African Microbiome Institute

Annual Report

Stellenbosch
UNIVERSITY
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forward together
sonke siya phambili
saam vorentoe

2024

Contents

MESSAGE FROM THE DIRECTORS

The African Microbiome Institute's (AMI) core focus is to facilitate networking among microbiome researchers in South Africa, Africa and internationally, and to provide support and training for early career scientists with the aim to contribute towards building a community of researchers with relevant expertise to elevate Africa's position as a leading hub in the field of microbiome research. This is achieved through multiple scientific interaction sessions, workshops as well as one-on-one consultations for training on microbiome data processing, analysis and presentation. As we reflect on another year, we are pleased to share the accomplishments and milestones that have shaped the AMI's endeavors in 2024. These efforts were aimed at enhancing capacity and fostering collaboration among various stakeholders.

As a testament to the commitment of the AMI team to facilitate networking and collaboration among microbiome researchers, the community of scientists participating in various activities spearheaded by AMI grew substantially. In 2025, we established many new connections and collaborations at local and international institutions, including the University of Cape Town, University of Zimbabwe, Council for Scientific and Industrial Research (CSIR, South Africa), World Microbiome Partnership (France), and University of Utrecht (Netherlands). The AMI Network now spans over 21 institutions in 9 countries.

A significant milestone was the addition of a computational biologist to the core team of AMI, which has resulted in formalization of data analysis services. This has opened-up opportunities for AMI to offer much needed support especially to research groups and students who have microbiome research integrated into their programmes but do not have in-house expertise for proper study designs and for data analysis. We concluded the year by hosting the 3rd biennial African Microbiome Symposium which for the first time took place at the Tygerberg campus and the recently launched BMRI institute with its modern conference venue, well suited for networking. Together, these milestones reflect our continued commitment to innovation and excellence.

Going forward, AMI commits to continue collaborate with other well-established experts to host workshops at affordable rates for students and early career researchers, and to bring together African scientists to collaborate in research addressing critical medical and agricultures challenges on the continent. Our core values of excellence, integrity, commitment, accountability, inclusivity, and innovation continue to underpin our success. As we look ahead, we remain committed to developing and building capacity in microbiome research at SU and across Africa, fostering innovation while making a positive impact on our communities and the environment.

We extend our sincere gratitude to the African Microbiome Network, including the steering committee, collaborators, sponsors, and participants for their unwavering support and partnership.

CHARISSA NAIDOO & EVODIA SETATI
Co-directors, AMI

THE African Microbiome Institute

Who we are

We are a **cross-faculty coordinating & directive** body for **microbiome** research, training, & service provision. Our goal is to serve as a **central resource** that integrates, develops, & exploits our **multidisciplinary expertise** to acquire competitive **funding** & foster **partnerships** with industry.

What we do

Science Networking

- Quarterly scientific **meetings**
- AMI-Blitz **Networking** events
- Research **symposia**

Teaching / Learning

- Monthly **webinars**
- Microbiome analysis **workshops**
- Consultation-based **training**

Services

- Microbiome data **analysis consultation**
- **Grant writing** assistance

Research

- We work with **local** & **international collaborators** to produce expert **multidisciplinary** academic outputs.

Where we're based

We are based in the **Division of Molecular Biology and Human Genetics**, Faculty of **Medicine and Health Sciences**, but also operate across the Faculties of **Science** and **AgriSciences,** and have established an **international network** of researchers.

GOVERNANCE AND TEAM

The AMI has an active steering committee, who assists the director(s) with the management of the AMI and execution of its vision, mission and aims.

Co-directors

Dr Charissa Naidoo
Lecturer, Clinical Mycobacteriology and Epidemiology (CLIME) Group, Division of Molecular Biology and Human Genetics, Faculty of Medicine and Health Sciences

Prof Evodia Setati
Associate Professor, South African Grape and Wine Research Institute (SAGWRI), Faculty of AgriSciences

Additional steering committee members

Prof Nico Gey van Pittius
Vice Dean: Research and Internationalisation

Prof Andrew Whitelaw
Professor, Division of Medical Microbiology, Department of Pathology, Faculty of Medicine and Health Sciences

Prof Grant Theron
Professor, Clinical Mycobacteriology and Epidemiology (CLIME) Group, Division of Molecular Biology and Human Genetics, Faculty of Medicine and Health Sciences

Prof Florian Bauer
Distinguished Professor, South African Grape and Wine Research Institute, Department of Viticulture and Oenology, Faculty of AgriSciences

Prof John Terblanche
Professor, Applied Physiological Ecology Lab, Department of Conservation Ecology & Entomology, Faculty of AgriSciences

Dr Itumeleng Moroenyane
Senior Lecturer, Plant Holobiont Lab, Department of Botany and Zoology, Faculty of Science

Prof Karin Jacobs
Professor, Jacobs Laboratory, Department of Microbiology, Faculty of Science

Staff members

Dr Kristien Nel Van Zyl
Computational Biologist, African Microbiome Institute, Division of Molecular Biology and Human Genetics

Vision

To maintain a unique **cross-faculty institute** and a **continental resource** for diverse microbiome investigations involving humans, animals, plants, and environments. We aim to **centralize expertise**, **attract funding** from competitive sources, and **facilitate research** in **advanced** analytical techniques that, together, **capacitates researchers** to address **critical continental challenges** in health, agriculture and the environment.

Mission

The AMI's mission is to **enhance capacity** in the **microbiome** field by promoting research, training, and collaboration among researchers at SU and across Africa.

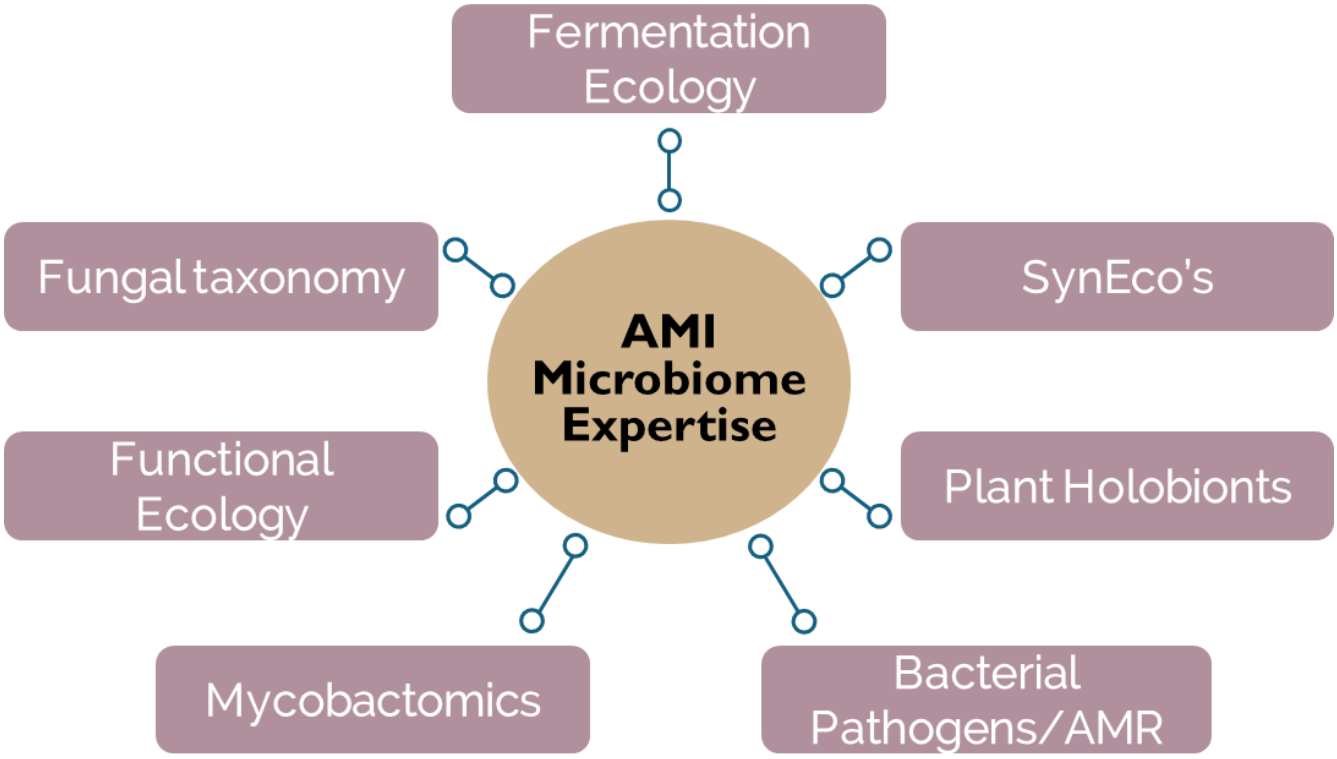
Core Values

The AMI's core values align with that of the Faculty of Medicine and Health Sciences, and Stellenbosch University, and includes **excellence, integrity, commitment, accountability, inclusivity, and innovation.**

AMI IDENTITY AND SERVICE ESTABLISHMENT

Expertise within AMI

The AMI boasts expertise in several fields of research including mycobactomics, functional ecology, synthetic ecology, microbiome engineering, fungal taxonomy, plant holobiont interactions, fermentation ecology, and human bacterial pathogens and antimicrobial resistance. The AMI steering committee members are available for collaborative research and to provide support and guidance in these areas.

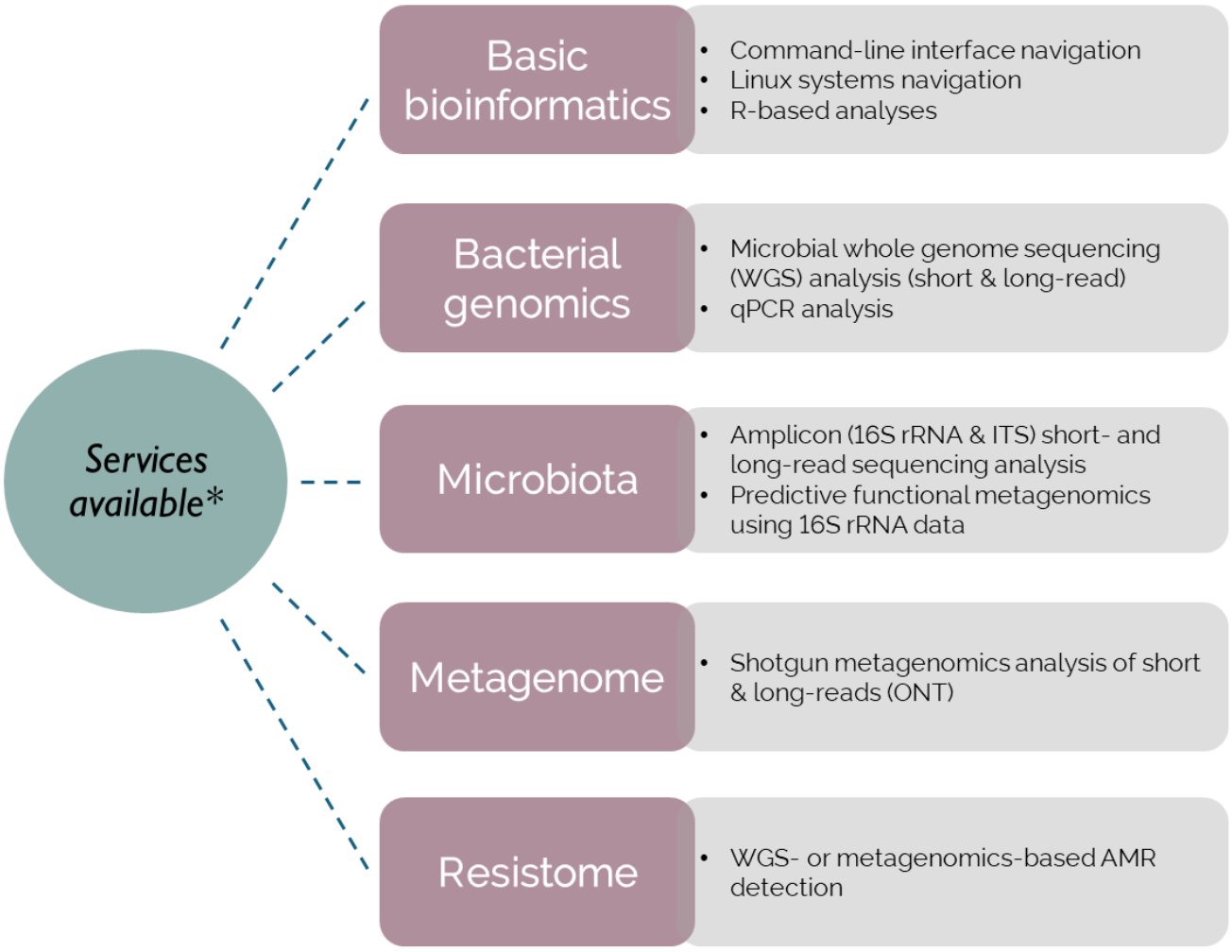


Website refresh

In 2024, in collaboration with the Division of Marketing and Communications, the AMI website underwent a complete refresh, to showcase the AMI's updated vision and mission. The new website features regular news articles, updates on our activities, links to events, and a new page for AMI services.

Services and SOPs established

2024 also saw the launch of AMI data analysis services through consultation and collaborative efforts. This service is currently led by the AMI's computational biologist, Dr Kristien Nel Van Zyl, and functions to assist SU and external researchers with microbiome-related research protocol development and analytical/technical support, or to link researchers with collaborators from an international network of researchers associated with the AMI.



**Where a study is out of scope of consultations, we can assist in identifying training opportunities and/or connections with potential collaborators from the AMI network.*

CORE FUNCTIONS: Networking

Quarterly Scientific Meetings

In 2024 the AMI hosted three scientific interactions meetings, two hybrid and one virtual, and concluded the annual activities with a symposium, which replaced the fourth quarterly meeting.

From Left to Right: Mr Hein Venter (Anatech), Miss Megan Tattersall (Division Medical Microbiology, SU), Dr Suereta Fortuin (AMI), Dr Lobke Steyn (Animal Sciences, SU)

At the first meeting which took place on the 29th of February at Tygerberg Campus. This hybrid event saw colleagues from different institutions joining in-person at the BMRI and online.

Miss Megan Tattersall presented her MSc research, which focused on the evaluation of Nanopore metagenomic sequencing for the characterisation and detection of infectious causes of disease.

Dr Lobke Steyn presented research from her group that elucidated the comparative effects of monensin and essential oil compounds in the diet of pre-weaned calves on the prevalence of antibiotic resistant *Escherichia coli*. Mr Hein Venter from Anatech shared how phenotypic research can be accessed through the Odin (Biolog, USA) all-in-one solution for cellular metabolic characterization, growth kinetics, and identification.

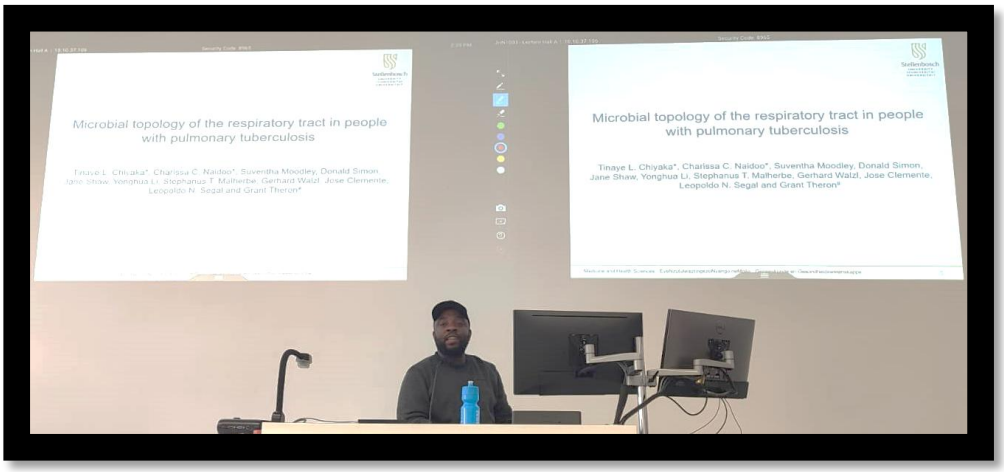
The second meeting held on the 9th of May was fully virtual and it hosted three international speakers. Dr. Ovokeraye Oduaran (WITS, South Africa) who currently chairs the H3Africa's Microbiome Task Force and the African Microbiome Special Interest Group, presented a snapshot of the AWI-Gen Microbiome Project.

Dr Mohammadali Khan Mirzaei (Technical University Munich School of Life Sciences, Germany) spoke about the interaction of phages and bacteria, and how the integration of holistic and reductionist approaches may be implemented in order to harness these interactions for the betterment of human health.

Prof Jose Clemente (Icahn School of Medicine at Mount Sinai, USA) delivered a presentation capturing the relationship of the microbiome and human health, specifically its characterisation and the employment of innovative therapeutic approaches.

From Top to Bottom: Dr. Ovokeraye Oduaran, Dr Mohammadali Khan Mirzaei, and Prof Jose Clemente

At the third meeting on the 19th of September on the Stellenbosch campus, Ms Tacha-Marie Joubert (research assistant intern in Dr. Itumeleng Moroenyane's Plant Holobiont lab, Department of Botany, SU) highlighted the functionality of the plant microbiome and showcased the potential of a curated microbiome library for breakthrough sustainability. Mr Tinaye Chiyaka (CLIME, Division of Molecular Biology and Human Genetics, SU) gave an insightful summary of his PhD research, which included the in-depth characterisation of the site-of-disease lung microbiome in people with TB.



Mr Tinaye Chiyaka delivering his research presentation.

3rd African Microbiome Symposium and Workshop

The activities of the year in 2024 were concluded with the 3rd African Microbiome Symposium and Workshop. The symposium was opened by the Rector and Vice-Chancellor, Prof Wim de Villiers who emphasised microbiome research as one of the focus areas of importance to Stellenbosch University and the value of translational research.

The symposium covered various aspects of the human microbiome, terrestrial microbiomes where Dr Leopoldo Segal (New York University) as a keynote speaker highlighted how a probabilistic approach which tracks transcripts, genes, and metabolites allows for reliable functional analysis of the lung microbiome, while Dr Jerolen Naidoo (Council for Scientific and Industrial Research; CSIR) raised awareness of the market potential held by microbiome studies and how the low representation of Africa derived microbiome data and reference genomes in global scientific resources hinder progress towards developing predictive health models.

In addition, Prof Donald Cowan (University of Pretoria) used the microbiomes of the Namib to demonstrate the crucial role of water as a driver of community structure and function, while Prof Oluranti Olubukola (North-West University) and Prof Kgabo Moganedi (University of Limpopo) showcased the diversity of plant-associated microbiota and how beneficial microbes can be harnessed for plant health and fitness, and to improve the quality of indigenous ferments. Most importantly this symposium brought to the fore, critical topics such as ethics and race in human microbiome research, where Dr Reinhard Böhmer (PathCare Laboratory) reiterated major ethics issues such as informed consent and respect for autonomy, data sharing and protection of privacy as well as informing subjects of research-related results. Prof Abigail Delgado (University of Utrecht) called upon researchers to re-imagine the descriptors used for human microbiome studies

and pay attention to descriptors that might generate racialized views on populations or create harmful stereotypes. The various informative and thought-provoking presentations inspired several critical questions for panel discussions. The panel findings will be submitted for publication in a peer-reviewed journal.

The symposium attracted 79 participants from seven South African institutions including Stellenbosch University, North-West University, University of Pretoria, Limpopo, Cape Town, and Zululand, five international institutions and two research centres viz. CSIR in South Africa and the National Research Institute for Agriculture, Food and Environment (INRAe) in France. Forty-one postgraduate students, postdoctoral fellows and early career researchers also attended a pre-symposium workshop titled "*Exploring cutting-edge tools and technologies for microbiome research*" hosted by one of the symposium partners and sponsors, Separations.

Please see the Symposium Picture Collage on the next page.

Workshop/Opening/Closing

Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

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20 - 22 NOVEMBER 2024

3RD AFRICAN MICROBIOME SYMPOSIUM

Beyond description: translation, application & implementation of microbiome research

Hosted by the **African Microbiome Institute**

Biomedical Research Institute, Tygerberg Campus, Stellenbosch University

Group Photo - Day 1

Panel - Day 1

Panel - Day 2

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Conference/workshop attendance

The AMI core team were active at many conferences and used these events to bring awareness to AMI and its activities to researchers and potential funders. This includes, but is not limited to:

- Microbiome Interactions in Health and Disease 2024, Wellcome Connecting Science, 14 – 16 Feb 2024, Virtual
- 34th Congress of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID Global), 27 – 30 April 2024, Barcelona, Spain
- SU-FMHS 68th Annual Academic Day, 28 – 29 August 2024, BMRI, Cape Town, SA
- 9th International Symposium on Microbial Ecology (ISME), 18 – 23 August 2024, Cape Town, SA
- Southern Africa Open Institute for Genomics and Bioinformatics Workshop on "*Prioritizing biodiversity genomics for improving the Southern African bioeconomy*", 9 – 10 September 2024, Virtual
- "*Microbiome: Discovering Barriers to Interventions*" workshop hosted by Wellcome Trust, 11-13 September 2024, London, UK
- African Microbiome Day 3, 16 September 2024, Virtual
- African Microbiomes in Health and Disease Symposium, 1 – 2 October 2024, Virtual

CORE FUNCTIONS: Teaching, training & capacity building:

Workshops

The AMI hosted three hands-on practical workshops throughout 2024. The first, *"Introduction to targeted microbiota analysis",* took place in July on Stellenbosch Campus and was funded by the NRF KIC programme. This 5-day hands-on practical workshop focused on best practises in microbiome study design, an introduction to R and command-line interfaces, and a comprehensive introduction to targeted microbiota data analysis on the QIIME2 and R platforms. The workshop was instructed by Dr Kristien Nel Van Zyl (AMI), with guest lectures by Dr Itumeleng Moroenyane (Plant Holobiont Lab, SU), and the teaching assistant, Mr Abhinav Sharma (Bioinformatics Group, Division of Immunology, SU).

Some of the participants and instructors of the "Introduction to targeted microbiota analysis" workshop

From 11 to 13 September, a collaborative effort from FMHS researchers and coordination from the AMI and the AfricaBP Project, brought the practical workshop, *"From sample to sequencing: metagenomic sequencing on the ONT long-read platform"*, to fruition at the Pathology Research Facility, Tygerberg Campus. The practical ran for three days and featured an extensive programme that introduced participants to proper sample handling, DNA extraction, sequencing on the Oxford Nanopore long-read platform, and an introduction to long-read metagenomics QC and analysis. We thank Dr Suereta Fortuin (VALIDATE, FMHS, SU) and Prof Wynand Goosen (Animal TB, SU), for providing support, samples, DNA, reagents, and consumables, and Dr Mae Newton-Foot (Division of Medical Microbiology, SU) for use of the sequencing facility and MinION devices.

From left to right: Ms Khensani Hattingh, Mr Fhulufhelo Mudau, Mr Mivuyo Mbovane, and Dr Kafilat Salvador-Oke

The AMI collaborated with the Eco2Wine Doctoral Programme and CREST, SU, to host a three day "*Metagenomics and Multivariate Data Analysis"* workshop, as part of the greater Eco2Wine workshop series. This practical course ran from 9 to 11 October 2024 across both Tygerberg and Stellenbosch campuses. Ten international doctoral candidates took part in the workshop. The candidates were also introduced to the BIOS system, which is featured in the BMRI on Tygerberg campus.

Participants touring the BIOS with Mr Rubeshan Nayager

The final workshop of 2024 was hosted by Separations as part of the 3rd African Microbiome Symposium, on the 20th of November. The workshop was titled *"Exploring cutting-edge tools and technologies for microbiome research"* and featured expert talks from application specialists, and researchers, on sample handling/storage, nucleic acid extraction, library preparation, and Illumina sequencing. The workshop also introduced participants to state-of-the-art translational research models, using bioprinting technology.

Educational webinars

In May, the Microbiome Mondays webinar series was initiated to introduce basic microbiomics & bioinformatics concepts to students and researchers. Six events were held in 2024, with more than 80 participants representing 14 local & international institutions attending throughout the year. The events covered an introduction of the microbiome, how different sequencing platforms can be utilised in microbiota research, targeted- and metagenomic sequencing approaches, and important analyses beyond microbiota descriptions. The series also featured a guest lecture by Dr Anel Sparks, from the Bioinformatics Group at the Division of Immunology, Stellenbosch University, to introduce participants to basic bioinformatics.

Dr Kristien Nel Van Zyl presented a Microbiome Masterclass, titled "*An Introduction to the Microbiome and the Importance of Multidisciplinary Microbiome Research in Africa*" in May, in collaboration with the African Doctoral Academy, which welcomed 63 participants from 9 countries, and facilitated international networking and collaboration opportunities.

International lecture series: DELGEME AMR Masters programme

Dr Kristien Nel Van Zyl, (AMI), Dr Charissa Naidoo (AMI, CLIME), Dr Suventha Moodley (CLIME), and Mr Tinaye Chiyake (CLIME), took part in a focused lecture and tutorial series for a structured MSc course as part of the DELGEME initiative in Mali, regarding AMR and the role of the microbiome. This lecture series covered a range of topics, ranging from basic microbiome concepts, to the interplay of the microbiome and resistome, the role of sequencing in microbiome research, and how bioinformatics is implemented in the microbiome context.

Consultation-based postgraduate training in microbiome and metagenome data analysis

The AMI computational biologist provided training and support for six students/postdoctoral fellows throughout 2024, for microbiome- and metagenome related projects. Two of these students handed in their thesis/dissertation at the end of 2024, and will be graduating in 2025.

1. Ms Megan Tattersall, MSc, Training and guidance for metagenomics analysis of clinical specimens using long-read sequencing data, as part of the project: *"Evaluating the use of a nanopore metagenomic sequencing approach for the detection and characterisation of infectious causes of disease"*, Division of Medical Microbiology, Department of Pathology, Stellenbosch University (SU).
   Project Status: Complete

2. Ms Kasiemobi Ezeora, PhD, Training and support for targeted microbiota analysis of yeasts, data visualisation, and statistical testing for the project: "*Fermentation optimization to valorize pomegranate fruit into wine using yeast isolated from pomegranate*", Department of Food Science, SU
   Project Status: Complete
3. Ms Faith Lutomia, MSc, Targeted microbiota analysis, and training as part of the project: "*Role of fecal bacteria in insulin sensitivity following exercise intervention in black South African women with obesity*", Division of Medical Microbiology, University of Cape Town
   Project Status: Ongoing
4. Mr Robert Glennon, MSc, Training in targeted microbiota analysis of bacteria, and subsequent visualisation and statistical testing, using PacBio long-read sequencing data as part of the SANeuroGut study, Department of Psychiatry, SU
   Project Status: Ongoing
5. Ms Taona Mudhluli, PhD, Training and support for metagenomic data analysis as part of the project: "*Investigating the impact of antiretroviral prophylaxis and human milk oligosaccharides (HMOs) on the gut microbiome of HIV-exposed infants compared to HIV-unexposed uninfected controls from low- and middle-income countries (LMICs)*", Department of Laboratory Diagnostic and Investigative Sciences, University of Zimbabwe
   Project Status: Ongoing
6. Dr Nazareth Siyoum, Postdoctoral fellow, Hands-on microbiota analysis and functional prediction training, for bacterial and fungal targets. Department of Microbiology and Plant Pathology, University of Pretoria
   Status: Ongoing

RESEARCH OUTPUTS

AMI-affiliated publications

- Nyawo G, **Naidoo CC**, Wu BG, et al. 2024. Bad company? The pericardium microbiome in people investigated for tuberculous pericarditis in an HIV-prevalent setting. *Microbes and Infection*. doi: 10.1016/j.micinf.2024.105434
- **Naidoo CC**, Venter R, Codony F, et al. 2024. Subtracting the background by reducing cell-free DNA's confounding effects on Mycobacterium tuberculosis quantitation and the sputum microbiome. *Scientific Reports*. doi: 10.1038/s41598-024-73497-3
- Conradie TA, Lawson K, Allsopp M & **Jacobs K**. 2024. Exploring the impact of fungicide exposure and nutritional stress on the microbiota and immune response of the Cape honey bee (*Apis mellifera capensis*). *Microbiological Research*. doi: 10.1016/j.micres.2023.127587
- Chiyaka TL, Nyawo GR, **Naidoo CC**, et al. 2024. PneumoniaCheck, a novel aerosol collection device, permits capture of airborne Mycobacterium tuberculosis and characterisation of the cough aeromicrobiome in people with tuberculosis. *Annals of Clinical Microbiology and Antimicrobials*. doi:10.1186/s12941-024-00735-x

- Moodley S, Kroon E, **Naidoo CC**, et al. 2024. Latent Tuberculosis Infection Is Associated with an Enrichment of Short-Chain Fatty Acid-Producing Bacteria in the Stool of Women Living with HIV. *Microorganisms.* doi:10.3390/microorganisms12061048
- Ramaboli MC, Ocvirk S, Khan Mirzaei M. et al. 2024. Diet changes due to urbanization in South Africa are linked to microbiome and metabolome signatures of Westernization and colorectal cancer. *Nature Communications*. doi:10.1038/s41467-024-46265-0
- Oduaran OH, Foláyan MO, Kamng'ona AW. et al. 2024. Microbiome research in Africa must be based on equitable partnerships. *Nature Medicine*. doi:10.1038/s41591-024-03026-2

Conference presentations

1. **Nel Van Zyl K**, Whitelaw AC, Hesseling AC, Seddon JA, Demers A-M, Newton-Foot M. Long-term levofloxacin therapy stunts diversification. 34th European Society of Clinical Microbiology and Infectious Diseases (ESCMID) Global Congress, 27 – 30 Apr 2024, Barcelona, Spain
2. **Jacobs K**, Page L, Conradie TA. Sense and Non-sense in Soil Health: The role of a functional microbiome in regenerative agriculture. 9th World Congress on Conservation Agriculture, 22-25 Jul 2024, Cape Town, South Africa
3. **Nel Van Zyl K**, Newton-Foot M, Goosen W, Fortuin S. From sample to sequencing: metagenomic sequencing on the ONT long-read platform. African Biogenome Project (AfricaBP) Open Institute For Genomic And Bioinformatics: Southern African Workshop, 9 – 13 Sep 2024, Virtual
4. Matukane S, Hattingh K, **Nel Van Zyl K**, Newton-Foot M, Whitelaw A. A pilot study exploring long-read nanopore metagenomics sequencing for heteroresistance detection in clinical specimens. 20th International Congress on Infectious Diseases (ICID), 3 – 6 Dec 2024, Cape Town, South Africa.
5. Tattersall MM, **Nel Van Zyl K**, Nel P, Moleleki M. Bacterial identification and antimicrobial resistance profiling in a variety of clinical specimens using nanopore metagenomic sequencing. 20th International Congress on Infectious Diseases (ICID), 3 – 6 Dec 2024, Cape Town, South Africa.

Collaborative research endeavours

New collaborations resulting from interactions with AMI

- Dr Jerolen Naidoo, Council for Scientific and Industrial Research (CSIR) and CLIME group (SU) to study host-microbiome interactions in people with pulmonary TB
- Ms Mosima Pheeha, the AMI computational biologist conducted microbiome analysis and provided consultations to support a PhD manuscript: "*Examining the composition of gut microbiota in a South African population: a comparative study between type 2 diabetes mellitus patients and non-diabetic individuals*" with colleagues from the Division of Epidemiology and Biostatistics, and the Department of Biomedical Sciences.

INTELLECTUAL INPUT

Prof ME Setati – Editorial Board Member, *South African Journal of Enology and Viticulture*

Dr K Nel Van Zyl – Manuscript Reviewer, *PLOS ONE*

FUNDING:

AMI-affiliated grant submissions

2023 NRF KIC2 (CC Naidoo)	Microbiome analysis workshop	successful
2024 NRF KIC1 (ME Setati)	3rd African Microbiome Symposium	successful