NATO DIANA
Defence | Innovation | Adoption

2027 Challenge: Human Survivability

Human Survivability

1. Challenge Summary: NATO operations increasingly place personnel in austere, contested environments where injury, physiological strain, environmental exposure, and cognitive degradation accumulate over time, often while specialist care and evacuation are delayed, constrained, or denied. In these conditions, survivability depends not only on treating discrete injuries, but on sustaining human performance and resilience under prolonged stress. Current approaches remain largely evacuation-centric and fragmented across protection, monitoring, care, and performance, creating critical gaps in the live-chain and continuum of care when medical capacity is disrupted, overwhelmed, or actively targeted. This opens an opportunity to shift toward more integrated, soldier-centric survivability and stabilisation concepts.

The Alliance seeks integrated, interoperable, and scalable solutions to protect individuals, mitigate threats, detect degradation early, and sustain human life and performance in contested and extreme environments. Emphasis is on maintaining force effectiveness when evacuation, resupply, and medical support are constrained or disrupted. Human survivability and the life-support chain must be treated as an operational system. Solutions must enable sustained, large-scale operations at high tempo while enhancing protection and situational awareness without increasing cognitive, physical, or logistical burden.

2. Illustrative Scenario: During a high intensity large-scale combat operation, dispersed NATO forces operate under persistent indirect fire, drone threat, electronic disruption, environmental stress, and uncertainty regarding chemical or biological exposure. Over time, personnel experience cumulative fatigue, dehydration, thermal stress, immune strain, and cognitive degradation, reducing decision quality, reaction time, and tolerance to injury. Following an engagement, multiple casualties occur due to blast and fragmentation, while environmental exposure and delayed treatment exacerbate survivability risks. Local and rear medical capacity is already exceeded due to the scale of operations, and evacuation is delayed for many hours due to contested airspace and dangerous ground routes. Integrated personal protection reduces secondary injuries and exposure. Wearable and environmental sensors detect blood loss, shock indicators, cognitive degradation, and early biological stress signals across the unit, enabling adaptive tasking and early intervention. Artificial Intelligence (AI)- guidance assists forward deployed stabilisation and prolonged field care, while hybrid crewed and uncrewed systems extract casualties under threat, with monitored in-transit care and digitised medical data supporting continuity of treatment.

3. Exemplar Enabling Technologies: The following list provides illustrative examples of technologies that may contribute to this challenge. The list is not exhaustive, and NATO DIANA encourages integrated and novel approaches that extend beyond it:

Adaptive Protection, Exposure Reduction, and Signature Management

- Lightweight, adaptive protection against ballistic, blast, chemical, biological, radiological and nuclear threats, directed-energy effects, and adverse weather, including thermal regulation and contamination resistance.
- Advanced camouflage and signature management reducing visual, thermal, acoustic, and electromagnetic detectability.

Prolonged Field-care, Casualty Extraction, and In-Transit Care

- Portable diagnostics, resuscitation tools, and point-of-need countermeasures for forward intervention, stabilization, treatment and prolonged field care.
- Technologies supporting autonomous or automated casualty and medical evacuation that reduce human overload, automate processes, and enable monitored in-transit care.
- AI-assisted triage, routing, and telemedicine support when specialists and evacuation assets are scarce.

Continuous Physiological, Cognitive, and Hazard Monitoring

- Multimodal biosensing for continuous assessment of vital signs, injury indicators, fatigue, and cognitive state.
- Monitoring of biological stress (e.g. immune or metabolic strain, early infection indicators) to anticipate degradation before injury.
- Pathogen (or synthetic entity) -agnostic detection of biological and chemical hazards for early warning and response.
- AI for converting sensor streams into actionable alerts and decision support.

Biotechnologies for Human Survivability and Scalable Operational Support

- Biological sensing and rapid diagnostics suitable for in-field deployment.
- Biotechnology-enabled countermeasures supporting protection, stabilisation, recovery, and sustainment under stress and injury.
- Biomanufacturing technologies for fuel, blood, protein, antibiotics, critical chemicals and high-energy materials.
- Scalable technologies for securing metabolic resilience in contested environments.

Human–Machine Teaming, Interfaces, and Interoperability

- Exoskeletons and dexterity augmentation to enhance mobility, casualty handling and surgery.
- Integrated soldier systems, including helmets with embedded sensing and communications.
- Augmented, virtual and mixed reality interfaces for training, tele-assistance, and real-time medical and operational support.
- Digitised medical documentation and patient tracking across the continuum of care.