

TREN ISU RUBT & pengembangan HBO ditengah arus globalisasi era society 5.0



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Seminar Nasional Kelautan HUT STIKES Maluku Husada Ke 10

Ambon, 29 Februari 2020



- **Kata Kunci**

- **Generasi Milenial**
- **Revolusi Industri 4.0**
- **Society 5.0**
- **Cinta Tanah Air**

Revolusi
Industri
4.0

- Advanced Robotics
- Artificial Intelligence
- Internet of Things
- Virtual and Augmented Reality
- Additive Manufacturing
- Distributed Manufacturing

Society 5.0

- Hunting Society
- Agrarian Society
- Industrial Society
- Information Society
- Super Smart Society

- BIOTHRAT :**
- Sulit Dideteksi
 - Cepat Menyebar
 - Mematikan

BIOTERORISM



Cinta Tanah Air



INDONESIA



“Rencana Strategis Pengembangan TOHB dan Sentra TOHB di Wilayah Maluku”



ð WAWASAN NUSANTARA:

- Lautan/ Selat diantara pulau-pulau merupakan jembatan pemersatu wilayah tanah air Indonesia.
- Jumlah pulau: 17.840.
- 2,01 juta km² daratan ; 3,25 juta km² lautan.

ð Penduduk yang tinggal di pantai bermata pencaharian terkait laut.

ð Akibat dari pekerjaan di laut banyak terjadi kasus kecelakaan & memerlukan penanganan cepat.

ð Sangat diperlukan peningkatan SDM sebagai pelaksana dukungan dan pelayanan kesehatan khususnya siaga selam.

ð Sesuai dengan program pemerintah untuk menyongsong arus globalisasi era society 5.0 dan pemanfaatan kemajuan pengetahuan bangsa kita di era industri 4.0 maka peningkatan dukungan pelayanan kesehatan pada kecelakaan laut khususnya kecelakaan penyelaman sangat perlu adanya langkah maju.



SDM PESISIR PANTAI

- Nelayan
- Peselam
- Perdagangan pantai
- Pekerja pelabuhan
- Keluarga masyarakat pesisir





PENINGKATAN PENGETAHUAN & KETERAMPILAN SDM

- Peselam & Tenaga Kesehatan Pelayanan Kesehatan
- Peningkatan Pengetahuan & Keterampilan Terkait Penyelaman & TOHB

Terapi Oksigen Hiperbarik meliputi sebagai berikut:

- ✓ Sejarah
- ✓ Teori selam; Hukum-hukum fisika
- ✓ Penyakit-penyakit akibat penyelaman
- ✓ Tabel-tabel pengobatan
- ✓ Tabel-tabel penyelaman
- ✓ Pengetahuan tim kesehatan dukungan kegiatan selam
- ✓ Pengetahuan tentang evaluasi korban kecelakaan penyelaman





Activities associated with Diving

PEARL & AQUACULTURE

ARKEOLOGI

UNDERWATER TRAVEL

MILITARY OPERATION

CIVIL CONSTRUCTION

SALVAGE

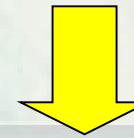
EXPLOITATION OF OIL AND GAS EXPLORATION

HYPERBARIC OXYGEN TREATMENT

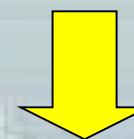
CAISSON/TUNNEL WORKER



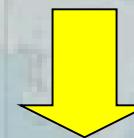
DIVING ACTIVITIES



ACCIDENT/WRECK



DIVING MEDICINE



HYPERBARIC THERAPY



Is the Hyperbaric Oxygen Treatment?

Hyperbaric Oxygen Treatment is:

**Treatment that combines breathe 100% oxygen with a pressure
of more than 1 to 3 in the Hyperbaric chamber atmosphere
absolute (RUBT)**



TERAPI OKSIGEN HIPERBARIK:

Suatu terapi dimana pasien bernafas menghirup oksigen murni di dalam ruangan bertekanan tinggi (*Hyperbaric Chamber*).

TUJUAN:

MENINGKATKAN KADAR OKSIGEN DALAM DARAH & JARINGAN.





Terapi Oksigen Hiperbarik



MONOPLACE CHAMBER



MULTIPLACE CHAMBER





INDIKASI TERAPI OHE

A. PENYAKIT PENYELAMAN

1. PENYAKIT DEKOMPRESI
2. EMBOLI / SUMBATAN OLEH GAS/UDARA

B. PENYAKIT KLINIS

1. KERACUNAN CO (KNALPOT, PEMANAS RUANGAN)
2. LUKA MEMBUSUK / GAS GANGREN, LEPRA, INFEKSI TUL
3. LUKA BAKAR
4. TETANUS
5. BEDAH PLASTIK DAN REKONSTRUKSI
6. BEDAH TULANG (PATAH TULANG TAK MENYAMBUNG)
7. PENYAKIT PEMBULUH DARAH TEPI / BUERGER'S
8. NEUROLOGI/ PENYAKIT SARAF (STROKE, MIGRAIN, PIKU)
9. DIABETES (KENCING MANIS)
10. ANEMIA

KONTRA INDIKASI

ABSOLUT

- PNEUMOTORAK YANG BELUM DI TERAPI

RELATIF

- INFEKSI SALURAN NAFAS ATAS
- SINUSITIS KRONIS
- EMFISEMA DISERTAI RETENSI CO₂
- PENYAKIT KEJANG
- PANAS TINGGI YG TIDAK TERKONTROL
- RIWAYAT PNEUMOTORAK SPONTAN
- NEURITIS OPTIK
- RIWAYAT OPERASI DADA ATAU TELINGA



Komplikasi THBO

- 1). Barotrauma
- 2). Keracunan O₂

Pelaksanaan THBO mempertimbangkan

- Kasus emergensi /elektif
- Faktor ekonomis
- Pasien lama / baru
- Tabel terapi & dosis terapi
- Faktor estetika
- Faktor penularan penyakit
- Syarat bila melakukan penerbangan



Terapi HBO pada Decompression Sickness/DCS

- đ Terapi hrs dilaksanakan sebelum 6 jam, maksimum 12 jam setelah timbul gejala
- đ Silent bubble → tdk ada gejala
- đ Berdasarkan teori neohaldanian → mengembalikan peselam pd kedalaman semula
- đ Tabel pengobatan: US navy, Royal Australian Navy, Royal British Navy, Comex, Padi



Tabel Terapi Rekompresi US Navy

- ð **Tabel terapi dgn udara tekanan tinggi**
tabel 1a,2a,3,4 → sdh ditinggalkan
- ð **Tabel terapi dgn oksigen tekanan tinggi**
Tabel 5 &6 → DCS type 1
Tabel 5a & 6a → DCS type 2
 O_2 dipakai pada kedalaman 60 fsw utk mencegah keracunan
- ð **Rekompresi basah ditempat kejadian**



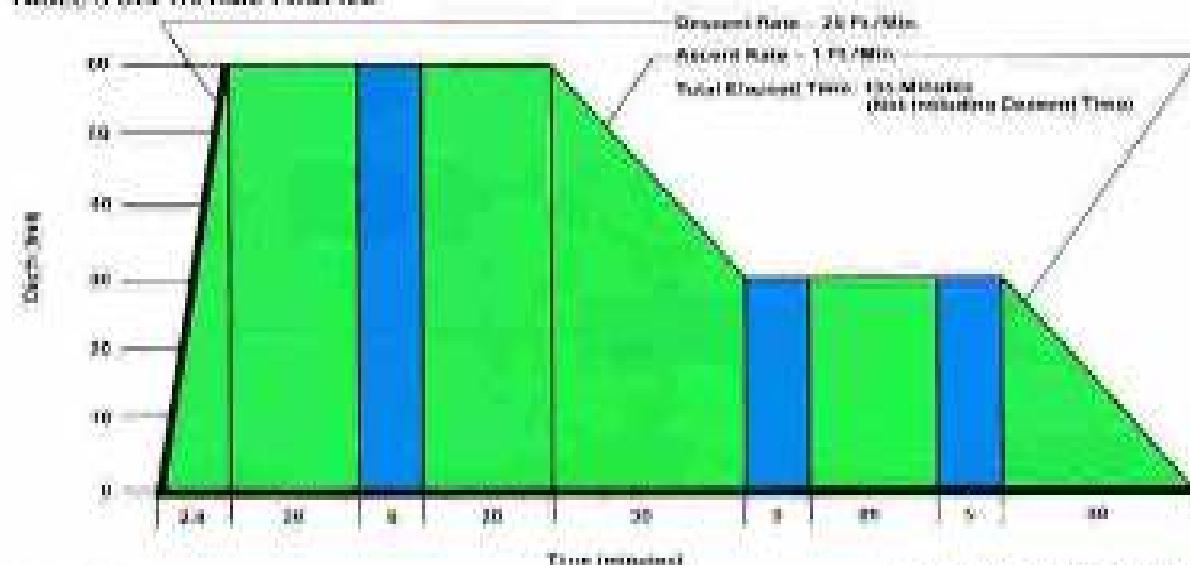
Treatment Table 6

OXYGEN TREATMENT OF TYPE I DECOMPRESSION SICKNESS

1. Treatment of Type II decompression sickness when symptoms are relieved within 10 minutes at 60 feet and a complete neurological exam is normal.
2. Pigment rate — 25 ft/min.
3. Ascent rate — 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halving the ascent.
4. Time at 60 feet begins on arrival at 60 feet.
5. If oxygen breathing must be interrupted, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 6.13.6.1).
6. If oxygen breathing must be interrupted at 60 feet, switch to Table 8 upon arrival at the 60-foot stop.
7. Tender breathes air throughout unless he has had a hyperbaric exposure within the past 12 hours, in which case he breathes oxygen at 60 feet in accordance with paragraph 6.13.6.7.

Depth ft/min	Time (minutes)	Breathing Media	Total Pigment Time (minutes)
60	20	Oxygen	0.20
60	5	Air	0.05
60	20	Oxygen	0.15
60 to 30	30	Oxygen	1.15
30	5	Air	0.20
30	20	Oxygen	1.40
30	5	Air	0.45
30 to 0	30	Oxygen	2.15

TABLE 6 DEPTH/TIME PROFILE





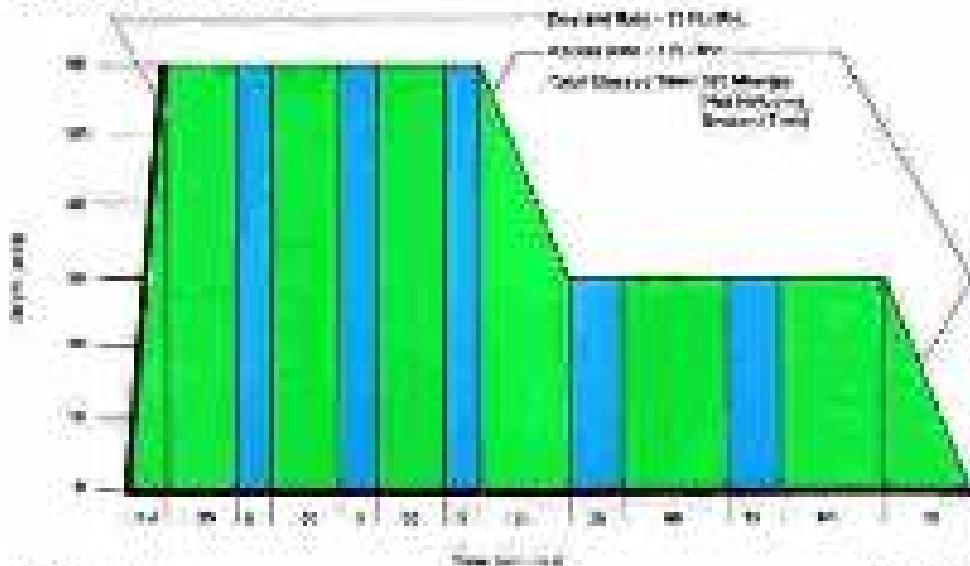
Treatment Table 6
OXYGEN TREATMENT OF TYPE II DECOMPRESSION DISEASE

1. Treatment of Type I or Type II decompression disease begins when symptoms are noticed within 12 minutes on C2 level.
2. Duration rule = 25 ft-min.
3. Pressure rule — 1 barorel (do not compensate for water pressure until decompression begins after 100 ft-min of bottom time).
4. Nitrogen off, start oxygen at arterial 60 mmHg.
5. Oxygen breathing starts 10 minutes after the bottom has entirely finished and oxygen supplemental starts at minimum level (approximately 0.12-0.13).
6. Nitrox dissolved in supplemental unless the bottom has depth > 120 ft-min, in which case oxygen is less than 0.20, but if more than 100 ft-min with gas switch 0.12-0.13.
7. May be open to supplemental up to 12 additional 10 minute periods of 60 min/100 ft-mins or more, in which case 0.12-0.13.

or to 100 ft-min/100 ft-mins or both. If Type II is determined to be 100% nitrogen off or 60-62 mmHg, then normal treated oxygen during the ascent from 30 ft-min to the surface. If more than one bottom is done, the cycle begins oxygen breathing for the last 100 ft-min during ascent to the surface.

Depth ft-min	Time min	Bottom Time	
		Mode	Seconds
60	30	Oxygen	300
60	30	Air	300
60	30	Oxygen	345
60	30	Air	345
60	30	Oxygen	390
60	30	Air	390
60-120	30	Oxygen	300
30	120	Air	3600
30	120	Oxygen	3600
30	120	Air	3645
30	120	Oxygen	4050
30	120	Oxygen	4455

TIME-DEPTH PROFILE





Treatment Table 6A

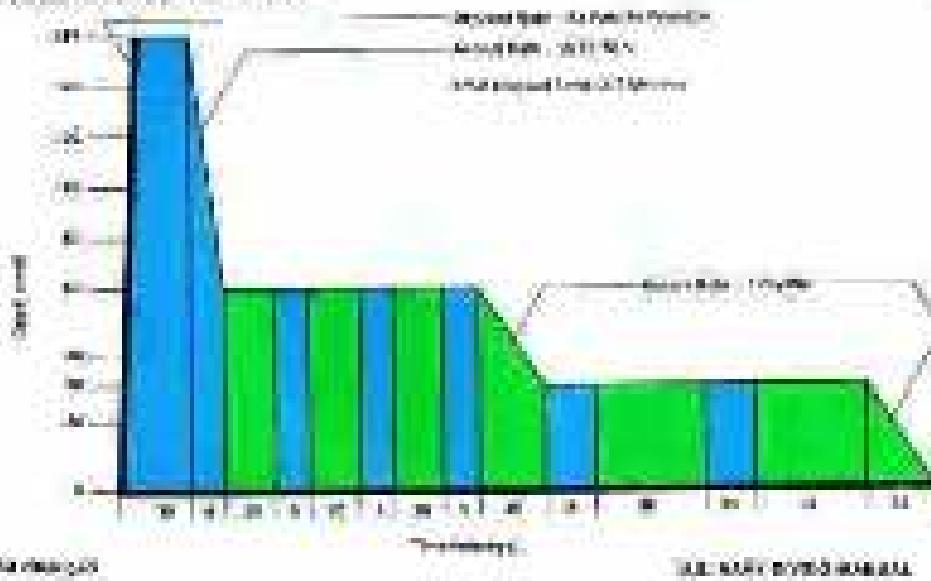
MATERIALS AND CRYPTOGRAPH TREATMENT OF ARTIFICIAL GAS EMBOLISM

1. Treatment of arterial gas embolism where "surgeon's rule" is followed when >30 mm Hg of gas has been shown to be in the arterial system after decompression and before the onset of symptoms or death.
2. Diver's rule — no fast decompression.
3. Pressure reduction. Do not compromise by releasing nitrogen bubbles. Concentrate for faster decompression by holding first pressure.
4. Time on 100% test — 100 seconds between the two times.
5. Treatment of air embolism must be interrupted when 100 seconds after the previous test, namely nitrogen bubbles are released at point of decompression (See Treatment 4, 10.2).
6. Treatment of oxygen bubble disease must be done to the patient under the medical direction of a medical director who can do internal release with oxygen bubbles until 100 seconds in accordance with paragraph 515.6.2.
7. Treatment of carbon dioxide embolism during decompression periods as outlined (See treatment 4).

oxygen and/or nitrogen with 100% oxygen (maximum partial pressure 30 mm Hg) and pressure on oxygen and 15 mm Hg (or 1 mm Hg of gas). If pulse CO₂ is available in excess of 15 mm Hg, the bubble removal may begin as soon as 15 minutes of the treatment. All treatments of 20 and 30 seconds will be carried out in the manner described, excepting those obtained without decompression of 100 seconds, which see Table A. Good luck with a Nuclear Medicine Doctor before starting if possible.

Depth Fathoms	Time seconds	Decompression method	Total pressure
100	2	Oxygen	100
90	2	Oxygen	90
80	2	Oxygen	80
70	2	Oxygen	70
60	2	Oxygen	60
50	2	Oxygen	50
40	2	Oxygen	40
30	2	Oxygen	30
20	2	Oxygen	20
10	2	Oxygen	10

TABLE A: CRYPTOGRAPH PROFILE



100 seconds

Decompression

Time (seconds)

Decompression

Depth (fathoms)

Decompression

Pressure (mm Hg)

Decompression

Time (seconds)

Decompression

Depth (fathoms)



TOHB di INDONESIA

< 2008

- Kasus Penyelaman >>>
- Indikasi Medis >
- Pelayanan Hiperbarik
Pemerintah (Angkatan Laut
→ LANTAMAL IX AMBON)





SARANA KESEHATAN dengan RUBT di INDONESIA

NO	NAMA RS	KOTA	JUMLAH	KONDISI
1	RS PT ARUN	Lhoksumawe	2	Operasional
2	RSAL dr. Midiyato-S	Tanjungpinang	1	Operasional
3	RSAL dr. Mintohardjo	Jakarta	4	Operasional; 3
4	Klinik Spesialis Ambar	Jakarta	1	Operasional
5	Pulau Pramuka	Kep. Seribu, Jakarta	1	Operasional
6	RS Pertamina Cilacap	Cilacap	1	Operasional
7	TAKESLA	Surabaya	3	Operasional
8	RSUD Sanglah	Denpasar, Bali	1	Operasional
9	RS Pertamina Balikpapan	Balikpapan	1	Operasional
10	RSUD Makasar	Makasar	1	Operasional
11	RSUD Gunung Wondong	Manado	1	Operasional
12	RSAL Halong	Ambon	1	Operasional
13	RSUD Blak	Blak	1 (Monoplace)	Operasional
14	RS China Oil Co.	Kasim, Sorong, Papua	1	Operasional
15	RS Pantai Wahyu	Solo	1	Rerkonstruksi
16	Puskesmas Serang	Serang	1 (Monoplace)	Operasional

KONDISI LAYANAN SAAT INI TERKAIT HIPERBARIK

**KOMPETENSI DAN SARANA YANKES BELUM
OPTIMAL → PENYAKIT AKIBAT HIPERBARIK
BELUM TERTANGANI→ KEDARURATAN**



- ð KURANGNYA PENGETAHUAN TENTANG KESEHATAN PENYELAMAN BAGI PETUGAS DI FASILITAS KESEHATAN DASAR MAUPUN RUJUKAN
- ð KURANGNYA FASILITAS LAYANAN KESEHATAN HIPERBARIK
- ð KURANGNYA PENGETAHUAN MASYARAKAT/ TEANAGA KESEHATAN TENTANG KESEHATAN HIPERBARIK



Potensi Propinsi Maluku

- ð Maluku > 90% laut
- ð Potensi Kekayaan Laut :
 - Pariwisata laut (penyelaman di P. banda)
 - ð Prasarana penunjang penyelaman
 - ð Health tourism
 - ð Meningkatkan kesehatan medis lainnya
 - Sumber daya laut :
 - ❖ Mutiara (Kep Kei)
- ð Kesehatan Kerja
 - Pembangunan pelabuhan baru
 - Pekerjaan penambangan (offshore)

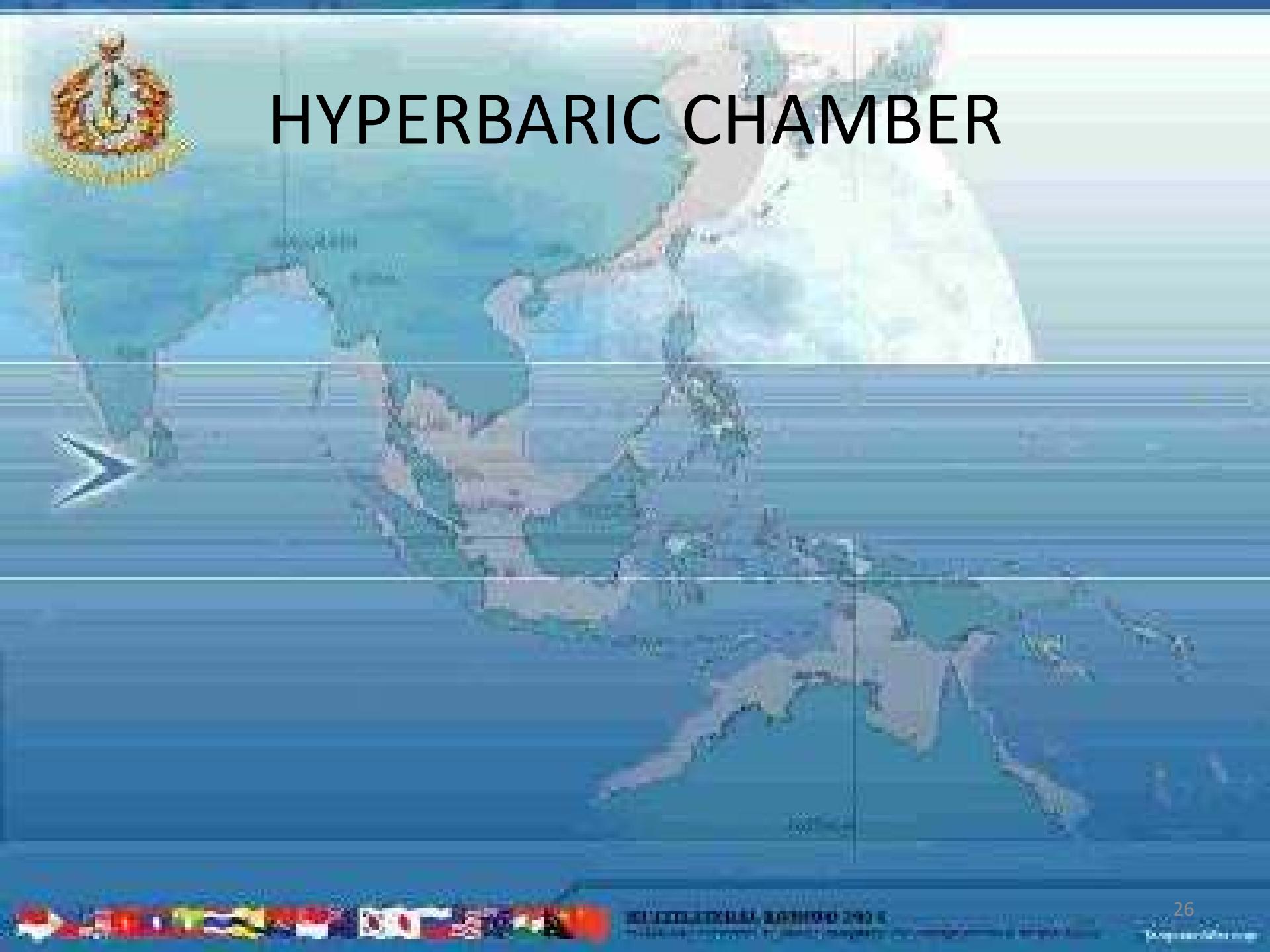


SDM Petugas Hiperbarik

- ð Dokter Umum
 - (telah ditraining untuk mengoperasikan Hiperbarik)
- ð Perawat
 - (ditraining untuk mengoperasikan Hiperbarik dan penanganan pasien Hiperbarik)
- ð Tehnisi Hiperbarik
 - * *Training bekerjasama dengan Angkatan Laut (Jakarta, Surabaya) → LANTAMAL IX AMBON*



HYPERBARIC CHAMBER





Model of Hyperbaric chamber

1. Multiplace Chamber
2. Duoplace Chamber
3. Monoplace Chamber
4. *Hyperlite*





Hyperbaric Chamber Duo Place

Back view



Side view





HIPERBARIK CHAMBER RUMKITAL dr FX

Suhardjo Lantamal 9 Ambon saat ini

CHAMBER HIPERBARIK LAMA



CHAMBER HIPERBARIK BARU





HMS MULTIPLACE CHAMBER RSUD RAJA AMPAT, PAPUA BARAT





RUMKITAL J.LILIPORY SABANG





RS PUSREHAB KEMHAN DR. SUYOTO



PERSATUAN OLAHRAGA SELAM SELURUH INDONESIA





RSUD KOTA MATARAM, NTB





Mobile Hyperbaric Chamber MARINIR TNI AL





Mobile Hyperbaric Chamber

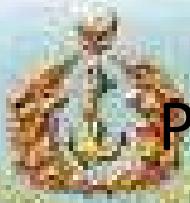
DISPOTMAR TNI AL





**PUSAT PENYELAMAN DAN TERAPI OKSIGEN
HIPERBARIK RUMKITAL dr FX Suhardjo
Lantamal 9 Ambon**

- EMERGENCY DIVING RESCUE
- DECOMPRESSION SICKNESS
- CLINICAL DISEASES
- COMBAT CAPABILITY TEST



PASIEN DEKOMPRESI DILAKUKAN THERAPY HBO



PROCESS

□ 1. EMERGENCY DIVING CASES & DECOMPRESSION SICKNESS



□ 2. CLINICAL DISEASE “Ulcus Diabetic”



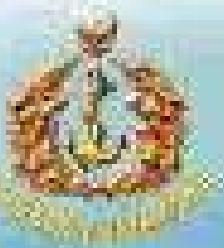


3. COMBAT CAPABILITY TEST



4. CONDUCTING RESEARCH, COURSE AND DEVELOPMENT IN THE FIELD OF NAVAL MEDICAL SCIENCE





CHARACTERISTICS OF HYPERBARIC THERAPY

- ❖ Safety
- ❖ Comfortable
- ❖ Non Invasive
- ❖ Physiological
- ❖ Clinical Trial
- ❖ Clinical Indicator :

***DOSIS, INDICATION, CONTRAINDICATION,
COMPLICATION, SIDE EFFECT***

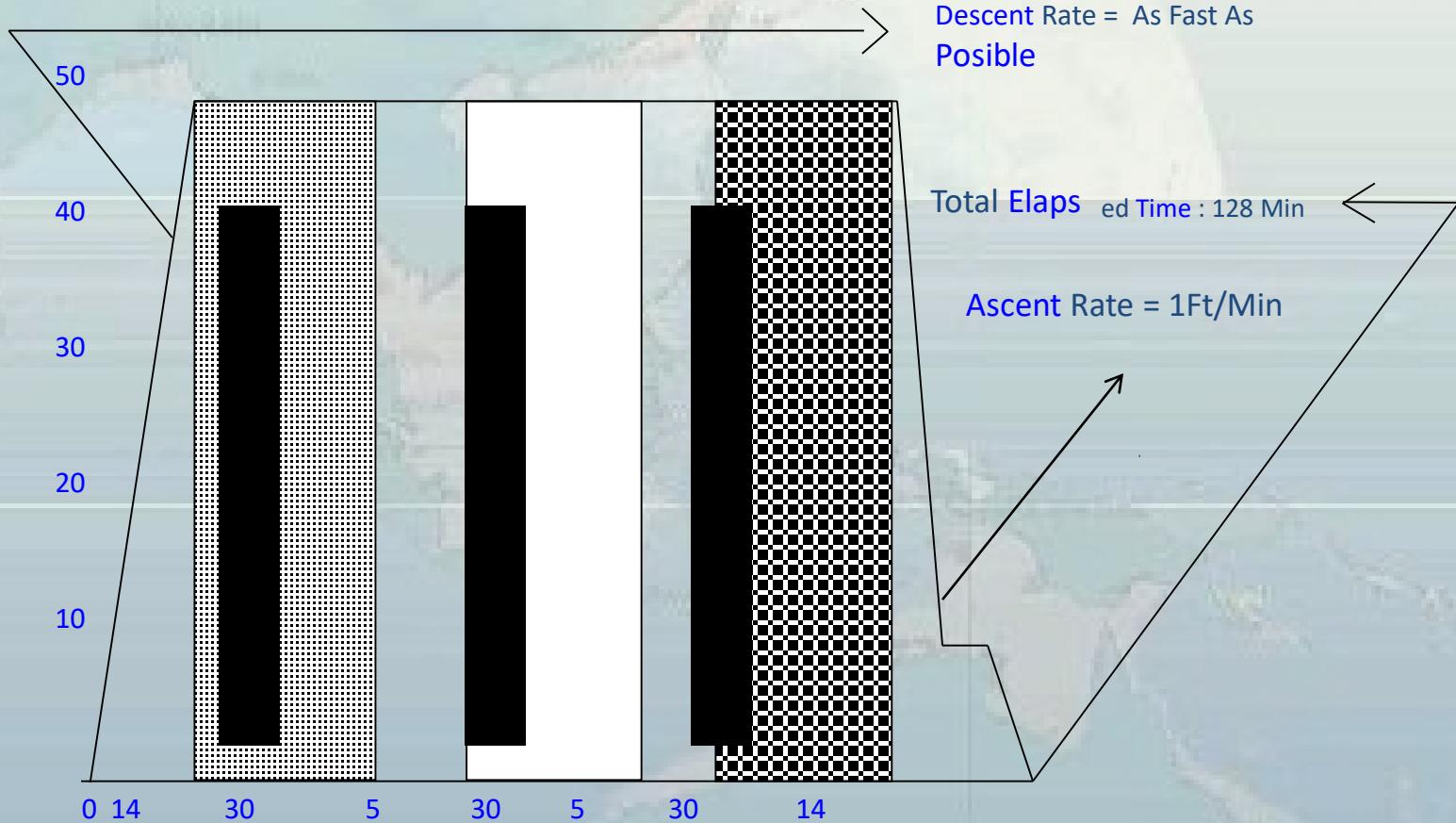


THERAPY

OHB therapy on clinical case put on a table Kindwall modification Guritno DNG pressure of 2.4 ATA for 3x30 minutes 100% O₂ suction interspersed with 5 minutes of air suction.



Fabel Kindwall



Tn. S 63 Thn, 2 FEB 2007



7 MAR 2007 (1 MO)



DEBRIDEMENT, 8 FEB 2007



18 APRIL 2007 (2 MO)



17 FEB 2007 (D-9), AFTER HBOT 5 X



16 MAY 2007 (3 M)



22 FEB 2007 (D-14), AFTER HBOT 10 X



20 JUNE 2007 (4 MO)



18 JULY 2007 (5 MO)





Lisa Face Off , Post Flap

PRA HBO



POST HBO





Case Report : SCALP DEGLOVING

MOI : Engine Boat Accident

Loc : Raja Ampat (Januari 2014)





Case Report : SCALP DEGLOVING

MOI : Engine Boat Accident

Loc : Raja Ampat (Januari 2014)





POST TERAPI OKSIGEN HIPERBARIK



Perkembangan Hiperbarik Jepang

- ⇒ JMSDF (Japan Maritime Self Defence Force)
- ⇒ Japan Undersea Medical Center (JUMC)
- ⇒ Underwater Medical Center (UMC)

JMSDF Undersea Medical Center

Location:

Yokosuka-city, Kanagawa, Japan

History:

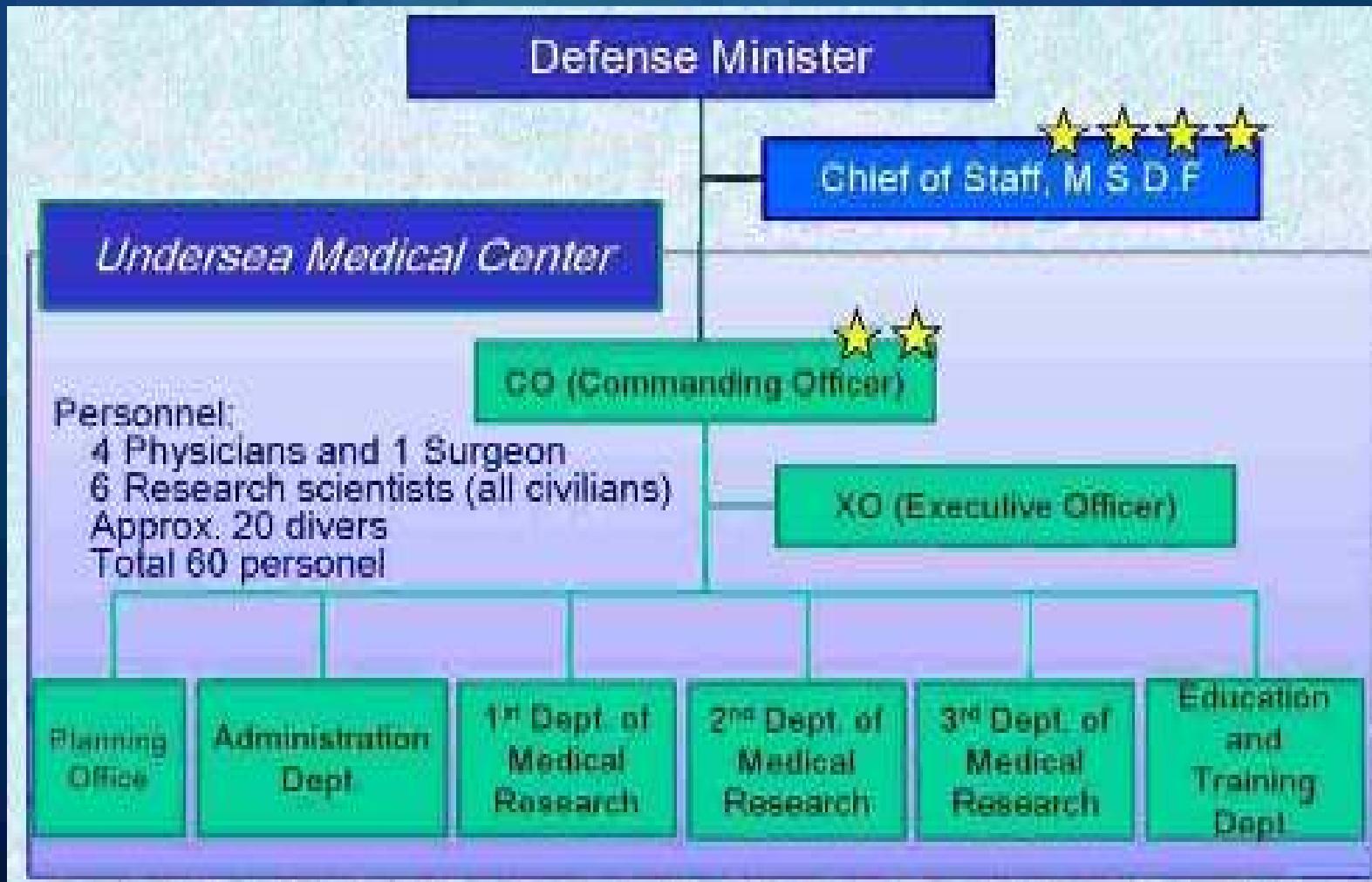
Feb. 1967 Organized as Undersea medical section
in JSDF Hospital Yokosuka.

Dec. 1977 Newly organized as JMSDF Undersea
Medical Center in Kurihama

Sep. 2012 Relocated from Kurihama to Taura
in Yokosuka.



Chain of command





UMC facilities



Our missions



Research

Research, experiment and testing on diving medicine and equipment



Education & Training

Education and training for saturation divers, diving medical officers and JMSDF crew.



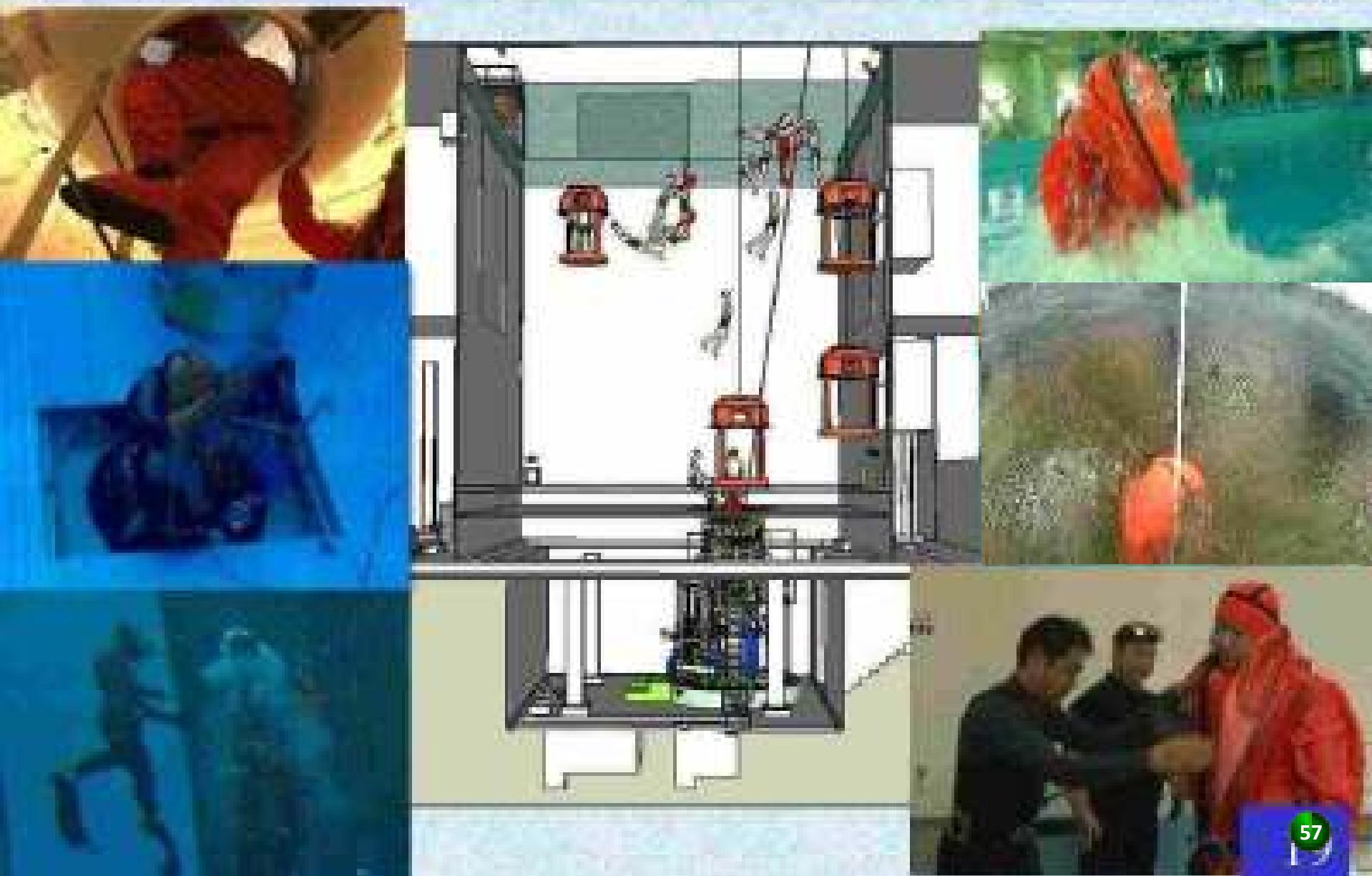
Medical Support

We provide hyperbaric oxygen therapy and aptitude testing for submariners and divers.

Diving Medical Officers Course



To Provide Submariners Confidence in an Emergency



Exercise area





simulation





Hyperbaric Chamber

Characteristics

- NATO STANAG flange

Specifications

Max. treatment pressure :

0.49Mpa (5.8ATA)

Capacity : 8 persons

Compression gas : Air

Size :

Diameter, 2.8m

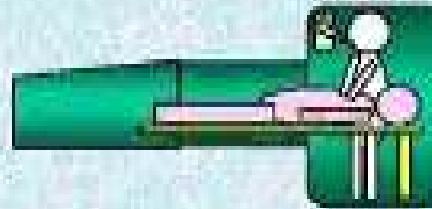
Length, 6.0m



Hyperbaric chamber connected to 2-men portable recompression chamber



Connecting 2-men Portable Recompression Chamber through NATO flange



2-man portable recompression chamber



SARAN TINDAK LANJUT PENYELAMAN SESUAI PERKEMBANGAN ILMU PENGETAHUAN (4.0)

- ð Penyebaran buku-buku, permen, juknik dan informasi lain tentang penyelaman ke seluruh Stake holder
- ð Mengikuti pelatihan kedokteran kelautan/penyelaman/hiperbarik bagi dokter, perawat, teknisi serta peselam.
- ð Instalasi pusat chamber hiperbarik di daerah yang ada kegiatan selam dilakukan pendataan dan dilakukan monitoring evaluasi , kerjasama antara Kemenkes dan TNI/TNI AL
- ð Informasi dunia selam dan kedokteran kelautan serta antisipasi darurat melalui internet/media sosial/start-up.





KESIMPULAN

- Untuk menurunkan angka kecelakaan pada penyelaman maka diperlukan sosialisasi dan pelatihan tenaga medis terutama penggunaan sarana internet, IT dan GPS
- Menyiapkan dukungan kesehatan pada setiap kegiatan penyelaman untuk meminimalisasi kejadian kecelakaan penyelaman
- Melakukan uji kemampuan penyelaman bagi penyelam secara berkala dengan pencatatan komputerisasi
- Melakukan pelayanan kesehatan dan evakuasi medis laut dengan menggunakan teknologi satelit atau radar
- Menggunakan sarana teknologi informasi seperti internet untuk melakukan pencegahan dini terhadap resiko terjadinya kecelakaan penyelaman

**THANK YOU
FOR YOUR ATTENTION**

