

# Opinion

## Diving medical courses: a primer

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### Key words

Underwater medicine, training, general interest

### Background

During 2006, being involved in a number of diving medical courses, I contemplated the difficulties of upgrading these courses. I initiated discussions with some of the organisers in the hope of improving the quality and logistics of the educational training we were offering. To my pleasant surprise, most were amenable to this proposal, but simply did not have the time to implement it themselves. As a consequence, I have prepared this paper, which I make available for discussion, and perhaps even implementation in some cases. This paper documents some of the items for consideration by course organisers.

Anyone could have prepared this document. I do it because I have the time and the experience; I do not have the evidence. But, in this context there is a general agreement about the need for the courses and the intended outcomes. We all want more knowledgeable diving clinicians who can make reasonable provisional diagnoses, administer appropriate initial treatments, conduct astute diving medical examinations and refer if appropriate. In this I am running with the pack, not leading it.

I claim no copyright on the suggestions made here. On the contrary, most have come from a variety of sources, including the invaluable critiques of students, the observations of my diving medical colleagues and the exasperation of organisers who did not achieve the outcomes they had contemplated. It is easy to blame the quality of the students for these shortcomings, but often it is the course that has failed them, not vice versa. I also do not blame the lecturers. In this field, most are enthusiastic and competent.

I have lectured at, or directed, more than 150 diving medical courses over the last four decades, and I am grateful to many organisations for demonstrating, to both me and their students, what not to do. My first course was in 1967, at the Royal Australian Navy School of Underwater Medicine. I was allocated two weeks to prepare it. Since then it has not changed much and some of the changes are not necessarily improvements. Nevertheless, it is still one of the best courses available, which does not say a lot about many of its successors.

To define our terms. I am not referring to the three-month US Navy diving medical course, which trains doctors to be divers, diving supervisors and chamber operators. Nor

the one-week Royal Navy course that merely titillates the interest of national health service bureaucrats. Nor the 'mickey mouse' diving medicine holiday courses, held on a Pacific island or in the Caribbean for doctors who dive.

I refer to the two-week, introductory, full-time courses carried out in Australia (Royal Australian Navy and Royal Adelaide Hospital) and devised as background for more comprehensive diving medical instruction, performance of diving medical examinations, or training of general practitioners who could perform initial assessments. Those who graduate usually do not operate hyperbaric treatment chambers, and use diving medical consultants for the more serious diving medical problems.

Some differentiate the course into a first 'basic' week and a second 'advanced' week. This has the advantage of permitting delegates to undertake the course over two separate time periods, not requiring a continuous two-week absence from their gainful employment. The depiction of the second week as 'advanced' is presumptuous. It is not necessary to designate it so untruthfully. Using the terms Part 1 and Part 2 of a 'Basic' or 'Introductory' course would serve the same purpose. Claiming that Part 2 is advanced is hypocritical on the part of the organisers and misleading to the students. It is analogous to the recreational diving industry's use of the term 'advanced diving' when referring to the courses that encompass a diver's fifth to eighth open water dives, when the diver is really still a novice.

About 30 is the maximum number of students that can be dealt with by lecturers before teaching becomes purely dictatorial, and thus could be as well done over the internet. Personal interaction is as necessary for the class questioners as it is for the more timid students who do not ask the questions they should. I refer to them all, in class, as 'delegates' but I treat them as students. You cannot underestimate the knowledge of general-trained doctors in this field of diving medicine.

### Instructors

A course requires at least three full-time lecturers, if it is to have sufficient variety to avoid over-exposure of lecturers and boredom from their voices. Other specialist lecturers may be required for lectures on respiratory, otological, pathological and marine toxicological topics, depending on the orientations of the full-time lecturers. Preferably even the specialists will have diving experience, to ensure their presentations have relevance and validity. The lecturers are usually:

- divers
- non-diving medical specialists
- medical specialists who are also divers
- diving physicians.

Rule 1 for any lecturer is to keep the class awake. To some degree all lecturers are entertainers or performers – but there must be more to the presentations. Some are fascinating and captivating but, at the end of the performance, one is left with a single ‘bottom line’ that the lecturer is a fantastic diver, a brilliant researcher or a lovely person. There may be little practical diving medical knowledge imparted. Interesting as these lecturers are to divers and medicos alike, they occupy valuable instructional time and should be allocated to after-dinner speaking, if at all. Researchers should be advised that they are there to teach, not to promote their own hobbyhorse research, unless it is directly relevant to the topic.

A full-time course chaperone, preferably a diving physician, is necessary to analyse the information supplied, note omissions in this, remedy these, integrate the information presented, explain discrepancies and supply continuity. He is also of value in ensuring that back-up logistics (morning and afternoon teas, social functions and lecture technology) are functioning appropriately. A high-class teacher, administrator and ‘goffer’.

### Syllabus

Assume nil knowledge, especially from new graduates and the older specialists. Otologists do not necessarily understand respiratory function tests, and respiratory physicians may not recognise an audiogram if they tripped over it. New graduates may have a superb theoretical knowledge of functional MRIs, but not be able to read a chest X-ray.

Unfortunately a syllabus, once designed, often becomes the default template for all future years – sometimes 40 of them! New directors may not feel confident enough to alter their predecessors’ course, and they often are not aware of previous critiques, or do not take these into account.

The sequence of the lectures is of major importance. Moving sequentially from the simple to the complex is preferred, with dogmatic, easily understood, presentations for the earlier, more basic part of the course. Unless one plans the syllabus so that the student is sequentially instructed from basic physics, physiology, and equipment, to aquatic environment, and finally diving hazards the less sophisticated will become confused. One should evolve from the known and recognised into the more exotic. Jumbling the lectures up according to the availability of lecturers will be disadvantageous to many of the non-diving students trying to comprehend new concepts. Lecturers should fit in with the course, not the other way around.

The principles of a typical course syllabus are as follows.

The first two days are often best presented by diving instructors, as they are accustomed to giving precise lectures, understandable to all, and bereft of medical terminology.

The first day would encompass a review of relevant physics and physiology. There are some excellent but outdated films produced by the Royal Navy and the US Navy, depending on whether you are using metric or imperial measurements. These also introduce the student to the diving diseases, but not in any significant clinical detail. They can be followed by brief oral reiterations of the major facts of the laws of physics, with responses to questions. Examples of the laws of physics should be worked through, as a class. Respiratory and otological physiology may be refreshed during these lectures, but the focus should be strictly on relevant diving physics and physiology. Diseases and pathology should only be touched on, to acquaint the students with the future direction of the lectures. Basic free-diving equipment can be discussed and illustrated. If time permits, to introduce diving medicine and entice the doctors’ interest, a lecture on free-diving, by a diving physician, may be incorporated. This is a wonderful introduction to the remainder of the course and it is applicable even to non-divers.

The second day can be devoted to equipment, from free-diving to chambers. Without the availability of films (DVDs now), I would occasionally do a whirlwind “Cook’s tour of diving accidents” at the end of the day.

The third day should be devoted to the hazards of the marine environment, applicable to all fishermen, seafarers and water-sports enthusiasts. This expands the range of the course and its relevance to ‘non-divers’. These lectures include drowning syndromes, thermal disorders, marine animal injuries, seasickness, etc.

The fourth day is initially devoted to diving fatalities, including the statistics and overviews of the contributing factors. This not only introduces the students to all the major diving diseases, but also gives them some perspective of their relative importance. So often doctors graduate from these courses with no concept of the frequency of stress factors such as panic and fatigue, the significance of drowning and cardiac deaths, or the relative infrequency of decompression sickness (DCS) and contaminated gases in recreational diving fatalities. They have presumed that the time allocated to these subjects is a reflection of their frequency and significance, whereas it really reflects the interests and commitments of the organisers.

The afternoon leads us finally to the very specific diving diseases, starting with the simplest gas law to understand. This day should be “Boyle’s Law Day” and kept totally isolated from any discussion on decompression or DCS, otherwise it will cause confusion to the less bright diving medical neophytes.

The fifth day can be “Henry’s Law Day” and devoted to the

various gas toxicities and decompression. A temptation to combine decompression with decompression sickness must be resisted. Otherwise some students are going to get very confused. One involves physiological theories, the other a specific medical disease. They are worlds apart. How often do the poor students confuse flying-after-diving restrictions (decompression) with medivac altitudes (DCS)?

The sixth day (hopefully with a weekend away from decompression calculations) is for DCS and other serious or specific diving diseases. First aid and resuscitation fits in well, as does the epidemiology of non-fatal diving accidents.

The whole seventh day should be spent on fitness for diving, with lectures (asthma, diabetes, drugs, etc.), interactive questioning and explanations of investigations (audiometry, tympanometry, respiratory spirometry, cardiac risk assessments, radiology and indications for more specific investigations). Introduction of diving medical fitness examinations earlier in the course is totally illogical, although it is frequently scheduled there. The students are not *au fait* with the real problems the medical must assess – and these must be covered before confronting fitness assessments. The latter relies entirely on a foundation of fatality and morbidity statistics

The eighth day could cover large topics related to diving medicine, depending on the orientation of the organisation. These could include hyperbaric medicine, submarine medicine, aviation medicine, etc. As these are self-enclosed topics, they could be included almost anywhere in the second week, depending on availability of the resources.

The ninth day deals with a miscellaneous group of problems, some quite complex and extending into contentious areas. Vertigo and disorientation, the long-term effects of diving, technical diving and indigenous divers are all covered in the morning session. The afternoon is spent discussing case histories supplied by the lecturers, and engaging the class in diagnosis and treatment decision making. It is important to include non-diving problems that can present during diving activities.

A written examination is best performed on the tenth or last day. A multiple-choice questionnaire with machine marking is preferable, as this can be performed rapidly, with the remainder of the morning devoted to discussion of the questionnaire results (essential as a teaching procedure). The afternoon is spent on the verbal critique, a written critique if required by credit-supplying authorities, and the issuing of certificates of attendance and/or success.

### Interactive techniques

There are various interactive techniques used by different lecturers, but there are also the more formal ones, such as student presentations and evolving case histories. These are

usually performed for half an hour at the start of each day.

The student presentations are used to reinforce basic knowledge and are thus more effective during the first week. They include laws of physics, effects and treatment of barotrauma, decompression calculations, etc. If, at the end of each day, students are given a list of five or so basic questions, and are informed that they will be chosen at random to give a presentation of less than five minutes without using notes or lecture aids, to their peers on the following morning, they are inspired to at least learn this essential and non-controversial material. I inform them that these presentations will be graded and the results integrated into their final exam mark.

The use of evolving case histories for general discussion, is obvious in the second week. These are both interesting and instructive, and introduce a practical element into the proceedings. They are of little value in the first week, and are often counter-productive, as the students do not have the background to analyse and comprehend the complexity of the cases.

### Literature

There are various attitudes to the question of literature. Two of the best courses I attend (the Diving Medical Centre DDME and the annual Malaysian Navy course) send a simple, easily readable text to the students a couple of weeks before the course, for their perusal. It is also useful during the course, to review the basic factual material. *Diving medicine for scuba divers* is ideal for this, even though it was originally designed for divers and dive instructors.<sup>1</sup> It is also of value for students whose first language is not English, besides being inexpensive.

Another two very impressive courses (the South African and Australian Navy courses) supply a comprehensive text for the duration of the course. *Diving and subaquatic medicine* is used as an authoritative and clinically orientated text, but is hardly bedtime reading.<sup>2</sup> A relatively inexpensive paperback version is now available.

Whichever of the texts are used, a specific medical fitness booklet is recommended. We tend to use Parker's *The sports diving medical*, even though it is not comprehensive and certainly not applicable to occupational divers.<sup>3</sup>

Often copious literature is supplied to support or extend the lectures. This includes Australian Standards medical forms, other official regulations, and handouts to be copied and used by diving physicians for diver education.

Some supply large manuals, often collected from previous years' lecturers. This is not as valuable as it may at first seem. The lectures have often been changed, with different lecturers and different content. The chapters vary with the writing capability of the various lecturers, and repetition is

annoying. There is often conflicting advice, and rarely is there an adequate index supplied.

What is of great value to the students is a selection of the major slides (about 10) from the PowerPoint presentation of each lecture. Do not deluge the students with the total number, sometimes up to a hundred a lecture, as this is overload.

### **Diving and recompression-chamber exposure**

It is my belief that a diving medical course that does not result in students experiencing both diving and the compression chamber is dull and boring. These guys and gals need something to boast about in their dinner party conversations, so that others are enticed to apply.

Of course, medical examinations must be performed, not only to illustrate fitness to dive, but also to teach about medicals. Most students can be made fit to swim underwater with scuba, attached to a buddy (instructor), at least in a shallow swimming pool. Experience with ear equalisation in a chamber is invaluable, and even exposure to inert gas narcosis may be possible.

The more exciting diving medical courses will have available diving experiences conducted by professional dive instructors during the weekend, in the middle of the course. This should not be a required or integral part of the course, or be commercially related to it.

### **Investigations**

Practical experience of performing an audiogram on a colleague, and spirometry and tympanometry on themselves, will produce results that will have much more meaning and encourage interpretation during the relevant lectures, when these investigations are subsequently described. The first time I introduced this 'testing' apparatus to the lecture room, with a paramedic to illustrate and correct the technique, I was amazed at its ability to promote interest and understanding. Much more than a passive PowerPoint presentation.

### **Examinations**

These are often copied from previous exams, dealing with questions not covered in the current course! This is one of the reasons for using a full-time diving doctor as observer and chaperone at the course. This will ensure that all the questions and answers are covered during the course.

Dr Bob Thomas, in his three-day Designated Diving Medical Examiners course, has taught me how to approach examinations constructively. The exams are used as a teaching opportunity, engaging all the full-time lecturers. They are essentially discussions about the most important subjects covered by the course (and reflected by the exam questions). The lecturers' varying attitudes demonstrate

the complexity of the subject, and the students' attempts to rationalise their incorrect answers allows us to focus on the failure of our instruction. These omissions can then be corrected.

### **Qualifications**

Bestowing of qualifications on attendees is beyond the scope of this discussion. Many delegates receive elaborate certificates that decorate consulting rooms and academic offices. Some declare successful completion of the course, others merely attendance. Some certificates confer the designation of Diving Medical Examiner (DDME), approved by the Australian Standards Association (and SPUMS) for either professional or recreational divers. Others imply an expertise in assessing and treating diving accidents.

The DDME qualification needs to be addressed, but not here and now. The relative value of the three-day specialised courses and the two-week more generalised diving medical courses may result in surprising outcomes in producing competent DDMEs. The surveys carried out in Queensland by Mark Marshall (364 respondents in the 1970s), as a master's thesis for the University of Queensland (reference not available), and Simpson and Roones' more recent questionnaire (52 respondents) are relevant.<sup>4</sup> In both there are claims that are, in my opinion, unsupportable, but both unquestionably demonstrate the widespread inadequacies of diving medical physician training and the implementation of accepted medical standards. The unpalatable conclusion is that the quality or focus of our instruction is lacking.

### **Critiques**

This is where we are taught what we really need to know. I find that during this time, when each student is required to say his piece and to criticise, not praise, it is best that the lecturers (all the full-time ones at least) should shut up and listen. Attempted rationalisations and even explanations are irrelevant. How the student experiences the course, and his wishes for improvement, are subjects on which he is the undoubted expert, not the lecturer.

### **Conclusion**

Of course, I do not expect most established diving medical courses to actually change, based on the above observations. That is why they are called 'established'. What I do hope for is that the younger, new diving medical physicians – the ones who have sought my views privately – will have the opportunity to peruse the suggestions in print, as opposed to the barely remembered snippets offered over a barbecue or bar, and compare them to the format of the courses currently available.

This paper is not the final answer. It is a work in progress, and if some, students or lecturers, dissent from my observations, I welcome their objections and suggestions.

## References

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## Editor's comments

A comparison between the 2007 Royal Australian Navy, and Royal Adelaide Hospital two-week diving medicine course programmes and Dr Edmonds' recommendations is provided in Table 1. The overall times are for structured components of each course and do not allow for travel time between venues, etc., nor for the informal interaction that occurs during refreshment/meal breaks and at the end of the day.

Not all components could be categorised in the same way for each course, and it is likely that some components that appear to be missing from one or other are actually embedded within other headings. This is probably particularly the case with the RAH course where a much greater time is spent on the broad category of 'diving equipment and techniques' that encompasses a number of items otherwise not specified in their programme. Also, the physiology component of the RAH and Edmonds programmes appears light, but is likely to be incorporated into most of the specific topics.

There is a similarity between the three with emphasis varying depending on the interests of individual lecturers. All three devote about 12–15% of the course time to interactive sessions, largely based on clinical issues such as evolving clinical problems and 'fitness-to-dive' scenarios. These interactive components are undoubtedly an important part of the learning process in pressure-cooker programmes like this. In looking at the actual timetables (not shown here), a logical sequence such as Dr Edmonds advocates is broadly followed at both venues.

The timetables for the most recent RAN and RAH courses and the hypothetical by Dr Edmonds are available from the journal office on request (<spumsj@cdhb.govt.nz>).

**Table 1**

**A comparison of the components and the time (hours) devoted to each of the Royal Australian Navy (RAN) and Royal Adelaide Hospital (RAH) two-week diving medicine courses and those suggested by Edmonds**

Component	RAN hrs	RAH hrs	Edmonds hrs
History of diving	0.75	1.5	1
Physics	1.5	1	2
Physiology	1	2.5	0.5
Breath-hold diving	1		1
Dive accidents and fatalities	1.5	2.5	3
Diving equipment & techniques	2.75	9	3.5
Technical diving		0.75	1
Diving environment			1.5
ENT problems and diving	1	1	1
Barotrauma: lung, other	1	1	3
Decompression theory/ tables/computers	3.75	1.5	3
DCI: pathophysiology	1	1	1
DCI: clinical presentation	1	1	1
DCI: treatment incl. tables	2	2	1
DCI: treatment in remote areas	1	1	
Oxygen: delivery systems	1		
Gas toxicities & contamination	1.75	1	3
Carbon monoxide poisoning	0.5	1	
Inert gas narcosis & HPNS		1.25	0.5
Hypothermia & hyperthermia	1	0.75	1
Resuscitation & CPR update	3	1	1
SWAS/near drowning/ sudden death	1	0.75	2.5
Dangerous marine animals	3	1	2.5
Long-term effects of diving	1	1	1
Women and diving			1
Indigenous diving			1
Fitness to dive: general principles	2.5	1	0.5
Fitness to dive: all aspects	3	1	4
Fitness to dive: medical forms	0.75		1.5
Recompression chambers	1	1.75	1
RCC experience	1.25	3.25	3
Diving medicine organisations	0.25		
Wet acquaint	3.5		
Submarine medicine & escape	3		1
Submarine familiarisation	1.5		
Hyperbaric medicine	2.25	5	2
Hyperbaric nursing		1	
Interactive-ECPs, fitness, etc	7.5	8.75	9.75
Examination: pre-course	0.75		
Examination: final	2	2	1.5
Examination: reviews/critiques	1.25	1.5	2
Introduction/course critique	1.25	1	1.5
<b>Total course time</b>	<b>63.25</b>	<b>59.75</b>	<b>64.75</b>