EDTC

Pressure chambers

Emergency Recompression Chambers (ERCs) for Diving Worksites and Tunnelling Applications: Purposes, Technical Characteristics, and Regulations

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This document has been developed with input sought from EDTC members representing France, Italy, the Netherlands, Poland, Switzerland, Sweden, Türkiye and the United Kingdom, as well as observers from Australia, South Africa and the United States, under the supervision of the EDTC Executive Board and General Assembly.

The **core working group** includes:
Pasquale Longobardi (MD, Italy – Coordinator), Marco Bellomo (Engineer, Italy), Jean-Claude Le Péchon (Engineer, France).

Reviewers (invited to contribute):

François Burman (Engineer, USA), Justin Costello (Senior Project Manager, USA), Erwin Helderman (Engineer, the Netherlands), Jacek Kot (MD, Poland), Ian Millar (MD, Australia), Owen O'Neill (MD, USA), Pieter-Jan van Ooij (MD, the Netherlands), Akın Savaş Toklu (MD, Türkiye)

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Scope

This document provides an overview of the specifications for **Emergency Recompression Chambers (ERCs)** used at diving worksites and for compressed-air work in tunnels, including those associated with Tunnel Boring Machines (TBMs), for emergency treatment of mild or stable cases of decompression illness (DCI). It also proposes ways to improve regulations governing commercial diving and compressed-air operations. ERCs used at worksites for operational decompression or emergency recompression are not medical devices under Regulation (EU) 2017/745 when the manufacturer's declared intended use is non-medical. These ERCs are distinct from chambers designed and placed on the market for medical hyperbaric oxygen therapy (HBOT) in clinical settings. This document does not concern HBOT or the clinical use of hyperbaric chambers in hospitals or independent hyperbaric medical centres.

The Two Types of Chambers

1. Medical hyperbaric oxygen (HBO) treatment chambers

Medical Hyperbaric Oxygen (HBO) Treatment Chambers are classified as Class IIb medical devices under Regulation (EU) 2017/745[1] and must be built in accordance with EN 14931[2] (Pressure vessels for human occupancy (PVHO) — Multi-place pressure chamber systems for hyperbaric therapy — Performance, safety requirements and testing) and EN 16081[3] (Hyperbaric chambers — Specific requirements for fire extinguishing systems — Performance, installation and testing).

For chambers used in non-medical environments but claiming hyperbaric oxygen therapy (HBOT) action, the European Underwater and Baromedical Society (EUBS) document, Joint Position Statement on the Use of 'Mild Hyperbaric Therapies' in Humans (2022), explains why certain types of chambers are not considered medical chambers and lists the requirements for a medical HBO chamber.[4] Fundamentally, a medical chamber is intended for patient treatment, either in a hospital or in an independent hyperbaric medical centre. Its dimensions and clinical configuration are generally not compatible with simple transport or relocation for diving or tunnelling operations. A suitable medical chamber may, however, be used to treat DCI depending on availability and travel time from the site of injury.

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2. Emergency Recompression Chambers (ERCs)

The other type of chamber is the Emergency Recompression Chamber (ERC), installed at diving worksites or compressed-air tunnelling worksites, with or without Tunnel Boring Machines (TBMs).

An ERC is collective protective equipment for operational use during diving or compressed-air work. Its use is guided by clear flowcharts and operational procedures in the relevant manuals, which specify standard recompression tables according to the type of decompression incident. It encompasses on-site measures designed to protect workers from hazards associated with exposure to hyperbaric or underwater environments. Chamber operation is a professional procedure and may be undertaken only by trained, competent and authorised personnel.

An ERC is not a medical device when its manufacturer's declared intended use is operational decompression or emergency recompression at a worksite and it is not placed on the market for clinical HBOT. It may be operated by competent site personnel and not exclusively by medical staff. This distinction does not reduce the need for medical governance of therapeutic procedures.

The use of ERCs for the treatment of DCI should be considered exceptional and limited to the initial management of mild, non-severe cases where immediate transfer to an appropriate clinical hyperbaric facility is not feasible. Such use should remain rare and is not intended as a substitute for definitive treatment in a clinical hyperbaric facility.

An ERC is used for recompression with three potential applications:

- **Recompression of divers using surface decompression with oxygen as a standard diving method.** It must be located very close to the point where the diver exits the water to comply with the time limits specified in dive tables. It is normally operated by the diving supervisor.
- **Recompression of divers after procedural errors (preventive use),** such as missed decompression stops. In the absence of medical symptoms, it is considered a preventative measure to avoid the development of decompression-related medical conditions.
- In rare situations, initial **recompression of workers with mild, non-severe DCI, pending transfer to an appropriate clinical hyperbaric facility,** should be performed in a chamber located close to the diving or compressed-air worksite and operated by trained and competent site personnel. Operators must have formal training in ERC procedures, including recognition of DCI symptoms, emergency oxygen administration, safe use of standard treatment tables (e.g. US Navy TT6), and communication protocols, in accordance with written procedures validated by the company's medical advisor. The manufacturer's declared intended use is decisive for the product's regulatory classification. National rules separately determine chamber availability and

operational requirements. Reference guidance includes IMCA D085 (February 2025), Guidance on Deck Decompression Chamber Operations for the Therapeutic Treatment of Divers.[5]

Regulatory Framework

The manufacturer defines the intended use of the product and must identify the applicable legislative framework. ERCs manufactured, assembled, acquired used or hired by diving contractors for non-clinical worksite use are not medical devices when their declared intended use is operational decompression or emergency recompression rather than clinical HBOT.

Under EU law, the Pressure Equipment Directive (PED) 2014/68/EU applies to pressure equipment above the relevant thresholds, regardless of medical or non-medical use. It governs the design, manufacture and conformity assessment of pressure vessels, including hyperbaric chambers.[6] Recital (6) and Article 1(1) cover pressure equipment subjected to a maximum allowable pressure PS greater than 0.5 bar. ERCs used at worksites are therefore subject to the PED, even though they are not medical devices. The CE mark under the PED reflects pressure safety and conformity with pressure-equipment requirements; it does not confer a medical intended purpose or MDR status.

The Italian Law “Codice del Consumo” (Consumer Code, 2005) and its subsequent amendments, specifically Article 102, paragraph 2, state that all products not covered by a specific standard must comply with the quality and safety requirements defined in Part IV of the Consumer Code.[7] Part IV defines the usual European risk management approach, meaning that manufacturers must demonstrate that a product is safe, based on a risk assessment aligned with the applicable Essential Safety Requirements, as well as national laws, regulations, and best practices.

Although IMCA guidance is focused on offshore diving and does not address other types of diving or pressurised work such as tunnelling, it remains a valuable benchmark for defining the technical standards and operational procedures of ERCs in the EDTC context. IMCA’s stricter offshore standards, including requirements for compliance with documents like IMCA D014, D018, and D023, as well as detailed specifications, checklists, and emergency procedures from IMCA D085, could help inform ERC design, inspections, and integration into site safety practices, even where not legally required under the Pressure Equipment Directive.[5]

National Regulations on Emergency Recompression Chamber Availability

National regulations vary across Europe concerning chamber availability. The EDTC document aims to provide a useful tool to support regulatory harmonisation across all countries, including those lacking specific pressure equipment legislation. This is a summary of the known requirements:

1. For diving worksites:

France

- According to Article 14 of the Arrêté du 14 mai 2019 relatif aux travaux hyperbares effectués en milieu subaquatique (mention A).[17]
- For interventions requiring no decompression stops, access time to a standby recompression chamber may exceed two hours but must not exceed six hours.
- For decompression procedures requiring less than 15 minutes of total stops, access time to the chamber must not exceed two hours.
- For decompression procedures requiring more than 15 minutes of total stops, access time must not exceed one hour, or a standby recompression chamber must be available at the worksite.
- There is no reference to a particular depth.

This should normally be written in the safety manual available at the workplace, which should also include a description of the recompression chamber, its location, how access time is calculated (day and night), and how the chamber's operation has been verified.

The OPPBTP 2025/2026 prevention standard reinforces the requirement to identify available recompression resources and their location in the hyperbaric safety manual. It also recommends addressing worksite chamber provision through project risk assessment and client–contractor coordination.[19]

Italy

According to UNI 11366 (2010), *Health and Safety in Underwater and Hyperbaric Professional Activities – Operating Procedures*, for any diving work at depths greater than 12 metres, an ERC must be present at the worksite.[8]

Additionally, Decree Law 24.01.2012 n.1 (Official Gazette n.19 of 24.01.2012, Supplement n.18) states that activities covered by Article 53 of Presidential Decree 24 May 1979 n. 886 must comply with current standards and the rules of good practice outlined in UNI 11366.[9-10]

More recently, Law No. 9 of 26 January 2026, Provisions on the Safety of Underwater Activities, established a comprehensive national framework for professional diving and hyperbaric work. It introduces defined professional qualifications and a mandatory register for professional divers and hyperbaric technicians, recognised training requirements, specialist medical fitness and health surveillance, and a bilingual personal digital logbook. It also provides for technical rules based on UNI, CEI and other European standards covering underwater operations, hyperbaric support, emergency procedures, equipment, diving medicine, occupational safety and hygiene, together with sanctions for non-compliant operators, employers and diving contractors. The implementing technical rules referred to in Article 25 require a ministerial decree. Law No. 9/2026 therefore transforms the Italian framework from fragmented provisions into a comprehensive and enforceable system for professional diving and hyperbaric safety.[11]

The Netherlands

The Netherlands: Under the Arbeidsomstandighedenbesluit (Working Conditions Act), Articles 6.18 and 6.20 require an on-site recompression chamber for dives or caisson work at depths of 15 msw or greater. For dives up to 15 msw, a hyperbaric chamber in a working clinical setting must be available within less than 2 hours, regardless of whether decompression dives are made or not. If not, it is mandatory to have a recompression chamber on-site.

Sweden

If decompression time exceeds 30 minutes, or the depth exceeds 9 metres, a hyperbaric chamber in a working clinical setting must be within six (6) hours of the worksite, or an ERC must be on site.

Switzerland

For occupational diving operations requiring more than 15 minutes of decompression, a recompression chamber must be available on site. An exception exists for rescue diving operations, where, if it is not feasible to have a chamber on site, an equivalent solution must be proposed to the authorities. For compressed air work, a recompression chamber is always required whenever the working pressure exceeds 0.7 bar. If total decompression time is more than 15 minutes, a hyperbaric chamber in a working clinical setting must be less than two hours from the worksite, allowing no more than 30 minutes for transport, or an ERC must be at the dive worksite.

Türkiye

For decompression dives deeper than 40 metres and for mixed-gas dives, it is mandatory to have a diving physician and a recompression chamber on site. If the chamber cannot be located at the dive site, it must be positioned so that the diver can be placed under pressure within a maximum of 30 minutes.

United Kingdom (UK)

- Dives shallower than 10 metres with in-water decompression less than 20 minutes: the chamber must be within six (6) hours travel time.
- Dives between 10 metres and 50 metres with in-water decompression less than 20 minutes: chamber availability should be based on risk assessment. If there is a significant risk of decompression illness (DCI) then the chamber should be on site. If there is a low risk of DCI then the chamber must be less than 6 hours travelling distance.
- For dives with in-water decompression stops exceeding 20 minutes, the chamber must be on site.

IMCA Position on Deck Decompression Chambers

IMCA D085 (February 2025), *Guidance on Deck Decompression Chamber (DDC) Operations for the Therapeutic Treatment of Divers*, is an important reference providing detailed expertise, procedures, and requirements for emergency drills. However, it primarily addresses offshore diving operations and does not cover other types of diving work or tunnelling.[5]

IMCA highlights the importance of rapid recompression to improve recovery outcomes and insists on operational readiness, including trained personnel, regular drills, and documented competence (IMCA D085, p.4, §1; pp.15–16, §§7.1–7.3).

IMCA prescribes detailed technical standards, covering chamber design, dual pressurisation systems, gas management, safety features, and rigorous certification and maintenance processes (IMCA D085, pp.17–18, §§8.1–8.2).

Medical support is considered integral, involving Diver Medic Technicians (DMTs), therapeutic recompression tables, and continuous monitoring during treatment (IMCA D085, pp.19–20, §9.2).

Practical tools, such as comprehensive checklists, are provided to support safe DDC operations (IMCA D085, Annex 1, pp.22–24).

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2. For tunnel sites:

Under Article 13 of the French Arrêté du 22 avril 2024 relatif aux travaux hyperbares effectués sans immersion (mention D), the employer, supported by the Hyperbaric Prevention Adviser (CPH) and after consulting the local emergency services, must assess whether a standby recompression chamber is required on site. Where a chamber is provided, it must have the required breathing stations and a personnel lock, be available from the start of the intervention until 12 hours after its completion, and be supported by trained and regularly drilled personnel. When total decompression stops are less than 15 minutes, access time must not exceed two hours. When total decompression stops exceed 15 minutes, access time must not exceed one hour or a standby recompression chamber must be available on site. For interventions requiring no decompression stops, access time may exceed two hours but must not exceed six hours. In the event of an accident or suspected hyperbaric accident, the supervisor activates the emergency procedure; where an on-site chamber is available, emergency recompression is undertaken after medical advice, within the limits of the supervisor's competence, by trained personnel applying the emergency recompression tables annexed to the Order.[18]

Procedures

Emergency recompression procedures for worksites must be established in advance, published in the company's safety documentation and available to the personnel responsible for their implementation.

Although guidance on hyperbaric practice in compressed air environments is relatively limited, the Guidelines for Good Working Practice in High Pressure Compressed Air (ITA/AITES, 2018) provide recommendations on safe working practices in high pressure compressed air (HPCA) tunnelling, including aspects of medical support and hyperbaric interventions. These guidelines, intended for use by regulators, clients, designers, contractors, insurers and others involved in HPCA work, recognise that exposure to hyperbaric environments in tunnelling shares physiological and operational challenges with diving. They promote goal-setting safety standards and advise that appropriate medical oversight and competencies be integrated into HPCA operations, acknowledging that best practice may derive from established diving and hyperbaric protocols.[16]

The Diving Medical Advisor (DMA) chosen by the employer determines the recompression procedure for the worksite. All details must be included in the company's safety manual and

approved by the DMA. The DMA should be contacted before therapeutic recompression whenever communication is available. If contact is delayed or temporarily unavailable, the competent site manager may initiate the pre-approved emergency procedure only when the written safety manual explicitly authorises this action. Pending medical advice, this may include pressurisation of the ERC to 120 kPa (1.2 bar gauge pressure; 2.2 bar absolute pressure) with oxygen breathing for casualties without obvious life-threatening conditions. Attempts to obtain medical advice and arrangements for definitive transfer must continue throughout.

IMCA D085 (February 2025), *Guidance on Deck Decompression Chamber (DDC) Operations for the Therapeutic Treatment of Divers*, is an important reference providing detailed expertise, procedures, and requirements for emergency drills.[5] However, it primarily addresses offshore diving operations and does not cover other types of diving work or tunnelling.

Further explanatory notes distinguishing clinical hyperbaric treatment chambers from Emergency Recompression Chambers (ERCs) are provided in the **Appendix.**

APPENDIX – EXPLANATORY NOTES

Medical Hyperbaric Oxygen chambers are used to deliver hyperbaric oxygen therapy (HBOT), with the use of BIBS (Built-In Breathing System), in which patients are exposed to oxygen under pressures higher than normal atmospheric levels (e.g. 2.5 bar). Although both medical treatment chambers and emergency recompression chambers are used in medical or industrial contexts, they differ considerably in operational practice, design, use, and functionality.

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1. Purpose and Application

A. Medical Treatment Chambers (HBOT):

- **Medical Use:** Medical Hyperbaric Treatment Chambers, located in hospitals or independent hyperbaric medical centres, are designed to deliver HBOT for accepted clinical indications, including decompression illness, under specialist medical supervision. At the date of publication of this guidance, the most recent ECHM recommendations available are those of the Tenth European Consensus Conference on Hyperbaric Medicine. ECHM recommendations are periodically reviewed and updated; the next Consensus Conference is scheduled to take place in Geneva on 14 September 2026.[20]

- **Patient Type**: Patients receiving HBOT for an accepted clinical indication following specialist medical assessment.

B. Emergency Recompression Chambers:

- **Diving Work and Compressed Air Work.** Emergency Recompression Chambers are typically incorporated into safety protocols for working diving and compressed air operations. In certain situations, they may be used on-site to initiate early support for mild decompression illness (DCI), pending transfer to an appropriate clinical setting. Such use remains limited and context-dependent.

- **Worker Type**: Primarily divers or compressed air workers showing symptoms of DCI, or divers undergoing surface decompression using oxygen.

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2. Oxygen Delivery System

A. Medical Treatment Chambers:

- **Pure Oxygen**: Hospital-based chambers generally use medical grade oxygen at pressures exceeding atmospheric levels (typically more than 1.7 times normal atmospheric pressure).

- **Environment:** These chambers are sealed environments where patients breathe pure oxygen or oxygen-enriched air via masks, hoods, or mechanical ventilation.

- **Monoplace or Multiplace Chambers**: Monoplace chambers accommodate a single patient; they are sometimes pressurised with medical grade oxygen, allowing the patient to breathe it directly from the chamber environment without wearing a mask. In other configurations, the chamber is pressurised with air and the patient breathes medical grade oxygen through a mask. Whereas multiplace chambers can treat multiple patients simultaneously, each breathing oxygen individually via masks or hoods.

B. Emergency Recompression Chambers:

- Air or Mixed Gas: ERCs employ oxygen breathing through a suitable breathing system. Oxygen or other breathing gases must meet the quality requirements applicable to the intended use and national jurisdiction. Certified diving-quality oxygen, including products supplied specifically for professional diving, may be used where permitted. In some cases, mixed gases (e.g. nitrogen/oxygen or helium/oxygen) may be used, depending on the procedure and the condition of the diver or compressed-air worker.[13-14]

- **Environment:** These chambers are usually housed in portable containers on-site and supplied with breathable air and gases (oxygen or mixed gases) from site storage facilities.

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3. Design and Structure

A. Medical Treatment Chambers:

- **Design**: Designed for clinical settings, these chambers are typically stationary installations equipped with medical monitoring equipment and auxiliary devices such as suction and ventilators.

- **Comfort and Safety**: Hospital chambers feature advanced safety and comfort systems for repeated treatment sessions, often lasting up to two hours each, with patients monitored continuously by medical staff.

B. Emergency Recompression Chambers:

- **Design**: These chambers are often portable units located on ships, oil rigs, or dive support vessels. They are compact to enable quick installation and immediate access for surface decompression or emergencies.

- **Durability**: Built to endure harsh industrial environments, these chambers are engineered for rapid pressurisation and robustness under challenging conditions.

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4. Duration and Frequency of Use

A. Medical Treatment Chambers:

- **Treatment Sessions**: Sessions in hospital chambers are structured and planned, often requiring multiple daily sessions over weeks or months, depending on the patient's medical condition.

- **Frequency**: Treatments are scheduled regularly, with each session lasting approximately 60 to 90 minutes. Multiplace chambers can accommodate up to 16 patients simultaneously.

B. Emergency Recompression Chambers:

- **Immediate Sessions:** Recompression sessions may last from two hours up to seven hours or more in severe cases. Generally, one patient plus an attendant are recompressed at a time. During surface decompression, usually one diver undergoes recompression; occasionally, two divers may require recompression in succession when operations are carried out back-to-back and working time is shorter than the decompression stop required in the chamber.

- **Surface Oxygen Decompression**: Each dive requiring surface decompression involves recompression to 2.2 bar, with the diver breathing pure oxygen. The duration of the stop depends on the dive duration and working depth, as specified by relevant decompression tables.

- **Emergency Use:** These chambers are employed in emergencies when divers or compressed-air workers experience symptoms of DCI, although such cases are relatively rare.

5. Monitoring and Medical Support

A. Medical Treatment Chambers:

- **Medical Supervision**: Medical Treatment Chambers are operated by medical professionals trained in HBOT and emergency care. These chambers feature advanced monitoring systems, such as heart rate monitors, oxygen saturation monitors, and other diagnostic equipment.

- **Emergency Management**: Hospital settings are equipped to manage various medical emergencies, including seizures, oxygen toxicity, cardiovascular incidents, and the treatment of decompression illness when patients are transferred from diving or compressed air worksites.

B. Emergency Recompression Chambers (ERCs):

- Operational Supervision: ERCs are operated by trained supervisors familiar with decompression protocols and the risks associated with diving or compressed-air work. In accordance with DMAC guidance (e.g. DMAC 11), the Supervisor shall consult the contractor's and/or client's DMA before initiating therapeutic recompression whenever communication is available. If communication fails, only a written procedure pre-approved by the DMA may authorise the competent Supervisor to begin the specified emergency table while continuing attempts to obtain medical advice. Ad hoc or unsupervised therapeutic use is strongly discouraged.[15]

- **Emergency Management:** Worksite ERCs have more limited medical support than clinical facilities. Procedures must therefore include casualty monitoring, management of foreseeable complications, communication with the DMA, and transfer to an appropriate clinical hyperbaric facility when required.

  Based on the MDR, medical treatment chambers have a more frequent and more expensive inspection routine by certifying inspection bodies than ERCs.

- **Field Setting**: Medical care in emergency recompression chambers may be limited. Following initial recompression, further medical treatment or additional HBOT sessions may require evacuation to a medical facility equipped with a hospital hyperbaric chamber.

6. Environment and Accessibility

A. **Medical Treatment Chambers:**

- **Controlled Environment:** Hospital chambers are installed in controlled, clean, and sterilised environments where infection prevention and patient safety are paramount.

- **Accessibility**: Such chambers are accessible to patients with various health conditions, including those who are immobile or critically ill. In more severe cases, chambers may be designed to accommodate critical care beds.

Emergency Recompression Chambers:

- **Field Environment**: Emergency Recompression Chambers are typically installed in remote environments such as oil rigs, ships, diving operations, or tunnelling sites. They are intended for immediate use to treat DCI cases as quickly as possible, as rapid intervention is crucial for effective recompression.

- **Accessibility:** Primarily accessible to personnel involved in diving or compressed air operations. Proximity to the worksite is a key factor for effective emergency response.

CONCLUSION

Medical Hyperbaric Treatment Chambers and Emergency Recompression Chambers both provide a pressurised environment and enable oxygen breathing; however, they differ substantially in intended purpose, regulatory status, design, governance and operating context. Medical hyperbaric chambers are designed for clinical HBOT and are regulated as medical devices. In contrast, ERCs are non-medical collective protective equipment intended for use at diving and compressed-air worksites for planned surface decompression, management of omitted decompression and, in exceptional circumstances, the initial recompression of workers with mild or stable decompression illness pending transfer to an appropriate clinical hyperbaric facility.

ERCs must be operated by trained and competent personnel in accordance with written procedures, approved recompression tables and medical governance established in advance by the Diving Medical Advisor. Their technical conformity under the Pressure Equipment Directive must remain clearly distinguished from the Medical Device Regulation applicable to chambers intended for clinical use.

European national requirements concerning the mandatory presence of an ERC, acceptable access time to an alternative chamber and operational arrangements remain inconsistent. This document therefore does not establish a single prescriptive depth, decompression threshold or travel time. These decisions remain dependent on national legislation, the manufacturer's declared intended use, project-specific risk assessment and operational context.

EDTC encourages regulators, clients, diving contractors, manufacturers and medical advisers to use this guidance as a common basis for improving regulatory consistency, operational readiness and the safe integration of ERCs into occupational diving and compressed-air work.

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Contributors to the EDTC Document

This document was developed through the combined efforts of the following contributors:

EDTC Executive Board

Jörn Ryberg (Sweden, Chairman), Akın Savaş Toklu (Türkiye, Secretary), Philip Crombie (United Kingdom, Treasurer), Pasquale Longobardi (Italy), Hélène Szulc (France), Pieter-Jan van Ooij (the Netherlands).

Core Working Group

Pasquale Longobardi (MD, Italy – Coordinator), Marco Bellomo (Engineer, Italy), Jean-Claude Le Péchon (Engineer, France).

Reviewers (invited to contribute):

François Burman (Engineer, USA), Justin Costello (Senior Project Manager, USA), Erwin Helderman (Engineer, the Netherlands), Jacek Kot (MD, Poland), Ian Millar (MD, Australia), Owen O'Neill (MD, USA), Pieter-Jan van Ooij (MD, the Netherlands), Akın Savaş Toklu (MD, Türkiye).