Hyperbaric Safety Talks

European Baromedical Association

for nurses, operators and technicians

Book of Abstracts

HST 1st Edition on EUBS 2025

INTRODUCTION

Hyperbaric Safety Talks (HST)

Hyperbaric Safety Talks (HST) is proposed as an annual platform dedicated to advancing safety in hyperbaric medicine through structured dialogue, knowledge exchange, and cross-disciplinary collaboration.

Positioned at the interface between clinical and technical practice, HST aims to convene professionals from across the hyperbaric field to address contemporary challenges, disseminate best practices, and explore future developments in safety.

The initiative is envisioned as an annual in-person session held alongside the European Underwater and Baromedical Society (EUBS) Congress, thereby maximising engagement and leveraging an established international audience.
Alternative alignment with the EUBS General Assembly or other coordinated events may also be considered to ensure flexibility and continuity.

With a dual focus on technical/operational safety and clinical safety, HST promotes a unified approach to risk management, encourages standardisation, and strengthens the culture of safety across hyperbaric facilities worldwide.

Ultimately, the initiative seeks to position safety not merely as a regulatory requirement, but as a shared professional value and a driver of excellence within the field.
We extend our sincere gratitude to all presenters and participants for contributing to this inaugural edition.

We look forward to welcoming you to Geneva for HST_2!!

Manuel Preto
Safety Committee Chairman

Manuel Preto*

Session: Hyperbaric Safety Talks - 1
Presentation Type: Oral Presentation
Title: *The Present… What Lies Ahead?*

Abstract:

Hyperbaric medicine operates in inherently high-risk environments where safety is fundamental to both patient care and operational integrity.

This presentation reviews the current state of hyperbaric safety, identifies persistent gaps, and proposes a forward-looking strategy aimed at achieving a more standardised and resilient field.

Despite well-established engineering standards, operational protocols, structured training pathways, and quality assurance systems, variability between centres, inconsistent incident reporting, and uneven regulatory oversight remain significant challenges.

Emerging technologies and system-based governance models offer opportunities to address these limitations.

Drawing on safety frameworks from high-reliability industries such as aviation, a roadmap is proposed that emphasises global standardisation, transparent reporting, and the cultivation of a robust safety culture.

The future vision is a globally aligned hyperbaric practice in which safety is fully embedded in both systems and professional culture.

(Presentation enclosed)

* *Dubai Police Hyperbaric Centre, (UAE)*
DAN Europe (Italy)

Hyperbaric Safety Talks

The present...
What lies ahead?!

Manuel Prata
September 2025

1

Hyperbaric Safety

Safety (in hyperbaric medicine) is the disciplined use of, **engineering, procedures safeguards**, and **clinical protocols** to mitigate risks (in high-pressure oxygen or air environments). Its purpose is to protect patients, staff, and equipment from physiological, technical, and environmental hazards while ensuring safe and effective treatment.

Hyperbaric safety is the philosophy of transforming high-risk environments into spaces of trust for our staff and patients by combining vigilance, respect, and a culture of responsibility.

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Why safety matters

- **Patients trust us with their safety and lives**
- **Complex environment = multiple risk factors**
- **Different realities – One global industry**
- **One incident can undermine confidence in the industry**

Safety in hyperbaric medicine is not optional, it is foundational.
Like aviation, our industry depends on public trust and zero-tolerance for avoidable errors.

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Current best practices_1

The safety pillars (today)

- **Engineering & Design Standards**
  ASME PVHO-1, PVHO-2, EN 14931, EN-ISO 14971, EN 16081
- **Operational Procedures**
  UHMS ECHM EDTC…
- **Training & Competency**
  NBDHMT, ECB, EBAss, DAN…
- **Maintenance & Quality Assurance**
  DNV, Lloyd's, Bureau Veritas, RAG's (Risk assessments and safety audits)
- **Incident Reporting & Learning**
  UHMS, DAN, !!!!

These are our current safety pillars – The backbone of safe hyperbaric operations
We have standards, audits, and training pathways. But regional fragmentation remains!!!

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Current best practices_2

The safety pillars (today)

- **Pre/Pos-operation checklists**
- **Strict gas management protocols**
- **Crew resource management (team communication)**
- **PPE, fire risk control, emergency drills**
- **Continuous education & retraining**

These are the daily practices that keep our chambers safe.
Checklists, protocols, and teamwork, much like in aviation.

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Where we fall short ??!!

The safety pillars (today)

- **Variability between centers & countries**
- **Lack of universal certification for operators**
- **Inconsistent incident reporting & root cause analysis**
- **Unequal regulatory oversight**

Our weaknesses today, lack of consistency, fragmented certification, and underreporting are barriers to aviation-like safety.

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Emerging challenges

- **Higher patient volumes (diabetes, chronic wounds)**
- **New technologies (portable chambers, hybrid designs)**
- **Integration of AI monitoring & data logging**
- **Aging infrastructure in some facilities**
- **Making hyperbaric centers financially sustainable**
- **New additions to the clinical framework (Indications)**

As hyperbaric medicine expands, the risks change too, technology is evolving, but so are the demands on our facilities and staff.

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The actual trends_1

Technology-Driven Safety

- **Monitoring and vigilance – human based**
- **Redundancy and fail-safe design**
- **Standardization of procedures across centers**
- **Routine scheduled maintenance and checks**

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The actual trends_2

People & Training

- **Human-centered safety**
- **From knowledge to culture**
- **Practical skills and scenario-based exercises**
- **Continuous improvement**

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The actual trends _3

System Approach & Governance

- **Holistic – System based on safety engineering**
- **Incident report and investigations trough general structures**
- **Badges of competence – already changing**

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Learning from aviation

Aviation 30/40 years ago moved from fragmented national rules → ICAO global alignment → regional regulators (EASA) → harmonized technical + SMS framework.

- Standardized checklists & **procedures**
- International **harmonization of training** & certification
- Culture of **"no blame** but learn**"** incident reporting
- Continuous **improvement** cycle

Aviation didn't get safe by chance, it was systematic.
Suggestion is to adopt the same philosophy: standardization, harmonization, and open learning.

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Future trend #1

Technology-Driven Safety

- **Advanced monitoring systems – AI monitoring**
- **Smart O_2 sensors and fire detection**
- **Automated logging of operations**
- **Real-Time Patient Monitoring - wearables**
- **Predictive maintenance**

Expect technology to take a central role, smarter sensors, automated data, predictive systems to prevent incidents before they occur.

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Future trend #2

People & Training

- **Virtual reality & simulation-based training (VR/AR)**
- **Competency frameworks like CHT, CHRN, ECHCO, ECHRN, ECHSM mandatory worldwide**
- **Cross-disciplinary team training (physicians, nurses, operators) – Tech and clinical**

Future training will be immersive and standardized, ensuring every operator is trained like a pilot with simulation and competency checks.

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Future trend #3

System Approach & Governance

- **International registry for incidents & near misses**
- **Stronger role of accreditation bodies**
- **Industry-wide safety culture campaigns**

We need a systematic approach, global databases, strong accreditation, and safety culture campaigns that shape how people think, not just what they do.

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What still lies ahead?!

1. **Global Standards Adoption**
2. **Universal Training & Certification**
3. **Digital Safety Systems – New technologies**
4. **Transparent Reporting & Learning**
5. **Zero-tolerance culture for unsafe practices**

This is our journey of challenges. Aviation shows it's possible, so, how do we get there?

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"Roadmap" for a safer industry

Call to Action

- **Adopt & enforce best practices**
- **Train beyond compliance**
- **Share data, not hide it**
- **Embrace new technology**
- **Build a culture where safety = pride**

ALL IN ON SAFETY

Safety is not just about ticking boxes, it's about culture, pride, and commitment.
Every one of us plays a role.

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Conclusion

"The Present… What Lies Ahead?!!"

Present = strong foundations
Future = safer, smarter, standardized industry
Vision = Hyperbaric Medicine as "safe as aviation"

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Thank you for your attention!!!!

Let's take this forward together…
What challenges and opportunities for hyperbaric safety do you experience in your day-to-day work?

We'll unpack this further during the panel discussion!!!

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François Burman*

Session: Hyperbaric Safety Talks - 2

Presentation Type: Oral Presentation

Title: *Hyperbaric Fire Safety: How real is this Issue? And How do We Manage It?*

Abstract:

The Issue
Fires in hyperbaric chambers are rare but usually catastrophic. In oxygen-rich environments, ignition spreads within seconds, leaving little chance of survival. Strict preventive measures are crucial.

History & Lessons Learned
45 reported chamber fires over 70+ years, mostly fatal outcomes.
Suppression systems were rarely effective – due to lack of maintenance or use
One should not focus only on fires: mechanical, operational, and physiological incidents also occur, but fire remains the most dangerous.

Key Risks
Ignition sources typically include electrical, static, friction, thermal and gas flow
Fuels: volatile compounds, non-compliant materials, and even patient clothing/bedding are all combustible.
Oxygen concentration: >23.5% accelerates combustion, reduces ignition temperature (minimum ignition energy), burns hotter and faster.

Prevention
All of the following are essential in preventing a hyperbaric chamber fire:
Control oxygen levels
Eliminate ignition sources
Use compliant materials
Ensure chamber and patient grounding (as stated in NFPA 99 chapter 14)
Train staff and conduct realistic drills to enhance awareness, response capabilities, and to avoid complacency.

Emergency Responses
Shut off oxygen at the chamber, switch to alternate breathing systems.
Activate the suppression/deluge system.
Sound the alarms
Cut power to circuits that are not safe when flooded.
Begin emergency decompression to the surface as fast as safely possible.
These steps can be automated, but older chambers may require performing a series of manual steps.
Only retrieve the patient(s) only once safe.

Case Studies (100% oxygen, monoplace chambers)
South Africa 2004: Modified, uncertified chamber failed due to a fire; cause not fully identified; fatalities (adults).
Florida 2009: Clamshell-style chamber fire; cause not fully identified;2 fatalities (child and adult).
Michigan 2025: Compliant chamber fire; cause identified as static discharge as a result of the failure to ground the patient; 1 fatality (child)

Takeaway
The Michigan case is the clearest, best-documented hyperbaric fire disaster. It proves that strict compliance with recognized safety standards would have prevented this catastrophic accident.
Every hyperbaric facility must treat fire prevention as non-negotiable.

* *DAN World (USA)*

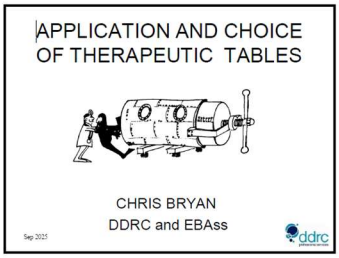
Chris Bryan*

Session: Hyperbaric Safety Talks - 3

Presentation Type: Oral Presentation

Title: *Application and choice of Therapeutic Tables (UK Centre)*

Abstract:



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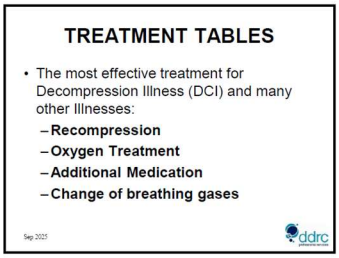

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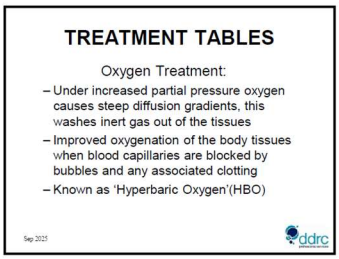

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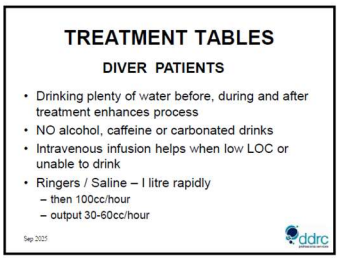

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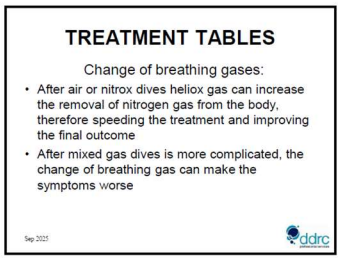

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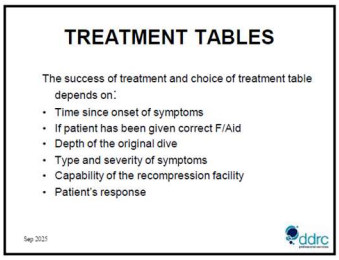

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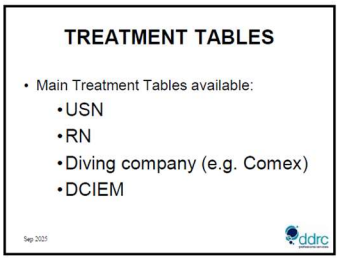

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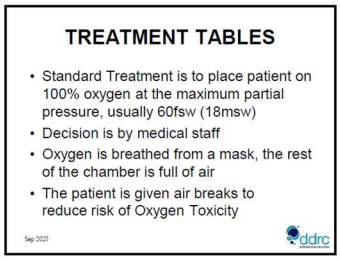

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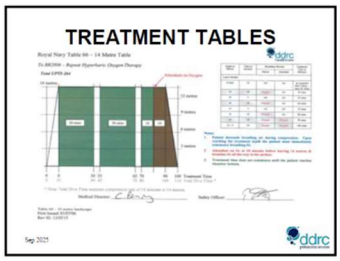

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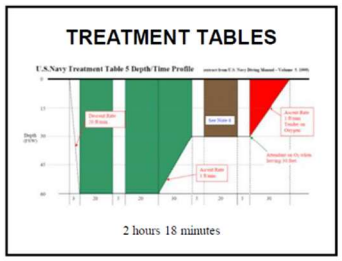

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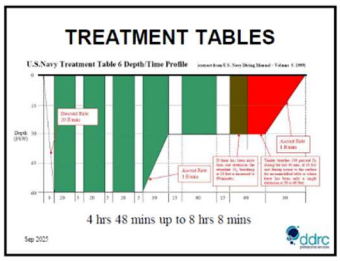

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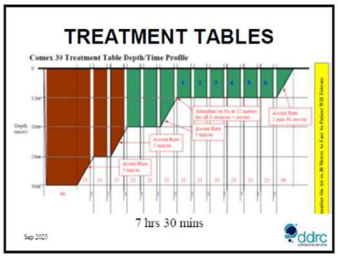

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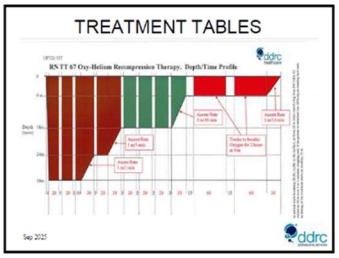

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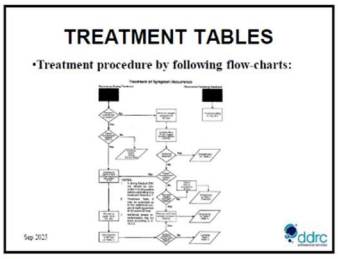

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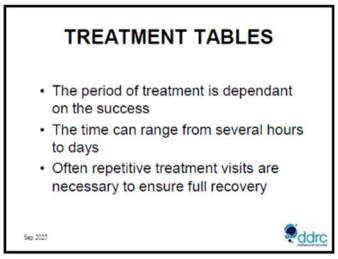

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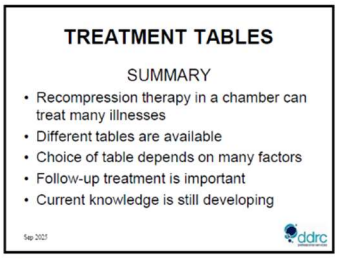

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** DDRC, (United Kingdom)*

Kari Keski-Saari*

Session: Hyperbaric Safety Talks - 4

Presentation Type: Oral Presentation

Title: *Clinical Safety of the Intensive Care Patient in Hyperbaric Oxygen Therapy (HBOT)*

Abstract:

Finnish National Center of Hyperbaric Oxygen Therapy is located in Turku University Hospital. We have both monoplace and multiplace chamber at our disposal. This presentation outlines the clinical safety protocols and operational structure for administering Hyperbaric Oxygen Therapy (HBOT) to intensive care patients. HBOT emphasizes multidisciplinary collaboration, specialized equipment, and rigorous training required to ensure patient and staff safety in a high risk, high-pressure environment. The presentation also details the roles and responsibilities of ICU nurses, chamber operators, and hyperbaric physicians, as well as emergency procedures and risk
mitigation strategies.
Expanded Bullet Points
- Centralized HBOT Services in Finland
- Turku University Hospital is the national center for HBOT, operating 24/7.
- Care is delivered in an ICU-led multiplace chamber environment.
- Staffed by ICU-trained professionals with specialized HBOT training.
- Team Composition and Roles
- Minimum team: chamber operator, hyperbaric nurse (inside), ICU nurse (outside), ICU doctor on-call.
- Hyperbaric physicians oversee patient eligibility, absolute/relative contraindications, treatment decisions, and follow-up.
- Nurse Qualifications
- Defined competency requirements for nurses and operators, minimum 3 years ICU experience.
- Appropriate initial medical examination for Hyperbaric nurses
- Certification in HBOT, chamber safety, emergency protocols.
- Annual emergency drills and periodic medical evaluations.
- Chamber Operator Responsibilities
- Pre-treatment chamber checks and protocol adherence.
- Monitoring treatment progress and nurse exposure times.
- Post-treatment shutdown procedures.
- Patient Monitoring and Equipment
- Continuous monitoring of vital signs, oxygen/CO2 levels, and chamber conditions
- Communication maintained continuously between in-chamber staff, operator and ICU-nurse.
- Continuous visual connection to chamber
- Use of certified hyperbaric-compatible devices (Corpuls3 monitor, Servo-i ventilator, Fresenius syringe pumps).
- Special ICU beds and ant decubitus mattresses designed for HBOT.
- **Safety and Risk Management**
- Risks include barotrauma injury, oxygen toxicity, fire, and decompression sickness.
- Strict exclusion of flammable, breakable, or metallic sharp items and electronical devices which are not made and tested for HBOT use
- Use of 100% cotton clothing and specialized bedding.
- **CU Nurse Preparation Protocol**
- ENT consultation and chest X-ray before first treatment.
- Medication sedation/analgesia planning and stabilization of hemodynamics.
- Use of aqua-filled intubation cuffs and cotton-only materials, removal of ignition sources and prohibited items.

- Use of standardized checklists before, during, and after treatments
- **Hyperbaric Nurse Duties During Treatment**
- Patient monitoring and documentation.
- Ventilator setup, fluid and drug treatment implementation.
- Emergency readiness (ambu bag, suction, i-gel, ephedrine, adrenalin).
- **Emergency Procedures**
- Regular drills for fire, barotrauma, oxygen toxicity, and arrest scenarios.
- Operator interrupts treatment for cardiac arrest/severe arrhythmia. Immediate decompression.
- Use of defibrillator, attach defibrillator pads and assess rhythm.
- If cardiac arrest: nurse apply BIBS mask, start CPR or defibrillate up to 3× for VF,continue CPR.
- Coordination with Medical Emergency Team (MET).
- Due to rapid decompression, the hyperbaric nurse will be re-pressurized (as per protocol) to mitigate decompression risk.
- **Post-Treatment Protocols**
- Oxygen breathing for nurses from six msw. decompression stop to the end of the treatment in order to get enhanced removal of nitrogen
- 12-hour rest period post-treatment for hyperbaric nurses.

***** *Turku University Hospital (Finland)*

Elisabete Silva

Session: Hyperbaric Safety Talks - 5
Presentation Type: Oral Presentation
Title: *The Hyperbaric Safety Blueprint*

Abstract:

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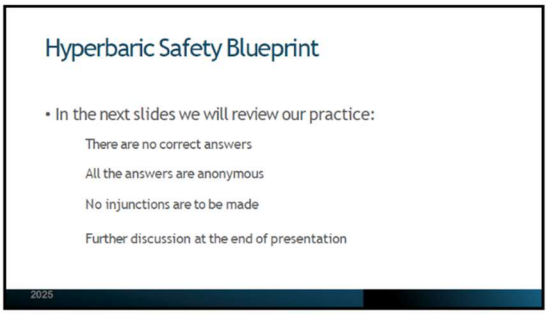

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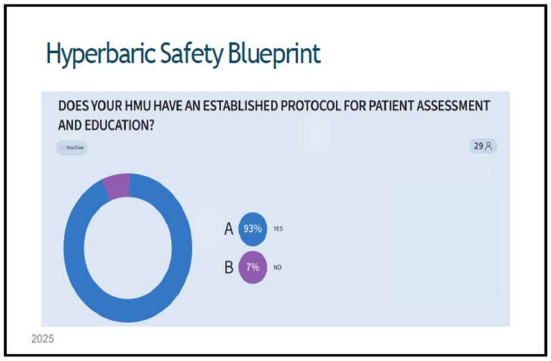

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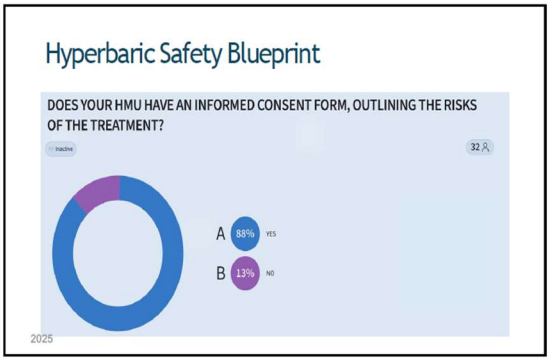

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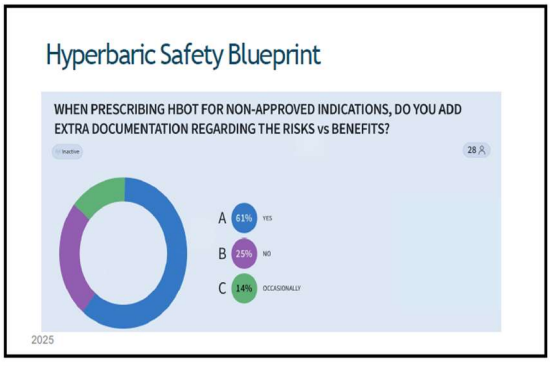

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Hyperbaric Safety - *clinical aspects*

- Risk Awareness
- Shared Decision-Making
- Transparency and Trust

→

- Reduces Miscommunication Errors
- Enhances Patient Engagement
- Supports Risk Management

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Hyperbaric Safety Blueprint

Treatment Plan

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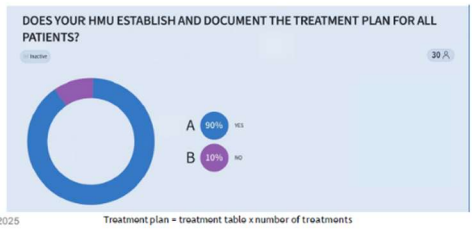
Hyperbaric Safety Blueprint



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Treatment plan = treatment table x number of treatments

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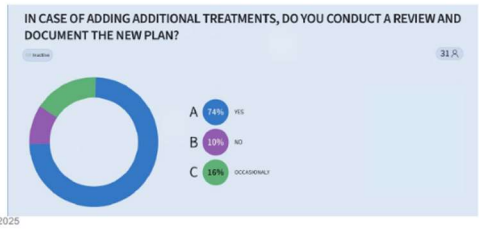
Hyperbaric Safety Blueprint



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Hyperbaric Safety - *clinical aspects*

Standardization and best practice ⟹ consistency in care

- Reduces Variability and Error
- Promotes Evidence-Based Practice
- Enables Monitoring and Evaluation
- Creates realistic goals
- Improves patient engagement

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Hyperbaric Safety Blueprint

Emergency Situations

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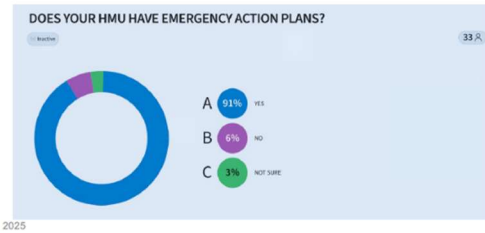
Hyperbaric Safety Blueprint



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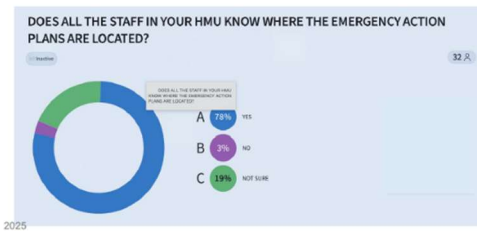
Hyperbaric Safety Blueprint



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Hyperbaric Safety Blueprint

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Hyperbaric Safety - *clinical aspects*

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Hyperbaric Safety Blueprint

Infection Control

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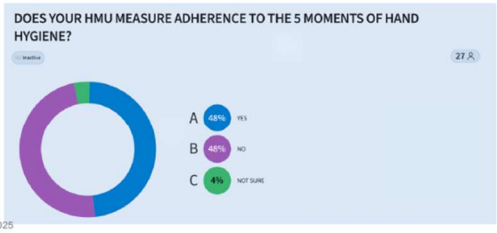
Hyperbaric Safety Blueprint



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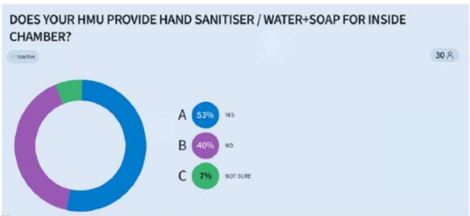

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Hyperbaric Safety - *clinical aspects*

Infection Control as landmark in patient safety:

- **Hand hygiene** (the single most effective measure)
- **Standard precautions** (gloves, masks, protective clothing where indicated)
- **Environmental cleaning** (high-touch surfaces, equipment)
- **Staff training and competency checks**

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Hyperbaric Safety Blueprint

Critically-ill patients for HBOT

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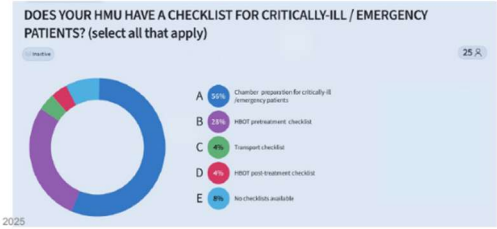
Hyperbaric Safety Blueprint



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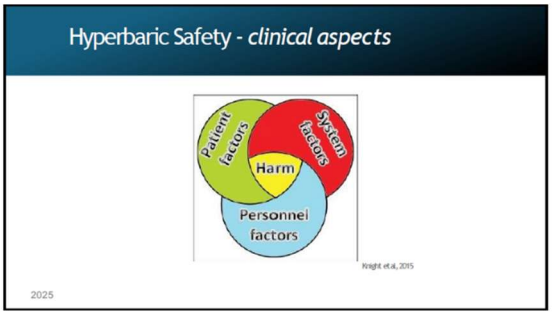

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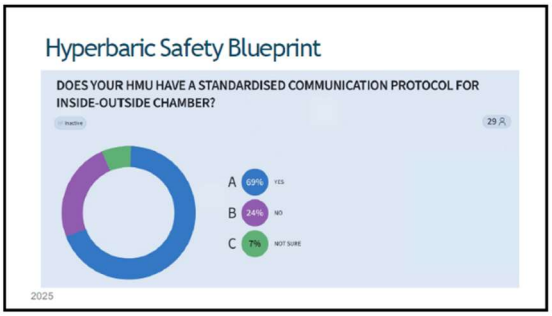

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*baroOdyssey Research (Portugal)

Aneta Miszewska*

Session: Hyperbaric Safety Talks - 6

Presentation Type: Oral Presentation

Title: *IC patient during HBOT session-risk factors for adverse events*

Abstract:

HBOT is commonly used in intensive care settings for conditions such as:
- carbon monoxide poisoning;
- necrotizing soft tissue infections;
- gas gangrene;
- crush injuries (including compartment syndrome);
- air and gas embolism;
- severe neurological decompression illness;
- acute thermal burns;
- intracranial abscesses.

The medical hyperbaric chamber environment presents an increased risk of adverse events such as:
- the heightened risk of fire due to the elevated percentage and partial pressure of oxygen;
- gas embolism;
- tracheal injury witch is associated with air trapped in the sealing cuff of the endotracheal tube;
- cerebral oxygen toxicity;
- negatively affects the cardiovascular and respiratory systems (due to increased right ventricular afterload, reduced venous return to the right ventricle, arterial vasoconstriction, and elevated systemic vascular resistance and left ventricular afterload).

What is more…

Transporting a critically ill patient also poses a risk of adverse events and may contribute to a deterioration in their condition. Therefore, continuous monitoring of vital parameters and the development of a structured protocol for preparing intensive care patients for transport to the hyperbaric chamber are essential.

HBOT session also affects the medical staff

Noise, large temperature fluctuations, and changes in the partial pressure of nitrogen can impair staff performance, potentially compromising the quality of care and increasing the risk of adverse events.

Risk factors and medical personel

The decline in cognitive function among staff is influenced not only by the hyperbaric chamber environment but also by high levels of stress, fatigue, time pressure, and the fast-paced nature of their work. Additionally, night shifts further contribute to cognitive impairment, increasing the risk of adverse events, particularly in ICUs. These factors also heighten the risk of decompression sickness among personnel working in a hyperbaric chamber.

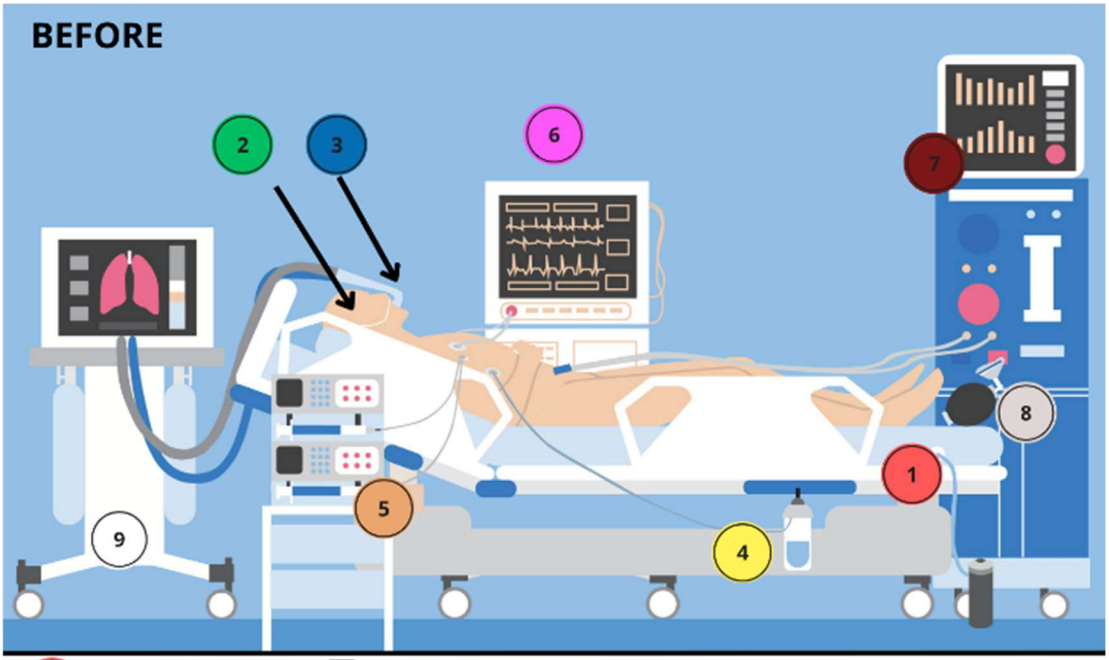
Based on the available literature, these factors have been identified as increasing the risk of adverse events during the intra-ward transport and HBOT session of ICU patients:
- ventilation via an endotracheal tube;
- continuous intravenous infusions of pressor amines and analgosedation;
- nighttime HBOT sessions (7:00 pm–7:00 am);
- hemodiafiltration, requiring discontinuation of therapy during the HBOT session- in our HC;
- presence of pleural cavity drainage
- the elevated percentage and partial pressure of oxygen
- transport.

Mechanical ventilation via an endotracheal tube:
- necessitating the replacement of air with fluid in the sealing cuff to prevent tracheal trauma

caused by pressure changes during HBOT;
- preparing an intubation set with the bag valve for transport and session;
- most common adverse events during intra-hospital transport involved the respiratory system, including tube obstruction and increased secretions in the airway.
Continuous intravenous infusions are related with:
- gas embolism, due to the absence of air bubbles in syringe lines;
- equipment/technical issues with syringe pumps, because the most common adverse events during transport are related to technical equipment

Nighttime HBOT sessions:
- patient safety is most at risk when staff struggle to stay alert during the second half of the night shift;
- Research indicates that employee performance is poorest between 4:00 am and 6:00 am, just after reaching minimum body temperature, which is precisely when focused concentration is needed for preparing a critically ill patient for transport and providing care in the hyperbaric chamber;
Hemodiafiltration:
- according to our hospital protocol, patients at the HC are disconnected from hemodiafiltration during HBOT sessions, and it;
  - extends the preparation time for transport;
  - increases the risk of clotting in the hemodiafiltration system.
Presence of pleural cavity drainage:
- increases the risk of lung injury due to pressure fluctuations during HBOT
- protecting drainage of the pleural caviti with the one-way valve.
How to reduce the risk of adverse events?
- to maintain proficiency in patient transport and care within a hyperbaric chamber, it is recommended that personnel complete approximately 100 practice sessions per year involving intensive care patients;
- investing in staff education can significantly enhance patient safety, as evidenced by findings from the international Registered Nurse Forecasting study. The data indicate a clear relationship between education levels and quality of care, demonstrating that higher levels of education among healthcare providers are associated with improved patient safety and overall better clinical outcomes;
- each adverse event or omission of critical actions prolongs the patient's hospital stay and increases the risk of complications. incorporating a checklist protocol into patient care may help reduce risk factors od adverse events.

OUR SUPPORT to reduce the risk factors
In our hyperbaric center, the transport of critically ill patients is performed entirely within the hospital—and even within the same ward—as we only need to change floors. The same medical team provides continuous care for the patient both in the intensive care unit and inside the hyperbaric chamber. This approach significantly reduces the risk of losing valuable clinical information and minimizes the likelihood of adverse events.
What is more In our centre care in hypervaric chamber and during preparatipn patient do HBOT session is primarily administered by nurses, given their high level of experience and qualifications
Based on the knowledge and experience of my colleagues, we developed a checklist that supports our cognitive functions and helps reduce the risk factors for adverse events.



1 Hospital bed	☐ Replacement/removal of hazardous materials ☐ Disconnecting the pump from anti-decubitus mattress
2 Nasogastric tube	☐ Protecting the NG gastric tube with a decompression bag
3 Airways	☐ Suction of secretions from the respiratory tract and oral cavity ☐ Checking ET/tracheostomy tube attachment ☐ Replacing air with liquid in the cuff of the ET/tracheostomy tube
4 Drainage systems	☐ Protecting drainage of the pleural cavity with a one-way valve
5 Drugs	☐ Preparing the necessary medications and disconnecting infusions that do not require continuation in the hyperbaric chamber ☐ Switching drugs to HBO-dedicated infusion pumps ☐ Checking the presence of air bubbles in the infusion lines
6 Monitoring	☐ ECG, BP, SpO2 monitoring
7 Limited equipment	☐ Disconnecting unnecessary/unwanted equipment ☐ Disconnecting renal replacement therapy
8 Safety	☐ Preparing the intubation set for the time of transport ☐ Preparing the bag valve
9 Ventilator	☐ Disconnecting capnometry measurement ☐ Switching the patient to a HBO- dedicated ventilator

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European Baromedical Association
for nurses, operators and technicians

Program	HST _1 - Hyperbaric Safety Talks		
Lecturers	**Content**	**Slots**	**Time**
	Wednesday - September 3, 2025		
	Registration and welcome	20 min	0900 - 0920
EBAss President (Angeliki Chandrinou)	Introduction of workshop and Annual Congress	10 min	0920 - 0930
Manuel Preto	Hyperbaric Safety – The present... and what lies ahead?	20 min	0930 - 0950
François Burman	Hyperbaric Fire Safety: How Real Is This Issue? And How Do We Manage It?	20 min	0950 - 1010
Chris Bryan	Application and choice of therapeutic tables (UK Centre)	20 min	1010 - 1030
Panel moderator: Angeliki Chandrinou	**Panel Discussion**	30 min	1030 - 1100
	Morning tea / Coffee Break	20 min	1100 - 1120
Kari Keski-Saari	Clinical safety of th I.C. patient in HBOT	20 min	1120 - 1140
Elisabete Silva	The Hyperbaric Safety Blueprint	20 min	1140 - 1200
Aneta Miszewska	I.C. Patient during HBOT session - Risk factors for adverse events	20 min	1200 - 1220
Panel moderator: Konstantina Gaitanou	**Panel Discussion**	20 min	1220 - 1240
	Closing Session	10 min	1240 - 1250
	LUNCH	60 min	1300 - 1400
	EUBS - Scientific program		1400 - 1800