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The One Health Stress Test: Global Biosecurity Lessons from 2025-2026

Climate Change * Urban Environment * Global Health

Global Biosecurity and the One Health Stress Test

Across the biosphere, modern biosecurity integrates public health, veterinary medicine, and ecological surveillance under the "One Health" framework. Throughout 2025-2026, climate-driven vector expansion, post-pandemic supply disruptions, viral evolution, and on-farm sanitation lapses subjected regional biodefense architectures in the United States, the European Union, and East Asia to an unprecedented stress test -- spanning H5N1 avian influenza in U.S. dairy cattle, the Texas New World Screwworm incursion, alpine arboviral and Bluetongue outbreaks in Europe, Eurasian African Swine Fever, and the Mpox Clade Ib emergency.

The United States: Heavy Federal Investment and Jurisdictional Complexity

Guided by the National Biodefense Strategy (updated October 2022 across DOD, HHS, DHS, and USDA under 6 U.S.C. 104), the United States pairs heavy federal investment with decentralized execution.[1] For FY 2025, HHS/ASPR and BARDA requested $10.54 billion for vaccines, diagnostics, and domestic countermeasure manufacturing -- including $95 million under the Make PPE in America Act -- while scientific bodies urged $500 million for USDA's Agriculture and Food Research Initiative.[2][3] Yet the Bipartisan Commission on Biodefense notes the absence of a single executive authority unifying human health (CDC, FDA) and agricultural (USDA) agencies.[4]

| Federal Agency / Department | | Funding Category / Initiative | | Proposed FY 2025 Allocation (USD) | | Strategic Objective |

| HHS / ASPR | | Mandatory Pandemic Preparedness | | 10.54 Billion | | Vaccines, diagnostics, manufacturing, and biosurveillance.[2] |

| HHS / BARDA | | Advanced Research and Development | | 970 Million | | Next-generation countermeasure platforms.[2] |

| HHS / ASPR | | Strategic National Stockpile | | 970 Million | | Medical supply sustainment and emergency logistics.[2] |

| HHS / ASPR | | Biodefense Production of MCMs | | 95 Million | | Onshoring essential medicines and PPE.[2] |

| USDA / AFRI (ASM Request) | | Agricultural Biosecurity Research | | 500 Million | | Food and agriculture research resilience.[3] |

Two 2025-2026 agricultural crises tested this system:

* New World Screwworm (Cochliomyia hominivorax): Held at Panama's Darien Gap via Edward Knipling and Raymond Bushland's Sterile Insect Technique (SIT) since 2006, the parasite breached the barrier in 2023.[5] Following an August 2025

travel-related human case in Maryland, the USDA confirmed the first U.S. livestock case since 1966 on June 3, 2026, in Zavala County, Texas -- establishing 20-km quarantine/surveillance zones, building a 300-million-fly-per-week SIT facility in Edinburg, Texas, and issuing FDA Emergency Use Authorizations for lotilaner, ivermectin, F10 sprays, and doramectin.[5][6][7][8]

* H5N1 Avian Influenza in Dairy Cattle: Following the spring 2024 spillover into dairy herds, the CDC recorded 71 human cases and two deaths among exposed individuals,[9] while the USDA committed $1 billion for farm biosecurity, FDA studies confirmed commercial pasteurization inactivates H5N1 in milk, and CDC sequencing verified the absence of sustained airborne human-to-human transmission.[9][10][11]

The European Union: Supranational Coordination and Climate-Driven Vectors

The European Union coordinates biosecurity across HERA, ECDC, and EFSA.[12][14] While NATO allies committed in 2025 to long-term targets of 3.5% of GDP for core defense and 1.5% for broader resilience, civilian biodefense straddles European Defence Fund budgets and EU4Health grants -- which HERA used in September 2025 for vector-borne diagnostics, CBRN countermeasures, and EU FAB manufacturing.[13][16][17]

Warming temperatures drove winter-diapausing Aedes albopictus mosquitoes into 369 regions across 16 European countries by June 2025.[18][19][20] In March 2026, surveillance reported a 2024 Swiss mosquito sample positive for Dengue virus (causing dengue fever) -- the first documented detection north of the Alps -- following 27 European Chikungunya outbreaks in 2025 (reaching Alsace, France) and a three-year high in Culex-borne West Nile virus across Italy and Romania, requiring expanded urban vector control.[19][21] Concurrently, Culicoides midge-borne Bluetongue virus (BTV-3 and virulent BTV8-FRA2023) swept Europe -- exceeding 1,104 French BTV-3 outbreaks in August 2025 and 343 UK cases -- accelerating DIVA-compatible VP2/VP5 viral protein subunit vaccines, while H5N1 antibodies in a Dutch cow prompted heightened surveillance.[15][22][23][24]

| Pathogen / Disease | | Primary Vector | | Most Affected European Regions (2025-2026) | | Biological Impact / Status |

| Dengue / Chikungunya | | Aedes albopictus | | France (Alsace), Italy, Switzerland | | Local transmission and detections at northern latitudes.[19][21] |

| West Nile Virus | | Culex species | | Italy, Romania | | Three-year peak and provincial expansion.[19] |

| Bluetongue (BTV-3) | | Culicoides midges | | France, Germany, UK, Netherlands | | Severe ruminant outbreaks; UK import vaccine rules.[23][24] |

| Bluetongue (BTV-8) | | Culicoides midges | | France, Italy, Switzerland, Austria | | Spread of virulent FRA2023 lineage.[22][23] |

| Avian Influenza (H5N1) | | Wild avian reservoirs | | Netherlands, EU wild birds | | Widespread avian circulation; Dutch bovine antibodies.[15][25] |

Asia: Legislative Centralization, Island Quarantine, and Farm Compliance

East Asian biosecurity highlights three governance models:[26][28][31]

* China: Under the 2021 Biosecurity Law and "Four Beams, Eight Pillars" framework governing epidemics, biotechnology, and BSL-3/4 labs, 2025-2026 analyses note inter-ministerial silos and uneven grassroots compliance.[26][27]

* Japan: Enforcing zero-tolerance border exclusion under MAFF (up to three years' imprisonment or 3-50 million fines), Japan screened over 40 million tourists in 2025-2026 via shoe disinfection, luggage checks, 180-day pet quarantines, and ISO microchip validation.[28][29][30]

* South Korea: Despite real-time One Health integration linking human (KDCA) and animal (KAHIS) databases, a March 2026 MAFRA audit of 53 HPAI-infected poultry farms (H5N1, H5N6, H5N9) revealed that 70% violated basic boot, clothing, or vehicle disinfection protocols.[31][32]

| Nation | | Lead Authorities | | Primary Structural Mechanism | | Identified Vulnerabilities / Limitations |

| China | | NPC, Health & Agriculture | | 2021 Biosecurity Law; "Four Beams, Eight Pillars". | | Agency silos and uneven local compliance.[26] |

| Japan | | MAFF | | Zero-tolerance border quarantine and fines. | | Border reliance under high tourist volume.[28] |

| South Korea | | KDCA, MAFRA | | Linked human (KDCA) and animal (KAHIS) databases. | | 70% of HPAI-infected farms failed sanitation.[32] |

Meanwhile, African Swine Fever (ASF) killed over 9,700 pigs in Mizoram, India in 2025 alone (bringing cumulative state losses since 2021 past 1,000 crore, or roughly $120 million), sparked outbreaks in Bhutan and South Korea, and raised EU domestic pig outbreaks by 76% in 2025 (585 outbreaks, 81% in Romania).[33][34][35][36]

Global Flashpoints: The Mpox Clade Ib Emergency

In human epidemiology, orthopoxvirus Mpox Clade Ib triggered a WHO Public Health Emergency of International Concern (August 2024-September 2025), exceeding 46,000 African cases (214 deaths) and 54,000 global cases (~500 deaths) by WHO External Situation Report No. 64 (March 2026), with ongoing clade Ib detections in Europe and travel-linked U.S. cases as the basic reproduction number exceeded unity under Kermack-McKendrick dynamics.[37][38][39]

Conclusion: Four Strategic Lessons for Global Biodefense

The 2025-2026 crises establish four core biosecurity lessons: (1) climate change has redrawn vector geography;[5][19] (2) digital surveillance fails without on-farm behavioral compliance;[32] (3) defense and civilian health funding must be unified;[4][16] and (4) active biological barriers require redundant supply chains.[5][38]

Updates... (Nov 23, 2026): Consolidated prior Nov 20, 2026 updates; replaced Ref. [10] (USDA APHIS hub title mismatch) with the dated USDA Feb 26, 2025 $1 billion

H5N1 biosecurity investment press release; replaced Cloudflare-gated Ref. [7] (Texas Tribune) and Cloudflare-429 Ref. [18] (bioRxiv) with USDA APHIS screwworm guidance and canonical DOI 10.64898/2026.03.06.710080 (Radici et al., Aug 1, 2026); corrected author initials in Ref. [26] (Min, K., Zhang, Y., et al.); and added exact date (Mar 14, 2025) to Ref. [11].

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