

From Research to Resilience: Preparedness Lessons from COVID-19

Executive summary



Contributors

We gratefully acknowledge the support and guidance of Natsuko Imai-Eaton (Research Lead, Epidemics) and Lesley Alborough (Social Research Specialist).

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Executive summary

The COVID-19 pandemic marked a transformative moment for pathogen genomic surveillance. For the first time, genomic sequencing was deployed at global scale in near real-time to inform pandemic response, demonstrating both its significant potential and revealing critical gaps in global capacity. While the immediate crisis has now passed, the lessons learned from this scaling of genomic surveillance have continuing value for strengthening global health security.

This report examines how research environments enable or constrain pathogen genomic surveillance during public health emergencies. By analysing the experiences of Wellcome-funded genomic sequencing projects, this report identifies key factors that transcend the specific context of COVID-19 to inform future emergency preparedness and response capabilities.

This work reveals fundamental principles for building sustainable surveillance systems that can rapidly pivot to address new threats while maintaining scientific integrity under intense pressure. By understanding both the visible infrastructure needs and invisible support systems required, funders can strategically invest in creating resilient research environments that stand ready for future emergencies.

Wellcome commissioned Research Consulting to explore the barriers and enablers faced by genomic sequencing projects during emergency conditions. The aims of this research were to:

- **Understand** the complete pathway from sample collection to policy uptake, identifying critical junctures where strategic support can maximise impact
- **Uncover** hidden processes and pressures that affect research teams during emergencies but often remain unacknowledged in traditional evaluations
- **Identify** practical solutions that address context-specific challenges faced by researchers across diverse settings

Conducted between August 2023 and January 2025, this study engaged with eight Wellcome-funded projects through interviews, focus groups and surveys. These projects spanned multiple regions including Africa, Asia, Latin America, and the Middle East, providing a global perspective on pathogen surveillance challenges and solutions.

This consultation revealed distinct barriers and enablers across the genomic sequencing pipeline and looked beyond the technical workflows to examine the broader context in which sequencing activities occurred.

Based on this consultation, this report identifies five key themes that influence all stages of genomic surveillance:

- Funding design and grant award
- Enabling infrastructure
- Research team capacity
- Data management and sharing
- Research uptake and community engagement

Funding design and grant award

Long-term investments in local genomic surveillance capacity create the foundation for effective emergency response. Wellcome's sustained funding relationships, particularly through its Africa and Asia Programmes, enabled researchers to rapidly redirect existing expertise toward emerging threats. When institutions have established pathogen genomics capabilities and collaborative networks before emergencies arise, they can mobilise quickly and maintain operations under pressure.

The review found the following key findings and potential actions relating to funding design and grant award:

Table ES1. Key findings relating to funding design and grant award

Key findings	Potential actions for research funders
Existing Wellcome grantees could receive funds quickly, while new partners faced significant delays due to mandatory due diligence processes (Main report, Section 3.1)	Develop context-sensitive due diligence frameworks for emergency response
Wellcome's reimbursement-based funding model caused friction with national regulations (Main report, Section 3.2)	Continue to review funding mechanisms as national regulatory requirements evolve
Projects led by institutions with existing partnerships were able to rapidly overcome roadblocks to delivery (Main report, Section 3.3)	Use dedicated sections in application form to identify existing partnerships and understand how applicants are integrated into local research and policy networks
Communication challenges delayed project initiation, particularly for newly-established funding partnerships (Main report, Section 3.4)	Create clear communication tools (like "one-pagers") for new partners explaining key processes, timelines, and explicitly inviting questions Continue to engage regularly with funded teams to support communication and explicitly communicate that questions are welcome from award holders
Community engagement (CE) funding supported core sequencing awards (Main report, Section 3.5)	Continue to provide ring-fenced funding for community engagement in line with findings from the supporting review of CE grants



Enabling infrastructure

Robust physical and technical infrastructure provides the essential foundation for genomic surveillance. During emergencies, even well-resourced institutions face challenges with cold chain infrastructure, reagent supply chains, and equipment maintenance. However, teams that developed innovative resource management strategies and leveraged local support networks were able to maintain operations despite these constraints.

The review found the following key findings and potential actions relating to enabling infrastructure:

Table ES2. Key findings relating to enabling infrastructure

Key findings	Potential actions for research funders
Limited access to basic physical infrastructure affected the integrity of critical reagents and consumables (Main report, Section 4.1)	Recognise limitations in abilities to address global supply chains but consider partnerships with organisations like UNICEF to include research needs in emergency logistics planning
Significant supply chain disruption necessitated careful consumables planning and management (Main report, Section 4.2)	Facilitate knowledge sharing about infrastructure challenges and solutions across funded teams
High resource costs and limited availability prompted innovative approaches to consumables management (Main report, Section 4.3)	Recognise limitations in abilities to address global supply chains but consider partnerships with organisations like UNICEF to include research needs in emergency logistics planning
Access to cutting-edge equipment and reliable technical support is critical to ensuring continuity in genomic sequencing (Main report, Section 4.4)	Consult with other funders about approaches to equipment servicing and support in low- and middle-income countries (LMICs)
Significant data demands of disease surveillance require substantial computing resources for processing, analysis and storage (Main report, Section 4.5)	Clarify approaches to funding maintenance of equipment e.g. allowing longer-term maintenance contracts



Research team capacity

Bioinformatics expertise emerged as a critical capability for effective pathogen genomic surveillance. Organisations that had invested in developing this specialised knowledge before the emergency were better positioned to analyse and interpret sequence data. Formal training programs and informal knowledge-sharing networks proved essential for building capacity and addressing technical challenges during the response.

The review identified the following key findings and potential actions relating to research team capacity:

Table ES3. Key findings relating to research team capacity

Key findings	Potential actions for research funders
Highly capable bioinformaticians were in significant demand to meet sequencing analysis needs (Main report, Section 5.1)	Continue to consider and embed investments in bioinformatics capacity building through existing initiatives that support training and researcher network building
Funded teams provided training to enhance in-house and partner bioinformatics capabilities (Main report, Section 5.2)	
Organisations established formal and informal networks to share expertise and resources (Main report, Section 5.3)	

Data management and sharing

Effective pathogen genomic surveillance requires balanced approaches to data sharing that recognise data generators' contributions while enabling timely analysis. Organisations navigated complex tensions between national data sovereignty concerns and the need for global collaboration. Platforms that credited data generators while enabling analysis were particularly valued by researchers in low and middle-income countries (LMICs).

The review identified the following key findings and potential actions related to data management and sharing:

Table ES4. Key findings relating to data management and sharing

Key findings	Potential actions for research funders
GISAID emerged as the primary platform for sharing SARS-CoV-2 sequence data and was particularly attractive to researchers in LMICs due to its policies on crediting data generators (Main report, Section 6.1)	Support tiered data sharing that allows rapid sharing to decision-makers while working towards full public release
Interim solutions were established to enable data sharing before full public sharing was possible, including restricted sharing with key stakeholders (Main report, Section 6.3)	
Metadata quality and completeness were a significant challenge, particularly in routine healthcare facilities (Main report, Section 6.4)	Promote use of existing frameworks to support metadata collection and adherence to relevant standards

Research uptake and community engagement

Successful translation of genomic data into policy action relies on established relationships between research institutions and government agencies. Projects with local leadership and pre-existing connections to policymakers achieved greater impact through timely information sharing. Technical advisory committees and formal governance structures provided crucial pathways for evidence-informed decision-making.

The review identified the following key findings and potential actions related to research uptake and community engagement:

Table ES5. Key findings relating to research uptake and community engagement

Key findings	Potential actions for research funders
Research uptake is enabled by existing relationships between research institutions and government agencies (Main report, Section 7.1)	Compile and share examples of successful policy engagement approaches from different contexts
Robust channels for communicating complex scientific information are critical to relaying information to policymakers (Main report, Section 7.2)	
Dedicated committees and advisory groups are a vital mechanism for information sharing (Main report, Section 7.3)	
Local leadership leads to more successful policy dialogue and engagement (Main report, Section 7.4)	Develop clear, accessible guidelines on community engagement expectations and approaches for emergency funding
Community engagement supports genomic sequencing efforts, provided that messaging is carefully crafted (Main report, Section 7.5)	

While identified through a review of COVID-19 experiences, the five themes outlines above represent fundamental principles for strengthening future emergency preparedness and response capabilities. By strategically addressing these elements, funders can help build resilient research environments that stand ready to respond effectively to future public health emergencies.



About Wellcome

Wellcome is a global charitable foundation which supports science to solve the urgent health issues facing everyone. We fund curiosity-driven research, and we're taking on three of the biggest health challenges facing humanity – climate change, infectious disease and mental health.

About Research Consulting

Research Consulting is an independent consultancy that helps solve challenges in research, scholarly communication, and knowledge exchange. We work with funders, universities, and research organisations worldwide to drive positive change in research practice and address emerging needs in the global research ecosystem.



Sample
collection



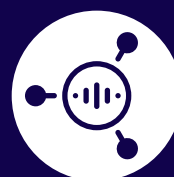
Sample
testing



Genomic
sequencing



Data
sharing



Data
analysis



Research
uptake

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