

AGENT-AGNOSTIC DETECTION AND CHARACTERISATION OF EMERGING BIOLOGICAL THREATS

Problem

Current biological detection and diagnostic capabilities are predominantly designed to identify known biological agents through predefined targets, signatures, reference libraries, or specific assays. While effective against recognised threats, these approaches may be insufficient for detecting emerging, previously unknown, engineered, modified, or otherwise unexpected biological hazards. Defence organisations operate in environments where biological threats may arise from naturally occurring outbreaks, accidental releases, or deliberate activities. Many advanced biological detection systems also require specialist operators, laboratory infrastructure, substantial logistical support, or extensive sample processing, limiting utility in deployed and resource-constrained environments. Defence therefore faces a capability gap in detecting, screening, and assessing biological threats when agent identity is unknown, uncertain, or deliberately obscured. There is a need for approaches that can be miniaturised, field-deployable, logistically simple, low-burden, and usable by personnel with limited specialist training while still providing actionable threat information.

Need & Relevance to Defence

Defence requires earlier awareness of biological hazards before traditional laboratory methods can conclusively determine agent identity. Operationally relevant solutions must support force protection, health protection, operational planning, and national security decision-making in contested, remote, and austere environments. Technologies should be capable of miniaturisation or deployment in portable, low-logistics form factors, minimise operator burden and training requirements, and provide meaningful biological threat awareness to non-specialist users. Such capabilities would reduce reliance on centralised laboratories and improve preparedness against emerging, engineered,

synthetic, or otherwise novel biological hazards.

Research Question

How might Defence develop agent-agnostic capabilities that can detect, screen, characterise, and assess emerging biological threats with reduced reliance on predefined target agents, signatures, or threat libraries?

Supporting research questions include detection of anomalous biological signatures; assessment of unknown samples; identification of emerging, synthetic, engineered, or modified threats; application of multi-omics; use of AI/ML and data fusion; uncertainty quantification and risk assessment; and development of portable, low-burden systems suitable for non-specialist operators

Expected Outputs

A prototype, demonstrator, analytical framework, or demonstrated methodology capable of detecting and/or characterising new, emerging, synthetic, engineered or modified biological threats.

Outcomes should contribute towards improved early warning of biologically significant events, enhanced awareness of unusual biological activity, improved support for decision-making under uncertainty, reduced dependence on laboratory confirmation, and actionable information for force protection and national security. Feasibility should be demonstrated within a 12-month project period.

Methodology/Approach

Research may investigate agent-agnostic detection technologies including but not limited to:

- biological anomaly detection

- characterisation of unknown samples
- identification of emerging novel, engineered or synthetic organisms, toxins
- genomics, transcriptomics, proteomics and metabolomics approaches
- sensing and multi-sensor data fusion
- AI/ML-enabled pattern recognition
- portable and autonomous systems
- stand-off detection
- confidence estimation and operational risk assessment
- laboratory studies, prototype development, analytical assessment, or limited field trials

Projects should focus on demonstrating technical feasibility and operational relevance.