### 【資料】

### Hyperbaric Medicine Activity in Indonesia

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Indonesia is a Republic country which 2/3 of its territory lies between Pacific and Indian Ocean that consists of more than 17,000 islands. The sea and the straits were the two important substances that act as a medium for the union of the country and in it laid the potential resources for the future. There is a need of divers, technology and highly equip diving system with the Hyperbaric Chamber (HC) facilities in addition with the qualified man resources and other supporting facilities to explore, protect, to utilize and to conserve the underwater, the richness and the resources of the sea, the beauty of the 5000 nautical miles coastline and the magnificent tropical coral.

The diving health care and hyperbaric was established with the installation of a hyperbaric chamber produce by "Kurimoto" Japan for the 1962 Graving Yard project in Naval Base Surabaya. At the moment there are 15 hospital equipped with HC with wide distribution territory in order to support the diving operation and marine tourism all around Indonesia. LAKESLA, Surabaya is the head quarter of the Hyperbaric Doctors Association for the East Indonesia region; and RSAL, Dr. Mintohardjo that guards the Indonesia's West region. The activities in those two referral mentioned concern of direct support for the diving operation, promotion and prevention for the diving work and accidents with the TOHB application clinic promotion, hyperbaric doctors' services, education and training for the Hyperbaric doctors, Hyperbaric paramedic, operators and the Hyperbaric Chamber's technician

At the moment maximum attempt of Standardizing the Diving and Hyperbaric Health Services in Indonesia and Standardizing the Competency of the Maritime and Diving manpower.

The Republic of Indonesia a maritime country that made of more than 17.000 islands whereas 2/3 of its region of the seas. The seas and the straits nor only act as the medium to unite the entire region but also as the International Sea Traffics. Besides the diversity of the marine life, many potential resources in the form of oil, gas and mineral; treasure within the wreckage ship that lay at the sea beds. The beauty of the coasts and the tropical coral reefs within the Indonesia's sea are incomparable. Most of the Indonesian, fishermen, local and foreigners divers live and depend to the Indonesian's sea for their living. Some of the local region has bean developed as the leisure diving center such as Maluku Islands, North Sulawesi, Seribu Island, Bali, Lombok, Biak, Raja Empat Island, Tanjung Pinang, Selayar Island and more. Skilled and trained divers comprehensive diving equipment and underwater technology along with other supporting infrastructure

is essential to explore the resources within the sea. To support diving activities that involve combat diving, underwater construction offshore oil and gas, fishermen divers, leisure divers, TNIAL 1962 has started to install Multiplace Hyperbaric Chamber (MHC) in Surabaya (started to operate in 1964) in order to support the building of the graving dock and diving activities in Indonesia.

Since 1962-1964 TNIAL has send some of their doctors, paramedic and technician to gain knowledge of the Diving Health and Hyperbaric in Poland, and Japan (at Medical and Dental Faculty of Tokyo University) in order to become a trained member of the Hyperbaric Chamber Society. So that now when the first HC TNIAL produce by Kurimoto, Japan has been installed in Surabaya the human resource is ready and well prepared. Until now HC Kurimoto still being utilize, but only for the "pressure test" for the candidate diver because it has not been equip by BIBS (Built in Breathing

System).

Within the progress and the advances that has been made in the diving technology, hyperbaric health care technology and with all of the demands and expectations to the needs of health diving and hyperbaric, thus MHC that once before only being employ to support the diving activities nowadays being consume for medical treatment and clinical cases, accordingly the number of MHC in Indonesia gradually increase.

To meet the requirements of the health equipments and HC crew therefore TNIAL periodically and consistently held scholar program for the doctors, and divers to United State of America, Russia, Yugoslavia, Australia, France and Japan manning HC, deep dive equipment and submarine. With the reserve of HC equipment and the professionals skilled mention. The Medical Department of Indonesian Navy (TNIAL) started the specific program to trained and drill hyperbaric medical officers, hyperbaric paramedic, HC operator along with HC technician initially for the interest of TNIAL and Pertamina, Department of Health of the Republic Indonesia Ministry of Health and the private hyperbaric clinic.

With the TNIAL interest in mind since 1991 Hyperbaric Medical Officer Training Course was initiated with the course duration of 6 months. The graduates are situated to man HC (RUBT) TINAL and other instances in the form of join forces. Since 1994 (Dokter Hiperkes Minatan Hiperbaric) in Jakarta enhance the quality of the Hyperbaric Medical Officer. Later was followed by Post grades hyperbaric course (basic science) in LAKESLA, Surabaya. There are four coordinator group HC in Indonesia with different task and main function according to each concern, however the entire force are ready to support the diving activities and

medical treatment for the diving cases in Indonesia and in South East Asian. The four coordinator HC in Indonesia are Indonesian Navy (TNIAL).

Pertamina Oil Company, Department of Health of the Republic Indonesia Ministry of Health and Private Hyperbaric Hospital and Clinic. The private sector at the moment is currently under the process of installation. In the elation of facing the globalization in the year 2003 therefore it is a must to have a legitimate standard sing and credibility in every aspect, scientific regulation, and social economy concerning of the utilization of the Medical Hyperbaric instrument and within it the human resources and the equipment.

Department of Health of Republic Indonesia the Minister of Health in corporation with Indonesian Hyperbaric Medicine Society (PKHI) is in the route of formulating Standardization Diving and Hyperbaric Health in Indonesia. Ministry of Man Power in corporation with PKHI is in the process of preparing Standardization of Competency Maritime and Diving Man Power.

### DISTRIBUION AND THE FUNCTION OF HYPERBARIC CHAMBER IN INDONESIA

- I HYPERBARIC CHAMBER IN INDONESIA NAVY (TNIAL)
- SEJUSAL (Sekolah Kejurusan Selam TNIAL in Surabaya), Naval Diving school

The facilities is equipped with the 4 person capacity Multiplace HC, working pressure 6 ATA; 2 monoplace chambers with the capacity of one person, working pressure 6 ATA. In the company of a dive tank

Main Function: divers and crews submarine escape training

- 2. LAKESLA (Lembaga Kesehatan Angkatan Lautan), Institute for Naval Health in Surabaya. The facility is the center for the diving health and Hyperbaric in the East Indonesia Region. Equipped with the 10 person capacity 2 Multiplace HC, working pressure 6 ATA; 1 unit Monoplace HC with the capacity of 2 person (L-tipe), working pressure 6 ATA, 1 unit small HC for the clinical experiment towards animal, that function as:
- a. To support diving operation:
  - ·Divers check (Pressure Tests and Oxygen Tolerance Test)
  - ·Personnel support and health equipment on the diving operation and combat.
- b. Hyperbaric Medical Services
  - ·Treatment to the diving cases (Decompression Sickness and Gas Emboli)
  - · Medical treatment to the clinic cases
- c. Promotion-prevention

To endorse prevention of the accident that might occur during the dive work to the uneducated and unskilled diver (traditional divers) from the island of Madura and it's surrounding, to the leisure divers, and also promotion efforts to socialize the medical hyperbaric services to the doctors society and the public.

- d. Education, Training and Research
  (In cooperation with the Medicine Faculty of Airlangga University, the Medicine Faculty of Hang Tuah University, Hang Tuah Nurse Academy.):
  - ·Post Grade Hyperbaric (basic science)
  - · Introductory Hyperbaric Medicine to students; medical faculty, nursing academy, etc.
  - ·Training /course to medical doctors and paramedics, chamber operator and hyperbaric technician.

- ·Inter-department training for Hyperbaric nurse and Chamber operator.
- ·Research: for the last 4 years 16 experimental research to human and animal had been carried out.

#### 3. DR.MINTOHARJO NAVAL, HOSPITAL, JAKALTA

As the central reference for the diving and hyperbaric medicines to the Indonesian West Region, operates 2 Multiplace HC with 10 person capacity, working pressure 6 ATA; 1 Multiplace HC with 10 person capacity without BIBS, 1 Vertical Monoplace HC (unserviceable) along with 1 diving tank, with the function:

- a. To Support diving operation:
  - ·Divers check (Pressure Tests and Oxygen Tolerane Test)
  - ·Personnel support and health equipment on the diving operation and combat.
- b. Hyperbaric Medical Services
  - •Treatment to the diving cases (Decompression Sickness and Gas Emboli)
  - · Medical treatment to the clinic cases
- c. Promotion-prevention

To endorse prevention of the accident that might occur during the dive work to the uneducated and unskilled diver (traditional divers) from the Seribu islands and its surrounding, to the leisure divers, and also promotion efforts to socialize the medical hyperbaric services to the doctors society and the public.

- d. Education, Training and Research
- (In cooperation with the Medicine Faculty of University of Indonesia, the Medicine Faculty of Universitas Pembangunan Nasional, Hang Tuah Nurse Academy, ORCA Dive School):
  - ·Post grade Hyperbaric (basic science)

- ·Introductory Hyperbaric medicine to students: medical faculty, nursing academy, etc.
- ·Training /course to medical doctors and paramedics, chamber operator and hyperbaric technician.
- ·Inter-department training for Hyperbaric nurse and Chamber operator.
- ·Research: for the last 4 years 7 experimental research to human and animal had been carried out.
- 4. Naval West Fleet Specialist Clinic, Jakarta

Operating 1 Multiplace HC with 4 person capacity, working pressure 6 ATA. With diving cases treatment and clinic cases as its main task

5. DR. Midiyato S Naval Hospital, Tanjung Pinang-Riau Island

Operating 1 Multiplace HC with 4 person capacity, working pressure 6 ATA. With diving cases treatment and clinic cases as its main task.

6. Halong Naval Hospital, Ambon-Maluku

Operating 1 Multiplace HC with 4 person capacity, working pressure 6 ATA. With diving cases treatment and clinic cases as its main task.

 KRI Pulau Rupat and KRI Pulau Rengat (Mine Hunter ships)

Operating 1 Multiplace HC with 4 person capacity, working pressure 6 ATA. 1 Monoplace Transport Chamber with 1 person capacity, working pressure 6 ATA. To support diving operations and DCS Medical Evacuation.

8. Lumba-lumba Diving Barge
Operating 1 Multiplace HC with 4 person capacity,

working pressure 6 ATA, 1 set SSBA diving gear for mixed gas diving max to 80 meter. Its function is to support diving operation.

### 9. KRI Leuser (Ocean Tug)

Equipped with 1 Monoplace with 2 person capacity, working pressure 6 ATA. Its main function is to support diving operation (Surface Decompression and Medivac).

# II. HYPERBARIC CHAMBER OWN BY PERTAMINA AND ITS SUBSIDLARY COMPANY

- Arun NGL Hospital, Lhokseumawe-Nangroe
   Aceh Darussalam
- 1 Multiplace Chamber with the capacity of 4 person, working pressure 6ATA for clinical treatment case
- 3 Multiplace Chamber with the capacity of 4 person, working pressure 6ATA to support diving operation (Surface Decompression)
- 2. Pertamina Hospital, Balikpapan-East Kalimantan Operating 1 Multiplace HC with 4 person capacity, working pressure 6 ATA. With diving cases treatment and clinical treatment cases as its main task.
- 3. Pertamina Hospital, Cilacap-Central Java

Operating 1 Multiplace HC with 4 persons capacity, working pressure 6 ATA. To support diving operations and clinical treatment cases.

4 China Petroleum Oil Company, Kasim Marine Terminal, Sorong-West Papua

Operating 1 Multiplace HC with 4 persons capacity, working pressure 6 ATA. With diving cases treatment and clinic cases as its main task.

### III. HYPERBARIC CHAMBER OWN BY THE HEALTH MINISTRY OF REPUBLIC INDONESIA

- 1 Sanglah District General Hospital, Denpasar-Bali
- Operating 1 Multiplace HC with 6 persons capacity, working pressure 6 ATA. To support marine tourism, leisure diving, fishermen diving and clinical treatment cases.
- 2 Dr. Wahidin Sudirohusodo District General Hospital, Makassar-South Celebes
- Operating 1 Multiplace HC with 4 persons capacity, working pressure 6 ATA. To support marine tourism, leisure diving, fishermen diving and clinical treatment cases.
- 3 Tanjung Wenang District General Hospital, Manado-North Celebes
- Operating 1 Multiplace HC with 4 persons capacity, working pressure 6 ATA. To support marine tourism, leisure diving, fishermen diving and clinical treatment cases.
- 4 District General Hospital Biak-West Papua
- Operating 1 Monoplace HC with 1 person capacity, working pressure 6 ATA. To support marine tourism, leisure diving, fishermen diving and clinical treatment cases. Condition: In reparation.
- 5 Public Health Center (Puskesmas), Serang-Banten
- Operating 1 Multiplace HC with 4 persons capacity, working pressure 3 ATA. To support marine tourism, leisure diving, fishermen diving and clinical treatment cases. Condition: under reconstruction progress.

# IV HYPERBARIC CHAMBER OWN BY PRIVATE SECTOR

- 1 Pantiwaluyo Hospital, Solo-Central Java
- Operating 1 Multiplace HC with 10 person capacity, working pressure 3 ATA. To support clinical treatment cases. Condition: under construction

#### **HUMAN RESOUCES**

- 1. HUMAN RESOUCES FORCES IN THE REFERAL HC (LAKESLA AND Dr. MINOHARJO NAVAL HOSPITAL, JAKARTA), consist of:
  - Consultant Doctor:
  - ·Doctor specialist in Marine Health Consultant with double specialist i.e. ENT; Dermatologist, Surgeon, Radiologist, Physiologist, Work Health Medicine, etc.
  - Other specialist (i.e. Internist, Surgeon, Neuro Surgery, Orthopedic, Physiatrist) with background studies abroad in Diving and Hyperbaric Medical officers of LAKESLA Surabaya with active experience posted in HC Naval Hospital.
- TOHB Implementer Doctors, qualified as:
  - ·Maritime Health Specialists
  - ·Work Health Specialists major in Hyperbaric Medicine
  - · General Practitioner trained with the Diving and Hyperbaric

Medicine course and or trained as Hyperbaric Medical officer.

- TOHB Operating Team, consists of 5 man team per HC:
- 1. Doctor In charge
- 2. Inside Tender: hyperbaric nurse that is responsible of the patients' physical condition

before, during and after TOHB.

- 3. Outside Tender 1: Responsible to conduct TOHB table/ doses therapy prescribe by the doctor in charge and responsible for the patient physical condition post TOHB
- Outside Tender 2: Hyperbaric nurse who responsible for the technical procedure of the TOHB.
- 5. Operator: Technician in charge for the continuity of air and oxygen supply during TOHB, and also in charge of the HC and each supporting equipment maintenance.

The hyperbaric nurse that has fulfilled the above requirement acted as the person in charge.

All team members must qualified as a rescue scuba diver that can be obtain through the formal training in the Navy or through the interdepartment training. Upon accomplishment of TOHB 2 working hours total rest is given

2. HUMAN RESOUCES IN OTHER HYPERBARIC CENTER, generally consist of one or two operating team, each team composed of:

- Doctor in charge :1 person

- Inside tender : 1 person

- Outside Tender 1 : 1 person

- Outside Tender 2 : 1 person

- Operator : 1 person

- Technician : 1 person

The personnel can be added by: Consultant doctor, Hyperbaric nurse, Operator and Technician as require.

### RBCORDS OF THE HYPERBARIC CENTER ACTIVITIES IN INDONESIA.

Until the end of the 1990 decade, the TOHB

activities in Indonesia still limited

/focused to the DCS treatment. Osteomyelitis and Diabetic ulcers dominated LAKESLA, Surabaya. Whereas the development and the progress of the clinical TOHB in Indonesia have the same obstacle that is also faced by other country such as:

- The insufficient support from the Medical School, Indonesian Medical Doctors

  Association (IDI), Medical Specialists Doctors

  Association that the majority of the visiting patient came without the doctors reference letter.
- The TOHB expenses are not covered by the Health Insurance Company (P.T.Askes Indonesia)
- · Inadequate sponsorship from: HC manufacture, Medical Oxygen producers, Pharmacies, etc. This situation has limited the hyperbaric health researches and development progress.
- There are still some limitation in TOHB experimental research towards human (Randomized Controlled Trial Study) to convince the clinic practitioners.

Since 1991 the HC Dr. Mintohardjo Naval Hospital Jakarta has introduce TOHB program for Fitness, Cosmetics and Geriatric as one of the strategy to overcome the obstacle and n order to develop TOHB clinical application. Hence the new program brought the stir in the number of the visiting patients. The number of patients in Jakarta has augmented and exceed to those in Surabaya.

Throughout the observation in the types of cases, numbers of patients, and the total visitors there are 4 Hyperbaric Center in Indonesia that has well-developed, there are: Dr. Mintohardjo Naval Hospital, Jakarta, LAKESLA (Navel Health

**Table 1**: Number of visitors and visits in HC Jakarta, Surabaya, Bali 2001.

NO	CASES	Dr. Mintohardjo		LAKESLA		RSUD BALI
		patients	visits	patients	visits	visits
A	Divers General check up	402	402	@	@	368*
В	Decompression Sickness	22	66	3	7	70
С	Fitness	411	3692	186	720	118
D	Clinical cases	692	5748	229	2911	203
1	Sudden Deafness	274	1783	0	0	110
2	Post Stroke Rehabilitation	175	1502	4	38	0
3	Diabetic foot ulcers	126	1197	98	1414	79
4	Arthralgia/Myalgia	34	214	6	40	0
5	Post Surgery	51	616	45	544	0
6	Osteomyelitis	17	183	9	177	0
7	Combustio	6	142	10	108	0
	Other cases	9	111	57	590	14
	Total	1527	9908	418	3638	759

<sup>@ =</sup> data is not recorded

**Table 3 :** Total number of the visitors and visits at HC Jakarta + Surabaya + Bali 2001 -2002

NO	CASES	Visitors (persons)		Visits		
		2001	2002	2001	2002	
Α	Divers General check up	770	625	770	625	
В	Decompression Sickness	25	22	143	177	
С	Fitness	597	428	4530	2571	
D	Clinical cases	921	968	8862	9558	
1	Sudden Deafness	274	262	1893	2665	
2	Diabetic foot ulcers	274	248	1540	2437	
3	Post Stroke Rehabilitation	179	92	2690	891	
4	Post Surgery	96	112	254	1088	
5	Diabetic Mellitus	0	41	0	327	
6	Arthralgia/ Myalgia	40	26	1160	257	
7	Osteomyelitis	26	26	360	360	
8	Combustio	16	0	250	0	
9	Vertigo	0	29	0	343	
10	Chephalgia	0	19	0146		
	Other cases	66	113	715	1044	
	Total	2313	2043	14305	12931	

Institute), Surabaya; Sanglah District General Hospital. Bali; Pertamina Hospital, Balikpapan. At the 4 Hyperbaric Centers mentioned above the total TOHB number for clinical cases is more than the total TOHB number for diving cases. In the other remain 11 hospital TOHB is still dominated by DCS, Diabetics gangrene, Osteomyelitis and other surgery cases.

The ratio between the divers check up, DCS, the largest clinical cases and the Fitness program in:

**Table 2 :** Number of patients and visits at HC Jakarta, Surabaya, Bari 2002

NO	CASES	Dr. Mintohardjo		LAKESLA		RSUD BALI
		patients	visits	patients	visits	visits
Α	Divers General check up	333	333	@	@	292
В	Decompression Sickness	15	45	7	37	95
С	Fitness	289	1897	139	648	26
D	Clinical cases	597	5902	371	3410	246
1	Sudden Deafness	262	2514	0	0	151
2	Diabetic foot ulcers	97	989	151	1375	73
3	Post Stroke Rehabilitation	85	806	7	74	11
4	Diabetic Mellitus	36	290	5	37	0
5	Post Surgery	29	254	83	834	0
6	Vertigo	29	338	0	0	5
7	Chephalgia	19	146	0	0	0
8	Osteomyelitis	17	183	9	177	0
9	Myalgia/ Arthralgia	14	160	12	97	0
	Other cases	9	222	104	816	6
	Total	1234	8177	517	4095	659

<sup>@ =</sup> data is not recorded

Dr. Mintohardjo Naval Hospital, Jakalta; LAKESLA (Navel Health institute), Surabaya; Sanglah District General Hospital, Bali for the year 2001 and 2002 are listed in the following table below;

#### DISCUSSION

From table 1 and 2 above we can draw some conclusion:

The total patients visit for the highest Decompression Sickness treatment is in HC Sanglah Hospital, Bali. Probably it is a result of the high rate of the recreational diving activities in addition with the diving activities perfomled by the traditional divers in Bali Island. Lombok and its surrounding. Without the support of sufficient knowledge, proper attitude and adequate practice to perform safe dive that causes the high rate of Decompression Sickness. The particular cases in Indonesia happen often to many traditional divers and recreational divers, but it seldom occurs to the military divers and professional worker diver.

- · Medical Check up for the military diver, professional dive worker, and also dive hasn't reached the traditional group divers. The check up data from the LAKESLA divers cannot be exposed because it is a part of the health regular check up to test the combat ability of the Navy soldiers that consists of: underwater construction, special war fare and Marine Corps.
- · In general the participants for the fitness programme has the highest rate of visitors. However the number is still considered low with the average 8 visits in the year of 2001 and 6 visits in the year 2002 where as expected 20 to 30 visits per participants per annum.

From table 1,2,3 TOHB clinical case can be concluded as follows:

 The highest number of patients and visits with the Sudden Deafness cases in HC Jakarta and Bali although its TOHB clinical application has only recently known.

But in HC LAKESLA Surabaya Sudden Deafness cases in not included in the top ten clinically case. Maybe that is because TOHB has only been introduce as a subsidiary therapy for the Sudden Deafness case.

- The next four group of case are Diabetic foot ulcers, Post surgery, Post Stroke Rehabilitation, Vertigo. Besides the cases that are listed on the table recently there are also a tendency in TOHB clinical application on the case such as closure of central retinal artery.
- · In most of the Post Stroke Rehabilitation cases the majority of the patients came late without the doctors referral therefore their healing process and their neurological status often beyond satisfactory to the patients, family member or the medical doctors in charge. To

avoid amputation to Diabetic gangrene patients and Post Stroke Rehabilitation patients most of them consider TOHB as an alternative treatment.

Besides the various types of the cases, the clinical specialist and general practitioners, acceptance to TOHB application varies to different area. TOHB clinical services include the supporting equipment and the human resource haven't yet the standardize services rules, in fact the publics need TOHB therefore the cooperation of Indonesian Hyperbaric Medicine Society has conducted several workshop and meetings to set up the standard. The workshop result titled "Standarisasi Pelayanan Kesehatan Penyelaman dan Hiperbark di Indonesia" (Standarisation Diving and Hyperbaric Health Services in Indonesia); and "Standarisasi Kompetensi Tenaga Kerja Kelautan dan Penyelaman" (Standardization of Competency Maritime and Diving Man Power) was introduced in the VI National Congress of Indonesian Hyperbaric Medicines Society in Denpasar, Bali recently. It is expected with establishment of those standard will expedite the development of Hyperbaric Health in Indonesia.

#### CONCLUSION

- 1. There are 15 hospitals in Indonesia that has been equipped with the HC under the referral of LAKESLA, Surabaya for East Indonesia Region and Dr. Mintohardjo Naval Hospital, Jakarta for the West Indonesia Region.
- 2. Both Hyperbaric Medical Center activities consist of diving operation support, Hyperbaric health services; Function for promotion and prevention; Training and researches.
- 3. With the foresaid standard enforce and the

cooperation amongst the 15 Hyperbaric Centers and other relevance instances there is high expectancy to fulfill minimum needs in supporting the diving activities throughout Indonesia.

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