frontiers | Frontiers in Tropical Diseases

TYPE Editorial
PUBLISHED 06 January 2026
DOI 10.3389/fitd.2025.1765132

OPEN ACCESS

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RECEIVED 10 December 2025
ACCEPTED 11 December 2025
PUBLISHED 06 January 2026

CITATION
Arez AP (2026) Editorial: From biological collections to solutions: the vital role of biobanking in one health and global health. *Front. Trop. Dis.* 6:1765132.
doi: 10.3389/fitd.2025.1765132

Editorial: From biological collections to solutions: the vital role of biobanking in one health and global health

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KEYWORDS

biodiversity, equity, infectious diseases, international collaboration, pandemic preparedness

Editorial on the Research Topic
From biological collections to solutions: the vital role of biobanking in one health and global health

Biological collections, preserved in biobanks, serve as a valuable source of high-quality specimens and associated data. These resources are essential for innovation and translational research in One Health and Global Health. Recent studies have highlighted the potential of biobanking for managing infectious diseases, identifying genetic markers for chronic conditions, and advancing precision medicine (1, 2). Regarding infectious diseases, biological collections—comprising samples from organisms, tissues, and other biological materials—offer an invaluable source of scientific data as they enable the identification and monitoring of pathogens, along with the characterization of vectors and reservoirs critical to human and animal health. These resources support early outbreak detection, track the spread of resistance to therapeutic agents, and reveal epidemiological patterns. Furthermore, they help elucidate the complex interactions between ecological systems and public health, reinforcing their essential role in surveillance through a One Health approach.

The COVID-19 pandemic has demonstrated both the critical importance of biobanking infrastructure and the persistent challenges of achieving equitable access to biological resources worldwide. The pandemic accelerated the recognition that sustainable biobanking networks are essential for preparedness and a rapid response to emerging infectious diseases (3, 4). However, the underutilization and limited awareness of biological collections and biobanking persist in One Health and Global Health research (5).

The four articles in this Research Topic collectively address critical dimensions of biobanking for global health: institutional capacity building, regional collaboration, intersectoral challenges, and innovative governance models. Together, they offer a comprehensive picture of both the obstacles and opportunities of leveraging biological collections for pandemic preparedness and One Health implementation.

da Silva et al described the establishment and evolution of a biobank at the Oswaldo Cruz Foundation (Fiocruz) in Brazil. Originally conceived during the COVID-19 pandemic to store SARS-CoV-2 viruses and human-derived clinical samples, it was subsequently expanded into the Biodiversity and Health Biobank (BBS Fiocruz) to encompass human biological materials and biodiversity samples related to a broader spectrum of emerging and re-emerging infectious diseases. The authors detailed critical areas that demand attention for sustainable biobank operations: establishing benchmarks and best practices, developing comprehensive business plans, forging strategic partnerships, diversifying funding sources, ensuring ethical and legal compliance, implementing rigorous quality control procedures, and investing in human resources and infrastructure. Their experience demonstrates that institutional biobanks in biodiversity-rich regions can serve dual purposes—reducing national dependence on imported biological materials while simultaneously strengthening pandemic preparedness capabilities. The unique integration of human and biodiversity materials within a single infrastructure represents an innovative model that reflects the interconnected nature of One Health.

Arez et al expanded the perspective from the institutional to the regional level by examining biobanking initiatives across Portuguese-speaking countries. Their analysis revealed striking disproportions in biobanking infrastructure worldwide, with the majority of facilities concentrated in high-income countries despite the disproportionate burden of infectious diseases in LMICs. This also highlighted significant geographical inequities that directly impact research capacity and pandemic preparedness. The article advocates for enhanced collaborative networks among Lusophone countries, where shared language and historical connections provide a foundation for strengthening biobanking capacity. These collaborations can facilitate knowledge transfer, harmonize ethical and regulatory frameworks, and enable resource sharing that would be difficult for individual countries to achieve independently. The authors emphasize that biobanking in tropical regions is not merely a technical challenge; it also requires navigating complex regulatory issues, particularly those concerning Access and Benefit Sharing. Regional partnerships can help address these challenges collectively while ensuring that benefits from biological resources are shared equitably with source countries and communities.

Wei et al provided a critical analysis of the structural and operational challenges facing biobanking within One Health and Global Health contexts. This work identified key barriers, including a lack of standardization, limited data-sharing frameworks, interoperability issues, and integration challenges across the human, animal, and environmental health sectors. These intersectoral challenges are particularly acute in LMIC settings, where resource constraints magnify existing difficulties. The authors propose that digital solutions—including artificial intelligence, blockchain technology for transparent benefit-sharing, and advanced laboratory information management systems—offer promising tools for overcoming these obstacles. However, they caution that technology alone is insufficient; successful implementation requires robust governance frameworks that span multiple sectors and ministries. The fragmented nature of health governance, with human health typically overseen by health ministries, while animal and environmental health fall under different authorities, poses ongoing coordination challenges, requiring biobanks to comply with multiple regulatory frameworks simultaneously. Fragmented, project-based funding landscapes also affect sustainability, as biobanking requires stable and predictable funding, consistent governance, capacity building, and adherence to data standards. The authors identify collaborative networks and coordinated digital solutions as a promising way forward.

Giri et al presented the Virtual Biorepository System (VBS) as a solution to biobanking challenges. Rather than relying on resource-intensive centralized facilities, the VBS proposes a federated network that connects local biorepositories—particularly in LMICs—into a trust-based system that promotes global equity and access. This approach is particularly relevant in the context of epidemic threats and global health emergencies, where rapid, coordinated access to samples and data across borders can accelerate research, diagnostics, and public health responses — thereby supporting preparedness and resilience on a global scale. The authors described the 10x10 pilot project, which demonstrated the feasibility of this approach by establishing partnerships across diverse geographical settings. The VBS facilitates specimen access while ensuring that specimens remain under local governance and control, which addresses several critical needs simultaneously: it reduces the cost and complexity of participation, enables rapid mobilization of specimens during outbreaks, ensures that diagnostic and vaccine development can assess performance across diverse populations, and provides mechanisms for equitable benefit sharing with specimen-contributing communities. Survey data presented by the authors revealed that participating institutions are motivated by networking opportunities, capacity building, enhanced visibility for their collections, and potential funding opportunities. This alignment of incentives with global health security needs suggests that the VBS model could be sustainable and scalable beyond the pilot phase.

The articles in this Research Topic collectively demonstrate that biobanking infrastructure is a necessity for global health security. The integration of biological collections spanning human, animal, and environmental specimens within the One Health framework enables the comprehensive surveillance, research, and rapid response capabilities needed to address emerging health threats. However, realizing this potential requires sustained investment, innovative governance models, regional and international collaboration, and an unwavering commitment to equity and benefit sharing.

As we face an era of accelerating environmental change, biodiversity loss, and increased pathogen spillovers, the role of biobanking in One Health and Global Health will only grow more critical. The work presented in this Research Topic provides a foundation for harnessing the full power of biological collections to create a healthier, more equitable, and more resilient world.

Author contributions

APA: Writing – original draft, Writing – review & editing.

Funding

The author(s) declared that financial support was received for this work and/or its publication. APA is the coordinator of the BIOTROP biobank, which is funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the Global Health and Tropical Medicine R&D unit (doi:10.54499/UID/04413/2025) and the Associated Laboratory in Translation and Innovation Towards Global Health REAL (LA/P/0117/2020).

Conflict of interest

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