



The Microbiota Vault
A global non-profit initiative to conserve long-term health for humanity

Microbiota Vault Launch in Switzerland Overview

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1. Introduction

Within the Microbiota Vault initiative, a pioneer team of international experts has come together with the aim of safeguarding microbial diversity by supporting collection efforts and creating an institution for safe preservation, the Microbiota Vault. The initiative takes inspiration from the Svalbard Global Seed Vault, which safeguards the global diversity of food crop seeds.

The rationale for the Microbiota Vault initiative rests on the premises that a) microbial diversity is of great importance for human well-being and health and that b) microbial diversity is globally threatened by westernization, urbanization, and environmental change proceeding at an unprecedented pace, resulting in risks and lost opportunities. Microbiomes and diversity thereof are strongly connected between humans, animals, and the environment — a relationship that is generally described as “One Health” concept. The global crisis of antibiotic drug resistance is one example of an important One Health related problem.

The Microbiota Vault initiative therefore strives to

- a) support the collection of this diversity while still possible through collaboration with and fostering of Local Working Collections (LWCs),
- b) to establish a Microbiota Vault biobank as a safe repository of backup specimens for long-term preservation,
- c) to catalyze through its actions a research ecosystem by enabling an international network for research partnerships, and
- d) to foster research by establishing an interoperable data and annotation framework following local and international legal regulations, FAIR principles of data access and providing interconnected and interoperable datasets for research, leading to open access to microbial metagenomic data to the research community.

A global ecosystem supporting One Health

Collect. The Microbiota Vault closely interacts with local collections and research efforts all over the world.

Preserve. The Microbiota Vault acts on behalf of the local working collections, providing safe backup storage and a framework for data services and collaboration.

Enable. The Microbiota Vault empowers the research of the local working collections, helps set protocols and standards, preserves the biodiversity of microbiota, and allows future restoration of health.



Figure 1: Framework of the Microbiota Vault Initiative

Microbiota Vault Launch

The rationale of the initiative was published in Science in 2018¹ and the concept was subsequently validated and refined in a feasibility study². It was supported by non-profit institutions and universities active in the field of the human gut microbiome, such as the Swiss Gebert Rüf Foundation along with the Seerave Foundation, the Calouste Gulbenkian Foundation (Portugal), Rutgers University (USA), Kiel University (Germany), Canadian Institute for Advanced Research (Canada), Bengt E. Gustafsson symposium foundation (affiliated to Karolinska Institutet, Sweden) and UC San Diego School of Medicine (USA).

During the feasibility study, a series of in-depth discussions with key opinion leaders took place, among them representatives from microbiome research, but also with experts on LMIC-HIC cooperation and representatives from UN level international organizations.

As such, the proposed framework is

1. Designed to provide an equitable solution for cooperation in the field of biodiversity preservation. This is reflected in the focus on developing inclusive governance and in the way the network is constructed around a center (the Vault proper) that acts on behalf of the LWCs.
2. Designed to catalyze international collaboration in research and to support open science. This is reflected in the concept to provide a bioinformatics framework for characterization and annotation of the specimens going into the vault, thereby creating incentives for collaboration and building a data platform for microbiota specimens from all over the world.

Situated at the interface of biodiversity and health, with its focus on long-term preservation and international collaboration, the initiative integrates research and policy objectives and is designed to be scaled to an international level. A multistep process is followed to realize the stated goals:

1. Feasibility study (published in June 2020)
2. Planning phase preparing the launch
- 3. Launch phase establishing Vault biobanking in Switzerland**
4. Scaling and expanding international connections

¹ <https://www.science.org/doi/10.1126/science.aau8816>

² https://www.microbiotavault.org/wp-content/uploads/2021/03/Microbiota_Vault_Report_Final_20200611.pdf

2. Launch phase

The Microbiota Vault initiative has decided to initiate the operational phase of the project in Switzerland and has designed a program for a two-year launch phase with the following objectives:

1. Proof-of-principle during the launch phase, including
 - a. installation of the biobanking infrastructure in Switzerland.
 - b. initiating collaboration projects for sample collection with local working collections.
 - c. shipping of such samples from the local working collections to the biobanking infrastructure.
 - d. collecting metadata associated with the samples in an interoperable fashion.
 - e. developing databases and platforms for specimen's metadata.
 - f. performing annotation and metagenomic characterization and data analysis of authorized samples.
 - g. concretizing the Microbiota Vault concept in such a fashion will be instrumental in addressing the political level and scaling.
2. Establishment of the management capabilities to build the organization and international network, to develop the required legal frameworks, and to drive the development at the political level.

For the execution of the launch phase, the Microbiota Vault initiative collaborates with a science team from the University Hospital Basel, the University of Basel, University of Lausanne, ETH Zurich, and Rutgers University.

2.1. Team



Maria Gloria Dominguez-Bello, Professor at Rutgers University, President of The Microbiota Vault Inc.

Dr. Dominguez-Bello focuses on the microbiome development from birth, functions for the host, impact by practices that reduce microbial transmission or disrupt the microbiota, and strategies for restoration. She also studies how Westernization changes environmental microbes and human exposures, integrating the fields of anthropology and architecture/urban studies into microbial ecology.



Nicholas Bokulich, Professor, ETH Zürich

Nicholas Bokulich is the Professor of Food Systems Biotechnology at the Institute of Food, Nutrition, and Health (ETH Zürich). The Bokulich laboratory develops computational methods and software for studying spatiotemporal dynamics of microbial ecosystems and applies these tools to investigate the interface between microbiomes, food, and human health.



Adrian Egli, Professor, Director, Institute of Medical Microbiology, University of Zurich

Prof. Egli's main goals are: 1) to develop new diagnostic for rapid detection of multidrug resistant and virulent pathogen; 2) to explore novel typing technologies such as whole genome sequencing and MALDI-TOF mass spectrometry for clinical applications; 3) to finally understand pathogen evolution in the broad context of the host/pathogen/environment interaction. This could lead to the identification of the most critical factors important for pathogenicity, resistance development, and transmission. Such information will allow the generation of novel intervention strategies to impact disease outcomes for a single patient but also the population burden of infections.

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Pascale Vonaesch, Professor at University of Lausanne

Pascale Vonaesch works on the role of the microbiota in nutrition-related diseases with a focus on child undernutrition as well as the triad linking nutrition, intestinal infection and the microbiota. Her current focus is on the development of microbiota-targeted interventions to ameliorate the current nutritional therapies, especially for under- and overnutrition and related health effects.



Dominik Steiger, PhD, Chief Executive Officer at EvalueScience Ltd

Dominik Steiger is Chief Executive Officer at EvalueScience Ltd, an independent company specialized in expert-based consulting and research in the fields of biomedicine, health, and digital health. He is first author of the Microbiota Vault Feasibility Study and coordinates the launch of the initiative. Dr. Steiger has done research on the molecular genetics of growth control and of metal homeostasis. He holds a PHD in natural sciences from the University of Zurich.

2.2. Overall plan

The project is organized in work packages. The overall plan for the launch phase is the following:

1. To manage and further develop the initiative and governance structure and associated legal framework needed to store the samples on behalf of the local collections (WP1).
2. To set up and validate standard operating procedures (SOP) for collection and storage of fecal samples, and when applicable, high-quality DNA isolation, metagenomics, bacterial strain isolation from frozen and lyophilized samples as well as other possible applications needed (i.e. metabolites). These protocols will serve local collections in LMIC countries and secure minimal quality standards (WP2).
3. To set up relationships with Local Working Collections (LWCs) and to validate a pipeline for collection and shipping of samples from LWCs to the Vault biobank in Switzerland (WP3 & WP4).
4. To set up secure storage of cryopreserved and lyophilized samples (Vault biobank) (WP5)
5. To set up and validate data management and metadata standards (minimal working sample metadata, and standard ontologies) as well as a data annotation pipeline (WP6).
6. Upon agreement with the depositor, to establish metagenomic analysis of specimens (WP7).
7. Provide a platform to collect and share Vault related data including metadata and metagenomic data (WP7).
8. To expand and consolidate the network of collaborators of the Microbiota Vault and prepare for scale-up of the initiative.

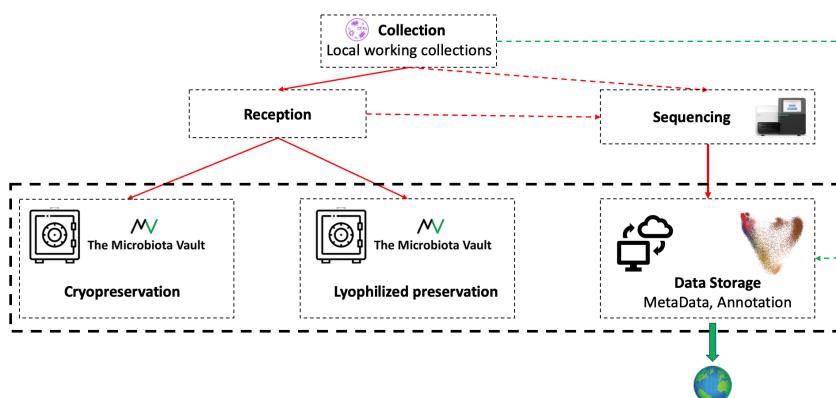


Figure 2: Flow of samples and data at the Microbiota Vault

3. Global outcomes of the proposed work

Given the rapidly ongoing processes of urbanization and losses of traditional lifestyles, global human-associated microbial diversity is continuously shrinking, at a time when science has just started understanding the health relevance and potential of our microbial environment and the microbiome.

The Microbiota Vault initiative sets out to preserve the diversity of human-associated microbiota by constructing an institution for the safe backup storage and preservation of microbiota samples and collections and their associated metadata, in collaboration with and on behalf of local working collections. Such samples and collections are to be made available for future resuscitation, culturing, and research based on clearly defined rules. The Microbiota Vault metadata, metagenomic sequencing and open access publication framework will be of great benefit to the research community and will help preserve and document these precious reserves of human microbial biodiversity.

In order to fulfill its goals, the Microbiota Vault Initiative interacts with and stimulates local collection efforts globally, and it builds bridges between developing countries (often the hosts of such diversity) and developed countries (often the hosts of technical and scientific expertise and research activities on microbial diversity and functions). It will contribute to international standards for collection and preservation and it will catalyze research.

During the launch phase, a strong team of stakeholders will initialize this endeavor and prove the principle in all its core elements (interaction between biobanking in Switzerland and Local Working Collections, development and validation of SOPs, establishment of annotation and metagenomics framework). This will lay the foundations for scaling the initiative and it will benefit the research into microbial diversity as well as the health implications of the microbiome.

The Microbiota Vault initiative has the potential to become a powerful global framework to support the preservation of biodiversity and to strengthen human microbiome research, with a focus on equitable access and benefit sharing. Via its international network, it will serve the establishment of common standards and guidelines. This standardization, combined with the computational and annotation frameworks developed during the launch phase have the potential to substantially enhance the research ecosystem, catalyzing the next generation of discoveries in human microbiome research and underpinning broader collaboration, standardization, and scientific reproducibility worldwide. In this respect, the Microbiota Vault Initiative has the potential to lead the next generation of standards and guidelines for microbiome research, similar to the role that the Human Microbiome Project and Earth Microbiome Project have played in shaping progress in this domain over the past decade.

4. About the Microbiota Vault initiative

The Microbiota Vault initiative is driven by The Microbiota Vault, Inc., a 501 c(3) public charity whose aim is support, launch and scale the Microbiota Vault initiative (MV).

The Board of Directors consists of the following persons:

- Prof. M Gloria Dominguez-Bello, PhD (President)
- Prof. Rob Knight, PhD (Vice President 1)
- Prof. Jack Anthony Gilbert, PhD (Vice President 2)
- Prof. Martin J. Blaser, MD (Treasurer)
- Prof. Thomas Bosch, PhD
- Prof. Dominique A. Caugant, PhD
- Prof. Deborah Delgado-Pugley, PhD
- Manuel Fankhauser, PhD
- Prof. Claire Fraser, PhD
- Prof. Keiji Fukuda, MD, MPH
- Prof. Robert M. Goodman, PhD
- Prof. James Joseph Heckman, PhD
- Alexander Kwarteng, PhD
- Marc LaForce, MD
- Prof. Richard J. Roberts, PhD

The MV collaborates with an expanding list of collaborators (currently 50 collaborators from 15 countries and 4 continents).

The MV initiative is designed to establish a global framework of equitable collaboration with Local Working Collections (LWCs), stressing the sovereignty of the LWCs. It is developing the network of collaboration by establishing an international network. Activities in this regard comprise the organization of international symposia in collaboration with local universities (in 2020, focusing on South America, in 2021, focusing on Africa).

Key achievements of the initiative:

2018: The rationale around the Microbiota Vault initiative was published in Science (<https://www.science.org/doi/10.1126/science.aau8816>) and The Microbiota Vault, Inc., was founded as a 501 c(3) public charity whose aim is support, launch and scale the Microbiota Vault initiative.

2019/2020: Execution and publication of the Microbiota Vault Feasibility Study, commissioned by Seerave Foundation, Gebert Rüf Foundation, Rutgers University, Calouste Gulbenkian Foundation, Kiel University / Kiel Life Science, The Microsetta Initiative / UC San Diego School of Medicine, Canadian Institute for Advanced Research (CIFAR), and Bengt E. Gustafsson symposium foundation, affiliated with Karolinska Institutet.

2020/2021: Concept for the Launch Phase (in collaboration with Rutgers University, ETH Zurich, University of Basel, University of Lausanne), framework agreement with Gebert Rüf Foundation and Seerave Foundation about executing the Launch Phase, grant by Rockefeller Foundation, start of the Launch Phase.