

the project.

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AUSTRALIA'S "DIVER EMERGENCY SERVICE" (DES) 008-088200

An analysis of recorded usage over a 35 month period during 1987-1990.

John Williamson, Christopher Acott, Robert Webb, Roger Capps, Fred Gilligan and Des Gorman.

Introduction

The Diver Emergency Service (DES) is Australia's (and its near neighbours') 24 hour, user-free emergency consultative telephone service for diving medical and diving safety information.

The service was born in 1984, and its origin and lively history to date have been described.¹ We present a detailed report of the activities of DES over a period of 35 months since April 1986, which follows two previous overviews in the Journal.^{1,2}

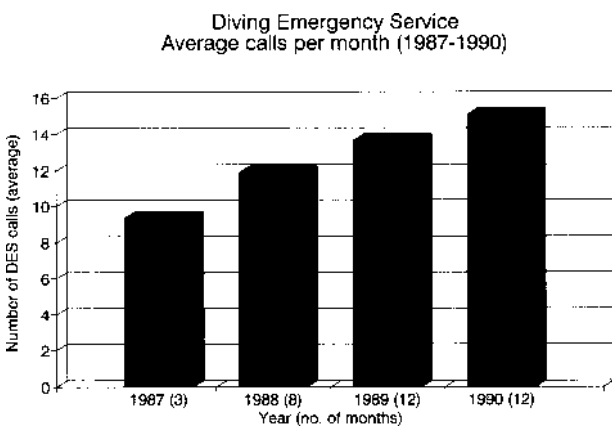


FIGURE 1. The average number of incoming DES calls per month, expressed on a yearly basis, over the 35 month period examined. The steadily increasing usage of the Service is shown. Note that records exist for only 3 months during 1987 and 8 months during 1988.

Method

We have analysed each written record of DES calls according to:-

- 1 Year, month, and time of day of call
- 2 Type of caller (diver, doctor, dive supervisor, etc.)
- 3 Location of caller, in Australia or beyond
- 4 Age of patient where recorded
- 5 Differential diagnoses over the 'phone'
- 6 Commonest presenting symptoms according to the provisional diagnoses
- 7 Medical referrals and aero-medivacs
- 8 Special features.

The advantages, disadvantages, lessons learned, trends usage characteristics, and future needs identified from this body of data are considered.

Results

The total of DES calls recorded in writing from 1987 to December 31, 1990 (35 months total) was 467. This approximates to 13 incoming calls a month.

USAGE TRENDS

Figure 1 shows the increasing recorded usage of the Service over the 35 month period.

Figure 2 shows that the busiest periods of usage during the year are the Australian warmer months of October to April.

The distribution of calls according to the time of day was:-

0800-1800	143	31%
1801-2300	58	12%
2301-0800	21	4%
Time not recorded	245	53%

OCCUPATION OF CALLER

Divers	223	48%
Medical Officers	107	23%
Dive Supervisors	40	9%
Friend or relative	17	4%
Rescue/First-Aid team	5	1%
Other	5	1%
Unidentified	70	14%

LOCATION OF CALLERS

WITHIN AUSTRALIA		
Queensland	111	24%

Diving Emergency Service Average number of calls (1987-1990)

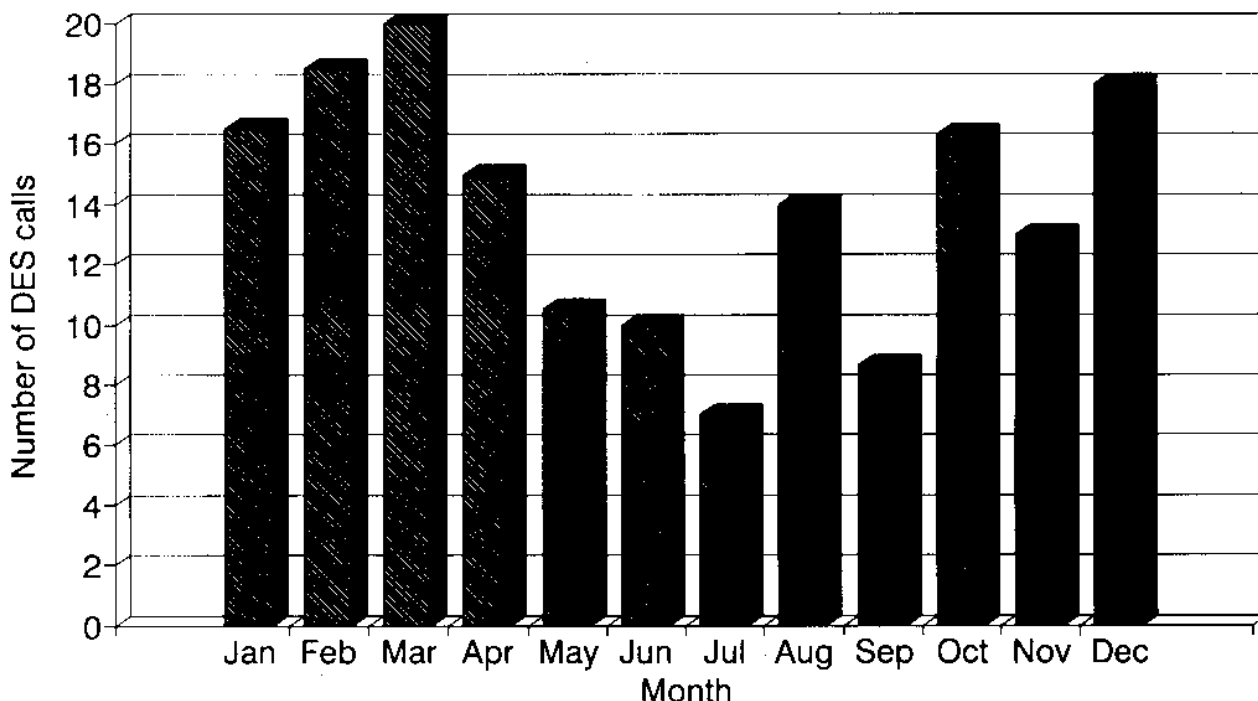


FIGURE 2.

The number of incoming DES calls received, during the 35 month period for which written records exist, plotted on a monthly average basis. The “quiet” months are the Australian winter months, while summer months are busier.

New South Wales	99	21%
Victoria	81	17%
South Australia	42	9%
Western Australia	29	6%
Northern Territory	16	4%
Aust. Capital Territory	3	

INTERNATIONAL

Papua/New Guinea	11	2%
Sultanate of Oman	2	
Fiji	2	
New Zealand	1	
Bouganville	1	
Vanuatu	1	
Christmas Island	1	

UNKNOWN

	62	13%
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years. Both these patients had decompression sickness (DCS).

DIAGNOSES

DECOMPRESSION ILLNESSES

<u>Decompression sickness</u>	210	45%
(1 life-threatening)		

Barotrauma

Pulmonary		
Cerebral arterial gas embolism (CAGE)	27	60%
(3 fatal, 2 near fatal)		
Other pulmonary (e.g. surgical emphysema)	12	3%
Middle ear	17	4%
Inner ear	4	1%
Sinus	3	1%
Alternobaric vertigo	1	

NEAR DROWNING SYNDROMES	5	1%
(2 life-threatening)		

Figure 3 shows the 3 monthly totals of calls received from the most frequent user State (Queensland) from April 1987 to December 1990.

AGE RANGE OF PATIENTS

The vast majority of patients were between the ages 20-35 years. The youngest was 15 years, and the oldest 57

Diving Emergency Service Queensland calls (3 months) (1987-1990)

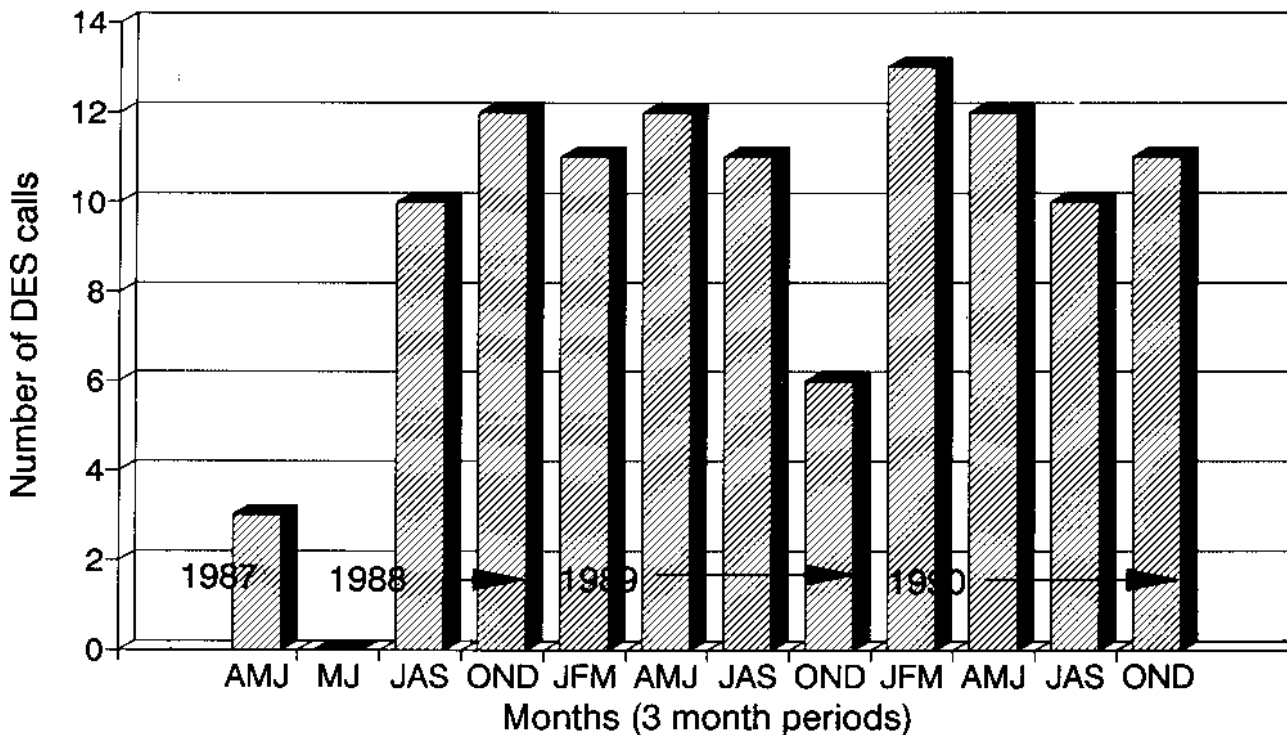


FIGURE 3

The number of incoming calls from Queensland during the 35 month period examined by this report. The calls are grouped into 3-month blocks. Note that the Queensland usage during this period was well sustained. (AMJ = April, May, June; MJ = May, June; JAS = July, August, September; OND = October, November, December; JFM = January, February, March.)

MARINE ENVENOMATIONS

“Irukandji” sting	2
Stingray	1
Stonefish	1
Blue-ringed octopus	1
Shellfish allergy	1

MISCELLANEOUS DIAGNOSES

Acute otitis externa	1
Hyperventilation	1

CALLS FOR ADVICE

52 11%

The commonest group was medical colleagues, seeking advice

NON-DIVING DIAGNOSES

18 4%

e.g. muscle and joint injury, respiratory tract infection, gastroenteritis and acute abdomen

DIAGNOSES UNKNOWN

109 23%

MEDICAL URGENCY AND/OR COMPLICATIONS

Most calls involved medical situations which could be attended to in a relatively unhurried manner. However some could not.

CAGE

27 calls all treated as relatively urgent.

two deaths occurred subsequent to DES contact, but both patients were comatose from their appearance on the surface, and a third death was dead on the surface.

Two other cases were in a dangerous condition, but survived with good first-aid, and rapid recompression.

DCS

One call, a patient with life-threatening pulmonary DCS, which responded to urgent recompression.

NEAR DROWNING

Two cases were in a critical condition, both survived.

LOST BUDDY

An urgent situation!

NON-DIVING RELATED MATTERS

One septicaemia and one carbon monoxide poisoning

MULTIPLE PATIENTS

Two calls involved more than one patient each.

COMMONEST PRESENTING SYMPTOMS

DECOMPRESSION SICKNESS

There were 202 cases where the presenting symptoms had been recorded

Pain	112	55%
Paraesthesiae, numbness	63	31%
Headache	40	20%
Dizziness, vertigo	30	15%
Lethargy, fatigue	25	12%
Nausea	16	8%
Weakness of muscles	15	8%
Visual disturbance	11	5%
Skin itch and/or rash	10	5%
Poor higher mental function	6	3%
"Chokes"	3	
Tinnitus	3	
Abnormal conscious state	2	
Speech affected	1	

The commonest presenting symptom groupings in DCS cases were joint pain and paraesthesiae followed by headache and dizziness.

CAGE

There were 18 survivors in whom no DCS coexisted

Collapse on the surface	5	27%
Impaired vision	4	22%
Respiratory distress	3	17%
Hemi- or para-plegia	3	17%
Dizziness	2	11%
Pain	2	
Paraesthesiae	2	
Haemoptysis	1	
Headache	1	
Vomiting	1	

OTHER PULMONARY BAROTRAUMA

There were twelve patients with pulmonary barotrauma without CAGE

Chest pain on surfacing	5	42%
Haemoptysis	5	42%
Surgical emphysema (voice change in 2)	4	33%
Pneumothorax, pneumomediastinum	2	
Acute dyspnoea	1	

The presenting symptoms of all the other diagnoses listed in this report were medically predictable, and unremarkable from a diagnostic point of view.

MEDICAL REFERRALS AND AERO-MEDIVACS

Hyperbaric referral details are available from 160 of the recorded DES calls during the period examined. Patients were referred to the following hyperbaric units for assessment:-

Townsville	57
Alfred Hospital, Melbourne	32
Prince Henry Hospital, Sydney	25
Royal Adelaide Hospital	14
HMAS PENGUIN, Sydney	9
Royal Darwin Hospital	8
Fremantle Hospital, W.A.	7
Royal Hobart Hospital	7
HMAS STIRLING, W.A.	1

34 air retrievals were recorded. They were to:-

Townsville	17
Prince Henry Hospital	9
Royal Adelaide Hospital	3
Alfred Hospital	2
Royal Darwin Hospital	1
Fremantle Hospital	1
HMAS "Penguin"	1

It was not recorded which of the air retrievals employed portable recompression facilities.

SPECIAL FEATURES

The three deaths in the series were all CAGE cases.

Two near drownings and 1 DCS ("Chokes") had life-threatening illnesses requiring resuscitation and critical care medicine.

The longest aero-medical retrieval was from Christmas Island to Townsville (approximately 4,500 kms).

The furthest away DES call was from the Sultanate of Oman.

Discussion

Although from the inception of DES at the Royal Adelaide Hospital an attempt was made to keep a written record of every call that it received, this did not happen. Two major practical difficulties interfered with this best of intentions. First, the service had to be located within the Intensive Care/Retrieval Centre at the RAH, where the 24 hour cover with the necessary communication skills already existed. The work load of this busy Unit mitigated against the staff having adequate time to spend on keeping records of DES calls, which may be protracted. Second, DES offers a service to international callers outside Australia (ISD 61-8-223 2855). This international access telephone is separate

from the DES "008" number, is not free of charge, and is used by the RAH Intensive Care medical staff to handle international retrieval, emergency and consultative needs that range far beyond diving medical matters.

As a result the early written records on which this report is based are incomplete covering 3 months in 1987, 8 months in 1988, and only become reasonably complete in late 1989. However the data that is available is objective, accurate, and sufficient for valid analysis.

On 13th September, 1990, the Communications Centre of St John Ambulance in South Australia agreed to accept the DES telephone interconnector link. From that time records have been precise, and the speed and reliability of connecting DES callers to the diving medical officer on duty has been much improved. This has been enhanced by the expert back-up received from Telecom Australia, for DES servicing requirements.

USAGE OF THE SERVICE

The increasing usage of the Service by the nation during the period reported is shown in Figure 1. Figure 2 shows that there is an annual variation in usage, with the Australian summer months being busiest.

Most callers use the service during "office" hours. However, as with all medical practices, "after hours" usage is significant. There is a preponderance of more urgent calls during the 1800-0800 period. Interestingly, the incidence of nuisance callers is remarkably low for a user-free service. Is it possible that the DES number is not widely known outside diving circles ?

THE CALLERS

Not surprisingly nearly half of the callers were divers. The great majority were recreational divers, but some alone divers, and a few professional divers were represented.

Usage of the Service by medical colleagues seeking advice concerning diving medical examinations, and clinical decision making related to diving is steadily increasing. This is to be commended and encouraged. Likewise calls from would-be divers querying the compatibility of diving with particular conditions (diabetes, asthma, ileostomy, etc.) is on the increase.

In general, taking a medical history from a friend or relative is less satisfactory than speaking to the diver, when this is easily possible and it frequently is ! Often it is obvious that the diver had been unwilling to phone the DES, and the friend or relative, has initiated proceedings.

Unusual callers included a fireman with carbon mon-

oxide poisoning, a pilot concerned about recent aviation decompression, occasional angry patients wanting to know why they were failed by their doctor for a diving medical examination, and a worried diver phoning to say he had lost his buddy ! Fortunately the buddy was safe.

OUTGOING DES CALLS:

Incoming DES calls that involve a diving medical emergency frequently result in the DES doctor on call making 3 to 5 outgoing calls immediately following the initial DES contact. These will be to the hyperbaric facility nearest to the problem site, followed by further calls to the nearest medical facility, to the people initially involved, back to the dive site and then possibly back to the hyperbaric facility which will manage the problem.

Consequently although the records show only an average of 13 incoming DES calls per month, the number of calls, both incoming and outgoing, actually made to and by DES would number more like 40 per month, during the 35 months examined. The records used for this report dealt only with incoming calls. At the time of writing (February 1991) the frequency of incoming DES calls has increased to between 1 and 2 daily.

WHERE DO THE CALLERS COME FROM ?

This data is of particular current interest. Clearly Queensland dominates overall during the period examined. However the State-based DES call frequency varies from month to month. For example during 1990, Victoria made the most calls in March, and New South Wales in November. Western Australians may perhaps tend to call their local hyperbaric facility more than other States, although they are never discouraged from using the DES first. It is of interest that the usage pattern, month by month, by Queensland divers and doctors fails to show the same summer/winter variation revealed by the national figures (Figure 3).

DES has long provided a service for diving in New Guinea, and the South-West Pacific, however its function in the Indian Ocean is less well known.

DIAGNOSES

The predominant incidence of decompression sickness reflects our current understanding.³

The overwhelming dominance of neurological DCS in this series may reflect self selection by callers with more serious and protracted symptoms. However, the concept that the human central nervous system is a prime target for the effects of DCS³ now has wide medical acceptance.

Of note is the relatively common incidence of pulmonary barotrauma (9% of all diagnoses), two thirds of whom (including all the deaths in this series) had CAGE. Reference has been previously made to the need to abandon the long held myth that these dangerous events are rare in diving.

Also as the data shows, divers can still drown, and/or suffer marine envenomations. Once again the "Irukandji" sting (a small tropical jellyfish of the *Carybdeidae* family)⁴ has (understandably) been confused with DCS⁵. Divers should remember the availability of the user-free Marine Stinger Hotline - 008-079909, a 24 hour service for expert medical advice concerning marine envenomations. However divers are not expected to make difficult differential diagnoses, and should continue to use the DES when in doubt.

Non-diving related diagnoses may also be important for the health and safety of the diver, and the differential diagnosis and subsequent appropriate referral of these cases are DES functions.

PRESENTING SYMPTOMS

This data is valuable because of its relative objectivity, and its immediate nature. Not often in medicine can a doctor obtain such early history as is made possible by the DES.

We wish to call attention again to the prominence of neurological symptoms in the DCS series. Pulmonary DCS ("chokes") is of serious prognostic significance, both cardiovascularly and neurologically, for it may be promptly followed by spinal DCS. Respiratory distress may occur in both DCS and pulmonary barotrauma. As this series both diagnoses co-existed in 5 cases.

This series again shows that convulsions (fitting) are not the commonest presenting symptom of CAGE. Collapse (i.e. acute loss of muscle power with variable sensory loss) and visual impairment are more common. Such collapse may be accompanied by retention of awareness by the patient. Attendants must mind what they say in the patient's hearing, and continue to talk to him or her during transport and treatment ! One case occurred with co-existent CAGE and pneumothorax.⁶

Haemoptysis appeared to be more commonly associated with pulmonary barotrauma, not involving clinically detectable gas embolism, which commonly presented with chest pain.

DIVING PRACTICE AND ERROR⁷

While the incomplete nature of many of the records did not permit a quantitative analysis of the dive profiles of

the DCS patients, it was obvious that the diving of many was outside even mildly conservative guidelines. Diving too deep for too long and/or too often (repetitive diving), and/or ascending too fast were the prime determinants of DCS. Rapid ascents carry additional serious potential penalties.

Of the 288 diving-related medical calls recorded, it is salutary to note that 21 (7%) of these were associated with a rapid ascent. Three of these developed CAGE. The remainder (18) had symptoms of DCS. The ascents came under a variety of different names, such as "rushed", "panicked", "emergency", "excessively rapid", "uncontrollable" and "runaway"; one of them was even listed as "multiple rushed ascents" ! Inexperience featured amongst this group. Five of the divers recorded running out of air. Another diver phoned for advice following his rapid ascent and remained well.

The dangerous diving practice of making multiple ascents also featured in the dive profile of at least 5 of the DCS cases in this report.

Six DCS patients admitted to being exposed to altitude following their diving, and at the time of onset of their symptoms (4 flying, 2 crossing mountains by road).

PARTICIPATING HYPERBARIC UNITS

A third of the recorded referrals, and half the retrievals involved the Townsville Hyperbaric Unit. The geographical situation of this recompression chamber makes it one of Australia's most used facilities by divers, and for diving retrievals.³ This chamber also acts as the referral facility for much of the South-West Pacific region, and at present is the only chamber between Darwin and Sydney; so diving retrievals are especially common to there. However all the Australian Units (Royal Darwin Hospital, Townsville General Hospital, Prince Henry Hospital, HMAS PENGUIN, Alfred Hospital, Royal Hobart Hospital, Fremantle Hospital, HMAS STIRLING) together with the two New Zealand Units (HMNZS PHILOMEL at Auckland, and the Christchurch Unit) have co-operated wonderfully with DES, and the Hyperbaric Medicine Unit at the Royal Adelaide Hospital, to the great benefit of divers everywhere.

FUNDING OF THE SERVICE

This has been previously described.¹ Some of the usual funding sources were interrupted during much of 1990, and the Australian Patient Safety Foundation provided on-going financial support for DES during that time.

Perhaps as a result of these events, temporary but unfortunate rumours, with no basis in fact, began in late 1990 that DES was financially destitute and in imminent danger of collapse ! As our data shows, during all this time the DES

maintained its unbroken 24 hour service to divers and doctors. This rumour has now been dispelled, and the financial needs of DES are securely provided for, irrespective of future development.

THE PRESENT AND FUTURE ROLE, FUNCTION, AND RESPONSIBILITIES OF DES¹

The Australian Diver Emergency Service (008-088-200) continues to provide a valuable "safety net" for all Australian (and beyond) diving. It exists and operates on the fundamental principle that in the event of a diving medical emergency the first essential requirement, following the ABC of resuscitation, is to make contact with a trained diving medical physician.

This facility can only be provided 24 hours a day, 7 days a week by a service such as the DES. The round-the-clock functions of such personnel, are to correctly diagnose the problem, offer relevant medical advice and choose the appropriate response to deal with the problem. This may involve immediate referral to the nearest medically staffed Hyperbaric Unit to the problem site. Excepting retrieval activities to the Royal Adelaide Hospital Hyperbaric Medicine Unit itself, DES' role is not to initiate retrieval activities (ground or air) to any Hyperbaric Unit. That decision can only be intelligently and efficiently made by the Units themselves. Immediate referral by DES doctors to a Hyperbaric Medical colleague, following emergency medical advice, is appropriate and demands excellent communication facilities. The Communication Centre of St John Ambulance, in South Australia provides just that.

Naturally it is essential that the divers know the DES telephone number ! An "aide memoire" to this has recently been suggested.⁸

The DES data as it accumulates and is anonymously analysed, is combined with that from the Diving Incident Monitoring Study (DIMS)⁷ and constantly fed back to divers, and diving training establishments, in order to improve the safety and enjoyment of all diving. The vehicle for such diver feedback is the DES Newsletter "Divesafe"¹, while diving medical physicians are reached through the pages of this Journal. The continued support and participation of divers and doctors is essential to this aim.

INTERNATIONAL DES

As can be seen, the international role of DES is significant and, despite the cost of international access to callers via 61-8-223-2855, continues to be patronised. These calls can be expected to increase in number in the future.

In February 1991 a meeting will be held in North Carolina, USA to initiate the organisation of the world's

diving emergency telephone services into a co-operative unit that will simplify their world use, irrespective of the nationality and the location of the diver in need. DES (along with the New Zealand Service) will be an inaugural member of this enterprise and will be represented at the North Carolina gathering.

Acknowledgements

It is a pleasure for three of the authors to acknowledge the pioneering efforts of Dr Des Gorman and Dr "Fred" Gilligan in the establishment of DES, and the on-going and expert collaboration of our medical colleagues and staff who man, around the clock, the (now 11 soon to be 12) Australian and New Zealand Hyperbaric Medicine Units. All authors also acknowledge with gratitude the financial and practical support of the Professional Association of Diving Instructors (PADI), the federation of Australian Underwater Instructors (FAUI), the National Association of Underwater Instructors (NAUI), the Australian Underwater Federation (AUF), the Commonwealth Department of Community Services and Health, Telecom Australia, the Australian Patient Safety Foundation, and the South Pacific Underwater Medicine Society. However, pivotal to the success and efficiency of DES, present and future, is the 24 hours a day skill, patience and attention to detail provided by the officers of the Communications Centre within the Headquarters of St John Ambulance, South Australia, in Adelaide. To them to our grateful thanks.

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Key Words

Diving, scuba-diving, diving emergency, retrievals,

diving safety, and medicine.

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THE RESPONSIBILITY OF DOCTORS PERFORMING "FIT TO DIVE" ASSESSMENTS

Michael Gatehouse and Tom Wodak

A doctor providing a medical service, be it advice, clinical or surgical treatment, is entering into a legal relationship with a patient which creates contractual rights and obligations and gives rise to a duty of care.

While the doctor is entitled to be paid for the service provided, the patient is entitled to expect that the service delivered will accord with the appropriate professional standard.

We wish to consider what constitutes the appropriate standard, in the context of an assessment by a hyperbaric doctor of the fitness of a candidate for an entry level diving course having regard specifically to the latent condition of patent foramen ovale (PFO).

A doctor must act in accordance with the practice accepted as proper by a responsible body of medical practitioners with commensurate experience and qualifications. What constitutes the requisite standard in particular circumstances will be determined by a court having regard to the skill, training, qualifications and experience of a reasonable body of peers of the doctor whose conduct is under scrutiny.

An entry level diving medical has a number of well established and essential ingredients which include, amongst other things, consideration of the age, cardiovascular status, respiratory function, patency of the Eustachian tubes and the circulatory system of the candidate. There can be no doubt

that a hyperbaric doctor who conducts an examination without regard to one or more of the universally accepted ingredients has failed to meet the requisite standard of care appropriate to such an examination.

PFO, and specifically the implications to a person who has such a latent condition and who is or has aspirations of becoming a diver, is the subject of on-going debate and research. At present there are no clear and established guidelines for use by hyperbaric doctors.

We do not believe that sufficient is known of the implications PFO holds for divers to justify candidates undergoing expensive and potentially hazardous echocardiography. However there is the question of what the candidate should be told about PFO.

English and Australian courts have ruled that the duty of care owed by a doctor to a patient does not extend to requiring the doctor to warn and advise the patient of every conceivable potential risk of a proposed treatment or procedure, irrespective of the grave and serious nature of the consequences which could follow. In a recent English case a patient requiring vital spinal surgery was not informed by the surgeon of a remote, but nonetheless known, risk of quadriplegia associated with the procedure. Unfortunately the patient was rendered quadriplegic. Evidence was heard from experienced surgeons whose practice it was not to inform their patients of that particular risk. Ultimately the court found that the surgeon in question had not breached his duty of care to the patient by failing to give such a warning.

If a patient asserts a breach of duty on the part of a doctor, it is incumbent on the patient to establish, on the balance of probabilities, that, had such warning been given, he or she would have accepted and acted upon that advice. For example, the patient would have refrained from undergoing the procedure as a consequence of having been so warned.

It is our view that PFO, and its consequences for a person with that congenital abnormality who dives, is well understood by the general body of hyperbaric doctors. This makes it incumbent upon a doctor, conducting an entry level diving medical examination, to provide the candidate with a sufficient understanding of the condition, and its potential to cause injury and disability, to enable the candidate to make an informed decision whether to undergo investigation for PFO or to take up or to continue diving.

Our conclusion is based on two factors. Firstly to a non-diver, and indeed to those who dive or practice hyperbaric medicine, sport diving is a recreation associated with medical risks beyond those encountered in many other sporting and recreational pursuits. The health of participants in sport diving is of far more critical consideration than it is in, for example, tennis, skiing or sailing.

Secondly, there is a marked distinction between the