

## **REPORT ON 1988 DIVING ACCIDENTS**

# **DIVERS ALERT NETWORK**

Report on 1988 Diving Accidents

December, 1989



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# Introduction



## 1.0 Introduction

The Divers Alert Network (DAN) is approaching the end of its first decade of service to the scuba diving public and diving medicine community. One of DAN's primary goals is the collection of scuba injury statistics. The last few years have seen increased efforts to collect more information on the causes of injury.

The injury statistics presented in the 1988 Annual Diving Accident Report seek to shed some light on the often uncertain causes of injury and death. As these causes become better understood, fewer injuries should occur and scuba diving should become a safer sport. This annual report and subsequent articles and seminars are the means by which DAN attempts to educate the diving public. Antecdotal accounts of decompression sickness and gas embolism have led to myths concerning the conditions predisposing to these injuries. Accurate knowledge about dive accidents will change divers' attitudes towards safer diving habits. The individual diver will have the greatest influence on safe diving.

Diagnostic Research, Inc. estimated there were 2.7 million active recreational scuba divers in 1988. With approximately 600 treated injuries in 1988, the injury rate is one diver in 4,500 or 2.2 injuries per 10,000 divers. If an equal number of injuries go untreated and an average of 90 fatalities also are included, the total number of fatal and non-fatal accidents is 4.7 per 10,000 dives. This low injury rate will not make a significant impression on the average diver. Motivation for improving his diving habits must come from specific examples and facts demonstrating the dangers of many unsafe practices.

Accidents do not just happen. The 500-600 dive injuries which occur each year can be attributed to no specific cause, but they are frequently a product of a series of events. While these events can be different for each diver, similarities do exist. Certain conditions or behaviors, in particular, are associated with injury. These include fatigue, inexperience, and/or alcohol on the preceeding night. Deep diving and repetitive diving are also strongly linked to decompression sickness, and inexperience is a major predisposing factor for both decompression sickness and air embolism.

Divers must learn to take control of their actions. This includes considering dive day conditions, pre-dive health, fitness, preparation for the dive, and competence of the other divers. In a given group, it is not unusual for a planned dive to exceed the experience and abilities of some of the divers. The dive need not be aborted in these circumstances, but the dive plan should be modified to correct the deficiencies and minimize the chance of injury.

The signs and symptoms of gas bubble disease are diverse, and divers must learn to be suspicious of the aches, pains, numbness, and fatigue which can develop after diving.

To effect more complete recovery, divers must report for treatment earlier than the current average of 15 hours. Although recreational diving is relatively safe as DAN enters its second decade, DAN has every intention of using its hotline, medical advisory, education, and research services to make diving even safer as the twenty-first century approaches.

### 1.1 General Information

The Divers Alert Network receives accident reports from hyperbaric treatment facilities and from divers who contact DAN on both the emergency and non-emergency lines. Most reports originate in the U.S. or from waters in which Americans dive, but some are received from around the world. Accident Report Forms are filled out by the injured divers and by hyperbaric facility staff. Hyperbaric staff provide information on treatment while the divers provide information concerning the dive profile and personal data such as medical history. For clarification and confirmation, personnel at DAN Central contact the treatment facilities by letter and telephone.

The Dive Accident Reporting Form has been modified to make it easier for divers, treatment centers, and DAN Central to use. Further evolution can be expected as our understanding improves. The 1989 Dive Accident Report and Fatality Report is included in Appendix B and C. This form may be reproduced for reporting fatal or non-fatal accidents. Appendix D defines the severity codes DAN uses to classify symptoms.

In 1988, 553 cases were treated, down 8% from 1987. Of these, DAN received 419 Accident Reports by June 1989. One hundred and eleven (111) cases were excluded because they were not recreational divers and 40 were excluded due to insufficient data. Thus, the 1988 report is based on 268 (49%) of the total treated cases. Twelve spontaneous recoveries of individuals who, in retrospect, were diagnosed as having DCS or AGE also are reported. These divers did not seek treatment and were not counted in the total treated cases for 1988.

Many facilities also send accident reports on non-recreational divers. These are described briefly in Appendix E. Some commercial divers are included because they were sport diving at the time of injury.

While 500-600 divers are treated per year, there is reason to believe the actual number of injuries may be higher. Both the 1987 and 1988 DAN report show that most divers delay calling for medical assistance. This may be because they do not want to admit to having a problem or because they do not understand the symptoms of gas bubble illness. Indeed, because of denial and ignorance, there may be as many untreated as treated accidents.

## Diver Characteristics



## 2.0 Diver Characteristics

This section contains data on diver age, sex, and level of certification. Diver experience, health, and fitness to dive are also discussed. There is no control population for comparison of diver traits, so it is not known if these are characteristics of all divers or just the injured population.

### 2.1 Age

The mean age of accident victims was 34 years (range 11-61 years). The number of 15-19 year old victims, and the number of 35-39 year olds decreased by half in 1988 from 1987. Increases in the 25-29, 40-44, 45-49 and 50-54 age groups spread approximately the same number of accident victims over a wider range of ages. Table 1 lists the age distribution of accident victims for 1988 and 1987-1988.

**Table 1.** Age Distribution of Accident Victims

AGE	1988		1987-1988	
	Frequency	Percent	Frequency	Percent
10-14	2	0.7	4	0.7
15-19	4	1.5	15	2.8
20-24	27	10.1	55	10.2
25-29	62	23.1	114	21.2
30-34	64	23.9	127	23.6
35-39	39	14.6	99	18.4
40-44	35	13.1	67	12.5
45-49	19	7.1	30	5.6
50-54	11	4.1	14	2.6
55-59	2	0.7	5	0.9
60-64	3	1.1	8	1.5
Total	268	100.0	538	100.0

### 2.2 Sex

Men were involved in diving accidents four times as often as women in both 1987 and 1988 (Table 2). This probably indicates a larger male diving population but may reflect higher risk diving habits for men.

**Table 2.** Sex of Accident Victims

Sex	1988		1987-1988	
	Frequency	Percent	Frequency	Percent
Female Divers	58	21.6	123	22.9
Male Divers	210	78.4	415	77.1
Total	268	100.0	538	100.0

### 2.3 Certification Level

Table 3 shows a breakdown of diver certification. Forty-nine percent of the injured divers were beginning level scuba certified (basic or open water) and fifty percent were certified at advanced levels (advanced or higher).

Table 3. Certification Level of Accident Victim

CERTIFICATION LEVEL	MALE	FEMALE	TOTAL	PERCENT
Basic	27	9	36	13.4
Open Water	70	25	95	35.4
Advanced	57	15	72	26.9
Divemaster	12	1	13	4.9
Instructor	24	6	30	11.2
Commercial	10	1	11	4.1
Other	7	1	8	3.0
Unknown	3	0	3	1.1
TOTAL	210	58	268	100.0

### 2.4 Experience

Table 4 shows the number of years male and female accident victims reported they have been diving and the number of dives they make per year. Diver experience is more than just the number of dives or the length of time a diver has been active. Forty-eight percent of the males and 65% of the females had been diving one year or less and made no more than twenty dives a year. The 1987 report showed a very similar finding with fifty-three percent of males and sixty-six percent of females.

The graphs of new divers with one year or less experience, on page 12, show that the majority (60 of 78) new diver injuries occurred in the severity codes indicating Central Nervous System DCS and Gas Embolism. Refer to appendix D for severity coding system by type of symptom and location. New diver profiles indicate 75% dived 20 times or less, 61% were diving deeper or equal to 80 feet, 50% were repetitive diving, 41% had a rapid ascent, and 31% were outside the USN dive tables as is indicated in the graph on the bottom of page 10. New divers are less knowledgeable about diving safety and may have a tendency to go along with more experienced divers doing higher risk diving.

There were 25 cases of gas embolism in the 78 divers who had been diving one year or less. These 25 cases were 32% of new divers but 69% of all embolism cases (46) in this report, suggesting that lack of experience may contribute to the risk of AGE. Rapid ascent occurred in 16 of the 25 new diver embolisms.

**Table 4.** Diver Experience by Sex

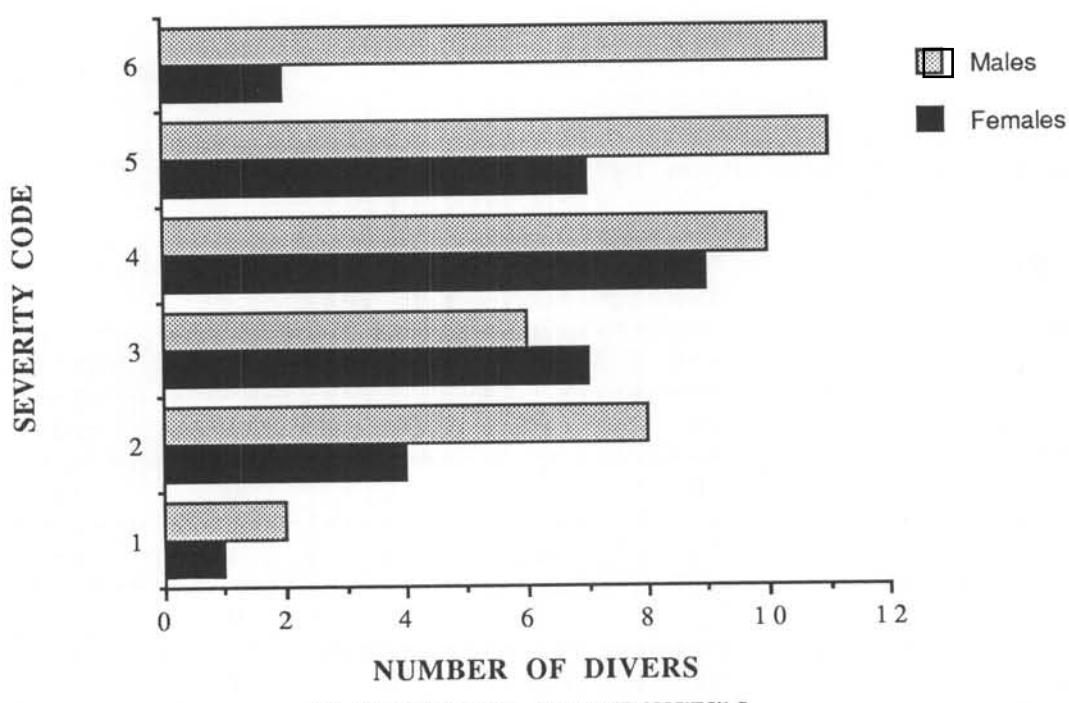
Female

Years Diving	Average Dives per Year					Total
	0-10	11-30	31-60	61-200	>200	
<1 Yr	13	10	2	0	0	25
1-4	2	8	7	0	0	17
5-9	2	4	0	5	1	12
>10	1	2	0	0	0	3
Total	18	24	9	5	1	57

Males

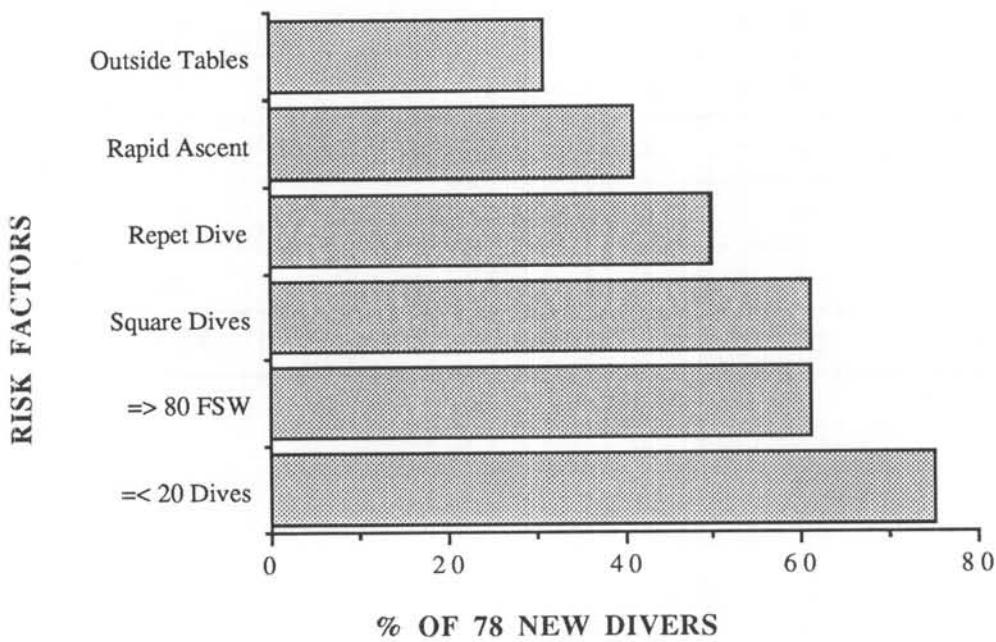
Years Diving	Average Dives per Year					Total
	0-10	11-30	31-60	61-200	>200	
<1 Yr	28	3	1	3	0	35
1-4	19	18	11	12	2	62
5-9	10	9	10	3	5	37
>10	5	6	6	7	1	25
15-19	4	5	6	12	2	29
>20	0	4	4	13	1	22
Total	66	45	38	50	11	210

### NEW DIVERS WITH 1 YEAR OR LESS EXPERIENCE



FOR SEVERITY CODING SYSTEM SEE APPENDIX D

### NEW DIVER PROFILE TRAITS



## 2.5 Fitness to Dive

Recreational scuba diving is generally considered an activity for healthy, physically fit individuals. It does not have rigid health requirements as required in military or commercial diving. There are medical conditions which are considered disqualifying, and also temporary diving restrictions for medical conditions which are not permanent.

Eighty divers listed a current medical problem in the past two months. Based on the guidelines from the second edition of the Medical Examination of Sport Scuba Divers (Jefferson C. Davis, M.D., editor) and Fitness to Dive from the 34th Undersea and Hyperbaric Medical Society Workshop, divers were classified as having temporary, relative, or absolute contraindications. The results are as follows: 29 divers had relative contraindications, 12 divers had absolute contraindications, and 31 divers had temporary contraindications. Diving was not restricted in 8 divers who listed a medical problem.

Sixty-seven percent of the accident population were diving without a recent health problem (i.e. pneumonia, flu, diarrhea) and 48% did not have a major illness (i.e. surgery, body trauma, organ disease, asthma) in recent years as can be seen in Table 7 and 8 on the following pages. Table 5 shows that 87% of the accident population said they were physically fit on the day of the dive. Table 6 shows 22% said they were taking prescription medication under a doctors direction and 27% were using a non-prescription medication. The most common medications used, were pseudoephedrine (Sudafed-19), Aspirin (10), and dimenhydrinate (Dramamine-9).

**Table 5. Physical Fitness\* of Accident Victim**

	Fit	Not fit
Male	184	26
Female	49	9
Total	233	35

\*As reported by diver

**Table 6. Medication Use of Accident Victim**

Prescription Use Frequency	Percent	Non-Prescription Use Frequency	Percent
58	22	71	27
No response = 3		No response = 7	

**TABLE 7: Current Medical History By Disease Severity Code<sup>a</sup>**

Frequency	Disease Severity Code			Total
	(1)	(2-5)	(6)	
Blood Pressure	2	2	1	5
Heart	0	2	0	2
Lungs	1	2	1	4
Asthma	2	3	0	5
Ear/Sinus	4	14	1	19
Eye	0	0	2	2
Circulation/Blood	0	0	1	1
CNS	0	1	0	1
Gastro/Abdominal	1	3	0	4
Muscular/Skeletal	2	5	2	9
Limb/joint DCS site	1	3	0	4
Skin	1	1	0	2
Allergies	2	7	3	12
Spine/Back	0	5	1	6
Mental/Emotional	1	4	1	6
Other	0	13	2	15
None	25	143	12	180
Total Responses	42	208	27	277 <sup>b</sup>

No Response = 8

<sup>a</sup> Within the past two months<sup>b</sup> A person can have more than one current medical history.

@ For Disease Severity Code see appendix D.

**TABLE 8:** Past Health Illness by Disease Severity Code

Frequency	Disease Severity Code			Total
	(1)	(2-5)	(6)	
Chest-Lung	0	14	0	14
Asthma	2	10	2	14
Chest-Heart	0	5	1	6
Gastro/Abdominal	2	20	2	24
Brain	0	3	0	3
Spine/Back	3	15	1	19
Limb/Joint DCS site	1	15	1	17
Circulation/Blood	0	2	2	4
CNS	1	3	1	5
Muscular/Skeletal	8	20	5	33
Eye	0	1	2	3
Mental/Emotional	0	2	0	2
Other	5	31	1	37
None	18	99	12	129
Total Response	40	240	30	310*

No Response = 3

\* More than two months previously

+ A person could have had more than one past medical problem.

**Weight** There was no evidence of an excessive number of obese individuals in our accident database. DAN uses the body mass index (BMI) to determine the obesity of our population, although it can be slightly misleading in that physically fit divers have a higher body mass index due to increased muscle mass. The BMI is defined as the weight (kg) divided by the Height (meters-squared).

Sex The female population showed no particular trend regarding special susceptibility to decompression sickness. Birth control pills and menses have been mentioned as possible DCS risks for women, but this has not been proven. Twenty-five percent of the injured population used birth control pills. A recent DAN prospective study questionnaire found 26.1% of 188 female divers were also on birth control pills. The most recent national survey on birth control methods published in 1982 by the National Center for Health Statistics (National Survey of Family Growth), found 20% of all married women and 16% of all females in the 15-44 year age group used birth control pills. Females who scuba dive do not necessarily represent the female population in general. No significance can be drawn about an apparent increase in birth control pill use in this small sub-group. Certainly the DAN statistics provide no evidence that birth control pills are a risk factor for diving accidents.

Twenty-five percent of the women were menstruating at the time of their injury. This is approximately the same proportion that would be expected in the general population.

Scuba diving restrictions apply to a variety of illnesses and medical conditions. These medical problems are thought to increase the risk of injury or "predispose" a diver to decompression sickness, gas embolism, or unconsciousness. Such conditions might obstruct or restrict the free flow of air out of the lungs (asthma), or prevent nitrogen off-gassing from the body with fluid retention (swelling) from injury or illness.

Some medical problems carry only a theoretical risk and there is disagreement about whether divers with such risk factors may safely dive. Spinal and back injury/surgery are an example. Twenty-six (12%) of the 1988 DCS accidents had a history of spinal or back problems. These included spinal surgery, degenerative diseases, and unspecified back problems.

Decompression sickness frequently affects the spinal cord in compressed air diving. The spinal cord may be susceptible to DCS because: It receives a high rate of blood flow, the epidural blood flow velocity is slow and susceptible to sludging; it has a high percentage of lipid (fat) material around nerve cells, and it is located adjacent to fatty tissue. Spinal surgery can interfere with local circulation possibly adding to a nitrogen elimination problem.

In the 1988 accident population, 67% (16 of 24) of the divers with back problems developed spinal cord symptoms such as paralysis, difficulty walking or standing, bowel or bladder problems, bilateral pain, numbness and tingling, or muscle weakness. This is compared to 52% (103 of 198) of the 1988 accident population without previous back problems. The remainder of the back injury cases were Type I "pain only" or peripheral nervous system symptoms.

Previous damage to the spinal cord or nerve roots could have contributed to some of these divers' injuries. Divers with previous injuries may also be more likely to report spinal cord type symptoms since they have experienced them before. They may also already have an abnormal neurological exam. The existence of pain or numbness as a result of trauma or surgery must be considered prior to diving.

The health of the diver prior to entering the water is an important factor in dive injuries. The events leading up to an injury often begin before divers ever put their equipment on. Starting the day fatigued or after drinking the night before can lead to impairment of the decision-making process or inhibit a divers' ability to physically perform underwater. There were 120 (44.7%) divers who had drunk at least one alcoholic drink the night before diving or prior to entering the water on the dive day (Table 9). It is unknown whether divers who have consumed alcohol close to the time of a dive are over-represented in the accident group. Forty-seven divers (17.5% of all cases) began their final dive, in the profile, exhibiting their first symptom of decompression sickness. This information is summarized in the following tables.

**Table 9. Alcohol Use**

<u>Pre-dive Alcohol Use</u>	
Severity Code	# of divers
1	18
2	11
3	11
4	40
5	32
6	8
Total	120 (44.7%)

All Alcohol Use

<u>Time of Use</u>	<u># of Divers</u>
Night Before	116
Predive	4
Between Dives	6
Post Dive	28
None	139
<u>No Response</u>	7
Total	300*

\*Divers may have engaged in drinking in more than one category

Thirty-five divers (13.1%) said they were presently smokers, 47 (17.5%) stated they were ex-smokers and 184 (68.7) said they had never smoked. Table 10 summarizes this.

**Table 10. Smoking History of Accident Victim**

<u>Smoke</u>	<u>Frequency</u>	<u>Percent</u>
Present	35	13.1
In Past	47	17.5
Never	184	68.7
<u>No Response</u>	2	0.7
Total	268	100.0

Of the 268 accident victims 20 reported being nauseated prior to their dive, 4 reported hangovers, 1 reported recreational drug use.

Table 11. Nausea, hangover and recreational drug use

<u>Nausea</u>		<u>Hangover</u>		<u>Recreational Drug Use</u>	
Male	12	Male	4	Male	1
Female	8	Female	0	Female	0
Total	20	Total	4	Total	1

Almost 15% of the male and 26.6% of the female dive population, exhibited DCS symptoms prior to their last dive. Fatigue or lack of sleep was reported by 32.9% of the male dive accident population and 27.6% of the female dive accident population.

Table 12. DCS Symptoms and/or fatigue prior to the last dive.

<u>DCS Symptoms Prior To Last Dive</u>			<u>Lack of sleep or Fatigue Prior To Last Dive</u>		
Male	31 of 210	14.8%	Male	69 of 210	32.9%
Female	16 of 58	26.6%	Female	16 of 58	27.6%
Total	47	268	Total	85	268

Forty-eight people reported strenuous exercise prior to their dive, 65 reported strenuous exercise during their dive, and 18 divers participated in strenuous activity after diving, as is indicated in Table 13.

Table 13. Strenuous Exercise

<u>Prior to Dive</u>	<u>During Dive</u>	<u>After diving</u>			
Male	36	Male	53	Male	14
Female	12	Female	12	Female	4
Total	48	Total	65	Total	18

Eighty-four percent of 535 divers for both years (87-88) were diving in salt water. Table 14 shows the results

Table 14. Type of Water Environment for 1987-1988

<u>Water type</u>	<u>Frequency</u>	<u>Percent</u>
Fresh Water	81	15.1
Salt Water	454	84.1
Total	535	100.0

(No Response = 3)





## Dive Profile



### 3.0 Dive Profile

Fifty-three percent (143) of the divers had their accident on the first day of this dive activity. Seventy-four percent suffered their injury within the first two days of their last dive. Sixty-one percent (160) of the divers had been diving safely within the past month of their last dive. Eighteen percent (47) made safe dives within one to five month prior to their last dive. Primary dive activity is shown with the graphs on page 27. Sixty percent of all divers were sightseeing (102) or wreck diving (58). The graphs on page 27 detail the particular trends in the 1988 cases that were analyzed.

The biggest change in the 1988 DCS risk profile was the increase of divers who were diving with the USN tables. Seventy-two percent were within the USN tables for 1988 vs. 58% in 1987. Multi-day diving and single day diving was evenly divided in 1988 at 50%. Seventy-two percent of divers were diving at 80 feet or greater compared with 68% in 1988.

The risk profile for AGE in 1988 was very similar to that of 1987. Most dives had a square profile, no decompression, were within USN tables, and were a single dive on a single day. Fifty-four percent of the Gas Embolism cases had a rapid ascent compared to 48% in the 1987 divers.

#### 3.1 Location

The total reported cases each year has ranged from 383 (1981) to over 600 (1987). The number of treated cases has remained fairly consistant over the last ten years despite the increasing population of scuba divers. The location of the injuries by state has also remained consistent. There is a statistical relationship between the number of injuries and the number of dives made in any given area or state. The total number of dives in any area is not known, so this figure can not be calculated.

For comparison with previous years, the number of dive accidents reported for 1986 through 1988 are summarized by the DAN Region in Table 16. The 1986 and 1987 figures include cases of spontaneous recovery and refused treatment. Tables 15-18 give detailed breakdowns of accidents by state, region, territory, and country. Most treated accidents which were analyzed occurred in Florida (89), with Mexico (18), Cayman Islands (13), Washington (13), California (11), and New York (10) following.

The 268 injury population, upon which this report is based, comes from the geographic areas on the following location pages. These figures reflect only the analyzed population. A complete break down of total accidents by state is listed on pages 24-26.

**Table 15:Total Reported Treated Cases**

1986 Dive Accident Cases Reported to DAN

Regions	SW	NW	MW	GU	PA+	NE	SE	Total
DCS I		6	2	1			68	77
DCS II	*69	11	13	8	7	33	133	*274
AGE		28	2			10	41	81
Reported w/o diagnosis					25		97	122
Cases w/no treatment, refused treatment or Spont. resolution			3			1	4	8
<u>Regional TOTALS</u>	100	19	15	9	32	44	343	
<u>TOTAL Incidences reported</u>								<b>562</b>

\*represents DCS Types I and II cases combined

## 1987 Dive Accident Cases Reported to DAN

<u>Regions</u>	SW	NW	MW	GU	PA+	NE	SE	Total
DCS I	15	4	2	15		30	61	127
DSC II	*58	25	12	20		26	199	*340
AGE	19	3	2	5		5	59	93
DCS-AGE combined	1	1		1		1		4
Reported w/o diagnosis					38			38
Cases w/no treatment or spont. resolution	2				3	17		22
<u>Regional Totals</u>	94	32	16	40	38	64	342	
<b>TOTAL Incidences reported</b>								<b>624</b>

\*represents DCS Types I and II cases combined  
+Hawaii only reports number of cases treated

## 1988 Dive Accident Cases Reported to DAN

<u>Regions</u>	SW	NW	MW	GU	PA+	NE	SE	Total
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
Reported w/o diagnosis					36			36
Cases w/no treatment or spont. resolution	3		1	1	2	5		12
<u>Regional Totals</u>	83	42	23	43	36	64	262	
<b>TOTAL Incidences reported</b>								<b>565</b>

+Hawaii only reports number of cases treated

**Table 16:**Total Cases Treated & Reported by DAN Regional Coordinators**Southwest Region (SW)**

<u>State Location</u>	DCS-I	DCS-II	A-G-E	DCS/A-G-E	<u>Total</u>
California	13	42	25	1	81
Arizona	1	1			2
Nevada					
<u>Utah</u>					
<b>TOTAL</b>	<b>14</b>	<b>43</b>	<b>25</b>	<b>1</b>	<b>83</b>

**Northwest Region (NW)**

<u>State Location</u>	DCS-I	DCS-II	A-G-E	DCS/A-G-E	<u>Total</u>
Alaska					
Washington	6	27	5		38
Oregon	3		1		4
<u>Montana</u>					
<b>TOTAL</b>	<b>9</b>	<b>27</b>	<b>6</b>		<b>42</b>

**Midwest Region (MW)**

<u>State Location</u>	DCS-I	DCS-II	A-G-E	DCS/A-G-E	<u>Total</u>
Wisconsin		1	2		3
Minnesota		3			3
Michigan	5	3			8
Ohio	1				1
<u>Illinois</u>	5	3			8
<b>TOTAL</b>	<b>11</b>	<b>10</b>	<b>2</b>		<b>23</b>

**Gulf Coast Region (GU)**

<u>State Location</u>	DCS-I	DCS-II	A-G-E	DCS/A-G-E	<u>Total</u>
Arkansas					
Colorado	1	1			2
Louisiana		10	1	3	14
Mississippi	1				1
Missouri	1	1			2
New Mexico					
Texas	10	13		1	24
<b>TOTAL</b>	<b>13</b>	<b>25</b>	<b>1</b>	<b>4</b>	<b>43</b>

**Pacific Region (PA)**

<u>State Location</u>	<u>Total</u>
Hawaii	36
<b>TOTAL</b>	<b>36</b>

**Northeast Region (NE)**

<u>State Location</u>	<u>DCS-I</u>	<u>DCS-II</u>	<u>A-G-E</u>	<u>DCS/A-G-E</u>	<u>Total</u>
Connecticut	2	1	2		5
Maine		1			1
Maryland	9	1			10
Massachusetts					
New Hampshire	2	5	3		10
New York	3	15	3		21
Pennsylvania	6	7	1		14
Virginia		3			3
West Virginia					
<u>Washington, D.C.</u>					
<u>TOTAL</u>	<u>22</u>	<u>32</u>	<u>10</u>		<u>64</u>

**Southeast Region (SE)**

<u>State Location</u>	<u>DCS-I</u>	<u>DCS-II</u>	<u>A-G-E</u>	<u>DCS/A-G-E</u>	<u>Total</u>
Alabama	2	2			4
Florida	41	91	18		150
Georgia		2			2
North Carolina	5	11			16
South Carolina		3	1		4
Tennessee			1		1
<u>TOTAL</u>	<u>48</u>	<u>109</u>	<u>20</u>		<u>177</u>

**Caribbean Basin (SE)**

<u>Location</u>	<u>DCS-I</u>	<u>DCS-II</u>	<u>A-G-E</u>	<u>DCS/A-G-E</u>	<u>Total</u>
Puerto Rico					
Turks & Caicos		1	1		2
Bahamas	1	2			3
Barbados	1	6	2		9
Panama Canal		2			2
Jamaica		2			2
Cayman	6	3	3	3	15
St. Thomas	4	5	2		11
Trinidad					
Bonaire	1	7		2	10
Curacao		2			2
<u>Mexico*</u>	<u>7</u>	<u>12</u>	<u>10</u>		<u>29</u>
<u>TOTAL</u>	<u>20</u>	<u>42</u>	<u>18</u>	<u>5</u>	<u>85</u>
<b>Totals for 1988</b>	<b>137</b>	<b>288</b>	<b>82</b>	<b>10</b>	<b>553</b>

\*Cancun and Cozumel

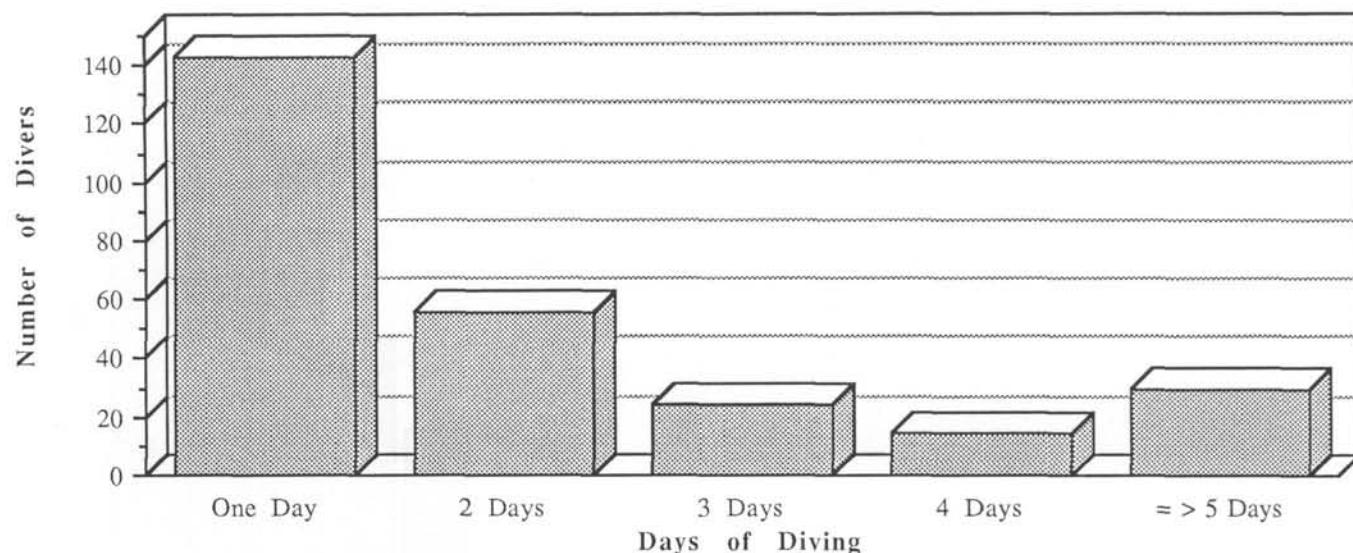
Table 17:Frequency of 268 accidents by Country where dive occurred

Dive Country	Frequency	Percent
Bahamas	2	0.4
Barbados	5	1.9
Bimini	1	0.4
Belize	2	0.8
Bonaire	4	1.5
British Virgin Islands	5	2.3
British West Indies	7	2.7
Canada	4	1.5
Fiji	1	0.4
Grand Cayman Islands	13	5.0
Honduras	4	1.5
Jamaica	3	1.1
Japan	1	0.4
Mexico	18	6.4
Saba	2	0.4
Saipan	1	0.4
Turks & Caicos	4	1.5
Tahiti	1	0.4
USA	190	67.4
TOTAL	268	100.0

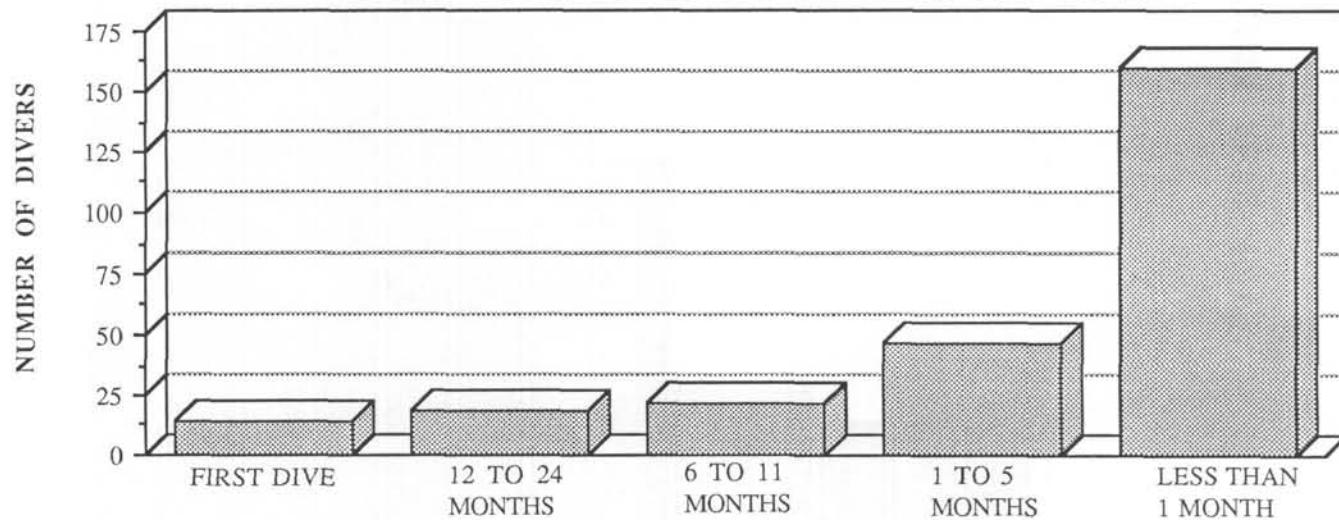
Table 18:Frequency of the 268 Dive Injuries by U.S. State

Dive State	Frequency	Percent
Alabama	2	1.05
California	11	5.79
Connecticut	2	1.05
Delaware	1	0.53
Florida	89	46.84
Georgia	1	0.53
Hawaii	2	1.05
Idaho	1	0.53
Massachusetts	1	0.53
Maryland	1	0.53
Maine	1	0.53
Michigan	8	4.21
Missouri	1	0.53
North Carolina	9	4.74
New Hampshire	1	0.53
New Jersey	7	3.68
New Mexico	2	1.05
New York	10	5.26
Oregon	1	0.53
Pennsylvania	1	0.53
Puerto Rico	2	1.05
Rhode Island	2	1.05
South Carolina	2	1.05
Texas	7	3.68
Virginia	3	1.58
Virgin Islands	9	4.74
Washington	13	6.84
TOTAL	190	100.00

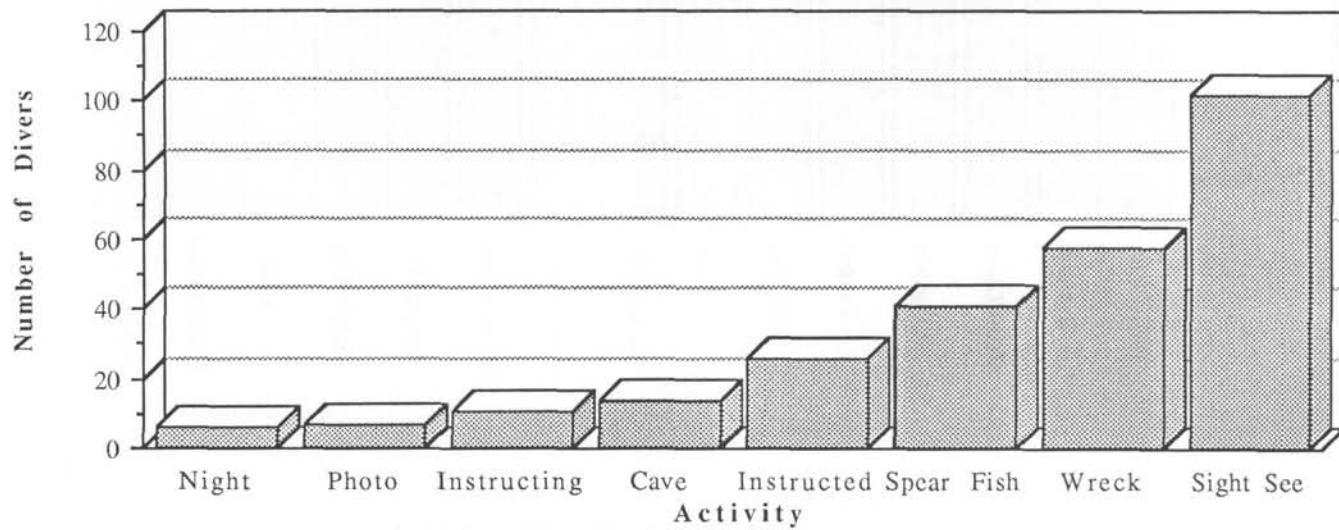
## NUMBER OF DAYS DIVING



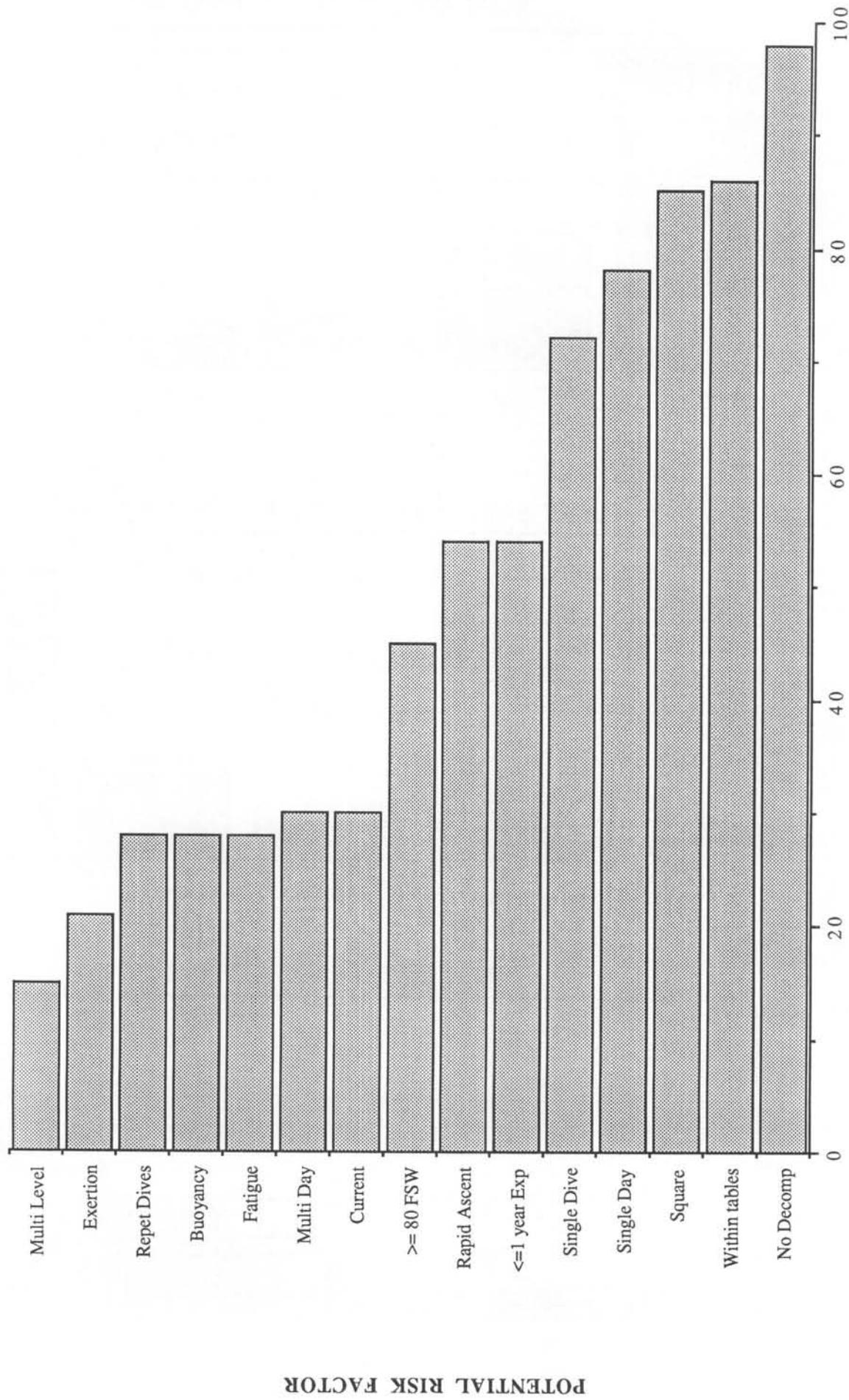
## LAST SAFE DIVE BEFORE INJURY DIVE



## PRIMARY DIVE ACTIVITY

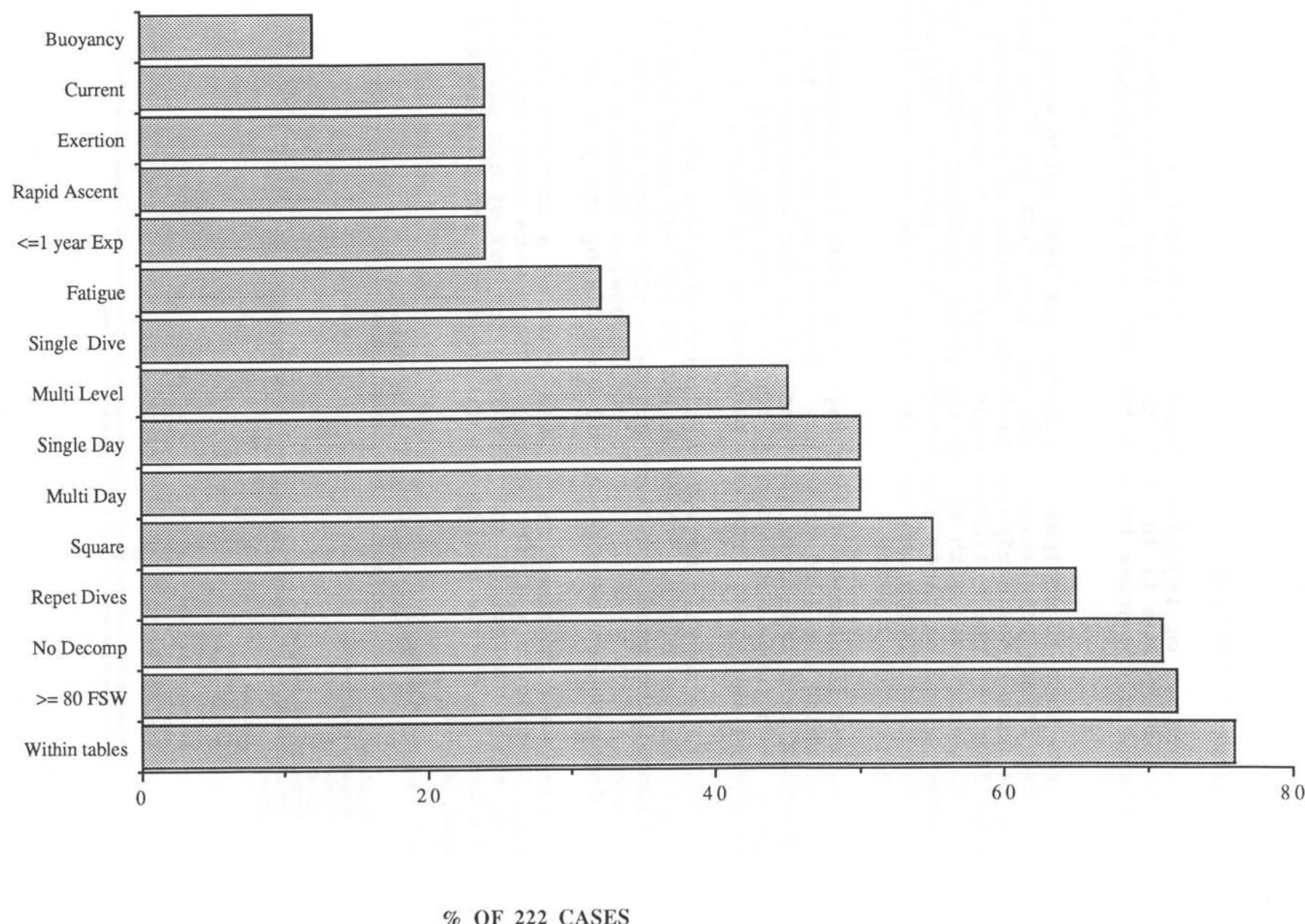


### A-G-E RISK PROFILE



## DCS RISK PROFILE

POTENTIAL RISK FACTORS



### 3.2 Equipment Problems

The number of injuries occurring in divers using decompression computers rose from 41 in 1987, to 84 in 1988. There were no significant differences between the 1987 and 1988 population analysis.

There were 32 equipment problems for 1988 which were, 11.9% of the total injury population. This was down from 15.2% in 1987. Table 19 summarizes equipment problems. Graphs of equipment used can be found on the following page. There were 8 cases of air embolism associated with the 32 equipment problems (25%). Seven of the eight embolism cases experienced a rapid ascent. Six embolism cases had been diving one year or less and one had been diving six times yearly for 2 years.

New and infrequent divers may be at risk for equipment problems which can lead to injury. Factors which tend to be compounded in a new diver are: lack of diving experience and skills (ascent techniques and buoyancy control) and not being familiar with diving equipment (rented, borrowed or recently purchased).

The relationship between equipment problems and decompression sickness is not clear. There is not an obvious cause and effect relationship between equipment problems and other aspects of diving accidents. Only five of the 24 decompression sickness cases, where equipment problems developed, had been diving one year or less.

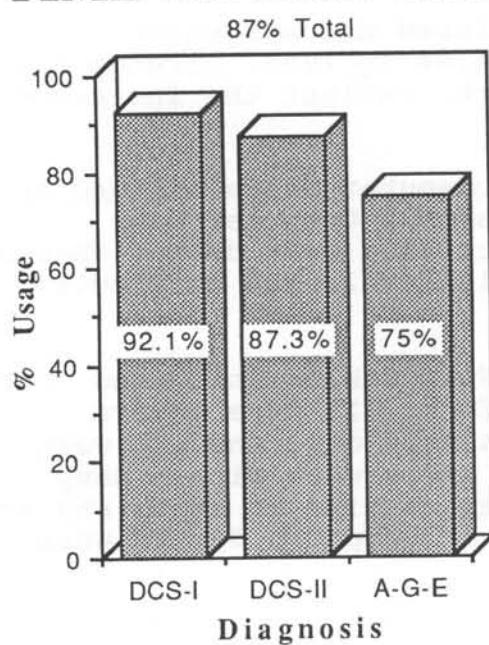
Equipment problems can be the start of a downward spiral of events leading to a diving injury. There were nine rapid ascents, 10 USN table violations and only four low/out of air problems. There were 14 divers making repetitive dives and 10 divers making single dives.

Table 19. Equipment Problems

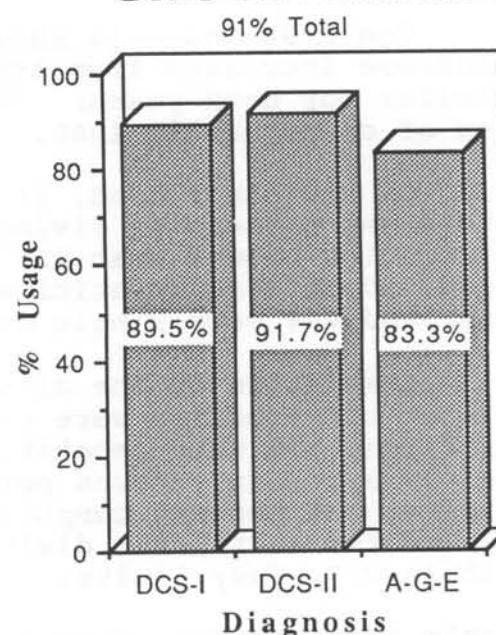
	Total Number of Cases	AGE Cases	Rapid Ascent	Low/Out of Air
Regulator	4	1	3	1
Buoyancy vest problem	6	3	5	1
Weight belt (lost)	1		0	
Dry suit *	4		3	
Decompression computer	1		0	
Inflator hose	3		0	1
Other:				
Unknown	3	3	2	2
Depth gauge	4		0	
Bottom timer	1		0	
Underweighted	1		1	
Wet suit problems	2		0	
Mask	1	1	1	
Lost fin	1		1	1
TOTAL	32	8	16	6

\*Four divers stated there was a problem during the dive with their dry suit but only two listed the problem. One had an inflator that stuck open and the other had positive buoyancy going into a current. Both lost control causing a feet first ascent.

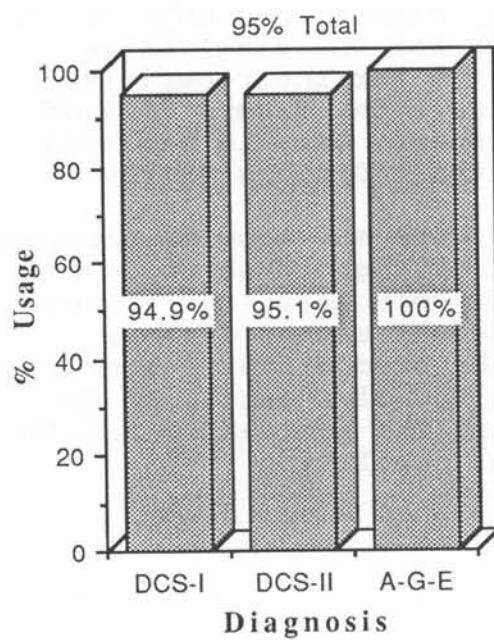
## TIME DEVICE USAGE



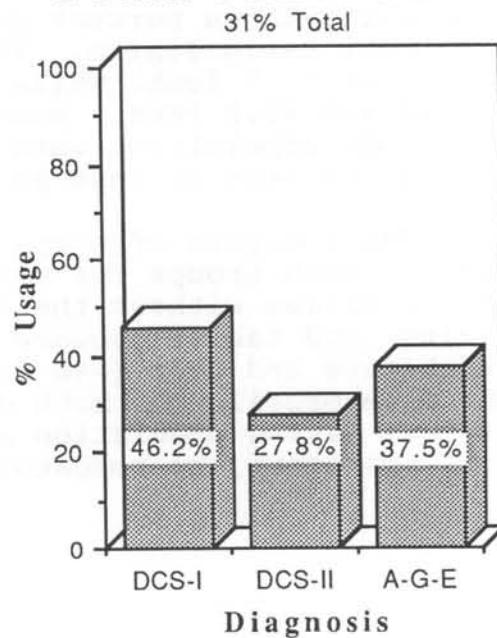
## GAUGE USAGE



## BUOYANCY VEST USAGE



## COMPUTER USAGE



### 3.3 Table and Computer Diving

The 1988 analysis shows computer-related decompression sickness increased from 14% in 1987 to 36.6% in 1988. Trends are similar for both years. This may, in part, reflect the increased use of computers in 1988.

On the other hand, it appears that computer users engaged in a different pattern of diving than table users. Computer dive statistics showed that 82% of the dive profiles were deeper than 80 feet, 80.5% were repetitive, 58% were multilevel, 55% were multi-day, and 45% were single day dives.

Statistics on the dives using U.S. Navy tables indicated that 67% of the profiles were deeper than 80 feet, 61% were square profiles, 57% were repetitive, 52% were single day, and 48% were multi-day. Sixty-seven percent of table users were within Navy limits, but because computers calculate exact time at depth and are geared for multilevel diving, only 41.6% of computer divers were within U.S. Navy limits.

**Table 20.** Table vs. Computer profiles

	USN		COMPUTER	
	#	%	#	%
Deeper than 80 fsw	97	67	62	81
Square Profile	89	61	32	42
Multi-day	69	48	42	55
Repetitive	83	57	62	81
Single Day	76	52	35	45

Fifty-three percent of the single day divers were outside the U.S. Navy table limits. The average depth for the single dive cases was 87.5 feet, while the average depth for the repetitive divers was 89.8 feet. Most of the 111 single day divers (50% of total DCS population) were fairly experienced. Only 15 had been diving one year or less and 66 made more than 20 dives yearly.

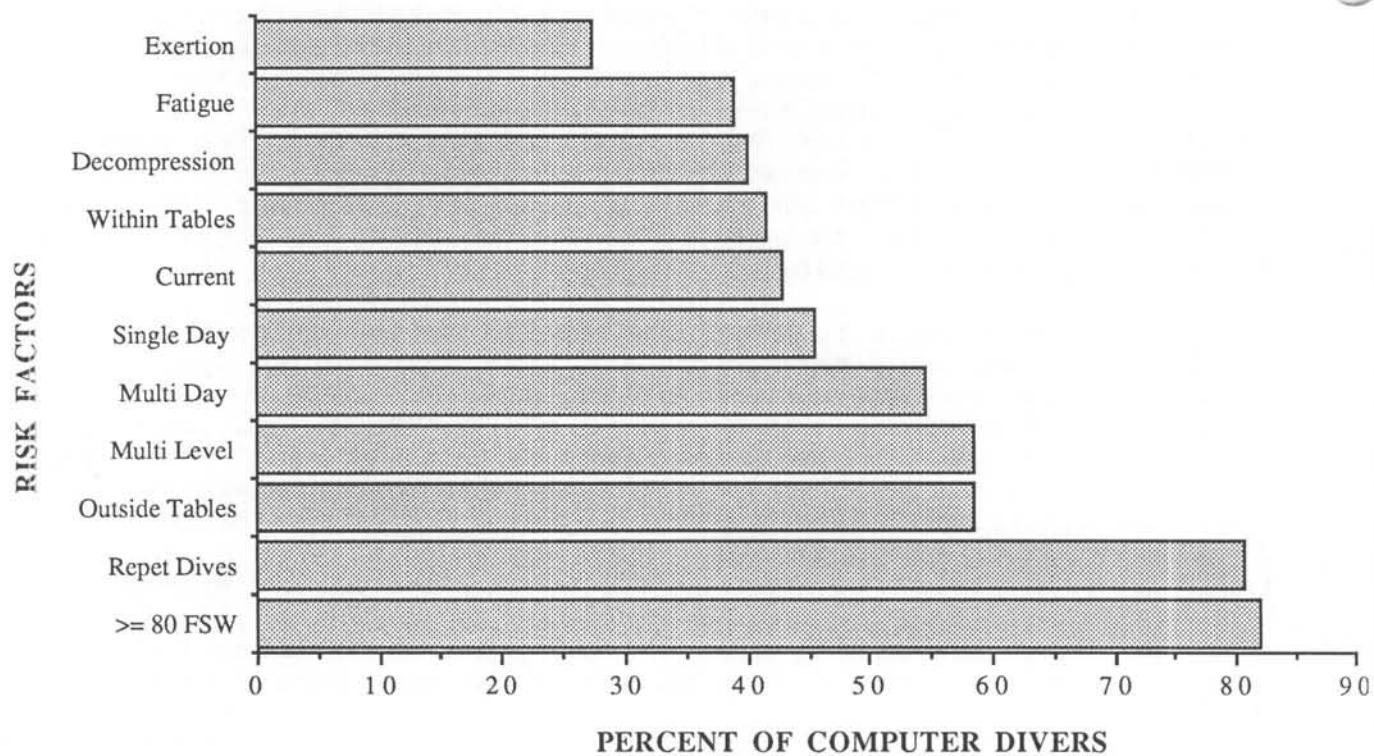
The analysis of computer and table divers may show an apparent risk in both groups for certain styles of diving. When we look at dive profiles without the common traits of computers (multilevel diving) and tables (square profiles, no decompression diving) repetitive and deep (>80 ft) diving are the predominant features of the dive profile for both groups. Again, the dive habits of the general diving population are not known and the accident cases can not, therefore, be compared with a control population.

Are dive computers more hazardous than tables for recreational divers? Computers are used differently than tables; maximum time at depth has different meaning for both methods of diving. Deep diving is strongly associated with both styles of diving resulting in injuries. The average depth of dives was 95 feet for computer users and 87 feet for table users. From the present data, it is impossible to determine which might be safer. A prospective study is currently underway to compare diving profiles of injured divers to an uninjured population.

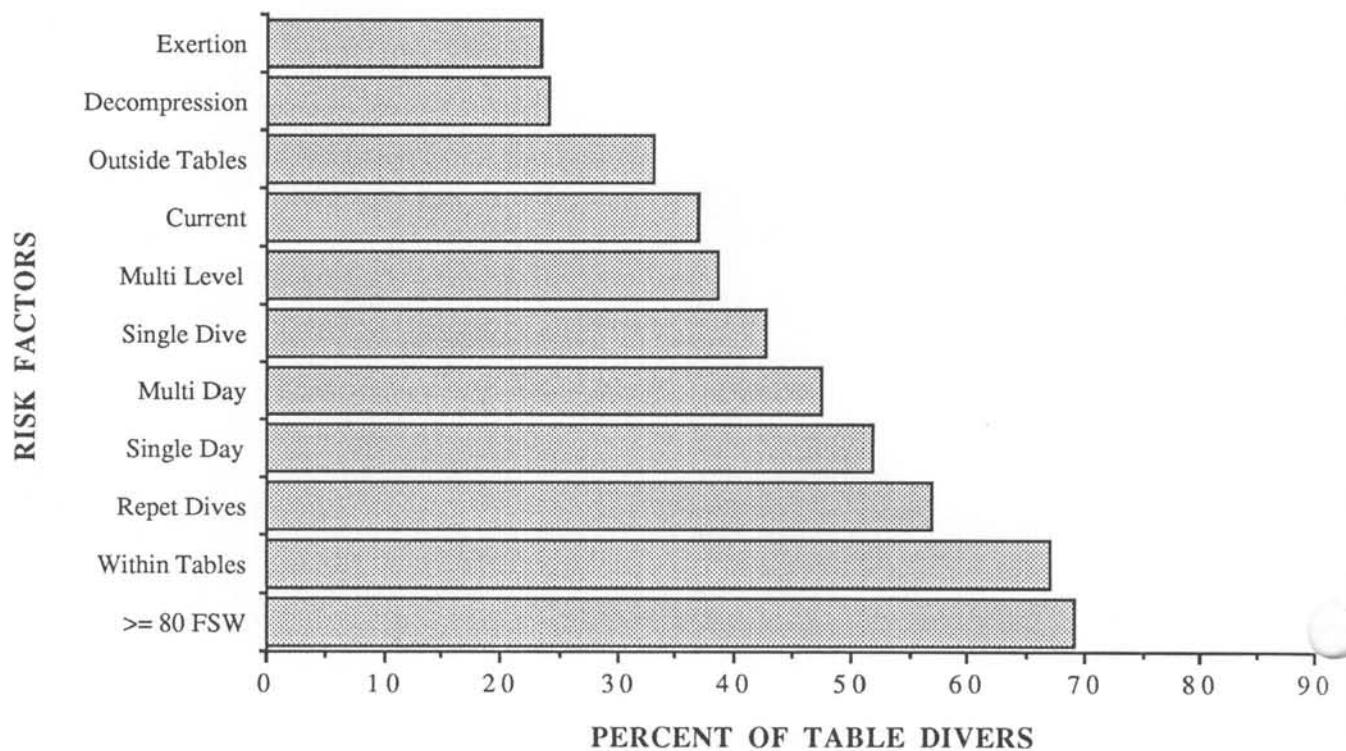
It is impossible to determine diving safety without the knowledge of how many safe dives are made yearly. An appropriate question might be "Are divers diving safely?" Computer users dived an average of 84 times a year and 62 of 77 (80.5%) had been diving two or more years. Table users dived an average of 52 times yearly and 107 of 145 (73.7%) had been diving more than two years. It is possible the injured divers had a higher risk of accident because of greater exposure to diving. They may also be trying to "get their money's worth" to justify the additional diving expense.

Computers are making dive calculations much easier for the average diver, but their ease of use could encourage high risk diving.

## RISK IN COMPUTER DIVES



## RISK FACTORS IN TABLE DIVES



### 3.4 Altitude Exposure

Flying home after a dive trip can be the event which provokes a case of decompression sickness. A commercial jetliner may fly with a cabin pressurized to an equivalent altitude of 8,000 feet. The resulting decompression may expand an existing bubble or promote the formation of new bubbles and symptoms.

Eighty-four cases of the 268 accident reports involved flying after diving. However, 35 of these cases were air evacuations. Symptoms occurred in divers who flew from one to twenty-nine hours after diving. The remaining 49 cases are broken down into categories of symptom onset.

#### Breakdown of 49 Flying After Diving Cases

Two divers flew and developed symptoms but did not seek treatment. One diver used oxygen and resolved his symptoms and the other diver's symptoms went away after two days.

Four divers were treated where they were injured and then flew home. One of these four divers had a return of symptoms during the flight.

Seven divers flew with obvious symptoms of decompression sickness but sought treatment soon after arriving home.

Sixteen divers developed symptoms, flew from the dive site and developed more symptoms en route home. Compounding these divers' injuries was an average delay to recompression of three and one-half days. Two divers waited eleven and thirteen days respectively.

Twenty divers flew and developed symptoms during or shortly after the flight was over. Seven of these twenty had mild unrecognized symptoms that intensified during the flight. The average time for recompression in this group of twenty divers was 45 hours or almost two days.

The most common first symptom for divers who flew were pain or numbness and tingling.

These divers demonstrate some common faults which generally compound each other.

1. There is a failure to understand the signs and symptoms of scuba diving injuries.
2. Failure to understand how the physiology of gas pressure relates to flying after diving.
3. A "wait and see if it gets better" attitude, or a denial attitude which keeps the diver from seeking proper treatment.

Divers Alert Network recommends a conservative waiting period of 24 hours before flying. This recommendation is based on DAN's observation that flying within the 12 to 24 hour time period may precipitate symptoms of DCS. DAN statistics show there were 25 cases of DCS whose first symptoms occurred between 12 and 24 hours post dive without any kind of increased elevation.



# Symptoms

## NOTES



#### **4.0 Symptoms**

The presentation of decompression sickness and arterial gas embolism represents a broad spectrum of disease symptomology and may often mimic other diseases. In order to obtain a better understanding of gas bubble symptomology, a severity code classification system was developed. This system allows DAN to generate data for research purposes by blinded diagnosis. A blinded diagnosis is based on a set of observed criteria developed by DAN to assign an injury severity code to each injured diver, and it is not influenced by personal surmise or observation.

##### **4.1 1988 Disease Diagnosis**

The coding system consists of six levels of severity. Pain only DCS is represented by a code 1. Severe symptoms such as paralysis and loss of consciousness are represented by a severity code of 6. A diver needs to exhibit only one symptom in a given code level to receive that classification. When a symptom appears in more than one code level, such as pain, it means the symptoms can appear along with other symptoms of the same level. All symptoms are not necessarily present for a blinded diagnosis. Severity code 7 has been added to represent a fatality for the 1989 report. See table 22.

The difference between the DAN severity coding system and the diagnosis code used by most hyperbaric facilities is shown on page 47. The six code classification allows the researcher to not only look at injuries by diagnosis, but by severity of the injury.

Arterial gas embolism, for example, can be one of the most severe gas bubble injuries. Generally speaking, symptoms exhibited by patients with diagnosis code 6 are due to AGE, but it is possible for milder symptoms to be caused by AGE, resulting in more cases diagnosed as AGE by the treating physician to be assigned to lesser severity code. The DAN coding system lists 24 code 6's while the unblinded diagnosis gives us 46 AGE cases. This is consistent with the nature of gas embolism. While all symptoms of embolism are serious, not all embolized divers lose consciousness and have convulsions. The DAN coding system allows embolism cases to be analyzed by the severity of symptoms which could be code 4 through 6. See table 23.

##### **4.2 Recognition of Symptoms**

Scuba diving has been a popular recreational sport for nearly 30 years and yet the signs and symptoms of its major illness (decompression sickness) are not well known to most divers. No one should be surprised that this is particularly true of the injury population in this report.

Forty-seven divers (17.5%) of the total injured population (268) continued diving after developing DCS symptoms prior to their final dive. Of these 47 divers, 24 (51%) had neurological symptoms and 21 (44.6%) of these divers had a pain only symptom. Two divers had minor symptoms of air embolism and still continued diving. The final diagnoses for this group of 47 divers was: 4 air emboli, 23 pain only DCS (Type I), and 32 neurological DCS (Type II). No diver should attempt to dive while experiencing any symptoms after a previous dive or having residual symptoms from a previous illness.

The general lack of understanding about the signs and symptoms of gas bubble disease has a dramatic impact on the treatment and care of injured divers. Divers simply do not realize they have sustained an injury and this leads to a delay in calling for assistance. The resulting delay in treatment lessens the chance for a complete recovery in many divers.

Air embolism and severe decompression sickness cases tend to get more immediate treatment and first aid because they often have a major neurological presentation such as seizures, loss of consciousness, or paralysis. This is enough to get most divers' attention. Fortunately for divers, the immediate and prolonged use of 100% oxygen can be extremely effective first aid for gas bubble disease. Unfortunately, some divers falsely believe oxygen alone is sufficient treatment and may not seek further medical assistance once major symptoms have resolved. The injured diver may be unaware of other subtle neurological changes that have taken place until fine motor movement or a period of prolonged concentration is needed. This attitude adds to the delay in appropriate treatment for injured divers. Divers suffering post-dive symptoms should seek immediate medical evaluation for any complaint.

#### **4.3 Symptom onset in AGE, Type I DCS and Type II DCS**

The most important factor in getting appropriate medical care and hyperbaric treatment after a dive accident is knowing that a dive injury has occurred. This can be difficult for the diver and the medical professionals who may have never seen a diving casualty and are not familiar with the signs and symptoms of injury. Obvious signs of injury such as loss of consciousness generally receive immediate attention, but the vague back and joint ache and sensory changes, like numbness and tingling, are frequently overlooked because of their less severe nature. These less severe symptoms are also more subjective and difficult to evaluate because there is no demonstrable injury. Scuba divers with an onset of these less severe signs or symptoms and with no previous history of a similar problem, may be diagnosed by the recent history of scuba diving or the divers response to the administration of 100% oxygen. Divers with a complaint of any ache, general discomfort, ill feeling, or sensory change post-dive should receive a professional medical evaluation as soon as possible.

#### 4.3.1 Arterial Gas Embolism (AGE)

Gas embolism does not always present with symptoms of seizures, paralysis, and loss of consciousness. Other signs and symptoms may involve sudden changes in vision, inability to perform simple equipment removing task and such extreme fatigue and weakness that a diver may want to lie down and go to sleep immediately after diving. The most important aspect of gas embolism symptoms is their relatively quick onset after surfacing from the dive. The majority of AGE symptoms will appear in the first 10 minutes post-dive. In the 1988 DAN cases 78% had their first symptoms in five minutes or less, while 88.0% had their first symptom in 10 minutes or less.

Two diagnosed cases of presumed embolism were excluded from the above analysis because of their unusual nature and also because telephone follow-up was not obtainable. They are both interesting cases and worthy of a brief comment. Case 1 involved an 11-year-old who did an 84 foot and 50 foot dive with buoyancy problems in the last 20 feet of the second dive. The diver's only immediate symptom was increased fatigue post-dive. Sixteen hours later the diver had a major motor seizure. There was no previous history of seizures. It is impossible to tell if there were other factors which might explain this delayed event. The information available is complete but it does not explain the seizure. Venous gas bubbles passing through a patent foramen ovale could trigger a delayed seizure. Alternatively, the seizure could have been unrelated to the dive. At any event it is questionable that an 11-year-old should be diving at all.

Case 2 involved a 22-year-old diver with a history of childhood asthma and recent history of blackout while breath holding and weight lifting. There was a rapid ascent to the surface to end the first dive which was followed immediately by a second dive. The diver had a headache immediately after the dive and chose to do nothing but go home and sleep it off. He awoke with symptoms of neck pain, generalized weakness, light-headedness, and a lacerated tongue, suggesting that he may have had a seizure during the night. All symptoms cleared after hyperbaric therapy.

These cases represent unusual presentations for AGE or could have been cerebral DCS. It is unlikely that symptoms occurring many hours after diving are caused by air escaping from the lungs. These two cases are rare and do not represent classic air embolism or decompression sickness.

#### Median Arterial Gas Embolism Symptom Onset

1st Symptom  
1 min

2nd Symptom  
1 min

#### 4.3.2 Type I Decompression Sickness

Type I decompression sickness has been classified as pain only. This pain can exist in and around the joint area, in the body of the muscles, and can migrate up or down an extremity. The pain has been described as deep, boring, sharp, aching, and dull. Type I pain can be provoked post-dive by strenous exertion, flying or altitude exposure greater than 1,000 feet above sea level, and dehydration through excess alcohol intake. Type I pain can begin suddenly or come on gradually, however, once the pain is noticed it remains unchanged with activity such as sports. Movement of the affected extremities generally will not make the pain worse or better. There is no evidence of trauma to the area, but swelling has occasionally been described. Areas of pain are not tender to the touch.

The time of onset of Type I DCS pain was analyzed. In 60 diagnosed cases of Type I DCS for 1988, 41 (68%) had first symptom onset in two hours or less. Nine Type I cases (15%) developed only one pain symptom. The remainder of the Type I cases went on to develop a second, third, and sometimes fourth pain symptom.

##### Median DCS Type I Symptom Onset

1ST SYMPTOM  
20 min

2ND SYMPTOM  
2 hrs

#### 4.3.3 Type II Decompression Sickness

Neurological decompression sickness (Type II) is the most common gas bubble injury in recreational scuba diving, whereas Type I (pain only) DCS is more common in Navy divers. Military diving experience has demonstrated a Type I DCS rate as high as 90% in their decompression sickness injuries. DAN statistics show that the analyzed population in 1988 were 22.4% Type I, 60.4% Type II and 17.2% gas embolism.

The 1987 report showed 17.4% Type I and 63.3% Type II DCS. The reported national cases show Type I cases representing 23% of the cases in 1987 and 26% in 1988. The Type II cases were 60% and 56% respectively.

The most prominent first symptom reported by divers in the DCS population studied for the combined years of 1987-1988 report was pain. Fourty-four percent of severity codes 1 through 5 had an initial onset of pain as the first symptom. Pain was also the most common second symptom.

Central nervous system symptoms are a less likely initial symptom, but, occur more often as a secondary symptom. Combined neurological symptoms make up the majority of all signs and symptoms in the recreational diver injury population.

Fifty-one Type II cases (31%) in 1988 began with pain but progressed to neurological symptoms. The majority of these cases (37) converted from Type I to Type II DCS immediately (21 cases) or within the first hour post-dive (16 cases). The remaining cases took greater than one hour (4 cases) and in some cases greater than ten hours (10 cases) to develop their first Type II symptom. It would seem that this late onset group may have benefited from an earlier recompression and may not have developed Type II DCS.

The symptoms of Type II DCS are similar in onset time to Type I pain but are more severe. Seventy-two percent of all Type II symptoms occur in the first two hours after the dive. There were nine Type II DCS cases (5%) with only one symptom.

#### Median DCS Type II Symptom Onset

1ST SYMPTOM  
30 min

2ND SYMPTOM  
2 hrs

#### 4.3.4 1987-1988 Most Frequent Injury Symptoms

Table 21: Most Frequent Injury Symptoms in DCS for 1987-1988

Total dive accident population	=	538
Cases with <u>Severity Code</u> 0-5 (DCS)	=	480

<u>1st Symptom occurs in &lt;=24 hrs</u>	
Pain	213
Numbness/tingling	77
Dizziness	42
Fatigue	25
Headache	23
Weakness	14
Other +	66

<u>*2nd Symptom occurs in &lt;=24 hrs</u>	
Pain	127
Numbness/tingling	98
Dizziness	16
Fatigue	25
Weakness	32
Headache	9
Other	129

<u>1st Symptom occurs &gt;24 hrs</u>	
Pain	7
Numbness/tingling	5
Dizziness	3
Fatigue	1
Weakness	0
Other	4

<u>*2nd Symptom occurs &gt;24 hrs</u>	
Pain	15
Numbness/tingling	15
Dizziness	3
Fatigue	1
Weakness	2
Other	8

% of 480 cases with 1st Symptom onset <= 2 hrs (338 cases) 70.4%

% of 480 cases with 1st Symptom onset >2 hrs but <24 hrs (112 cases) 23.3%

% of 480 cases with 1st Symptom onset >= 24 hrs (30 cases) 6.3%

\* Of 480 cases 334 had 2nd symptoms.

+ Other includes all symptoms listed on the reporting form (see Appendix A) as well as other symptoms such as: Disorientation and, light-headedness

**4.4 DISEASE SEVERITY CODE CONVERSION TO DISEASE DIAGNOSIS****Table 22.** 1987-1988 Disease Severity Code

SEVERITY CODE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0 = ASYMPTOMATIC	1	0.2	1	0.2
1 = DCS TYPE I	70	13.0	71	13.2
2-5 = DCS TYPE II	409	76.0	480	89.2
6 = A-G-E	58	10.8	538	100.0

**Table 23.** 1988 Disease Diagnosis

BLINDED SEVERITY CODE	Frequency	Percent	Cumulative Frequency	Cumulative Percent
(1) usually DCS-I	39	14.6	39	14.6
(2-5) usually DCS-II	205	76.5	244	91.0
(6) usually AGE	24	9.0	268	100.0
UNBLINDED DIAGNOSIS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
DCS-I (A)	60	22.4	60	22.4
DCS-II (B)	162	60.4	222	82.8
A-G-E (C)	46	17.2	268	100.0

Table 24 shows the distribution of 1988 diver injuries by severity code vs. the severity code of a previous dive injury. Fifteen percent of the males and 9% of the females had previous DCS or AGE injuries.

**Table 24.** Present Severity Code vs. Previous Dive Injury Diagnosis

PRESENT SEVERITY CODE	MALE			FEMALE		
	PREVIOUS AGE	DCS	NONE	PRESENT SEVERITY CODE	PREVIOUS AGE	DCS
1	6	30		1		3
2	4	21		2		9
3	1	19		3		7
4	6	51		4	3	16
5	5	46		5	1	15
6	3	15		6	1	3
<u>No Response</u>		2				
TOTAL	3	23	184	TOTAL		53

**Table 25: Age by Disease Severity**

**Female Divers**

Age	Disease Severity			Total
	DCS-I (1)	DCSII (2-5)	A-G-E (6)	
10-14	0	0	1	1
15-19	0	1	0	1
20-24	0	8	1	9
25-29	1	13	0	14
30-34	0	15	0	15
35-39	0	5	0	5
40-44	1	4	0	5
45-49	0	4	1	5
50-54	1	0	0	1
55-59	0	1	0	1
60-64	0	0	1	1
Total	3	51	4	58

**Male Divers**

Age	Disease Severity			Total
	DCS-I (1)	DCSII (2-5)	A-G-E (6)	
10-14	0	1	0	1
15-19	0	2	1	3
20-24	3	13	2	18
25-29	5	39	4	48
30-34	13	34	2	49
35-39	7	22	5	34
40-44	5	24	1	30
45-49	3	9	2	14
50-54	0	8	2	10
55-59	0	1	0	1
60-64	0	1	1	2
Total	36	154	20	210

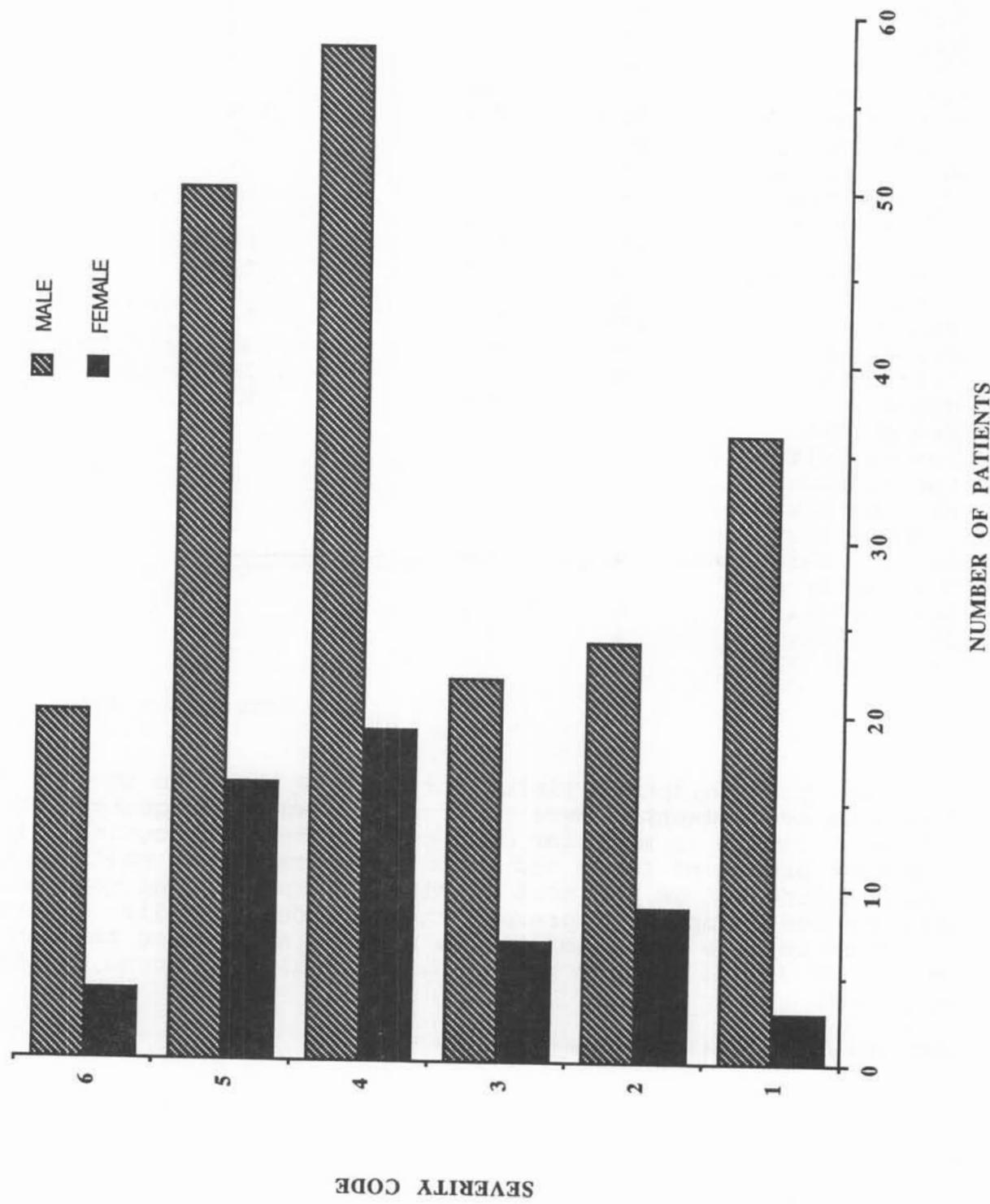
**Table 26: 1987-1988 Injury Symptoms**

Symptom	1st Symptom Frequency	Percent	2nd Symptom Frequency	Percent
Reflex Change			1	0.2
+Other	25	4.6	9	1.8
Pain	224	41.6	146	29.6
Rash	8	1.5	9	1.8
Itching	6	1.1	8	1.6
Weakness	20	3.7	39	7.9
Numb/Ting.	93	17.3	116	23.5
Dizzy/Vertigo	52	9.7	22	4.5
Semi-Conscious	1	0.2	4	0.8
Unconscious	9	1.7	8	1.6
Restlessness	1	0.2	1	0.2
Fatigue	27	5.0	29	5.9
Visual Disturb.	8	1.5	11	2.2
Speech Disturb.	1	0.2	2	0.4
Headache	24	4.5	20	4.1
Paralysis	6	1.1	13	2.6
Difficult Breath	6	1.1	14	2.8
Nausea/Vomit	13	2.4	22	4.5
Hemoptosis			2	0.4
Muscle Twitch			2	0.4
Convulsions	1	0.2	1	0.2
Hearing Loss			1	0.2
Ringing Ears	1	0.2	2	0.4
Altered Skin Sens.	4	0.7	4	0.8
Bladder Problem			1	0.2
Bowel Problem	1	0.2	1	0.2
Personality Chg	4	0.7	3	0.6
Difficult Walk	3	0.6	2	0.4
(No Response = 45)				

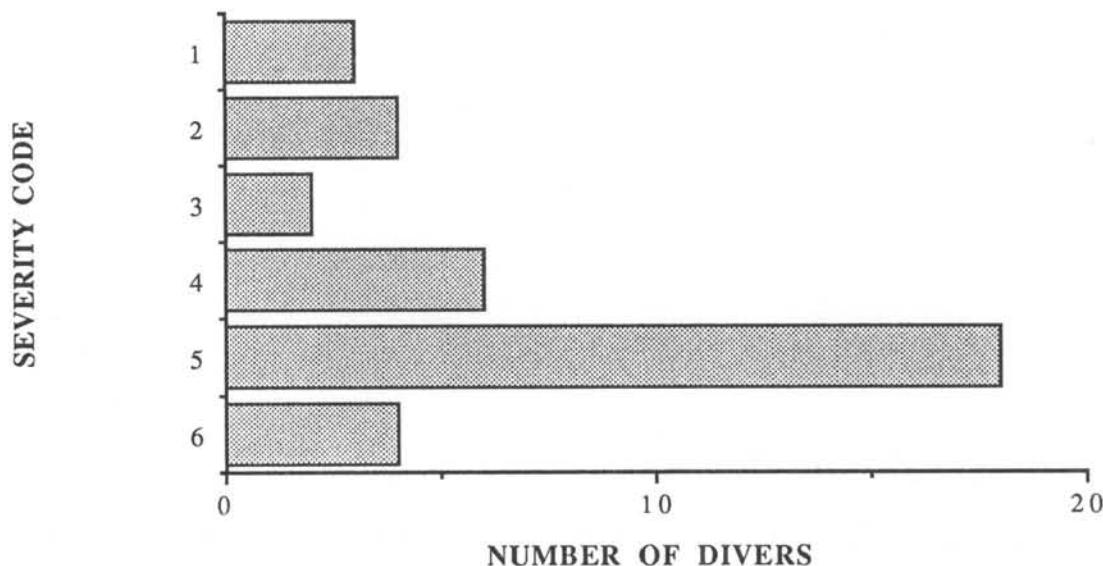
The total symptoms listed for the 538 cases in the DAN 1987-88 database are presented here and broken down by frequency. No differentiation is made for diagnosis or severity coding. Pain is the most prominent first and second symptom, after which numbness and tingling become the most prominent symptom. The combined neurological symptoms represent the most frequent dive injury. No response in this series of tables may be interpreted to mean the number of divers who did not go on to develop a second, or third symptoms.

(+) Other refers to less common, rare, or symptoms which may not be related to the dive injury.

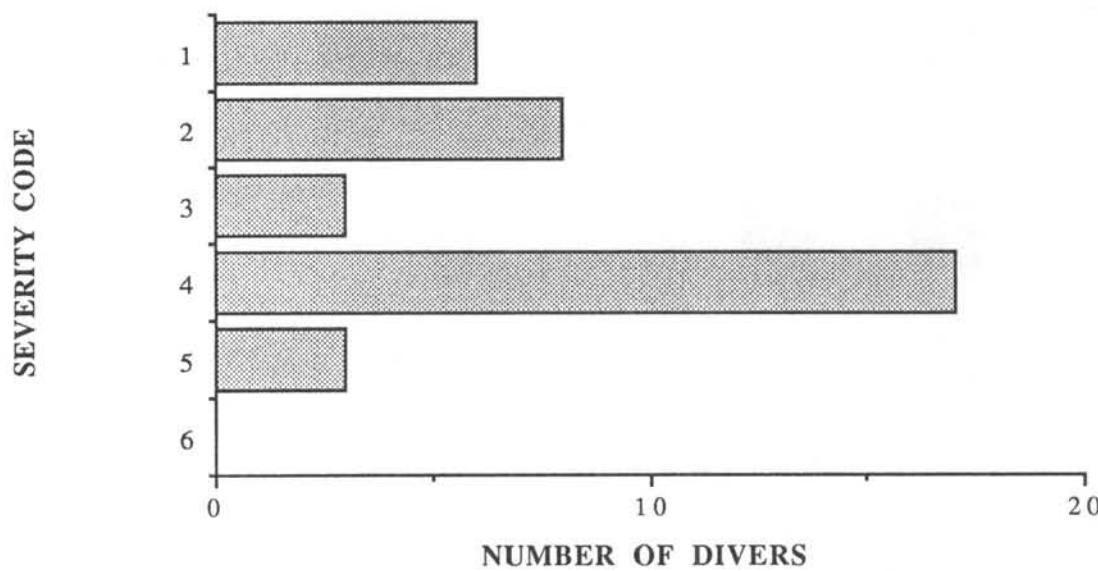
SEVERITY CODE VS. OCCURRENCE



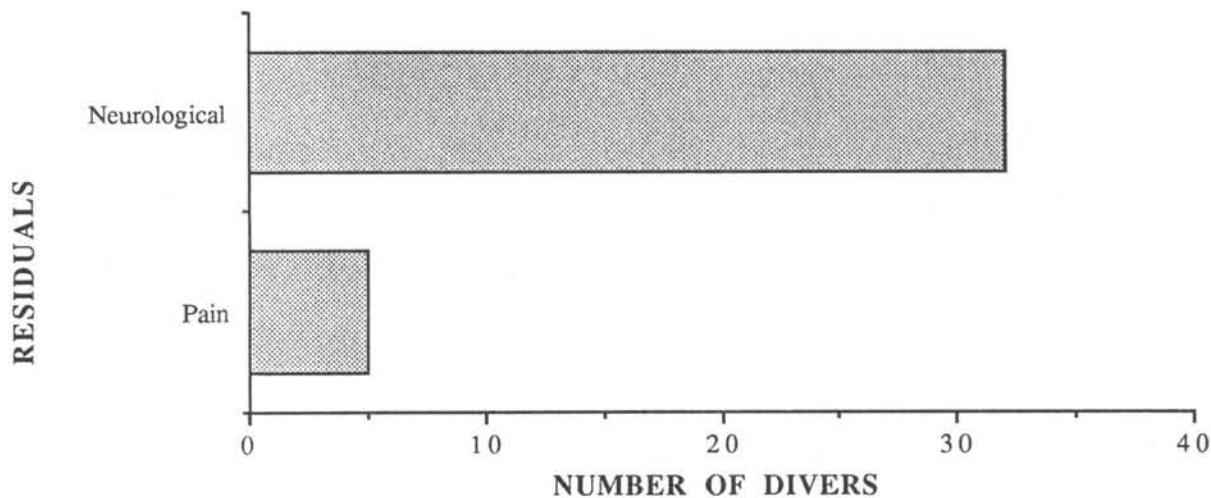
### DIAGNOSIS BY SEVERITY CODE



### RESIDUAL SYMPTOMS BY SEVERITY CODE



### TYPE OF RESIDUALS





# Treatment

## NOTES



## 5.0 Treatment

The major factor affecting appropriate recompression therapy in recreational dive accidents is the delay in calling for assistance (table 25) and the subsequent delay to recompression. Only fifty-one percent of injured divers called for assistance within twelve hours after symptom onset and only 44% were treated in the first 12 hours. Eighteen percent of all divers waited more than 48 hours to call for assistance and 22% had a delay of more than 48 hours to treatment.

### 5.1 First Aid

The graphs on page 55 show who divers contact for assistance and what first aid measures are being used. Sixty-three percent of all injured divers received first aid of some nature. Only 91 of this number received oxygen as first aid. Oxygen remains the best first aid for the field management of dive injuries and should be used whenever it is available. It is recommended that oxygen be carried on all dive boats and shore dive sites whenever feasible.

### 5.2 Spontaneous Resolution

A common myth in diving is that dive injuries are not serious and require treatment only if the symptoms are severe. Although symptoms of DCS and AGE do sometimes resolve without treatment a permanent subclinical injury may have occurred.

There were 10 diagnosed cases of DCS and 2 of AGE reported to DAN in 1988 which were not treated with hyperbaric oxygen. All had eventual resolution of their symptoms. They either elected not to seek treatment, they were asymptomatic by the time they were examined, used oxygen to relieve their symptoms, or were advised that hyperbaric therapy would be ineffective because of the time delay in seeking treatment.

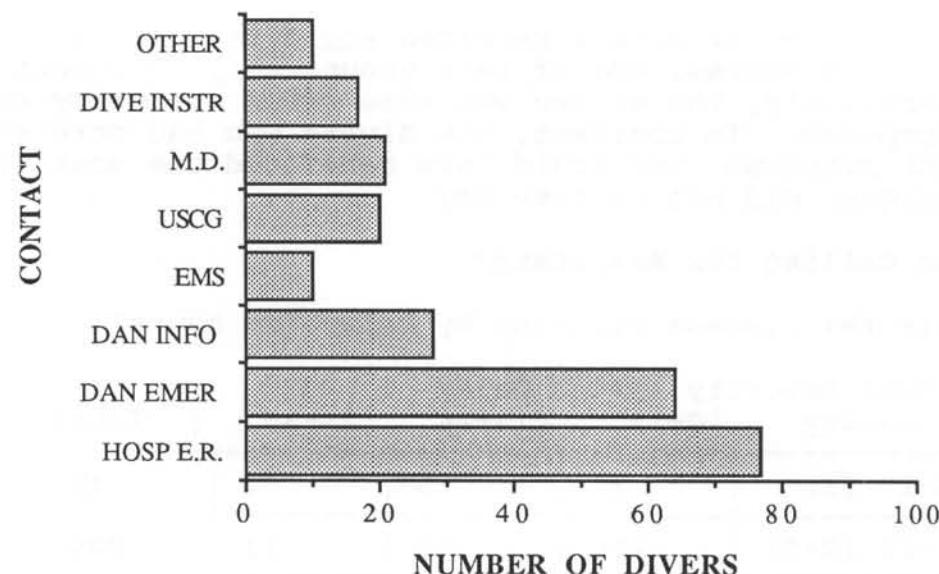
**Table 27. Characteristics of Spontaneous Resolution Cases**

Type	Number	Onset	Residual	Mean			
				Oxygen	Fluids	Position	Aspirin
DCS-I*	6	13 min	1.5 days	4	1	0	1
DCS-II	4	2 hrs	7.9 days	0	1	1	1
AGE	2	1 min	54 days	0	1	0	0

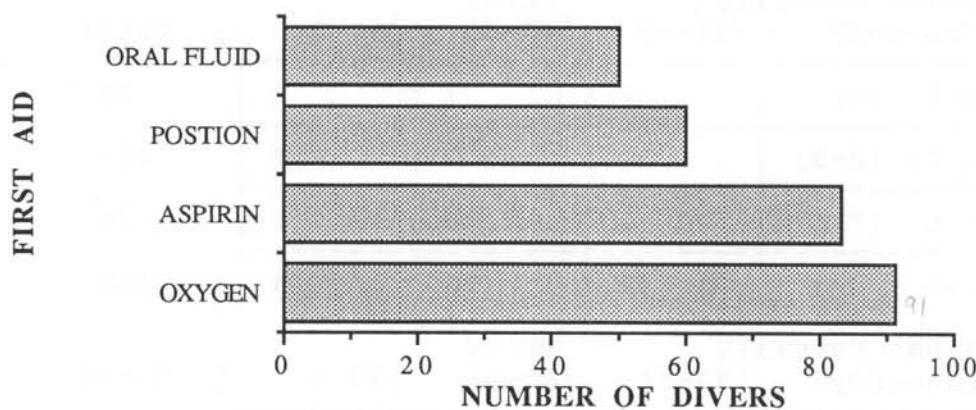
\*Type I DCS had an outlier of 21 days which was not included in the analysis, the range was 0.5-3 days.

Two of these divers delayed more than a week before calling DAN or seeking medical help. Of the remaining 10 divers, the average delay before calling was 20.1 hours.

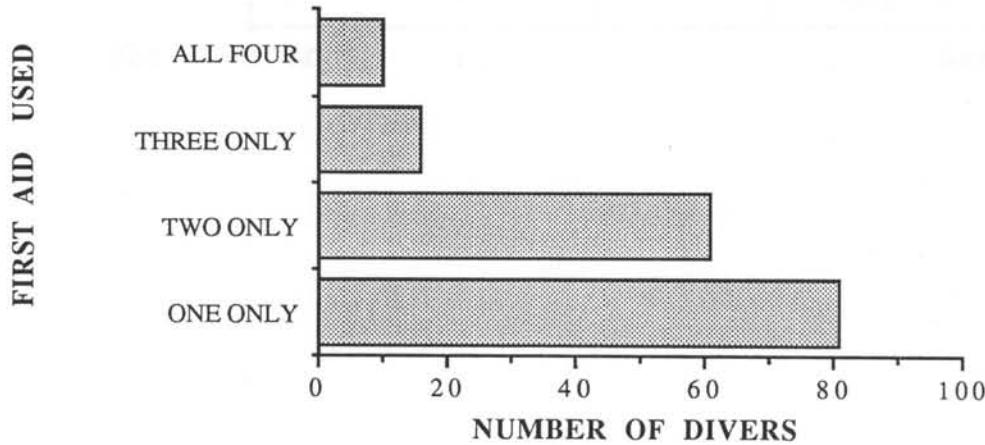
## FIRST CONTACT FOR ASSISTANCE



## FIRST AID USED



## NUMBER OF FIRST AID MEASURES USED



Only six out of 12 divers received any first aid after reporting their symptoms, and of this group, only four received oxygen. Surprisingly, the divers who were given emergency oxygen had DCS I symptoms. In contrast, the divers who had more serious DCS II or AGE symptoms, and could have benefited the most from emergency oxygen, did not receive any.

### 5.3 Delay to Calling for Assistance

**Table 28:** Disease Severity by Delay (in hours)

Disease Severity Frequency	0-12	Delay 13-24	25-36	Total
DCS-I (1)	17	5	3	39
DCS-II (2-5)	100	36	13	205
A-G-E (6)	21	2	0	24
Total	138	43	16	268

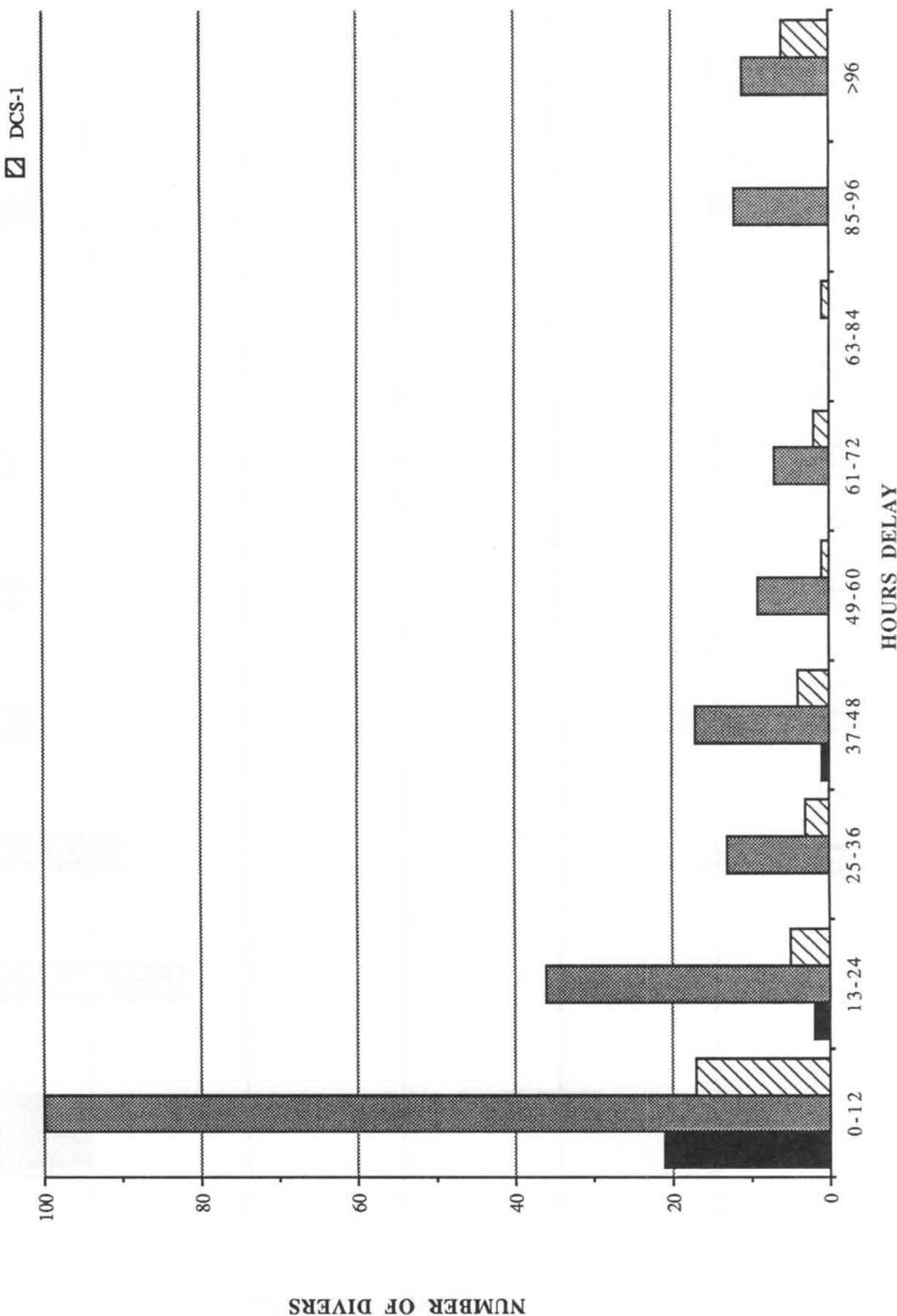
Disease Severity Frequency	37-48	Delay 49-60	61-72	Total
DCS-I (1)	4	1	2	39
DCS-II (2-5)	17	9	7	205
A-G-E (6)	1	0	0	24
Total	22	10	9	268

Disease Severity Frequency	73-84	Delay 85-96	97 >	Total
DCS-I (1)	1	0	6	39
DCS-II (2-5)	0	12	11	205
A-G-E (6)	0	0	0	24
Total	1	12	17	268

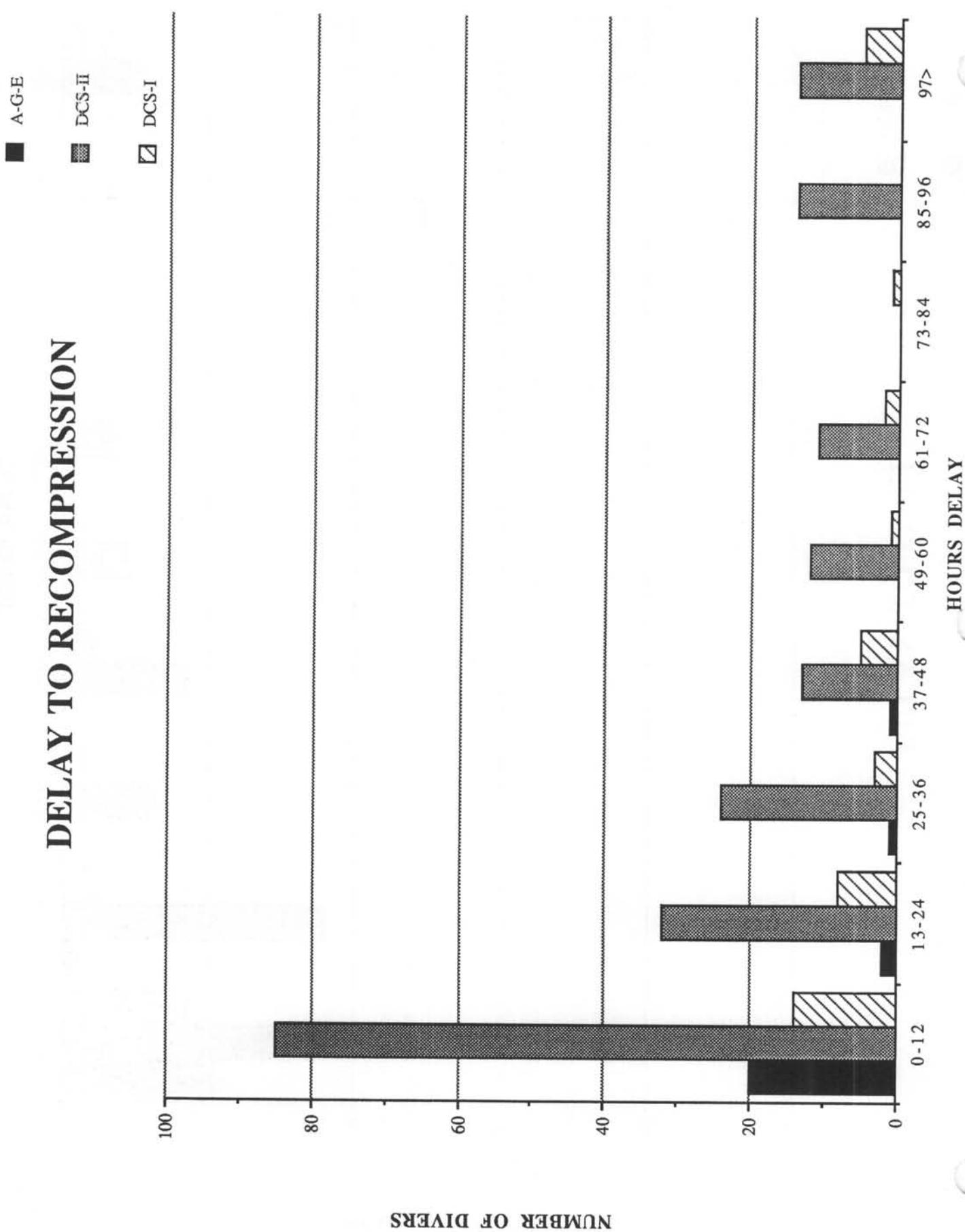
A-G-E

DCS-II

## DELAY TO CALL



## DELAY TO RECOMPRESSION



#### 5.4 Delay to Recompression

Table 29: Disease Severity by Delay to Recompression (in hours)

Disease Severity Frequency	0-12	13-24	25-36	Total
DCS-I (1)	14	8	3	39
DCS-II (2-5)	85	32	24	205
A-G-E (6)	20	2	1	24
Total	119	42	28	268

Disease Severity Frequency	37-48	49-60	61-72	Total
DCS-I (1)	5	1	2	39
DCS-II (2-5)	13	12	11	205
A-G-E (6)	1	0	0	24
Total	19	13	13	268

Disease Severity Frequency	73-84	85-96	97 >	Total
DCS-I (1)	1	0	5	39
DCS-II (2-5)	0	14	14	205
A-G-E (6)	0	0	0	24
Total	1	14	19	268

### 5.5 Treatment Table used

**Table 30: Frequency of 1988 Initial Recompression Table Used**

TREATMENT TABLE	Frequency	Percent
Kindwall Protocol*	10	4.3
USN Table 5	18	7.7
Hart Protocol**	10	4.3
45 FSW @ 90 Min	10	4.3
33 FSW @ 120 Min	1	0.4
USN Table 4	4	1.7
USN Table 6	90	38.3
USN Table 6A	24	10.2
COMEX 30	1	0.4
RN 71	1	0.4
Other Tables	19	8.1
USN Table 6 With Extentions	47	20.0
No Response	33	

### 5.6 Residual Symptoms in Diving Injuries

The possibility exists for permanent long-term injuries after a dive accident. DAN follows its injured diver population for up to three months in order to document persistent residual symptoms. Thirty-seven (13.8%) of the 268 divers studied continued to have pain or neurological residual symptoms beyond three months. The arbitrary end of follow up at three months is primarily due to the time and effort involved in continuing to contact the divers.

The most important factor influencing the poor outcome of this group of 37 divers was the severity of their injury. Twenty-eight divers (75.6%) had the highest severity codes (4-6) for decompression sickness and air embolism. A comparative analysis of all cases with severity codes four through six is presented in the following tables. The cases are broken up into three categories: no residuals after treatment, residuals less than three months after treatment, and residuals for greater than three months after treatment. Table 30 shows the outcome of severity codes 4-6 with median hour delay to treatment.

**Table 31: Outcome of Severity Codes 4-6**

	No Resid.	Temp. Resid.	Long Term Resid.	Total
First Aid	27/77 35%	23/57 40%	12/29 41%	62
Oxygen	34/77 44%	22/57 39%	12/29 41%	68
Delay to Tx.	9 hours	22 hours	10 hours	

**Table 32: Breakdown of Severity Code vs. Outcome**

<u>Severity Code #</u>	<u>No Resid.</u>	<u>Temp. Resid.</u>	<u>Long Term Resid.</u>	<u>Total</u>
4	38/77 49%	30/57 52.6%	6/29 21%	74
5	29/77 38%	18/57 31.6%	18/29 62%	65
6	10/77 13%	9/57 15.8%	5/29 17%	24
Total	77	57	29	163

Twenty-two divers said they received some form of first aid after their symptoms of DCS or AGE began. Only 14 of those receiving first aid had any pre-hospital oxygen. Seven of the 10 divers diagnosed as embolism cases received oxygen presumably because of the severity of their symptoms and because it was available.

The majority of first symptoms in this group began in ten minutes or less (26). Eight first symptoms began in 20 minutes to four hours and three cases developed symptoms 14 hours or more after diving. One was provoked by flying too soon. Eight divers made their situation worse by continuing to dive after symptoms developed from earlier diving.

The group consisted of seven females, (19%) which is slightly less than the percentage of females in the total population. The average age for females was 34 years. The average age for males was 35.5 years.

Six of the seven female divers had been diving less than one year. The seventh female was diving with a recent history (past 7-12 months) of laminectomy and residual neck pain after surgery. Neck, back, spine and shoulder symptoms began 10 minutes post dive

Only four of the male divers had been diving one year or less and the remainder averaged seven years and four months of diving experience.

The median symptom onset, call for assistance and delay to treatment are given in the following table by the final diagnosis of the divers.

MEDIAN FIRST SYMPTOM ONSET

<u>AGE</u>	<u>DCS-I</u>	<u>DCS-II</u>
1 min.	45 min.	10 min.

MEDIAN TIME TO CALL FOR ASSISTANCE

<u>AGE</u>	<u>DCS-I</u>	<u>DCS-II</u>
1 hr.	6 days	6 hrs

MEDIAN DELAY TO TREATMENT

<u>AGE</u>	<u>DCS-I</u>	<u>DCS-II</u>
5 hrs	6 days	16 hrs

The treatment for this group of individuals did not completely resolve their symptoms for several possible reasons. The embolism cases had very severe symptoms which were hard to resolve. The pain only type I DCS cases (4) waited so long to call for assistance and get treatment that secondary tissue changes may already have occurred. The type II DCS (23) cases like the AGE cases exhibited more severe symptoms, and combined with the delay in getting treatment, made a complete recovery less likely.

Twenty-nine of these divers received a minimum treatment of a USN Treatment Table 6 (4.5 hours) which is the standard treatment for all types of. Some received an extended treatment. Only eight divers received a USN Treatment Table 5 or a similar short treatment table which is approximately 2 hours shorter than a table 6 and is not encouraged today. Thirty four divers (92%) received more than a single treatment and the average number of treatments was 9.5 per diver.

Complete recovery is possible even with delay. Treatment therefore should not be discouraged just because a diver is four days or more out from the onset of symptoms. There were thirty-three divers who waited four days or more in 1988 to seek recompression therapy. The median delay in these divers was five days. The range for delay was four days to 24 days. Only four divers of 33 were left with residual symptoms. The remaining 29 cleared with treatment or prior to the three month follow-up. Each diver and dive injury is different, and only a trial of recompression will demonstrate who will benefit from hyperbaric recompression therapy.

**Table 33: Residual Symptoms After Initial Recompression Therapy  
For 1988 Dive Injuries**

<u>RESIDUALS</u>	<u>Frequency</u>	<u>Percent</u>
Pain Only	32	12.5
Neurologic Residual	98	38.3
No Change In Condition	4	1.6
Completely Resolved	122	47.7
No Treatment	12	

• "Serious Symptom Cases- Treatment of serious symptoms (Type II) bends requires that the patient be taken to 26 pounds per square inch breathing 100% oxygen in the monoplace chamber and that the patient be held at that pressure for one-half hour followed by decompression over 30 minutes to 14.7 psig and maintained at that pressure for one hour. The chamber is then decompressed to the surface taking an additional thirty minutes. If the symptoms are not completely relieved using this treatment schedule, it may be repeated after the patient has had a one-half hour surface interval breathing air." Hyperbaric Medicine Procedures E.P. Kindwall and R. W. Goldman pp 118-119, St. Luke's Hospital, Milwaukee, WI (1988)

■ "Initial treatment involved pressurization to 3 ATA for 30 min, following which the pressure was reduced to 2.5 ATA for an additional 1 hour. (Decompression from 3 ATA to 2.5 ATA and to surface is done as tolerated by the patient over a 7-10 minute period.) "The Treatment of Decompression Sickness and Air Embolism in a Monoplace Chamber" G.B. Hart, M.B. Strauss, and P.A. Lennon Journal of Hyperbaric Medicine, Vol.1, No. 1, Winter 1986

+ Note: Many of these will have further recompression, hyperbaric oxygen therapy, physical therapy, etc. over ensuing months and continue to improve for periods of as long as two years.



## Appendices



## **Appendix A:Definitions**

**BLINDED DIAGNOSIS** - Diagnosis assigned by DAN on the basis of strict objective criteria.

**DISEASE SEVERITY CODES** - The DAN coding system used throughout this report on which the method of blinded diagnosis is based. Refer to page 40 and appendix D.

**FINAL DIAGNOSIS CODES** - The letter codes assigned to disease categories used throughout this report which are based on the method of unblinded diagnosis.

**GAS BUBBLE DISEASE** - Gas bubble injury from arterial gas embolism, (AGE) and/or decompression sickness (DCS).

**UNBLINDED DIAGNOSIS** - The diagnosis assigned using standard criteria, mainly relying on the impression of the treating physician.



## Appendix B:

**DAN DIVE ACCIDENT REPORTING FORM**

BOX 3823 • DUKE UNIVERSITY MEDICAL CENTER  
DURHAM, NORTH CAROLINA 27710  
Information Mon.-Fri. 9-5 (E.T.) (919) 684-2948  
Emergencies Only (919) 684-8111

**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

**2. OCCUPATION**

MI

**3. ADDRESS**

STREET

CITY

ST

ZIP

**4. PATIENT PHONE (HOME)****5. PATIENT PHONE (WORK)****6. COUNTRY (IF NOT USA)**7. AGE  
YRS8. SEX  
M or F9. HEIGHT  
FT IN10. WEIGHT  
LBS.

11. CERTIFYING AGENCY

12. CERTIFICATION LEVEL

13. DAN  
MEMBER?

- |                          |           |                          |                |
|--------------------------|-----------|--------------------------|----------------|
| <input type="checkbox"/> | A - PADI  | <input type="checkbox"/> | A - Basic      |
| <input type="checkbox"/> | B - NAUI  | <input type="checkbox"/> | B - Open Water |
| <input type="checkbox"/> | C - NASDS | <input type="checkbox"/> | C - Advanced   |
| <input type="checkbox"/> | F - Other | <input type="checkbox"/> | D - Divemaster |
| <input type="checkbox"/> | G - None  | <input type="checkbox"/> | E - Instructor |

- |                          |                |
|--------------------------|----------------|
| <input type="checkbox"/> | F - Commercial |
| <input type="checkbox"/> | G - Other      |
| <input type="checkbox"/> | H - None       |
| <input type="checkbox"/> | I - Student    |

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

**14. YEARS DIVING**

YEARS      MONTHS

**15. NUMBER OF DIVES MADE**

Total

Previous  
12 months**16. PREVIOUS DIVE  
ACCIDENTS**

- |                          |                     |
|--------------------------|---------------------|
| <input type="checkbox"/> | A - Possible DCS    |
| <input type="checkbox"/> | B - DCS             |
| <input type="checkbox"/> | C - AGE             |
| <input type="checkbox"/> | D - Pul. barotrauma |
| <input type="checkbox"/> | E - None            |

**17. CURRENT  
MEDICATIONS**

Y or N

- |                          |                  |
|--------------------------|------------------|
| <input type="checkbox"/> | Prescription     |
| <input type="checkbox"/> | Non-prescription |

List \_\_\_\_\_

**18. CIGARETTE USE**

- |                          |               |
|--------------------------|---------------|
| <input type="checkbox"/> | A - Presently |
| <input type="checkbox"/> | B - In past   |
| <input type="checkbox"/> | C - Never     |

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

**19. PREVIOUS MAJOR ILLNESSES/  
SURGERY**

(Provide up to 3 responses)

- |                          |                               |
|--------------------------|-------------------------------|
| <input type="checkbox"/> | A - Chest-lung                |
| <input type="checkbox"/> | B - Asthma                    |
| <input type="checkbox"/> | C - Chest-heart               |
| <input type="checkbox"/> | D - Gastrointestinal/Abdomen  |
| <input type="checkbox"/> | E - Brain                     |
| <input type="checkbox"/> | F - Spine/Back                |
| <input type="checkbox"/> | G - Limb or joint of DCS site |
| <input type="checkbox"/> | H - Circulation/Blood         |
| <input type="checkbox"/> | I - Neurologic/Nervous system |
| <input type="checkbox"/> | J - Muscle/Skeleton system    |
| <input type="checkbox"/> | K - Eye                       |
| <input type="checkbox"/> | L - Mental/Emotional          |
| <input type="checkbox"/> | M - Other _____               |
| <input type="checkbox"/> | N - None                      |

- |                          |                 |
|--------------------------|-----------------|
| <input type="checkbox"/> | Past:           |
| <input type="checkbox"/> | A - 2-6 months  |
| <input type="checkbox"/> | B - 7-12 months |
| <input type="checkbox"/> | C - 1-3 years   |
| <input type="checkbox"/> | D - 2-5 years   |
| <input type="checkbox"/> | E - 6+ years    |

List and describe specific problems:

---



---

**20. CURRENT HEALTH PROBLEMS  
WITHIN PREVIOUS 2 MONTH**

(Provide up to 3 responses)

- |                          |                               |
|--------------------------|-------------------------------|
| <input type="checkbox"/> | A - Chest-lung                |
| <input type="checkbox"/> | B - Asthma                    |
| <input type="checkbox"/> | C - Chest-heart               |
| <input type="checkbox"/> | D - Gastrointestinal/Abdomen  |
| <input type="checkbox"/> | E - Brain                     |
| <input type="checkbox"/> | F - Spine/Back                |
| <input type="checkbox"/> | G - Limb or joint of DCS site |
| <input type="checkbox"/> | H - Circulation/Blood         |
| <input type="checkbox"/> | I - Neurologic/Nervous system |
| <input type="checkbox"/> | J - Muscle/Skeleton system    |
| <input type="checkbox"/> | K - Eye                       |
| <input type="checkbox"/> | L - Mental/Emotional          |
| <input type="checkbox"/> | M - Other _____               |
| <input type="checkbox"/> | N - None                      |

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**

http://ubicon-foundation.org

**21. PURPOSE OF DIVE**

- A - Pleasure  
 B - Work/Labor

**22. DIVE ACTIVITY (up to 2 responses)**

- |  |  |
|--|--|
| <input type="checkbox"/> A - Wreck             | <input type="checkbox"/> F - Providing Instruction         |
| <input type="checkbox"/> B - Cave              | <input type="checkbox"/> G - Spearfishing/ Game collecting |
| <input type="checkbox"/> C - Night             | <input type="checkbox"/> H - Sightseeing                   |
| <input type="checkbox"/> D - Photography       |  |
| <input type="checkbox"/> E - Under Instruction |  |

**23. ENVIRONMENT**

- |                          |                |
|--------------------------|----------------|
| <input type="checkbox"/> | A - Freshwater |
| <input type="checkbox"/> | B - Saltwater  |

**24. ALTITUDE OF DIVE**

- |                          |                                |
|--------------------------|--------------------------------|
| <input type="checkbox"/> | A - Sea Level                  |
| <input type="checkbox"/> | B - > Sea Level but < 1000 ft. |
| <input type="checkbox"/> | C - > 1000 ft.                 |

**25. Was this dive or dive series typical of your normal type of diving?**

- Y - Yes      IF NO, Explain \_\_\_\_\_  
 N - No

**26. DIVER'S PERCEPTION OF TEMPERATURE**

- |                          |                 |
|--------------------------|-----------------|
| <input type="checkbox"/> | A - Cold        |
| <input type="checkbox"/> | B - Hot         |
| <input type="checkbox"/> | C - Comfortable |

**27. CURRENT STRENGTH**

- |                          |              |
|--------------------------|--------------|
| <input type="checkbox"/> | A - Strong   |
| <input type="checkbox"/> | B - Moderate |
| <input type="checkbox"/> | C - Mild     |
| <input type="checkbox"/> | D - None     |

**28. AIR SUPPLY**

- |                          |                           |
|--------------------------|---------------------------|
| <input type="checkbox"/> | A - Scuba Air             |
| <input type="checkbox"/> | B - Surface Supply Air    |
| <input type="checkbox"/> | C - Mixed gas             |
| <input type="checkbox"/> | D - None/Breath-hold dive |

**29. AIR CONSUMPTION**

- |                          |                                   |
|--------------------------|-----------------------------------|
| <input type="checkbox"/> | A - Ran low                       |
| <input type="checkbox"/> | B - Out of air                    |
| <input type="checkbox"/> | C - Not a problem                 |
| <input type="checkbox"/> | D - Buddy breathing (not octopus) |

**30. BUOYANCY PROBLEM**

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

**31. RAPID ASCENT**

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

**32. WITHIN LIMITS-Y or N**

- |                          |                            |
|--------------------------|----------------------------|
| <input type="checkbox"/> | Tables (which table _____) |
| <input type="checkbox"/> | or Computer (type _____)   |

**33. TYPE OF SUIT**

- |                          |                 |
|--------------------------|-----------------|
| <input type="checkbox"/> | A - Wet         |
| <input type="checkbox"/> | B - Partial Wet |
| <input type="checkbox"/> | C - Dry         |
| <input type="checkbox"/> | D - Lycra       |
| <input type="checkbox"/> | E - Swim        |

**34. EQUIPMENT USED ON DIVE:**  
(please check all that apply)

- |                          |                         |
|--------------------------|-------------------------|
| <input type="checkbox"/> | Depth gauge             |
| <input type="checkbox"/> | Timing device/watch     |
| <input type="checkbox"/> | Buoyancy vest           |
| <input type="checkbox"/> | BC Inflator hose in use |
| <input type="checkbox"/> | Decompression computer  |

**35. EQUIPMENT MALFUNCTION:**

- |                          |                             |                          |  |
|--------------------------|-----------------------------|--------------------------|--|
| <input type="checkbox"/> | A - None                    | <input type="checkbox"/> | I - Equipment was not familiar to you. |
| <input type="checkbox"/> | B - Regulator               | <input type="checkbox"/> | J - Other                              |
| <input type="checkbox"/> | C - BC Vest                 | <input type="checkbox"/> | Reason: _____                          |
| <input type="checkbox"/> | D - Weight belt             | <input type="checkbox"/> |  |
| <input type="checkbox"/> | E - Dry suit                | <input type="checkbox"/> |  |
| <input type="checkbox"/> | F - DC Computer             | <input type="checkbox"/> |  |
| <input type="checkbox"/> | G - Inflator hose           | <input type="checkbox"/> |  |
| <input type="checkbox"/> | H - Contaminated air supply | <input type="checkbox"/> |  |

**36. TYPE OF DIVE**

- |                          |            |
|--------------------------|------------|
| <input type="checkbox"/> | Y - Yes    |
| <input type="checkbox"/> | N - No     |
| <input type="checkbox"/> | Single     |
| <input type="checkbox"/> | Repetitive |

**37. WOMEN, PLEASE RESPOND**  
(up to 2 responses)

- When the accident occurred, were you:
- |                          |                                 |
|--------------------------|---------------------------------|
| <input type="checkbox"/> | A - Menstruating                |
| <input type="checkbox"/> | B - On birth control medication |
| <input type="checkbox"/> | C - Pregnant                    |
| <input type="checkbox"/> | D - None of the above           |

**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 EXERCISE**

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

- |                          |                   |
|--------------------------|-------------------|
| <input type="checkbox"/> | 24 hours pre dive |
| <input type="checkbox"/> | During dive       |
| <input type="checkbox"/> | 6 hours postdive  |

**41. PREDIVE HEALTH**

- |                          |                     |
|--------------------------|---------------------|
| <input type="checkbox"/> | A - Nausea/vomiting |
| <input type="checkbox"/> | B - Hangover        |
| <input type="checkbox"/> | C - Diarrhea        |
| <input type="checkbox"/> | D - Other           |
| <input type="checkbox"/> | E - No Problem      |

**45. FATIGUE OR LACK OF SLEEP PRIOR TO DIVE?**

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

**42. ALCOHOL**

Please check:

- |                          |               |
|--------------------------|---------------|
| <input type="checkbox"/> | None          |
| <input type="checkbox"/> | Night Before  |
| <input type="checkbox"/> | Predive       |
| <input type="checkbox"/> | Between Dives |
| <input type="checkbox"/> | Post Dive     |

Number of drinks, beers, or wine

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

**43. RECREATIONAL DRUG USE**Prior to,  
between,  
or after dive

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

**44. Do you consider yourself physically fit?**

- |                          |         |
|--------------------------|---------|
| <input type="checkbox"/> | Y - Yes |
| <input type="checkbox"/> | N - No  |

- |                          |   |
|--------------------------|---|
| <input type="checkbox"/> | Do you exercise on a weekly basis? (Y or N) |
| <input type="checkbox"/> | # Days per week                             |

**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 . . . . .

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

Any night dive? (How many) . . . . .

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

Any symptoms? (Y or N) . . . . .

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

A - All no stop dive(s)  
- Any safety stop  
- Any dive requiring decompression stops

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

A - Multilevel (time divided)  
B - Square

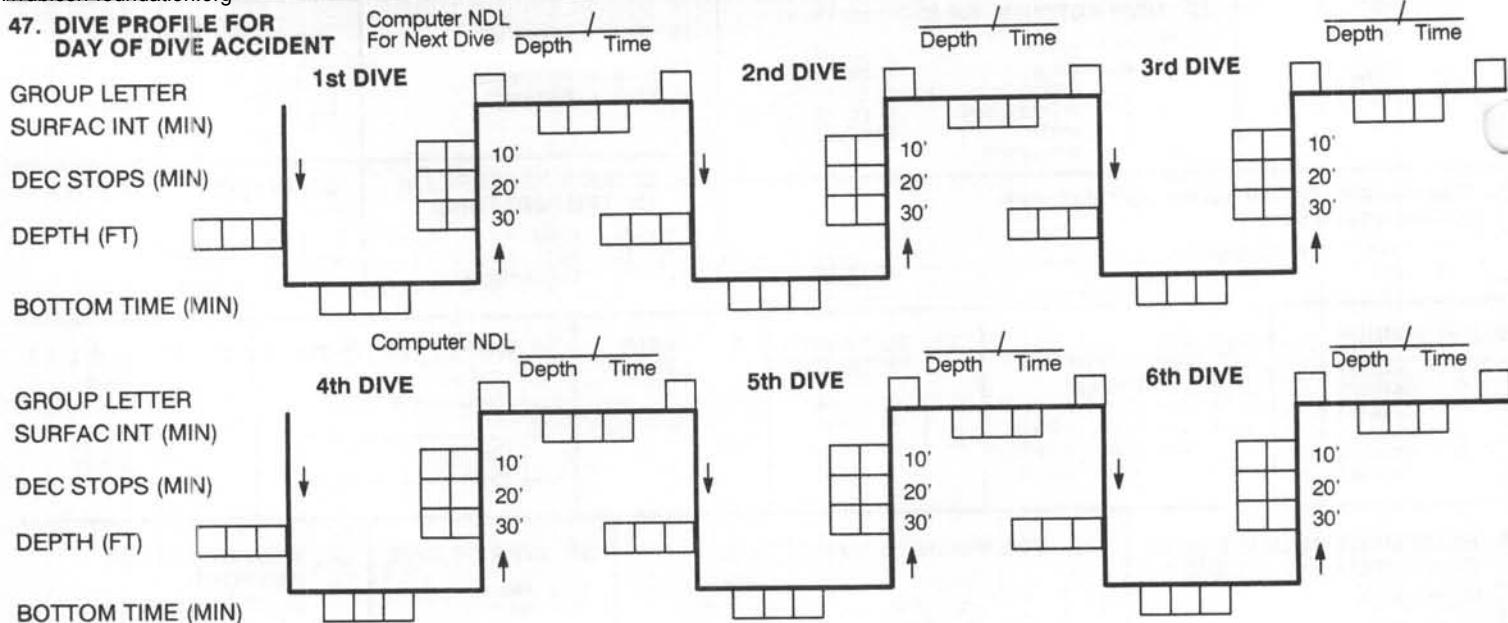
<input type="checkbox"/>						
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Deepest Dive (ft.) . . . . .

# DIVE ACCIDENT (cont.)

<http://ubicon.foundation.org>

## 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 & SYMPTOMS

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

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

- |             | A                        | L                        | R                        | B                        |
|-------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1st Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2nd Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3rd Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4th Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5th Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6th Symptom | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- |                |                  |
|----------------|------------------|
| A - Head       | S - Abdomen      |
| B - Face       | T - Buttock      |
| C - Sinus      | U - Groin        |
| D - Eyes       | V - Hip          |
| E - Ears       | W - Entire leg   |
| F - Neck       | X - Thigh        |
| G - Shoulder   | Y - Knee         |
| H - Entire arm | Z - Calf         |
| I - Upper arm  | 1 - Shin         |
| J - Elbow      | 2 - Ankle        |
| K - Forearm    | 3 - Foot         |
| L - Wrist      | 4 - Toes         |
| M - Hand       | 5 - Trunk        |
| N - Fingers    | 6 - Generalized  |
| O - Chest      | 7 - Other: _____ |
| P - Back       |                  |
| Q - Upper back |                  |
| R - Lower back |                  |

### 53. SYMPTOM ONSET:

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

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

Y - Yes      If yes, which symptoms?  
 N - No

- 1st       Other   
 2nd       Explain: \_\_\_\_\_  
 3rd   
 4th   
 5th   
 6th

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

- Y - Yes
  - N - No
  - Oxygen
  - Aspirin
  - Oral fluids
  - Head down position/  
Trendelenburg
- If oxygen was received was delivery by:
- A - Demand valve
  - B - Freeflow valve
  - C - Don't know

# PRE-CHAMBER INFORMATION (cont.)

## 56. HOSPITAL TREATMENT ADMINISTERED

(Please check all that apply):

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

## 57. RELIEF BEFORE CHAMBER TREATMENT?

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

## 59. PRE-CHAMBER RELIEF OCCURRED:

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

## 58. IF ANY RELIEF OCCURRED, WHICH SYMPTOMS FROM #51 ABOVE?

(Please check):

- 1st   
 2nd   
 3rd   
 4th   
 5th   
 6th

# CHAMBER TREATMENT

## 60. CHAMBER TREATMENT FACILITY LOCATION

CITY

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                 |
| <input type="checkbox"/> Monoplace  | <input type="checkbox"/> Monoplace  |
| <input type="checkbox"/> Dualplace  | <input type="checkbox"/> Dualplace  |
| <input type="checkbox"/> Multiplace | <input type="checkbox"/> Multiplace |
| No chamber treatment given          |                                     |

## 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
- 
- 

## 62. TOTAL DELAY FROM SYMPTOM ONSET TO RECOMPRESSION

HOURS      or      DAYS

## 64. TABLE EXTENSIONS REQUIRED?

- Y - Yes  
 N - No

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

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

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

TABLE	NUMBER OF TREATMENTS
<input type="checkbox"/>	<input type="checkbox"/> 1
<input type="checkbox"/>	<input type="checkbox"/> 1
<input type="checkbox"/>	<input type="checkbox"/> 1

- 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



**Appendix C:**  
**DAN FATALITY**  
**REPORTING FORM**

BOX 3823 • DUKE UNIVERSITY MEDICAL CENTER  
 DURHAM, NORTH CAROLINA 27710  
 Mon. - Fri. 9-5 (E.T.)  
 MEDICAL COORDINATOR (919) 684-2948



The information requested is to be used for a national yearly statistical report whose purpose is to aid in the understanding and prevention of diving related fatalities. All information is strictly confidential. Reports may be sent in with or without the victim's name; names are used only to establish a relationship with other pertinent reports.

Please fill out this form as completely as possible in addition to the four-page accident form. You may contact the Divers Alert Network Monday through Friday, 9 a.m. to 5 p.m. Eastern Standard Time if there are any questions. Ask for the Medical Coordinator at (919) 684-2948.

**PLEASE PRINT OR TYPE**

Name of victim: \_\_\_\_\_

Name(s)  
of witness(es): 1. \_\_\_\_\_

Phone: (      ) -

Official report  
available? (  )

2. \_\_\_\_\_

Phone: (      ) -

Police contact person: \_\_\_\_\_

Phone: (      ) -



EMS contact person: \_\_\_\_\_

Phone: (      ) -



U.S. Coast Guard (station): \_\_\_\_\_

Phone: (      ) -



Dive buddy (if different  
from witnesses): \_\_\_\_\_

Phone: (      ) -



Medical Examiner: Name: \_\_\_\_\_

Address: \_\_\_\_\_



City, State, Zip: \_\_\_\_\_



Work phone: (      ) -

Was the body recovered?  Yes Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_  No

Was an autopsy performed?  Yes Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_  No

Cause of death: \_\_\_\_\_

Death occurred: Please Check (  )

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> A. in the water    | <input type="checkbox"/> C. during resuscitation | <input type="checkbox"/> E. other (explain) _____ |
| <input type="checkbox"/> B. after surfacing | <input type="checkbox"/> D. during medical care  |   |

\*All postage, copying charges and/or official report fees will be reimbursed by DAN with appropriate invoice(s).

List and describe the events which occurred prior to, during, and immediately after this fatality. Please use this space to give further explanation or to clarify problems listed on the accident form (such as equipment failure, amount of air in tank, etc.).

Signature: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Title: \_\_\_\_\_

Please enclose this fatality sheet with the 4-page Accident Form.

## Appendix D: Diagnosis Coding for Disease Severity

CODE = 0      This code is used to designate an asymptomatic condition.

<u>CODE = 1</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
PAIN	A	G, H, I, J, K, L, M, N, U, V, W, X, Y, Z.	ANY
RASH	B	ANY	ANY
ITCHING	C	ANY	ANY
<u>CODE = 2</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
PAIN	A	F, D, Q, R, S, T, 4, 5.	ANY
NUMB/TINGLE	E	ANY	L/R
RESTLESS	I	ANY	ANY
HEADACHE	M	ANY	ANY
SKIN-SENSATION	V	ANY	L/R
MUSCLE-TWITCH	R	ANY	ANY
<u>CODE = 3</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
RINGING EARS	U	ANY	ANY
DIZZINESS	F	ANY	ANY
PAIN	A	O	ANY
FATIGUE	J	ANY	ANY
REFLEX	I	ANY	ANY
<u>CODE = 4</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
WEAKNESS	D	ANY	L/R
NUMB/TINGLE	E	ANY	BOTH
BREATHING	O	ANY	ANY
NAS/VOMIT	P	ANY	ANY
HEARING LOSS	T	ANY	ANY
SKIN-SENSATION	V	ANY	BOTH
PERSONALITY	Y	ANY	ANY
WALK/STANDING	Z	ANY	ANY
<u>CODE = 5</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
VISUAL-DIS	K	ANY	ANY
SPEECH-DIS	L	ANY	ANY
WEAKNESS	D	ANY	BOTH
PARALYSIS	N	ANY	BOTH
BLADDER	W	ANY	ANY
BOWEL	X	ANY	ANY
<u>CODE = 6</u>	<u>PROBLEM</u>	<u>LOCATION*</u>	<u>SIDE</u>
SEMI-CONSCIOUS	G	ANY	ANY
UNCONSCIOUS	H	ANY	ANY
PARALYSIS	N	ANY	L/R
CONVULSIONS	S	ANY	ANY

CODE = 7      **Fatality.**

\*Location of symptom is used for differential diagnosis. The use of letters under "Location" refers to specific body locations which can be found in Appendix B, on the Accident Report Form, question # 52.

#### Appendix E:CASE COLLECTION FOR 1988

Divers Alert Network receives case reports on injured divers from treatment facilities in the USA and around the world. Although there was a total of 553 divers treated in 1988, DAN received 419 Accident reports by June, 1989. One hundred and eleven (111) cases were excluded because they were not recreational divers.

Three hundred eight reports (55.7% of total treated cases) were reviewed for inclusion in the 1988 analysis. Forty (40) of these reports were excluded due to insufficient data. Two hundred and sixty-eight (268) cases remained for analysis in the 1988 report. These 268 cases include only recreational divers and are reported on in the body of the report.

#### ANALYSIS OF 111 NON-RECREATIONAL SCUBA DIVING CASE REPORTS

Fifty-three (53) of the reported cases were not recreational divers. Their dives were frequently deep, required decompression, performed strenuous labor, or participated in stressful activities. This group include:

Military Divers	4	DCS
Scientific Divers	1	DCS
Search and Rescue	1	AGE
Commercial Mixed Gas	2	DCS
Commercial Air	1	AGE
	4	DCS
	1	Muscle Strain Trial of pressure
	1	Viral Illness Trial of pressure
Commercial Fatalities	3	

#### Professional Fisherman and Game Collectors:

Unlike commercial divers, these divers are frequently self-employed or contract laborers and are not regulated closely.

USA Fishermen                    9                    DCS

All 9 were certified divers and were making decompression dives.

4 of the 9 omitted decompression stops

3 of the 9 had previous episodes of DCS

Caribbean Fishermen            1                    AGE  
                                    25                    DCS

5 of the 26 were certified. These divers typically make decompression dives and omit the decompression stops. They also, typically have very short surface intervals between dives.

Depth range = 70-220 ft. Average depth = 103 ft.  
Average dives per day = 4.  
17 of the 26 had previous episodes of DCS

Pulmonary Barotrauma 10

Chest pain	7
Chest pain	
Mediastinal emphysema	1
Pneumothorax	2

Recreational Fatalities 19

Recreational fatalities were reported to DAN but analysis is not included in the 1988 report. There will be a 1989 report on the 1989 recreational scuba fatalities.

Other Medical Conditions

The signs and symptoms of decompression sickness are often vague, subjective, and mimic other diseases. The diagnosis of decompression sickness many times is made on the basis of a history of the dive and the presentation of symptoms. An accurate diagnosis is not always possible with examination alone. A trial of pressure in a hyperbaric chamber sometimes is ordered to evaluate the divers' response. This method is by no means foolproof but is often the only tool available to the diving medicine physician. The following cases were referred for evaluation but were judged not to be decompression sickness or air embolism.

<u>Final Physician Assessment</u>	<u>No Treatment</u>	<u>Trial Of Pressure</u>	<u>Total</u>
Myocardial Infarction		1	1
Hyperventilation	1		1
Contaminated Air		1	1
Neurological			3
History-Multiple Sclerosis		1	
Convulsion (History-Seizure)		1	
Headache With Visual Changes		1	
Near Drowning	5		5
ENT	5	2	7
Nerve Entrapment Syndrome		2	2
Musculo/Skeletal Pain	4	5	9

29

1 missed stop prophylactic treatment  
1 DCS symptom - refused to be evaluated/treated

## Appendix F: Physicians

Mario Abarca MD	Cozumel, Mexico
Craig Altus MD	Orlando, Florida
Cheryl Adkinson MD	Minneapolis, Minnesota
Robert Bartlett MD	Columbia, South Carolina
Paul Bilunos MD	Sacramento, California
David Boaz MD	St. Thomas, U.S. Virgin Islands
Phil Boysen MD	Gainesville, Florida
David Bright MD	Stuart, Florida
Fran Brooks MD	Bronx, New York
Michael Brown MD	Barbados, West Indies
James Bullen MD	Alpena, Michigan
Enrico Camporesi MD	Durham, North Carolina
Peter Canaday MD	Denver, Colorado
Jeffery Cantrell MD	Galveston, Texas
Tom Chayka MD	Durham, New Hampshire
Thomas Chidsey	West Palm Beach, Florida
Paul Cianci MD	San Pablo, California
James Clark MD	Philadelphia, Pennsylvania
John Clements MD	Bahamas, West Indies
Lawrence Crouthamel MD	Stuart, Florida
John Davidson MD	Chesterfield, Missouri
John Dircks MD	Kalamazoo, Michigan
J. Roy Duke MD	West Palm Beach, Florida
I. A. Feingold MD	Miami, Florida
Orlando Florette MD	Gainesville, Florida
James Gallagher MD	Gainesville, Florida
Paul Gennis MD	Bronx, New York
Glen Goodhart MD	Atlanta, Georgia
David Hardman MD	Durham, North Carolina
Takashi Hattori MD	Monterey, California
Jean Hawkins MD	Northridge, California
Tim Hayes MD	Key Largo, Florida
Clifton Hector MD	Jamaica, West Indies
Harry Heinitsch MD	Miami, Florida
Allen Holcomb MD	Orlando, Florida
Kelly Hill MD	Baton Rouge, Louisiana
Robert Hood MD	Panama City, Florida
Irving Jacobi MD	San Diego, California
Louis F. James MD	West Palm Beach, Florida
Jim Joyce MD	St. Thomas, U.S. Virgin Islands
Eric Kindwall MD	Milwaukee, Wisconsin
Robert Kirby MD	Gainesville, Florida
Peter Klainbard MD	Bronx, New York
Ren Kozikowski MD	Baltimore, Maryland
Barry Kronman MD	Melbourne, Florida
Joseph Layon MD	Gainesville, Florida

Bobby Lewis MD	Birmingham, Alabama
James Loewenherz MD	Miami, Florida
John Lore MD	Austin, Texas
James Louis MD	West Palm Beach, Florida
Jon Mader MD	Galveston, Texas
Frank McCullar MD	Portland, Oregon
Jack McFarland MD	Scottsdale, Arizona
Edward McGough MD	Gainesville, Florida
John McMahon MD	Mobile, Alabama
G. Yancy Mebane MD	Durham, North Carolina
Evan Menzies MD	Turks and Caicos
Edward Michaelson MD	Ft. Lauderdale, Florida
P. Miller MD	Walnut Creek, California
Thomas Millington MD	Thousand Oaks, California
Phillip Mitchell MD	Durham, North Carolina
Richard Moon MD	Durham, North Carolina
Roy Myers MD	Baltimore, Maryland
Tom Neuman MD	San Diego, California
Joel Papowitz MD	Norwalk, Connecticut
Claude Piantadosi MD	Durham, North Carolina
Pascual Piccolo MD	Cozumel, Mexico
Don Plumley MD	Gainesville, Florida
Albert Pollard MD	Sanford, Maine
James Polson MD	Grand Cayman, West Indies
Tim Roach MD	Barbados, West Indies
Jeff Rudell MD	Bronx, New York
Karl Sanzenbacher MD	Durham, New Hampshire
John E. Schoell MD	Kalamazoo, Michigan
Ronald Scott MD	Plano, Texas
Aran Seigel MD	Gainesville, Florida
Bonnie Sidoff MD	Portland, Oregon
William Snover MD	Philadelphia, Pennsylvania
Merle Spivey MD	West Palm Beach, Florida
Richard Stack MD	Sacramento, California
Igal Staw MD	Norwalk, Connecticut
William Stenson MD	Norwalk, Connecticut
John Sterba MD	Panama City, Florida
Felicia Stonedale MD	Austin, Texas
Myrel Stringer MD	Panama City, Florida
Paul Thombs MD	Denver, Colorado
John Titus MD	Alexandria, Virginia
Roberto Torrez MD	Cozumel, Mexico
Mike Touger MD	Bronx, New York
Theodore Van der Vaart MD	Bonaire, Netherland Antilles
E. Vasquez MD	Ft. Lauderdale, Florida
J. B. Wilmeth MD	Thousand Oaks, California
Claude Zanetti MD	Chicago, Illinois
Gerald Zel MD	Seattle, Washington

**Appendix G: Directors, Head Nurses and Support Personnel**

William Bartow	PA	Alexandria, Virginia
Carol Benner	RN	Thousand Oaks, California
Deborah Bice	RN	Birmingham, Alabama
Kay Blodgett	RN	Denver, Colorado
Barb Burke	RRT	Melbourne, Florida
Kevin Carlisle	PAC	Ft. Lauderdale, Florida
Dick Clarke	TD	Columbia, South Carolina
Barbara Cross	RTT	Stuart, Florida
Dave Desautels	TD	Gainesville, Florida
Richard Dunford	MS	Seattle, Washington
Georgia Endicott	RRT	Chesterfield, Missouri
Steve Fabus	TD	Milwaukee, Wisconsin
Brian Foley	MS	Denver, Colorado
John Fontana	RN	New Orleans, Louisiana
Wayne Garner, Jr	TD	Pinellas Park, Florida
Teresa Hardy	RN	Orlando, Florida
Carolyn Jacobs,	RN	Scottsdale, Arizona
Mark Kaiser	TD	Miami, Florida
Toni Kempner	RN	Portland, Oregon
B. J. Larson-Jones	RN	Atlanta, Georgia
Paul Lavoie	TD	Durham, New Hampshire
E. Miller	RN	Walnut Creek, California
Sharon Mitchell	RN	Sacramento, California
Chuck Moran	TD	Danville, Pennsylvania
Andrew Mrozinski	RRT	West Palm Beach, Florida
Carl Nicholas	MD	Pacific Grove, California
Paul Rodier	TD	Baltimore, Maryland
Sam Rugh	TD	Northridge, California
Dick Rutkowski	TD	Key Largo, Florida
Bill Sartin	PA	Panama City, Florida
Ray Scofield	RRT	San Pablo, California
Dennis Selmont	RRT	Norwalk, Connecticut
Mary Jo Schuak	RN	Minneapolis, Minnesota
Delmar Shelton	PAC	Durham, North Carolina
Tom Sutton	PA	Galveston, Texas
Kevin Thorpe	RRT	Kansas City, Missouri
David Trimmer	RRT	Mobile, Alabama
James Tyrell	RRT	City Island, New York
Joyce Vibbert	RN	Plano, Texas
Debbie Wagner	RRT	Miami, Florida
Richard Welch	RRT	Austin, Texas

**NOTES**