U.S. residents.*

Divers Alert Network began collecting information on recreational scuba fatalities in 1989. This work originally began in 1970 with the National Underwater Accident Data Center (NUADC) at the University of Rhode Island, but due to the decreasing availability of government funding, NUADC joined with DAN to assist in a joint effort to collect data on recreational scuba fatalities.

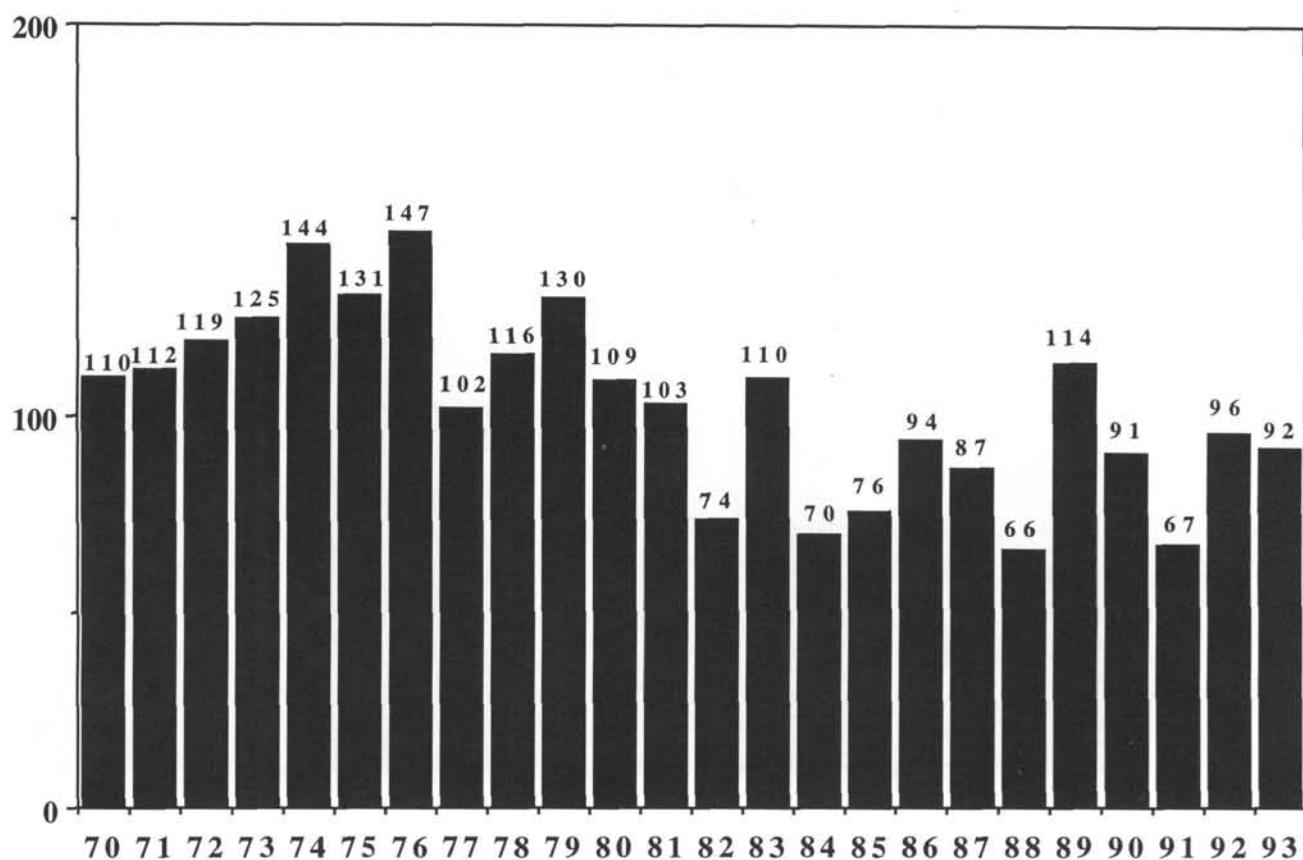
Over the past 24 years, there has been a total of 2,485 recreational scuba deaths reported among U.S. residents. Figure 6.1 shows the trend in the number of fatalities reported yearly. The average number of deaths for these years has been 103 to 104 deaths per year. The average number of deaths over the last 10 years has been approximately 85 deaths per year. Out of the last 10 years, only one year had more than 100 reported deaths. Of the last four years, three had over 90 scuba deaths. The 1993 report on scuba fatalities is based on data from 92 scuba fatalities. All deaths were among U.S. residents.

Figure 6.2 gives a breakdown of recreational scuba deaths. This breakdown is made on the basis of information available on each case. Deaths among certified divers who reportedly dived within the limits of their certification and experience have accounted for up to 67 deaths a year over the last four years. The number of recreational divers who were attempting to make a dive they were not qualified for has averaged nine deaths per year. These individuals were performing dives such as technical diving that required special training and equipment they did not possess. The largest number of these deaths involved deep diving.

A technical dive is one in which a diver participates in one of the following conditions: diving more than 130 feet; using breathing mixture other than compressed air; or going into decompression or overhead diving (diving into shipwrecks or caves). These levels of exposure go beyond established recreational limits. Not all divers who make technical dives have specialized training for this activity.

Deaths among divers who have received specialized training have never accounted for more than 11 deaths in any given year.

**Figure 6.1 Yearly U.S. Recreational Diving Fatalities**



This group averages six deaths per year with a range of two to 11 deaths annually.

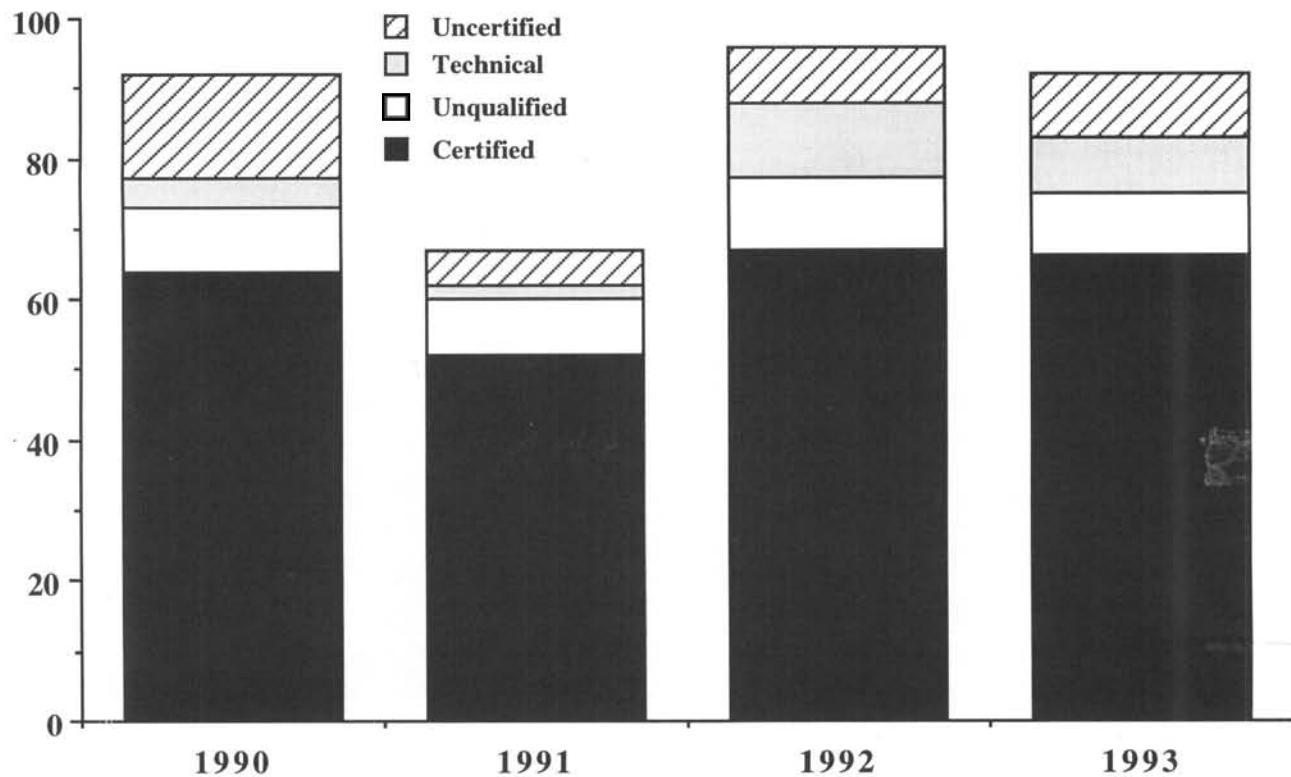
Despite the lack of appropriate training, between five and 15 uncertified divers attempted scuba each year and died over the last four years. All divers are considered in the analysis of scuba fatality data for this report.

It is not possible to determine a mortality rate among recreational scuba divers with any degree of certainty, since the number of active divers in any given year is unknown. At this time, it is only practical to provide an estimated range of divers and the number of reported fatalities.

*The average number of deaths over the last 10 years has been approximately 85 deaths per year.*

Estimated Divers	1993 Deaths	Estimate / Diver
1,000,000	92	9.2 / 100,000
2,000,000	92	4.6 / 100,000
3,000,000	92	3.1 / 100,000

**Figure 6.2 Breakdown of Scuba Fatalities**



*Of the 93 total deaths thus far in 1994, 21 involved females. This represents 23 percent of the total fatality population.*

### *Preliminary Report on 1994 Recreational Fatalities*

As of Nov. 11, 1994, there were 93 recreational or recreational/technical scuba fatalities reported to DAN for 1994. In all likelihood, there will be additional fatalities reported for the remaining two months of 1994. Fifty percent (46 cases) have occurred since the first of July. Forty-four percent (41 cases) occurred between June and September: June (7), July (13), August (8) and September (13). Of the 93 total deaths thus far in 1994, 21 involved females. This represents 23 percent of the total fatalities. The number of uncertified divers in the population has not yet been established. Florida has the highest number of reported deaths for 1994 at 25. Since 1985, Florida has had the highest number of reported scuba fatalities in the United States. California had the second highest number of fatalities with 11. It should be recognized, however, that Florida and California have the highest diving activity in the United States.

# Methods of Fatality Data Collection

Figure 7.1 shows the agencies and services that supply initial contact information regarding recreational scuba fatalities. The majority of reports come from DAN subscription services, which include news clipping services (Luce and Burrelle) and computer services (CompuServe). About 30 percent of fatality contacts come to DAN via telephone calls. The DAN network of hyperbaric chamber personnel, emergency line assistance calls or callers on the DAN information line account for the majority of telephone contacts. Medical examiners or coroners may call, as well as direct calls from newspapers seeking information regarding scuba fatalities in general. Dive agencies also may inform DAN of fatalities involving their certified divers. The other category of contacts represent foreign government offices.

*About 30 percent of fatality contacts come to DAN via telephone calls.*

**Figure 7.1 Initial Contacts**

	Inside United States	Outside United States	Total	Percentage
DAN Network	19	8	27	29.3
Subscription Services	42	4	46	50.0
Non Member	0	0	0	0.0
Dive Agency	5	0	5	5.4
Investigative*	4	0	4	4.3
Medical Examiner/Coroner	3	3	6	6.5
Newspaper Direct	1	1	2	2.2
Other	0	2	2	2.2
<b>Total</b>	<b>74</b>	<b>18</b>	<b>92</b>	<b>99.9</b>

\* Police, Sheriff, and USCG

Sheriff and police departments, U.S. Coast Guard and other reporting agencies provide fatality incidents to DAN and receive periodic mailings from DAN concerning diving safety and current medical issues in scuba diving. Since scuba fatalities are relatively rare, many agencies who deal with fatality investigations are unfamiliar with scuba diving. DAN offers investigators and medical examiners information regarding investigation and autopsy protocols. In this manner, DAN assists investigation agencies. DAN, however, is not an investigative agency.

**Figure 7.2 Primary Sources of Information**

Autopsy and investigative report	31
Autopsy, medical/coroner report and family/witness interview	24
Autopsy and news clippings/local contact	16
Investigative report	7
Local contact	7
Newspaper only	4
Family/friend report	2
Autopsy and family/witness interview	1
<b>TOTAL</b>	<b>92</b>

*The analysis of this information is used to identify any common trends, factors, or conditions which are specific to scuba fatalities.*

Figure 7.2 shows the primary sources of information used in the analysis of scuba fatalities. DAN receives news clippings that are used as a starting point to collect more information. Once a reported fatality has been verified through local authorities, information-gathering concerning the death can begin. DAN requests information on fatalities from autopsy reports and investigative agency reports (i.e. sheriff, police, USCG, Marine Patrol, lifeguard services or coroner/medical examiner's reports). If possible, DAN receives statements from persons involved in or are witnesses to the dive event. The analysis of this information is used to identify any common trends, factors, or conditions which are specific to scuba fatalities. In some cases DAN may speak with the family regarding the deceased's medical history and experience level prior to the fatality. The cause of death can best be identified through autopsy reports and contributing factors that are often provided through the witness or family interview. The quality of the analysis depends on the detail and accuracy of the reporting agencies and individuals involved.

Diving fatalities fall under the jurisdiction of the local medical examiner, and the decedent is frequently subjected to a forensic autopsy. DAN may obtain autopsy reports on many of these cases. In 1993, autopsies were performed on 72 out of 92 cases. No body was recovered in five incidents. An autopsy report was available to DAN in 64 cases out of the 72 cases which represents 89 percent of all autopsied cases. The increased efforts being made at collecting information are resulting in more autopsy and investigative reports being received by DAN. Sufficient information was available to review all of the dive fatalities, but an autopsy report makes it possible to define contributing medical conditions and individual behaviors which may contribute to scuba fatalities.

*An autopsy report makes it possible to define contributing medical conditions and individual behaviors which may contribute to scuba fatalities.*

**Figure 7.3 Location of Diving Fatalities by State**

	Certified	Uncertified	Unknown	Total	Percent
Florida	24	3	0	27	29.3
California	15	0	0	15	16.3
Hawaii	3	3	1	7	7.6
Oregon	2	1	0	3	3.2
Massachusetts	2	1	0	3	3.2
New York	3	0	0	3	3.2
Washington	2	0	0	2	2.2
Michigan	2	0	0	2	2.2
Texas	2	0	0	2	2.2
Wisconsin	2	0	0	2	2.2
Virginia	1	0	0	1	1.1
South Carolina	0	1	0	1	1.1
Delaware	1	0	0	1	1.1
Pennsylvania	1	0	0	1	1.1
Louisiana	1	0	0	1	1.1
Oklahoma	1	0	0	1	1.1
Nevada	1	0	0	1	1.1
New Jersey	1	0	0	1	1.1
<b>Total</b>	<b>64</b>	<b>9</b>	<b>1</b>	<b>74</b>	<b>80.4</b>

*The number of deaths in Florida and California represent over 50 percent of all deaths in the United States, but the deaths in both Florida and California occurred at many different dive sites throughout the state.*

*In addition, both have a large population of certified divers and are probably the most frequented U.S. diving states.*

All cases have some information missing. Most notable is the previous health record, which is rarely obtained. Information is also limited due to local or state regulations, litigation, family request or the remoteness of foreign locations, which makes data collection difficult. All cases are counted and have some information included in their report.

Figures 7.3 and 7.4 show the location of scuba fatalities by state within the United States or by foreign location. No conclusion can be drawn concerning the relative safety or risk of any of the dive locations listed. Typically, deaths occur at a variety of dive sites and under various conditions. The number of deaths in Florida and California represent over 50 percent of all deaths in the United States, but the deaths in both Florida and California occurred at many different dive sites throughout the state. In addition, both Florida and California have a large population of certified divers and are probably the most frequented U.S. diving states. The deaths in these two states may seem high, but there has been an overall decrease in the average number of deaths in both states since the early 1980s.

**Figure 7.4 Location of Diving Fatalities Outside the United States**

Country	Total	Percent
US Virgin Islands	6	6.5
Mexico	6	6.5
Cayman Islands	2	2.2
Bonaire	1	1.1
Bahamas	1	1.1
Honduras	1	1.1
Tahiti	1	1.1
<b>Total</b>	<b>18</b>	<b>19.6</b>

There were four deaths in the combined geographic area of New York and New Jersey in 1993. From 1989 to 1992 there were 23 deaths in this region, with a range of two to six deaths per year. In 1993, the four deaths in this region did not involve technical level or technical divers, and this represents the average fatality rate for this area. The 1992 numbers were high because they represented five technical divers involved in deep, advanced dives.

The number of U.S. citizens who died while scuba diving abroad increased from 13 to 15 in 1992, but the percentage of deaths outside the United States decreased from 19.5 percent to 15.5 percent. There has been some overall decrease in deaths abroad since 1990, when one out of every four scuba fatalities reported occurred in a foreign location or U.S. territory.

Additionally, there was an average of 25 foreign deaths in 1989 and 1990 compared to an average of only 16 deaths for the past two years. There was an average of 12 U.S. fatalities in foreign countries or U.S. territories during the 1980s. The cumulative totals by state and foreign location since 1970 are shown in Appendix D of this report.

*The percentage of deaths outside the U.S. decreased from 19.5 percent to 15.5 percent.*

# Fatality Dive Profile

*A diver's choice of activity is usually consistent with his training and dive experience.*

A certified diver has a wide range of scuba activity in which to participate. A diver's choice of activity is usually consistent with his training and dive experience. Some scuba activities, such as wreck penetration, require additional training and diver skills to participate safely.

Figure 8.1 shows the primary dive activity for 1993 scuba fatalities. Both certified and non-certified divers are included. Primary activity, such as pleasure diving, implies the main purpose of the dive. Pleasure diving and spearfishing have consistently been the top two activities associated with scuba fatalities.

In 1993 there was one more death while cave diving and three more deaths during a night dive than reported in 1992. There were two less scuba deaths in individuals under instruction who were not yet certified and six less deaths in divers who were doing a wreck dive. There were no deaths among divers involved in underwater photography in 1993, but there were two deaths while providing instruction. The number of incidents where the dive activity was unknown was reduced from five in 1992 to one incident in 1993.

Figure 8.1 also shows that out of 92 total scuba fatalities, nine were not certified divers. Four of these fatalities occurred in students who were participating in their initial scuba certification. Five deaths, or 5 percent of all fatalities, were in divers who had never received standard scuba training. The two deaths of instructors occurred during instruction. One fatality occurred in a 57-year-old male after a pool session and was related to medical health. The other was in a 20-year-old female providing instruction in cold water.

Among the certified population of divers there were nine technical or technical level deaths in 1993. Seven of the nine deaths involved divers who had received special training and certification in cave diving and died during a cave dive. The activity of one individual was a deep dive (greater than 130 feet). There were an additional nine deaths in divers who attempted technical level diving without additional specialized training and equipment. Five of these nine divers were involved in deep diving (greater than 130 feet), one was involved with wreck

diving and with a wreck penetration and another was cave diving. The two remaining divers were performing pleasure dives in a partially frozen lake and ended up under the ice. One diver was searching for the other lost diver and ultimately became a fatality himself.

**Figure 8.1 Primary Dive Activity**

Primary Dive Activity	Certified to Scuba Dive	Not Certified to Scuba Dive	Unknown	Total	Percent
Pleasure	41	4	1	46	50.0
Spearfishing/Hunting	11	1	0	12	13.0
Cave	7	0	0	7	7.6
Under Instruction	2	4	0	6	6.5
Wreck	5	0	0	5	5.4
Night	5	0	0	5	5.4
Deep Dive	4	0	0	4	4.3
Work	3	0	0	3	3.3
Instruction	2	0	0	2	2.2
Other	1	0	0	1	1.1
Unknown	0	0	1	1	1.1
<b>TOTAL</b>	<b>81</b>	<b>9</b>	<b>2</b>	<b>92</b>	<b>99.9</b>

**Figure 8.2 Dive Platform**

Entry	1993 Percent	1992 Percent	1991 Percent	1990 Percent
Shore	44.6	39.2	49.3	47.8
Charter Boat	32.6	26.8	28.4	30.4
Private Boat	20.7	29.9	20.9	20.7
Pool	1.1	1.0	1.5	0.0
Unknown	1.1	3.1	0.0	1.1
<b>Total</b>	<b>100.1</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

***More fatalities occur  
after a shore entry  
than either a  
charter- or  
private-boat entry.***

Figure 8.2 shows the dive platform used by divers to enter the water. Additional information has been gathered on the dive platform over the last two years, and Figure 8.2 has been updated to reflect recent changes. More fatalities occur after a shore entry than either a charter- or private-boat entry. Boat entries still comprise at least 50 percent of all fatalities. Approximately one death a year has occurred in the pool for the last three years.

Figure 8.3 shows the number of individuals in the dive group at the time of the fatality. This number includes all of the divers in the water and perhaps an observer from the shore or on board a vessel. It would not include individuals not directly involved with the dive group or party in which the fatality occurred.

Fifty-one percent of all fatalities occurred in dive parties of four or fewer divers. This is approximately the same number and percentage represented in the previous year. The percentage of fatalities that occurred in the different dive group sizes are fairly similar.

A total of 10 divers were diving solo. In an additional 43 cases, buddy separation was reported to have occurred. In 26 of these 43 buddy separation cases, a surface observer noted the diver to be distressed or panicked. A surface observer or buddy noted distress or panic in 30 divers of the remaining 44 cases where a buddy separation did not occur (this includes the 10 solo divers).

**Figure 8.3 1993 Number of Divers in a Group**

Number in Dive Party	1993	1992
	Percent	Percent
1	5.4	4.2
2	25.0	30.2
3	10.9	13.5
4	9.8	4.2
5	8.7	3.1
6	4.3	3.1
7	2.2	3.1
8	3.3	4.2
9	1.1	0
≥10	15.2	16.7
Unknown	14.1	17.7
<b>TOTAL</b>	<b>100.0</b>	<b>100.0</b>

An immediate search and assistance was begun in 57 cases. Immediate assistance, which may include a diver at the surface to perform a rescue, cardiopulmonary resuscitation (CPR) and oxygen administration are key elements to successful outcomes in underwater emergencies. Incidents that occur in small groups and after buddy separation may not contain these important elements.

Figures 8.4 and 8.5 show the approximate time (when) and the phase (where) of the dive that the problems occurred. Divers are assigned to these categories based on the information obtained from investigative reports or witness statements. Incidents that occur while still at the surface prior to descent and in the early dive may be due to a failure to check equipment properly or prepare for entry into the water. Incidents that occur midway through or late in a dive may be due to air consumption problems. In 25 cases, the diver ran out of air and in seven cases the diver was determined to be low on air. There were only three associated rapid ascents in these two groups of air problems. There was one attempt to buddy breathe during an ascent that ultimately led to a rapid ascent. Other problems which occurred during or late in the dive were the entanglement or entrapment of divers, which represented nine cases. Health problems, such as cardiovascular disease, may have affected the diver at any time or phase of the dive. Divers rarely drop their weight belts, and this contributes to the problems divers experience on the surface post-dive.

*Divers rarely drop their weight belts, and this contributes to the problems divers experience on the surface post-dive.*

**Figure 8.4 When Problem Occurred**

	1993 Percent	1992 Percent
Late Dive	31.5	27.1
Post Dive	16.3	16.7
Early Dive	15.2	15.6
Mid Dive	15.2	11.4
Unobserved	9.8	15.6
Surface-Predive	6.5	5.2
Unknown	4.3	4.2
Immediately	1.1	4.2
<b>TOTAL</b>	<b>99.9</b>	<b>100.0</b>

*n=92*      *n=96*

**Figure 8.5 Where Problem Occurred**

	1993 Percent	1992 Percent
At Depth	32.6	22.9
During Ascent	22.8	22.9
Surface Post Dive	16.3	17.7
Unobserved	12.0	15.6
Surface-Predive	6.5	5.2
Descent	5.4	11.5
Unknown	4.3	4.2
<b>TOTAL</b>	<b>99.9</b>	<b>100.0</b>

*n=92*      *n=96*

# Dive Fatalities Among Certified Divers

*The largest increase in fatalities was in the 50- to 59-year old age range, where the number of fatalities doubled to 20 in 1993.*

This section deals only with those scuba divers who were certified or undergoing their initial student training in scuba diving. This also includes the two unknown certification levels from Figure 8.1. Although information was somewhat limited, the location and type of diving suggest the individuals were certified divers.

Figure 9.1 shows the age for the 87 certified fatalities in 1993. No fatalities were reported among junior or teenage divers. The known ages ranged from 20 to 73 years of age. The percentage of fatalities in the 20- to 49-year-old age range fell from 84 percent in 1992 to 70 percent for 1993. The number of scuba fatalities in the 50 or older age range almost doubled from 13.6 percent in 1992 to 26.1 percent in 1993. The largest increase in fatalities was in the 50- to 59-year-old age range, where the number of fatalities doubled to 20 in 1993. The percentage of certified female fatalities dropped to 12 percent of the 1993 deaths compared to 20 percent of all deaths in 1992 among all certified divers.

**Figure 9.1 Age and Sex Comparison of 1993 Fatalities**

Age	Male	Female	Total	Percent
10-19	0	0	0	0.0
20-29	9	2	11	12.6
30-39	27	3	30	34.5
40-49	16	3	19	21.8
50-59	19	1	20	23.0
60-69	2	0	2	2.3
70-79	2	0	2	2.3
Unknown	2	1	3	3.4
<b>TOTAL</b>	<b>77</b>	<b>10</b>	<b>87</b>	<b>99.9</b>

Figure 9.2 shows the highest level of certification for the 1993 scuba fatalities. As in previous years, the majority of scuba fatalities (59 percent) occurred in divers with basic open-water certification or who were participating in initial training. Seventeen deaths were recorded among advanced divers and three among divemasters. There were five instructor deaths, three of which involved a recreational, non-instructional dive. One death in a military trained diver performing a recreational dive was reported, and seven deaths among certified cave divers.

Figure 9.3 shows the diving experience for all certified divers. Divers are placed into one of seven categories (listed in Figure 9.3). General terms are used to describe the experience of divers based upon their total lifetime dives. The exact number of dives is difficult to obtain in the majority of diving fatalities. For this reason, a range of dives is given that best suits the available data.

**Figure 9.2 Certification Level of 1992 Fatalities**

Student*	4	4.6%
Basic/Open Water	47	54.0%
Advanced	17	20.0%
Dive Master	3	3.4%
Instructor	5	5.7%
Cave	7	8.0%
Military	1	1.1%
Unknown	2	2.3%
<b>Total</b>	<b>87</b>	<b>99.1 %</b>

\*Under initial training.

The overall experience shown in Figure 9.3 refers to the individual's experience since becoming certified. Experience within activity or environment refers to the experience within a specific activity being conducted at the time of the incident. Only 6 percent of all divers had done five dives or less, but 11.5 percent had done five dives or less within the activity they were participating. The majority of activities occurred in divers who had made 61 lifetime dives or more. This classification does not imply these divers were expert divers — indeed, 35.6 percent were also very experienced within their specific activity. The table does not take into account characteristics such as infrequent diving or specialty training required for some activities.

***The majority of scuba fatalities (59 percent) occurred in divers with basic open-water certification or who were participating in initial training.***

***In general, there  
are usually several  
potentially dangerous  
factors involving  
diving in  
uncertified divers.***

The five uncertified divers are excluded from this section. In general, there are usually several potentially dangerous factors involving diving by uncertified divers. One uncertified male diver had pre-existing medical problems and was using recreational drugs at the time of the dive. One female diver had been drinking prior to diving. Two uncertified males experienced problems during their dive, and both ended in a panicked situation and death. In the fifth incident, pre-existing medical problems and borrowed equipment were the major factors in the death of an obese male.

**Figure 9.3 Diving Experience in Fatalities**

	<b>Overall Experience</b>		<b>Within Activity or Environment</b>	
Student	4	4.6%	4	4.6%
Novice ( $\leq$ 5 dives)	5	5.7%	10	11.5%
Inexperienced (6 - 20 dives)	16	18.4%	22	25.3%
Intermediate (21 - 40 dives)	9	10.3%	8	9.2%
Advanced (41 - 60 dives)	14	16.1%	6	6.9%
Experienced ( $\geq$ 61 dives)	33	38.0%	31	35.6%
Unknown	6	6.9%	6	6.9%
<b>TOTAL</b>	<b>87</b>	<b>100%*</b>	<b>87</b>	<b>100%*</b>

\*Percent of certified divers

# Appendix A

## Fatality Case Reports with Autopsy 1993

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### **Introduction**

The causes of death and contributing factors listed in DAN reports use the terminology of the *International Classification of Disease Clinical Modification* (ICD-9-CM) based on the World Health Organization's *International Classification of Diseases*<sup>1</sup>. The codes used are listed in Appendix F. The final diagnoses were usually in agreement with the medical examiner; however, in a few cases, the diagnoses were changed based on the information following the complete investigation.

A total of 69 fatality case reports with autopsies appear in the following pages, classified according to the immediate cause of death. Autopsy reports provided essential information in establishing the diagnoses in these cases. Obviously, certain conditions appear more frequently than others in this group. Although frequency of occurrence indicates the importance of these conditions, it is a mistake to assume that the incidence in this select group is the same as for all fatalities.

Local authorities decide whether or not to perform an autopsy based on their own standards. Although there is no uniformity among the numerous jurisdictions, the majority of such deaths are autopsied revealing valuable information. The complete investigation of a diving fatality requires an autopsy. In many cases an unexpected finding changes the interpretation of the events leading to the death. Even in cases, obviously due to diver error, the autopsy findings are very useful. Finally, autopsy information is always valuable when litigation follows an accident, as it frequently does in scuba deaths.

As mentioned, the method of case collection does not allow statistical analysis due to the many sources of bias. However, the case report is a basic type of descriptive study and when expanded to a case series, describes the characteristics of individuals who share a common outcome. In this series, unfortunately, the end point is death, and all the individuals were involved at some point prior to death in recreational scuba diving. Obviously death is not the expected outcome of a scuba dive, and the study of these cases should reveal significant factors which occur repeatedly. The analytic study should give some insight into the cause of the fatal outcome for these individuals and to identify the risks for this group, which are different than the risks for the millions of individuals, who dive without a serious problem.

Previous DAN fatality reports have identified factors which are associated with recreational scuba fatalities.

*Identifiable causal factors include the following:*

- Inadequate training/experience
- Equipment inadequacies
- Equipment misuse
- Equipment defects
- Environment

- Current
- Overhead barrier
- Visibility

*There are identifiable host factors which include the following:*

- Age
- Pre-existing disease
- Physical fitness
- Alcohol/drugs

The role of alcohol and drugs in the diving fatality requires special mention here. Frequently in the reports we receive there is mention of prescribed or recreational drug use or of alcohol abuse.

As these comments are not documented, we do not include them in our database. The cases in which these substances are included as contributing factors were confirmed by toxicology studies reported to us. Although toxicology studies are routine in forensic autopsies, the results are frequently not in the reports we receive. Consequently, the true influence of these substances on the dive fatality is unknown. Many therapeutic agents have adverse side effects which may be intensified by the effects of diving. There is very little information available concerning these effects.

## ***Decompression Illness***

The term *decompression illness* includes the two diseases most identified with diving — i.e. *decompression sickness* and *arterial gas embolism*. These are grouped together because they are characterized by the presence of bubbles; a pressure change is required to produce the disease; and treatment for both is similar.

In looking at our autopsy series, however, we find only one death which was clearly due to decompression sickness and seven due to arterial gas embolism. Decompression sickness is a serious disease and can produce catastrophic injury, but it appears that arterial gas embolism is more likely to produce death in the recreational diver than decompression sickness. Further study of the arterial gas embolism group discloses inexperience as a factor which appears repeatedly. This same factor appears in the divers who survive arterial gas embolism.<sup>2</sup>

There is a lesson here for the scuba instructor. New divers need repeated emphasis on the causes and prevention of arterial gas embolism. All members of a new diver-instructor team in the water are at risk. The new diver must understand the mechanism and the instructor must be vigilant for any indication of difficulty. The newly certified, inexperienced divers must have an understanding of their limitations. The term advanced open water diver is a misnomer for the diver who has completed a few dives after initial certification and implies greater knowledge and skill than the diver may actually possess.

## ***Air Embolism***

**DAN RECORD NUMBER: 493    DOB: 1946    SEX: M    DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Air embolism, suspected

**Due to:** Rapid ascent

**Due to:** Accident d/t water sports activity

ICD-9-CM

958.0

E902.2

E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Rheumatic heart disease	398.9
2: Mitral insufficiency	394.1
3: Aortic stenosis	395.0
4: Cardiomegaly (740 gm)	429.3

Autopsy (Y/N): Y Findings available (Y/N): Y

This gentleman was in a training situation, making his second open water dive and beginning ascent. The report is that he lost his weight belt at about 15 fsw and made a rapid ascent. At the surface he was or soon became unconscious with bloody froth coming from the airway. Death followed rapidly despite attempts at resuscitation.

The decedent had extensive cardiovascular disease as a result of childhood rheumatic fever. The pathologist describes aortic and mitral valvular disease with massive cardiomegaly (720 gm). His medications were digoxin, potassium, Zestril, Zyloprim, and Lasix. The combination of medications suggests heart failure with the Zyloprim for gout. Other findings at autopsy included mild coronary atherosclerosis, cholelithiasis and chronic cholecystitis and lungs consistent with pulmonary edema. The pathologist was uncertain as to exact cause of death and favored a drowning terminal event. We have called it an air embolism due to the circumstances of rapid ascent after loss of weight belt. Another speculation is acute pulmonary edema due to volume overload from immersion effects leading to the well- recognized sudden death of aortic stenosis.

There is very little doubt this gentleman had absolute contraindications to scuba diving.

**DAN RECORD NUMBER:** 1493    **DOB:** 1943    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

<b>IMMEDIATE:</b> Air embolism	958.0
<b>Due to:</b> Rapid ascent	E902.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Exogenous obesity (325 LB)	278.0
2: Pseudoephedrine	E941.2

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an obese male diving in shallow, tropical, current-free water at about 12-15 fsw. He indicated to companion a need to surface and at the surface became unconscious after stating that he was "very tired." Cardiac arrest followed immediately, and resuscitation was not possible.

Autopsy discloses air in both ventricles suggesting death may have been due to coronary artery air embolism in view of sudden death. There was borderline cardiomegaly, but no other significant findings.

**DAN RECORD NUMBER:** 4093    **DOB:** 1941    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

<b>IMMEDIATE:</b> Air embolism	958.0
<b>Due to:</b> Accident d/t diving pressure change	E902.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Coronary atherosclerosis	414.0
2: Cardiomegaly	429.3

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was diving around oil rigs and made a rapid ascent for unknown reasons. His depth gauge gave maximum dive depth at 170 fsw. At the surface he was in trouble immediately and was unconscious when rescued. CPR was unsuccessful.

The autopsy disclosed evidence of air embolism and coronary atherosclerosis with 50 percent obstruction of the left anterior descending coronary artery and 30 percent obstruction of the right coronary artery, as well as cardiomegaly.

**DAN RECORD NUMBER:** 5493 **DOB:** 1952 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH** ICD-9-CM

<b>IMMEDIATE:</b> Air embolism	958.0
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: s/p Alcohol depend NEC/NOS, remission	303.93
2: s/p Drug dependence NOS, remission	304.93
3: Reactive depressive psychosis-history	298.0

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an experienced diver and frequently used home-mixed nitrox in diving. The terminal dive took place at a saltwater cove where decedent was observed preparing to dive while standing on rocks at the water edge. Witnesses state that he apparently slipped and fell into the water before he had flippers on or had a regulator in his mouth. (Apparently he was able to place the regulator in his mouth while submerged.) He immediately screamed for help and submerged. His body was recovered by lifeguards within about 30 minutes, but resuscitation was not possible.

Autopsy report is available. Postmortem chest X-ray shows massive amounts of air filling all chambers of the heart as well as the aorta, carotids and brachial arteries. The pathologist describes foamy blood present in major vessels with gas present in the pulmonary artery. He also describes numerous small bubbles in the leptomenigeal vessels of both hemispheres.

**DAN RECORD NUMBER:** 7993 **DOB:** 1968 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH** ICD-9-CM

<b>IMMEDIATE:</b> Air embolism	958.0
<b>Due to:</b> Rapid ascent	E902.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Traumatic pneumothorax, closed	860.0
2: Interstitial emphysema	518.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an inexperienced diver making a dive from a group charter boat. He made a rapid breathhold ascent for unknown reasons. He was in cardiac arrest at the surface or very soon afterwards and could not be resuscitated.

Autopsy disclosed air in right ventricle and cerebral matter. Pneumomediastinum and pneumothorax were also present.

In view of the rapid death, embolization of coronary artery is a possible cause of death.

**DAN RECORD NUMBER:** 8293    **DOB:** 1961    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Air embolism	ICD-9-CM 958.0
<b>Due to:</b> Rapid ascent	E902.2
<b>Due to:</b> Insufficient air	E913.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

Decedent was an inexperienced diver diving from a private boat with friends at a marine park. He indicated to his buddy that his air was low, and he apparently made a breathhold ascent. He was in cardiac arrest when he arrived at the surface. CPR was administered without success.

Autopsy report is brief, but medical examiner diagnosis is air embolism. In view of immediate death, coronary artery embolism is possible.

**NOTE:** See also case #5393 in the section on entrapment.

## *Decompression Sickness*

**DAN RECORD NUMBER:** 7593    **DOB:** 1959    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Caisson disease	ICD-9-CM 993.3
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Secundum type atrial septal defect	745.5
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Autopsy (Y/N): Y    Findings available (Y/N): Y

The decedent was solo diving from his own boat while a companion remained with the boat. One report states that the diver made two dives to 80 fsw for 30 minutes with a one-hour surface interval. The other report is that the decedent made a morning dive of 30 minutes to 80 fsw, then fished from the boat until afternoon and began his terminal dive at 1530 hours. At the end of the second dive, he passed his equipment into the boat and then told the companion that he did not feel well. He may have lost consciousness at that time, as the companion reported noisy respiration and moaning followed by quiet. The decedent was thought by the companion to be asleep. Later the companion determined that decedent was unresponsive. The companion was unable to operate the radio and unfamiliar with boat operation but succeeded in returning to land after about two hours. He ran the boat up on the beach and received assistance from residents and EMS. At that time it was obvious that decedent had been dead for some time.

The autopsy revealed foamy blood in all blood vessels and a dilated right atrium filled with frothy blood. Frothy blood was found in all the major vessels as well. There was a patent foramen ovale (PFO) which easily permitted a finger through the opening.

The dive times are unreliable, as the witness was not familiar with diving at all. The pathological findings are consistent with severe decompression sickness, and the PFO finding is of interest.

## ***Cardiovascular Disease — Immediate Cause of Death***

Cardiovascular disease is the leading cause of morbidity and mortality in the United States as well as most Western countries. There are almost one million deaths per year in the United States, and 10 times that number which result from accident. The death rate for white men aged 25 to 34 is about 1/10,000; for age 55-64, it is nearly 1/100. Between the ages 35-44, the death rate for white men is 6.1 times that for white women. The sex difference is less apparent for nonwhites, for unknown reasons.

The *absolute risk* — that is, the risk at any given time—of having a heart attack is about one chance per million for an otherwise healthy 50-year-old man. A person whose *relative risk* of having a heart attack is 2.0, which doubles his or her absolute risk. Heavy physical exertion increases the risk by 5.9 times and anger increases it by 3.0 times. The risk after first awakening in the morning is 2.3 times the absolute risk<sup>3</sup>.

Cardiovascular disease is treacherous in that it is frequently present in severe form without symptoms until sudden death, heart attack or stroke occur. It is not a surprise then that these events occur during scuba diving, just as they might with any other human activity. Prevention of death due to cardiovascular disease while diving will be difficult. The presence of coronary artery disease (CAD) is usually interpreted as a contraindication to diving, particularly if there has been myocardial infarction (heart attack) or coronary artery bypass graft procedure. However, highly motivated individuals who meet certain requirements do dive successfully in the presence of coronary artery disease.

Is there some unknown factor about exercise effects from diving as opposed to those from other exercise? And does that unknown factor increase the risk for the diver with CAD? The unique effects of exercise and immersion are well known and described in many diving physiology texts<sup>4</sup>. There is some information about the second part of the question. There have been studies which confirm the link between heavy exertion and acute myocardial infarction<sup>5, 6</sup>. In these events, the exercise is the trigger which initiates the event in an already-diseased vascular system. The protective effect of regular exercise, however, is well known. These studies were not done in divers, but in individuals on land-based activities. Given the knowledge that there are unique effects of immersion, and that exercise can trigger a myocardial infarction, it is not unreasonable to assume that the diver with coronary artery disease may have excessive risk.

Should the individual with known coronary artery disease be advised not to dive? The individual making that decision must understand the requirements of diving and the limitations imposed by the disease. In some individuals the risk is clearly too high. Other individuals may be at lower risk, but not wish to assume any risk. The decision in most cases is a personal one. It does appear that the diver with CAD is at increased risk and may not survive a heart attack that occurs while diving. There are published guidelines to assist in the decision.<sup>7</sup>

It is apparent that there are less stringent restrictions for the diver with CAD than with asthma or diabetes. The evidence for increased risk of death while diving in the asthmatic is not convincing. Most of the deaths of individuals with diabetes while diving are due to CAD rather than the diabetes. Of course, diabetes mellitus is a risk factor for CAD. It does appear that there is excessive mortality due to coronary artery disease among divers past the age of 40.

In the following cases there are many examples of individuals who were known to have complications considered disqualifications for diving.

**DAN RECORD NUMBER:** 393    **DOB:** 1953    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Heart failure NOS                          428.9  
**Due to:** Benign hypertensive heart disease            402.11

Other significant conditions contributing to death but not resulting in underlying cause

1. Accident d/t water sports activity                          E910.1
2. Acute bronchitis    466.0
3. Tobacco abuse, continuous                                    305.11

Autopsy (Y/N): Y Findings available (Y/N): Y

The decedent had made several dives on a liveaboard dive vessel and had retired to his cabin after dinner at about 2130 hours. He did not appear for breakfast or the dive briefing the next morning and shortly afterwards was found dead in his berth. The body was cold with rigor mortis established, indicating death had occurred several hours prior to discovery.

The autopsy disclosed significant cardiovascular disorder consistent with congestive heart failure and hypertension. Bubbles were present in the vessels which the pathologist interpreted as indications of decompression illness and felt cause of death was "fatal decompression illness." A more likely explanation is congestive heart failure as the cause of death with postmortem bubble formation.

**DAN RECORD NUMBER:** 1093    **DOB:** 1935    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Acute myocardial infarction                410.90  
**Due to:** Coronary atherosclerosis                            414.0

Other significant conditions contributing to death but not resulting in underlying cause

- 1: Epilepsy NOS w/o intractable epilepsy                    345.90
- 2: Accident d/t water sports activity                        E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent had episode of right chest and right shoulder pain about four days before death. He was evaluated by a physician who felt symptoms were musculoskeletal in origin. The physician was also aware that decedent had a seizure disorder and was taking Dilantin. Decedent was on a liveaboard dive vessel and had made a 110 fsw, 20-minute (computer) dive followed by a surface interval of one hour. He had started the second dive and was brought back to the surface a few minutes later by members of his group. The decedent was probably dead at that time. Subsequent autopsy revealed extensive coronary artery disease with rupture of the left ventricle and cardiac tamponade.

The chest pain four days before death was quite likely undiagnosed acute myocardial infarction with cardiac rupture occurring during the dive.

**DAN RECORD NUMBER:** 1793    **DOB:** 1929    **SEX: M**    **DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Acute myocardial infarction                410.90  
**Due to:** Coronary atherosclerosis                            414.0  
**Due to:** Accident d/t water sports activity                E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Old myocardial infarction	412
2: Congestive heart failure	428.0
3: Diabetes, uncomplicated, type II	250.00

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was diving in tropical waters, and made only a short dive before returning to the boat, complaining of fatigue. He was rescued and almost immediately developed cardiac arrest.

Autopsy revealed severe coronary artery disease with new and old myocardial infarction.

**DAN RECORD NUMBER:** 2493 **DOB:** 1946 **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Acute myocardial infarction	410.41
<b>Due to:</b> Coronary atherosclerosis	414.0

Other significant conditions contributing to death but not resulting in underlying cause

1: S/P CABG 1 vessel	36.11
2: Accident d/t water sports activity	E910.1
3: Cardiomegaly	429.3
4: Myocardial degeneration	429.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent had known ischemic heart disease with previous myocardial infarction and coronary artery bypass graft (one vessel). He was diving with his wife and had just begun the dive when he indicated difficulty. He rapidly lost consciousness and was retrieved by his wife. He was in cardiac arrest and could not be resuscitated.

The autopsy report concerning the heart is as follows. Heart weighs 650 gm. The heart is enormous, the epicardium with innumerable frayed fibrous tags. The valves are intact and appear functional. The endocardium is focally gray-white and opacified; the myocardium shows many interdigitating gray-white patches. Just beyond the aortic valve is a solitary bypass ostium ringed with black sutures; a metal ring is concentric to the ostium. The natural coronary arteries are greatly thickened and frequently calcified. The lumen of the bypass vessel is occluded by a red-brown clot.

**DAN RECORD NUMBER:** 4393 **DOB:** 1939 **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Cardiac dysrhythmia NOS	427.9
<b>Due to:</b> Cardiomegaly	429.3
<b>Due to:</b> Coronary atherosclerosis	414.0

Other significant conditions contributing to death but not resulting in underlying cause

1: s/p cerebral aneurysm	437
2: Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent and wife were diving in shallow water around pilings supporting a pier. The wife noted the decedent having difficulty staying afloat. She inflated his buoyancy vest and attempted to assist in keeping his head above water. Nearby fisherman managed to get him out of the water and into a small boat where CPR was begun.

There is an extensive autopsy report. A few of the significant findings include the following. Prior brain surgery for aneurysm by history, but operative site not definite on gross exam; coronary atherosclerosis; left ventricular hypertrophy; and atherosclerosis of aortic valve.

The final diagnosis was dysrhythmia due to coronary artery disease and left ventricular hypertrophy.

**DAN RECORD NUMBER:** 6493    **DOB:** 1947    **SEX:** M    **DIVER CAT:** R

**CAUSE OF DEATH**      **ICD-9-CM**

**IMMEDIATE:** Cardiovascular disease NOS 429.2

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiomegaly 429.3

2: Accident d/t water sports activity E910.1

3: Chronic nonalcoholic liver disease 571-8

Autopsy (Y/N): Y      Findings available (Y/N): Y

Diver lost consciousness shortly after reaching the surface while diving in open ocean. At time of rescue he had no spontaneous respiration or pulse. He was administered CPR during evacuation by USCG to a hospital where he was pronounced dead.

Autopsy disclosed severe coronary atherosclerosis with near total obstruction of major coronary arteries. There was heart enlargement and fatty degeneration of the liver.

**DAN RECORD NUMBER:** 7193    **DOB:** 1942    **SEX:** M    **RIVER CAT:** B

## **CAUSE OF DEATH**      **ICD-9-CM**

**IMMEDIATE:** Chronic ischemic heart disease

Other significant conditions contributing to death but not resulting in underlying cause

1: True posterior wall infarction 410.60

2: Cardiomegaly 429 3

3: Accident d/t water sports activity

Autopsy (Y/N): Y Findings available (Y/N): Y

Fifty-one-year-old male with previous myocardial infarction was diving with companions in about 50 fsw when he became unresponsive. He was immediately rescued and CPR-ALS performed. He was transferred to a chamber and a USN treatment table 6 was started. He was pronounced dead after about 40 minutes of treatment.

DAN RECORD NUMBER: 8393 DOB: 1961 SEX: M RIVER CAT: B

**CAUSE OF DEATH** ICD-9-CM

**IMMEDIATE:** Primary cardiomyopathy

**IMMEDIATE:** Primary cardiomyopathy 425.1  
Due to: Coronary atherosclerosis 414.0

Other significant conditions contributing to death but not resulting in underlying cause:

1: Cardiomegaly 429 3

1: Cardiomegaly	129.5
2: Obesity	278.0

3: Accident d/t water sports activity E910 1

3: Accident d/t water sports activity E910.1  
4: Tobacco abuse, episodic 305.12

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an uncertified diver who had some experience and owned a 40-foot boat from which he made his final dive. The dive was 200 yards off a rocky coast with 4-6 foot seas and current. The victim did not give indication of trouble during the dive and the dive was terminated when decedent's tank pressure reached 700 pounds psi. At the surface, the decedent started swimming rapidly, yelled for help and then became unconscious. He was rescued by companions, but resuscitation was unsuccessful.

The autopsy disclosed obesity, cardiomegaly and coronary atherosclerosis.

## *Drowning*

## **DROWNING WITH CARDIOVASCULAR DISEASE CONTRIBUTING OR PRESENT**

PAN RECORD NUMBER: 793 DOB: 1956 SEX: M RIVER CAT: B

**CAUSE OF DEATH** ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause:

1: Diabetes uncomplicated type I 250.01

1: Diabetes, uncomplicated, type 1	250.0
2: Essential hypertension NOS	401.9

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was a 37-year-old male who lost consciousness while diving and drowned. He was an insulin-dependent diabetic and hypertensive. The cause for the loss of consciousness has not been determined.

The autopsy was unremarkable except for five milliters of air (sic) in the aorta and approximately 30 ml in the pulmonary artery. The vitreous glucose level was 47 gm/dl. The autopsy was done three days after death. During that time the glucose level would have fallen and was probably near normal at the time of death. The gas bubbles could have formed postmortem.

**PAN RECORD NUMBER:** 1293    **DOB:** 1943    **SEX:** M    **DIVER CAT:** B

DAN RECORD NUMBER: 1295 DOB: 1945 SEX: M DIV: 1  
CAUSE OF DEATH ICD-9-CM:

**IMMEDIATE: Anoxic encephalopathy**

**IMMEDIATE:** Anoxic encephalopathy  
**Due to:** Drowning/nonfatal submersion

**Due to:** Drowning/non fatal submersion 994.1  
**Due to:** Accident d/t water sports activity E010.1

Other significant conditions contributing to death but not resulting in underlying cause

1; Coronary atherosclerosis, minimal 414.0

Autopsy (Y/N): Y Findings available (Y/N): Y

This was a 50-year-old male who made a 30 fsw dive for 24 minutes in sea described as rough with 2-knot current. Decedent and buddy surfaced down current, about 100 yards from boat. During swim against current, decedent developed difficulty and then became unconscious. He was rescued and eventually reached a recompression chamber where he received a USN treatment table 6 with no apparent benefit. He was admitted to ICU where support was discontinued after a few hours.

Autopsy disclosed evidence of encephalopathy and pathologist coded as "Extra Alveolar Air Syndrome." The history suggests drowning and resultant encephalopathy, which was fatal.

**DAN RECORD NUMBER:** 1593 **DOB:** 10/10/30 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH**

ICD-9-CM

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	994.1
<b>Due to:</b> Coronary artery disease	414.9

Other significant conditions contributing to death but not resulting in underlying cause

1: Accident d/t water sports activity	E910.1
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Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was a 62-year-old male experienced diver making an ocean dive with three companions. The decedent had done many similar dives with no difficulty. At the end of the dive he was observed floating with buoyancy compensator inflated and unresponsive. He was rescued and CPR continued during return to shore. However, he was pronounced DOA at the scene.

Autopsy reveals extensive coronary artery disease which probably produced a dysrhythmia resulting in drowning.

**DAN RECORD NUMBER:** 1993 **DOB:** 1942 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH**

ICD-9-CM

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	994.1
<b>Due to:</b> Accidental suffocation, lack of air	E913.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Coronary atherosclerosis	414.0
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Autopsy (Y/N): Y Findings available (Y/N): Y

A newspaper clipping is the source of information about this dive incident. Reports that the decedent was too low on air, and speculate on out-of-air situations versus heart attack.

The medical examiner reports drowning as cause with coronary artery disease contributing. The autopsy discloses occlusion of coronary vessels (40 percent RCA, 50 percent LAD, 40 percent Lcirc).

**DAN RECORD NUMBER:** 2993 **DOB:** 1934 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH**

ICD-9-CM

<b>IMMEDIATE:</b> Drowning	994.1
<b>Due to:</b> Arteriosclerotic heart disease	429.2

Other significant conditions contributing to death but not resulting in underlying cause

1: Accident d/t water sports activity	E910.1
2: S/P Angioplasty	36.05
3: Cardiomegaly	429.3
4: Chronic nonalcoholic liver disease	571.8

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was diving near an ocean inlet with his son in an area of strong current at a depth of approximately 65 fsw. He was found on bottom in cardiac arrest with air remaining in his tank.

He was a known cardiac patient with previous myocardial infarction and angioplasty. He had had a recent exercise stress test which revealed ischemia with exercise.



Decedent was diving in 8-10 fsw when he developed some difficulty and was rescued by his brother and bystanders. He was in cardiac arrest and could not be resuscitated.

The autopsy is consistent with drowning.

DAN RECORD NUMBER: 5593 DOB: 1942 SEX: M DIVER CAT: R  
CAUSE OF DEATH ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Coronary atherosclerosis 414.0  
 2: Renal cell carcinoma 189.0

Autopsy (Y/N): Y Findings available (Y/N): Y

The decedent had surfaced at the end of the second dive of day and immediately developed difficulty in flotation. He was wearing 28-pound weight and his BC inflator hose was not connected.

The autopsy is consistent with drowning. There was mild coronary artery disease and an early renal cell carcinoma, which was not significant at the time of death.

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	994.1
<b>Due to:</b> Accidental suffocation, lack of air	E913.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Primary cardiomyopathy 425.4

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an inexperienced diver diving for lobster with a more experienced companion. The dive was uneventful except that decedent's air consumption was greater than companion. They returned to the surface when the decedent's gauge read 700 psi. They began an underwater return swim to the boat. En route the decedent's pressure gauge read 400 psi. At that time the companion returned to the bottom because he saw a lobster. When the companion returned to the surface, the decedent was missing. His body was recovered later by the USCG.

On examination of the pressure gauge it was determined that the gauge would not read lower than 400 psi even if the tank was empty. Evidently the decedent relied on the gauge and was unable to deal with an unexpected out-of-air situation.

The autopsy was consistent with drowning although it did reveal a cardiomyopathy which may have contributed to the outcome.

**DAN RECORD NUMBER:** 6593    **DOB:** 1939    **SEX:** M    **DIVER CAT:** R

**IMMEDIATE:** Drowning/nonfatal submersion      994.1  
**Due to:** Accident d/t water sports activity      E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiomegaly 429.3  
2: Coronary atherosclerosis (moderate) 414.0

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was a 54-year-old male diving with a group. He was found face down on the surface, was unresponsive and could not be resuscitated.

Autopsy disclosed left ventricular hypertrophy and moderate coronary artery disease. Conclusion as to cause of death was drowning. He may have aspirated and hypoxia triggered a dysrhythmia influenced by the catecholamine release.

**DAN RECORD NUMBER:** 6993    **DOB:** 1938    **SEX:** M    **DIVER CAT:** R

## **CAUSE OF DEATH**      **ICD-9-CM**

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiomegaly 429.3  
2: Chronic ischemic heart disease NOS 414.9

Autopsy (Y/N): Y Findings available (Y/N): Y

A 55-year-old male in apparent good health was diving with a charter group at night in the open ocean. At the end of the dive, as the group surfaced, he was found floating face down in the water. He was rescued and CPR administered. He was transferred to a local hospital by USCG where he survived a few hours.

The autopsy findings were consistent with drowning and a mild coronary atherosclerosis. The CAD was not felt to play a role in the drowning.

**DAN RECORD NUMBER:** 7293    **DOB:** 1939    **SEX:** M    **DIVER CAT:** R

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Coronary atherosclerosis	414.0
2: Diabetes, uncomplicated, type II	250.00

Autopsy (Y/N): Y Findings available (Y/N): Y

This experienced diver was a 53-year-old male with diabetes mellitus Type II and arteriosclerotic cardiovascular disease (ASCVD). He had completed a dive and was returning to the boat when he was observed to be in trouble and was rescued. CPR reportedly expelled a large quantity of water. The autopsy revealed severe ASCVD and cause of death was felt to be drowning, with diabetes and ASCVD contributing.

**DAN RECORD NUMBER:** 8193    **DOB:** 1921    **SEX:** M    **DIVER CAT:** R

**IMMEDIATE:** Drowning/nonfatal submersion                    994.1  
**Due to:** Accident d/t water sports activity                    E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiovascular disease (severe)	429.2
2: Cardiomegaly	429.3

Autopsy (Y/N): Y Findings available (Y/N): Y

The only details available come from a brief newspaper clipping which indicates that decedent disappeared while diving in shallow water. There is a complete autopsy report which is consistent with the diagnoses.

**DAN RECORD NUMBER:** 9293 **DOB:** 1951 **SEX:** M **DIVER CAT:** R

**CAUSE OF DEATH** ICD-9-CM

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	994.1
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Chronic ischemic heart disease NOS	414.9
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Autopsy (Y/N): Y Findings available (Y/N): Y

The decedent was a 42-year-old male diving with two companions. It is not clear if decedent ever descended, but he probably developed a problem on the surface prior to descent. The decedent had limited dive experience and was participating in a deep-water class offered by a local dive shop. Due to the current, the decedent told his companion to "head back in." Both divers had trouble with the current and became separated. The decedent was recovered by a wind surfer and brought to shore with difficulty, the rescue requiring 20-30 minutes. CPR was unsuccessful. The medical examiner reports the cause of death as drowning with coronary artery atherosclerosis as a contributory factor.

### ***DROWNING WITH MEDICAL CONDITION PRESENT***

*(excluding cardiovascular disease)*

Obesity appears in most of the following cases as a contributing factor. Obesity is prevalent in the United States, 24 percent of men and 27 percent of women weighing 20 percent more than standard height-weight charts. The reason for obesity is essentially unknown, but very complex. The mechanism, however, is simple — one takes in more calories than one expends. The result is an increase in body fat.

Obesity generally implies poor physical fitness and adversely affects the performance of physical activity. The increased body mass requires more physical effort to move about on land or submerged. Morbidity and mortality from all accidents and injuries are significantly higher among obese persons and increase with the magnitude of the obesity.<sup>8</sup>

The obese diver is at a disadvantage for the following reasons: difficulty with proper fit of dive gear and increased weight requirement for buoyancy control. These add to an already overloaded diver, which increases resistance to movement in the water due to bulk and reduced physical fitness, most especially the reduced respiratory capacity.

**DAN RECORD NUMBER:** 3993 **DOB:** 1964 **SEX:** F **DIVER CAT:** R

**CAUSE OF DEATH** ICD-9-CM

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	994.1
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Obesity 278.0

Autopsy (Y/N): Y    Findings available (Y/N): Y

Decedent was diving in a quarry with one buddy and other companions. She had made one dive with some ear-clearing difficulty and had started a second dive. Buddy had some difficulty with regulator and indicated to decedent to ascend. She was not at the surface when he arrived. After a brief delay the companions started to search and found decedent at 132 feet with regulator out of mouth. Weight belt was dropped by rescuer and buoyancy compensator inflated. CPR was started at the surface, but she was DOA at the local hospital. Sheriff report states gear intact, but newspaper article says she lost a flipper and could not reach surface.

Autopsy consistent with drowning. There were multiple small bubbles in blood vessels which probably formed postmortem.

DAN RECORD NUMBER: 5993 DOB: 1948 SEX: M DIVER CAT: R

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Cardiac dysrhythmia NOS 427.9

**Due to:** Asphyxia (hypoxemia d/t exertion) 799.0

**Due to:** Asphyxia (hypoxemia at exertion) 799.8  
**Due to:** Exhaustion due to excess exertion 994.5

**Due to:** Accident d/t water sports activity

Other significant conditions contributing to death but not resulting in underlying cause

1: Obesity 278.0

Autopsy (Y/N): Y    Findings available (Y/N): Y (oral)

Decedent was a beginning diver making his first ocean dive after two open water (river) dives. Instructor was first aware of problem when other students found decedent floating face down in the water. No other details are available.

The medical examiner listed the cause of death as recorded above and also reports the absence of coronary artery disease and the presence of morbid obesity. This incident probably started as a surface near-drowning, with aspiration of water escalating into the other problems.

DAN RECORD NUMBER: 6793 DOB: 1955 SEX: F DIVER CAT: R

**DEATH RECORD NO. \_\_\_\_\_  
CAUSE OF DEATH \_\_\_\_\_**

ICD-9-CM

**IMMEDIATE:** Instantaneous death 798.1

**Due to:** Accident d/t water sports activity

Other significant conditions contributing to death but not resulting in underlying cause

1: Obesity 278.0

2: Asthma NOS w/o status asthmaticus 493.90

3: Chronic nonalcoholic liver disease NEC 571.8

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent and her buddy were diving in open ocean 300 yards offshore to depth of 17 feet for 20 minutes. They surfaced, and decedent indicated that she was not feeling well. Both began swimming toward shore. The decedent became fatigued, dropped her weight belt and stated that she could not make it to shore. She was assisted to nearby rocks, where she was cyanotic and not breathing. CPR and eventual ALS were not successful.



**DAN RECORD NUMBER:** 2093    **DOB:** 1952    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accidental suffocation, lack of air

E913.2

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y (oral)

Decedent was making a night dive in a large fresh water lake on a designated dive trail and failed to reappear. He was wearing a 35-pound weight belt. He and his buddy had become separated during the dive. The body was recovered the following day. At the time of examination, his air cylinder was reported to be empty. Oral report from medical examiner is that findings were consistent with drowning.

**DAN RECORD NUMBER:** 2593    **DOB:** 1956    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Insufficient air

E913.2

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

Deceased was diving with a buddy in conditions of poor visibility at about 60 fsw. Approximately 10 minutes after beginning the dive, the deceased indicated to his buddy that his air was low. Buddy confirmed that the gauge read 700 pounds. They started to ascend, but became separated. At the surface, the buddy could not see bubbles from the victim and alerted the boat crew. A search was begun a few minutes later. Victim was discovered after searching 20 minutes or more on the bottom with buoyancy compensator deflated and regulator out of his mouth. The gear was jettisoned at the time of body recovery, but later found and examined. The tank pressure at that time was 170 pounds.

Toxicology studies disclosed the presence of diphenhydramine. No alcohol or other drugs were detected.

**DAN RECORD NUMBER:** 3593    **DOB:** 1958    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Insufficient air

E913.2

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

Deceased was an experienced diver, diving at a new wreck site in an area of strong current and at a depth of 98 fsw. He was not with a buddy and became low on air. Another diver attempted to assist, but victim apparently became panicky or lost consciousness due to hypoxia. The rescuer was unable to remove the victim from their location inside the wreck and was forced to surface because of his own low air supply.

The autopsy is consistent with drowning. Numerous gas bubbles in the arterial and venous system formed postmortem as death occurred at depth.

**DAN RECORD NUMBER:** 5093    **DOB:** 1962    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

ICD-9-CM

994.1

**Due to:** Accidental suffocation, lack of air

E913.2

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

Decedent was a 30-year-old experienced diver, according to report. He was making an open-ocean dive and was found on the bottom with regulator out of his mouth. He had not indicated difficulty to companions. His cylinder on examination was found to contain less than 100 psi.

Autopsy findings were consistent with drowning.

### **DEATH DUE TO ENTRAPMENT**

These deaths resulted due to a physical barrier preventing return to the surface. In some cases there was an overhead barrier, and in others there was entrapment due to kelp, a drain, or a spillway. All of these hazards are well recognized, yet they produce a number of fatalities every year.

**DAN RECORD NUMBER:** 193    **DOB:** 5/6/59    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

ICD-9-CM

994.1

**Due to:** Entrapment - ice

E918.3

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

Two divers entered open water on a partly ice-covered river, but became lost and entered the ice-covered portion of the river. They were unable to locate open water, ran out of air and drowned.

Autopsy consistent with drowning.

**DAN RECORD NUMBER:** 293    **DOB:** 1954    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

ICD-9-CM

994.1

**Due to:** Insufficient air

E913.2

**Due to:** Entrapment (ice)

E918.3

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): Y

The decedent was a 38-year-old diver who entered a river partially covered with ice and with low water visibility. A short time later his buddy surfaced and said that he had lost sight of decedent. At that time the divemaster entered the water to search. Neither diver returned to the surface.

The autopsy is consistent with drowning.

**DAN RECORD NUMBER:** 593    **DOB:** 1958    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

ICD-9-CM

994.1

**Due to:** Entrapment (Cave)

E918.2

**Due to:** Insufficient air E913.2  
**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause  
1: Coronary atherosclerosis, minimal 414.0

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was cave diving with a friend and apparently became disoriented. He went deeper into a dead end chamber instead of ascending and was found at 123 feet with empty cylinder.

Autopsy is consistent with drowning and the coronary artery disease was probably not a major factor.

**DAN RECORD NUMBER:** 693    **DOB:** 1953    **SEX:** M    **DIVER CAT:** R

### **CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Entrapment - drain pipe 918.9  
**Due to:** Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiovascular disease NOS 429.2

Autopsy (Y/N): Y Findings available (Y/N): Y

The decedent and others were attempting to clear the drain at a camp pond. He apparently removed the grate over the drain and was forced into the drain by water pressure. Recovery took many hours by members of rescue teams.

**DAN RECORD NUMBER:** 1193    **DOB:** Unknown    **SEX:** M    **DIVER CAT:** R

**CAUSE OF DEATH**      ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Entanglement - kelp E918.4  
**Due to:** Accident d/t water sports activity E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

According to sheriff and medical examiner reports, the decedent and a female companion entered the water from a dive boat before the vessel was anchored securely. They were in trouble immediately and the boat may have passed over them due to the current. The female diver was rescued and survived. The decedent was tangled in kelp, not recovered immediately and did not survive.

**DAN RECORD NUMBER:** 4693    **DOB:** 1964    **SEX:** M    **DIVER CAT:** R

## **CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion 994.1  
**Due to:** Entrapment — cave E918.2  
**Due to:** Accident d/t water sports activity E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent and companion were recently certified cave divers. They entered a cave and were unable to return to the exit for unknown reasons. Both were found two days after death.

Autopsy consistent with drowning.

**DAN RECORD NUMBER: 4793 DOB: 1955 SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	ICD-9-CM 994.1
<b>Due to:</b> Accidental suffocation, lack of air	E913.2
<b>Due to:</b> Entrapment, cave	E918.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was a member of a buddy team exploring a cave. Unknown difficulties developed, and both drowned.

Autopsy was consistent with drowning.

**DAN RECORD NUMBER: 5193 DOB: 1969 SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	ICD-9-CM 994.1
<b>Due to:</b> Entrapment — cave	E918.2
<b>Due to:</b> Insufficient air	E913.2
<b>Due to:</b> Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was a highly skilled cave diver engaged in mapping a large cave. He had penetrated some 8,000 feet and was returning to entrance when he apparently was snagged at a restriction and unable to free himself. He was freed by fellow divers, but following that he had difficulty with equipment and gas supply and died almost immediately.

Autopsy consistent with drowning.

**DAN RECORD NUMBER: 5393 DOB: 1942 SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Air embolism	ICD-9-CM 958.0
<b>Due to:</b> Entanglement, kelp	E918.4
<b>Due to:</b> Accident d/t water sports activity	E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Coronary atherosclerosis-minimal	414.0
2: Malignant neoplasm, prostate	185
3: Secundum type atrial septal defect	745.5

Autopsy (Y/N): Y Findings available (Y/N): Y

The decedent was diving with a companion in an ocean bay and was noted missing by companion, who surfaced and found decedent entangled in kelp with regulator out of mouth. He was brought to surface and placed on dive boat for CPR, which was unsuccessful. Autopsy disclosed mild focal 50 percent narrowing of mid portion of left anterior descending coronary artery. There was probe patent foramen ovale (PFO). There were gas bubbles in the blood in the aortic arch. Blood vessels of brain contained numerous bubbles. Air embolism seems most likely in view of dive time on computer of slightly over five minutes at maximum depth of 12 feet. The probe patent PFO is an interesting finding.



**DAN RECORD NUMBER:** 8493   **DOB:** 1952   **SEX:** F   **DIVER CAT:** R

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	ICD-9-CM 994.1
<b>Due to:</b> Accident d/t water sports activity	E910.1
<b>Due to:</b> Entrapment - cavern	E918.2

Other significant conditions contributing to death but not resulting in underlying cause

1: Chronic lymphocytic thyroiditis	245.2
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Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was diving in a river for artifacts with companions. Visibility was no more than 1-2 feet and there was current. She did not surface with companions, and a two-hour search found her under a ledge in a cavern along the river bottom. She had apparently wandered into the area or was swept in by the current and unable to find her way out due to the low visibility.

The autopsy was consistent with drowning.

**DAN RECORD NUMBER:** 2193   **DOB:** 1946   **SEX:** M   **DIVER CAT:** R

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	ICD-9-CM 994.1
<b>Due to:</b> Oxygen toxicity	987.8
<b>Due to:</b> Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was diving at 224 fsw when he was discovered on the bottom vomiting and coughing up blood with the regulator out of his mouth. His dive buddy was unable to assist and was forced to return to the surface for help. The decedent had filled his own tanks and the gas composition is not known. He carried a bottle of 100 percent oxygen for decompression. When this bottle was measured after the incident, it contained 600 psi. The buddy thinks the decedent accidentally switched to the pure oxygen regulator at depth and experienced a seizure.

**DAN RECORD NUMBER:** 2393   **DOB:** 1958   **SEX:** M   **DIVER CAT:** R

**CAUSE OF DEATH**

<b>IMMEDIATE:</b> Drowning/nonfatal submersion	ICD-9-CM 994.1
<b>Due to:</b> Accident d/t water sports activity	E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was a 35-year-old male diving from shore on a bay. The divers made a surf entry despite current and rough seas. Decedent was carried against rocks by surge and was noted to be unconscious by companions. He was retrieved with difficulty because of sea conditions and was in cardiac arrest. Resuscitation at the scene and hospital Emergency Department was attempted, but it was unsuccessful.

Autopsy is consistent with drowning.

**DAN RECORD NUMBER:** 2793    **DOB:** 1946    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

There are no details about the dive itself available to us. The medical examiner autopsy report indicates drowning as the cause of death.

**DAN RECORD NUMBER:** 4193    **DOB:** 1957    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**    ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was diving alone in an inlet during a time of unusual tidal activity. He was seen by one witness changing tanks following a dive and another witness saw him floating in the channel with the outgoing tide toward the harbor mouth. His body was found about two weeks later on a beach a mile outside the harbor.

Autopsy was consistent with drowning.

**DAN RECORD NUMBER:** 4593    **DOB:** 1963    **SEX: F DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent and husband were diving on a lobster reef with companions. The husband and wife became separated on the bottom, but the husband was not aware of any problem. The group instituted a brief search and called the USCG. A dive team recovered the body about three hours later. The tank still contained air, and the buoyancy compensator was in operating condition. The weight belt weighed 9 pounds, and her mask was missing. There is a reported possibility the husband made contact with the wife as he swam a few kicks away looking for lobster. If her mask was dislodged at that time, aspiration could have occurred.

Autopsy is consistent with drowning.

**DAN RECORD NUMBER:** 4893    **DOB:** 1959    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

The decedent was a student diver wearing a 22-pound weight belt performing a checkout dive with an instructor in a quarry at about 60 feet, with water temperature of about 45 degrees F. Very little information is available about the dive except a newspaper report about litigation. Both divers died, and there is speculation that icing of the regulators caused a problem. The instructors tank was "nearly empty," and the decedent's tank contained "more than adequate" air.

Autopsy is consistent with drowning.

Autopsy (Y/N): Y Findings available (Y/N): Y

Decedent was an instructor performing a checkout dive with one student in a quarry at depth about 60 feet with water temperature of about 45 degrees F. Her weight belt weighed 19 pounds; his weighed 22 pounds. Unknown difficulty developed, and their bodies were recovered at a 74-foot depth. His tank contained about 1,900 psi, and hers contained about 175 psi. Speculation is that icing occurred in one or both regulators and they may have been using the instructors equipment which free flowed with icing until empty.

The autopsy was consistent with drowning.

Other significant conditions contributing to death but not resulting in underlying cause  
1: Accident d/t water sports activity E910.1

Autopsy (Y/N): Y      Findings available (Y/N): Y

Decedent was a 56-year-old male, experienced diver making a wreck dive at 75 fsw. He and his buddy began ascent together, but decedent failed to surface. His body was found about eight days later decomposed and skeletonized by animal feeding. Autopsy was essentially for identification as most vital organs were missing.

Other significant conditions contributing to death but not resulting in underlying cause  
1: Alcohol abuse, unspecified (.10%) 305.00

Autopsy (Y/N): Y Findings available (Y/N): Y

This was a 34-year-old untrained female diver making a river dive with her companion looking for shark teeth. She lost contact with her boyfriend and disappeared. Body was discovered the next day. Equipment was intact with empty cylinder and fishline around regulator. Teen-aged son made statement that mother had four beers before diving.

Autopsy consistent with drowning.

**DAN RECORD NUMBER:** 7393    **DOB:** 1952    **SEX: F DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y (oral)

Decedent was an experienced diver making a dive in rough, cold northeastern coastal water with a companion. A surface difficulty developed as the two were swimming to shore on the surface.

They reached a breakwater and as the companion was removing his gear to assist the decedent, she drifted away in the current. She was found unconscious by a nearby fisherman. Resuscitation was unsuccessful.

The oral report of the autopsy is consistent with drowning. This case probably represents a surface drowning.

**DAN RECORD NUMBER:** 7693    **DOB:** 1952    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was searching a breakwater area for lost scuba tanks and disappeared from contact with buddies. They were diving independently and the decedent failed to surface. A search was conducted during the next few days with no recovery. Three weeks later the body was discovered on the breakwater in advanced decomposition with skeletonization by animal feeding.

Autopsy disclosed fractured ribs as well as the effects of decomposition. The final impression was drowning.

**DAN RECORD NUMBER:** 8993    **DOB:** 1972    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity

E910.1

Autopsy (Y/N): Y   Findings available (Y/N): Y

Decedent was a 20-year-old male who was diving with a friend and was found floating at the surface dead.

The complete autopsy report is consistent with drowning.

**DAN RECORD NUMBER:** 9193    **DOB:** 1968    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

ICD-9-CM

**IMMEDIATE:** Drowning/nonfatal submersion

994.1

**Due to:** Accident d/t water sports activity:

E910.1

**Due to:** Acute stress reaction, emotional

308.0

Autopsy (Y/N): Y   Findings available (Y/N): Y

Diver was one of four inexperienced divers who were diving with two experienced divers in about 15 fsw. According to newspaper account the decedent panicked and began taking off equipment. He fought off rescuers and sank.



**DAN RECORD NUMBER:** 3293    **DOB:** 1949    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

**Due to:** Accident d/t water sports activity

ICD-9-CM

994.1

E910.1

Autopsy (Y/N): Y    Findings available (Y/N): N

A single newspaper clipping is our only information, with no response to our request for reports.

**DAN RECORD NUMBER:** 8593    **DOB:** 1947    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

**Due to:** Accident d/t water sports activity

**Due to:** Acute stress reaction, emotional

**Due to:** Insufficient air

ICD-9-CM

994.1

E910.1

308.0

E913.2

Autopsy (Y/N): Y    Findings available (Y/N): N

The information comes from death certificate and a newspaper clipping. The decedent was apparently making his first open-ocean dive and had a problem at the surface, which lead to panic and drowning. It is reported that he was out of air.

**DAN RECORD NUMBER:** 9093    **DOB:** 1935    **SEX: M DIVER CAT: R**

**CAUSE OF DEATH**

**IMMEDIATE:** Drowning/nonfatal submersion

**Due to:** Accident d/t water sports activity

ICD-9-CM

994.1

E910.1

Other significant conditions contributing to death but not resulting in underlying cause

1: Cardiovascular disease NOS (severe)                          429.2

Autopsy (Y/N): Y    Findings available (Y/N): N

Brief news clipping gives dates and minimal details. The autopsy report is not available to DAN. The diagnoses are from the death certificate.

## ***Fatality Reports — Autopsy Not Done***

The complete investigation of a diving fatality requires an autopsy. Autopsy provides information which assists in determining the cause and manner of death. Scuba deaths may be considered sudden deaths, because they are unexpected and occur within a short time of the causal event. The factors leading to a fatal outcome are often clarified or confirmed by the findings at postmortem exam.

There is tremendous psychological trauma to families and survivors who receive some solace with the full disclosure of the details of the accident or illness. It is very important to answer the family's questions fully, making it clear how and why the diver died.

There are legal reasons for autopsy. Frequently life insurance benefits are determined by the autopsy findings — for example, the double indemnity provision in many policies for accidental death.

Scuba deaths are occasionally the basis for a lawsuit. The scuba death strikes suddenly and unexpectedly, with little or no prior warning signals, often with many legal consequences. The local medical examiner needs to keep this possibility of legal action in mind when deciding whether or not to order autopsy. Reports should be written very carefully to avoid a suggestion of error by anyone when, in fact, none is known to exist.

Decedent was cave diving at depth below 230 feet when he was observed to lose consciousness. He was brought to surface by companions, but was dead at the surface.

Autopsy was not done.

Other significant conditions contributing to death but not resulting in underlying cause  
1: Accident d/t water sports activity E910.1

Decedent was making an evening dive from a pier when he complained of breathing difficulty. He required assistance in leaving the water and rapidly deteriorated. He died at the hospital or shortly before reaching it.

He had had a previous myocardial infarction at age 36.

Decedent was ocean diving with a group and became separated from buddies. He was found floating on surface unresponsive and was rescued. He was given CPR and evacuated to the USCG station. He was then transferred to a local hospital for resuscitation; then to a regional trauma center; and finally to a hospital with monoplace recompression facility. He received recompression treatment with no response. His course was downhill, and he died a few hours later.

No autopsy was done.

## Other significant conditions contributing to death but not resulting in underlying cause 1: Cataplexy and narcolepsy 347

Decedent was an inexperienced diver with a history of narcolepsy. He was participating in an underwater wedding and had used 29 pounds of weight to control buoyancy. He made an unplanned descent to 50 feet, lost his regulator and became unconscious during a rapid ascent attempt to reach the surface and then sank to the bottom. He could not be resuscitated when recovered.



Decedent made a dive in an ocean canyon with five companions. They reached bottom at 115 fsw and stirred up silt. When the group reached about 40 fsw the decedent was missing. A brief search was unsuccessful and the body was recovered later by lifeguards at 147 fsw depth. Diver had 22-pound weight belt which he had not released and was wearing double 62-cubic-foot cylinders. Buoyancy compensator was partially inflated, but body was still negatively buoyant.

Autopsy was not done. Death was drowning due to insufficient air and excessive weight.

DAN RECORD NUMBER: 6293 DOB: 1955 SEX: M DIVER CAT: R

## **CAUSE OF DEATH**

**IMMEDIATE:** Instantaneous death 798.1

**Due to:** Accident d/t water sports activity

Very little information is available. Diver disappeared from a group while diving in a salt water gulf. The body was recovered several hours later, but the authorities will not release reports.

DAN RECORD NUMBER: 6693 DOB: 1946 SEX: M DIVER CAT: R

**IMMEDIATE: Drowning/nonfatal submersion** ICD-9-CM 994.1

**IMMEDIATE:** drowning, nonfatal submersion  
**Due to:** Effects of electric current

**Due to:** Accident d/t water sports activity E910.1

Decedent was diving in a fresh water lake with a companion and disappeared. The companion searched and found decedent in contact with an underwater electrical cable which was electrified. The decedent was retrieved and CPR attempted. No autopsy was done.

DAN RECORD NUMBER: 7493 DOB: 1963 SEX: M DIVER CAT: R

CAUSE OF DEATH ICD-9-CM

**IMMEDIATE:** Death, cause not determined

**IMMEDIATE:** Death, cause not determined 798.2  
**Due to:** Accident d/t water sports activity E910.1

Report from a DAN member is that the decedent was spear fishing and was dragged by a large fish to 205 fsw. He then surfaced rapidly, followed by a return to 60 fsw for an attempt at in-water recompression. He was then transported to a local medical center for recompression treatment in a chamber. He died at the hospital and it is not known to us whether or not he was recompressed.

DAN RECORD NUMBER: 7793 DOB: 1942 SEX: M DIVER CAT: R

**CAUSE OF DEATH** ICD-9-CM

**IMMEDIATE:** Coronary atherosclerosis 414.9

**Due to:** Hypertensive heart disease NOS 402.90

Other significant conditions contributing to death but not resulting in underlying cause

1: Accident d/t water sports activity E910.1

Decedent was a scuba instructor in process of giving a lesson in a local pool. He left the pool and went into the locker room where he collapsed and died. An autopsy was not done.

This 32-year-old female was diving in tropical waters and developed unknown problem on descent of first dive of day. She was rescued and CPR attempted unsuccessfully. She was a certified diver with certification five years prior to death.

Autopsy was not done.

### *Bodies Not Recovered*

Each year divers are lost and not recovered. Sometimes the cause for the death is apparent, but more often there is insufficient information available to make a judgment. Two of these divers apparently had difficulty with buoyancy and at least two more were diving past 300 feet or more depth.

Decedent and wife were diving at a tropical reef. They were observed having difficulty with buoyancy control and were seen to surface and resubmerge, but were never seen again. Bodies were not recovered.

**DAN RECORD NUMBER:** 993    **DOB:** unknown              **SEX:** F    **DIVER CAT:** R  
**CAUSE OF DEATH**    **ICD-9-CM**  
    799.9  
**IMMEDIATE:** Unknown cause morbidity/mortality              799.9  
**Due to:** Accident d/t water sports activity                      E910.1

Decedent and husband were diving at a tropical reef. They were observed having difficulty with buoyancy control and were seen to surface and resubmerge, but were never seen again. Bodies were not recovered.

This diver was diving alone at dusk and disappeared. The body was not recovered.

All information comes from a brief newspaper clipping which states that diver "disappeared." That implies that body was not recovered.

This young male disappeared while on a recreational dive with a friend. The cause of the difficulty is not reported.

Decedent had completed four days of deep decompression diving at a tropical resort. The final dive was to 340 fsw. On ascent he was observed by companions to become unconscious and then sink due to negative buoyancy. The body was never recovered.

Decedent and companion were attempting to set "personal best" depth records. The decedent was last seen at 400 fsw and his body was not recovered. His companion survived by inflating BC just as he lost consciousness.

*There is some doubt that the following cases are actual fatalities, and they are not included in the survey at present.*

The son reports that he and decedent were at 55 fsw, beginning their ascent and that he never saw his father again. Decedent had been convicted of federal tax evasion and was awaiting sentencing. Law enforcement investigation of possible ruse continues.

**DAN RECORD NUMBER:** None **DOB:** 1950 **SEX:** M **DIVER CAT:** R  
**CAUSE OF DEATH** ICD-9-CD  
    **IMMEDIATE:** Unknown cause morbidity/mortality 799.9  
    **Due to:** Accident d/t water sports activity E910.1

Decedent rented a boat and several tanks for the alleged purpose of diving a reef at 73 fsw. A companion was not a diver and could not operate the boat or radio. The decedent apparently was heavily weighted and the plan was for the companion to lower tanks to the decedent at intervals using a line. There was no response from the decedent after entering the water and none of the auxiliary tanks on the bottom were used. An extensive search was made, but no body recovered.

The FBI made an investigation because of previous activity by the decedent, but results are not available.

## **Summary**

Each fatality reported here is unique in some way, but they do share many causal factors. The factors listed at the beginning of this report appear many times in the case reviews. These factors are usually the responsibility of the diver. The diver should know if training has been adequate for the planned dive, that equipment is adequate and functional, that skills are sufficient for the conditions at the site such as poor visibility, current, overhead barrier and other features. The diver's personal attributes of age, pre-existing disease, physical fitness and the influence of drugs or other substances on behavior are important contributing factors in the fatal dive accident. The diver must be responsible for understanding how these factors interact with diving. In summary, it can be said that most diving fatalities are the result of a number of causative factors, most under the diver's control, which escalate to the final outcome.

## **Notes**

<sup>1</sup> *International Classification of Diseases — Clinical Modification* (9th Revision), U.S. Department of Health and Human Services, Public Health Services, Health Care Financing and Administration.

<sup>2</sup> Divers Alert Network, (1992) Report on Diving Accidents & Fatalities. DAN, Durham, N.C. p. 35.

<sup>3</sup> Muller, James E. (1992) *Risk of Heart Attack* American Heart Association Annual Meeting, Abstract #2740.

<sup>4</sup> Bennett, P.B., & Elliott, D. (1993) *The Physiology and Medicine of Diving*, W.B. Saunders Ltd., London, Philadelphia.

<sup>5</sup> <sup>6</sup> Mittleman, MA, MacIre M, Tobler GH, Sherwood JB, Goldberg RJ, Muller JE. Triggering of acute myocardial infarction by heavy physical exertion-protection against triggering by regular exertion. *N Engl J Med* 1993;329:1677-83.

<sup>7</sup> Willis SN, Lewis M, Lowel H, Arntz H-R, Schubert F, Schroder R. Physical exertion as a trigger of acute myocardial infarction. *N Engl J Med* 1993;329:1684-90.

<sup>8</sup> Bove, AF, & Davis, J. (1990) *Diving Medicine*, W.B. Saunders, Philadelphia. 239-248.

<sup>9</sup> Merck Manual - 16th Edition (1992), Merck & Co., Rahway NJ. p. 984.



# DIVING DECOMPRESSION ILLNESS REPORTING FORM

This reporting form is entirely confidential. This is not an insurance claim form. Send form to:  
Divers Alert Network, Box 3823, Duke University Medical Center, Durham, North Carolina 27710

<b>DATE &amp; TIME OF ACCIDENT</b>			
MONTH/DAY/YEAR			
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Time _____		AM	PM

<b>IS THIS A FATALITY REPORT?</b>	
<input type="checkbox"/> YES	<input type="checkbox"/> NO

For DAN Office Use Only

CASE	<input type="text"/>
SEVERITY CODE	<input type="text"/>
BMI	<input type="text"/>

<b>1. PATIENT NAME</b>			<b>2. OCCUPATION</b>		
LAST	FIRST	MI			

<b>3. ADDRESS</b>					
STREET			CITY	ST	ZIP

<b>4. PATIENT PHONE (HOME)</b>		<b>5. PATIENT PHONE (WORK)</b>		<b>6. COUNTRY (IF NOT USA)</b>	

<b>7. AGE YRS</b>	<b>8. SEX M or F</b>	<b>9. HEIGHT FT IN</b>	<b>10. WEIGHT LBS.</b>	<b>11. CERTIFYING AGENCY</b>	<b>12. CERTIFICATION LEVEL</b>	<b>13. DAN MEMBER?</b>		
<input type="text"/> <input type="text"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/>	<input type="checkbox"/> A - PADI B - NAUI C - NASDS	<input type="checkbox"/> D - YMCA E - SSI F - Other G - None	<input type="checkbox"/> A - Basic B - Open Water C - Advanced D - Divemaster E - Instructor	<input type="checkbox"/> F - Commercial G - Other H - None I - Student	<input type="checkbox"/> Y - Yes N - No

<b>14. YEARS DIVING</b>	<b>15. NUMBER OF DIVES MADE</b>	<b>16. PREVIOUS DIVE ACCIDENTS</b>	<b>17. CURRENT MEDICATIONS</b>	<b>18. CIGARETTE USE</b>	
YEARS <input type="text"/> <input type="text"/>	MONTHS <input type="text"/> <input type="text"/>	<input type="checkbox"/> Total <input type="text"/> <input type="text"/> Previous 12 months <input type="text"/> <input type="text"/>	<input type="checkbox"/> A - Possible DCS B - DCS C - AGE D - Pul. barotrauma E - None	<input type="checkbox"/> Prescription <input type="checkbox"/> Non-prescription List <input type="text"/>	<input type="checkbox"/> A - Presently B - In past C - Never <input type="checkbox"/> Packs per day

<b>19. PREVIOUS MAJOR ILLNESSES/ SURGERY</b> (Provide up to 3 responses)		<b>20. CURRENT HEALTH PROBLEMS WITHIN PREVIOUS 2 MONTH</b> (Provide up to 3 responses)	
<input type="checkbox"/> A - Chest-lung <input type="checkbox"/> B - Asthma <input type="checkbox"/> C - Chest-heart <input type="checkbox"/> D - Gastrointestinal/Abdomen <input type="checkbox"/> E - Brain <input type="checkbox"/> F - Spine/Back <input type="checkbox"/> G - Limb or joint of DCS site <input type="checkbox"/> H - Circulation/Blood <input type="checkbox"/> I - Neurologic/Nervous system <input type="checkbox"/> J - Muscle/Skeleton system <input type="checkbox"/> K - Eye <input type="checkbox"/> L - Mental/Emotional <input type="checkbox"/> M - Other _____ <input type="checkbox"/> N - None		<input type="checkbox"/> Past: <input type="checkbox"/> A - 2-6 months <input type="checkbox"/> B - 7-12 months <input type="checkbox"/> C - 1-3 years <input type="checkbox"/> D - 2-5 years <input type="checkbox"/> E - 6+ years	
List and describe specific problems: <hr/> <hr/>		List and describe specific problems or additional current medications: <hr/> <hr/>	

PLEASE ATTACH SEPARATE SHEET FOR ADDITIONAL INFORMATION OR NARRATIVE.

I understand that the information in this form will be used for research purposes only, and that all personal information will be kept strictly **confidential**. I also understand that the Divers Alert Network may need to contact me in the future for clarification of information provided on this form.

Patient Signature

## DIVE ACCIDENT

<b>21. PURPOSE OF DIVE</b>	<b>22. DIVE ACTIVITY</b> (up to 2 responses)		<b>23. ENVIRONMENT</b>	<b>24. ALTITUDE OF DIVE</b>	
<input type="checkbox"/> A - Pleasure <input type="checkbox"/> B - Work/Labor	<input type="checkbox"/> A - Wreck <input type="checkbox"/> B - Cave <input type="checkbox"/> C - Night <input type="checkbox"/> D - Photography <input type="checkbox"/> E - Under Instruction	<input type="checkbox"/> F - Providing Instruction <input type="checkbox"/> G - Spearfishing/ Game collecting <input type="checkbox"/> H - Sightseeing	<input type="checkbox"/> A - Freshwater <input type="checkbox"/> B - Saltwater	<input type="checkbox"/> A - Sea Level <input type="checkbox"/> B - > Sea Level but < 1000 ft. <input type="checkbox"/> C - > 1000 ft.	
25. Was this dive or dive series typical of your normal type of diving?		26. DIVER'S PERCEPTION OF TEMPERATURE		27. CURRENT STRENGTH	
<input type="checkbox"/> Y - Yes      IF NO, Explain _____ <input type="checkbox"/> N - No		<input type="checkbox"/> A - Cold <input type="checkbox"/> B - Hot <input type="checkbox"/> C - Comfortable	<input type="checkbox"/> A - Strong <input type="checkbox"/> B - Moderate <input type="checkbox"/> C - Mild <input type="checkbox"/> D - None		
<b>28. AIR SUPPLY</b>	<b>29. AIR CONSUMPTION</b>	<b>30. BUOYANCY PROBLEM</b>	<b>31. RAPID ASCENT</b>	<b>32. WITHIN LIMITS-Y or N</b>	<b>33. TYPE OF SUIT</b>
<input type="checkbox"/> A - Scuba Air <input type="checkbox"/> B - Surface Supply Air <input type="checkbox"/> C - Mixed gas <input type="checkbox"/> D - None/Breath-hold dive	<input type="checkbox"/> A - Ran low <input type="checkbox"/> B - Out of air <input type="checkbox"/> C - Not a problem <input type="checkbox"/> D - Buddy breathing (not octopus)	<input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No	<input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No	<input type="checkbox"/> Tables (which table _____) or <input type="checkbox"/> Computer (type _____)	<input type="checkbox"/> A - Wet <input type="checkbox"/> B - Partial Wet <input type="checkbox"/> C - Dry <input type="checkbox"/> D - Lycra <input type="checkbox"/> E - Swim
<b>34. EQUIPMENT USED ON DIVE:</b> (please check all that apply)		<b>35. EQUIPMENT MALFUNCTION:</b>		<b>36. TYPE OF DIVE</b>	<b>37. WOMEN, PLEASE RESPOND</b> (up to 2 responses)
<input type="checkbox"/> Depth gauge <input type="checkbox"/> Timing device/watch <input type="checkbox"/> Buoyancy vest <input type="checkbox"/> BC Inflator hose in use <input type="checkbox"/> Decompression computer		<input type="checkbox"/> A - None <input type="checkbox"/> B - Regulator <input type="checkbox"/> C - BC Vest <input type="checkbox"/> D - Weight belt <input type="checkbox"/> E - Dry suit <input type="checkbox"/> F - DC Computer <input type="checkbox"/> G - Inflator hose <input type="checkbox"/> H - Contaminated air supply	<input type="checkbox"/> I - Equipment was not familiar to you. <input type="checkbox"/> J - Other Reason: _____	<input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No  <input type="checkbox"/> Single <input type="checkbox"/> Repetitive	When the accident occurred, were you: <input type="checkbox"/> A - Menstruating <input type="checkbox"/> B - On birth control medication <input type="checkbox"/> C - Pregnant <input type="checkbox"/> D - None of the above
<b>38. DIVE LOCATION:</b>		<b>39. How long ago was your last Dive Trip/Series?</b>		<b>40. STRENUOUS EXERCISE</b>	
State, Province, or Island: <hr/> _____		Country or nearest country: <hr/> _____		<input type="checkbox"/> Circle one: Days      Weeks      Months	
<b>41. PREDIVE HEALTH</b>		<b>42. ALCOHOL</b>		<b>43. RECREATIONAL DRUG USE</b>	
<input type="checkbox"/> A - Nausea/vomiting <input type="checkbox"/> B - Hangover <input type="checkbox"/> C - Diarrhea <input type="checkbox"/> D - Other <input type="checkbox"/> E - No Problem		Please check: <input type="checkbox"/> None <input type="checkbox"/> Night Before <input type="checkbox"/> Predive <input type="checkbox"/> Between Dives <input type="checkbox"/> Post Dive		Number of drinks, beers, or wine <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <input type="text"/>  <input type="text"/> </div> <div style="text-align: center;"> <input type="text"/>  <input type="text"/> </div> <div style="text-align: center;"> <input type="text"/>  <input type="text"/> </div> </div>	
<b>45. FATIGUE OR LACK OF SLEEP PRIOR TO DIVE?</b>				Prior to, between, or after dive <input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No	
<input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No				<input type="checkbox"/> Y - Yes <input type="checkbox"/> N - No  Do you exercise on a weekly basis? (Y or N) <input type="checkbox"/> # Days per week	
				<input type="checkbox"/> 24 hours predive <input type="checkbox"/> During dive <input type="checkbox"/> 6 hours postdive	

## 46. DIVE SERIES

Please fill in all that apply up to and including your last dive. If you skipped a day please leave that day blank.

**DIVE ACCIDENT (cont.)**

<b>47. DIVE PROFILE FOR DAY OF DIVE ACCIDENT</b>	Computer NDL For Next Dive	Depth / Time	
GROUP LETTER	1st DIVE	2nd DIVE	3rd DIVE
SURFAC INT (MIN)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DEC STOPS (MIN)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DEPTH (FT)	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'
BOTTOM TIME (MIN)	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>
GROUP LETTER	4th DIVE	5th DIVE	6th DIVE
SURFAC INT (MIN)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DEC STOPS (MIN)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DEPTH (FT)	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'	<input type="text"/> 10' <input type="text"/> 20' <input type="text"/> 30'
BOTTOM TIME (MIN)	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/>

**PRE-CHAMBER INFORMATION**

<b>48. INITIAL CONTACT WAS:</b> <input type="checkbox"/> A - DAN Emergency <input type="checkbox"/> B - DAN Non-emergency <input type="checkbox"/> C - Hospital emergency room <input type="checkbox"/> D - Emergency medical service <input type="checkbox"/> E - US Coast Guard <input type="checkbox"/> F - Physician <input type="checkbox"/> G - Dive instructor/shop <input type="checkbox"/> H - Other: _____	<b>49. Total delay from symptom onset to contacting DAN or other medical help:</b> HOURS <input type="text"/> or DAYS <input type="text"/>	<b>50. FLYING OR INCREASED ELEVATION AFTER DIVING AND PRIOR TO TREATMENT?</b> <input type="checkbox"/> A - Commercial airliner <input type="checkbox"/> B - Unpressurized aircraft <input type="checkbox"/> C - Med Evac Flight <input type="checkbox"/> D - Mountain elevation <input type="checkbox"/> E - Does not apply Hours post dive (flew or went into elevation) <input type="text"/> elevation (in feet) <input type="text"/>
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**51. SIGNS & SYMPTOMS**

1st Symptom	<input type="checkbox"/> A - Pain <input type="checkbox"/> B - Rash <input type="checkbox"/> C - Itching <input type="checkbox"/> D - Weakness <input type="checkbox"/> E - Numbness/Tingling <input type="checkbox"/> F - Dizziness/Vertigo <input type="checkbox"/> G - Semi-consciousness <input type="checkbox"/> H - Unconsciousness <input type="checkbox"/> I - Restlessness <input type="checkbox"/> J - Extreme fatigue <input type="checkbox"/> K - Visual disturbance <input type="checkbox"/> L - Speech disturbance <input type="checkbox"/> M - Headache <input type="checkbox"/> N - Paralysis <input type="checkbox"/> O - Difficulty breathing <input type="checkbox"/> P - Nausea/Vomiting <input type="checkbox"/> Q - Hemoptysis/coughing blood from lungs	R - Muscle twitching <input type="checkbox"/> S - Convulsions <input type="checkbox"/> T - Hearing loss <input type="checkbox"/> U - Ringing ears <input type="checkbox"/> V - Decreased skin sensation <input type="checkbox"/> W - Bladder problem <input type="checkbox"/> X - Bowel problem <input type="checkbox"/> Y - Personality change <input type="checkbox"/> Z - Difficulty walking/standing <input type="checkbox"/> 1 - Reflex change <input type="checkbox"/> 2 - Other: _____
2nd Symptom		
3rd Symptom		
4th Symptom		
5th Symptom		
6th Symptom		

**52. LOCATION:** Block A = location of symptom  
Then please check (✓)  
L = Left R = Right B = Bilateral/Both Sides

1st Symptom	A	L	R	B	A	S
2nd Symptom	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
3rd Symptom	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
4th Symptom	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
5th Symptom	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
6th Symptom	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>

**53. SYMPTOM ONSET:**

	HOURS	MINUTES	or	BEFORE SURFACING FROM DIVE
1st Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>
2nd Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>
3rd Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>
4th Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>
5th Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>
6th Symptom	<input type="text"/>	<input type="text"/>		<input type="text"/>

**54. ANY OF THE SYMPTOMS FROM #51 PRIOR TO THE LAST DIVE?**

<input type="checkbox"/> Y - Yes	If yes, which symptoms?
<input type="checkbox"/> N - No	
1st <input type="text"/>	Other <input type="text"/>
2nd <input type="text"/>	Explain: _____
3rd <input type="text"/>	_____
4th <input type="text"/>	_____
5th <input type="text"/>	_____
6th <input type="text"/>	_____

**55. FIRST AID ADMINISTERED BEFORE HOSPITAL OR CHAMBER HELP WAS RECEIVED?**

- Y - Yes  
N - No
- Oxygen  
 Aspirin  
 Oral fluids  
 Head down position/  
Trendelenburg

If oxygen was received was delivery by:  
 A - Demand valve  
 B - Freeflow valve  
 C - Don't know

**PRE-CHAMBER INFORMATION (cont.)****56. HOSPITAL TREATMENT ADMINISTERED**

(Please check all that apply):

- |                                      |   |
|--------------------------------------|---|
| <input type="checkbox"/> None        | <input type="checkbox"/> Steroids         |
| <input type="checkbox"/> Oral fluids | <input type="checkbox"/> Anticoagulant    |
| <input type="checkbox"/> IV fluids   | <input type="checkbox"/> Aspirin          |
| <input type="checkbox"/> Oxygen      | <input type="checkbox"/> Other medication |
- 
- 

**57. RELIEF BEFORE CHAMBER TREATMENT?**

- A - Complete  
 B - Partial  
 C - Temporary  
 D - None

**59. PRE-CHAMBER RELIEF OCCURRED:**

- A - Without first aid or medical care  
 B - Following first aid  
 C - Following pre-chamber hospital care  
 D - No relief occurred

**58. IF ANY RELIEF OCCURRED, WHICH SYMPTOMS FROM #51 ABOVE?**(Please check):  
 1st   
 2nd   
 3rd   
 4th   
 5th   
 6th 
**CHAMBER TREATMENT****60. CHAMBER TREATMENT FACILITY LOCATION**

CITY

<input type="checkbox"/>						
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

STATE

COUNTRY

<input type="checkbox"/>						
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Date &amp; Time of Treatment

MONTH/DAY/YEAR

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Time _____	AM	PM
--------------------------	--------------------------	--------------------------	--------------------------	------------	----	----

Name of hyperbaric facility:

<input type="checkbox"/>						
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Treating doctor

<input type="checkbox"/>						
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Form Completed By

**61. TYPE OF CHAMBER (please check)**

- |   |   |
|---|---|
| Initial Treatment                                   | Retreatment Chamber                           |
| <input type="checkbox"/> Monoplace                  | <input checked="" type="checkbox"/> Monoplace |
| <input type="checkbox"/> Dualplace                  | <input type="checkbox"/> Dualplace            |
| <input checked="" type="checkbox"/> Multiplace      | <input type="checkbox"/> Multiplace           |
| <input type="checkbox"/> No chamber treatment given |   |

**62. TOTAL DELAY FROM SYMPTOM ONSET TO RECOMPRESSION**HOURS      or      DAYS  

<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------

**64. TABLE EXTENSIONS REQUIRED?** Y - Yes  
 N - No**63. INITIAL TREATMENT**

- A - USN TT4  
 B - USN TT5  
 C - USN TT6  
 D - USN TT6A  
 E - HART Protocol  
 F - KINDWALL Protocol  
 G - 45 fsw 90 min  
 H - 33 fsw 120 min  
 I - Other
- 

**66. RETREATMENT GIVEN (Provide up to 3 responses)**

NUMBER OF TREATMENTS

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

- A - USN TT4  
 B - USN TT5  
 C - USN TT6  
 D - USN TT6A  
 E - HART Protocol  
 F - KINDWALL Protocol  
 G - 45 fsw 90 min  
 H - 33 fsw 120 min  
 I - Other
- 

**67. RELIEF AFTER HYPERBARIC THERAPY COMPLETED?**

- A - Complete  
 B - Partial  
 C - Temporary  
 D - Hyperbaric therapy not completed  
 E - None

**68. RESIDUAL SYMPTOMS AFTER HYPERBARIC THERAPY COMPLETED?**

- A - Pain only  
 B - Neurologic  
 C - Hyperbaric therapy not completed  
 D - None

**65. RELIEF AFTER INITIAL TREATMENT OF SYMPTOMS FROM # 51?**

- 1st   
 2nd   
 3rd   
 4th   
 5th   
 6th
- Please indicate:  
 A - Complete  
 B - Partial  
 C - Temporary  
 D - None

**69. DURATION OF RESIDUAL SYMPTOMS**(Circle one)  
 DAYS  
 WEEKS  
 MONTHS  


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**70. FINAL DIAGNOSIS:**

- A - DCS I  
 B - DCS II  
 C - Air Embolism  
 D - Pulmonary Barotrauma  
 O - Other
- 

**I WOULD LIKE TO RECEIVE DAN INFORMATION.** Y - Yes  
 N - No



# Diving Fatality Reporting Form

This reporting form is entirely confidential. This is not an insurance claim form. Send form to:  
Divers Alert Network, Box 3823, Duke University Medical Center, Durham, North Carolina 27710  
Fatality Research (919) 684-2948

*DAN research use only:*

DAN CN \_\_\_\_\_ Source 1 \_\_\_\_\_ Source 2 \_\_\_\_\_ Source 3 \_\_\_\_\_ Source 4 \_\_\_\_\_  
ME CN \_\_\_\_\_ First Contact \_\_\_\_\_  
IA CN \_\_\_\_\_ Telephone \_\_\_\_\_ - (\_\_\_\_\_) - \_\_\_\_\_ - \_\_\_\_\_  
Diver classification \_\_\_\_\_ Region \_\_\_\_\_

**Diver Information**

Date / time of accident \_\_\_\_\_

Date / time of death \_\_\_\_\_

Accident location \_\_\_\_\_

County \_\_\_\_\_ State \_\_\_\_\_ Country \_\_\_\_\_

Death location \_\_\_\_\_

County \_\_\_\_\_ State \_\_\_\_\_ Country \_\_\_\_\_

Name of deceased \_\_\_\_\_ last \_\_\_\_\_ first \_\_\_\_\_ middle \_\_\_\_\_

Occupation \_\_\_\_\_

Date of birth \_\_\_\_\_

Age \_\_\_\_\_ Sex (please circle) Male \_\_\_\_\_ Female \_\_\_\_\_ Race \_\_\_\_\_

Height (please circle) \_\_\_\_\_ feet & inches centimeters \_\_\_\_\_ Weight (please circle) \_\_\_\_\_ pounds kilograms \_\_\_\_\_

Marital status \_\_\_\_\_ Next of kin \_\_\_\_\_ Relationship \_\_\_\_\_

Next of kin telephone \_\_\_\_\_ - (\_\_\_\_\_) - \_\_\_\_\_ - \_\_\_\_\_

**Diver Experience**

Certified (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_

Certifying agency (please circle) BSAC \_\_\_\_\_ CMAS \_\_\_\_\_ NASDS \_\_\_\_\_ NAUI \_\_\_\_\_ PADI \_\_\_\_\_ PDIC \_\_\_\_\_ SSI \_\_\_\_\_ YMCA \_\_\_\_\_ None \_\_\_\_\_

Other \_\_\_\_\_

Certification level (please circle) Open Water \_\_\_\_\_ Open Water I \_\_\_\_\_ Open Water II \_\_\_\_\_ Advanced \_\_\_\_\_ Rescue \_\_\_\_\_ Divemaster \_\_\_\_\_  
Instructor Assistant Instructor Commercial Other \_\_\_\_\_ None \_\_\_\_\_ Student \_\_\_\_\_

Number of years diving \_\_\_\_\_ years \_\_\_\_\_ months \_\_\_\_\_

Total lifetime dives made \_\_\_\_\_ Number of dives made in past year \_\_\_\_\_

Time since last dive series \_\_\_\_\_ days \_\_\_\_\_ months \_\_\_\_\_ years \_\_\_\_\_

General experience level (please circle) Non-certified \_\_\_\_\_ Novice (0 to 5 dives) \_\_\_\_\_ Inexperienced (6 to 20 dives) \_\_\_\_\_

Intermediate (21 to 40 dives) \_\_\_\_\_ Advanced (41 to 60 dives) \_\_\_\_\_ Experienced (61+ dives) \_\_\_\_\_

Experience level with activity / environment (please circle) Non-certified \_\_\_\_\_ Novice (0 to 5 dives) \_\_\_\_\_

Inexperienced (6 to 20 dives) \_\_\_\_\_ Intermediate (21 to 40 dives) \_\_\_\_\_ Advanced (41 to 60 dives) \_\_\_\_\_ Experienced (61+ dives) \_\_\_\_\_

**Diver Health**

Previous major illness \_\_\_\_\_ When \_\_\_\_\_ years \_\_\_\_\_ months \_\_\_\_\_

Current health problems \_\_\_\_\_

Undiagnosed health problems \_\_\_\_\_

Current Medications Prescription (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_ (please list) \_\_\_\_\_

Nonprescription (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_ (please list) \_\_\_\_\_

Previous dive accidents (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_ (please list) \_\_\_\_\_

Physically fit (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_

Regular exercise (please circle) Yes \_\_\_\_\_ No \_\_\_\_\_

<b>Cigarette use</b> (please circle)	Have never smoked	Have smoked in past	Presently smoke				
Years smoking _____	Packs per day _____						
<b>Predive health</b> (please circle)	Nausea	Hangover	Diarrhea	Predive alcohol	No problem		
Other _____							
<b>Influences at accident time</b> (please circle)		Alcohol	Recreational drugs	None			
<b>Mental status</b> (please circle)	Stressed	Anxious	Quiet	Agitated	Talkative	Depressed	No problem
Other _____							
<b>Fatigue</b> (please circle)	Yes	No					

**Dive Conditions**

<b>Type of water entry</b> (please circle)	Shore	Private boat	Charter boat	Pool	
Other _____					
<b>Altitude of dive</b> (please circle)	Sea level (below 1,000 feet)	Greater than 1,000 but less than 3,000 feet			
Greater than 3,000 feet					
<b>Water environment</b> (please circle)	Saltwater	Freshwater			
<b>Water temperature</b> _____ °F °C	<b>Water depth</b> (please circle) _____ feet metres				
<b>Seas</b> _____	<b>Visibility</b> (please circle) _____ feet metres				
<b>Surge</b> _____	<b>Current</b> (please circle) None Mild Moderate Strong				
<b>Bottom type</b> _____					
<b>Weather conditions</b> (describe) _____	<b>Air temperature</b> _____ °F °C				
<b>Overhead environment</b> (please circle)	Yes	No			
(if yes, please circle)	Cavern	Cave	Ice	Wreck penetration	
Other _____					
<b>Diver's first time at location</b> (please circle)	Yes	No	<b>Surface observer</b> (please circle)	Yes	No
<b>Surface tender</b> (please circle)	Yes	No			

**Dive Profile****Dive activity** (please circle)

<b>Primary</b>	Wreck (no penetration)	<b>Secondary</b>	Wreck (no penetration)
	Wreck (penetration)		Wreck (penetration)
	Cave		Cave
	Cavern		Cavern
	Night		Night
	Ice		Ice
	Photography		Photography
	Under instruction		Under instruction
	Providing instruction		Providing instruction
	Spearfishing / game collection		Spearfishing / game collection
	Pleasure / sightseeing		Pleasure / sightseeing
	Work / task; commercial; deep dive		Work / task; commercial; deep dive
	Other _____		Other _____

**Specialty dive** (please circle) Yes No**Buddy** (please circle) Yes No**Number in buddy team** \_\_\_\_\_**Single dive** (please circle) Yes No**Nitrogen narcosis** (please circle) Yes No**Trapped** (please circle) Yes No**Dive profile** Dive 1

Depth (feet) \_\_\_\_\_

Bottom time (min) \_\_\_\_\_

Surface interval (hours / min) \_\_\_\_\_

hours : min

**Specialty certified** (please circle) Yes No**Buddy separation** (please circle) Yes No**Number in dive party** \_\_\_\_\_**Decompression dive** (please circle) Yes No**Lost** (please circle) Yes No**Entangled** (please circle) Yes No

Dive 2

Dive 3

hours : min

hours : min

**Dive Equipment & Problems****Familiar with equipment (please circle)** Yes No**Equipment source (please circle)** Borrowed Rented Owned**Dive computer (please circle)** Yes No

<i>Computer</i>	<i>Model</i>	<i>Computer</i>	<i>Model</i>
Beuchat		Scubapro	
Dacor		Sherwood	
Mares		Suunto	
Oceanic		Tekna	
Orca		U.S. Divers	
Parkway		Other	
		Unknown	

**Air supply (please circle)** Scuba Surface-supplied Mixed-gas scuba Mixed-gas surface Breathhold diving

Rebreather Bad air supply

**Air tested (please circle)** Yes No Agency \_\_\_\_\_**Air consumption (please circle)** Not a problem Low on air Out of air Buddy breathing / sharing air**Exposure suit (please circle)** Wet Partial wet Dry Lycra Swim None Other \_\_\_\_\_**Weight belt (please circle)** \_\_\_\_\_ lbs kgs **Weight belt dropped (please circle)** Yes No**Buoyancy problem (please circle)** Yes No **Rapid ascent (please circle)** Yes No**Infrequent diver (please circle)** Yes No **Equipment problems (please circle)** Yes No**List problems (1) \_\_\_\_\_ (2) \_\_\_\_\_ (3) \_\_\_\_\_****Recovery & First Aid****Was event witnessed (please circle)** Yes No **By whom** \_\_\_\_\_**How long into the dive did the problem occur** \_\_\_\_\_ (minutes) \_\_\_\_\_ (feet)**When problem occurred (please circle)** Surface pre-dive Immediately Early dive Mid-dive Late dive Post-dive

Unobserved

**Where problem occurred (please circle)** Surface pre-dive Descent Bottom Ascent Surface post-dive Unobserved**Signs of diver in distress (please circle)** Yes No **Panic (please circle)** Yes No**Immediate search (please circle)** Yes No

If no, after \_\_\_\_\_ (days) \_\_\_\_\_ (hours) \_\_\_\_\_ (minutes)

**Body recovered (please circle)** Yes No

If yes, after \_\_\_\_\_ (days) \_\_\_\_\_ (hours) \_\_\_\_\_ (minutes)

**CPR done (please circle)** Yes No Not applicable**Oxygen available (please circle)** Yes No **Oxygen administered (please circle)** Yes No Not applicable**USCG (please circle)** Yes No **Medevac (please circle)** Yes No**Emergency Treatment****Hospital** \_\_\_\_\_**Location (city, state, country)** \_\_\_\_\_**Contact** \_\_\_\_\_**Telephone** \_\_\_\_\_ - (\_\_\_\_\_) - \_\_\_\_\_**Hyperbaric treatment (please circle)** Yes No**Type of chamber (please circle)** Monoplace Dualplace Multiplace**Attending physician** \_\_\_\_\_**Hospital treatment including hyperbaric treatment**


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**Investigative Report**

**Agency** (please circle)      Police      Sheriff      USCG      Other

**Investigator / Contact** \_\_\_\_\_

**Telephone** \_\_\_\_\_ - (\_\_\_\_\_) - \_\_\_\_\_

**Accident scenario** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Medical Examiner Report**

**Medical Examiner's name** \_\_\_\_\_ **Coroner's name** \_\_\_\_\_

**Address** (street, city, state, zip, country)  
\_\_\_\_\_  
\_\_\_\_\_

**Place death was registered** \_\_\_\_\_

**Probable cause of death** \_\_\_\_\_

Due to or as a result of 1 \_\_\_\_\_

Due to or as a result of 2 \_\_\_\_\_

Due to or as a result of 3 \_\_\_\_\_

Due to or as a result of 4 \_\_\_\_\_

Due to or as a result of 5 \_\_\_\_\_

DAN research use only:

ICD-9-CM \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

**Contributing condition(s)**

1 \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

2 \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

3 \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

4 \_\_\_\_\_

ICD-9-CM \_\_\_\_\_

**Manner of death** (please circle)      Natural      Accident      Homicide      Suicide      Pending

**Autopsy done** (please circle)      Yes      No

**Organ donor** (please circle)      Yes      No

**Organs harvested** (please list)  
\_\_\_\_\_  
\_\_\_\_\_

**Individual Submitting This Report**

**Name** \_\_\_\_\_ **Daytime Telephone Number** \_\_\_\_\_ - (\_\_\_\_\_) - \_\_\_\_\_ - \_\_\_\_\_

**Address** (street, city, state, zip, country)  
\_\_\_\_\_  
\_\_\_\_\_

I understand that the information in this form will be used for research purposes only and that all personal information will be kept strictly confidential. I also understand that Divers Alert Network may need to contact me in the future for clarification of information provided on this form.

**Signature** \_\_\_\_\_

**Diving Emergencies** (919) 684-8111 • **Medical/Safety Information** (919) 684-2948 • **FAX** (919) 493-3040

# Appendix D

## Fatality Location Tables

*U.S. Fatalities from 1970 to 1993 in Foreign Areas*

Country	1970-1979	1980-1989	1990-1992	1993	Country Totals
Anguilla		1			1
Antigua		1			1
Aruba	1				1
Australia	1	2			3
Bahamas	17	19	6	1	43
Barbados		2			2
Bequia			1		1
Bermuda	1	1	1		3
Belize	2	4	1		7
Bonaire			2	1	3
British Virgin Islands		4			4
Canada	7	6	1		14
Caribbean Area	27		2		29
Cayman Islands	3	5	2	2	12
Central America	1				1
Costa Rica		1			1
Cuba		2			2
Dominica			1		1
Egypt			1		1
Fiji Islands		2			2
French Antilles		2			2
Greece	3	1			4
Honduras		2	1	1	4
Italy			2		2
Jamaica			3		3
Malaysia		1			1
Martinique		1	1		2
Mediterranean Area	2				2
Mexico	18	28	15	6	67
Micronesia			1		1
Morocco		1			1
Netherlands Antilles		2			2
New Caledonia		1			1
Okinawa	11	3	2		16
Palau			1		1
Panama			1		1
Phillipines		2			2
Portugal		1			1
Red Sea		3			3
St. Martin			1		1
St Vincent/Grenadines		4			4
Saipan		1	1		2
Tahiti				1	1
Thailand		1			1
Saudi Arabia		2			2
Unknown		1			1
<b>Totals</b>	<b>94</b>	<b>107</b>	<b>47</b>	<b>12</b>	<b>260</b>

# Fatality Location Tables

## *U.S. Fatalities from 1970 to 1993 by State*

State	1970-1979	1980-1989	1990-1992	1993	State Totals
Alabama	4	2	1		7
Alaska	9	9	2		20
Arizona	2	4			6
Arkansas	5	8	1		14
California	262	155	39	15	471
Colorado	4				4
Connecticut	9	9	1		19
Delaware		3	1	1	5
Florida	297	231	58	27	613
Georgia	9	11	1		21
Hawaii	63	54	8	7	132
Idaho	2	4			6
Illinois	10	3	1		14
Indiana	6	1	1		8
Iowa	3		2		5
Kansas	1				1
Kentucky	3	1			4
Louisiana	6	5	3	1	15
Maine	17	8	5		30
Maryland	9	1			10
Massachusetts	39	32	5	3	79
Michigan	33	12	2	2	49
Minnesota	5	4	1		10
Mississippi	1	3			4
Missouri	18	3	5		26
Montana		2	1		3
Nebraska	4	5			9
Nevada	4	2	1	1	8
New Hampshire	4	4			8
New Jersey	25	15	11	1	52
New Mexico	6	4	2		12
New York	38	21	10	3	72
North Carolina	8	12	3		23
Ohio	9	6	2		17
Oklahoma	2	1		1	4
Oregon	15	11	2	3	31
Pennsylvania	7	7	10	1	25
Rhode Island	11	19	4		34
South Carolina	7	3		1	11
South Dakota	1		1		2
Tennessee	5	4	2		11
Texas	32	19	4	2	57
Utah	14	5	1		20
Vermont	2	1			3
Virginia	9	5		1	15
Washington	96	67	8	2	173
West Virginia	1		1		2

# Fatality Location Tables

## *U.S. Fatalities from 1970 to 1993 by Territory*

U. S. Territory	1970-1979	1980-1989	1990-1992	1993	Territory Totals
Guam	1				1
Marshall Island	1				1
Puerto Rico	4	5	1		10
Virgin Islands	1	11	3	6	21
<b>Totals</b>	<b>7</b>	<b>16</b>	<b>4</b>	<b>6</b>	<b>33</b>

# Appendix E: DAN's Diving Incident Report Form

One day you may find yourself several fathoms underwater when, unexpectedly, you run out of air. Hopefully you'll revert to your training, quickly solve the situation and escape unharmed. What you do afterwards could help a lot of other divers.

An explanation of exactly how the situation occurred could help prevent others from having similar experiences in the future. Reporting events leading to near-misses also can give researchers important insights into the causes of diving accidents and deaths.

This type of incident reporting procedure is being used with great success in other industries. For example, pilots involved in inadvertent violations of flight regulations or incidents that didn't entail damage to property or people have the opportunity to confess via an incident reporting form to NASA.

Though the reports offer some degree of legal protection for pilots, the real aim is to help aviators learn more about the type of incidents that lead to accidents. The effect of these forms, combined with lessons from aviation accident and fatality data, has made a significant contribution to aviation safety.

This is precisely the type of impact DAN hopes to make with the new Diving Incident Report Form. According to DES Australia's Dr. Chris Acott, the developer of the original incident reporting process, most diving incidents don't cause any harm. Reporting these events provides researchers with valuable information.

Filling out the facing questionnaire may at times seem a chore, but the DAN research staff urges you to do it as soon as you can after a dive where you encountered a near-miss. Don't waste your valuable experiences — share them for the benefit of all.

The key to using the Diving Incident Report Form is understanding the meaning of the word "incident." DAN defines an incident as any error that could — or did — compromise the safety margin for a diver on a particular dive. You, your dive buddy or someone else may experience a problem that has the potential to cause injury to a dive party member.

Dr. Acott requests that you keep a few guidelines in mind when completing the form. First, be sure to fill out the first page completely, checking all appropriate boxes.

You should also describe the incident in your own words, including in detail any factor which you believe may have contributed to — or minimized — the incident. Suggestions on measures which might be employed in the future to prevent a similar incident from happening again are also requested. Extra space is provided on the back of the form for these firsthand reports. Feel free to use more paper, if necessary.

If more than one incident occurred, divers should fill out a separate form for each incident. Confidentiality is an important part of the Diving Incident Report Form, so please don't identify any person involved.

The Diving Incident Report Form is distributed by DAN all over the world. We encourage all divers to help in this process. Feel free to make photocopies of the form and place a few in your logbook. Dive stores and charter boat operators are also encouraged to make photocopies of the form and keep a supply on hand.

After the forms are filled out, return them to DAN's Medical Division, where they will be processed. This will lead to the creation of a database of diving incidents.

DAN believes this information can be used to help form a more complete picture of the causes of a variety of diving accidents. And that data should help all divers better understand how to prevent accidents and incidents from occurring in the first place.

If you would like to request additional Diving Incident Report Forms, or if you need more information about this program, call DAN at (919) 684-2948, extensions 237 or 269.



# DIVING INCIDENT REPORT FORM

Please return this completed form to:

Divers Alert Network, Attn: Medical Division, 3100 Tower Blvd., Suite 1300,  
Durham, NC 27707 USA. Phone (919) 684-2948; fax (919) 490-6630.

All the following questions relate to the particular dive involved in the incident. They do not, however, have to be filled out by the diver involved, but by **the person observing the incident**.

## THE INCIDENT

1. On the back of this form, please briefly describe the incident. To report more than one incident, you may photocopy this form.
2. Whose incident was it?  
 yours     your buddy's     someone else's
3. When was it detected?  
 preparation     during dive     descent     entry     ascent     after exit
4. Did any harm result to anyone?  Yes     No
5. Do you think any of the following factors contributed to the incident (you may need to check more than one)?  

<input type="checkbox"/> none	<input type="checkbox"/> poor dive planning	<input type="checkbox"/> drug or alcohol intake
<input type="checkbox"/> anxiety about the dive	<input type="checkbox"/> poor servicing of equipment	<input checked="" type="checkbox"/> failure to understand equipment
<input type="checkbox"/> inexperience in diving	<input type="checkbox"/> sea sickness	<input type="checkbox"/> lack of medical clearance to dive
<input type="checkbox"/> weather conditions	<input type="checkbox"/> insufficient training	<input type="checkbox"/> inadequate supervision
<input type="checkbox"/> poor physical fitness	<input type="checkbox"/> not familiar with diving conditions	<input type="checkbox"/> failure to understand dive table
<input type="checkbox"/> failure to check equipment	<input type="checkbox"/> error in judgment/incorrect decision	<input type="checkbox"/> poor maintenance of equipment
<input type="checkbox"/> haste	<input type="checkbox"/> poor communication	<input type="checkbox"/> malfunction or failure of equipment
<input type="checkbox"/> inattention	<input type="checkbox"/> lack of a buddy check	
6. Did the incident occur while under training?  Yes     No
7. What influence did the incident have on the dive plan?  
 none     delayed the dive     aborted dive     changed the plan
8. Did the incident involve (you may need to check more than one):  

<input type="checkbox"/> none	<input type="checkbox"/> multiple ascents/descents/bounce diving	<input type="checkbox"/> equalization problem on descent
<input type="checkbox"/> out-of-air situation	<input type="checkbox"/> loss of buddy contact	<input type="checkbox"/> giddiness/vertigo
<input type="checkbox"/> rapid ascent	<input type="checkbox"/> marine animal	<input type="checkbox"/> flying/altitude after diving
<input type="checkbox"/> omission of decompression stops	<input type="checkbox"/> equalization problem on ascent	<input type="checkbox"/> problem at safety stop
<input type="checkbox"/> misreading of decompression tables/computer		<input type="checkbox"/> buoyancy problem at decompression stop
9. Was the diver involved:  
 a diving student     untrained     certified diver
10. Diver certification level:  
 basic     open-water     advanced     not known  
 instructor     divemaster     commercial
11. Sex: M    F    Diver's age: \_\_\_\_\_ years     not known
12. Which country did the diver train in? \_\_\_\_\_ Phone no. \_\_\_\_\_ (Please include country & area codes.)
13. Please indicate geographical location of incident. Country \_\_\_\_\_ Phone no. \_\_\_\_\_

## AIR SUPPLY

1. Air consumption:  
 ran low     out of air     not a problem  
 octopus used     not known     buddy breathing
2. If there had been an alternative air source (i.e. a Pony Bottle, "Spare Air"), would it have helped in the situation?  
 Yes     No     Not known
3. Regulator and air supply:  
 didn't check contents gauge regularly     contents gauge inaccurate/failed     problem w/ regulator despite frequent servicing  
 air supply not turned on     unable to read contents gauge at depth     hose rupture  
 second stage problem     first stage problem     not involved

City where normally serviced: \_\_\_\_\_ Phone no. \_\_\_\_\_

Air consumption this dive greater than previous dives:  Yes     No

## BUOYANCY

1. Buoyancy problem:  Yes     No  
 overweighted     air used frequently to maintain buoyancy  
 underweighted     weight belt problem
2. Buoyancy jacket:  

<input type="checkbox"/> not worn	<input type="checkbox"/> vest leaked	<input type="checkbox"/> incorrect use
<input type="checkbox"/> inflation device failed	<input checked="" type="checkbox"/> vest provided inadequate buoyancy	<input type="checkbox"/> not involved
<input type="checkbox"/> inflation device not connected correctly	<input type="checkbox"/> vest uncomfortable to wear	
<input type="checkbox"/> unable to vent vest to slow down	<input type="checkbox"/> unfamiliar with its use	Name/model of vest: _____

## DIVE TABLES/COMPUTER

1. Dive tables used:  
 None     USNavy     RN     BSAC/RNPL     other (specify) \_\_\_\_\_  
 NAUI     DCIEM     BASSETT     PADI
2. Was a dive computer used?  
If so:  stopped working     unable to read number  
 inaccurate     forgot to activate it

Make: \_\_\_\_\_ Model: \_\_\_\_\_



## DIVING INCIDENT REPORT FORM

Please return this completed form to:

**Divers Alert Network, Attn: Medical Division, 3100 Tower Blvd., Suite 1300,  
Durham, NC 27707 USA. Phone (919) 684-2948; fax (919) 490-6630.**

*Describe the incident below. You may include the date and year of the incident, location, weather conditions, or any other information which you feel may be helpful.*

# Appendix F

## ICD-9-CM Codes for Dive-Related Incidents

36.05	Angioplasty
36.10	Coronary artery bypass graft
36.11	CABG — one vessel
36.12	CABG — two vessel
36.13	CABG — three vessel
36.14	CABG — four vessel
36.15	CABG — internal mammary artery
185	Malignant neoplasm — prostate
189.0	Renal cell carcinoma
245.1	Chronic thyroiditis
245.2	Chronic lymphocytic thyroiditis
250.0	Diabetes mellitus
250.4	Diabetes mellitus with glomerulosclerosis
278.0	Obesity, exogenous
293.0	(Nitrogen narcosis) acute delirium
293.0	Acute confusional state
298.0	Reactive depressive psychosis
303.0	Ethanol dependence syndrome .0 unspecified .1 continuous .2 episodic .3 in remission
305	non-dependent drug abuse
305.0	Alcohol abuse (acute)
305.1	Tobacco abuse
308.0	Panic state Acute stress reaction, emotional
336.1	Intraparenchymal hemorrhage of spinal cord
345.9	Epilepsy NOS without intractable epilepsy
347	Cataplexy and narcolepsy
348.1	Anoxic brain damage Anoxic encephalopathy
348.5	Cerebral edema
394.1	Mitral insufficiency
395.0	Aortic stenosis
398.90	Rheumatic heart disease
401.9	Hypertension
402.0	Hypertensive vascular disease (HVD)
404.0	HVD with renal involvement

410.6	True posterior wall infarction
410.9	Acute myocardial infarction
414.0	Coronary atherosclerosis
414.9	(chronic myocardial ischemia)
414.9	Coronary artery disease
425.4	Hypertrophic cardiomyopathy
	Primary cardiomyopathy
427.41	Ventricular fibrillation
427.9	Cardiac dysrhythmia (unspecified)
428.0	Congestive heart failure
428.1	Left heart failure (pulmonary edema)
429.1	Myocardial degeneration
429.2	Arteriosclerotic cardiovascular disease (ASCVD)
429.3	Ventricular hypertrophy (cardiomegaly)
436	Cerebrovascular accident (CVA)
437	Cerebral aneurysm
440	Atherosclerosis aorta
466.0	Acute bronchitis
490	Bronchitis NOS
492.0	Emphysematous blebs
492.8	Pulmonary emphysema
493.9	Asthma (unspecified)
496	Chronic obstructive lung disease
508.9	Pulmonary edema due to external agent
512.0	Spontaneous pneumothorax
518.1	Pneumomediastinum
	Interstitial emphysema, mediastinal emphysema
518.5	Acute respiratory distress syndrome (ARDS)
	Post traumatic pulmonary insufficiency
518.8	Other pulmonary insufficiency
531.9	Stomach ulcer NOS
571.2	Cirrhosis of liver (alcoholic)
571.8	Fatty liver
	Chronic nonalcoholic liver disease
584.5	Lower nephron nephrosis
	Acute tubular necrosis
745.5	Secundum type atrial septal defect
	Patent foramen ovale
753.1	Cystic kidney disease
780.0	Coma
780.3	Seizure disorder
782.3	Pulmonary edema
786.09	Respiratory insufficiency, distress, wheezing
786.3	Pulmonary hemorrhage
789.1	Hepatomegaly
798.1	Instantaneous death, cause not discovered
798.2	Death within 24 hours, cause not discovered

798.9	Body found after 24 hours, cause not discovered (i.e., mutilated, skeletonized, etc.)
799.0	Asphyxia (hypoxemia d/t exertion)
799.9	Death, unspecified cause (body not found)
81.59	Bilateral hip prosthesis
853.0	Hemorrhage, brain — traumatic
854.0	Intracranial injury (head injury) closed or not specified
854.1	Intracranial injury, (head injury) open
860.0	Pneumothorax, tension, traumatic
958.0	Air embolism
958.7	Subcutaneous emphysema
980.0	Ethanol, toxic effect
986	Carbon monoxide poisoning (see E codes)
987.8	Oxygen toxicity
993	Barotrauma
993.0	Barotrauma, otitic
993.1	Barotrauma, sinus
993.3	Decompression sickness
994.1	Drowning and non-fatal submersion
994.5	Exhaustion due to excess exertion
994.8	Effects of electric current
E830	Rowboat drown accident, occupant
E830.1	Powerboat drowning accident, occupant
E838.5	Struck by boat
E902.2	Rapid ascent
E906.3	Shark bites
E910.1	Accident d/t water sports activity
	Recreational activity with diving equipment
E910.3	Diving for purposes other than recreation with diving equipment
	Marine salvage, rescue, construction, etc.
E913.2	Insufficient air
	Accidental suffocation, lack of air
E918	Caught, entangled, entrapment (specify)
E918.1*	Shipwreck
E918.2*	Cave, cavern, marine or freshwater
E918.3*	Ice
E918.4*	Kelp (or other underwater vegetation)
E918.5*	Rope, line, cable, diving equipment
E918.9*	Other entrapment

## Chemical Substances

E868.9	Carbon monoxide accidental effect
E952.1	Carbon monoxide suicide attempt
E934.4	Benzodiazepine

E935.2	Codeine
E935.8	Propoxyphene
E937.0	Butalbital
E939.0	Fluoxetine (Prozac)
E939.0	Nortriptyline
E941.2	Pseudoephedrine
E980.3	Cannabinoids
E980.3	Methamphetamine
E980.4	Cocaine

\* DAN adaptation of code

## Toxicology

**Volatiles** — ethanol, methanol, acetone, isopropanol, and toluene.

**Amphetamines** — includes amphetamine, methamphetamine, phenylpropanolamine, MDA, ephedrine, pseudoephedrine and related compounds.

**Barbiturates** — includes diazepam, chlordiazepoxide, flurazepam, alprazolam, triazolam, oxazepam, and metabolites.

**Opiates** — includes heroin metabolites, morphine, codeine, meperidine, hydromorphone, hydrocodone, and related compounds.

**Cyclic antidepressants** — includes amitriptyline, nortriptyline, imipramine, desipramine, doxepin, chlorpromazine and other related compounds such as cyclobenzaprine, thioridazine, diphenhydramine, and structurally related compounds.

**Antihistamines** — includes diphenhydramine, tripelennamine, chlorpheniramine, and other related compounds.

**Psychotropics** — includes phenothiazines, cyclic antidepressants, antianxiety agents, and other related compounds.

**Organic bases** — includes pentazocine, methaqualone, propoxyphene, strychnine, methadone, ethchlorvynol, quine, chlorinated hydrocarbons, and other related compounds.

## Abbreviations

d/t	due to	CABG	Coronary artery bypass graft
s/p	status post	LAD	Left anterior descending coronary artery
w/o	without	Lcirc	Circumflex coronary artery
ALS	Advanced life support	NOS	Not otherwise specified
ARDS	Adult respiratory distress syndrome	RCA	Right coronary artery
ATN	Acute tubular necrosis		
CAD	Coronary artery disease		

# Appendix G Diving Definitions

**Buoyancy Control** — The ability to maintain neutral buoyancy. Common causes of buoyancy problems include a current pushing a diver either up or down, being either over- or underweighted, overinflation of the buoyancy compensator, or lack of the actual skill.

**Current** — Refers to a strong or moderate current being present during the day of interest.

**Day of Interest** — Usually considered to be the day of the accident.

**Decompression Diving** — Diving exposure requiring staged in-water stops before continuing to the surface.

**Exertion** — The diver may exercise more than normal on a dive on the day of interest. The main causes of exertion during a dive are current or extra equipment (for photography or specialty diving).

**Fatigue** — At the time the diver first entered the water on the day of interest, the diver may have complained of being tired, experiencing a lack of sleep, or a generalized fatigue.

**≥ 80fsw** — At least one dive in the diver's profile on the day of interest is at 80 feet of sea water or deeper.

**< 2 year Experience** — The diver had been diving for less than 24 months on the day of interest.

**Multiday** — More than one day of diving was done in this particular dive series. Multiday and single-day are mutually exclusive.

**Multilevel Dive** — The diver descends to one depth, staying at that depth for a while then either ascending or descending to a new depth for a while. Many different levels can be visited in one dive before finally ascending (for example, a diver descends to 60 feet and stays for 10 minutes then descends to 80 feet and stays for five minutes, ascends to 50 feet for 10 minutes and then to 20 feet for five minutes before surfacing).

**No-Decompression** — A dive which is within the recreational diving limits, not requiring a staged stop to allow the amount of nitrogen in body tissues to decrease before continuing to the surface. This can be with either tables or computers.

**Rapid Ascent** — The currently recognized recommended ascent rate is no faster than 60 feet per minute. A rapid ascent occurs when a diver ascends faster than recommended. Rapid ascents are often uncontrolled and can be caused by overinflation, being underweighted or panic.

**Repeat Dive** — More than one dive was done on the day of interest. Single dive and repeat dive are mutually exclusive.

**Single-Day** — Only one day of diving was done in this particular dive series. Single-day does not denote the number of dives, rather a single day of diving (for example, four dives could be done in a single day, or one dive could be done in a single day).

**Single Dive** — Only one dive was done on the day of interest.

**Square Dive** — The diver descends to maximum depth staying at that depth until ascending to the surface (for example, a diver descends to 60 feet and stays at 60 feet for 30 minutes before ascending). Square and multilevel dives are mutually exclusive.

**Within Tables** — A dive which is within the allowable limits of the dive planning table or device used by the diver.

# Notes

# Notes

# Notes