Closing the CBRNE Gap: The Operational Cost of Slow Biological Confirmation

Chemical, radiological, nuclear and explosive threats have been confirmed in the field for decades. Biological threats have not — and the cost of that gap, measured in disrupted operations rather than missed attacks, is the subject of this brief.

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Version 1.0 — 31 August 2026 | Biomeme, Inc., 401 North Broad Street, Suite 222, Philadelphia, PA 19108

CBRN is usually named as four domains, but most equipment sets and doctrine already treat it as five: chemical, biological, radiological, nuclear and explosive — CBRNE. Explosives earn the fifth letter for the same reason chemical, radiological and nuclear threats are routinely confirmed at the point of encounter: each leaves a physical signature a handheld instrument can read directly, whether that's trace particle and vapor analysis, spectroscopy and ion mobility, or gamma spectrometry.

Biology is the exception — no radiation signature, no spectroscopic fingerprint separating a pathogen from the background organisms around it, so identification has to interrogate molecular composition instead. The physics of why is covered in full in the companion technical reference, Biothreat Detection: Field Identification Methods and Specifications. What this document covers is what that exception has cost operationally, and what has changed to close the gap.

What biothreat detection actually means

Biothreat detection is the identification of biological warfare agents and pathogens using molecular or immunological methods. In practice this covers a defined set of organisms and toxins. The U.S. Centers for Disease Control and Prevention categorizes biological agents by the threat they present to public health, with Category A covering the highest-priority organisms — those that are easily disseminated or transmitted, cause high mortality, and require specific preparedness action — and Category B covering a second tier of moderately easy to disseminate agents with lower mortality.

Detection in this context is a chain, not a device. A sample has to be collected from air, liquid or a surface. Genetic material or protein has to be liberated from the sample and separated from everything that would interfere with the analysis. Only then can the analysis itself run. Each link in that chain has historically required its own equipment and its own training, which is why “field biological detection” meant, for a long time, field *screening* followed by laboratory *identification*.

Three method classes, in brief

Three method classes dominate field biological detection. Lateral flow immunoassays read surface proteins and return a presumptive result in minutes at low cost, but carry real cross-reactivity risk. Nucleic acid amplification tests — real-time PCR and isothermal chemistries — read genetic sequence directly and are the confirmatory reference standard. Sequencing is target-agnostic and information-rich but too slow and

infrastructure-heavy for point-of-need use.

For the full comparison — basis of identification, confidence level and principal limitation for each class — see Biothreat Detection: Field Identification Methods and Specifications.

The three levels of identification, in brief

Not every positive result carries the same weight. **Detection** means something anomalous was sensed, with identity unknown. **Presumptive identification** means a specific agent is likely present and is enough to justify masking, cordoning, or beginning decontamination. **Confirmatory identification** definitively identifies the agent and is what allows an incident to be closed rather than escalated. The gap between the second and third level is where most of the operational cost lives — the subject of the next section.

For what each level establishes, the methods that produce it, and what it supports operationally, see Biothreat Detection: Field Identification Methods and Specifications.

Why the gap is expensive

A presumptive positive keeps personnel masked, an area cordoned, and operations disrupted for as long as it takes to package a sample, document it under chain of custody, and transport it somewhere that can confirm it — commonly hours, sometimes days.

What makes this expensive is the base rate: the overwhelming majority of biological alarms in the field are not attacks. They are environmental interferents, sensor faults, or benign organisms that happen to trip a trigger. That reframes what confirmatory identification is actually for. The value of doing it quickly is usually not catching an attack — it's **ruling one out** fast enough that a unit isn't masked, an area isn't cordoned, and a mission isn't stalled for longer than the ambiguity actually justified.

It also reframes the comparison procurement conversations tend to get wrong. The question isn't “does a molecular platform cost more than a strip test?” It's “what does a day of unnecessary disruption cost, and how often does that day happen?” Multiply an average disruption cost — idled personnel, lost operational tempo, a delayed mission — by how often a presumptive alarm turns out to be nothing, and the field-deployable confirmatory instrument is rarely the expensive line item.

What moved confirmatory identification into the field

Closing this gap took several technical problems solved together: automating sample preparation into a sealed disposable cartridge, miniaturizing PCR/isothermal instrumentation into a battery-powered handheld, and stabilizing reagents through lyophilization so cold chain isn't required. Biothreat Detection: Field Identification Methods and Specifications covers those three in detail.

A fourth constraint is easy to miss, and it's the one screening tools consistently fail on the way to the point of testing: time to result. Operators are typically in MOPP4 or Level A personal protective equipment, frequently running a battery-powered PAPR or breathing from a compressed air tank that may hold only 30 minutes of air, sometimes in a contested environment. A test that takes longer than about 15 minutes is unlikely to be used at all — not because the answer isn't valuable, but because the operator's practical window closes first. A system that solves sample prep, miniaturization and reagent stability but misses this constraint still delivers a laboratory method with a laboratory timeline attached.

Field-deployable versus fixed-facility, in brief

Fixed-facility systems offer the greatest analytical breadth — a reference laboratory can identify agents outside any predefined panel — at the cost of transit time and infrastructure. Field-deployable systems trade that breadth for an answer at the point of sampling, which is what matters when a team has to decide whether to stay masked or clear a cordon. The two are complements, not alternatives: a serious capability uses field systems for decisions that can't wait and a reference laboratory for the ones that need depth.

For the full field-deployable vs. fixed-facility comparison, see Biothreat Detection: Field Identification Methods and Specifications.

Evidence and validation

Peer-reviewed validation of portable molecular platforms exists and is worth reading directly rather than taking on faith. Biomeme platforms have been evaluated in the open literature across clinical, veterinary, environmental and biosurveillance settings; Biothreat Detection: Field Identification Methods and Specifications lists the full set of studies with citations.

Independent government evaluation is also public: the Director, Operational Test and Evaluation publishes annual assessments of Department of Defense acquisition programs including the Joint Biological Tactical Detection System (JBTDS), and the Joint Program Executive Office for CBRN Defense publishes fact sheets on fielded capabilities such as the Joint Handheld Bio-Agent Identifier (JHBI). Both are primary sources, and more informative than vendor claims about the same programs.

Biomeme can also connect you with U.S. government representatives who can provide performance data on its biowarfare agent detection panels.

Summary

- CBRN is usually named as four domains; most equipment sets already treat it as five (CBRNE), and explosives are confirmed the same way chemical, radiological and nuclear threats are — directly, from a physical signature. Biology is the exception.
- The expensive part isn't detection — it's the gap between a presumptive alarm and a confirmatory answer, because most alarms are false and every hour of ambiguity carries an operational cost.
- Closing that gap in the field required solving sample preparation, instrument miniaturization and reagent stability — plus a fourth, often-missed constraint: getting time to result inside the window an operator in full PPE actually has to use the instrument.
- Field-deployable and fixed-facility systems are complements, not alternatives — field for the decisions that can't wait, laboratory for the ones that need depth.
- For the underlying method classes, identification levels, platform specifications and full independent-validation bibliography, see Biothreat Detection: Field Identification Methods and Specifications.

Biomeme builds field-deployable biological identification systems; the current platform, the Biomeme/5, delivers confirmatory-grade molecular results in under 15 minutes at 2 lbs. For how this applies to a full-spectrum CBRN capability, see CBRN detection solutions; for platform specifications and panel coverage, see the Biothreat Detection Suite; and for the full technical reference, see Biothreat Detection: Field

Identification Methods and Specifications.

Sources

[1] Centers for Disease Control and Prevention. Category A and B Biological Agents. https://stacks.cdc.gov/view/cdc/138996

[2] Joint Program Executive Office for CBRN Defense. Program fact sheet: Biomeme test systems. U.S. Department of Defense. https://www.jpeocbrnd.osd.mil/Portals/90/jpm-fact-sheet-biomeme-test.pdf

[3] Director, Operational Test and Evaluation. FY2025 Annual Report — Joint Biological Tactical Detection System (JBTDS). https://www.dote.osd.mil/Portals/97/pub/reports/FY2025/dow/2025jbtds.pdf

For the full independent-validation bibliography and additional primary sources, see Biothreat Detection: Field Identification Methods and Specifications.