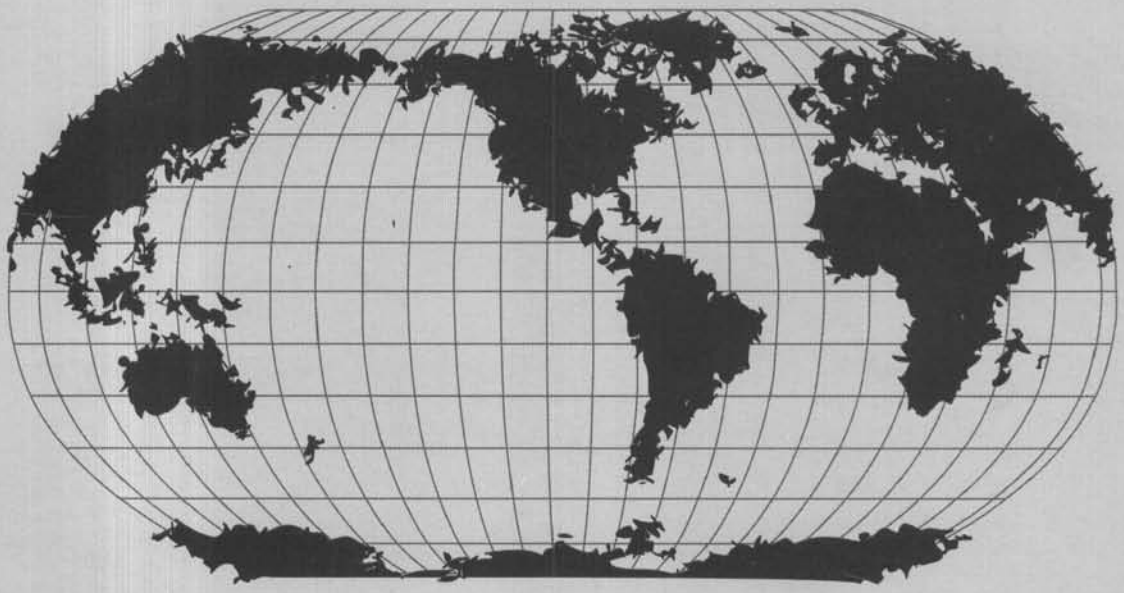
DAN

Report on Diving Accidents & Fatalities

1996 EDITION



THE ANNUAL REVIEW OF
RECREATIONAL SCUBA DIVING
INJURIES AND DEATHS
BASED ON 1994 DATA

RESEARCH

Report on Diving Accidents & Fatalities

1996 Edition

The annual review of recreational scuba diving injuries and deaths based on 1994 data by Divers Alert Network

DAN
Divers Alert Network

Divers Alert Network

The majority of the funding that makes this report possible is from individual DAN member donations.

Divers Alert Network's *Report on Diving Accidents and Fatalities* represents self-reported, retrospective data from chambers who share their accidents or fatality data with DAN. This edition includes accidents and fatalities that occurred in the calendar year of 1994 (Jan. 1-Dec. 31, 1994).

In 1994, 1,164 cases of decompression illness (DCI) were reported to DAN through hyperbaric treatment facilities. DAN received *Diving Accident Reporting Forms* on 858 cases. The DAN database used for 1994 contains 566 DCI cases from the 858 reports sent to DAN. Trends in the accident database are reported on an eight-year period. The *Report* also reviews 97 recreational scuba fatalities.

This is the last DAN Report to receive direct financial support from the National Oceanic and Atmospheric Administration (NOAA Grant NA26RU0449). The Diving Equipment and Marketing Association (DEMA) also contributes financial assistance for the production of this annual Report. DAN annual membership dues provide the majority of the funding for this Report. DAN also wishes to recognize the many DAN Sponsor dive clubs, stores, instructors, corporations and friends of DAN who support DAN and diving safety.

This is also the final report written with the assistance of John J. McAniff of the University of Rhode Island, who is retiring after the 1994 reporting year. McAniff has worked for over 25 years collecting information and reporting on recreational scuba and commercial diving fatalities. He will continue to gather information and report on diving issues involving occupational diving, including commercial, military, scientific and technical diving.

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DAN Report on Diving Accidents & Fatalities: 1996 Edition
Based on 1994 data

Acknowledgments

Data for the *1996 Report on Diving Accidents and Fatalities* has been collected and assembled by DAN employees and associated 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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Stephanie Young M.D.	*Steve Simonson M.D.*
	Bret Stolp M.D., Ph.D.

DAN's network of diving safety is represented worldwide with hyperbaric physicians, DAN on-call staff, nurses and technicians, as well as local sheriff, police, emergency medical personnel, U.S. Coast Guard, medical examiners and coroners.

DAN Regional Coordinators represent worldwide hyperbaric expertise.

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DAN — Your Dive Safety Association

Divers Alert Network (DAN) is a 501(c)(3) nonprofit diving safety association affiliated with Duke University Medical Center in Durham, N.C. DAN was founded in 1980 to provide an emergency hotline to serve injured divers and the medical personnel who care for them. DAN was originally funded by government grants.

Today DAN is privately supported and relies on membership, dive industry sponsors, product sales and fund-raising to remain in service.

Since DAN's inception more than 15 years ago, over 100,000 callers have been assisted by using DAN's 24-Hour Diving Emergency Hotline and the 9-to-5 Medical Information Line.

The DAN Mission

DAN's historical and primary function is to provide emergency medical advice and assistance for underwater diving accidents, to work to prevent accidents and to promote diving safety.

DAN promotes and supports underwater diving research and education, particularly as it relates to the improvement of diving safety, medical treatment and first aid.

DAN strives to provide the most accurate, up-to-date and unbiased information on issues of common concern to the diving public, primarily, but not exclusively, for diving safety.

The 24-Hour Diving Emergency Hotline (919) 684-8111 is DAN's primary service. In addition to the Hotline, DAN offers divers a medical information line to answer nonemergency diving safety and health questions. DAN's Medical Information Line at (919) 684-2948 is available weekdays from 9 a.m. to 5 p.m. Eastern Time (1400-2200 Greenwich Mean Time).

The Medical Information Line is designed to allow callers to talk to a specially trained diving medical technician about nonemergency diving safety and health concerns. If callers need assistance in answering a question, DAN medics have the resources of DAN on-call physicians, the diving medicine researchers at Duke University's F.G. Hall Hypo/Hyperbaric Center and other experts. In some cases, callers may be referred to a diving specialist or physician in their region for further evaluation. Since DAN's inception more than 15 years ago, over 100,000 callers have been assisted by using these telephone services.

DAN's Research Division is dedicated to scientific medical study of diving health issues. One of the most ambitious programs is a study using volunteer test subjects for flying after diving. The experiment, which simulates various dive profiles and a subsequent flight to 8,000 feet/2,432 meters is being researched both by DAN and F.G. Hall Hypo/Hyperbaric Center. Its goal is to develop guidelines for recreational divers regarding safe intervals between scuba diving and flying aboard a commercial airliner.

Other major projects at F.G. Hall include a NASA-funded study testing different nitrogen washout protocols during oxygen breathing (such as exercise, water immersion and body position) to determine which method provides the most protection, and a Surface Interval Oxygen study to extend repetitive dive time, the development of a decompression algorithm for a U.S. Navy dive computer, and the development of in-water oxygen decompression.

Another current study is Project Dive Safety, in which DAN researchers will use recording dive computers to collect information on dive profiles and create the largest database of its kind. This will provide more insight into the behavior, dive profiles and characteristics of recreational scuba divers who may be prone to DCI.

This type of research requires the use of specialized hyperbaric facilities, consultants, software development and staffing — all expensive and privately funded through DAN membership and dive industry support. Without DAN, many important questions about recreational diving safety would remain uninvestigated.

DAN was also a co-sponsor of an international workshop on the treatment of DCI at the annual meeting of the Undersea and Hyperbaric Medical Society in June 1995.

DAN provides important training and financial support to recompression chambers throughout the Caribbean and other popular dive destinations, to ensure that they remain in operation and stay properly staffed. This program complements DAN's biannual dive medical courses for physicians, nurses and paramedics, to educate the international medical community on the proper care and treatment of injured divers.

For scuba instructors and dive enthusiasts, DAN offers the world's most popular oxygen first aid program. Until DAN developed its oxygen training program and line of oxygen equipment, many injured divers did not benefit from emergency oxygen. As of August 1995, more than 30,000 diving enthusiasts and 4,500 diving professionals have been trained under this program. DAN also distributes a line of specialized oxygen delivery systems for the treatment of injured divers.

Without DAN, many important questions about recreational diving safety would remain uninvestigated.

DAN Membership

As of August 1995, there are approximately 150,000 DAN members in the United States, the Caribbean and Canada. As DAN members, they receive the following dive and travel benefits:

DAN member evacuation assistance and dive accident insurance policy records are in one place — at DAN.

In 1994, DAN medical information specialists and physicians responded to 1,951 emergency calls.

■ DAN *TravelAssist*

One of the automatic benefits of DAN Membership is DAN TravelAssist℠, which provides up to $45,000 of emergency medical evacuation assistance for *any* injury or illness — dive related or not — incurred outside a 100-mile radius from home.

■ *Alert Diver* Magazine

DAN members also receive a subscription to award-winning *Alert Diver* magazine, the only publication dedicated to diving safety and health.

■ DAN *Dive and Travel Medical Guide*

DAN members will receive a copy of the DAN *Dive and Travel Medical Guide*, a valuable reference on treating common diving and travel injuries and illnesses.

■ DAN Dive Accident Insurance

All DAN members are eligible for DAN Dive Accident Insurance. DAN currently offers three policies — the Standard, Plus and Master Plans. DAN pioneered dive accident insurance in 1987 and in 1992 launched medical evacuation assistance benefits for its members. These moves helped fill a medical and financial need that was not being met at the time, and provided DAN members with additional benefits. In the past, divers had often been saddled with huge medical bills, because most health insurance would not cover any or all of the charges associated with a diving injury. This problem still exists for some divers, though DAN strives to help bridge this information gap.

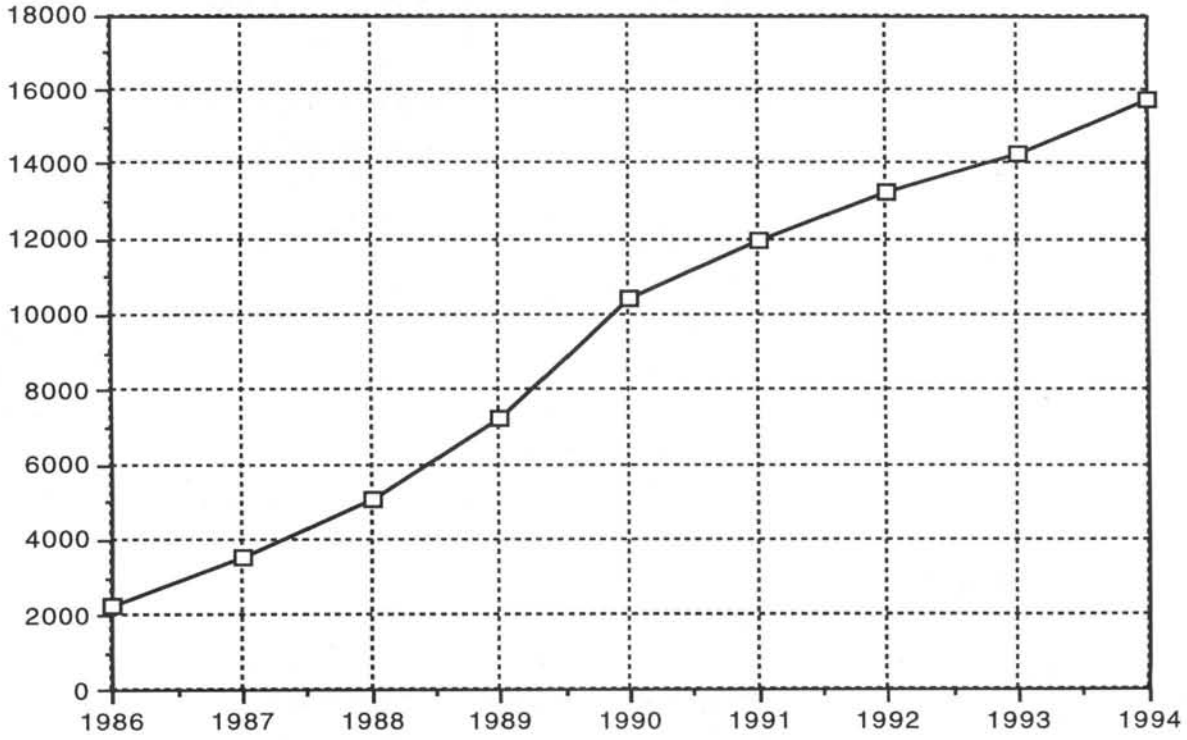
■ DAN Educational Materials and Exclusive Products

DAN's product line includes a variety of books and videos on the subject of dive safety and health. The DAN Product Catalog listing these and other DAN products is available in every issue of *Alert Diver*.

■ DAN Tag

In 1995, DAN introduced the first medical ID tag for divers — the DAN Tag™. Only DAN members can purchase this item. A portion of DAN Tag sales will go directly to support DAN's Diving Emergency Hotline and DAN Dive Research.

DAN Emergency and Information Services Combined Telephone Call Volume



■ DAN 24-Hour Diving Emergency Hotline / Immediate Insurance Verification

Dive and travel medical emergencies can happen at any time, any day of the week. Callers to DAN's 24-hour diving emergency hotline can reach a person who is specially trained and experienced to handle dive and travel medical emergencies ***at any time***, day or night.

With DAN's exclusive record-keeping system, DAN member evacuation assistance and dive accident insurance policy records are in one place — at DAN. As a DAN member, if you (or your friend, spouse or physician) call DAN's 24-Hour Diving Emergency Hotline, membership benefits and insurance coverage can be verified right away, and arrangements can be made for evacuation and recompression treatment.

In 1994, DAN medical information specialists and physicians responded to 1,951 emergency calls.

■ DAN Medical Information Line

When divers have questions about their health and how it might affect their diving, DAN's Medical Information Line is there. Whether it's to find a diving doctor in their area, inquire about medicines and diving or to find out about diving after surgery, the Medical Line is open from 9 a.m.-5 p.m. Eastern Time to help divers. The DAN Medical Department received 13,779 information calls in 1994.

Introduction to Scuba Accidents

The purpose of DAN's accident data collection is to obtain details of how DCS and AGE occur in divers.

This information can then be used to inform and educate the diving community — from the recreational scuba diver to the dive researcher and medical doctor.

Focus on Decompression Illness and Fatalities

The 1996 edition of DAN's *Report on Diving Accidents and Fatalities* is the eighth annual report published by Divers Alert Network. The 1996 edition is based on data gathered in the year 1994 on treated cases of decompression illness and on confirmed fatalities in recreational scuba divers. The Report is divided into two major divisions: the first focuses on diving injuries resulting from decompression illness (DCI); and the second division, beginning with section 6.0, discusses the 97 recreational scuba diving fatalities in the DAN database.

The DAN accident database now contains data on 3,364 cases of DCI treated over the past eight years.

Decompression Illness (DCI)

Decompression illness is a general term used to describe a broad spectrum of signs and symptoms of a scuba diving injury. Arterial gas embolism (AGE) and decompression sickness (DCS) are the conventional terms used to describe two different and specific DCI injuries.

Arterial gas embolism can result after breathing compressed gas followed by voluntary breathholding, or it can result from 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 change in the level of consciousness, paralysis or other cerebral symptoms.

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

Why DAN Collects This Data

DAN collects all accident data to obtain details on how decompression sickness and arterial gas embolism occur in divers. This information is also valuable in determining changes or trends in the types of diving injuries and symptomatology that occurs, as well as how treatment affects the outcome.

This information can then be used to inform and educate the diving community — from the recreational scuba diver to the dive researcher and medical doctor.

Data from previous years has been combined into three-year increments. This is meant to make for easier reading and comparison of results.

How DAN Does It

Each year DAN surveys the hyperbaric recompression facilities that treat injured divers worldwide to determine the number of treated cases of DCI. The annual totals of treated DCI reported to DAN by the hyperbaric chambers (1986-1994) are reported in Table 1.1 (pages 12-13).

Decompression Illness

Table 1.1 shows a breakdown of decompression illness cases by conventional diagnoses, which are:

- **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;
- **Arterial gas embolism** (AGE) represents arterialized gas bubbles primarily associated with immediate cerebral symptoms.

These diagnoses are based upon the diagnoses of the treating physician. Table 1.1 represents the total cases treated in 1994 by the DAN region where the treatment was received. The Caribbean basin area is included in the Southeast totals in Table 1.1.

Table 1.2 (pages 14-16) represents the total number of cases by diagnosis reported to DAN in 1994, separated into regions and then state. The Caribbean basin is represented separately in this table.

The numbers for 1994 represent the total number of treated cases reported from 34 states, 18 countries and four U.S. territories. Although there may be some non-U.S. citizens treated at U.S. facilities, the number of treated cases for any given year refers primarily to U.S. citizens, who are treated both in U.S. and overseas chambers.

The total number of treated decompression illness cases reported and treated annually has been slowly increasing each year (Graph 1.1 — page 19).

The total number of treated DCI cases reported annually has been slowly increasing each year, with the sharpest increase reported from chambers in the United States.

Table 1.1 *Total Reported Cases by Year and Region*

1994	Other•	SW	NW	MW	GU	PA	NE	SE**	TOTALS
DCS-I	3	39	13	13	26	1	39	93	227
DCS-II	14	59	50	24	68	8	85	336	644
AGE	2	18	5	2	16	15	3	30	91
No case breakdown	2	40		11	1	89	6	53	202
TOTALS	**21**	**156**	**68**	**50**	**111**	**113**	**133**	**512**	**1164**

•Includes all foreign countries and US Military personnel (these cases involved active duty military personnel who were diving recreationally and treated in military chambers)

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
TOTALS	**8**	**136**	**64**	**44**	**98**	**92**	**81**	**435**	**958**

•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
TOTALS	**95**	**70**	**51**	**93**	**84**	**73**	**410**	**876***

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
TOTALS	**144**	**35**	**35**	**63**	**59**	**95**	**389**	**820***

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
TOTALS	**104**	**17**	**29**	**75**	**31**	**77**	**362**	**695***

Table 1.1 *(Continued) Total Reported Cases by Year and Region*

1989	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
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
No Treatment++								
TOTALS	**147**	**30**	**38**	**41**	**58**	**65**	**299**	**678***

1988	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
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
TOTALS	**83**	**45**	**23**	**44**	**37**	**66**	**267**	**565***

1987	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
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
TOTALS	**95**	**33**	**16**	**41**	**38**	**65**	**336**	**624***

1986	SW	NW	MW	GU	PA+	NE	SE**	TOTALS
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
TOTALS	**100**	**19**	**15**	**9**	**32**	**44**	**343**	**562***

* *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.*

Table 1.2 *Total Cases Treated & Reported in 1994 by Region*

Table 1.2 represents the total number of cases by diagnosis reported to DAN in 1994, separated into regions and then state.

Southwest Region	DCS-I	DCS-II	AGE	TOTALS
Arizona	3	1	2	13*
California	36	56	16	141
Utah	0	2	0	2
TOTALS	**39**	**59**	**18**	**156***

*Specific diagnoses were not provided in these cases.

Northwest Region	DCS-I	DCS-II	AGE	TOTALS
Alaska	0	2	0	2
Oregon	2	8	2	12
Washington	11	40	3	54
TOTALS	**13**	**50**	**5**	**68**

Midwest Region	DCS-I	DCS-II	AGE	TOTALS
Illinois	4	5	0	9
Indiana	2	4	0	6
Kentucky				2*
Michigan	6	3	0	9
Minnesota			2	9*
Ohio	1	9	0	12*
Wisconsin	0	3	0	3
TOTALS	**13**	**24**	**2**	**50***

*Specific diagnoses were not provided in these cases.

Gulf Region	DCS-I	DCS-II	AGE	TOTALS
Colorado	4	8	2	14
Kansas	6	1	0	7
Louisiana	6	24	1	31
Mississippi	0	0	1	1
New Mexico	2	0	0	2
Oklahoma	1	4	0	5
Texas	7	31	12	51*
TOTALS	**26**	**68**	**16**	**111***

*Specific diagnoses were not provided in these cases.

Pacific Region	DCS-I	DCS-II	AGE	TOTALS
Hawaii			8	85*
Australia				9*
Fiji				3*
Guam	1	8	7	16
TOTALS	**1**	**8**	**15**	**113***

Table 1.2 *(Continued)* *Total Cases Treated & Reported in 1994 by Region*

Northeast Region	DCS-I	DCS-II	AGE	TOTALS
Connecticut	3	4	0	7
Maine	0	4	0	4
Maryland	6	8	0	14
New Jersey	4	15	0	19
New York	11	40	0	51
Pennsylvania	11	8	2	23*
Virginia	4	6	1	15*
TOTALS	**39**	**85**	**3**	**133***

*Specific diagnoses were not provided in these cases.

Southeast Region	DCS-I	DCS-II	AGE	TOTALS
Alabama	4	5	0	9
Florida	43	203	17	268
Georgia	9	4	0	13
North Carolina	14	15	0	29
South Carolina	9	3	2	17
Tennessee	1	2	0	3
TOTALS	**80**	**232**	**19**	**339***

*Specific diagnoses were not provided in these cases.

Caribbean Basin	DCS-I	DCS-II	AGE	TOTALS
Bahamas	0	5	0	5
Barbados	0	5	0	5
Belize	0	7	3	10
Bermuda	0	2	0	2
Bonaire	0	8	0	8
Cabo San Lucas	2	4	0	6
Cayman				33*
Cozumel	4	29	8	41
Honduras	0	15	0	15
Jamaica	3	4	0	7
Martinique	0	1	0	1
Panama (Canal Zone)	1	3		4
Puerto Rico	0	4	0	4
Saba	3	9	0	12
St. Thomas				12*
Turks & Caicos	0	8	0	8
TOTALS	**13**	**104**	**11**	**173***

*Specific diagnoses were not provided in these cases.

The Caribbean basin is represented separately in this table.

Table 1.2 *(Continued)* *Total Cases Treated & Reported in 1994 by Region*

Other	DCS-I	DCS-II	AGE	TOTALS
Canada		1		1
Japan				2*
US Military	3	13	2	18
TOTALS	**3**	**13**	**2**	**21***

*Specific diagnoses were not provided in these cases.

Although there may be some non-U.S. citizens treated at U.S. facilities, the number of treated cases for any given year refers primarily to U.S. citizens, who are treated both in U.S. and overseas chambers

Collection of DAN Database Cases

Divers Alert Network utilizes a network of 247 hyperbaric chambers in the United States and around the world to report decompression illness (DCI) injuries. The DAN network is divided into seven regions, each overseen by a Regional Coordinator (see listing on page 4). These Regional Coordinators remain in contact with the hyperbaric treatment centers in their areas and help collect the dive accident reports which are sent to DAN. They also assist in directing injured divers to area medical centers for evaluation and treatment in their area.

Most chambers send accident reports directly to DAN. Some chambers rely on the patients to fill out the form and send it to DAN, while a few do not offer the forms for reporting.

Each year, DAN surveys hyperbaric treatment centers to solicit their participation in the reporting program. In 1994, 1,164 cases of treated DCI were reported to DAN, while only 858 cases were received at DAN. The names and identifying personal information are confidential and are not available to anyone outside of the DAN research and medical department. Accident data is not used to imply individual fault or blame in determining the cause of scuba accidents. The number of individuals with DCI who did not seek medical attention, or who were not referred for treatment, is unknown.

DAN reporting forms on 1994 data must have been received at DAN Headquarters by July 1, 1995, for inclusion in the 1996 edition of the Report. By this date, DAN had received 858 DAN *Diving Accident Reporting Forms* for 1994. Divers who were treated at more than one hyperbaric facility were counted only once unless there was a second, separate episode of DCI in the same calendar year.

When an accident case is received at DAN it is logged into a computer tracking database. The DAN medical information specialists then follow up on all cases that meet the inclusion criteria. Cases are not followed up if the person involved could not be located, failed to remember accident details or if the case was in litigation. Patients with residual symptoms at the time of follow-up are contacted by DAN three months after the accident or until they no longer have residual symptoms.

In 1994, 1,164 cases of treated DCI were reported to DAN, 858 cases were received at DAN, and of these, 566 cases were completed and included in the DAN accident database

Case Selection Criteria

Of the 858 forms received, 566 were completed and included in the DAN accident database. To be included in the DAN database, a case must meet the following criteria:

- The diver must be a recreational scuba diver using scuba and breathing compressed air only.
- Only scuba instructors or divemasters providing dive instruction are included under "work-related" injuries.
- The diver must be a U.S. or Canadian citizen.
- Final diagnosis by the treating hyperbaric physician must be decompression illness.
- Cases must be received by July 1 of the following year for each collection year (e.g., July 1, 1995 for the 1994 reporting year).

(A discussion of possible diagnostic misclassification is provided on page 48.)

Commercial, occupational and scientific divers are excluded from DAN's DCI accident database, as well as divers using mixed gases, surface-supplied air and breath-hold divers.

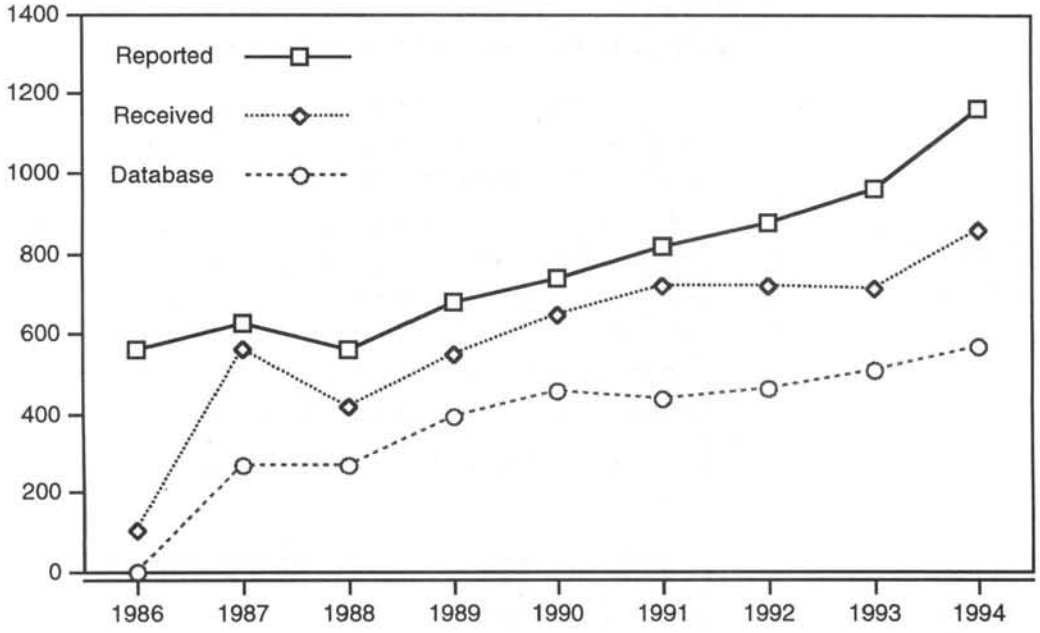
A total of 292 cases was excluded from the DAN accident database for the reasons cited below:

- The injured diver was a commercial, occupational or scientific diver (n = 61);
- The injured diver was a non-U.S. or non-Canadian citizen (n = 90);
- DCI was not diagnosed; i.e., the injury was something else, such as ear barotrauma, pulled muscle, or marine life envenomation (n = 65);
- No hyperbaric treatment was received (n = 2);
- Diver was using mixed gases, surface-supplied air or was breath-hold diving (n = 28);
- Cases in which no follow-up was possible by DAN medical staff (n = 46).

Graph 1.1 on the following page shows the dive accident reporting and collection trends since 1986.

The top solid line indicates the total number of cases treated yearly (1,163 in 1994); the middle dotted line represents the total number of cases sent to DAN for review (858); and the bottom dashed line represents the total number of cases which were completed, verified and entered into the 1994 DAN accident database (566 in 1994).

Graph 1.1 ***Total Number of Cases Reported Received and Completed by DAN***



Database Cases

In the 566 accident cases in the 1994 database, there are fields in the reporting form that were not completed. In the event a question is left blank, tables in the report may show 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 the *frequency missing* is not used, there is an 'n' followed by a number. This represents the population size, or the number of people represented in that table or graph.

Percentages were rounded to the nearest tenth or hundredth. Many tables have categories which include very few responses, which has resulted in a small number (i.e., the number of respondents replying yes) divided by a large number (i.e., the total number of respondents). This leads to occasional rounding errors and percentages totaling slightly less than or more than 100 percent.

A copy of the DAN *Diving Accident Reporting Form*, which is used to gather the information in this report is located in the Appendix section of this report.

The location of the dive accident for the cases (566) analyzed in this report are contained in Tables 1.3 (page 20) and 1.4 (page 21).

Also excluded from the DAN DCI accident database are cases not diagnosed as DCI, such as ear barotrauma, pulled muscle, or marine life envenomation

Table 1.3 (below) shows the number of cases broken down by country (n = 566); and Table 1.4 on the following page represents the number of accidents treated in the U.S. states and territories (n = 360).

Tables 1.3 and 1.4 do not necessarily indicate treatment location.

Tables 1.3 and 1.4 do not necessarily indicate treatment location.

Table 1.3 *Accidents by Country & U.S. Territories*

Country	Frequency	Percentage
Australia	1	0.2
Bermuda	1	0.2
Guam	1	0.2
Micronesia	1	0.2
Palau	1	0.2
St. Lucia	1	0.2
Tahiti	1	0.2
Tobago	1	0.2
British Virgin Islands	2	0.4
Japan	2	0.4
New Guinea	2	0.4
Barbados	3	0.5
Grenada	3	0.5
Truk	3	0.5
Canada	4	0.7
Jamaica	4	0.7
Bonaire	5	0.9
Honduras	5	0.9
Fiji	7	1.2
Turks & Caicos	8	1.4
Antilles	11	1.9
Belize	11	1.9
U.S. Territories	12	2.1
Bahamas	18	3.2
Caymans	30	5.3
Mexico	80	14.1
USA	348	61.5
TOTAL	**566**	**100**

Table 1.4 *Accidents by U.S. States & Territories*

State	Frequency	Percent
Alaska	1	0.3
Georgia	1	0.3
Indiana	1	0.3
Maine	1	0.3
Ohio	1	0.3
Oklahoma	1	0.3
Massachusetts	1	0.3
Minnesota	1	0.3
Utah	1	0.3
Illinois	2	0.6
Nevada	2	0.6
Virginia	2	0.6
Oregon	2	0.6
Missouri	2	0.6
Alabama	3	0.8
Wisconsin	3	0.8
Pennsylvania	3	0.8
Rhode Island	3	0.8
New Mexico	3	0.8
Maryland	3	0.8
Louisiana	3	0.8
South Carolina	4	1.1
Hawaii	4	1.1
Texas	8	2.2
US Territories	12	3.4
New York	16	4.4
North Carolina	17	4.7
New Jersey	18	5.0
Washington	46	12.8
California	47	13.1
Florida	148	41.1
TOTALS	**360**	**100.2**

Table 1.4 represents the 360 cases treated in the United States.

Summary

Each year, DAN's telephone services refer an increased number of diving accidents to hyperbaric facilities. In 1994, the number of treated injuries reported to DAN increased by 20.5 percent. The overall combined increase in information and emergency calls to DAN was 10.3 percent. In addition, there was an increase of 12.5 percent in the number of cases reported and completed by DAN in 1994 — the highest number of cases ever treated and entered in the DAN database.

This Report on 1994 data represents 48.7 percent of the total number of divers treated by reporting hyperbaric facilities. Since the first annual Report in 1987, DAN has reported on 43 to 62 percent of all 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 referred for evaluation and treatment.

In the meantime, collection efforts continue to improve and provide an effective method of collecting accident forms for review.

In 1994, the number of treated injuries reported to DAN increased by 20.5 percent.

To report an injury, a fatality, or a near-miss in diving, call the DAN Medical Department.

Divers Alert Network
3100 Tower Boulevard · Suite 1300
Durham, NC 27707
(919) 684-2948

Dive Injury Characteristics

The purpose of this section is to describe the characteristics of, or factors affecting, the population of divers in the DAN 1994 accident database. The characteristics/factors described, such as age and sex, are associated with diving injuries but are not necessarily causative and are reported as a percentage of the injured diver population. These percentages can be compared to those of previous years, and trends in these characteristics can then be established.

The most recent years' data — 1993 and 1994 — are presented individually. Information gathered prior to 1993 has been averaged and is presented in three-year increments where it is appropriate. Some information currently being collected was added after 1987, and this is reflected in some of the tables shown in this section.

In 1994, almost 70 percent (69.4%) of all injuries were in divers between 25 and 44 years old, and 91.5 percent of all injuries were in divers less than 50 years of age.

Table 2.1 ***Age Distribution of Accident Cases***

Age	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
10-14	0.7	0.8	0.6	0.5
15-19	3.7	2.2	2.9	2.8
20-24	8.5	8.9	9.0	9.4
25-29	20.8	15.4	18.4	22.4
30-34	17.5	23.2	23.0	22.9
35-39	15.7	20.5	21.2	16.8
40-44	15.4	11.4	12.8	12.4
45-49	9.9	8.3	6.8	6.4
50-54	4.8	4.7	2.9	3.3
55-59	2.7	3.0	1.1	1.7
60-64	0.0	1.2	1.1	1.4
>=65	0.4	0.6	0.2	0.0
TOTALS	**100.1**	**100.2**	**100.0**	**100.0**

Age Distribution in Injured Divers

The age distribution for injured divers is shown in Table 2.1 (above), which shows there have been small changes in the percentage of injuries within these age groupings over the last eight years. In 1994, almost 70 percent (69.4%) of all injuries were in divers between 25 and 44 years old, and 91.5 percent of all injuries were in divers less than 50 years of age. Only 4.4 percent of injuries were in divers 19 years old or younger — up from 3.0 percent in 1993.

Both the 19-and-under and the 50-and-over groups make up only a small percentage of reported injuries. Assuming that the age distribution of the diving population is represented among injured divers, then this may simply reflect the fact that there are fewer active divers in both extremes of the age distribution. These groups may also choose to dive in more shallow waters or less often, which may also account for fewer injuries among the older and younger diver populations.

Table 2.2 *Sex of 1987-1994 Accident Cases*

Sex	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
Female	28.6	31.1	27.0	24.2
Male	71.4	68.9	73.0	75.8
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Distribution of Sex in Diving Injuries

Although the change is slight, there is a tendency toward an increase in the percentage of females among injured divers since 1987 — this now represents 28.6 percent of all injured divers (Table 2.2 — above). This number is consistent with but less than the previous high of 31.3 percent in 1993. In this year's Report, however, there were 162 cases of injuries in female divers this year — the most ever available for analysis. This may reflect increasing participation of women in recreational diving.

In addition to the differences between males and females in relatively new divers, there is a difference in males and females who have been diving 10 years or more . . .

Diver Experience in Injury Cases

Table 2.3 (page 25) shows the diving experience of 404 male and 162 female divers. The distribution of injuries is different in males and females — as indicated by the tables.

The number of years in diving are listed down the left-hand side of the table; the total dives made in a lifetime — up to the injury dive — are shown across the top of the table. For example, there were no divers — male or female — who had been diving six to seven years and making between 61-80 dives who reported injuries. However, there are 37 males and one female who had been diving 20 years or more, and making over 121 dives, who reported DCI.

Injured males and females have a different distribution of injuries. The most obvious difference is the higher occurrence of injuries among women divers earlier in their diving careers — in the first year of diving, 49 percent of the total female reported injuries. Males reporting injuries during their first year totaled 25 percent. Interestingly, 48 percent of the males and only 21 percent of the females reported making over 100 dives before their current injury.

Table 2.3 *1994 Diver Experience Among Injured Divers*

Male	Total Lifetime Dives							
Years Diving	0-20	21-40	41-60	61-80	81-100	101-120	121+	TOTAL
0-1	64	16	13	3	2	2	3	103
2-3	12	12	14	10	8	2	12	70
4-5	0	4	9	5	11	2	20	51
6-7	1	1	3	0	1	0	23	29
8-9	0	1	1	0	1	1	21	25
10-11	0	1	0	1	3	1	19	25
12-13	0	0	5	1	1	0	14	21
14-15	1	0	0	0	0	0	20	22
16-17	0	0	0	0	0	1	9	10
18-19	2	0	0	0	0	0	6	8
20-21	1	0	1	0	1	0	37	40
TOTALS	81	35	46	21	28	9	184	404

Female	Total Lifetime Dives							
Years Diving	0-20	21-40	41-60	61-80	81-100	101-120	121+	TOTAL
0-1	51	19	5	3	0	1	1	80
2-3	6	14	3	3	5	0	5	36
4-5	5	3	1	1	1	2	4	17
6-7	0	1	0	0	0	3	8	12
8-9	0	0	2	0	0	0	3	5
10-11	1	0	0	0	0	0	0	1
12-13	0	0	0	0	0	0	1	1
14-15	0	1	0	0	2	0	2	5
16-17	0	0	0	0	0	0	2	2
18-19	0	0	0	0	0	0	1	1
20-21	1	0	0	0	0	0	1	2
TOTALS	64	38	11	7	8	6	28	162

Diving Injuries versus Diving Experience

The difference in years of diving experience among injured divers is further broken down in Table 2.4 (page 26) where ranges of dive experience are grouped. The trends in injuries by years of diving experience are shown to be fairly consistent over the years reported. In addition to the differences between males and females in relatively new divers, there is a difference in males and females who have been diving 10 years or more.

The trend in injuries is reversed in more experienced divers, however, where 32.9 percent of all male injuries occur, versus 7.4 percent of the injuries in females. In 1994 there was a minimal difference in divers who had been diving between two and nine years.

Other interesting comparisons are the differences in the means and medians for lifetime dives between males and females. The mean number of lifetime dives for the database population is 327, but it is 413 for males and 114 for females. In addition, the median number of lifetime dives for the total population is 70, but for males it was 100 and for females only 28.5 dives.

. . . The trend in injuries is reversed in more experienced divers, however, where 32.9 percent of all male injuries occur, versus 7.4 percent of the injuries in females.

Table 2.4 breaks down diving experience for injured males and females into four experience groups, which are ordered side by side for direct comparisons. This also clearly demonstrates the trend in injuries for males and females.

Table 2.4 *Number of Injured Divers by Years of Experience*

Years Diving	Sex	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
<2 Years	Male	25.0	28.3	26.5	19.2
	Female	49.5	44.9	46.8	39.0
2 to 5 Years	Male	27.9	24.3	31.6	28.1
	Female	28.4	35.4	32.9	32.8
6 to 9 Years	Male	14.6	13.1	12.7	15.6
	Female	13.6	8.2	9.9	18.2
≥ 10 Years	Male	32.9	34.3	29.2	37.1
	Female	7.4	11.4	10.4	9.9

The data does not explain the difference in the broad range of injuries reported between males (25 %) and females (50%) in the category of divers diving for less than two years.

With this limited data, it is difficult to determine why there are differences in injury patterns associated with a diver's sex and years of experience in diving. In the less-experienced category (less than two years experience), male injuries represent 25 percent, while females represent approximately 50 percent. The data does not explain this difference, but the simplest explanation may be that females quit diving actively earlier than males.

When all four categories of experience were evaluated for previous dive accidents, however, only the males in the six- to nine-years' experience category had a higher percentage of second injuries than the female group. Additionally, males tended to be slightly older than females in the first two groups of experience, but the females were older in the second two groups.

Among those in the category with less than two years of diving experience, females had no more equipment problems or rapid ascents than males. In general, injured males had more dives in the previous year and had more lifetime dives than injured females in all four experience groups. They also made more dives on the day of the accident, except in the group of divers with 10 years' experience or more. Males also dived deeper than females in the series of dives that preceded the injury dive. There was a slightly higher use of computers by males in all experience groups.

After comparison of age, years of diving and number of lifetime dives between injured male and female divers, DAN researchers found no relationships thought to contribute to the development of decompression illness. Although there were small differences in the characteristics of diving between injured males and females, these were not statistically significant and do not explain these different occurrences of injury.

After comparison of age, years of diving and number of lifetime dives between injured male and female divers, DAN researchers found no relationships thought to contribute to the development of decompression illness.

Certification Levels in Diving Injuries

Table 2.5 (below) shows certification levels for all divers. Basic or open-water certification made up 47 percent of the divers, while 26.7 percent of divers were certified as advanced divers, and 21.5 percent were certified as a divemaster or instructor.

Table 2.5 ***Certification Level of 1988-1994 Accident Cases***

	Male	Female	Totals	1994 Percent	1993 Percent	92-90 Percent	89-87 Percent
Student	4	7	11	1.9	4.5	1.9	1.3
Basic	23	13	36	6.4	8.5	7.2	11.6
Open Water	149	81	230	40.6	39.0	42.5	38.1
Advanced	111	40	151	26.7	25.6	25.4	25.9
Divemaster	44	7	51	9.0	7.7	8.0	5.6
Instructor	61	10	71	12.5	12.4	10.4	10.9
Commercial	0	0	0	0.0	0.0	0.3	1.3
Other	8	1	9	1.6	2.2	2.9	1.8
None	4	3	7	1.2	0.2	1.3	1.2
Unknown						0.2	2.3
TOTALS	**404**	**162**	**566**	**100.0**	**100.1**	**100.1**	**100.0**

DCI in student divers was down after a high in 1993 of 4.5 percent (23 cases). The 11 student injuries represent 4 percent of the female and 1 percent of the male populations. Males led females in divers getting a second scuba certification. Some 71 percent of females were basic or open-water-certified compared to 42.4 percent of the males.

New Diver Traits

Table 2.6 (page 28) shows information on new divers with less than two years of experience, or infrequent divers who have logged 20 or less dives since certification. These divers composed 37.6 percent of

all injured divers. Most new diver traits have remained relatively stable for this group in recent years.

Sixty-one percent of these divers dived repetitively, 55.5 percent dived to at least 80 feet in the dive series when they were injured, and 31.4 percent had a rapid ascent associated with their dive. Compared to the entire 1994 accident database of divers, the percentage of rapid ascents was higher than in those divers diagnosed with DCI (21.5 percent) but lower than those who suffered an AGE (52.7 percent).

Table 2.6 *New Diver Profile Traits*

Traits	1994 Percent	1993 Percent	1992-1990 Percent	1989-1988 Percent
≤20 Dives	68.9	78.4	72.0	73.4
Square Dives	56.9	63.3	50.9	55.2
Repeat Dive	61.3	62.1	61.6	55.2
Diving ≥ 80 fsw	55.5	53.0	60.8	52.1
Rapid Ascent	31.4	32.3	35.6	42.2
Last Dive ≥ 80 fsw	27.8	24.0	30.3*	
Outside Limits	10.8+	18.2	22.6	23.4
	n=213	*n=198*	*n=528*	*n=192*

* from 1992 only
+ refers to 195 cases

In 1994, only 10.8 percent of these divers reported diving outside the limits of the table or computer they were using — versus 18 percent in 1993.

The most striking change from the 1993 data was the decrease in the percentage of injured new divers who said they made their dives outside their table or computer limits. In 1994, only 10.8 percent of these divers reported diving outside the limits of the table or computer they were using — versus 18 percent in 1993.

This difference may only reflect a difference in methodology, since in previous years a diver may have been counted as outside the limits if they were not within both computer and table limits. The outside limits determination was based on whether the divers said they were outside their table limit or their computer limit. Eighteen divers — 8 percent of these new divers — were excluded from the outside limits analysis because they were not using any device to calculate or plan their dive. Sixty-four new divers — 30 percent — were using computers in this group and 131 divers — 61.5 percent — were using tables. Three computer divers and 18 table divers stated they were outside their limits.

Among these less experienced or infrequent divers, there was a slightly higher percentage of AGE — 13.6 percent — when compared to the entire 566 divers, which was 9.7 percent.

Divers with Type II central nervous system symptoms of DCS accounted for 64.3 percent, which is the same as the entire accident population. Pain-only Type I DCS cases totaled a little less in new divers than the entire database, accounting for 22.1 percent of DCI in the new diver group.

New divers with Type II DCS accounted for 64.3 percent, which is the same as the entire accident population.

Table 2.7 *Current Medical History of Decompression Illness Cases for the Years 1994-1988*

Problem	1994	1993	1992-1990	1989-1988
None	430	396	994	462
Other	37	55	125	87
GI/Abdomen	15	15	37	13
Spine/Back	24	13	51	29
Muscl/Skel System	14	7	54	23
Chest-lung	10	7	37	13
Asthma	14	5	21	11
Cir/Blood	11	5	12	9
Mental/Emotion	9	4	27	12
Neuro/Nerv System	8	4	17	4
Chest-Heart	4	4	12	10
Eye	3	4	6	5
Limb/joint DCS	6	1	16	5
Brain	1	1	2	-
No Response	0	1	1	
TOTALS	586*	522*	1412*	683*

** Some divers reported multiple health problems.*

Current Medical History in Divers With DCI

One of the major issues affecting fitness for diving is health problems or chronic disease. Tables 2.7 through 2.10 (pages 29-30) display this information on the injured divers. In Tables 2.7 and 2.9, the body system affected by a current or previous medical condition or disease is shown. Little detail is recorded or obtained regarding the exact nature of their illnesses or their severity.

A major issue affecting fitness for diving is health problems or chronic disease.

Table 2.8 *Percentage of Divers Without Current Health Problems*

Current	1994	1993	1992-1990	1989-1987
Frequency	430	396	994	636
Percent	76.0	78.0	75	68.5

Table 2.9 *Previous Illness and Diseases of Decompression Illness Cases for the Years 1994-1988*

Problem	1994	1993	1992-1990	1989-1988
None	320	250	664	313
Other	81	81	203	108
Muscl/Skel System	52	59	169	83
Spine/Back	39	44	130	58
GI/Abdomen	43	43	129	69
Limb/joint DCS	28	24	101	25
Asthma	21	18	49	30
Chest-Heart	10	15	34	17
Chest-Lung	17	13	57	28
Eye	17	12	25	11
Mental/Emotion	7	7	22	5
Neuro/Nerv System	12	6	33	8
Brain	5	6	12	5
Cir/Blood	6	5	17	10
No Response	0	2	1	0
TOTALS	658	585	1646	770

Common body systems reported involved in illness are the spine or back, musculoskeletal system, gastrointestinal tract or abdomen, and the chest or lungs.

The most common body systems reportedly involved in illness are the spine or back, musculoskeletal system, the gastrointestinal tract (GI) or abdomen, and lungs. Whether these medical conditions caused decompression illness cannot be determined from this data. The data does suggest that personal illness or chronic disease will not stop someone from diving. Indeed, many divers listed diving with one or more current or previous illness and disease.

Table 2.10 *Percentage of Divers Without Past Health Problems*

Current	1994	1993	1992-1990	1989-1987
Frequency	320	250	664	444
Percent	56.5	49.2	46	47.8

Table 2.11 *Reported Physical Fitness in Injured Divers*

	1994	1993	1992-1990	1989-1988
Sex	Percent	Percent	Percent	Percent
Male	92.6	92.9	91.2	91
Female	89.5	91.8	88.3	87
TOTAL	**91.7**	**92.5**	**90.4**	**90**

Divers and Current Health Problems, Physical Fitness

Table 2.8 (page 29) shows that 76 percent of the 1994 injured diver population were not diving with health problems. Table 2.10, however, shows that less than 56 percent of injured divers dived without past health problems.

The lack of physical fitness has been suggested as a potentially predisposing factor in decompression illness. Individual weight and fitness may play some part in the development of DCI, but its role is not clear from this data.

Close to 90 percent of both males and females (Table 2.11, page 30) subjectively report being physically fit when they were injured, and they also report doing regular exercise to support this claim. The information from this group of divers cannot support the suggestion that physical fitness offers any protection from DCI nor can it disprove that lack of fitness would contribute to DCI.

The information from this group of divers cannot support the suggestion that physical fitness offers any protection from DCI, nor can it disprove that lack of fitness would contribute to decompression illness.

The Use of Medications in Injured Divers

The percentage of injured divers who used prescription or non-prescription medication is shown in Table 2.12 below. Of the 16.3 percent who used nonprescription medications when diving, 47 percent were using an over-the-counter analgesic or anti-inflammatory type of medication, and 33 percent were using some medication or nasal spray as a decongestant.

Of the 16.3 percent of divers who used nonprescription medications when diving, 47 percent were using an over-the-counter analgesic or anti-inflammatory type of medication, and 33 percent were using some medication or nasal spray as a decongestant.

Table 2.12 *Medication Use in Accident Cases*

1994 Prescription Use		Nonprescription Use	
Frequency	Percent	Frequency	Percent
172	30.4	85	16.3

1993 Prescription Use		Nonprescription Use	
Frequency	Percent	Frequency	Percent
129	26.4	71	17.4

1992-1990 Prescription Use		Nonprescription Use	
Frequency	Percent	Frequency	Percent
372	28.03	234	19.95

1989-1988 Prescription Use		Nonprescription Use	
Frequency	Percent	Frequency	Percent
151	23.6	96	16.3

Six divers were using medication to prevent seasickness, five divers used supplemental vitamins, four divers were taking medication for some type of GI upset and two divers were treating themselves for a cold.

The 30.4 percent of injured divers who use prescription medication represent a higher portion of the injured population.

The 30.4 percent of injured divers who use prescription medication represent a higher portion of the injured population. Birth control medication was the only medication used by at least 20 percent of divers taking prescription drugs.

Antibiotics were used by 10.4 percent of the injured divers. Prescription antihistamine medication, hormone replacement therapy, and central nervous system medication such as antidepressants were used by at least 16 percent of those individuals taking medication. Cardiovascular medication for hypertension or dysrhythmias was used by 11 percent of the divers. Nasal steroids were used by eight divers — or 4.6 percent — and five divers were using an inhaler for asthma. Two divers were taking medication for seizures.

Table 2.13 *Percentage of Alcohol Use in 1988-1994 Accident Cases*

Time of Use	1994	1993	1992-1990	1989-1988
Night before	37.1	41.9	38.1	41.8
Pre-dive	1.1	1.4	1.4	1.7
Between dives	0.7	1.2	1.5	2.3
Post-dive	15.4	15.7	14.5	13.5
None	56.0	50.8	55.2	49.7
	n=566	*n=508*	*n=1358*	*n=659*

** Some divers engage in drinking at more than one time before and/or after diving.*

The Use of Alcohol Reported In Accident Cases

Table 2.13 (above) shows that 56 percent of all divers abstain from any alcohol during their diving, compared to 1993's figure of nearly 51 percent. There was a decrease in alcohol consumption for all time periods evaluated, but overall there has been no significant change since 1988. The largest decrease was among those individuals who usually drink the night before diving. The current percentage is consistent with the previous three-year average of 38.1 percent of all divers.

Table 2.14 (page 33) shows the number of drinks consumed up to 12 hours before diving on the evening prior to their dive injury. This group represents the 37.1 percent of the divers who drank the night before in Table 2.13. In 1994, 60 percent of those divers who

drank the night before only had one or two drinks. Fewer divers also had six or more drinks in 1994.

There are two principle concerns with drinking and diving: the dehydrating effects of alcohol; and aftereffects of decreased performance and impaired thinking.

Table 2.14 *Percentage of Alcohol Use in 1988-1994 Accident Cases*

	Number of Drinks - 12 hours before diving							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
1994	58	68	32	27	10	9	6	**210**
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**

The dehydrating effects of alcohol are well known. Although dehydration alone does not cause decompression sickness, it may act in combination with other dive or diver factors to influence the body's response to high partial pressures of nitrogen.

The primary concern with diving after drinking centers around the aftereffects of alcohol use — the fatigue divers experience after drinking can lead to a decreased physical performance or impaired decision-making process. Both conditions could lead to mistakes and injuries.

Two principle concerns with drinking and diving are: the dehydrating effects of alcohol; and the aftereffects of decreased performance and impaired thinking.

Predive Health Issues

Table 2.15 (below) shows the number of injured divers who reported a health issue or recreational drug use the day of the dive. The four conditions listed are of concern because they represent a possible impairment in physical or mental performance.

Table 2.15 *1994 Nausea, Hangover, Diarrhea and Recreational Drug Use*

Sex	Nausea	Hangover	Diarrhea	Drug Use
Male	15	4	7	6
Female	7	3	9	2
Totals	**22**	**7**	**16**	**8**

For divers who are nauseated, under the influence of drugs or fatigued from lack of sleep, the effects of illness or alcohol use may make them less likely to be able to muster appropriate responses.

These conditions may not produce additional illness or injury, but they may place the individual at increased risk for injury if these conditions cause impairment.

Divers must be able to respond to a variety of environmental stimuli such as strong currents while diving. For divers who are nauseated, suffering from a hangover, under the influence of drugs or fatigued from lack of sleep, the effects of illness or alcohol use may make them less likely to be able to muster appropriate responses.

Summary

■ There are different patterns of injury among male and female divers. Female divers tend to have injuries earlier in their diving careers. Males are more active than most female divers and perform many more dives in a lifetime and in a series of dives.

■ The DAN database shows that most cases of decompression illness occur among divers who have a single certification. Only one out of five incidents were reported in divers with a divemaster certification or higher.

■ Previous and current health problems are common among injured divers, but no obvious relationship to DCI has been established. Ninety percent of all injured divers considered themselves physically fit prior to their accident.

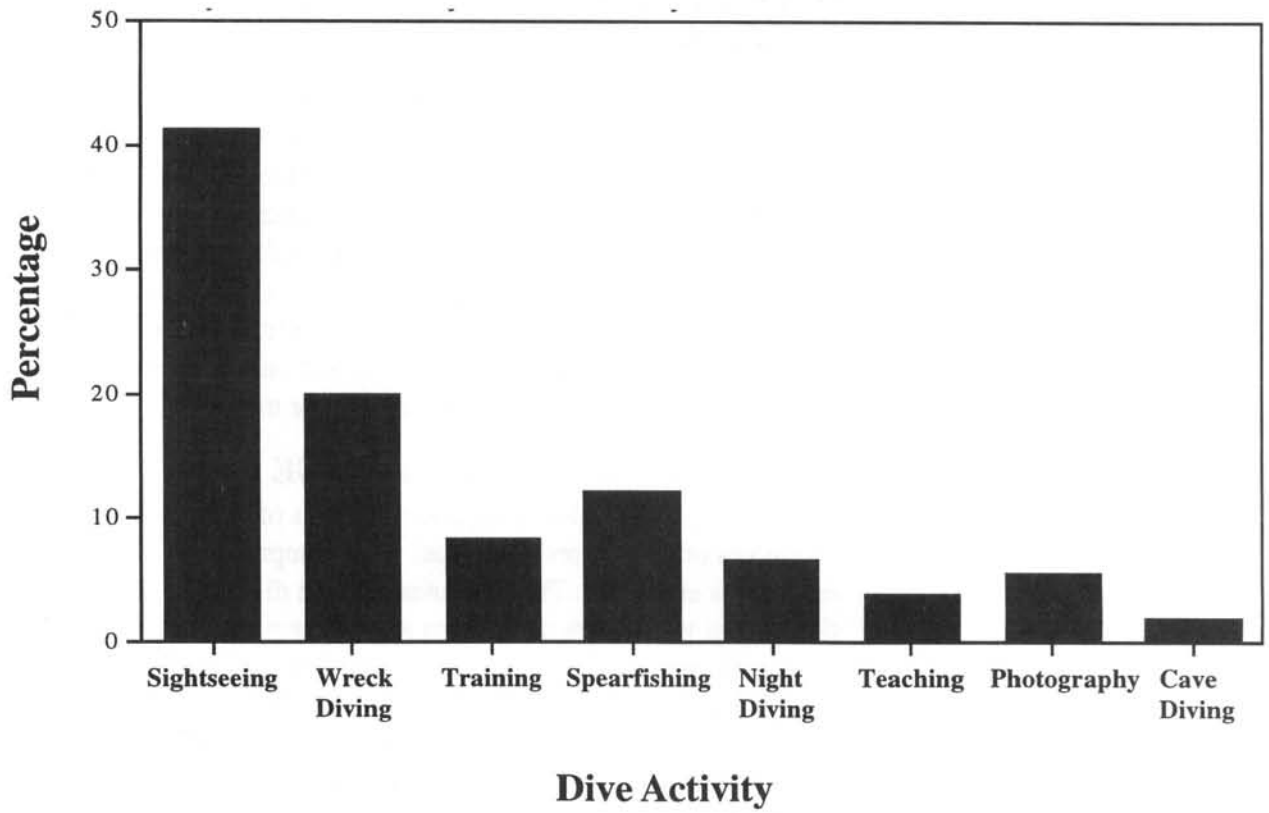
Dive Profile / Accident

Dive Activities

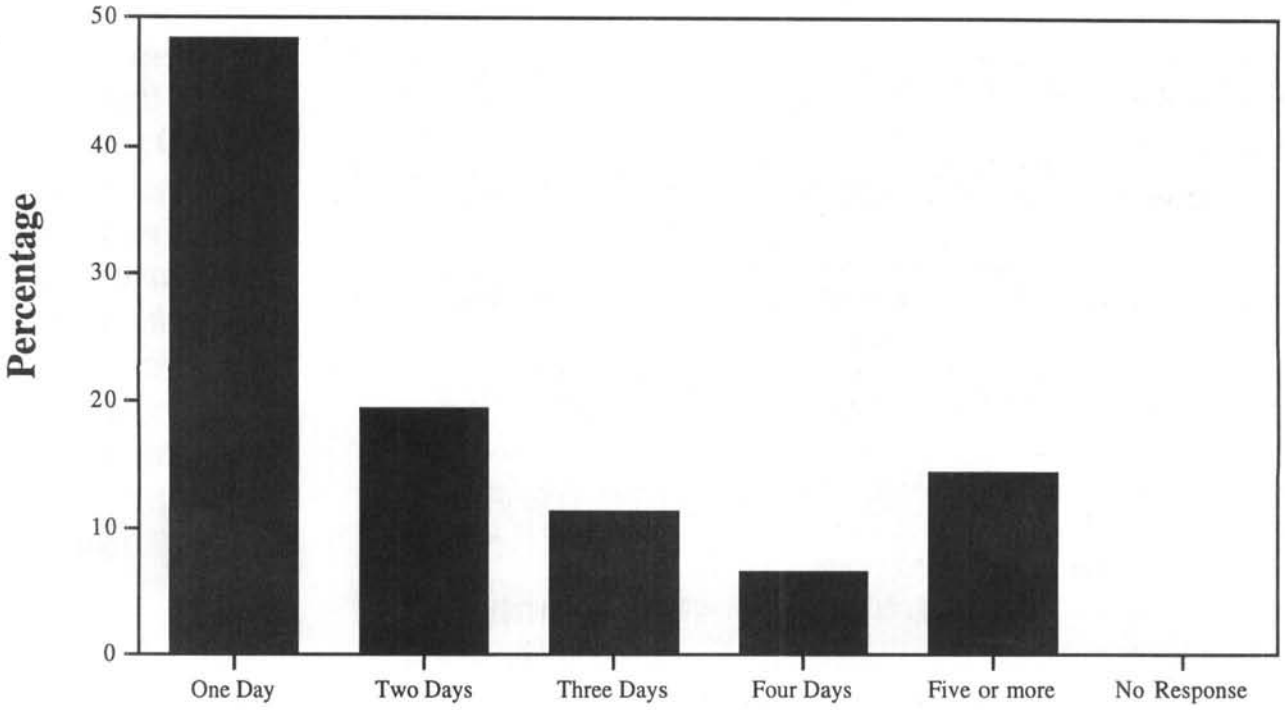
The dive profile section is composed of tables and graphs which demonstrate the type of underwater activity being performed, as well as various attributes of the dives when an incident occurred. The dive profile information is limited and should be considered only in relation to various attributes of dives recorded by DAN. In the future, more accurate dive profile information will be available from Project Dive Safety through computer records of time and depth notations. A total of 41 percent of all incidents occurred while sightseeing; the next most common activity was wreck diving (Graph 3.1 — below). Wreck diving incidents (20 percent) may seem relatively high because many wrecks off the U.S. coast are deep, and most dives tend to be repetitive and square. The average depth of a dive for wreck divers was 92 feet, compared to 74.5 feet for sightseeing divers. Additionally, 3.5 percent of wreck dive injuries were classified as AGE, compared to 11.6 percent of sightseeing dive injuries.

Wreck diving incidents (20 percent) may seem relatively high because many wrecks off the U.S. coast are deep, and most dives tend to be repetitive and square.

Graph 3.1 ***Primary Dive Activity***



Graph 3.2 ***Number of Days of Continuous Diving***



In 1994, 48.8 percent of injured divers suffered their accidents during a single-day dive program.

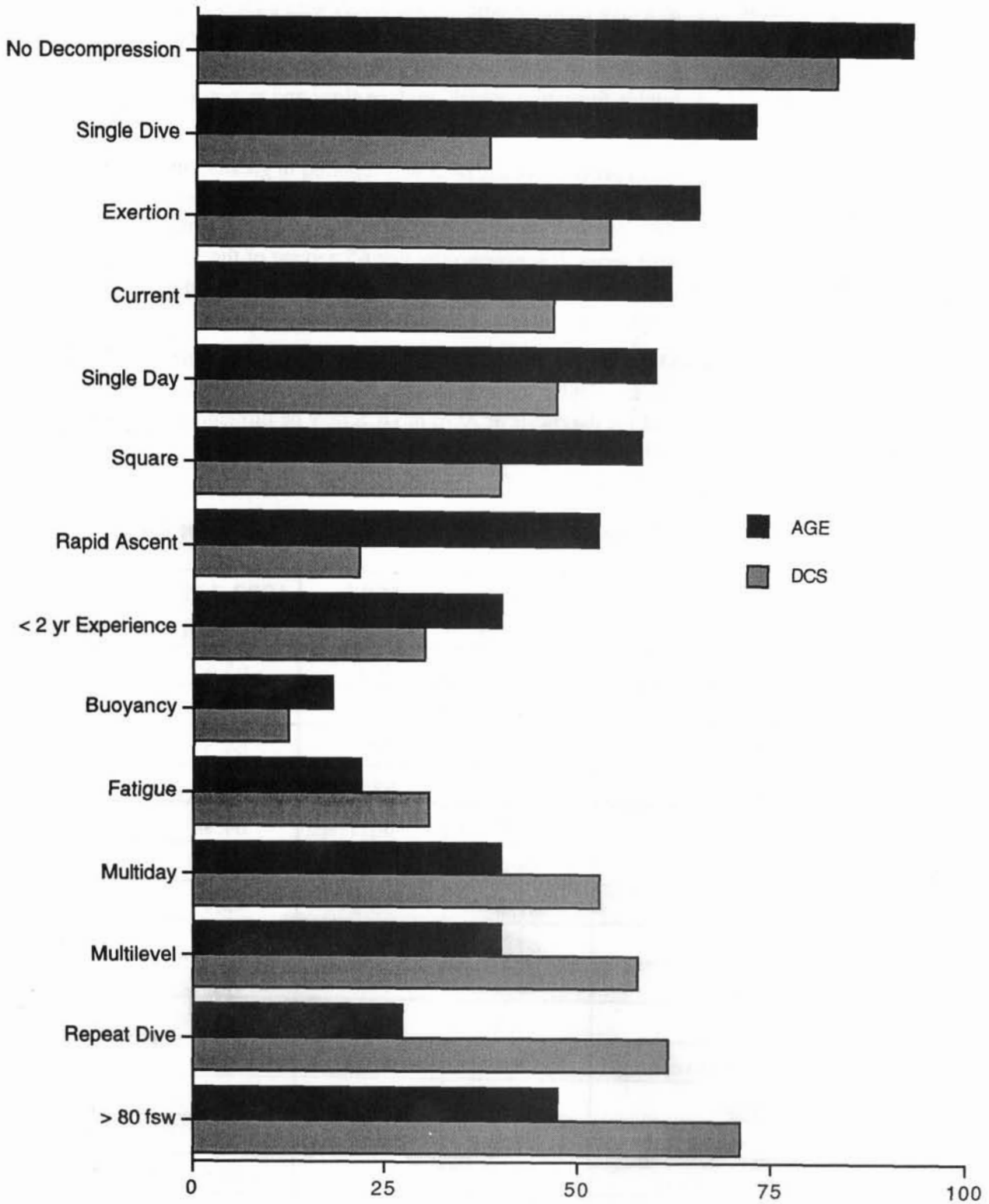
Number of Days Diving

Graph 3.2 (above) shows that in 1994, 48.8 percent of injured divers suffered their accident during a single-day dive program. This is very similar to previous years. Further analysis of the single-day diving group revealed that 55.8 percent were more frequent divers and had completed a dive in the last 30 days. Additionally, 46.9 percent of those divers with less than two years of diving experience or 20 dives were also injured on the first day of diving. Fifty-one percent were injured after two or more days of diving, and only 14 percent of divers were injured as part of a series of five days or more.

Dive Characteristics of DCS and AGE

Graph 3.3 (page 37) shows the characteristics of dives that result in both types of decompression illness — decompression sickness and arterial gas embolism. The attributes of these dives were broadly similar, but we do note differences among them due to the difference in classification used by some of the referring facilities that produce reports. Because of this, it is becoming clear that this distinction may not be useful as far as diagnosis and treatment is concerned and may be of historical interest only. Without more accurate symptomatology and descriptive terms used by clinicians, the difference is hard to determine, though the data is recorded as was reported.

Graph 3.3 *Percentage of DCS and AGE Dive Characteristics*



. . . sixty-five percent of those subjects diagnosed with AGE experienced marked exertion. Fifty-two percent also claimed to have made a rapid ascent.

Rapid ascent is one of the risk factors associated with arterial gas embolism and may also be a factor in classical decompression illness. In the 1994 Report, however, rapid ascent is less frequently mentioned as a dive characteristic among divers with a DCS injury. Decompression sickness usually results from a prolonged exposure at a depth of 30 or more feet of sea water. Both conditions can cause bubble formation, which produce signs and symptoms in the affected individual.

As in previous years, DCS was reported in greater numbers than AGE (511 compared to 55). The typical AGE incident occurs in a no-decompression dive, within dive limits and as part of a single dive series. It is noteworthy that 65 percent of the 1994 subjects experienced marked exertion. Fifty-two percent also claimed to have made a rapid ascent, a predominant factor in AGE.

Only 27 percent of AGE divers were making repetitive dives, which fits the classic scenario. There is a confounding factor, however, in that the diagnosis of AGE or DCS may be influenced by a knowledge of the dive profile.

Table 3.1 *Characteristics of Dives that Resulted in DCS*

Attribute	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
Within Limits	86.9	46.0	65.4	56.5
No Decompression	83.2	78.9	80.0	78.5*
≥ 80 fsw	71.2	70.8	64.5	74.6*
Repeat Dive	61.8	63.6	68.2	52.9
Multilevel	57.9	50.5	64.1	51.9*
Exertion	54.0	59.7	49.3	29.8
Multi Day	52.8	53.2	48.7	51.0*
Single Day	47.2	46.6	51.3	53.3
Current	46.6	54.5	50.5	40.7
Square	39.9	36.2	35.8	42.8*
Single Dive	38.2	36.2	32.6	32.7*
Fatigue	30.7	29.0	34.5	34.1
< 2 yr. Experience	30.1	32.2	30.9	26.1
Rapid Ascent	21.5	21.8	21.9	24.3
Buoyancy	12.3	11.1	11.6	13.6

*These percentages are from 1989 only.

DCS Characteristics

A comparison of Tables 3.1 and 3.2 shows various characteristics of both AGE and DCS. Traits of the classic DCS case, for example, show a no-decompression, repetitive dive at multiple levels. It was also most likely to be part of a multiday dive series and that several dives would be at greater than 80 feet of sea water. The majority of divers as shown before had more than two years of dive experience.

AGE Characteristics

In contrast to DCS cases, AGE cases are characterized by single dives and single-day dives that are square versus multilevel. AGE cases tend to involve a higher percentage of rapid ascents, but not as many deep dives to greater than 80 feet. The two different final diagnoses have several similar characteristics, which include no-decompression diving, being within the limits of the table or computer used and being affected similarly by physical exertion.

AGE cases tend to involve a higher percentage of rapid ascents, but not as many deep dives to greater than 80 feet.

Table 3.2 *Characteristics of Dives that Resulted in AGE*

Attribute	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
Within Limits	96.0	59.2	90.4	80.0
No Decompression	92.7	87.8	68.1	92.3*
Current	61.8	42.9	45.5	32.6
Single Dive	72.7	61.0	70.1	67.3*
Exertion	65.5	49.0	41.9	19.3
Single Day	60.0	55.1	67.9	48.6
Square	58.2	59.2	58.3	55.8*
Rapid Ascent	52.7	55.1	56.3	52.0
≥ 80 fsw	47.3	44.9	49.4	46.2*
< 2 yr. Experience	40.0	44.9	35.7	49.3
Multi Day	40.0	44.9	32.1	46.2*
Multilevel	40.0	22.4	41.7	35.5*
Repeat Dive	27.3	30.6	29.9	29.3
Fatigue	21.8	22.4	13.1	29.3
Buoyancy	18.2	38.8	28.6	21.3

*These percentages are from 1989 only.

The 'within limits' field represents only those divers who used a computer or table and were within the limits of the device they used.

These data offer only trends in dive characteristics and cannot explain why an increase or decrease occurs in any given year. For example, there was an increase in divers who reported diving in a moderate to strong current and experiencing an AGE injury and a decrease in divers who reported diving in a current and experiencing DCS.

Diving "within limits" increased in both AGE and DCS cases. This was in part due to the removal of a small group of divers who were considered separately because they chose to dive without the use of a computer or calculate their dive tables. Additionally, in earlier reports there were fewer computer users and divers may have been considered "outside limits" if they were not within both computer and table limits. In this report, each group is considered separately.

Table 3.3 *Computer and Table Divers with Decompression Illness*

	Computer Users							
	1994 Percent	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
DCS I	27.8	27.1	22.3	20.1	28.1	31.0	31.0	26.8
DCS II	66.1	66.9	71.4	73.4	64.0	62.7	60.7	61.0
AGE	6.1	6.0	6.3	6.5	7.9	6.3	8.3	12.2
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
	n=313	*n=266*	*n=224*	*n=199*	*n=203*	*n=126*	*n=84*	*n=41*

	Table Users							
	1994 Percent	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
DCS I	22.9	18.6	12.9	16.0	17.2	18.5	18.5	15.8
DCS II	62.8	67.8	75.1	66.8	61.3	64.9	60.3	63.6
AGE	14.2	13.6	12.0	17.2	21.5	16.6	21.2	20.6
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
	n=218	*n=242*	*n=241*	*n=238*	*n=256*	*n=256*	*n=184*	*n=228*

	Neither Computer nor Table
	1994 Percent
DCS I	20.0
DCS II	65.7
AGE	14.3
TOTAL	**100.0**
	n=35

Dive Computer Use

In 1994, 55 percent (313) of injured divers used computers. The breakdown of DCI into the historical categories of DCS I, II and AGE are further broken down in Table 3.3 into computer users, table users and divers who used neither. Over 6 percent of divers (35) apparently used neither computers nor tables. The incidence of neurological DCI for computer divers, table divers, and in divers who used neither was broadly similar. As in previous years, table use was twice as high among AGE cases than with computer use (14.2 percent vs. 6.1 percent). This is similar to previous data reported here.

The incidence of neurological DCI for computer divers, table divers, and in divers who used neither was broadly similar.

Tables 3.4 and 3.5 (below, and page 42) show the attributes of both table and computer divers. Seven percent of computer divers were outside the tables by their own admission; the percentage of table divers outside the tables was 17.4 percent. The percentage of injured divers within limits increased in 1994 because the field was evaluated more closely than in previous years. The within limits/outside limits fields were based on whether the diver was outside the limit of the respective device they used (computer or table). The 35 individuals who used neither computers or tables were excluded from Tables 3.4 and 3.5.

Computer divers also were making a decompression dive out of choice in nearly 23 percent of cases, whereas table divers chose that type of dive in only 10 percent of cases. It is recommended by most of the computer manufacturers that computers not be used for planned decompression stage diving. As expected, multilevel dives were

Table 3.4 ***Attributes of Computer Divers From 1987-1994***

Attribute	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
Repeat Dive	82.6	82.1	69.0	63.7
≥ 80 fsw	78.1	79.1	73.1	86.5
Multilevel	74.6	77.7	78.8	71.4
Within Limits	91.1	64.9	59.1	32.7
Exertion	54.9	61.5	48.4	29.9
Current	45.8	54.9	48.9	43.8
Multi Day	55.3	51.7	48.6	53.2*
Single Day	44.7	48.3	51.2	50.6
Outside Limits	7.0	35.1	40.9	39.4
Fatigue	28.5	28.3	32.5	31.0
Decompression	22.8	24.3	24.5	32.7

*These percentages are from 1989 only.

Table 3.5 *Attributes of Table Divers From 1987-1994*

Attribute	1994 Percent	1993 Percent	1992-1990 Percent	1989-1987 Percent
Repeat Dive	73.4	78.5	58.8	51.0
≥ 80 fsw	57.3	57.0	53.7	63.4*
Multilevel	36.7	28.1	45.9	45.3*
Within Limits	82.6	73.1	74.4	70.5
Exertion	56.0	57.0	49.7	27.4
Current	45.4	52.1	50.5	37.8
Multi Day	47.7	53.3	44.7	49.1*
Single Day	52.3	46.7	54.6	53.2
Outside Limits	17.4	17.8	25.6	28.7
Fatigue	33.0	29.8	31.4	34.2
Decompression	10.6	11.2	13.2	20.2

*These percentages are from 1989 only.

Multilevel dives were performed by 75 percent of computer divers but only by 38 percent of table divers . . .

. . . because dive computers allow for the offgassing of nitrogen at different depths in their algorithms.

performed by 75 percent of computer divers but only by 38 percent of table divers. This difference is expected, because dive computers allow for the ongassing and offgassing of nitrogen at different depths (multilevel) in their algorithms.

The 35 divers who used neither computers nor tables dived deeper than 80 feet in 65.7 percent of cases and made multiday dives in approximately 43 percent of cases and repetitive dives in 51.4 percent (Table 3.6 — below). Although computer users in the

Table 3.6 *Attributes of Divers Using Neither Computer nor Table*

Attribute	1994 Percent
Current	88.6
≥ 80 fsw	65.7
Exertion	62.9
Single Day	57.1
Multilevel	57.1
Repeat Dive	51.4
Multi Day	42.9
Fatigue	28.6
Decompression	2.9

(n=35)

DAN database were more experienced divers, and had been diving more often and for a greater number of years than table users, there was no difference between groups in the number of divers who ran out of air. In the group who used neither computer or tables, 8.6 percent of divers ran out of air, and 14.3 percent ran low on air, compared to 11 percent of table users and 7.7 percent of computer users.

There was no difference between the computer users or table users in the number of divers who ran out of air.

Equipment

Scuba diving is an activity that requires knowledge of the equipment used as well as adequate maintenance of that equipment. Correct functioning of the equipment and the knowledge of how to use it safely are essential to safe diving. Of the cases in the 1994 report, 13.7 percent involved equipment problems (Table 3.7 — below).

The number of accidents due to equipment problems has remained low over the years. The fact that an equipment problem was reported does not necessarily mean that the equipment failure caused the incident but merely that the diver recognized the problem. One other reason for reporting an equipment problem is unfamiliarity with the complex equipment that is carried by many divers. Half of the divers with AGE and equipment problems reported a problem with their regulator or air supply problems.

Half of the divers with AGE and equipment problems reported regulator or air supply problems.

The next most common equipment problem was unfamiliarity with equipment. Those divers with DCI who reported an equipment problem were most likely to have trouble with a regulator, BC vest, weight belt or computer. Some divers also listed "other" problems which in some way influenced their dive profile. These problems included five mask problems, six depth or pressure gauge problems and three problems with the scuba tank.

Table 3.7 *1994 Equipment Problems*

Equipment	Frequency	DCS	AGE
BC	8	7	1
Unfamiliar Equipment	12	11	1
Regulator	13	8	5
DC Computer	9	9	0
Inflator Hose	6	4	2
Weight Belt	9	9	0
Dry Suit	2	2	0
Contaminated Air	1	1	0
Other	18	17	1
TOTALS	**78**	**68**	**10**

A majority of divers stated they stayed within the limits of their tables or computer, but 6 percent of all divers did not use any means of dive calculation.

Summary

- Decompression illness was reported by both frequent and infrequent divers.
- AGE-related cases are characterized by single-day, single-dive, square profiles that are associated with a rapid ascent in 52 percent of all AGE injuries.
- In DCS cases divers tend to have more experience and engage in multiday, deeper repetitive dives. In AGE cases, this diving pattern was not observed as often.
- A majority of injured divers stated they stayed within the limits of their tables or computer, but 6 percent of all divers did not use any means of dive calculation.
- Among injured divers, computer users tend to be more experienced divers and now make up 55 percent of the divers reported on each year.
- Equipment problems were associated with 13.7 percent of the DCI cases, suggesting a need for better understanding and care of diving equipment.

Symptoms of DCI

Frequency Distribution of Symptoms

The frequency of occurrence of the various symptoms of decompression illness (including all cases of both AGE and DCS) is shown in Table 4.1 (page 46). DCI often consists of several different symptoms developing over a period of time — thus, the occurrence with which a symptom is the first (presenting) symptom may be different from the total occurrence of that symptom. Total occurrence represents the number of times a symptom appeared in the entire injury population.

As in 1993, pain was the most frequent first symptom of DCI. In approximately one-third of the cases, pain was the presenting symptom, while nearly 80 percent of divers with DCI experienced pain at some time in their illness. The second most frequent presenting symptom was numbness (one-fifth of cases). This occurred at some time in over 80 percent of cases.

In Table 4.1, the shaded "total" lines represent actual occurrence of symptoms within the given classification of severe or mild neurological symptoms and pain/skin/nonspecific symptoms. For example, the totals for pain symptoms represent the total occurrence of pain as a first symptom among all classifications (n=313) and the number of times pain occurred without any neurological symptoms (n=106).

Neurological symptoms have been classified as either serious or mild. While weakness could be classified as a serious symptom, it is an ambiguous term since it can be interpreted as either frank (unmistakable) motor weakness, or a vague feeling of generalized malaise. Certain symptoms such as hearing loss and tinnitus (ringing in ears), while serious, have not been listed as severe neurological symptoms, because they can be manifestations of otic barotrauma and cannot be definitively ascribed to decompression illness. Similarly, difficulty breathing is ambiguous in that it may be a manifestation of anxiety, pulmonary barotrauma or aspiration of water.

While 40 percent of divers had a neurological symptom as an initial symptom, 81.3 percent of divers ultimately developed one. Only 4.4 percent of divers with DCI initially presented with severe symptoms, but over one-quarter (153 divers) had severe symptoms at some time. The development of neurological symptoms when only pain or fatigue were present initially, and the progression from mild symptoms to severe ones, suggests that neurological or severe symptoms might be preventable with early treatment.

Traditionally DCI has been classified into AGE — the injection of gas into the vascular system due to pulmonary overpressurization — and DCS — the formation of gas within tissues due to inert gas supersaturation.

Table 4.1 *1994 Most Frequent Symptoms of Decompression Illness*

			First Symptom		Total Occurrence	
			N	Percent	N	Percent
Neurological	Severe	Unconsciousness	12	2.1	24	4.2
		Paralysis	4	0.7	32	5.7
		Visual Disturbance	0	0.0	36	6.4
		Difficulty Walking	3	0.5	60	10.6
		Semi-Consciousness	3	0.5	19	3.4
		Bowel Problem	0	0.0	9	1.6
		Speech Disturbance	2	0.4	16	2.8
		Bladder Problem	0	0.0	17	3.0
		Convulsions	1	0.2	2	0.4
Total Severe Neurological Symptoms			**25**	**4.4**	**153**	**27.0**
	Mild	Numbness	123	21.7	472	83.4
		Dizziness	47	8.3	134	23.7
		Decreased Skin Sensation	3	0.5	61	10.8
		Personality Change	1	0.2	18	3.2
		Reflex Change	0	0.0	7	1.2
		Weakness	31	5.5	146	25.8
Total Mild Neurological Symptoms			**205**	**36.2**	**307**	**54.2**
Total Neurological Symptoms			**230**	**40.6**	**460**	**81.3**
Cardiorespiratory		Difficulty Breathing	10	1.8	23	4.1
Pain/skin/nonspecific		Pain	192	33.9	444	78.4
		Extreme Fatigue	31	5.5	118	20.8
		Headache	46	8.1	128	22.6
		Nausea	19	3.4	90	15.9
		Itching	15	2.7	47	8.3
		Rash	4	0.7	25	4.4
		Restlessness	2	0.4	23	4.1
		Muscle Twitch	2	0.4	20	3.5
		Hemoptysis	2	0.4	4	0.7
Total Pain/Skin/Nonspecific Symptoms			**313**	**55.3**	**106**	**18.7**
Ambiguous		Hearing Loss	0	0.0	6	1.1
		Ringing in Ears	1	0.2	19	3.4
Other		Stiffness	1	0.2	4	0.7
		Hot/cold Flashes	2	0.4	3	0.5
		Cramps	2	0.4	3	0.5
		Swelling	1	0.2	5	0.9
		Pressure Sensation	1	0.2	5	0.9
		Amnesia	1	0.2	2	0.4
		Fullness	1	0.2	1	0.2
		Muscle Ache/Soreness	2	0.4	5	0.9
		Euphoria	0	0.0	2	0.4
		Discoloration of Skin	0	0.0	2	0.4
		Unequal Pupils	1	0.2	1	0.2
		Coughing up mucus	0	0.0	1	0.2
Total Other Symptoms			12	2.4	34	6.2
		Total			**566**	**100.0**

Table 4.2 *Traditional Classification of DCS*

DCS-I	DCS-II
Pain	Neurological
Fatigue	Cardiorespiratory (chokes)
Skin	
Lymphatic	

Table 4.3 *Conventional Disease Diagnosis*

Final Diagnosis	1994 Percent	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent	1987 Percent
DCS-I	25.4	23.0	17.4	17.8	22.0	22.5	22.4	17.4
DCS-II	64.8	67.3	73.3	69.8	62.5	64.5	60.4	63.3
AGE	9.7	9.6	9.2	12.4	15.5	13.0	17.2	19.3
TOTAL	**100.0**	**99.9**	**99.9**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

These observations provide support for the recommendation that all divers with symptoms of DCI should obtain early evaluation and treatment.

Traditionally DCI has been classified into arterial gas embolism (AGE) — the injection of gas into the vascular system due to pulmonary overpressurization — and decompression sickness (DCS) — the formation of gas within tissues due to inert gas supersaturation. DCS has been further classified into Type I, or DCS-I; and Type II, or DCS-II (Table 4.2, top).

The distributions of conventional diagnoses are shown in Table 4.3 (above). The differentiation of AGE and the two forms of DCS was previously believed to be important because the classification dictated the form of recompression treatment.

It is often possible to differentiate between these diagnoses. For example, a diver who makes a shallow dive for a minute or two and then is observed to surface while holding his breath or making a panic ascent — after which he loses consciousness and has a convulsion — is most likely to have AGE.

Alternatively, a diver who has a deep dive profile and enough time to develop a significant inert gas load and experiences joint pain two hours after surfacing most likely has DCS.

In many instances, however, it is impossible to make an accurate differentiation because contributing factors, such as the rate of ascent or breath-holding, may not have been observed. Additionally, a diver may have had a depth-time profile sufficient

A diver who makes a shallow dive for a minute or two and then is observed to surface while holding his breath or making a panic ascent — after which he loses consciousness and has a convulsion — is most likely to have AGE.

. . . a diver who has a deep dive profile and enough time to develop a significant inert gas load and experiences joint pain two hours after surfacing most likely has DCS.

to develop DCS and an ascent likely to produce AGE. Moreover many diving physicians feel that the treatment table should be dictated more by clinical response to treatment rather than by the history.

Because of its widespread use, the traditional classification as assigned by the treating physician is reflected in addition to the individual symptoms reported.

Ninety-five percent of divers with AGE became symptomatic within 70 minutes, and 95 percent of those with DCS were symptomatic within approximately 33 hours.

Errors in Classification

Analysis of subgroups of Table 4.1 reveals that many divers assigned the diagnosis of DCS-I had symptoms which should have led to their classification as DCS-II. Of 144 divers classified by the treating physician as DCS-I, 72 reported neurological complaints (50.0 percent of divers diagnosed with DCS-I and 12.4 percent of all divers). Of these divers, 13 were classified as severe (9.0 percent of divers diagnosed with DCS-I and 2.3 percent of all divers).

Of the 460 divers who had neurological complaints, 15.7 percent were incorrectly classified by the person filling out the form as Type I; of the 153 divers with severe neurological complaints 8.5 percent were similarly misclassified. The reason for this is unknown, but it may be due to either unfamiliarity of the treating physician with the classification scheme or failure of the diver to report neurological symptoms to the treating physician. Difficulties such as this have led to the recent emphasis on individual symptoms or symptom clusters as better predictors of outcome than the traditional scheme. Work to develop better outcome predictors is ongoing. The classification into mild and severe symptoms outlined in Table 4.1 represents a preliminary approach.

Despite the errors in classification, the reported numbers reflect the diagnosis assigned by the treating physician. The proportion of divers in each diagnostic category remains unchanged from 1993. The continued decrease in the proportion of AGE cases observed from 1987 (when 19.3 percent of the reported cases were due to AGE) to 1994 (9.7 percent of cases diagnosed as AGE) could be due to several factors, including a gradual change in the criteria by which the diagnosis of AGE is assigned or selective reporting of AGE in the earlier years of data collection. Alternatively, it may be due to better ascent training, greater use of decompression computers with ascent rate alarms and perhaps a true reduction in the proportion of dive accidents due to gas embolism. These possibilities cannot be distinguished on the basis of available DAN data.

Symptom Onset Time

Symptom onset time is shown in Table 4.4 (page 49). Because the distribution of onset times is not symmetrical, the typical onset time is best estimated by the median (time at which 50 percent of divers have become symptomatic), rather than the mean. Interestingly, the onset times

Table 4.4 *Symptom Onset Time after Surfacing (hours): All Divers*

Classification	N	Mean	Standard Deviation	Median	95% Time*
DCS-I	144	7.3	13.4	1.0	39.4
DCS-II	367	6.5	13.0	1.0	26.8
AGE	55	0.5	2.4	0.02	1.2
All DCI	566	6.1	12.6	0.5	30.0

*Time after surfacing by which 95% of individuals have developed symptoms.

of DCS-I and DCS-II are remarkably similar. As expected, the onset time of AGE is significantly shorter. Ninety-five percent of divers with AGE became symptomatic within 70 minutes, and 95 percent of those with DCS were symptomatic within approximately 33 hours.

. . . one half of cases of DCI have symptom onset within 30 minutes after surfacing.

Since it is established that altitude exposure can precipitate symptoms after a delay, the data have been analyzed after excluding all cases in which altitude exposure occurred. They are displayed in Table 4.5 (below).

Table 4.5 *Symptom Onset Time after Surfacing (hours) Divers with Altitude Exposure Excluded*

Classification	N	Mean	Standard Deviation	Median	95% Time*
DCS-I	98	4.6	10.7	0.5	25.8
DCS-II	261	4.9	9.9	0.5	24.0
AGE	33	0.1	0.3	0.02	0.6
All DCI	392	4.4	9.8	0.5	24.0

*Time after surfacing by which 95% of individuals have developed symptoms.

Inspection of Table 4.5 provides clinically useful information. For instance, one half of cases of DCI have symptom onset within 30 minutes after surfacing. In the absence of any altitude exposure, 95 percent of cases develop symptoms within 24 hours.

In the absence of any altitude exposure, 95 percent of cases develop symptoms within 24 hours.

Symptoms Prior to Last Dive

One of the disconcerting aspects of the data is that 105 divers — 18.4 percent of all divers, 17.6 percent of males, 20.4 percent of females — reported having experienced symptoms prior to their last dive (Table 4.6 — page 50). Three of these individuals reported diving with severe neurological symptoms, and two individuals continued diving while having what they described as numbness/weakness in the legs and difficulty walking. Both of these individuals were treated between 36 and

Table 4.6 *Decompression Illness Symptoms Prior to Last Dive*

Sex	1994 Percent	1993 Percent	1992 Percent	1991 Percent	1990 Percent	1989 Percent	1988 Percent
Male	17.6	17.7	20.1	16.8	13.9	12.4	14.8
Female	20.4	26.6	22.1	24.5	19.0	25.3	26.6
TOTAL	**18.4**	**20.5**	**20.7**	**18.8**	**15.2**	**15.7**	**17.5**
	n=566	n=508	*n=465*	*n=437*	*n=459*	*n=381*	*n=268*

The percentage of divers continuing to dive after symptom onset is unchanged from previous years.

48 hours after symptom onset. After completion of hyperbaric treatment, they both had residual symptoms for four to five months. One diver had neurological residual symptoms (numbness/weakness and difficulty walking), while the other experienced only residual pain. The third individual had some numbness and paralysis in the hand. After follow-up, it was revealed that this was a pre-existing symptom that became worse, and remained after completion of hyperbaric treatment.

Table 4.7 *Symptom Classification of Divers Experiencing Symptoms Prior to Last Dive*

Symptom Category	Number	Percent
Severe Neurological	3	2.9
Mild Neurological	48	45.7
Pain Only	51	48.6
Difficulty Breathing	2	1.9
Tinnitus/Hearing Loss	1	0.9
TOTAL	**105**	**100.0**

The percentage of divers continuing to dive after symptom onset may as in previous years (Table 4.6 — top) indicate a lack of awareness of the symptoms of DCI, a tendency to ignore minor symptoms or attribute them to some cause other than DCI, or perhaps the potential for yielding to perceived peer pressure (i.e., not wishing to cut short everyone else's dive). A distribution of symptoms experienced prior to the last dive is shown in Table 4.7 (above).

Table 4.8 ***Previous Accident Classification by Present Diagnosis***

	Previous Accidents					
Present Diagnosis	**Possible DCS**	**DCS**	**Pulmonary Barotrauma**	**AGE**	**None**	**TOTALS**
DCS-I	6	7	0	0	129	142
DCS-II	15	30	1	0	320	366
AGE	2	0	0	0	51	53
TOTALS	**23**	**37**	**1**	**0**	**500**	**561**

Previous Decompression Illness

Table 4.8 (above) shows the type of previous dive accident reported by injured divers. Similar to previous years, of 561 divers who provided the relevant information, 61 (10.8 percent) had previously experienced either possible DCS, actual DCS or pulmonary barotrauma. Divers with previous accidents could be ones with greater experience, and hence at inherently higher risk because of greater exposure to the environment.

Indeed, divers who reported previous DCS (N = 37) had logged more dives (median number 260) than those who had not reported such history (median 60 dives), and 10 of these divers reported having logged 1000 or more dives. Divers with recurrent DCI could also be at higher risk because of high-risk diving patterns.

This is not supported by the available data, since only 13 of 37 (35 percent) of divers with previous DCS had either rapid ascent, buoyancy or equipment problems or were not within table or computer limits — obviously lower than the 63 percent in the entire 1994 accident population.

Since the probability of DCI in this recreational population is unknown, it is not possible to state whether this apparently high frequency of recurrence implies an intrinsically higher risk for divers who have previously experienced DCI.

Divers who reported previous DCS had logged more dives than those who had not reported such history, and 10 of these divers reported having logged 1000 or more dives.

Eighteen percent of divers reported having experienced symptoms before their last dive, supporting the need for more education about DCI.

Summary

- In one-third of DCI cases, pain was the presenting symptom, while nearly 80 percent of divers with DCI experienced pain at some time in their illness.

- The second most frequent presenting symptom was numbness (one fifth of cases), which occurred at some time in over 50 percent of cases.

- The frequent progression from mild to severe symptoms provides support for the recommendation that all divers with symptoms of DCI should obtain early evaluation and treatment.

- The traditional classification scheme (DCS-I, DCS-II, AGE) is frequently applied incorrectly. Over 48 percent of 144 divers classified as DCS-I reported neurological symptoms to DAN.

- In one-half of the cases reported, the first symptoms developed within 30 minutes. In 95 percent of these cases, DCI symptoms developed within 30 hours, and in the absence of altitude exposure, 95 percent were symptomatic within 24 hours.

- Eighteen percent of divers reported having experienced symptoms before their last dive; three of these reported severe neurological symptoms, supporting the need for more education regarding the symptoms of DCI.

- Previous decompression illness was reported by nine percent of divers in this database. These divers tended to be more experienced, and compared to the others in the database, these divers had fewer reported rapid ascents, buoyancy problems, equipment problems and depth-time exposures outside table or computer limits.

Treatment

Three important factors help determine the ultimate outcome for divers with decompression illness. They are:

- Early recognition of symptoms;
- Prompt diagnosis; and
- Appropriate treatment.

The following data summarizes treatment information submitted to DAN in 1994 for the 566 reported cases of decompression illness.

Delaying the Call for Assistance

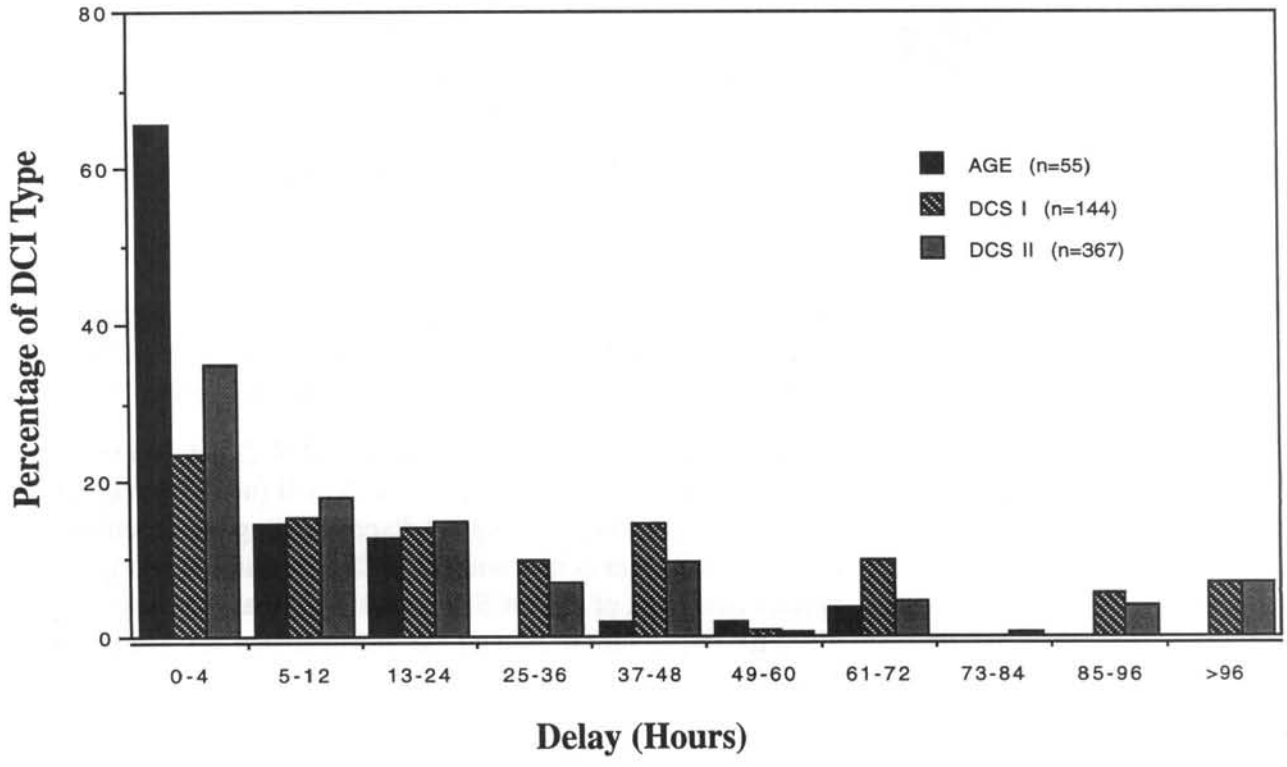
The data in Graph 5.1 (below) is similar to that of previous years, demonstrating that 65 percent of all cases of AGE reported to DAN did so within the first four hours of symptom onset. This may be in part related to the emergent nature and the severity of symptoms often associated with AGE.

In contrast to these data, only 28.8 percent of all DCS cases reporting to DAN did so in the first four hours (DCS-I — n=32; DCS-II — n=129, out of 511 total DCS cases). Considerable delay and variability is again noted this year in the time from symptom onset to time of request for medical assistance for DCS. A total of 6 percent of all DCI reported to DAN in 1994 requested assistance more than 96 hours after the onset of symptoms was reported.

65 percent of all AGE cases reported to DAN within the first four hours of symptom onset.

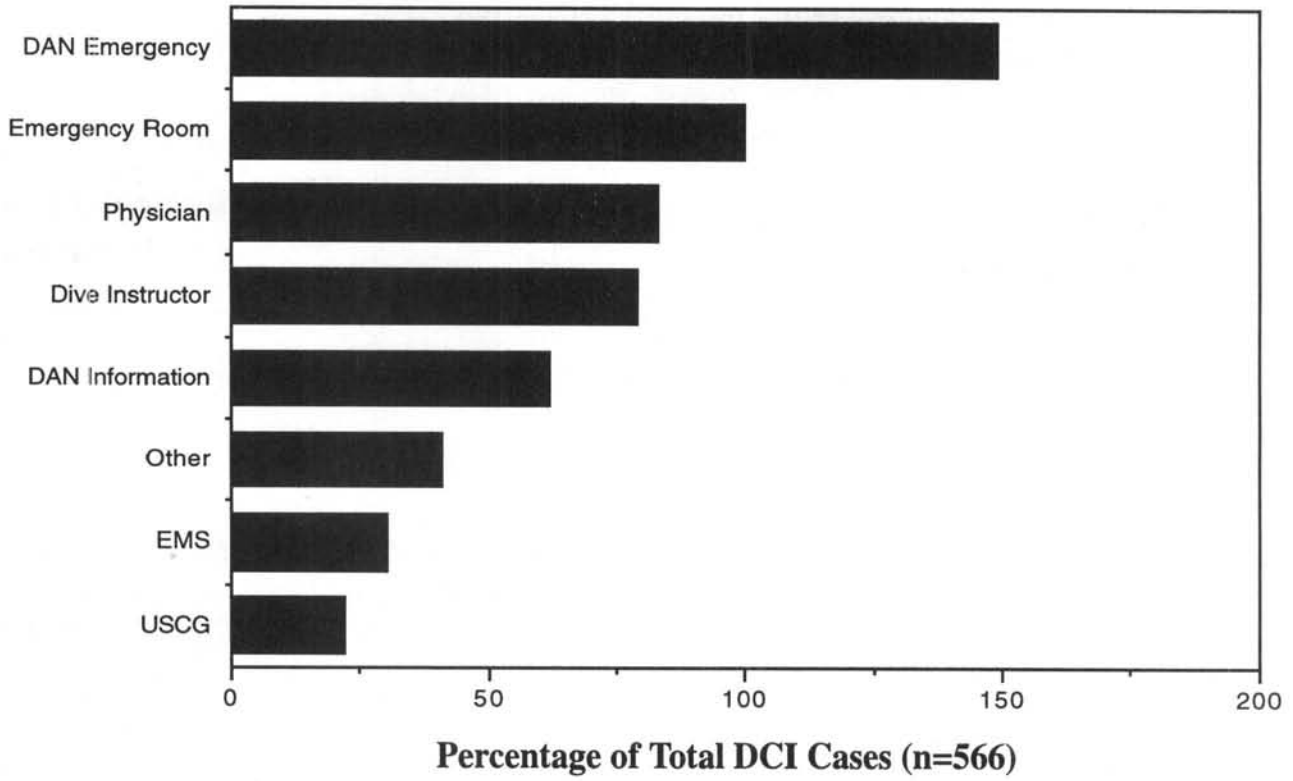
In contrast, only 28.8 percent of all DCS cases reporting to DAN did so in the first four hours.

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



Nearly 70 percent of all DCI cases in the 1994 database initially contacted either DAN, a local physician, or a hospital emergency department for assistance and/or evaluation (Graph 5.2 — below). The remaining cases received initial assistance from the U.S. Coast Guard, Emergency Medical Services (EMS), or dive instructors. The "other" category includes direct contact with hyperbaric chamber staff, dive club management, public safety departments, certifying agencies, friends or dive buddies.

Graph 5.2 ***First Contact for Assistance***



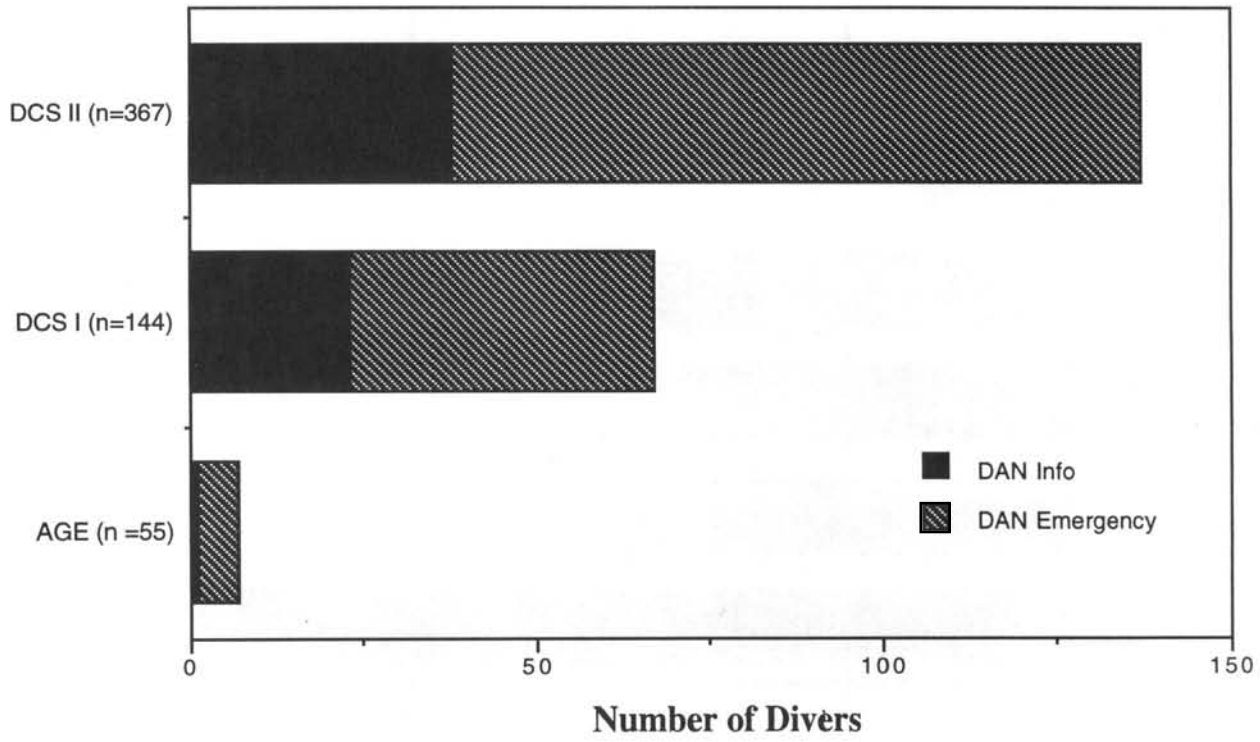
The percentage of divers using the non-emergency line for consultation on DCS-II remains at nearly 30 percent . . .

Initial Contacts for Help

Graph 5.3 shows the distribution of calls to DAN as a function of DCI type and whether the contact was made through the DAN Medical Information Line or the DAN Diving Emergency Hotline.

Of the 211 divers who initially contacted DAN, 204 did so for assistance with either DCS-I (n=67) or DCS-II (n=137) symptoms. As in past years, the percentage of divers utilizing the nonemergency information line for consultation on DCS-II remains at nearly 30 percent (n=38 out of 137 DCS-II cases). This is a disturbing statistic given the importance of prompt medical treatment in cases of severe neurological DCS.

Graph 5.3 *Intial Call to DAN by DCI Type*



Only seven of the 55 reported cases of AGE (13 percent) utilized DAN as the point of contact for initial assistance, but six of seven of these utilized the emergency line and not the information line for assistance.

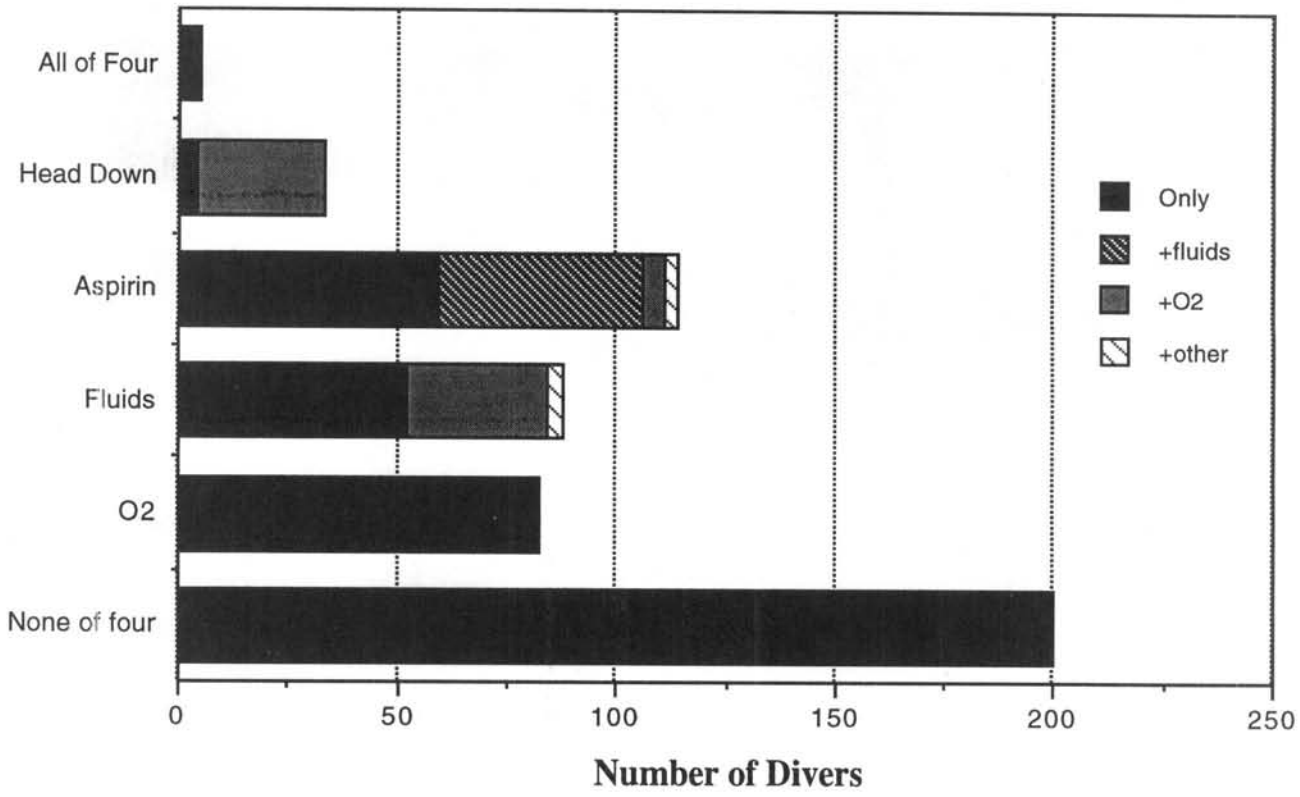
The Use of Oxygen in First Aid

One hundred and eighty-nine of the 566 DCI cases (33 percent) reported to DAN in 1994 utilized oxygen alone or in combination with other treatment modalities for first aid (Graph 5.4). Eighty-two cases (14 percent) utilized oxygen only, while 32 (6 percent) used fluid and oxygen therapy.

One hundred and six cases (19 percent) used fluid alone (n=52, 9 percent) or in combination with other interventions (not including oxygen) as a first aid measure. There were 266 cases (47 percent), out of all reported DCI cases, that did not use either fluid or oxygen as a first aid measure.

Of the 566 DCI cases reported to DAN in 1994, 33 percent utilized oxygen alone or in combination with other treatment modalities for first aid.

Graph 5.4 *First Aid Used*



The increase in the frequency of injured divers receiving supplemental oxygen — from 26 percent in 1993 to 33 percent in 1994 — is encouraging, but still low.

The increase in the frequency of injured divers receiving supplemental oxygen — from 26 percent in 1993 to 33 percent in 1994 — is encouraging. However, despite the theoretical and clinical evidence that surface oxygen is efficacious, this percentage is disappointingly low. A subset of the DAN injured diver database consisting of 1,935 divers from 1989-1993 has revealed the following statistics (Table 5.1 — below).

Table 5.1 *Surface Oxygen Use: 1989 - 1993*

Diagnosis	Number of Divers	Percent Using Surface Oxygen
AGE	264	68.6
DCS-II Severe	327	50.5
DCS-II Mild	905	26.0
DCS-I	439	24.4
All DCI	**1935**	**35.6**

Delay to Recompression

Significant variability from the time of symptom onset to beginning of recompression therapy is noted in Graph 5.5 (below). These trends are similar to DAN accident data from previous years. Twenty-one of the 55 reported AGE cases (38 percent) received hyperbaric therapy within four hours of symptom onset, while 67 percent (n=37) were recompressed within 12 hours.

Delay to treatment for cases of DCS-I and DCS-II was greater, with only 11 percent and 17 percent respectively (16 of 144 and 62 of 367), being treated within four hours of symptom onset; and 28 percent and 38 percent (41 of 144 DCS-I, and 139 of 367 DCS-II) being treated within 12 hours.

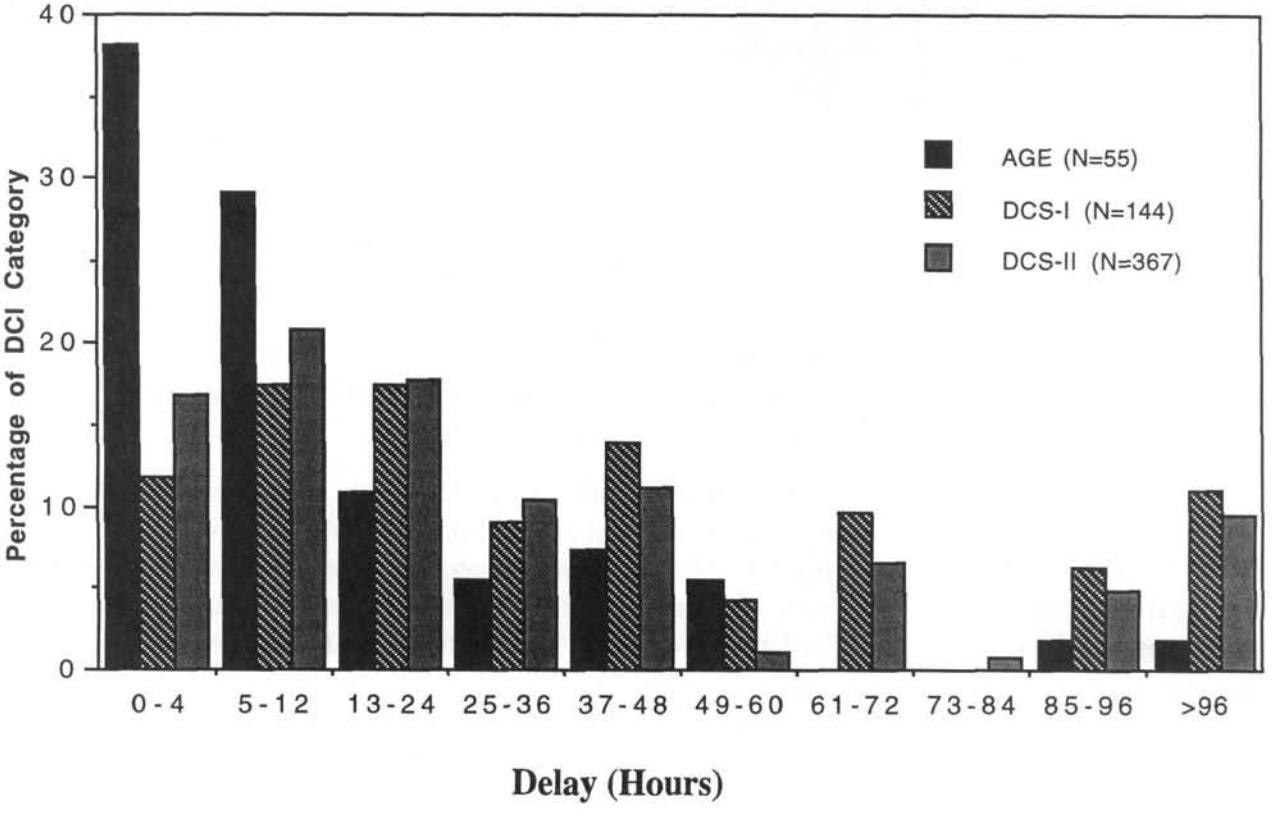
Delay to treatment for cases of DCS-I and DCS-II was greater this report year.

The causes for delay to treatment can include a variety of reasons:

- Patient denial of symptoms;
- Failure to recognize the signs and symptoms of DCS;
- Remote dive locations requiring long intervals until evacuation; and
- Failure of symptoms to spontaneously resolve without treatment.

Again, the more rapid response to treatment for AGE is likely related to the severity and emergent nature of the symptoms.

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

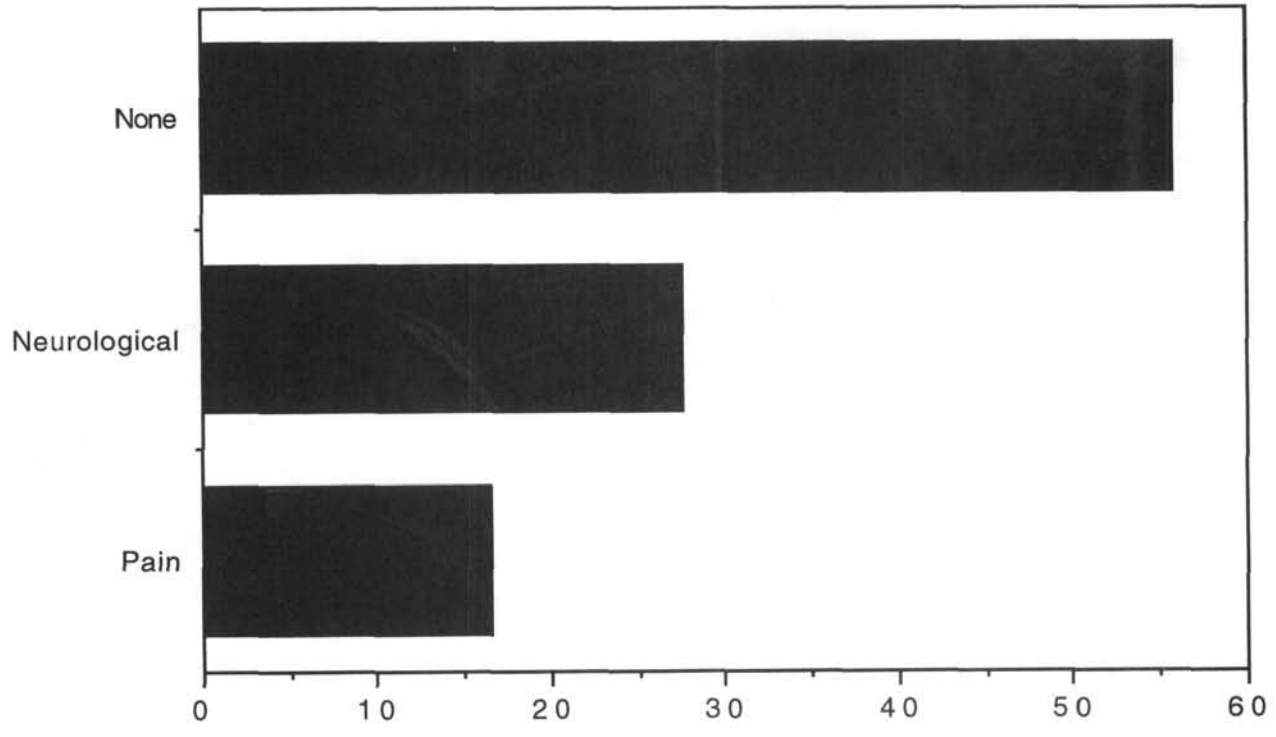


The Effectiveness of Emergency Oxygen

Graph 5.6 (below) shows that hyperbaric oxygen therapy for the 1994 DCI cases reported to DAN resulted in complete resolution of symptoms at the end of hyperbaric therapy slightly more than half of the time (56 percent, 316 of 566 cases).

Of the divers with residuals, 28 percent had residual neurological symptoms, while 17 percent had pain-only residual (156 and 94 out of 566).

Graph 5.6 *Post-Treatment Residuals*



Twelve percent of all reported DCI cases were symptom-free following surface oxygen before recompression therapy.

The following table (5.2 — page 59) shows the improvement in overall symptom-free outcome for those divers who receive emergency first aid surface oxygen.

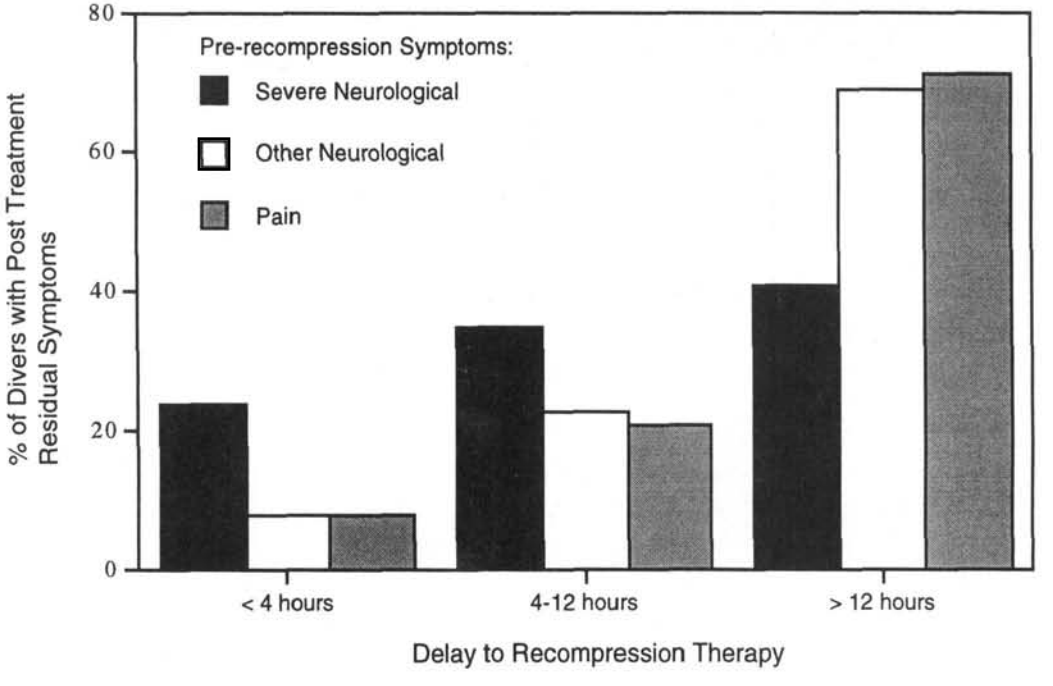
Twelve percent of all reported DCI cases were symptom-free following surface oxygen before recompression therapy, whereas only 3 percent of the DCI cases not receiving supplemental surface oxygen were symptom-free before recompression. Sixty-nine percent of all DCI cases were symptom-free following recompression therapy when the divers were given oxygen first aid or pre-chamber treatment, whereas only 52 percent of the recompressed divers not treated with emergency oxygen were symptom-free.

Table 5.2 *Complete Relief of Symptoms in Divers Who Did and Did Not Receive Emergency First Aid Surface Oxygen (%)*

Diagnosis	Relief Before Recompression		Relief After Recompression	
	No Oxygen	Oxygen	No Oxygen	Oxygen
AGE	7.2	13.8	55.4	58.0
DCS-II Severe	3.7	16.4	56.2	66.7
DCS-II Mild	2.1	10.6	49.0	73.2
DCS-I	1.5	12.1	54.8	70.1
All DCI	**2.9**	**12.4**	**52.4**	**69.3**

The delay to institution of hyperbaric oxygen therapy is directly correlated to the success of the treatment as measured by its ability to reduce or totally resolve the symptoms. Increasing delays result in incomplete resolution of symptoms for all types and severity of DCI (Graph 5.7 — below).

Graph 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*



There appears to be an increasing number of divers who begin using surface oxygen, then terminate its use without ever receiving a medical evaluation.

Summary

- Education in symptom recognition and emergency first aid of suspected DCI is important in the ultimate resolution of decompression problems. Delays due to confusing symptoms, symptom denial by the diver and remote dive locations far removed from treatment facilities all contribute to the presence of residual symptoms after recompression therapy.

- The number of divers who recognize the symptoms of DCI and begin immediate therapy with surface-supplied oxygen continues to increase each year with improvements in the overall success of treatment.

- One-third of all DCI cases reported to DAN in 1994 involved the use of supplemental oxygen. This is an unfortunately low number given the theoretical and clinical evidence of the efficacy of surface-supplied supplemental oxygen. Additionally, there appears to be an increasing number of divers who begin using surface oxygen, then terminate its use without ever receiving a medical evaluation.

- Delayed recompression treatment is associated with a significantly greater probability of residual symptoms for all types of DCI.

Scuba Fatalities

Introduction

Divers Alert Network began collecting information on recreational scuba fatalities in 1989. Data shown for years prior to 1989 were collected by the National Underwater Accident Data Center (NUADC) at the University of Rhode Island. Due to the decreasing availability of government funding, NUADC joined with DAN in 1989 in a joint effort to collect data on recreational scuba fatalities.

Over the past 25 years, a total of 2,682 recreational scuba deaths have been reported among residents of the United States. 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 95 deaths per year. Only one year out of the 10 had more than 100 reported deaths. Of the last five years, four had over 90 scuba deaths.

The average number of deaths over the last 10 years has been 95 deaths per year.

The 1994 report on scuba fatalities is based on data from 97 scuba fatalities, which occurred between Jan. 1 - Dec. 31, 1994. All but one death were among U.S. citizens.

Exclusion Criteria

Several factors are used to exclude a case from being followed up and entered into the fatality database. The fatality may have involved:

- a commercial, scientific or occupational diver;
- a free-diver or snorkeler
- a foreign diver in foreign waters
- a non-diving related accident, such as a boating accident.

The DAN fatality database does not include any of these categories.

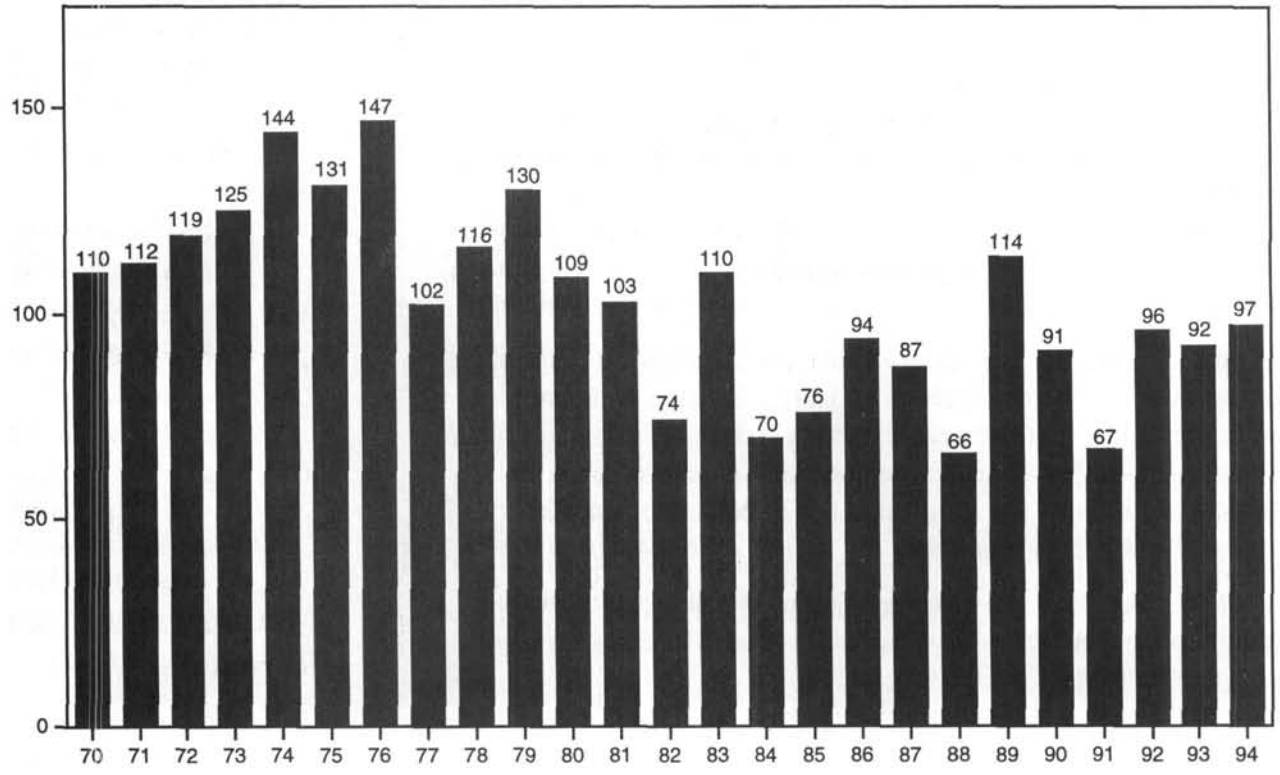
1994 DAN Fatality Data: How It's Broken Down

In 1994, DAN received notice of 157 possible scuba deaths. DAN collects baseline information on all of these deaths to determine each diver's activity. The DAN medical staff directs its efforts in collecting information only on recreational and technical scuba diving fatalities involving U.S. citizens worldwide and foreign divers in U.S. waters.

Of the 157 deaths reported in 1994, 13 were commercial divers, 22 were free-divers, 10 were foreign nationals, 14 were non-diving-related, and one was an unconfirmed fatality.

Initially, it appeared there would be 104 recreational/technical scuba diving deaths for follow-up, but seven were removed. While collecting data it was determined that two of these involved free-diving accidents and were included in the 22 free-diving accidents. Three more deaths

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



The number of recreational divers who were attempting to make a dive they were not qualified for has averaged 10 deaths per year.

were unconfirmed and involved divers missing after their boat sank. Although they were using scuba at the time, their possible deaths (and disappearance) may have had nothing to do with the use of scuba. The postmortem medical exam declared one fatality due to heart complications when a death occurred several hours after a dive.

Finally, one fatality relayed to the DAN Medical Information Line was unconfirmed. A death was reported, but no record or document could be found in the small island nation where it had reportedly occurred to substantiate this death.

Breakdown of Fatalities by Year, Certification

Graph 6.2 (page 63) gives a breakdown of recreational scuba deaths, which 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 accounted for 73 deaths in 1994. In the previous four years, this has not been greater than 67.

The number of recreational divers who were attempting to make a dive they were not qualified for has averaged 10 deaths per year. These individuals were performing dives, such as technical level diving that requires special training and equipment that they did not possess. The largest number of these deaths involved attempts at deep diving,

wreck penetration or cave diving. In 1994, this number represented 15 fatalities.

A technical dive is one in which a diver participates in one of the following conditions:

- Diving to more than 130 feet/40 meters;
- Using breathing mixture other than compressed air; or
- Going into decompression or overhead diving (diving in shipwrecks or caves).

These levels of exposure go beyond established recreational limits. Not all divers who make technical dives have the specialized training for the activity.

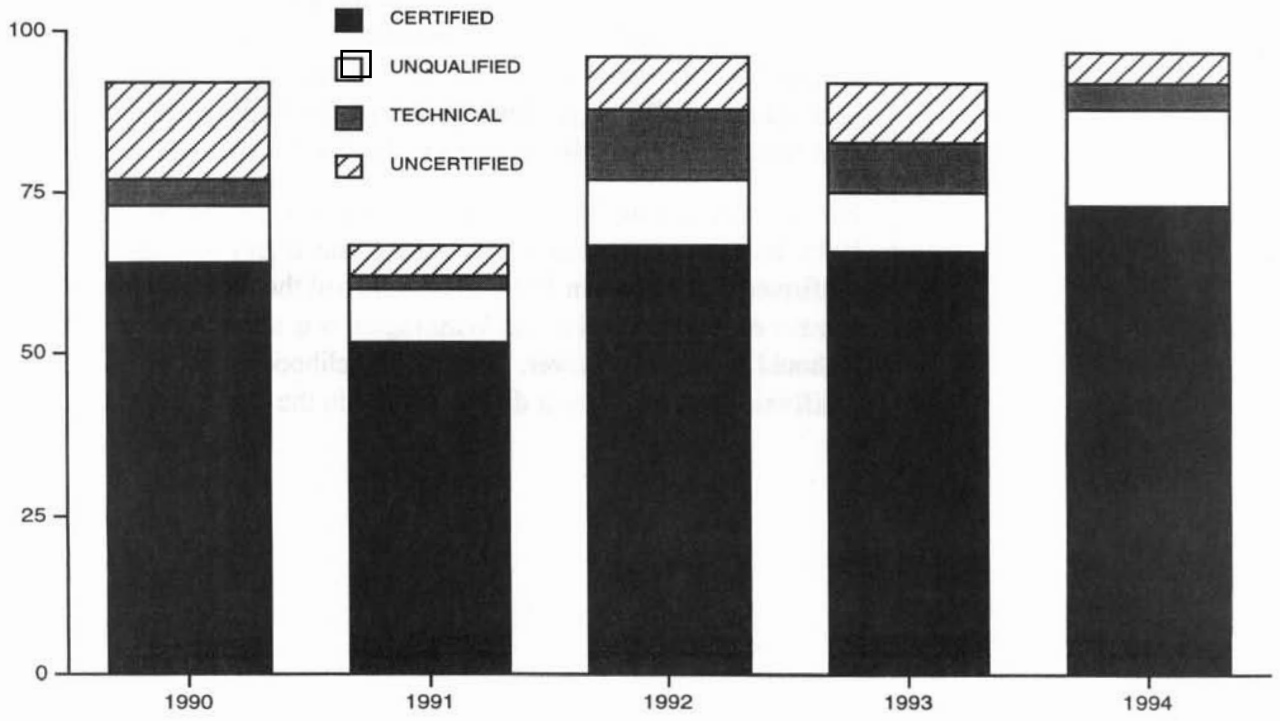
Mixed-gas diving statistics are included among fatalities only. Deaths among divers who have received specialized training have never accounted for more than 11 deaths in any given year. This group averages five deaths per year, with a range of two to 11 deaths annually. In 1994, technical divers accounted for four fatalities.

Despite the lack of appropriate training, between five and 15 uncertified divers die each year attempting to scuba dive. (All diver fatalities are considered in the analysis of scuba fatality data for this Report.)

Mixed-gas diving statistics are included in fatality statistics only.

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

Graph 6.2 *Breakdown of Scuba Fatalities*



In 1994, five dive fatalities involved uncertified divers. These were uncertified individuals who did not participate in an instructional dive course.

It is not possible to determine a mortality rate among recreational scuba divers with any degree of certainty since the number of active divers and number of dives in any given year is unknown.

1995 PREVIEW:

With 29 fatalities, July had the most fatalities reported thus far in 1995. Twenty-nine deaths in a single month is the most recorded since DAN started collection in 1989 and is well above the five-year average for July, which is 16.4 deaths.

Preliminary Report on 1995 Recreational Fatalities

As of September 30, 1995, a preliminary total of 85 fatalities have been reported to DAN for 1995. Of these 85 cases, 63 were recreational divers, nine were recreational/technical (unqualified divers), five were technical, and five were conducting personal tasks. There were also three uncertified divers. These are *preliminary* numbers, and there are likely to be more by the end of 1995 fatalities. Of the 85 fatalities reported thus far in 1995, 14 (16.9 percent) have involved women.

Sixty-one percent (51 cases) of all fatalities occurred between June and August: June (11), July (29), August (11). With 29 fatalities, July had the most fatalities, representing 34.9 percent of the total fatalities reported. Twenty-nine deaths in a single month is the most recorded since DAN started collection in 1989 and is well above the five-year average for July, which is 16.4 deaths. The summer months (May - September) usually ranges from four to 14 deaths per month. Only 31.3 percent of the deaths occurred in the first five months of 1995.

Florida again has the highest number of reported deaths thus far in 1995. With 19 reported as of this writing, this is less than the 25 deaths confirmed at this time in 1994. California had the second-highest number of fatalities at 11; and Washington was third, with six deaths. It should be noted, however, that, in all likelihood, Florida and California have the highest diving activity in the United States.

Methods of Fatality Data Collection

In general, case collection expands to form a case series, where the characteristics of individuals who share a common outcome are described. Unfortunately, however, in this series the end point is death, and all the individuals were involved in recreational scuba diving at some point prior to death. Obviously, since death is not the expected outcome of a scuba dive, the detailed study of the cases reported should give us some insight into the causes of these fatal outcomes. In addition, it helps to identify the risks for this group, which are different than the risks for the millions of individuals who dive without a serious problem.

Initial contact on the majority of DAN's fatality reports come from DAN subscription services, which include news clipping services and computer services.

How Information Is Collected — Initial Contacts

Table 7.1 (below) shows the agencies and services that supply DAN with initial information regarding scuba diving fatalities. The majority of reports come from DAN subscription services, which include news clipping services (Luce and Burrelle) and computer services (CompuServe) About 40 percent of fatality contacts come to DAN via telephone calls through the DAN network.

Table 7.1 *Initial Contacts*

	Inside United States	Outside United States	Total	Percent
DAN Network	32	9	41	42.3
Subscription Services	23	7	30	30.9
Newspaper Direct	7	1	8	8.2
Medical Examiner/Coroner	3	2	5	5.2
Dive Agency	1	3	4	4.1
Investigative*	3	1	4	4.1
Non Member	2	0	2	2.1
Family	0	2	2	2.1
Other	1	0	1	1.0
Total	**72**	**25**	**97**	**100.0**

The DAN network includes calls on the DAN Medical Information Line, the Diving Emergency Hotline and hyperbaric chamber personnel. Medical examiners, coroners, or investigative agencies may also call, as well as newspapers seeking information on scuba fatalities in general. Dive agencies will also inform DAN of fatalities involving their certified divers. In 1994, the other category of contacts represents a call from the owner of a dive shop.

Table 7.2 *Primary Sources of Information*

Primary Source	Total	Percent
Autopsy and investigative report	42	43.3
Medical examiner only	19	19.6
Investigative report only	12	12.4
Newspaper only	5	5.2
Local contact	5	5.2
Medical examiner, investigative and newsclip	4	4.1
Autopsy and news clippings/local contact	4	4.1
Investigative and news	3	3.1
Chamber only	1	1.0
Autopsy and family/witness interview	1	1.0
Family/friend report	1	1.0
Autopsy, medical examiner/coroner report and family/witness	0	0.0
TOTAL	**97**	**100.0**

The DAN network includes:

- ***DAN Medical Information Line***
- ***DAN Diving Emergency Hotline***
- ***Hyperbaric chamber personnel***

The investigative agencies (sheriff and police departments, U.S. Coast Guard, and other reporting agencies) and the medical examiners/coroners who provide fatality incidents to DAN receive periodic mailings of *Alert Diver* as well as an annual copy of this report.

Since scuba fatalities are relatively rare, many agencies who follow up on fatality investigations are unfamiliar with scuba diving. DAN offers investigators and medical examiners information regarding protocols in investigation and autopsy. In this manner, DAN assists investigation agencies but is not an investigative agency itself.

Collecting Information After Initial Contact

Table 7.2 (above) shows the primary sources of information used in the analysis of scuba fatalities. DAN usually receives a news or CompuServe clipping that can be used as a starting point for the collection of more information.

Once a reported fatality has been verified through local authorities, information-gathering can begin. DAN obtains 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 with or witnesses to the dive event. This may include dive buddies, other divers or rescue diver personal. In some cases, DAN may speak with the decedent's family to receive information regarding the deceased's medical history and dive experience level prior to the fatality.

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 1994, a body was recovered in 90 incidents, and autopsies were performed on 84 of these cases. Only six decedents did not have an autopsy performed. An autopsy report was available to DAN in 72 cases out of the 84 cases — which represents 85.7 percent of all autopsied cases.

In general, DAN is receiving more autopsy and investigative reports for analysis because of increased efforts by the DAN medical staff in collecting this information. Often sufficient information is available to review dive fatalities, but an autopsy report makes it possible to define contributing medical conditions and individual behaviors which may contribute to scuba fatalities.

Unfortunately, all cases have some information missing due to the nature of our non-investigative data collection — most notably, the previous health record. This is rarely obtained, except at autopsy. Information can also be limited because of local or state regulations, litigation, family request or the remoteness of foreign locations. All cases are counted, however, unless they fall into one of the previously mentioned exclusion categories.

Once a fatality reported through the DAN network has been verified through local authorities, information-gathering can begin.

Locations of Scuba Fatalities

Tables 7.3 and 7.4 (pages 68-69) show the location of scuba fatalities by state within the United States or by foreign locations., though 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 37 percent of all deaths in the United States, but these deaths occurred at many different dive sites throughout the state. As with accident cases, 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.

Table 7.3 *Location of Diving Fatalities by State*

	Certified	Uncertified	Unknown	Total	Percent
Florida	19	3	3	25	25.8
California	8	1	2	11	11.3
Washington	4	0	2	6	6.2
Massachusetts	4	0	0	4	4.1
New Jersey	2	0	1	3	3.1
New York	2	0	0	2	2.1
Michigan	2	0	0	2	2.1
Pennsylvania	1	0	1	2	2.1
Alabama	2	0	0	2	2.1
Wisconsin	1	0	0	1	1.0
Virginia	1	0	0	1	1.0
South Carolina	1	0	0	1	1.0
Texas	1	0	0	1	1.0
Ohio	1	0	0	1	1.0
Hawaii	0	1	0	1	1.0
Alaska	1	0	0	1	1.0
Arkansas	1	0	0	1	1.0
Arizona	1	0	0	1	1.0
Georgia	1	0	0	1	1.0
Maine	1	0	0	1	1.0
Maryland	1	0	0	1	1.0
Mississippi	1	0	0	1	1.0
New Mexico	1	0	0	1	1.0
West Virginia	1	0	0	1	1.0
Total	**58**	**5**	**9**	**72**	**73.9**

Typically, deaths occur at a variety of dive sites and under various conditions.

There was a decrease in the number of fatalities in Florida and California from 1993 to 1994.

There were five deaths in the combined geographic area of New York and New Jersey in 1994. From 1989 to 1994 there were 32 deaths in this region, with a range of two to six deaths per year. In 1994, the five deaths in this region did not involve technical level or technical divers, and represents the average number of fatalities for this area.

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

Country	Total	Percent
Bahamas	6	6.2
US Virgin Islands	3	3.1
Guam	3	3.1
Cayman Islands	3	3.1
Mexico	2	2.1
Marshall Islands	2	2.1
Antilles	2	2.1
British Virgin Islands	1	1.0
Honduras	1	1.0
Australia	1	1.0
Japan	1	1.0
Total	**25**	**25.8**

The 1992 numbers were high because there were five technical divers involved in deep, advanced dives.

The number of U.S. citizens who died while scuba diving abroad represented 25.8 percent of all fatalities recorded in 1994. In 1989 and 1990 there was an average of 25 foreign deaths. In 1992 and 1993, this percentage had decreased to 16 deaths, while there was an average of 22 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. There were six fatalities which occurred in U.S. Territories. The cumulative totals by state and foreign location since 1970 are shown in Appendix D of this report.

The number of U.S. citizens who died while scuba diving abroad represented 25.8 percent of all fatalities recorded in 1994.

Fatality Dive Profile

Sightseeing or pleasure diving . . . usually accounts for 40 to 50 percent of all fatalities.

Primary Dive Activities

Table 8.1 (below) shows the primary dive activity of both certified and noncertified divers who died in 1994. There is also an unknown category that represents divers who were reported to be certified, but whose certifying agency and level of certification were unknown. Most divers will choose a scuba activity that is consistent with their training, their diving experience and familiarity with different dive sites — this is the best way to minimize a diver's risk of injury or death while scuba diving. Unfortunately, some individuals will attempt scuba diving without certification or proper equipment. There were only five such individuals among the 1994 fatalities.

Table 8.1 ***Primary Dive Activity***

Dive Activity	Certified	Uncertified	Unknown	Total	Percent
Pleasure	41	3	2	46	47.4
Spearfishing/Hunting	6	1	1	8	8.2
Wreck	6	0	0	6	6.2
Under Instruction	5	7	0	12	12.4
Work	5	0	0	5	5.2
Cave	4	0	0	4	4.1
Deep dive	4	0	0	4	4.1
Photography	4	0	0	4	4.1
Night	2	1	0	3	3.1
Other	2	0	0	2	2.1
Unknown	2	0	0	2	2.1
Providing Instruction	1	0	0	1	1.0
TOTAL	**82**	**12**	**3**	**97**	**100.0**

Sightseeing, Spearfishing & Instruction

Some comparisons can be made between the primary activity of fatalities and the DCI injury population by reviewing Table 8.1 (above) and Graph 3 (page 38). Sightseeing or pleasure diving is the primary activity for scuba diving in general and usually accounts for 40 to 50 percent of all fatalities. There were four less spearfishing/hunting deaths and three less cave diving deaths in 1994 than in 1993. Scuba fatalities occurring under instruction increased from six to 12. Five of these fatalities occurred in divers who were getting a higher certification. There were seven uncertified divers undergoing initial instruction, which represents an increase of three divers over last year.

Working Dives & Underwater Photography

The "work" dive activity does not refer to individuals who were occupational divers or being paid to perform a scuba task. These five divers were individuals who were using scuba diving to perform a dive-related or personal task. The activity of these five individuals were: attempting to free an anchor line, setting the anchor line from a dive boat, helping a friend retrieve a sunken boat, testing underwater communication equipment and retrieving a fouled line from the dive boat. One individual died as a result of being struck by the boat.

These examples illustrate the need for caution when a diving task requires that the diver focus attention on the task and away from maintaining an open airway, monitoring dive gauges and keeping an awareness of overhead obstructions. The same might be true for photography as a primary activity. There were no deaths while doing underwater photography in 1993, but there were four deaths in 1994.

Technical Dives

Among the certified population of divers, there were four technical-level diver fatalities in 1994. All of these deaths involved special training and equipment to make their scheduled dive. There were two deep cave diving deaths using mixed gas and one cave death in shallow water during an exploration for mapping. The fourth death involved a deep wreck dive on air.

Technical-Level Dives (by unqualified divers)

There were also 15 deaths among individuals attempting a technical-level dive without the necessary training or equipment. These dives were either deep, in a cave or associated with a wreck dive. These 15 deaths also involved two triple fatalities and three double fatality episodes. These multiple deaths underscore the potential consequences of diving outside suggested safety guidelines and without the proper dive training and experience.

Dive Entries — Shore, Boat, Pool

Table 8.2 (page 72) shows the range of different dive platforms used by divers to enter the water. Since 1990, shore-entry dives have been made in up to 49.3 percent of all fatality dives, but in 1994, this percentage dropped to 27.8 percent. Charter- or private-boat diving made up a total of 70.1 percent of all scuba fatalities in 1994 — the first time private-boat diving has accounted for the most fatalities in a given year. This increase is due in part to two triple deaths and one double death that occurred aboard private vessels. Three out of the five divers listed as doing work were also on private vessels, and an additional six deaths involved spearfishing from private vessels. Seventeen divers out of 37 who died diving off a private vessel were involved in pleasure diving. The table also shows a consistent trend in the number of pool deaths each year.

There were 15 deaths among individuals attempting a technical-level dive without the necessary training or equipment.

Table 8.2 *Dive Platform*

Entry	1994 Percent	1993 Percent	1992 Percent	1991 Percent	1990 Percent
Shore	27.8	44.6	39.2	49.3	47.8
Charter Boat	30.9	32.6	26.8	28.4	30.4
Private Boat	39.2	20.7	29.9	20.9	20.7
Pool	1.0	1.1	1.0	1.5	0.0
Unknown	1.0	1.1	3.1	0.0	1.1
Total	**99.9**	**100.1**	**100.0**	**100.0**	**100.0**

These data suggests that the risk of death while under the supervision of an instructor is quite low when compared to open-water diving.

Number of Divers In Groups Involving Fatalities

Table 8.3 (below) shows the number of divers listed in the dive group at the time of the fatality. This number includes all divers associated with the organized dive party but not individuals associated with other groups at the same dive site. Many of these percentages remain the same from year to year with only small changes. For example, while the percentage of solo diving has been increasing one or two percent each year, the percentage of fatalities in a two-diver group has been steadily decreasing from 30 percent since 1992. The percentage of fatalities in three- and four-diver groups increased in 1994, however. Almost 57 percent of all fatalities occurred in dive parties of four or fewer divers.

The percentage of fatalities in a two-diver group has been steadily decreasing from 30 percent since 1992.

Table 8.3 *1994-Number of Divers in a Group*

Number in Dive Party	1994 Percent	1993 Percent
1	6.2	5.4
2	22.7	25.0
3	16.5	10.9
4	11.3	9.8
5	6.2	8.7
6	6.2	4.3
7	2.1	2.2
8	2.1	3.3
9	2.1	1.1
≥10	15.5	15.2
Unknown	9.3	14.1
TOTAL	**100.2**	**100.0**

When diving in smaller groups, there are special considerations that can increase the diver's risk. Of the 55 divers in groups of four or less, 24 cases had an associated buddy separation: after the six solo divers were removed from this group, buddy separation was a factor in almost 49 percent of these cases. Immediate assistance, or search and rescue, depend on an incident being observed. If there is buddy separation, assistance may not be available, which could decrease the chance of survival.

When & Where in A Dive Problems Occurred

Tables 8.4 and 8.5 (below) show the approximate time (when) and the part (where) of the dive that a problem was reported to have occurred. Divers are assigned to these categories based on the information collected from witness statements and investigative reports.

Incidents that occur early in the dive or on the surface predive are frequently associated with a failure to check equipment prior to entry or properly prepare for entry into the water. Surface post-dive deaths are more commonly associated with an insufficient air situation, inability to maintain buoyancy at the surface or pre-existing health problems, such as heart disease. Thirty-one scuba fatalities were reported to have run out of air, and 10 fatalities were associated with a low-air situation. A total of 41 fatalities (42 percent) were associated with an insufficient air problem. Additionally, buoyancy problems occurred in 14 divers, and 13 divers had a rapid ascent. Only one attempt to assist a distressed diver with buddy breathing was reported. Ultimately, this individual had a buoyancy problem and rapid ascent as well.

Thirty-one scuba fatalities were reported to have run out of air, and 10 fatalities were associated with a low-air situation.

Table 8.4 *When Problem Occurred*

	1994 Percent	1993 Percent
Late Dive	29.9	31.5
Post Dive	20.6	16.3
Early Dive	11.3	15.2
Mid Dive	5.2	15.2
Unobserved	23.7	9.8
Surface-Predive	4.1	6.5
Unknown	4.1	4.3
Immediately	1.0	1.1
TOTAL	**99.9**	**99.9**
	n=97	*n=92*

Table 8.5 *Where Problem Occurred*

	1994 Percent	1993 Percent
At Depth	29.9	32.6
During Ascent	16.5	22.8
Surface Post Dive	25.8	16.3
Unobserved	16.5	12.0
Surface-Predive	5.2	6.5
Descent	3.1	5.4
Unknown	3.1	4.3
TOTAL	**100.1**	**99.9**
	n=97	*n=92*

Summary

The true incidence of adverse events among scuba fatalities is difficult to determine. For instance, in 1994, seven bodies were not recovered so specific aspects of these cases cannot be known, and contributing factors such as running out of air could not be counted in the total. Additionally, specific information can be lost when events are unobserved. Because of this, the actual occurrence of contributing factors is probably higher than stated in this Report.

In 1994, seven bodies were not recovered so specific aspects of these cases cannot be known, and a contributing factor such as running out of air would not be counted in the total.

Dive Fatalities Among Certified Divers

This section reports not only on certified divers but also includes those divers who were in their initial training or whose exact level of certification was unknown. The five uncertified divers have been excluded from this section's analysis.

Age and Sex in Diver Fatalities

The ages and gender for the 92 certified divers are shown in Table 9.1 (below). The 21 female fatalities represent 29.5 percent of all scuba deaths. The number and percentage of female deaths can vary greatly from year to year, as past data indicates. The percentage of female deaths is high for 1994, considering that they only accounted for 12 percent of the 1993 certified deaths and 20 percent of the 1992 deaths among certified divers. The age range for female divers was 16 to 64 years of age; males ranged from 17 to 79 years of age. The six deaths reported in the 19-and-below age range is the most reported for the last four years. The 19-or-under and the 40-to-49 groups both have the greatest increase in percentage of total fatalities, which is 6.5 percent over last year. The greatest decrease was in the 30 to 39 year age range, where there were only 19 deaths or 20.7 percent of all deaths, compared to 30 deaths or 34.5 percent in 1993.

The 19-or-under and the 40-to-49 groups both have the greatest increase in percentage of total fatalities in 1994.

Table 9.1 ***Age and Sex Comparison of 1994 Fatalities***

Age	Male	Female	Total	Percent
10-19	3	3	6	6.5
20-29	13	3	16	17.4
30-39	19	0	19	20.7
40-49	18	8	26	28.3
50-59	14	4	18	19.6
60-69	2	2	4	4.3
70-79	1	0	1	1.2
Unknown	1	1	2	2.2
TOTAL	**71**	**21**	**92**	**100.1**

Certification Levels Among Fatalities

Table 9.2 (below) shows the level of certification among the 1994 scuba fatalities. Fifty-eight divers, or 63.0 percent, had received only one scuba certification prior to their fatal incident. This result is comparable to certification analysis among those divers with DCI. This finding suggests that with more training some fatalities might be prevented. The unusually high percentage of open-water or basic divers resulted in the corresponding decrease for other certification levels. The decrease in the number of advanced open-water divers (8.7 percent) represents the greatest decrease — from 20 percent in the 1993 statistics. One death involved a military trained diver who was performing a recreational dive.

The decrease in the number of advanced open-water divers (8.7 percent) represents the greatest decrease — from 20 percent in the 1993 statistics.

Table 9.2 *Certification Level of 1994 Fatalities*

Certification Level	Total	Percent
Open Water/Basic	58	63.0
Advanced	8	8.7
Unknown	8	8.7
Student*	7	7.6
Instructor	5	5.4
Cave	2	2.2
Rescue	2	2.2
Military	1	1.1
Dive Master	1	1.1
Total	**92**	**100.0**

**Under initial training*

Fatalities Grouped By Experience Levels

Table 9.3 (page 77) shows the experience for all certified divers based upon the reported number of lifetime dives. This number is obtained from the information reported to DAN, which is not always exact. The experience in this table is indicated by a range of dives which indicates the general experience of the divers.

Other indicators which help determine the experience of a diver are the length of time they have been certified and the frequency of their diving. Unfortunately, this information is difficult to obtain in scuba fatalities since the deceased is frequently the only individual who has this information. Therefore, these diver attributes are most likely under-reported. Over 30 percent of the certified dive fatalities involved divers with two years or less experience in diving. Twenty-three percent were divers with greater than five years' experience.

However, in the largest percentage (39.1 percent) of divers, the number of years' diving experience was unknown. Similarly, information on dives within the past 30 days or dives made within the past year is not available. In 76 percent of the fatalities, it was unknown if they had dived in the past year, and in 79.0 percent of the deaths, dives made in the past 30 days were unknown.

Table 9.3 *Diving Experience in Fatalities*

	Overall Experience		Within Activity or Environment	
	Total	**Percent**	**Total**	**Percent**
Student	3	3.3	4	4.3
Novice (≤ 5 dives)	14	15.2	8	8.7
Inexperienced (6 - 20 dives)	21	22.8	26	28.3
Intermediate (21 - 40 dives)	12	13.0	20	21.7
Advanced (41 - 60 dives)	7	7.6	5	5.4
Experienced (≥ 61 dives)	28	30.4	22	23.9
Unknown	7	7.6	7	7.6
TOTAL	**92**	**99.9***	**92**	**99.9***

**Percent of certified divers*

Table 9.3 is also divided into two different types of diving experience. "Overall Experience" refers to the total diving experience that is based on all known scuba dives. "Experience Within Activity or Environment" refers to how experienced a diver was reported to have been in the specific activity, such as cave diving, spearfishing/game collecting or pleasure diving.

The most fatalities in any single group occurred among those divers with 61 dives or more.

The most fatalities in any single group occurred among those divers with 61 or more dives. In 1993 there were 33 fatalities among divers in this experience group who were involved in 38 percent of all deaths. The greatest increase in deaths in any experience group occurred in the novice, or five-or-fewer dives group, in which there were 14 deaths (15.2 percent) compared to only five deaths, or 5.7 percent of all deaths in 1993.

The greatest increase in deaths among divers under the fatalities category "within activity or environment" occurred in the intermediate group, in which 21.7 percent of all fatalities occurred, compared to 9.2 percent in the previous year. The greatest decrease was in the experienced group, with 61 or more dives, where there was a decrease from 31 fatalities to only 22 in 1994.

Appendix A

1994 Fatality Case Reports with Autopsy Findings

By G. Yancey Mebane M.D., DAN Assistant Medical Director and
James Caruso M.D., DAN On-Call Senior Staff Physician

Introduction/Overview

In the reporting year of 1994, upon which this Report is based, Divers Alert Network examines a total of 97 scuba diving-related fatalities, 72 of which are represented by autopsies in the following pages.

As in previous years, the causes of death and the factors contributing to death used in the DAN fatality case reports use the terminology of the International Classification of Diseases Clinical Modification (ICD-9-CM) based on the World Health Organization's International Classification of Diseases.[1] The codes used are listed in Appendix F.

The summaries and final anatomic diagnoses are arrived at by correlating all available information — which includes statements by witnesses, police and U.S. Coast Guard reports, DAN accident report forms, and autopsy findings. Most of the causes of death in the DAN case reports agree with the findings of the medical examiner. The rare exceptions occur when there is substantial clinical or historical information upon which an alternative cause of death can be based. The most notable example of this is the diagnosis of arterial gas embolism (AGE). Depending on the person performing the autopsy, much or little is made of the finding of intravascular bubbles — seen in cases of AGE, but may also be due to other causes.

From a practical viewpoint, divers who have been breathing compressed air or mixed gas at depth have significant amounts of inert gas dissolved in their tissues. After these divers return to the surface, whether alive or dead, the inert gas diffuses out of the tissues and a portion will end up in intravascular spaces.

Additionally, the process of decomposition causes production of gas. The amount of intravascular gas present at autopsy depends on several factors, including:

- the dive profile;
- whether the diver expired during the dive or in the post-dive period;
- the delay between the time of death and autopsy; and
- the autopsy techniques used.

Findings that are indicative of a possible arterial gas embolism include:

- air (more accurate if gas samples are taken to confirm an oxygen content approximating air) in the left ventricle in an autopsy performed soon after death;
- bubbles in cerebral or coronary arteries but not veins; or
- evidence of a pulmonary overinflation injury.

The autopsy protocol in Appendix F of the 1992 *Report on Diving Accidents and Fatalities* is recommended.[2] This protocol is designed to assist the pathologist in determining the immediate cause of death in a scuba diver. It discusses the different injuries to scuba divers as well as the appropriate techniques to use in a diver autopsy. In general, it is recommended to open the thoracic cavity after placing a layer of water over the anterior chest wall. The location and amount of gas found in the mediastinum and vessels should be meticulously recorded.

Occasionally erroneous conclusions are drawn from obtaining air through a simple thoracic puncture or by seeing bubbles generally distributed in the cerebral or coronary circulation. Intravascular gas is not pathognomonic (diagnostic) for either air embolism or decompression sickness. The history preceding death, especially the dive profile, are much more reliable pieces of information in arriving at the diagnosis of an arterial gas embolism.

Because all diving fatalities are at least initially categorized as non-natural deaths, the medical examiner system assumes jurisdiction in most states. Autopsies are performed in most cases, and it is recommended in all diving fatalities. Even fatalities attributed to

drowning require a postmortem examination because drowning is essentially a diagnosis of exclusion and other causes of death or contributing factors must be ruled out.[3]

A complete investigation of a diving fatality includes information on the following:
- the decedent's health status;
- the decedent's level of diving expertise;
- the decedent's dive profile;
- a detailed narrative of the events surrounding the fatality;
- a compete autopsy; and
- a thorough examination of all equipment used by the decedent.

Autopsied Cases

Classified by Immediate Cause of Death

A total of 72 fatality case reports with autopsies appear in the following pages, categorized according to the immediate cause of death. Autopsy reports provide essential information in establishing the diagnosis on these cases. Some conditions appear more frequently than others and 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 fatalities in general.

Contributing Factors: Cardiovascular Disease and Inexperience

Two recurring themes appear in the fatality case reports with notable frequency and are worthy of separate mention. They are cardiovascular disease and lack of experience.

For the past several years cardiovascular disease has been a leading cause of death in the DAN fatality case reports. One reason for this is intuitive — cardiovascular disease is the leading cause of death for both men and women in the United States and Europe.[4]

Because of the nature of diving, there are increased risks involved for a person who has atherosclerotic coronary artery disease. Physical exertion can initiate an ischemic episode because of the heart's increased need for oxygen. Surviving a cardiac arrest or myocardial infarction while on a dive trip is less likely than if the event occurred at home or at work — not only is there the increased hazard of being in the water, but most diving still occurs in areas remote from tertiary medical care facilities.

In general, diving should be considered potentially strenuous exercise and a thorough physical examination is necessary for adequate assessment for fitness to dive. Because the risk of cardiovascular disease increases with age, the evaluation must include appropriate provocative studies, such as an exercise stress test in older divers, whether they are new to diving or continuing divers.

The other potentially preventable contributing factor to diving deaths is inexperience with diving in general or a specialized type of diving. This factor appears in several fatality reports each year. A number of mishaps have occurred during the initial open-water certification dives or, more commonly, during the novice period when a diver has performed fewer than 10 to 15 open-water dives.

There are also a number of deaths involving qualified, even experienced, open-water divers who engage in dive activities that they are unqualified or unprepared for, such as cave diving or deep diving. And there are always a few fatalities each year involving noncertified divers. This only underscores the importance of proper training and a thorough familiarity with all equipment used during a dive.

Summary of Fatality Collection

The primary reason for collecting and publishing the DAN fatality case studies is to help avoid potential future accidents — by sharing the lessons learned from the unfortunate experiences of others, we can help educate ourselves and others to become safer divers.

DAN's ultimate goal, of course, is to finish the year with no diving fatalities to report. The best way to accomplish this goal is to advocate:
- physical fitness;
- appropriate training and education;
- proper and well-maintained equipment; and
- safe diving habits.

Encouraging this awareness in divers of all levels — from novice to instructor — can help reach DAN's goal of safer diving everywhere.

The 1994 database of scuba diving fatalities can be found in the following pages.

Decompression Illness

Decompression Sickness (DCS) and Arterial Gas Embolism (AGE)

The term *decompression illness* (DCI) includes the two diseases most identified with diving — *decompression sickness* (DCS) and *arterial gas embolism* (AGE).

These disorders are grouped together because they are characterized by:

- the presence of bubbles,
- pressure change is required to produce the disease, and
- treatment for both is similar.

In looking at the autopsy series in the DAN database, however, we find only one death which was clearly due to DCS and 10 due to AGE. 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 DCS.

Further study of the AGE group discloses that inexperience is a factor that appears repeatedly. The same factor appears in the divers who survive an arterial gas embolus.[5]

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 mechanisms of AGE, 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. This may imply greater knowledge/skill than the diver may truly possess.

Decompression Sickness

DAN RECORD NO: 5094 **DOB:** 1960 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Adult Respiratory Distress Syndrome	518.5
Due to: Decompression sickness	993.3
Due to: Rapid ascent	E902.2
Due to: Accident d/t water sports activity	E910.1

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

1: Left ventricular hypertrophy	429.3

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

A 34-year-old male was participating in a spearfishing rodeo when he made a rapid ascent from 130 to 70 fsw. It was his third deep dive of the day. On the boat the diver developed shoulder pain and progressive paralysis. He was treated on a USN TT7 but died four days later.

Air Embolism

DAN RECORD NO: 794 **DOB:** 1954 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Anoxic brain damage	348.1
Due to: Air embolism	958.0
Due to: Accident d/t diving pressure check	902.2
Due to: Accident d/t water sports activity	E910.1

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

Decedent was an experienced diver taking a night dive specialty course in a Florida sinkhole. Her buddy was her husband. He indicated for both to ascend, but lost sight of her and descended to look for her. When he returned to surface his wife was on the surface receiving CPR. She had apparently made a rapid ascent from an undetermined depth. Her computer recorded maximum depth at 147 feet. She survived a few days, but died of encephalopathy after receiving three HBO treatments.

Autopsy was consistent with anoxic encephalopathy. The cause was probably air embolism.

DAN RECORD NO: 994 **DOB:** 1973 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Air embolism	958.0
Due to: Accidental suffocation, lack of 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: Interstitial emphysema	518.1
2: Traumatic subcutaneous emphysema	958.7

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

Little information is available about the dive or clinical course after the injury. Apparently the diver made a rapid ascent after running out of air, surviving long enough to reach a local hospital. It is not clear that he was alive when he reached the trauma center for hyperbaric treatment.

The autopsy was consistent with a pulmonary overpressure accident.

DAN RECORD NO: 2494 **DOB:** 1955 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Accident d/t diving pressure change	E902.2
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 (mild)	414.0

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

Decedent was diving with two partners approximately eight miles offshore. Some three minutes after beginning the dive, the decedent indicated to one partner that he was going to the surface. The partner reported that the decedent showed no sign of distress. At the surface, the victim shouted for help and could not reach a line thrown to him. He drifted away from the boat and was picked up by another dive boat in the vicinity. He was apneic and without a pulse when recovered, and divers began CPR. The USCG continued with CPR and eventually transported him to the hospital by helicopter. He was DOA at the hospital.

The autopsy is not revealing; the pathologist records the cause of death as air embolism.

DAN RECORD NO: 2994 **DOB:** 1936 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Rapid ascent	E902.2
Due to: 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 had completed a dive in the Florida Keys and was returning to the boat with his buddy. The buddy swam underwater; the victim was on the surface. Victim indicated distress was rescued, but developed cardiac arrest. Resuscitation was not possible.

Autopsy revealed the cardiac chambers and superior vena cava filled with air.

DAN RECORD NO: 3394 **DOB:** 1932 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Accident d/t water sports activity	E910.1

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

Decedent and husband were members of a dive group aboard a charter in the Florida Keys. The dive was apparently uneventful, but the decedent became short of breath near the end of the dive or at the surface and required rescue. She became unconscious, possibly in cardiopulmonary arrest, but was resuscitated and transported to the hospital. The time interval from arrest to the hospital admission is not given. She died the following day at the hospital.

The autopsy was unremarkable. The pathologist's impression was air embolism as the cause of death .

DAN RECORD NO: 3594 **DOB:** 1945 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Accident d/t diving pressure check	E902.2
Due to: Accident d/t water sports activity	E910.1

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

1: Hypertensive heart disease, NOS	402.10
2: Obesity	278.0
3: Hyperlipidemia, NEC/NOS	272.4
4: Allergic rhinitis, NOS	477.9

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

Decedent was a "borderline" hypertensive, with exogenous obesity; he was on a weight-loss program. He was also taking Lorcet and Flexeril, commonly used for musculoskeletal problems, but decedent's indications for the medication are unknown. Both are CNS depressants.

The end of the dive was complicated by a low-air situation, but the ascent did not appear to have been rapid. Cardiac arrest occurred at the surface.

Autopsy disclosed air in the epicardial and cerebral vessels. The scuba equipment was not examined.

DAN RECORD NO: 3894 **DOB:** 1959 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Accident d/t diving pressure check	E902.2
Due to: Accident d/t water sports activity	E910.1

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

Decedent was a relatively inexperienced diver, without a diver certification, who was diving with a group on a charter in the Florida Keys. Decedent made an observed ascent to the surface. At the surface he was in immediate trouble and indicated he needed help. He was responsive enough to drop his weight belt on command but then became unconscious and apneic. By the time he was retrieved and brought aboard the boat, CPR was unsuccessful.

Autopsy revealed both heart ventricles filled with air.

DAN RECORD NO: 4594 **DOB:** 1971 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Accident d/t water sports activity	E910.1

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

A 23-year-old male made a dive to 137 feet in fresh water to view a wreck. It was only his second dive to deeper than 100 feet, but it was uneventful until ascent. After beginning their ascent the decedent's partner states he observed the decedent coughing frequently as they moved up through the water column. The decedent skipped the preplanned safety stop at 15 feet and was in obvious distress on the surface. He became unconscious, and resuscitation efforts were unsuccessful.

The autopsy lists the cause of death as air embolism based upon 50cc of air in the right ventricle. There were no specific lung findings, and the brain was not examined. The conclusion of air embolism is more reliably based upon the dive history in this case.

DAN RECORD NO: 5494 **DOB:** 1958 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Arterial gas embolism	958.0
Due to: Rapid ascent	E902.2
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: Panic	308.0
2: Subcutaneous emphysema	958.7
3: Pneumomediastinum	518.1

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

An inexperienced diver, 36 years old, made a freshwater dive to 71 feet for 25 minutes with a more experienced buddy. The dive was planned to 150 feet to test underwater communications equipment. Both divers ran out of air and attempted to make a somewhat controlled ascent, although the experienced diver admits to using the last of his air to inflate his BC. The decedent became unconscious in the water column, and resuscitation efforts on the surface were unsuccessful.

An autopsy showed numerous bubbles in the coronary and cerebral circulation, as well as subcutaneous and mediastinal air.

DAN RECORD NO: 8494 **DOB:** 1940 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958.0
Due to: Rapid ascent	E902.2
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: Obesity	278.0
2: Hypertension	401.9
3: Fatty liver	571.8

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

A 54-year-old, experienced male diver was making his second dive of the day when he noticed that he was low on air. He made a rapid ascent and developed severe distress during the surface swim back to the boat.

The autopsy contained several findings that are consistent with pulmonary barotrauma and air embolism.

Drowning With Air Embolism

DAN RECORD NO: 3494 **DOB:** 1946 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Air embolism	958.0
Due to: Rapid ascent	E902.2
Due to: Accident d/t water sports activity	E910.1

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

1: Nitrogen narcosis	293.0

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

A 48-year-old man was making a quarry dive with an excursion into an old mine shaft. He and his dive partner used air to 200 feet. At that depth they switched to trimix, down to 303 feet. They also used propulsion scooters for movement.

The decedent experienced regulator problems at 270 feet; at the same time his scooter became stuck in the ON position. He was subsequently dragged around the shaft at a depth of about 180 feet. The decedent became unresponsive. His dive buddy tried his best to render assistance until it was apparent that the diver was dead. The body was recovered the next day.

The autopsy showed large amounts of intravascular air as well as subcutaneous emphysema. Hemorrhages were also present in the lungs, skull, and right eye. The deep dive profile can account for the intravascular gas load, but the dive history does suggest air embolism as the likely catastrophic event.

DAN RECORD NO: 7694 **DOB:** 1941 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Arterial gas embolism	958
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 artery disease	414.0
2: Obesity	278.0

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

A 53-year-old male made a 153-foot dive, penetrating a shipwreck. He became separated from his buddies and was found five minutes later — without his regulator in his mouth and unconscious.

The autopsy findings included large amounts of intravascular air; the report lists arterial gas embolism as a cause of death.

DAN RECORD NO: 7894 **DOB:** 1947 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Insufficient air	E913.2
Due to: Arterial gas embolism	958.0
Due to: Accident d/t water sports activity	E910.1

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

1: History of alcoholism	303.3
2: Affective disorder/depression	296.2

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

A 47-year-old male made a dive to 70 fsw for approximately 20 minutes. After ascending, the diver became short of breath during a brief surface swim and required assistance getting onto the boat. On board, he became unconscious, and resuscitation efforts were unsuccessful. Inspection of the diving gear revealed an empty tank.

The autopsy showed hyperexpanded lungs and bubbles in the cerebral and coronary arteries. Toxicology was positive for diphenhydramine.

DAN RECORD NO: 9294 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Air embolism	958.0
Due to: Accident d/t water sports activity	E910.1

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

A 43-year-old male was diving in a large group. He had been down only a few minutes when he surfaced and then began to sink back towards the bottom. The diver was recovered 52 minutes later and could not be resuscitated.

The autopsy disclosed air in the left ventricle and findings consistent with drowning.

Cardiovascular Disease

As Immediate Cause of Death

Cardiovascular disease is the leading cause of morbidity (sickness) and mortality in the United States as well as most Western countries. There are almost 1 million deaths from cardiovascular disease per year in the United States; this is 10 times the number that result from accidents. The death rate due to cardiovascular disease 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 experiencing a heart attack is about one chance per million (1.0) for an otherwise healthy 50-year-old man. A person whose relative risk of having a heart attack is 2.0 *doubles* the absolute risk. Heavy physical exertion increases the risk by 5.9 times; anger increases it by 3.0 times. The risk after first awakening in the morning is 2.3 times the absolute risk[6].

Cardiovascular disease is treacherous — frequently it is present in a severe form without symptoms until sudden death, or a heart attack or stroke occurs. It is not a surprise, then, that these events occur during scuba diving — just as they might with any other human activity. 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 a coronary artery bypass graft procedure. However, highly motivated individuals who meet certain requirements do dive successfully in the presence of coronary artery disease.

Prevention of death due to cardiovascular disease while diving, however, can be difficult. Is there some unknown factor about exercise effects from diving versus those effects 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.[7] Exercise increases cardiac output as well as myocardial oxygen requirements. The effects of immersion are manifested by a decrease in blood pooling in the extremities and an increase in the amount of blood returning to the heart and located in the thorax.

There is some information about the second part of the question — i.e., is there an increased risk for divers with CAD? Studies have confirmed the link between heavy exertion and acute myocardial infarction.[8,9] In these events, exercise is the trigger which initiates the event in an already-diseased vascular system.

The protective effect of regular exercise is well known. These studies in CAD 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 the 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.[10]

It is apparent that there are less stringent restrictions for divers with CAD than for those with asthma or diabetes. The evidence for increased risk of death while diving in the asthmatic is not convincing, however. 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 appears there is excessive mortality due to coronary artery disease among divers past the age of 40.

In the following cases there are a few examples of individuals who were known to have health problems considered disqualifications for diving.

DAN RECORD NO: 1594 **DOB:** 1916 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Cardiovascular disease, NOS	429.2
Due to: Accident d/t water sports activity	E910.1

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

1: Obesity	278.0
2: Chronic airway obstruction, NEC	496
3: HTN renal NOS w/o renal failure	403.90

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

This man and a companion were collecting fish in warm water at a site not requiring undo physical effort. At the end of the second dive the victim surfaced complaining of severe chest pain. He was cyanotic, and cardiac arrest followed quickly. Resuscitation was not possible. The decedent was under treatment for heart disease, but the details are not known to DAN.

The autopsy was consistent with a cardiovascular cause for the death.

DAN RECORD NO: 2394 **DOB:** 1946 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Acute myocardial infarction (AMI), NOS	410.90
Due to: Chronic ischemic heart disease	414.9

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 (oral)

Decedent was a 48-year-old male under dive instruction when he reportedly became short of breath and then died. A heavily censored sheriff's office report gives very little information. The autopsy report was received orally from the medical examiner tech and paramedic. An autopsy disclosed an obstructed right coronary artery (RCA) with acute myocardial infarction due to ischemic heart disease.

The medical examiner tech also reports that the victim had reached the surface alive and had called for help before the cardiac arrest occurred.

DAN RECORD NO: 4194 **DOB:** 1942 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Probable acute myocardial infarction/ dysrhythmia	410.9
Due to: Coronary atherosclerosis	414.0

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

1: Accident d/t water sports activity	E910.1
2: Alcohol intoxication	305.0

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

A 52-year-old male went diving for lobster after taking a five-year break from diving. Eight minutes into the dive he surfaced unconscious and without his regulator in his mouth.

An autopsy revealed severe atherosclerosis of the coronary arteries and pulmonary edema. Alcohol consumption was likely contributory.

DAN RECORD NO: 4994 **DOB:** 1938 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Myocardial infarction	410.9
Due to: Coronary atherosclerosis	414.0

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

1: Left ventricular hypertrophy	429.3
2: Obesity	278.0
3: Accident d/t water sports activity	E910.1

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

A 56-year-old male diver made an uneventful first dive and was on the surface preparing to descend on a second dive when he returned to the boat and complained of fatigue. He quickly became unresponsive and was brought into the boat. CPR was initiated, but resuscitation efforts were unsuccessful. The decedent had a strong family history of heart disease and had been noncompliant with blood pressure medication.

An autopsy showed an acute myocardial infarction, mild to moderate coronary atherosclerosis and hypertrophy (thickening of the wall) of both ventricles of the heart.

DAN RECORD NO: 6194 **DOB:** 1956 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Myocardial infarction	410.9
Due to: Coronary atherosclerosis	414.0

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

1: Left ventricular hypertrophy	429.3 0
2: Obesity	278.0
3: Diabetes mellitus	250.0
4: Accident d/t water sports activity	E910.1

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

A 37-year-old male with numerous medical problems and a history of poor treatment compliance was diving in a freshwater quarry. After the dive he became unresponsive and CPR was initiated. The diver was pronounced dead at a local hospital.

The autopsy disclosed severe three-vessel coronary atherosclerosis and left ventricular hypertrophy. Urine tested positive for glucose and ketones.

DAN RECORD NO: 6594 **DOB:** 1946 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Arterial gas embolism	958.0
Due to: Cardiac dysrhythmia	427.9
Due to: Coronary atherosclerosis	414.0

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

1: Left ventricular hypertrophy	429.3
2: Obesity	278.0

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

A 48-year-old male entered the water with 50 pounds of extra gear for the purpose of cave exploration. Prior to descent, the diver experienced difficulty breathing and became unconscious on the surface. The decedent was pulled to the boat by other divers who then performed CPR. The diver, however, could not be resuscitated.

An autopsy disclosed severe coronary atherosclerosis and moderate left ventricular hypertrophy.

DAN RECORD NO: 7494 **DOB:** 1947 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Cardiac dysrhythmia	427.9
Due to: Idiopathic hypertrophic, subaortic stenosis	425.4

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

1: Ventricular hypertrophy	429.3
2: Coronary artery disease	414.9
3: Obesity	278.0
4: Thymoma	212.6
5: Cannabinoids (Drugs)	E980.3
6: Accident d/t water sports activity	E910.1

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

A 47-year-old male was diving for lobster while being towed behind the family boat. He signaled for the boat to stop and appeared to make a descent. Shortly thereafter he was on the surface in obvious respiratory distress. The decedent was brought to the boat, but failed to respond to resuscitation efforts.

The autopsy disclosed significant cardiac abnormalities, and toxicology was positive for cannabinoids (Urine .37 ug/ml, blood .18 ug/ml).

DAN RECORD NO: 8894 **DOB: 1936** **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Probable acute myocardial infarction/ dysrhythmia	410.9
Due to: Coronary atherosclerosis	414.0

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

1: Accident d/t water sports activity	E910.1
2: Fatty liver	571.8

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

A 58-year-old male was making his first open-water dive during the initial certification course. He did fine during drills at 20 fsw, but as the group ascended, the decedent surfaced and removed his regulator, in obvious distress. He lost consciousness and submerged to 64 fsw before being rescued. Resuscitation efforts were unsuccessful.

An autopsy revealed severe coronary atherosclerosis with rupture of a calcified plaque.

Drowning With Cardiovascular Disease
Contributing Or Present

DAN RECORD NO: 894 **DOB:** 1949 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Exhaustion due to excess exertion	994.5
Due to: 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

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

The decedent was diving with friends from a private sailboat in the Virgin Islands. He and his buddy were swept away from the boat by the current and were unable to return to the boat. The buddy landed on a nearby rock and was rescued. The decedent was found floating on his side with his snorkel in his mouth, but the end submerged. The companions were unable to resuscitate him.

The autopsy is consistent with drowning and shows an atheromatous plaque in the left main coronary artery with 50 percent occlusion. The drowning resulted from exhaustion, panic and probably coronary artery disease (CAD).

DAN RECORD NO: 1394 **DOB:** 1954 **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: Cardiovascular disease NOS	429.2
2: Cocaine abuse, unspecified	305.60

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

The decedent was a 42-year-old Hispanic male, self-taught scuba diver with 20 years of dive experience. He was reported to be in good health. He was diving for scallops with friends. The decedent surfaced, called for help and was apparently trying to release a game bag. He subsequently sank and was later recovered from 157 fsw with his weight belt on and still attached to the game bag. CPR and ALS were attempted with no result.

Autopsy showed severe arteriosclerotic heart disease (ASHD), levels of benzoylecgonine, and findings consistent with drowning.

DAN RECORD NO: 1894 **DOB:** 1930 **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

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

1: Secundum type atrial septal defect	745.5
2: Essential hypertension NOS	401.9
3: Cardiomegaly	429.3
4: Senile osteoporosis (severe)	733.01

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

This 64-year-old female was an experienced diver with more than 60 logged dives. She was diving with a close friend and usual dive buddy. The dive was not anticipated to be difficult, and she made no complaint prior to the dive. She was first in the water and was lost to sight immediately. Her buddy followed and went to the bottom, but returned to the surface when he could not find her. He returned to the boat and spotted the decedent 100 yards from the boat. She was recovered, received CPR after a significant delay but was eventually DOA at a local hospital.

There are several significant autopsy findings including a quarter-inch patent foramen ovale (PFO) and left ventricular hypertrophy (LVH). She had a history of many years of hypertension under treatment with unspecified medication. This may represent syncope due to a dysrhythmia followed by drowning. LVH is a well-known marker for sudden death.

DAN RECORD NO: 2694 **DOB:** 1947 **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

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

1: Coronary atherosclerosis - moderate/severe	414.0
2: Hypertension (HTN) renal NOS, w/o renal failure	403.90
3: Hyperplasia of prostate	600

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

This was a 47-year-old male reported to be an experienced diver. He was diving alone in a deep freshwater lake from a boat operated by a friend. When he failed to surface after about an hour, she alerted authorities who recovered the body. The rescue diver reported the body was lying under a tree on the bottom, but did not appear trapped. The diver's BC could not be inflated, and the weight belt was removed before recovery of the body.

Examination of the equipment later revealed that the buoyancy compensator was inoperative and the submersible pressure gauge gave a reading about 125 psi over the actual pressure. The air cylinder was empty at the time of examination.

The investigator's report states that the friend stated that the decedent usually continued all his dives until he was nearly out of air. It is probable the defective SPG contributed to the diver running out of air.

The autopsy revealed moderately severe coronary artery disease with 75 percent occlusion of left anterior descending artery. Toxicology studies were negative. The pathologist gave asphyxiation as cause of death.

DAN RECORD NO: 4094 **DOB:** 1947 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Arterial gas embolism	958
Due to: Acute myocardial infarction	410.9
Due to: Coronary artery disease	414.0

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

A 47-year-old male was diving alone to try out a new speargun. When he did not return at the expected time a search was initiated. The decedent's body was found hours later.

The autopsy showed evidence of recent and old myocardial infarcts and severe coronary artery disease.

DAN RECORD NO: 4294 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Congestive heart failure	428.0
Due to: Aortoatrial shunt (vascular shunt, NEC)	V45.89
Due to: Aortic valve disease (AI)	424.1

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

1: Accident d/t water sports activity	E910.1
2: Anticoagulation	286.5

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

A 50-year-old male went diving in the Caribbean six months after having a mechanical aortic valve inserted for aortic insufficiency. He was on chronic anticoagulation therapy. Soon after completion of his dive he developed acute cardiopulmonary distress and was transported to the United States, where he died later that same day.

An autopsy showed a false aneurysm in the aortotomy site which had ruptured and created a shunt between the aorta and right atrium.

DAN RECORD NO: 4694 **DOB:** 1951 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
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: Hypertension	401.9

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

The diver was a 42-year-old male making a night dive in a quarry as part of an advanced open-water certification course. After a shore entry, the four divers in the group hit bottom at 20 feet and stirred up the silt. At this point the diver's buddy lost

visual contact and surfaced, but the diver could not be located. A search of the area found the diver two hours later on the bottom in 50 feet of water with an empty tank.

Autopsy findings included bubbles in the cerebral vessels, which were of uncertain significance. Also, there was evidence of pulmonary edema and congestion. Cardiomegaly consistent with a history of systemic hypertension was noted as well.

DAN RECORD NO: 7594 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Coronary artery disease	414.0

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

1: Accident d/t water sports activity	E910.1
2: Tobacco abuse	305.1

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

A 52-year-old male was at 60 fsw for 25 minutes when he signaled to his partner that he was low on air and ascended. The dive buddy stayed down a short time longer and then ascended to find the decedent on the surface and unconscious. Resuscitation efforts were unsuccessful.

The autopsy disclosed severe coronary atherosclerosis and changes consistent with drowning.

DAN RECORD NO: 7794 **DOB:** 1956 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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: Left ventricular hypertrophy	429.3

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

A 38-year-old male was diving in a quarry with two dive buddies when he became separated from the group. After a 72-foot dive for 16 minutes, the other two divers exited the water and the decedent surfaced in the middle of the quarry. He called for help and lost consciousness. Resuscitation efforts were unsuccessful.

The autopsy was consistent with drowning, but distention and rupture of the alveoli were also noted. The incident report states that the diver was unfamiliar with type of equipment he was using.

DAN RECORD NO: 9394 **DOB:** 1948 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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: Alcohol intoxication (blood 0.28 grams percent)	305.0
2: Codeine use	E935.2
3: Coronary atherosclerosis	414.0

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

A 45-year-old male made a night dive as part of a large group, but preferred to venture off on his own. The next morning a pair of divers found the decedent at 60 fsw.

An autopsy disclosed severe coronary artery disease and toxicology was positive for alcohol and codeine.

Drowning With Medical Condition Present

Excluding Cardiovascular Disease

Obesity appears in many of the following cases as a contributing factor to death. This condition is prevalent in the United States, with 24 percent of men and 27 percent of women weighing 20 percent more than standard height-weight charts.

The reasons for obesity are essentially unknown, though complex, while the mechanisms are simple: obese individuals take in more calories than they expend, resulting in 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 increases with the magnitude of the obesity.[11]

The obese diver is at a disadvantage, with increased weight requirement for buoyancy control and difficulty with proper fit of dive gear. These add to an already overloaded diver, which increases resistance to movement in the water and taxes the diver's reduced respiratory capacity.

Other significant health problems may compromise a person's fitness to dive. Two of the most controversial examples are asthma and diabetes mellitus. Most diving and hyperbaric physicians would agree that someone with severe asthma or a poorly controlled diabetic should not participate in scuba diving. There is considerable disagreement, however, regarding the fitness to dive of a well-controlled diabetic or a person who has a history of asthma after age 12, but has minimal or no symptoms of a reactive airway disease.

A remote history of epilepsy or a well-controlled seizure disorder (no seizures on medication in the past three years) is another potentially disqualifying risk factor for diving. At present, the numbers of divers who fall into the gray area on these health problems are too few to make a statistically sound conclusion.

DAN RECORD NO: 1094 **DOB:** 1948 **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

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

1: Obesity (300+ pounds, 65 inches height)	278.0
2: Lung involvement in other diseases	517.8
3: Sarcoidosis	135
4: Chronic thyroiditis NEC/NOS	245.8

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

This was a morbidly obese female diver with limited diving experience. The dive was a drift dive in the Florida Keys. The sea state and current were marginal for diving, and at least one of the experienced local divers on board did not want to dive. The victim was in trouble immediately upon entering the water and was rescued after some difficulty. CPR by an EMT and MD on the boat was not successful.

The autopsy disclosed sarcoidosis, which apparently was mild and may not have been diagnosed antemortem. There was also chronic thyroiditis. The most significant factor was the massive obesity and the poor physical condition. The decedent was not qualified for diving under such conditions.

DAN RECORD NO: 2794 **DOB:** 1949 **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: Human immunodeficiency virus type 2	079.53
2: S/P Pneumocystosis	136.3
3: Diabetes, uncomplicated, type II	250.02
4: Malnutrition of moderate degree	263.0

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

A 46-year-old male scuba diver apparently became exhausted while swimming and scuba diving. He was a known AIDS patient of many years' duration and recently had lost considerable weight and strength.

While scuba diving and swimming at an east-end beach area, he was noted floating motionless face-down in the water while wearing his scuba equipment. CPR was attempted at the scene by a bystander, but was unsuccessful.

He was pronounced dead on arrival in the emergency room of the hospital. No body injuries were noted.

Reportedly, the Department of Public Safety confiscated his scuba equipment for inspection.

DAN RECORD NO: 3294 **DOB:** 1974 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Acute stress reaction, emotional	308.0
Due to: 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

The decedent was engaged in an advanced open-water training with an instructor. He had completed his mask-clearing skill and was attempting to remove and replace his regulator when an unknown difficulty occurred. He could not replace his regulator, apparently panicked and pushed his instructor away. The instructor lost sight of the victim due to silt. The decedent was not recovered for more than 30 minutes.

The autopsy was consistent with drowning. The victim weighed more than 300 pounds, which may have contributed to the drowning.

DAN RECORD NO: 4894 **DOB:** 1952 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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: History of alcoholism	303.3
2: Affective disorder/depression	296.2

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

A 41-year-old woman was conducting her first night dive with a small group making a shore entry. In the surf zone she became separated from her dive buddy. She was found by the other divers a short time later unconscious and face down and could not be resuscitated.

The autopsy was consistent with drowning. Toxicology revealed the presence of caffeine and quinine.

DAN RECORD NO: 5394 **DOB:** 1965 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
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: Panic	308.0
2: Obesity	278.0

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

A 28-year-old obese male was doing his initial training dives in a freshwater lake when he became separated from the group, apparently to follow a fish he had seen. He was next seen on the surface in obvious distress. The decedent was brought to shore and briefly responded to CPR, but was pronounced dead at a local hospital.

An autopsy was consistent with drowning. The decedent had also had a large meal prior to the dive. An equipment check revealed the pressure gauge to read erroneously high.

DAN RECORD NO: 8294 **DOB:** 1963 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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: Asthma	493.9

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

A 30-year-old noncertified female with a past medical history of asthma made a shallow dive into a river for approximately 15 minutes. Little is known about the circumstances regarding her death, but she developed difficulty on the surface at the end of the dive and was pronounced dead at a local hospital.

The autopsy was signed out with drowning as the cause of death.

DAN RECORD NO: 8394 **DOB:** 1943 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Air embolism	958.0
Due to: Accident d/t water sports activity	E910.1

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

1: Diabetes mellitus	250.0
2: Fatty liver	571.8

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

A 50-year-old female with a history of diabetes made her third dive of the day to 40 fsw. After finishing the dive, she complained of shortness of breath, fatigue, and chest pain. She lost consciousness and could not be resuscitated.

An autopsy was performed three days later by a forensic pathologist familiar with diving physiology. He decided upon the cause of death based on history and an absence of other signs of natural disease.

Drowning Due to Insufficient Air

The following cases shared the common factor of insufficient air. There were similar cases in some of the other categories where insufficient air contributed to the problem, but these cases seemed to represent the most obvious instances of fatality due to lack of air.

DAN RECORD NO: 294 **DOB:** 1949 **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
Due to: Accidental suffocation, lack of air	E913.2

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

The decedent was a diver of moderate experience diving with a 14-diver group on a charter boat. The sea conditions were marginal, and several divers had difficulty. The decedent was low on air, but not in immediate difficulty and was escorting another diver who was in trouble and required rescue by the boat crew and divers. When that emergency was over, it was recognized that the decedent was missing. The search revealed her floating face down in the water with BC inflated. Resuscitation efforts produced no response.

The autopsy was consistent with drowning. It is reported that her cylinder contained 200-300 psi, which may have been inadequate to operate her regulator. When recovered, she did not have her regulator or snorkel in her mouth.

DAN RECORD NO: 5894 **DOB:** 1962 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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

A 31-year-old inexperienced male diver was looking for lobster in 35 fsw when he became separated from his dive buddies. After the other divers returned to the boat, an unsuccessful search was made for the decedent. The body was recovered 10 days later with an empty tank and a weight belt far exceeding what should be required.

The autopsy was consistent with drowning.

DAN RECORD NO: 5994 **DOB:** 1961 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
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: Panic	308

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

A 33-year-old male was ascending from a deep dive when he apparently ran out of air. He panicked and grabbed the primary regulator from a fellow diver who was providing assistance. He then swam away from the anchor line and efforts to assist him to the boat were unsuccessful. The body was recovered six days later.

The autopsy was consistent with drowning.

DAN RECORD NO: 6294 **DOB:** 1970 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
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: Ethanol use (0.15 grams percent)	305.0

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

A 24-year-old uncertified and untrained male made an early-morning dive with a friend. The two divers utilized a shore entry and became separated during the dive. The second diver returned to shore, but the decedent did not. A fisherman pulled in the decedent's gear, including an empty tank the next day.

The body was recovered a day later, and the autopsy was consistent with drowning.

DAN RECORD NO: 7094 **DOB:** 1973 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH:	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Insufficient air	E913.2
Due to: Diving for purposes other than recreation	E910.3

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

A 21-year-old man was using diving gear with many modified parts and in poor repair to search for the body of a missing woman in a local lake. He made a dive to 80 feet and ran out of air. His body was found in 20 feet of water.

An autopsy was consistent with drowning.

DAN RECORD NO: 9694 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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

A 35-year-old male was making a penetration into an underwater cave when he suddenly stopped ahead of his dive partner. The diver was in noticeable distress and his buddy brought him to an air pocket to administer artificial respirations. Despite the buddy's efforts the diver could not be resuscitated. Examination of the decedent's equipment revealed both tanks to be empty, possibly due to mechanical trauma to a valve on the reserve tank.

The autopsy was consistent with drowning.

Death Due to Entrapment

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

DAN RECORD NO: 494 **DOB:** 1957 **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

The diver was a dive shop owner and a very experienced diver, but not cave-certified or cave-experienced. He entered a saltwater cave in the Bahamas without proper gear and became lost. He had a dive companion (see number 3094) who also died with him.

The autopsy discloses considerable gas bubbles in the blood vessels which undoubtedly formed postmortem.

DAN RECORD NO: 694 **DOB:** 1965 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Entrapment/cave	E918.5
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

Diver and companion (see number 2594) entered a cave where diving is prohibited and became lost. Neither were cave-trained or had any of the necessary equipment for cave diving.

The autopsy was consistent with drowning.

DAN RECORD NO: 1494 **DOB:** 1963 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Entrapment, kelp	E918.4
Due to: Accident d/t water sports activity	E910.1

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

1: Poisoned by methamphetamine*	E980.3

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

*Medical examiner reports methamphetamine toxicity based on toxicology report of .08ng/ml. This is possible, but it should be pointed out that phenylproponolamine metabolizes to methamphetamine and is commonly used by divers as a nasal decongestant.

The decedent was a 30-year-old male scuba diver who became separated from his companions and did not surface. He was subsequently found entangled in kelp, with the regulator out of his mouth and empty tanks.

DAN RECORD NO: 1694 **DOB:** 1968 **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: Entrapment - shipwreck	E918.1
Due to: Accident d/t water sports activity	E910.1

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

The decedent was a member of a three-man dive group (see numbers 2094 and 2894) who attempted a wreck penetration at night (2300) in a silty harbor at 124 fsw. They became lost, and all three drowned.

The autopsy was consistent with drowning.

DAN RECORD NO: 1794 **DOB:** 1956 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning/nonfatal submersion	994.1
Due to: Entrapment anchor line	E918.5
Due to: Accident d/t water sports activity	E910.1

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

This individual was attempting to free his anchor line in 70 fsw and became entangled in a second anchor line from an abandoned anchor. His companions on the vessel were not divers and called for assistance after 47 minutes of submergence. The body was recovered later and an autopsy was done the next day.

The autopsy discloses bubbles in the venous system especially brain and jugular veins. The lungs show "massive pulmonary edema." The medical examiner interprets these findings as air embolism. However, in view of the entrapment and death at depth and that the observed bubbles formed postmortem, the cause of death was drowning. The diagnosis has been changed accordingly.

DAN RECORD NO: 2094 **DOB:** 1971 **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: Entrapment shipwreck	E918.1
Due to: Accident d/t water sports activity	E910.1

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

The decedent was a member of a three-man dive group (see numbers 1694 and 2894) who attempted a night (2300) dive and penetration of a shipwreck in a silty harbor at 124 fsw. They became lost, and all drowned.

The autopsy was consistent with drowning.

DAN RECORD NO: 2594 **DOB:** 1963 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Entrapment, cave	E918.2
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

The decedent and a companion (see number 694) were certified open-water divers but without training or experience in caves. They entered a cave with none of the required equipment for cave diving and probably became lost immediately. Their bodies were recovered several hours later, about 35 feet into the cave.

The autopsy was consistent with drowning.

DAN RECORD NO: 2894 **DOB:** 1965 **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: Entrapment shipwreck	E918.1
Due to: Accident d/t water sports activity	E910.1

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

The decedent was a member of a three-man dive group (see numbers 1694 and 2094) who attempted a nighttime (2300) penetration of a wreck in a silty harbor at 124 fsw. They apparently became lost, and all three drowned.

The autopsy was consistent with drowning.

DAN RECORD NO: 3094 **DOB:** 1964 **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: Entrapment, cave	E918.2
Due to: Accident d/t water sports activity	E910.1

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

The decedent was an experienced diver and possibly cave-trained, although that is not clear. He entered a saltwater cave with a companion (see number 494) and both drowned.

The autopsy findings were consistent with drowning.

DAN RECORD NO: 4794 **DOB:** 1950 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Entrapment	E918
Due to: Accident d/t water sports activity	E910.1

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

A 44-year-old male was assisting two friends in the recovery of a sunken boat in a freshwater lake. During the third dive of the day the decedent became entangled in one of the lines. Another diver found him unconscious and without his regulator in his mouth. None of the divers had a knife. The lines were untied and the decedent was brought to the surface.

The autopsy was consistent with drowning.

DAN RECORD NO: 5194 **DOB:** 1945 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Insufficient air	E913.2
Due to: Entrapment (wreck)	E918
Due to: Accident d/t water sports activity	E910.1

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

A 49-year-old experienced diver with no previous experience in wreck penetration made a dive to 122 fsw to explore an old ship. She and her partner entered the hull, but the decreased visibility due to the silt caused them to become disoriented. She ran out of air and was using the octopus from her dive buddy, who was also running out of air. Rescue divers from the boat found them and provided nitrox to the divers, but the decedent had already drowned. The dive buddy survived and one of the rescue divers required treatment for decompression sickness.

The autopsy was consistent with drowning.

DAN RECORD NO: 5294 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Entanglement (kelp)	E918
Due to: Accident d/t water sports activity	E910.1

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

1: Panic	308.0

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

A 35-year-old male was making his first open-water dive in a kelp bed. He became separated from his buddy who found him unconscious in the water.

The autopsy was consistent with drowning.

Drowning/Accident

DAN RECORD NO: 394 **DOB:** 1947 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Scuba diving	E910.1

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

1: Bipolar disorder	296.5

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

The decedent was a recently certified diver who accompanied a male friend and other divers who were participating in an open-water certification series. Due to weather, the dive took place in an inlet rather than the open ocean. The boat carried a mix of certified divers and students. A certified diver had a problem and returned to the boat, delaying the students from entering the water. Meanwhile, the decedent had made an entry from the other side of the boat and was to accompany the divers who were making initial training dives. She was not seen during the dive and was not searched for until roll call at the end of the dive. She was located by a USCG helicopter and retrieved. Resuscitation was attempted at a local hospital. The autopsy revealed a myxoid mitral valve and findings consistent with drowning.

The decedent had been prescribed divalproex (Depakote) presumably for bipolar disorder. There is one comment in the record that she did not have her medication with her. The medication is primarily indicated for seizure disorders and alters the seizure threshold. If she stopped the medicine suddenly she may have been susceptible to a withdrawal seizure. Status epilepticus has been reported upon withdrawal of this drug.

She had difficulty with her equipment prior to the dive and was diving alone although there were many other divers in the group. The death was due to multiple causes and the decedent had at least one contraindication to diving.

DAN RECORD NO: 2194 **DOB:** 1950 **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 with her 16-year-old daughter under quasi instruction from husband/father who was a certified instructor (see number 2294 below). The father also had another student under instruction, and they became separated from the two females. Discovering the females were missing, they attempted a search, but were unsuccessful. The bodies were recovered several hours later still clinging together. The slates contained references to an unspecified regulator problem and a message to return to the anchor.

The autopsy findings were received orally from medical examiner tech. The autopsy was unremarkable; the cause of death was drowning.

DAN RECORD NO: 2294 **DOB:** 1978 **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)

Mother and daughter were under quasi instruction from husband/father instructor who also had another student under instruction (see number 2194 above). The instructor and student became separated from the mother-daughter and could not locate them. Eventually a rescue group recovered the two bodies still clinging to one another. There was a reference on one slate to a regulator problem and to return to the anchor. There are no details available beyond that. There is no reference in the sheriff's report to the autopsy.

The medical examiner's office called and gave an oral report on the autopsy. There were no remarkable findings; the cause of death was drowning.

DAN RECORD NO: 3994 **DOB:** 1964 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

The diver was a 29-year-old female who was spearfishing with her husband. The woman had several fish attached to a stringer which was on her weight belt. Both divers were struck by a large marine mammal, which caused them to lose their regulators and become separated. After recovering, the husband searched for his wife and found her on the bottom approximately 20 minutes later. He brought her to the surface, ditched all of their scuba gear, and called out for assistance. The

decedent was unconscious and resuscitation efforts were unsuccessful. The equipment was recovered days later, revealing one empty and one near-empty tank.

The autopsy revealed 25cc of air in the aorta and bubbles in the carotid arteries. The long bones of both legs had been donated prior to the autopsy which makes the finding of intravascular air less significant. The delay from the time of death to the autopsy was also too long to conclude much from the finding of intravascular gas.

DAN RECORD NO: 4394 **DOB:** N/A **SEX:** F **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause of death 799.9

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

A 49-year-old female who had recently completed her open-water certification course was making her first unsupervised dive. Thirty minutes into the dive she surfaced unconscious.

An autopsy did not disclose a cause of death.

DAN RECORD NO: 6794 **DOB:** N/A **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A 35-year-old male went down to set the anchor prior to a group dive on a wreck in cold water. Visibility was poor, and when he did not return the other divers assumed he had continued along the wreck. He was not with the other divers when they returned from the wreck. The decedent's body was found seven hours later with his pony bottle empty and his main tank full. It was later learned that he did not receive a final equipment check prior to entering the water.

The autopsy was consistent with drowning.

DAN RECORD NO: 7294 **DOB:** 1971 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1

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

A 23-year-old male was making his first ocean dive in a group. He descended to 60 fsw but immediately returned to the surface where he removed the regulator from his mouth and put his mask up on his forehead. A large swell came up over the diver knocking his mask off and he disappeared beneath the surface. The diver was found on the bottom nearly two hours later.

The autopsy was consistent with drowning. An equipment check revealed that the buoyancy compensator failed to hold air.

DAN RECORD NO: 7394 **DOB:** 1969 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A 24-year-old male was making training dives off an oil platform with his instructor. During the second dive the buddy pair became separated following an ascent to check their location.

An autopsy was consistent with drowning.

DAN RECORD NO: 8594 **DOB:** 1959 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

Autopsy (Y/N): Y Findings available (Y/N): Y
A 35-year-old noncertified male diver went to 60 fsw with a friend. Both divers surfaced together, but the decedent took his regulator out, gasped and sank to the bottom. He was rescued but could not be resuscitated.

The autopsy was consistent with drowning; the history is suspicious for air embolism.

DAN RECORD NO: 8994 **DOB:** 1975 **SEX:** F **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A 19-year-old woman was participating in an advanced open-water course with a group of fellow students. After an uneventful dive to 60 fsw, the group ascended to 30 fsw, where the decedent was last seen. Her body was recovered one week later.

The autopsy was consistent with drowning.

DAN RECORD NO: 9094 **DOB:** 1975 **SEX:** F **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A 19-year-old experienced diver became separated from her dive buddy at 140 fsw. A search and rescue team found the woman, but she could not be resuscitated.

The autopsy was signed out as an air embolism, but it was performed three days postmortem. The location of the gas is compatible with offgassing, especially in consideration of the dive profile.

Death While Diving — Miscellaneous

DAN RECORD NO: 5794 **DOB:** N/A **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Carbon monoxide poisoning E868.9
Due to: Accident d/t water sports activity E910.1

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

A 55-year-old male made a wreck dive in a large group aboard a charter boat. When all of the other divers were back on the boat he was noted to be missing. The decedent was found unconscious in 65 fsw.

Initially the autopsy stated the cause of death as arterial gas embolism, but toxicology studies revealed severe carbon monoxide poisoning.

DAN RECORD NO: 6494 **DOB:** 1959 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Exsanguination/hemorrhage 459.0
Due to: Multiple lacerations, scalp, thorax, extremities 873.1/879/894.1
Due to: Struck by boat E838.5
Due to: Accident d/t water sports activity E910.1

Other significant conditions contributing to death but not resulting in underlying cause
1: Hypertension 401.9

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

The decedent was a 36-year-old male who worked as the first mate on a recreational dive boat. The weather was sunny and clear, with 3- to 5-foot seas. A group of 18 divers made a dive to 53 feet for an average of 27 minutes on a sunken barge. The dive boat was tied off to the barge and after all divers had returned to the boat, the first mate went back down to remove the line from the barge. Upon surfacing he was noted to be several yards from the stern and the boat was backed toward him. The boat was reportedly put in neutral at the same time a surge threw the decedent into the propellers. He suffered multiple lacerations and was brought aboard immediately, but resuscitation efforts were unsuccessful.

Autopsy findings showed multiple injuries including near amputation of both legs and deep lacerations to the chest and abdomen.

DAN RECORD NO: 7994	**DOB:** 1948	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Drowning			994.1
Due to: Intracranial injury, open			854.1
Due to: Struck by boat			E838.5
Due to: Accident d/t water sports activity			E910.1

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

The decedent was a 46-year-old male who was videotaping a group of divers for a recreational dive boat. The boat operator habitually backed the boat toward the divers while they were at their 15-foot safety stop in order to expedite their exit. The boat was underway for five minutes before the crew realized that the decedent was not on board. The boat returned to the area of the dive. A search later found the decedent on the bottom with multiple injuries .

The autopsy revealed lacerations of the head, neck and shoulders with several broken ribs. The head wound penetrated the skull through a distance 2 inches into the brain. It was concluded that the diver's cause of death was due to being struck by a boat propeller.

Autopsied Cases — Report Not Available

DAN experiences excellent cooperation from medical examiners in allowing access to reports on dive-related fatalities. This year there were 12 autopsied case reports not available to DAN — eight of these occurred in non-U.S. waters.

DAN RECORD NO: 1294	**DOB:** 1974	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Drowning			994.1
Due to: Entrapment, cave			E918.2
Due to: Scuba diving			E910.1

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

The diver was a member of a group of three who entered a saltwater cave in the Bahamas and perished when they became lost (see the following cases 1994 and 3194). They were led by an experienced divemaster who was not a cave diver. They did not have lights or cave diving equipment.

Drowning due to entrapment was the obvious cause of death, but autopsy reports from the Bahamas are not available.

DAN RECORD NO: 1994	**DOB:** 1969	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Drowning			994.1
Due to: Entrapment, cave			E918.2
Due to: Scuba diving			E910.1

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

The diver was an experienced dive guide who led two teenage divers into a saltwater cave in the Bahamas (see cases 1294 and 3194). They did not have lights or cave gear and were unable to return to the exit. All three died.

An autopsy was done but the report was not available.

DAN RECORD NO: 3194 **DOB:** 1977 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due to: Entrapment, cave	E918.2
Due to: Scuba diving	E910.1

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

The decedent was a 17-year-old inexperienced diver who was led into a cave with another 17-year-old by a 25-year-old resort guide with no cave training (see cases 1294 and 1994). An unknown problem developed and all three died in the cave.

An autopsy was done but the report was not available.

DAN RECORD NO: 4494 **DOB:** N/A **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Air embolism	958
Due to: Rapid ascent	E902.2
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: Panic	308.0

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

A 25-year-old woman was diving in a group and descended to 100 fsw. Ten minutes into the dive she apparently ran out of air and made a panic ascent. Upon reaching the surface she became unconscious and did not respond to resuscitation efforts.

An autopsy report is unavailable.

DAN RECORD NO: 5594 **DOB:** 1936 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Coronary artery disease	414.01

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

1: Accident d/t water sports activity	E910.1
2: Entangled - line	E918

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

The decedent was a 58-year-old male who was an experienced underwater photographer. He had no known significant health problems but was known to stretch his air sources to maximize bottom time. The sea conditions were calm and the weather was clear and sunny. The diver and his buddy made separate dives while the other stayed behind in the boat. The decedent entered the water and headed away from the boat, which was in 65 feet of water. After an hour had passed the dive buddy detached the anchor line from the boat and made a surface search for the decedent. He then pulled up the anchor which revealed the decedent tangled in the line near the anchor. Resuscitation efforts produced no results.

It was reported that the autopsy listed coronary artery disease as the cause of death. A thorough examination of the dive gear revealed an empty pony bottle, 2950 psi in the primary tank, and a 2-inch dive knife in nearly unusable condition. The regulator and buoyancy compensator functioned normally.

DAN RECORD NO: 6894 **DOB:** N/A **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	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: Exhaustion/exertion	994.5

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

A 55-year-old diver made two dives to greater than 100 fsw. At the end of the second dive, she and her dive buddy surfaced far from the boat and were carried away in the current. The two divers were in the water nearly two hours before being rescued and the decedent had become unconscious about 30 minutes earlier.

Resuscitation efforts were unsuccessful and no autopsy report is available.

DAN RECORD NO: 7194 **DOB:** 1934 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause of death 799.9

Other significant conditions contributing to death but not resulting in underlying cause
1: Exhaustion/exertion 994.5
2: Accident d/t water sports activity E910.1

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

A 60-year-old male made two uneventful dives near a coral reef. At the end of the second dive he swam to the boat and immediately collapsed. Witnesses stated that he appeared to have had a heart attack.

An autopsy report is unavailable.

DAN RECORD NO: 8094 **DOB:** N/A **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Myocardial infarction 410.9

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): N

A 63-year-old male suffered sudden death while on a diving trip. He reportedly suffered a heart attack.

An autopsy was done but the report is not available.

DAN RECORD NO: 8194 **DOB:** N/A **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A 45-year-old male with 20 years of diving experience made a dive to approximately 40 fsw and surfaced in distress. He was brought to the boat where CPR was initiated and a pulse returned. The diver died three days later.

An autopsy was done but the report is unavailable.

DAN RECORD NO: 9194 **DOB:** N/A **SEX:** F **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Air embolism 958.0
Due to: Rapid ascent E902.2
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: Panic 308.0

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

A 45-year-old recently certified female diver was making her second night dive and was having difficulty maintaining buoyancy. She became low on air and panicked. Her husband tried to render aid but she rejected the regulator he provided for her. She lost consciousness in the water column and was pronounced dead at a local hospital.

The autopsy report was not released.

DAN RECORD NO: 9494 **DOB:** 1938 **SEX:** F **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1
Due To: Air embolism	958.0
Due To: Rapid ascent	E902.2
Due to: Accident d/t water sports activity	E910.1

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

A 56-year-old woman was taking an advanced open-water class in cold water, utilizing a shore entry. She was on multiple medications including Prozac and Vancenase. A short time after descending, the decedent ascended unexpectedly and then went back down. She was found unconscious 30 minutes later on the bottom. The decedent did not respond to resuscitation efforts. One of the observers stated that the decedent seemed to have ascended too rapidly.

The autopsy report was not released.

DAN RECORD NO: 9794 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Drowning	994.1

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

Verified death but no information was made available to DAN in this case.

Fatality Reports — Autopsy Not Done

The complete investigation of a scuba diving fatality requires an autopsy. 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 and manner of death are often clarified or confirmed by the findings at post-mortem examination.

Diving deaths cause tremendous psychological trauma to families and survivors. They may receive some solace, or an understanding of the event with 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, such as the double indemnity provision in many policies for accidental death.

Scuba deaths are occasionally the basis for a lawsuit. Additionally, the victim is often young and otherwise healthy. The local medical examiner needs to keep the possibility of legal action in mind when deciding whether or not to order an autopsy. Reports should be written very carefully to avoid a suggestion of error by anyone when, in fact, none is known to exist.

DAN RECORD NO: 1194 **DOB:** 1949 **SEX:** M **DIVER CAT:** RAT

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Instantaneous death	798.1
Due to: Accident d/t water sports activity	E910.1

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

The decedent was attempting rapid descent to 900-1,000 feet using mixed gases. He was not observed during the deep portion of the dive and failed to surface. His body was later retrieved beneath a ledge at about 250 feet.

There are many know physiological and mechanical problems associated with diving to such a depth. The exact problem which caused this death will probably not be determined.

DAN RECORD NO: 5694 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Decompression sickness	993.3
Due to: Rapid ascent	E902.2
Due to: Accident d/t water sports activity	E910.1

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

1: Nitrogen narcosis	293.0

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

A 27-year-old experienced diver and his buddy were attempting to set a personal depth record on a deep wall. He surfaced after a dive in excess of 250 fsw in severe distress and rapidly lost consciousness. The diver wore two tanks with separate regulators. One tank was empty; the other contained 575 psi. Additional scuba tanks were suspended at depths of 20 and 100 fsw.

The diver's buddy was never found, and no autopsy information is available.

DAN RECORD NO: 6094 **DOB:** 1972 **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Unknown cause of death	799.9
Due to: Accident d/t water sports activity	E910.1

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

1: Nitrogen narcosis	293.0

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

The diver was in a man-made lake with poor visibility. He told a friend he was going to touch bottom - which he thought was 70 feet. He descended rapidly and was not seen again. The actual depth in the area averaged over 185 feet. The body was recovered six months later.

No autopsy was performed.

DAN RECORD NO: 6694 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Unknown cause of death	799.9
Due to: Accident d/t water sports activity	E910.1

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

1: Nitrogen narcosis	293.0

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

A 21-year-old American serviceman was diving in his off-duty hours while stationed overseas. The group of divers made a shore entry and descended to at least 150 fsw when the buddy of the decedent felt the effects of narcosis and made an emergency ascent. After all of the divers had surfaced they searched unsuccessfully for the missing diver.

The body was recovered nine months later; further information is unavailable.

DAN RECORD NO: 8694 **DOB:** N/A **SEX:** M **DIVER CAT:** R

CAUSE OF DEATH	ICD-9-CM
IMMEDIATE: Acute MI, NOS	410.9
Due to: Coronary atherosclerosis	414.0

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

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

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

A 61-year-old male scuba instructor was assisting divers during a cross-training session. After the dive, he collapsed in the locker room. The decedent had no history of heart disease, but he was not in good physical condition.

An autopsy was not performed; the medical examiner based the cause of death on circumstantial evidence.

DAN RECORD NO: 8794 **DOB:** N/A **SEX:** F **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Drowning 994.1
Due to: Accident d/t water sports activity E910.1

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

A newly certified female diver was making her third dive of the day to 18 feet in a quarry when she became separated from her buddy. She was found unconscious on the bottom and resuscitated at the scene. The woman never regained consciousness and died in a hospital one week later.

No autopsy was performed.

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.

DAN RECORD NO: 194 **DOB:** 1964 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9
Due to: Accident d/t water sports activity E910.1

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

This was an inexperienced diver participating in a dive in an area of very strong current — made more so by astronomical conditions (moon). The divers attempted to ascend after being caught in a current. The decedent failed to surface and his companions were only able to do so with difficulty. The body was not recovered.

DAN RECORD NO: 594 **DOB:** 1943 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9
Due to: Accident d/t water sports activity E910.1

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

The decedent is reported to have made a dive to 350 fsw and then surfaced. After five minutes on the surface he stated that he would dive again. He was seen to enter the water and last seen finning toward the bottom with the regulator out of his mouth. His body was not recovered.

DAN RECORD NO: 3694 **DOB:** 1949 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9
Due to: Accident d/t water sports activity E910.1
Autopsy (Y/N): N Findings available (Y/N): N

The decedent was diving in Lake Tahoe with a companion and developed unknown difficulty. The buddy attempted a rescue, but was low on air and unable to assist. The decedent sank in 1,200 feet of water. The body was not recovered.

DAN RECORD NO: 3794 **DOB:** 1946 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9
Due to: Accident d/t water sports activity E910.1
Autopsy (Y/N): N Findings available (Y/N): N

The decedent was diving a wreck located at 240 fsw with limited visibility and cold water. The dive group of three had completed a 20-minute dive on the wreck and were ascending to complete decompression while drifting. The decedent was wearing a drysuit and carried four tanks. He was reported as overweight by 40 pounds, but body weight is not given. He was last seen at 175 fsw, when the three lost sight of each other. No body was recovered.

There is a report that he had experienced an episode of syncope while diving at Truk Lagoon three months earlier.

DAN RECORD NO: 6394	**DOB:** 1960	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Drowning			994.1
Due to: Oxygen toxicity			987.8
Due to: Accident d/t water sports activity			E910.1

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

A 34-year-old male was making a repetitive dive on air to greater than 180 fsw to explore a wreck. He was making decompression stops at 20 and 10 fsw on 100 percent oxygen when he suffered a witnessed seizure and lost consciousness. His dive buddies attempted to bring the diver to the boat, but the decedent quickly descended. The body was not recovered.

DAN RECORD NO: 6994	**DOB:** Unk	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Unknown cause of death			799.9
Due to: Accident d/t water sports activity			E910.1

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

1: Nitrogen narcosis	293.0

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

A 27-year-old male was diving on a deep wall in an apparent effort to set a personal depth record. Additional scuba tanks were hung at 20 and 100 fsw. The decedent's buddy (see number 5694) was found on the surface with no vital signs. The decedent's body was never recovered.

DAN RECORD NO: 9594	**DOB:** Unk	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Death, unspecified cause			799.9

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

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

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

A 54-year-old male made a shore entry dive as part of a navigation exercise during advanced open-water training. He became separated from his buddy and was last seen paying close attention to his compass, but possibly having difficulty maintaining buoyancy. The body was never recovered.

Unknown Cause of Death

There is some doubt that the following cases are actual fatalities, or are even dive-related. They are not included in data analysis at present.

DAN RECORD NO: none	**DOB:** Unk	**SEX:** M	**DIVER CAT:** R
CAUSE OF DEATH			ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality			799.9

A DAN member called the information line regarding a presumed diver fatality in a Caribbean Island. After a lengthy effort to follow-up and confirm this information, no additional information was obtained.

DAN RECORD NO: none **DOB:** 1962 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9

The decedent died many hours after finishing several quarry dives. The decedent's death was attributed to pre-existing health problems, and diving was believed not to have been a factor.

DAN RECORD NO: none **DOB:** 1970 **SEX:** M **DIVER CAT:** R
CAUSE OF DEATH ICD-9-CM
IMMEDIATE: Unknown cause morbidity/mortality 799.9

Three decedents were part of a four-team dive trip aboard a private vessel offshore. All surfaced from the dive to find their vessel sinking. They all attempted to swim for shore or (a landing spot). Only one member of the party was rescued.

No evidence of the other three was ever located.

Summary

Each fatality reported here is unique in some way, but they do share many causal factors that are usually the responsibility of the diver.

Divers should know the following:
- whether their training is adequate for the planned dive;
- that their equipment is adequate and functional;
- that their skills are sufficient for the conditions at the site — that they are able to cope with conditions such as poor visibility, strong current, overhead barrier and other features.

Important contributing factors in the fatal dive accident are the diver's personal attributes, such as:
- age;
- pre-existing disease;
- physical fitness; and
- the influence of drugs or other substances on behavior.

The diver must be responsible for understanding how these factors interact with diving. Most diving fatalities are the result of a number of causative factors — most under the diver's control — that contribute to the final outcome.

Notes

1 International Classification of Disease-Clinical Modification (9th Revision), U.S. Department of Health and Human Services, Health Care Financing and Administration.

2 Kindwall EP and Pellegrini J. Divers Alert Network, Report on Diving Accidents & Fatalities. (DAN, Durham, North Carolina, 1992), pp. 120-126.

3 DiMaio DJ and DiMaio VJM. Forensic Patholog y (Boca Raton, Florida, CRC Press, 1993), pp. 357-365.

4 National Center for Health Statistics, U.S. Public Health Service, DHHS.

5 Dovenbarger JD, ed. Divers Alert Network, Report on Diving Accidents & Fatalities. (DAN, Durham, North Carolina, 1993), p. 34.

6 Muller, James E. Risk of Heart Attack, American Heart Association Annual Meeting, Abstract #2740, 1992.

7 Bennett PB and Elliot D. The Physiology and Medicine of Diving, (London, Philadelphia: W.B. Saunders Ltd., 1993).

8,9 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.

10 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.

11 Bove AF and Davis J. Diving Medicine, (Philadelphia: W.B. Saunders Ltd., 1990), pp. 239-248.

The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government.

DAN

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

DATE & TIME OF ACCIDENT
MONTH/DAY/YEAR
Time _____ AM PM

IS THIS A FATALITY REPORT?
☐ YES ☐ NO

For DAN Office Use Only
CASE
SEVERITY CODE
BMI

1. PATIENT NAME
LAST FIRST MI

2. OCCUPATION

3. ADDRESS
STREET CITY ST ZIP

4. PATIENT PHONE (HOME)

5. PATIENT PHONE (WORK)

6. COUNTRY (IF NOT USA)

7. AGE YRS

8. SEX M or F

9. HEIGHT FT IN

10. WEIGHT LBS.

11. CERTIFYING AGENCY
A - PADI D - YMCA
B - NAUI E - SSI
C - NASDS F - Other
G - None

12. CERTIFICATION LEVEL
A - Basic F - Commercial
B - Open Water G - Other
C - Advanced H - None
D - Divemaster I - Student
E - Instructor

13. DAN MEMBER?
Y - Yes
N - No

14. YEARS DIVING
YEARS MONTHS

15. NUMBER OF DIVES MADE
Total
Previous 12 months

16. PREVIOUS DIVE ACCIDENTS
A - Possible DCS
B - DCS
C - AGE
D - Pul. barotrauma
E - None

17. CURRENT MEDICATIONS
Y or N
Prescription
Non-prescription
List _____

18. CIGARETTE USE
A - Presently
B - In past
C - Never
Years Smoking
Packs per day

19. PREVIOUS MAJOR ILLNESSES/ SURGERY
(Provide up to 3 responses)

A - Chest-lung
B - Asthma
C - Chest-heart
D - Gastrointestinal/Abdomen
E - Brain
F - Spine/Back
G - Limb or joint of DCS site
H - Circulation/Blood
I - Neurologic/Nervous system
J - Muscle/Skeleton system
K - Eye
L - Mental/Emotional
M - Other _____
N - None

Past:
A - 2-6 months
B - 7-12 months
C - 1-3 years
D - 2-5 years
E - 6+ years

List and describe specific problems:

20. CURRENT HEALTH PROBLEMS WITHIN PREVIOUS 2 MONTH
(Provide up to 3 responses)

A - Chest-lung
B - Asthma
C - Chest-heart
D - Gastrointestinal/Abdomen
E - Brain
F - Spine/Back
G - Limb or joint of DCS site
H - Circulation/Blood
I - Neurologic/Nervous system
J - Muscle/Skeleton system
K - Eye
L - Mental/Emotional
M - Other _____
N - None

List and describe specific problems or additional current medications

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

21. PURPOSE OF DIVE
- A - Pleasure
- B - Work/Labor

22. DIVE ACTIVITY (up to 2 responses)
- A - Wreck
- B - Cave
- C - Night
- D - Photography
- E - Under Instruction
- F - Providing Instruction
- G - Spearfishing/ Game collecting
- H - Sightseeing

23. ENVIRONMENT
- A - Freshwater
- B - Saltwater

24. ALTITUDE OF DIVE
- A - Sea Level
- B - > Sea Level but < 1000 ft.
- C - > 1000 ft.

25. Was this dive or dive series typical of your normal type of diving?
- Y - Yes
- N - No

IF NO, Explain _____

26. DIVER'S PERCEPTION OF TEMPERATURE
- A - Cold
- B - Hot
- C - Comfortable

27. CURRENT STRENGTH
- A - Strong
- B - Moderate
- C - Mild
- D - None

28. AIR SUPPLY
- A - Scuba Air
- B - Surface Supply Air
- C - Mixed gas
- D - None/Breath-hold dive

29. AIR CONSUMPTION
- A - Ran low
- B - Out of air
- C - Not a problem
- D - Buddy breathing (not octopus)

30. BUOYANCY PROBLEM
- Y - Yes
- N - No

31. RAPID ASCENT
- Y - Yes
- N - No

32. WITHIN LIMITS-Y or N
- Tables (which table _____)
- or
- Computer (type _____)

33. TYPE OF SUIT
- A - Wet
- B - Partial Wet
- C - Dry
- D - Lycra
- E - Swim

34. EQUIPMENT USED ON DIVE: (please check all that apply)
- Depth gauge
- Timing device/watch
- Buoyancy vest
- BC Inflator hose in use
- Decompression computer

35. EQUIPMENT MALFUNCTION:
- A - None
- B - Regulator
- C - BC Vest
- D - Weight belt
- E - Dry suit
- F - DC Computer
- G - Inflator hose
- H - Contaminated air supply
- I - Equipment was not familiar to you.
- J - Other

Reason: _____

36. TYPE OF DIVE
- Y - Yes
- N - No
- Single
- Repetitive

37. WOMEN, PLEASE RESPOND (up to 2 responses)

When the accident occurred, were you:
- A - Menstruating
- B - On birth control medication
- C - Pregnant
- D - None of the above

38. DIVE LOCATION:

State, Province, or Island: _____

Country or nearest country: _____

39. How long ago was your last Dive Trip/Series?

Circle one: Days Weeks Months

40. STRENUOUS EXCERCISE
- Y - Yes
- N - No
- 24 hours predive
- During dive
- 6 hours postdive

41. PREDIVE HEALTH
- A - Nausea/ vomiting
- B - Hangover
- C - Diarrhea
- D - Other
- E - No Problem

42. ALCOHOL

Please check:

	Number of drinks, beers, or wine
None	
Night Before	
Predive	
Between Dives	
Post Dive	

43. RECREATIONAL DRUG USE

Prior to, between, or after dive
- Y - Yes
- N - No

44. Do you consider yourself physically fit?
- Y - Yes
- N - No
- Do you excercise on a weekly basis? (Y or N)
- # Days per week

45. FATIGUE OR LACK OF SLEEP PRIOR TO DIVE?
- Y - Yes
- N - No

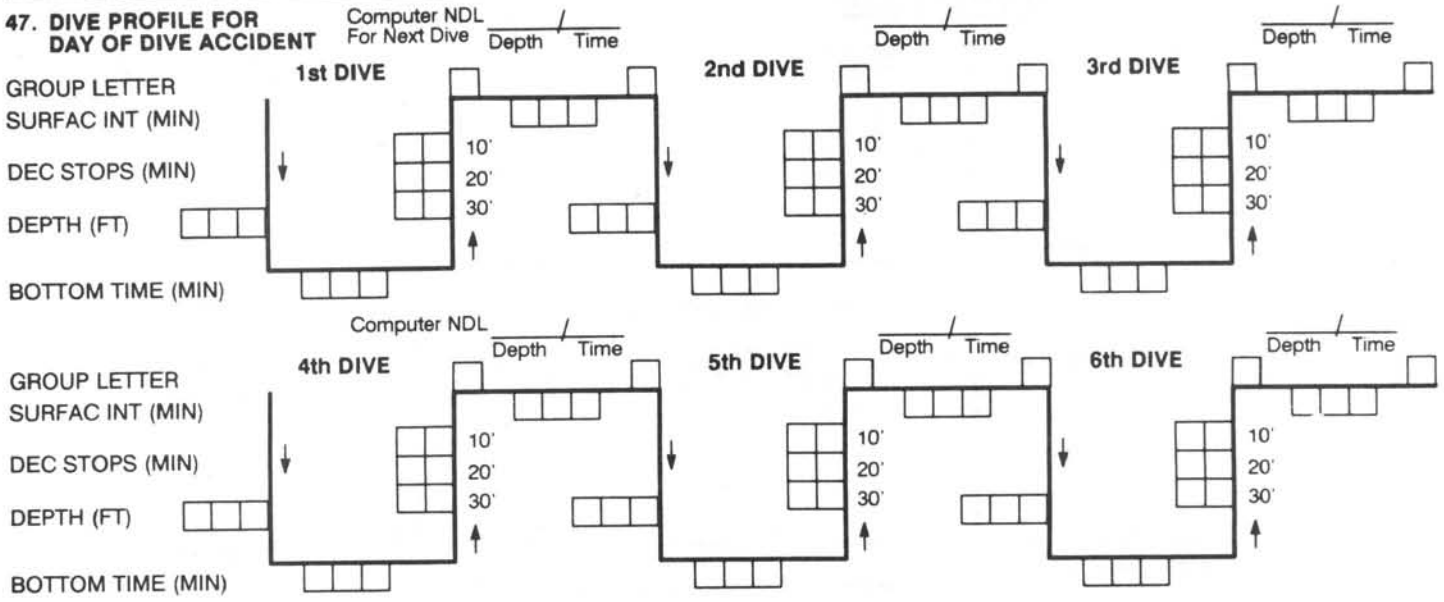
46. DIVE SERIES

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

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
Total # of dives							
Any night dive? (How many)							
Any symptoms? (Yor N)							
A - All no stop dive(s) B - Any safety stop C - Any dive requiring decompression stops							
A - Multilevel (time divided) B - Square ↓ → ↑							
Deepest Dive (ft.)							

DIVE ACCIDENT (cont.)

47. DIVE PROFILE FOR DAY OF DIVE ACCIDENT



PRE-CHAMBER INFORMATION

48. INITIAL CONTACT WAS:

- A - DAN Emergency
- B - DAN Non-emergency
- C - Hospital emergency room
- D - Emergency medical service
- E - US Coast Guard
- F - Physician
- G - Dive instructor/shop
- H - Other: _____

49. Total delay from symptom onset to contacting DAN or other medical help:

HOURS or DAYS

50. FLYING OR INCREASED ELEVATION AFTER DIVING AND PRIOR TO TREATMENT?

- A - Commercial airliner
- B - Unpressurized aircraft
- C - Med Evac Flight
- D - Mountain elevation
- E - Does not apply

Hours post dive (flew or went into elevation)

elevation (in feet)

51. SIGNS & SYMPTONS

1st Symptom / 2nd Symptom / 3rd Symptom / 4th Symptom / 5th Symptom / 6th Symptom

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

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

A L R B

1st Symptom / 2nd Symptom / 3rd Symptom / 4th Symptom / 5th Symptom / 6th Symptom

- A - Head
- B - Face
- C - Sinus
- D - Eyes
- E - Ears
- F - Neck
- G - Shoulder
- H - Entire arm
- I - Upper arm
- J - Elbow
- K - Forearm
- L - Wrist
- M - Hand
- N - Fingers
- O - Chest
- P - Back
- Q - Upper back
- R - Lower back
- S - Abdomen
- T - Buttock
- U - Groin
- V - Hip
- W - Entire leg
- X - Thigh
- Y - Knee
- Z - Calf
- 1 - Shin
- 2 - Ankle
- 3 - Foot
- 4 - Toes
- 5 - Trunk
- 6 - Generalized
- 7 - Other: _____

53. SYMPTOM ONSET:

	HOURS	MINUTES	or	BEFORE SURFACING FROM DIVE
1st Symptom				
2nd Symptom				
3rd Symptom				
4th Symptom				
5th Symptom				
6th Symptom				

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

Y - Yes
N - No

If yes, which symptoms?

1st / 2nd / 3rd / 4th / 5th / 6th

Other

Explain: _____

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):

- ☐ None
- ☐ Oral fluids
- ☐ IV fluids
- ☐ Oxygen
- ☐ Steroids
- ☐ Anticoagulant
- ☐ Aspirin
- ☐ 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

STATE COUNTRY

Date & Time of Treatment

MONTH/DAY/YEAR

Time _____ AM PM

Name of hyperbaric facility

Treating doctor

Form Completed By

_____

61. TYPE OF CHAMBER
(please check)

Initial Treatment	Retreatment Chamber
☐ Monoplace	☐ Monoplace
☐ Dualplace	☐ Dualplace
● Multiplace	☐ Multiplace
☐ No chamber treatment given	

62. TOTAL DELAY FROM SYMPTOM ONSET TO RECOMPRESSION

HOURS ☐ or DAYS ☐

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

_____

_____

64. TABLE EXTENSIONS REQUIRED?

☐
Y - Yes
N - No

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

66. RETREATMENT GIVEN
(Provide up to 3 responses)

TABLE	NUMBER OF TREATMENTS
☐	☐
☐	☐
☐	☐

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

69. DURATION OF RESIDUAL SYMPTOMS

(Circle one)

☐
DAYS
WEEKS
MONTHS

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

Cigarette use *(please circle)* Have never smoked Have smoked in past Presently smoke

Years smoking _____ Packs per day _____

Predive health *(please circle)* Nausea Hangover Diarrhea Predive alcohol No problem

Other _____

Influences at accident time *(please circle)* Alcohol Recreational drugs None

Mental status *(please circle)* Stressed Anxious Quiet Agitated Talkative Depressed No problem

Other _____

Fatigue *(please circle)* Yes No

Dive Conditions

Type of water entry *(please circle)* Shore Private boat Charter boat Pool

Other _____

Altitude of dive *(please circle)* Sea level (below 1,000 feet) Greater than 1,000 but less than 3,000 feet

Greater than 3,000 feet

Water environment *(please circle)* Saltwater Freshwater

Water temperature _____ °F °C

Water depth *(please circle)* _____ feet metres

Seas _____

Visibility *(please circle)* _____ feet metres

Surge _____

Current *(please circle)* None Mild Moderate Strong

Bottom type _____

Weather conditions *(describe)* _____

Air temperature _____ °F °C

Overhead environment *(please circle)* Yes No

(if yes, please circle) Cavern Cave Ice Wreck penetration

Other _____

Diver's first time at location *(please circle)* Yes No

Surface observer *(please circle)* Yes No

Surface tender *(please circle)* Yes No

Dive Profile

Dive activity *(please circle)*

Primary	*Secondary*
Wreck (no penetration)	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

Specialty certified *(please circle)* Yes No

Buddy *(please circle)* Yes No

Buddy separation *(please circle)* Yes No

Number in buddy team _____

Number in dive party _____

Single dive *(please circle)* Yes No

Decompression dive *(please circle)* Yes No

Nitrogen narcosis *(please circle)* Yes No

Lost *(please circle)* Yes No

Trapped *(please circle)* Yes No

Entangled *(please circle)* Yes No

Dive profile	Dive 1	Dive 2	Dive 3
Depth (feet)	_____	_____	_____
Bottom time (min)	_____	_____	_____
Surface interval (hours / min)	_____:_____ hours : min	_____:_____ 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

Computer	*Model*	*Computer*	*Model*
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

_____

_____

_____

_____

_____

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 _____

DAN research use only:

Probable cause of death _____ ICD-9-CM _____

Due to or as a result of 1 _____ ICD-9-CM _____

Due to or as a result of 2 _____ ICD-9-CM _____

Due to or as a result of 3 _____ ICD-9-CM _____

Due to or as a result of 4 _____ ICD-9-CM _____

Due to or as a result of 5 _____ 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 _____

Appendix D

Fatality Location Tables

U.S. Fatalities from 1970 to 1994 in Foreign Areas

Country	1970-1979	1980-1989	1990-1992	1993	1994	Country Totals
Anguilla		1				1
Antigua		1				1
Australia	1	2			1	4
Bahamas	17	19	6	1	7	50
Barbados		2				2
Bequia			1			1
Bermuda	1	1	1			3
Belize	2	4	1			7
British Virgin Islands		4			1	5
Canada	7	6	1			14
Caribbean Area	27		2			29
Cayman Islands	3	5	2	2	3	15
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	1	5
Italy			2			2
Jamaica			3			3
Japan	11	3	2		1	17
Malaysia		1				1
Martinique		1	1			2
Mediterranean Area	2					2
Mexico	18	28	15	6	2	69
Micronesia			1			1
Morocco		1				1
Netherlands Antilles - Saba, Aruba, Bonaire, Curacao	1	2	2	1	3	9
New Caledonia		1				1
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	1
Thailand		1				1
Saudi Arabia		2				2
Unknown		1				1
Totals	**94**	**107**	**47**	**12**	**18**	**279**

Fatality Location Tables

U.S. Fatalities from 1970 to 1994 by State

State	1970-1979	1980-1989	1990-1992	1993	1994	State Totals
Alabama	4	2	1		2	9
Alaska	9	9	2		1	21
Arizona	2	4			1	7
Arkansas	5	8	1		1	15
California	262	155	39	15	11	482
Colorado	4					4
Connecticut	9	9	1			19
Delaware		3	1	1		5
Florida	297	231	58	27	25	638
Georgia	9	11	1		1	22
Hawaii	63	54	8	7	1	133
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		1	31
Maryland	9	1			1	11
Massachusetts	39	32	5	3	4	83
Michigan	33	12	2	2	2	51
Minnesota	5	4	1			10
Mississippi	1	3			1	5
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	3	55
New Mexico	6	4	2		1	13
New York	38	21	10	3	2	74
North Carolina	8	12	3			23
Ohio	9	6	2		1	18
Oklahoma	2	1		1		4
Oregon	15	11	2	3		31
Pennsylvania	7	7	10	1	2	27
Rhode Island	11	19	4			34
South Carolina	7	3		1	1	12
South Dakota	1		1			2
Tennessee	5	4	2			11
Texas	32	19	4	2	1	58
Utah	14	5	1			20
Vermont	2	1				3
Virginia	9	5		1	1	16
Washington	96	67	8	2	6	179
West Virginia	1		1		1	3
Wisconsin	20	10	3	2	1	36
Wyoming		2				2
Washington DC	1					1
Totals	**1138**	**788**	**203**	**74**	**72**	**2275**

Fatality Location Tables

U.S. Fatalities from 1970 to 1994 by U.S. Territory

U.S. Territory	1970-1979	1980-1989	1990-1992	1993	1994	Territory Totals
Guam	1				3	4
Marshall Island	1				2	3
Puerto Rico	4	5	1		0	10
Virgin Islands	1	11	3	6	2	23
Totals	**7**	**16**	**4**	**6**	**7**	**40**

To report an injury, a fatality, or a near-miss in diving, call the DAN Medical Department.

Divers Alert Network
3100 Tower Boulevard · Suite 1300
Durham, NC 27707
(919) 684-2948

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 the goal of the DAN *Incident Reporting 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, however, provides researchers with valuable information for future safety.

Since 1994, DAN has received 317 incident forms. Of these, 237 incident forms have been entered into an incident database. DAN plans to use this data to help form a more complete picture of the causes of mishaps and accidents and to help educate divers about common diving mishaps and how to avoid them.

Analysis of this incident database will be discussed periodically in editions of the *Alert Diver.*

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 or someone else encountered a near-miss.

Don't waste these valuable experiences — share them for the benefit of all.

The key to using the *Diving Incident Report Form* is understanding the meaning of "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.

There are a few guidelines to keep 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. DAN also requests suggestions on measures which might be employed in the future to prevent a similar incident from happening again. Extra space is provided on the back of the form for these firsthand reports, and 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* has been distributed by DAN all over the world. We encourage all divers to help in this process. 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 and included in the incident database.

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):**
   ☐ none
   ☐ anxiety about the dive
   ☐ inexperience in diving
   ☐ weather conditions
   ☐ poor physical fitness
   ☐ failure to check equipment
   ☐ haste
   ☐ inattention
   ☐ poor dive planning
   ☐ poor servicing of equipment
   ☐ sea sickness
   ☐ insufficient training
   ☐ not familiar with diving conditions
   ☐ error in judgment/incorrect decision
   ☐ poor communication
   ☐ lack of a buddy check
   ☐ drug or alcohol intake
   ☐ failure to understand equipment
   ☐ lack of medical clearance to dive
   ☐ inadequate supervision
   ☐ failure to understand dive table
   ☐ poor maintenance of equipment
   ☐ malfunction or failure of equipment
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):**
   ☐ none
   ☐ out-of-air situation
   ☐ rapid ascent
   ☐ omission of decompression stops
   ☐ misreading of decompression tables/computer
   ☐ multiple ascents/descents/ bounce diving
   ☐ loss of buddy contact
   ☐ marine animal
   ☐ equalization problem on ascent
   ☐ equalization problem on descent
   ☐ giddiness/vertigo
   ☐ flying/altitude after diving
   ☐ problem at safety stop
   ☐ buoyancy problem at decompression stop
9. **Was the diver involved:** ☐ a diving student ☐ untrained ☐ certified diver
10. **Diver certification level:** ☐ basic ☐ instructor ☐ open-water ☐ divemaster ☐ advanced ☐ commercial ☐ not known
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 ☐ octopus used ☐ out of air ☐ not known ☐ not a problem ☐ 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
   ☐ air supply not turned on
   ☐ second stage problem
   ☐ contents gauge inaccurate/failed
   ☐ unable to read contents gauge at depth
   ☐ first stage problem
   ☐ problem w/ regulator despite frequent servicing
   ☐ hose rupture
   ☐ 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
   ☐ underweighted
   ☐ air used frequently to maintain buoyancy
   ☐ weight belt problem
2. **Buoyancy jacket:**
   ☐ not worn
   ☐ inflation device failed
   ☐ inflation device not connected correctly
   ☐ unable to vent vest to slow down
   ☐ vest leaked
   ☐ vest provided inadequate buoyancy
   ☐ vest uncomfortable to wear
   ☐ unfamiliar with its use
   ☐ incorrect use
   ☐ not involved

   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?** ☐ Yes ☐ No
   If so: ☐ stopped working ☐ inaccurate ☐ unable to read number ☐ forgot to activate it

   Make: _____ Model: _____

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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	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

ICD-9-CM Codes for Dive-Related Incidents — Continued

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

* DAN adaptation of code

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

Toxicology

Volatiles — ethanol, methanol, acetone, isopropanol and toluene.

Amphetamines — includes amphetamine, methamphetamine, phenylpropanolamine, MDA, ephedrine, pseudoephedrine and related compounds.

Barbiturates and Sesatives — includes phenobarbital, 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, diphenydramine 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, cocaine and metabolites, propoxyphene, strychine, methadone, ethclorvynol, quine, chlorinated hydrocarbons and other related compounds.

Abbreviations

d/t	due to
s/p	status post
w/o	without
ALS	Advanced life support
ARDS	Adult respiratory distress syndrome
ATN	Acute tubular necrosis
CAD	Coronary artery disease
CABG	Coronary artery bypass graft
LAD	Left anterior descending coronary artery
Lcirc	Circumflex coronary artery
NOS	Not otherwise specified
NEC	Not elsewhere classifiable
RCA	Right coronary artery

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 bouyancy 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.

Appendix H

Abstracts and Articles — 1994-95

Bennett PB: Epidemiology of decompression illness in recreational divers. Edited by Wattel F and Matthier D. In Proceedings 1st European Consensus Conference on Hyperbaric Medicine. Lille, France. Centre Hospitalier Regional Universitaire De Lille, Sept. 19-21, 1994, pp 28-34.

Corson KS and Dovenbarger JA: A Survey of Divers Wearing Contact Lens. Gulf Coast Undersea and Hyperbaric Medical Society Conference, Memphis, Tennessee. March, 1994.

Davis PE, Piantadosi CA, Moon RE: Treatment of severe neurological decompression illness with saturation vs. multiple shore O^2 tables: a retrospective review. Undersea and Hyperbaric Medicine 21(suppl): 93, 1994.

Dear G de L, Dovenbarger JA, Corson K, Stolp BW, Moon RE: Diabetes among recreational divers. Undersea and Hyperbaric Medicine 21(suppl): 94, 1994.

Dear G de L, Dovenbarger JA, Willingham BL, Walker KP, Stolp BW, Moon RE, Bennett PB: A two-year survey of emergency calls to the Divers Alert Network. Undersea and Hyperbaric Medicine 22(suppl): 56, 1995.

Dear G de L, Hampson NB, Dunford, Kraft K, Davis P, Clark EM: The Neurobehavioural Cognitive Status Examination (NCSE) Test in Recreational Divers with Decompression Illness. Undersea and Hyperbaric Medicine 21(suppl): 89, 1994

Denoble PJ, Vann RD, Gerth WA, Sitzes CR: Project Dive Safety: Medical Aspects. Undersea and Hyperbaric Medicine 22(suppl): 57, 1995.

Dovenbarger JA, Uguccioni DM, Corson K: Analysis of Trends in Recreational SCUBA Injuries and Fatalities. Undersea and Hyperbaric Medical Society Gulf Coast Meeting, New Orleans, Louisiana. March, 1995.

Dunford R, Huggins K, Wachholz C, Bennett PB. Relationship of deepest dive or deepest quarter of dive to doppler scores. Proceedings Annual Scientific Meeting, Undersea and Hyperbaric Medical Society. June 1994. Undersea and Hyperbaric Medicine 21(suppl): 88-89, 1994.

Hodson JD, Dovenbarger JA, Mebane GY: Medical Conditions Contributing to Death while Scuba Diving. Gulf Coast Undersea and Hyperbaric Medical Society Conference, Memphis, Tennessee. March, 1994.

Hodson JD, Dovenbarger JA, Mebane GY: Factors Related to Death among 255 Recreational Scuba Divers. Gulf Coast Undersea and Hyperbaric Medical Society Conference, Memphis, Tennessee. March, 1994.

Lowe VJ, Hoffman JM, Hanson MW, Paine S, Massey EW, Jordan LK, Gray L, Moon RE, Coleman RE: Cerebral imaging of decompression injury patients with 18F-2-fluoro-2-deoxyglucose positron emission tomography. Undersea Hyperbaric Medicine 21:103-113, 1994.

Maynor M, Stolp BW, Saltzman HA, Massey EW, Moon RE. Recurrence of severe neurological symptoms precipitated by aircraft flight after treatment of DCI. Undersea and Hyperbaric Medicine 22(suppl): 62, 1995.

Moon RE, Vann RD, Bennett PB: The physiology of decompression illness. Scientific American, pp 54-61, August 1995.

Moon RE: 1995 Workshop on the Treatment of Decompression Illness. UHMS/ASMA/US Navy.

Moon RE, Massey EW, Hanson MW, Coleman RE. Persistent altitude induced symptoms after DCI: Investigation using position emission tomography (PET). Undersea and Hyperbaric Medicine 22(suppl): 63, 1995.

Moon RE, Uguccioni DM, Dovenbarger JA, Dear GD, Mebane GY, Stolp BW, and Bennett PB. Surface oxygen for decompression illness. Undersea and Hyperbaric Medicine 22(suppl): 37, 1995.

Uguccioni DM and Dovenbarger JA. Equipment Problems in Recreational Diving. Undersea and Hyperbaric Medical Society Gulf Coast Meeting, New Orleans, Louisiana. March, 1995

Uguccioni DM, Vann RD, Smith LR, Butler, Roye DB, Ruer RD. Effect of safety stop on venous gas emboli after no-stop diving. Undersea and Hyperbaric Medicine 22(suppl): 38, 1995.

Vann RD, Gerth WA, Denoble PJ, Sitzes CR, Shuster B. Project Dive Safety: An Overview. Undersea and Hyperbaric Medicine 22(suppl): 58, 1995.

Vann RD, Gerth WA, Denoble PJ, Smith LR. DCS and flying after diving. Undersea and Hyperbaric Medicine 22(suppl): 34, 1995.

Vann RD, Bute BP, Uguccioni DM, Smith LR. Prognostic factors in DCI in recreational divers. UHMS /DAN/USN/ Asthma Society Workshop Proceedings, 1995.

Vann RD: Pressure-Volume Characteristics of "Lung Packing." Undersea and Hyperbaric Medicine 21(suppl): 42, 1994.

Vann RD: Effects of One Minute of Hyperventilation and One Breath of Oxygen on Resting Breath-hold Time. Undersea and Hyperbaric Medicine 21(suppl): 43, 1994.

Vann RD, Gerth WA, Corson KS, Denoble PJ: DCS and Preflight Surface Intervals After Dry, Resting Dives to 60 FSW. Undersea and Hyperbaric Medicine 21(suppl): 94, 1994