Biothreat Detection: Field Identification Methods and Specifications

A technical reference on biological detection within CBRN defense

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Version 1.1 — 31 August 2026 | Biomeme, Inc., 401 North Broad Street, Suite 222, Philadelphia, PA 19108

This document describes how biological threats are detected and identified in field conditions, the confidence levels those methods produce, and the specifications of the Biomeme/5 platform. It is published as an open, non-gated technical reference.

For the CBRNE five-domain framing and what the presumptive-to-confirmatory delay costs operationally, see the companion brief, Closing the CBRNE Gap: The Operational Cost of Slow Biological Confirmation.

1. Why biological detection is a distinct problem

Chemical, radiological and nuclear threats are detected through physical signatures that can be measured directly. A chemical warfare agent is a molecule with characteristic mass, mobility and spectroscopic behavior, measurable by ion mobility spectrometry, infrared and Raman spectroscopy, or gas chromatography. Radiological and nuclear materials emit ionizing radiation continuously, measurable by gamma spectrometry and neutron detection.

Biological agents offer no equivalent. A bacterium, a virus or a protein toxin has no distinguishing radiation signature and no spectroscopic fingerprint separating a pathogen from the harmless organisms surrounding it in an environmental sample. Identification requires interrogating molecular composition — either surface proteins or internal genetic sequence.

The consequence is that biological confirmation has historically been the step that sent a sample to a laboratory. Chemical and radiological detection matured toward handheld instruments decades ago; biological identification did not, because the methods producing a trustworthy answer were tied to laboratory infrastructure.

2. Detection method classes

Two method classes dominate field biological detection, with sequencing available where laboratory infrastructure exists. They are not interchangeable.

Method	Basis of identification	Confidence level	Principal limitation
Lateral flow immunoassay	Antibody binding to surface proteins	Presumptive	Cross-reactivity with near-neighbor organisms; lower sensitivity; requires dilution for high biomass samples
Nucleic acid amplification tests (NAATs) — real-time PCR and isothermal	Amplification of a DNA or RNA sequence unique to the target	Confirmatory	Restricted to targets for which the assay was designed; historically run on heavier and more power-hungry equipment
Sequencing	Direct reading of genetic sequence	Confirmatory and characterizing	Infrastructure and analysis time; laboratory-bound

NAATs are the reference standard used by public health and reference laboratories. Because the target is a sequence chosen to be unique to the organism, specificity is high enough to differentiate closely related species. Because amplification is exponential, sensitivity is high enough that a small number of genetic copies is sufficient.

3. The three levels of identification

Not every positive result carries the same weight. Conflating these levels is a persistent source of ambiguity in requirement documents.

Level	What it establishes	Typical methods	What it supports
1. Detection	Something anomalous is present; identity unknown	Aerosol particle counters, biological triggers, standoff sensors	Triggering a sampling action
2. Presumptive identification	A specific agent is likely present	Lateral flow immunoassay, handheld antibody assays	Immediate protective action — masking, cordon, decontamination
3. Confirmatory identification	The agent is definitively identified	Real-time PCR, isothermal, sequencing, reference laboratory culture	Stating what was present; closing or escalating an incident

The operational cost sits in the gap between levels two and three. A presumptive positive keeps personnel in protective posture, an area cordoned and operations disrupted while a sample is packaged, documented under chain of custody and transported for confirmation — an interval measured in hours or days.

The base rate matters here. The majority of biological alarms in the field are not attacks; they are environmental interferents, sensor faults, or benign organisms that trip a trigger. The practical value of rapid confirmatory identification is therefore frequently the speed with which a threat can be **ruled out** and normal operations resumed.

4. Field-deployable versus fixed-facility systems

This distinction should be settled before any other requirement, because it determines everything downstream.

	Fixed-facility	Field-deployable
Analytical breadth	Broadest; can identify agents outside any predefined panel	Restricted to the assay panel carried
Time to result	Includes sample transit — hours to days	At the point of sampling — typically under one hour
Infrastructure	Mains power, controlled environment, cold chain, trained laboratory staff	Battery power; shelf-stable reagents; operator-level training
Primary role	Depth, characterization, attribution	Decisions that cannot wait

Neither substitutes for the other. A serious capability generally uses field systems for time-critical decisions and a reference laboratory for questions requiring depth. Claims that a single instrument covers both, or covers all five CBRNE domains at once, warrant scrutiny.

5. What moved confirmatory identification into the field

Three technical problems had to be solved together. Partial solutions carry laboratory constraints with them.

- **Sample preparation.** Extracting and purifying nucleic acid from a raw sample traditionally required pipetting, reagent handling, a centrifuge and the skill to avoid contaminating the workspace. Automating this inside a sealed disposable cartridge removes both the equipment and the training requirement, and closes the contamination pathway.
- **Instrument miniaturization.** Real-time PCR and professional-grade isothermal molecular testing require precise, repeatable thermal control and sensitive multi-channel fluorescence measurement. Achieving this in a fully automated sample-to-answer, battery-powered package weighing a few pounds required rethinking the design of the fluidics, optics, and thermal management rather than miniaturizing a benchtop architecture.
- **Reagent stability.** Liquid PCR and isothermal reagents require cold chain, which is impractical to sustain in the field. Lyophilization — freeze-drying reagents into a shelf-stable form that reconstitutes on use — removes that dependency.

6. Platform specifications — Biomeme/5

Biomeme/5 figures are pre-release and are not yet published on biomeme.com; comparator figures are as published by their manufacturers. Confirm against the current datasheet before relying on any figure for procurement.

Specification	Biomeme/5	Franklin ISP	BioFire RAZOR MK II	BioFire FilmArray
Chemistry	DTECT isothermal	Real-Time PCR, Isothermal	Real-Time PCR	Real-Time PCR

Specification	Biomeme/5	Franklin ISP	BioFire RAZOR MK II	BioFire FilmArray
Weight	2 lbs	4.3 lbs	11 lbs	20 lbs
Dimensions	200 x 100 x 70 mm	132 x 187 x 117 mm	289 x 645 x 482 mm	254 x 393 x 165 mm
User interface	Integrated screen	Mobile app	PC + barcode scanner	PC + barcode scanner
System control & data	USB-C, BLE, Wi-Fi, ATAK	Wireless (BLE) or wired	Wired	Wired
Integrated sample prep	Yes	Yes	No	Yes
Max targets per run	60	27	12	45
Battery operated	Yes	Yes	Yes	No
Battery life	5 hours	6 hours	3 hours	—
Operate while charging	Yes	Yes	No	—
Test kit shelf life	24 months	12 months	6 months	6 months

6.1 Biomeme/5 Assay Panels

Panel	Purpose
Hazard Panel	Detection and differentiation of up to 17 biowarfare agents from a single sample, across 21 gene targets and 1 internal control. Shelf-stable lyophilized reagents. Time-to-result in less than 15 minutes.
Biowarfare (BW) Panel 3.0	Detection and differentiation of 29 Category A and B biowarfare agents across 33 gene targets and 1 internal control from a single sample. Shelf-stable lyophilized reagents. Detection in less than 15 minutes.
BW Simulant Panel	Detection of 4 biowarfare simulant organisms, enabling realistic training without handling threat material.
Verification Panel	Confirms instrument functionality and readiness with a pass/fail result before the platform is relied upon.

7. U.S. Department of Defense programs

Biomeme technology is associated with two Department of Defense programs of record. The primary sources below name Biomeme directly and are preferable to vendor claims.

Joint Handheld Bio-Agent Identifier (JHBI)

A handheld biological identification system with integrated sample preparation, developed for U.S. Special Operations Forces. The JPEO-CBRND program fact sheet identifies the fielded capability as the Biomeme Franklin platform — approximately four pounds, battery or mains powered, results in under an hour, smartphone-controlled. [1]

Joint Biological Tactical Detection System (JBTDS)

An expeditionary, networked biological detection and sampling capability for austere and forward environments, integrating aerosol sampling, automated detection triggers and biological identification. The FY2025 Director, Operational Test and Evaluation annual report names Biomeme as a major contractor on the program, and records Milestone C approval in September 2023 and delivery of the identifier component to U.S. Special Operations Command in July 2025. [2]

Note on contract data. No public contract value or award number has been published for Biomeme in SAM.gov, FPDS or Department of Defense contract announcements. Any specific dollar figure attributed to Biomeme should be treated as unverified.

8. Independent validation

Claims about field molecular platforms should be checked against independent evaluation rather than manufacturer literature. The peer-reviewed studies below evaluate or deploy Biomeme platforms across clinical, veterinary, environmental and biosurveillance applications. Listed most recent first; each entry links to its PubMed record.

Auer A, et al. Comparative analysis of laboratory-based and portable qPCR platforms: CFX, MIC, and Biomeme Franklin for African swine fever and avian influenza detection. *BMC Vet Res*. 2026. https://pubmed.ncbi.nlm.nih.gov/42321793/

Struewing I, et al. Evaluation of a field method for qPCR analysis of toxigenic cyanobacteria. *Harmful Algae*. 2026. https://pubmed.ncbi.nlm.nih.gov/41832035/

Park J, et al. Development of molecular diagnostic tests for marine mammal DNA viruses, herpesvirus, poxvirus, and anellovirus, using a portable Biomeme Franklin thermocycler. *Ecotoxicol Environ Saf*. 2025. https://pubmed.ncbi.nlm.nih.gov/40577922/

Iglesias-Ussel MD, et al. A rapid host response blood test for bacterial/viral infection discrimination using a portable molecular diagnostic platform. *Open Forum Infect Dis*. 2025. https://pubmed.ncbi.nlm.nih.gov/39758742/

Kamau J, et al. Comparison of test performance of a conventional PCR and two field-friendly tests to detect *Coxiella burnetii* DNA in ticks using Bayesian latent class analysis. *Front Vet Sci*. 2024. https://pubmed.ncbi.nlm.nih.gov/38962707/

Greening SS, et al. Validation of a field-portable, handheld real-time PCR system for detecting *Pseudogymnoascus destructans*, the causative agent of white-nose syndrome in bats. *J Wildl Dis*. 2024. https://pubmed.ncbi.nlm.nih.gov/38329747/

Stanhope J, et al. Development, testing and validation of a SARS-CoV-2 multiplex panel for detection of the five major variants of concern on a portable PCR platform. *Front Public Health*. 2022. https://pubmed.ncbi.nlm.nih.gov/36590003/

Park K, et al. A portable diagnostic assay, genetic diversity, and isolation of Seoul virus from *Rattus norvegicus* collected in Gangwon Province, Republic of Korea. *Pathogens*. 2022. https://pubmed.ncbi.nlm.nih.gov/36145479/

Onyilagha C, et al. Evaluation of mobile real-time polymerase chain reaction tests for the detection of severe acute respiratory syndrome coronavirus 2. *Sci Rep*. 2021. https://pubmed.ncbi.nlm.nih.gov/33931684/

Zowawi HM, et al. Portable RT-PCR system: a rapid and scalable diagnostic tool for COVID-19 testing. *J Clin Microbiol*. 2021. https://pubmed.ncbi.nlm.nih.gov/33674285/

Prunuske A, et al. Middle-school student engagement in a tick testing community science project. *Insects*. 2021. https://pubmed.ncbi.nlm.nih.gov/34940224/

Tomaszewicz Brown A, et al. Development and validation of a portable, point-of-care canine distemper virus qPCR test. *PLoS One*. 2020. https://pubmed.ncbi.nlm.nih.gov/32320441/

Seah A, et al. MinION-based DNA barcoding of preserved and non-invasively collected wildlife samples. *Genes (Basel)*. 2020. https://pubmed.ncbi.nlm.nih.gov/32325704/

Hole K, et al. Foot-and-mouth disease virus detection on a handheld real-time polymerase chain reaction platform. *Transbound Emerg Dis*. 2019. https://pubmed.ncbi.nlm.nih.gov/31077564/

Nguyen TL, et al. Rapid detection and monitoring of *Flavobacterium psychrophilum* in water by using a handheld, field-portable quantitative PCR system. *J Aquat Anim Health*. 2018. https://pubmed.ncbi.nlm.nih.gov/30269364/

Russell JA, et al. Unbiased strain-typing of arbovirus directly from mosquitoes using nanopore sequencing: a field-forward biosurveillance protocol. *Sci Rep*. 2018. https://pubmed.ncbi.nlm.nih.gov/29615665/

Comparative studies do not uniformly favor any single platform, and results vary by target and sample type. Readers evaluating platforms for a specific target set should read the relevant comparison directly rather than generalizing from a headline result.

9. Patented technology

U.S. Patent	What it covers
12,121,901	Compact battery-powered real-time PCR device with integrated heating block, optical fluorescence detection and wireless connectivity receiving test instructions from a mobile device.
12,023,666	Automated sample-preparation system in which a disposable cartridge docks with a reusable processing unit that sequentially mixes sample with lysis and wash reagents, removing manual pipetting.
11,892,461	Lightweight portable analyzer using a moving-magnet mechanism, with a heated block holding sample tubes and a movable optics carriage performing cycling and detection.
9,926,553	Nucleic-acid extraction using a porous medium acting as a one-way valve, capturing and purifying genetic material in a single hand-operated motion without power.

A complete list of granted patents is published at biomeme.com/patents.

References

[1] 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

[2] 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

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

[4] Peer-reviewed evaluations of Biomeme platforms are listed in full in section 8.

For the CBRNE five-domain framing and the operational cost of the presumptive-to-confirmatory gap, see the companion brief, Closing the CBRNE Gap: The Operational Cost of Slow Biological Confirmation.