



Confidential

Application

Epidemic Science Leadership and Innovation Network (EPSILON) Preliminary Application

Reference number	EPS-P-193
Application title	Genomic surveillance for enhanced preparedness of emerging outbreaks through an integrated One Health and wastewater-based epidemiological approach in sub-Saharan Africa
Applicant	Dr. Inacio Mandomando
Institution	Fundacao Manhica

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Application Summary

EPSILON Name	Genomic surveillance for enhanced preparedness of emerging outbreaks through an integrated One Health and wastewater-based epidemiological approach in sub-Saharan Africa
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1. Proposed duration (months)

Plan for a minimum of 60 months (5 years) and a maximum of 72 months (6 years).

72

2. Primary thematic focus

Select one thematic area from the drop-down menu below which best describes the main focus of your research.

Virology – genotype to phenotype

2(a) Secondary thematic focus (optional)

If applicable, select a secondary area of focus for your research programme.

Climate change, biodiversity and pandemic prevention / One Health

Lead Applicant Details

3. Lead Applicant details

Title	Dr.	Institution	Fundacao Manhica
Forename(s)	Inacio	Address Line 1	Rua 12, Bairro Cambeve
Middlename		Address Line 2	
Surname	Mandomando	Address Line 3	
Nationality	Mozambican	Postcode	1929
Department	Bacterial, Viral and Neglected Tropical Diseases Research Area	Country	Mozambique

4. Lead applicant's position at the lead institution

Coordinating Researcher and Coordinator of Bacterial, Viral and Neglected Tropical Diseases

5. Lead applicant's ORCID ID

ORCID iD	0000-0002-1078-2187
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6. Publications

List up to 20 of your most relevant and significant peer-reviewed publications or other scholarly contributions and other research outputs, e.g. patents, policy guidelines or briefings.

- Please ensure that at least five of these are from the last five years. You may also provide a statement describing their significance (up to 50 words per output).
- Give citation in full, including title of paper and all authors* (*All authors, unless more than 10, in which case please use 'et al', ensuring that your position as author remains clear).

Manjate F, Quintó L, Chirinda P, Acácio S, Garrine M, Vubil D, Nhampossa T, João ED, Nhacolo A, Cossa A, *et al.* (20/20). Impact of rotavirus vaccination on diarrheal hospitalizations in children younger than 5 years of age in a rural southern Mozambique. *Vaccine*. 2022 Oct 19;40(44):6422-6430. doi: 10.1016/j.vaccine.2022.09.050. Epub 2022 Oct 1.

Martínez-Martínez FJ, Massinga AJ, De Jesus Á, Ernesto RM, Cano-Jiménez P, Chiner-Oms Á, Gómez-Navarro I, Guillot-Fernández M, Guinovart C, Siteo A, *et al.* (18/20). Tracking SARS-CoV-2 introductions in Mozambique using pandemic-scale phylogenies: a retrospective observational study. *Lancet Glob Health*. 2023 Jun;11(6):e933-e941. doi: 10.1016/S2214-109X(23)00169-9.

Manjate F, João ED, Mwangi P, Chirinda P, Mogotsi M, Messa A Jr, Garrine M, Vubil D, Nobela N, Nhampossa T, *et al.* (19/19). Genomic characterization of the rotavirus G3P[8] strain in vaccinated children, reveals possible reassortment events between human and animal strains in Manhiça District, Mozambique. *Front Microbiol*. 2023 Jun 5;14:1193094. doi: 10.3389/fmicb.2023.1193094. eCollection 2023.

Manjate F, João ED, Chirinda P, Garrine M, Vubil D, Nobela N, Kotloff K, Nataro JP, Nhampossa T, Acácio S, *et al.* (17/17). Molecular Epidemiology of Rotavirus Strains in Symptomatic and Asymptomatic Children in Manhiça District, Southern Mozambique 2008-2019. *Viruses*. 2022 Jan 12;14(1):134. doi: 10.3390/v14010134.

Nhatsave N, Garrine M, Messa A Jr, Massinga AJ, Cossa A, Vaz R, Ombi A, Zimba TF, Alfredo H, **Mandomando I.** (10/11). Molecular Characterization of *Staphylococcus aureus* Isolated from Raw Milk Samples of Dairy Cows in Manhiça District, Southern Mozambique. *Microorganisms*. 2021 Aug 8;9(8):1684. doi: 10.3390/microorganisms9081684.

Acácio S, Nhampossa T, Quintó L, Vubil D, Garrine M, Bassat Q, Farag T, Panchalingam S, Nataro JP, Kotloff KL, *et al.* (14/14). Rotavirus disease burden pre-vaccine introduction in young children in Rural Southern Mozambique, an area of high HIV prevalence. *PLoS One*. 2021 Apr 8;16(4):e0249714. doi: 10.1371/journal.pone.0249714. eCollection 2021.

Mandomando I, Messa A Jr, Biey JN, Paluku G, Mumba M, Mwenda JM. (1/6). Lessons Learned and Future Perspectives for Rotavirus Vaccines Switch in the World Health Organization, Regional Office for Africa. *Vaccines* (Basel). 2023 Apr 3;11(4):788. doi: 10.3390/vaccines11040788.

Mandomando I, Vubil D, Boisen N, Quintó L, Ruiz J, Sigauque B, Nhampossa T, Garrine M, Massora S, Aide P, *et al.* (1/20). *Escherichia coli* ST131 clones harbouring AggR and AAF/V fimbriae causing bacteremia in Mozambican children: Emergence of new variant of fimH27 subclone. *PLoS Negl Trop Dis*. 2020 May 1;14(5):e0008274. doi: 10.1371/journal.pntd.0008274. eCollection 2020 May.

Strydom A, Motanyane L, Nyaga MM, João ED, Cuamba A, **Mandomando I**, Cassocera M, de Deus N, O'Neill H. (6/9). Whole-genome characterization of G12 rotavirus strains detected in Mozambique reveals a co-infection with a GXP[14] strain of possible animal origin. *J Gen Virol*. 2019 Jun;100(6):932-937. doi: 10.1099/jgv.0.001270. Epub 2019 May 29.

Strydom A, João ED, Motanyane L, Nyaga MM, Christiaan Potgieter A, Cuamba A, **Mandomando I**, Cassocera M, de Deus N, O'Neill HG. (7/10). Whole genome analyses of DS-1-like Rotavirus A strains detected in children with acute diarrhoea in southern Mozambique suggest several reassortment events. *Infect Genet Evol*. 2019 Apr;69:68-75. doi: 10.1016/j.meegid.2019.01.011. Epub 2019 Jan 11.

Deus N, João E, Cuamba A, Cassocera M, Luís L, Acácio S, **Mandomando I**, Augusto O, Page N. (7/9). Epidemiology of Rotavirus Infection in Children from a Rural and Urban Area, in Maputo, Southern Mozambique, before Vaccine Introduction. *J Trop Pediatr*. 2018 Apr 1;64(2):141-145. doi: 10.1093/tropej/fmx032.

Kotloff KL, Nataro JP, Blackwelder WC, Nasrin D, Farag TH, Panchalingam S, Wu Y, Sow SO, Sur D, Breiman RF, *et al.* (33/43). Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. *Lancet*. 2013 Jul 20;382(9888):209-22. doi: 10.1016/S0140-6736(13)60844-2. Epub 2013 May 14.

Bassat Q, Blau DM, Ogbuanu IU, Samura S, Kaluma E, Bassey IA, Sow S, Keita AM, Tapia MD, Mehta A, *et al.* (24/40). Causes of Death Among Infants and Children in the Child Health and Mortality Prevention Surveillance (CHAMPS) Network. *JAMA Netw Open*. 2023 Jul 3;6(7):e2322494. doi: 10.1001/jamanetworkopen.2023.22494.

Blau DM, Baillie VL, Els T, Mahtab S, Mutevedzi P, Keita AM, Kotloff KL, Mehta A, Sow SO, Tapia MD, *et al.* (22/40). Deaths Attributed to Respiratory Syncytial Virus in Young Children in High-Mortality Rate Settings: Report from Child Health and Mortality Prevention Surveillance (CHAMPS). *Clin Infect Dis*. 2021 Sep 2;73(Suppl_3):S218-S228. doi: 10.1093/cid/ciab509.

Disclaimer: I have included key publications from my Co-applicants that are relevant to this application.

Ayodeji E Ogunbayo, Milton T Mogotsi, Hlengiwe Sondlane, Saheed Sabiu, **Martin M Nyaga**. Metagenomics characterization of respiratory viral RNA pathogens in children under five years with severe acute respiratory infection in the Free State, South Africa. *J Med Virol*. 2023 May;95(5):e28753. doi: 10.1002/jmv.28753.

Christiana Eleojo Aruwa, Charlene Pillay, **Martin M Nyaga**, Saheed Sabiu. Poultry gut health - microbiome functions, environmental impacts, microbiome engineering and advancements in characterization technologies. *J Anim Sci Biotechnol*. 2021 Dec 2;12(1):119. doi: 10.1186/s40104-021-00640-9.

Wasonga M Opere, Maingi John, Omwoyo Ombori, **Nicholas M Kiulia**. Identification of enteroviruses along Lake Victoria shoreline - a potential indicator of sewage pollution. *Access Microbiol.* 2022 Apr 25;4(4):000334. doi: 10.1099/acmi.0.000334. eCollection 2022.

Wei Li, **Nicholas M Kiulia**, Jason M Mwenda, Atunga Nyachieo, Maureen B Taylor, Xichen Zhang, Lihua Xiao. *Cyclospora papionis*, *Cryptosporidium hominis*, and human-pathogenic *Enterocytozoon bieneusi* in captive baboons in Kenya. *J Clin Microbiol.* 2011 Dec;49(12):4326-9. doi: 10.1128/JCM.05051-11. Epub 2011 Sep 28.

Wei Li, Vitaliano Cama, Frederick O Akinbo, Sandipan Ganguly, **Nicholas M Kiulia**, Xichen Zhang, Lihua Xiao. Multilocus sequence typing of *Enterocytozoon bieneusi*: Lack of geographic segregation and existence of genetically isolated sub-populations. *Infect Genet Evol.* 2013 Mar;14:111-9. doi: 10.1016/j.meegid.2012.11.021. Epub 2012 Dec 19.

Nicholas M Kiulia, Raul Gonzalez, Hannah Thompson, Tiong Gim Aw, Joan B Rose. Quantification and Trends of Rotavirus and Enterovirus in Untreated Sewage Using Reverse Transcription Droplet Digital PCR. *Food Environ Virol.* 2021 Jun;13(2):154-169. doi: 10.1007/s12560-020-09455-9. Epub 2021 Feb 16.

(Lead Applicant CV - CV_Inacio_Mandomando_EPSILON_Virology_31JAN2024_final.pdf) is included as an appendix within this file.

(Lead Institution letter of support - Letter of support_EPSILON_FM-FS.pdf) is included as an appendix within this file.

Consortium Details

9. Lead and partner institutions

Provide summary information of all the institutions that comprise your consortium, including the lead institution.

- The partner institutions included in this section should match the co-applicants institutions in section 9 below.
- The lead institution should not be added as a partner institution.

Institution name	Institution role	Country where institution is based	Link to institution's website
Next Generation Sequencing Unit - University of the Free State	Partner institution	South Africa	https://ufs-ngs.org.za/
Hararghe Health Research Partnership	Partner institution	Ethiopia	https://www.hararghe.org/
Kenya Institute of Primate Research	Partner institution	Kenya	https://primateresearch.org/
Center for Vaccine Development Mali-(CVD)	Partner institution	Mali	www.cvd-mali.org

10. Co-applicants in partner institutions

Title	Prof.	Organisation	Haramaya University
Forename(s)	Nega	Address Line 1	
Surname	Assefa	Address Line 2	
ORCID iD	0000-0003-0341-2329	Address Line 3	
Nationality	Ethiopian	Country	

Title	Dr.	Organisation	Institute of Primate Research, Kenya
Forename(s)	Nicholas	Address Line 1	
Surname	Kiulia	Address Line 2	
ORCID iD		Address Line 3	
Nationality		Country	

Title	Prof	Organisation	University of the Free State
Forename(s)	Martin	Address Line 1	
Surname	Nyaga	Address Line 2	
ORCID iD	0000-0002-5017-5584	Address Line 3	
Nationality	Kenyan	Country	

Title	Prof	Organisation	Centre pour le Developpement des Vaccins Mali
Forename(s)	Samba	Address Line 1	Ex-Institut Marchoux, BP251, Ministère de la Santé et du Développement Social, Bamako, Mali.
Surname	Sow	Address Line 2	
ORCID iD	0000-0002-6335-5066	Address Line 3	
Nationality	Malian	Country	Mali

11. Collaborating Institutions

List all collaborating institutions that will contribute to your research work. Please refer to the definition of *Collaborating Institution* in this section.

1. Faculty of Veterinary, Eduardo Mondlane University, Mozambique
2. ISGlobal-Barcelona Institute for Global Health - Campus Clínic, Spain
3. Ethiopian Public Health Institute (EPHI), Ethiopia
4. The Pathogen and Microbiome Institute, Northern Arizona University, Arizona, United States

Research Focus

12. Describe your research programme

Briefly describe your research proposal including research question(s) and justification, research aim, objectives and methods. How is the research bold and innovative?

One Health approach recognizes the interconnectedness of human, animal, and environmental health. Low-resource countries, especially in sub-Saharan Africa, are hotspots of zoonotic diseases, including waterborne and viral diseases due to inadequate sanitation infrastructure, weak healthcare systems, climate change, and cultural practices. We hypothesize that an integrated surveillance platform allied to diagnostic tools would help to identify the dynamics of emerging infection to inform policy decisions. The goal of this collaborative research is to enhance genomic surveillance to detect and identify zoonotic pathogens of public health significance in sub-Saharan Africa through training and research. To achieve this goal, we plan to integrate One Health and wastewater-based epidemiological approaches to boost our pandemic preparedness and response in 5 countries in sub-Saharan Africa. This is by developing early warning public health systems through surveillance of potential zoonotic pathogens at the animal-human interphase and environmental ecosystems.

Specific objectives

1. To develop an early warning public health system in Kenya, Ethiopia, Mali, and Mozambique using wastewater-based genomics to alert on the potential zoonotic pathogens to inform policy-making decisions.
2. Determine the recovery of enteric and respiratory viruses in wastewater using quantitative PCR-based methods for detection and characterization.
3. To identify potential zoonotic pathogens circulating in the animal population that are in proximity to the human population using multiplex serological assays.
4. Create disease hotspot maps that identified regions in Kenya, Ethiopia, Mali, Mozambique, and South Africa that are at risk of potential zoonotic spillover, to inform policy on pandemic preparedness.
5. To strengthen existing laboratory capacity in the 5 sub-Saharan African countries to improve prompt detection and rapid response of potential zoonotic pathogens.
6. To train and build public health and laboratory genomics surveillance human capital.

Methodology

We will carry out large-scale wastewater and environmental genomic surveillance in Mozambique, Mali, South Africa, Ethiopia, and Kenya using a One-Health approach. Environmental samples including raw sewage from community and hospital lagoons systems will be collected. In addition, sampling of domesticated animals will be carried out from poultry, donkeys, camels, and other animals that are in proximity to the human population to monitor for zoonotic pathogens. We will leverage on the existing diarrhea and respiratory diseases surveillance systems in our countries and collect fecal and oral swab samples from human clinical cases to detect zoonotic enteric and respiratory pathogens. Animals fecal and oral swab samples will also be collected to hunt for potential zoonotic pathogens such as enteroviruses, coronaviruses, Crimean-Congo haemorrhagic fever (CCHF) viruses, respiratory syncytial virus, and other emerging pathogens. These samples will first be analyzed using multiplex serological assays for initial screening. In addition, metagenomic next generation sequencing (mNGS) will be used to detect potential zoonotic pathogens from animals and humans that could cause future pandemics. If significant contigs of pathogens of zoonotic potential are detected from the mNGS and positive multiplex serological assays, genotyping and sequencing will be done using whole genome sequencing for further characterization. ArcGIS and QGIS will be used to perform spatial analysis and to develop disease hotspot maps to identify regions at risk of potential zoonotic spillover.

13. How will your EPSILON ensure sustainability and impact?

How does the proposed network advance the current research ecosystem (capabilities and partnerships) in Africa?

Africa has long been a hub of innovative research, with numerous genomic surveillance breakthroughs and discoveries made in recent years during and before the COVID-19 pandemic. For example, South Africa through the Network for Genomic Surveillance (NGS-SA) and Ghana, Malawi, Kenya, and South Africa through the African Enteric Virus Genome Initiative (AEVGI) have been instrumental in extensive respiratory and enteric genomics surveillance, respectively, in detecting and reporting new variants of concern to the WHO to inform policy decisions.

However, there is still much work to be done to strengthen, support, integrate, and conduct in a coordinated manner genomic surveillance in public health systems in other regions and/or countries in Africa. That's where the proposed network and partnership highlighted in this proposal comes in. This proposed research has the potential to transform the landscape of genomic research in Africa to improve pandemic preparedness and response. By building stronger partnerships and networks across the continent, we can ensure that African researchers have the skill sets, access to the tools, and expertise in genomics research that they need to tackle some of the most pressing health challenges facing the continent. The participating partners of this next network, have proven experience in south-to-south collaboration in previous studies such as the Global Enteric Multicenter Study on which Kenya, Mali, and Mozambique were involved, and currently, three sites in Mozambique, Kenya, and Mali are part of an ongoing mortality surveillance, named CHAMPS (Child Health and Mortality Prevention Surveillance - <https://champshealth.org/>) aimed to track definitive cause of deaths in children under-five and stillbirths in sub-Saharan Africa and South Asia. Furthermore, the Free State University and the Manhiça Health Research Centre, have long-lasting collaboration on the metagenomics NGS.

Strong partnerships will be sustained with close collaboration with countries' ministries of health (MOH) and other government agencies implementing pandemic preparedness. The proposed countries have experience working with countries' MOH to implement sustainable programs, for example, the exciting WHO vaccine-preventable diseases surveillance systems. We will also create genetic dashboards for easy visualization of the genomic data being generated to inform public health actions. Overall, we believe that our current research ecosystem as mentioned above, diverse expertise in infectious diseases, molecular virology, immunology, microbiology, and genomics, by the consortium's investigators has demonstrated capacities and the willingness and track record to establish robust partnerships. Therefore, the consortium we are proposing on this EPSILON grant represents a major step forward in supporting the genomics research capabilities and partnerships in Africa. We propose through this consortium to develop shared wastewater genomics, wet-laboratory assays, and data management protocols in the 5 sub-Saharan African countries to streamline genomic surveillance. We also plan to develop and implement a continuing professional education program in the 5 sub-Saharan African countries. This training program will be led by experts within the consortium and collaborators and will include a series of seminars and short courses on One Health, epidemic preparedness, and response guidelines, outbreak preparedness, infectious disease control strategies for public health officers, laboratory personnel, disease surveillance officers, and veterinarians.

14. Describe how your EPSILON will develop research quality and the next generation of scientists.

What is your strategy to strengthen leadership and capacity in your partner institutions? How will you foster a working environment that cultivates the skills, knowledge and networks to nurture and retain young professionals?

Our consortium is composed of a multidisciplinary team with extensive experience in training and mentorship of young researchers in various disciplines such as virology, immunology, microbiology, and genomics science. These young scientists are a critical backbone to our research programs which include genotyping of enteric pathogens, vaccine effectiveness, surveillance, and clinical epidemiological studies. Our South African Partner from the University of the Free State, a WHO collaborating center for vaccine-preventable diseases surveillance and pathogen genomics has proven experience in the use of genomics tools including NGS and training of African researchers on NGS methods, bioinformatics analysis and applications. In addition, CISM in Mozambique has longstanding experience in training future generation of African researchers. The Training Fellowship Program established by our Mozambican partner is aimed at identifying talented young graduate students from universities interested in biomedical research. The young researchers are trained and mentored through the postgraduate programs (Master, PhD, and Postdocs) in most of the prestigious universities around the world, and later absorbed at our institution. This initiative has contributed to increased deployment of scientific human capital at CISM and in other institutions in Mozambique. Additionally, CISM has established a research career offering competitive salaries comparable to other African Research Institutions as a strategy to retain key staff and researchers. Our partner institutions the Kenya Institute of Primate Research (KIPRE), a WHO collaborating center for reproductive and infectious diseases, an African Network for Drug and Diagnostics Initiative (ANDI) center of excellence for preclinical research has a well-structured training program for young scientists through its partnership with several Kenyan universities. KIPRE has recently been given autonomy by the Kenyan government to conduct basic and translational biomedical research that is of public health importance. KIPRE's training and recruiting policy is to train and retain, unique talents to spearhead its research activities on translational biomedical research. Our Co-applicant from Kenya is an example of a scientist that KIPRE mentored, trained, and retained at a younger age, and now he is leading a research

program on enteric pathogens, environmental research, and microbiome studies. Our partners in Mali and Ethiopia also have a well-structured program to train and retain young generation of researchers. Therefore, through this proposed EPSILON grant we will utilize the existing training infrastructure in our partner institutions to train and mentor 10 laboratory technologists, 10 MSc, 10 PhD students, and 5 postdocs on various clinical, epidemiology, bioninformatics, modeling and laboratory skill sets. Thus, developing the research capacities and providing human capital in the 5 sub-Sahara African countries partnering in this consortium. In addition, selected young researchers will have an opportunity to visit the laboratories of our collaborating partners in Spain and the United States to gain additional skill sets. This generation of young African researchers will have the opportunity to develop their skill sets and advance their research careers and capacities in genomic surveillance within the context of this project. Finally, we will strengthen and/or establish the genomics and laboratory diagnostics capacities at participant sites for preparedness and response to future pandemics.

Additional Information

15. Does your project involve human participants or human biological material?

Yes

16. Does your project involve data that could potentially identify individuals?
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Yes

17. Does your project involve the use of animals?
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No

18. Does your project pose any biosecurity risks?
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No

19. Will your project generate any research outcomes that could be misused for harmful purposes?

No

EPSILON Budget

Personnel

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	290,496.69	286,903.90	312,814.30	324,488.73	338,810.79	207,407.48	1,760,921.89

Personnel narration

In this budget line, we refer to the overall personnel cost from the 5 sub-Saharan African Countries under this consortium for the day-to-day implementation and management.

Materials and Consumables

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	123,359.16	135,328.68	132,663.00	121,859.61	91,338.87	23,827.29	628,376.61

Materials & Consumables narration

As the study requires the sampling of wastewater, animal, and human samples, all the safety and general supplies required to be used at all health facilities and communities will be acquired with this line. This is also budgeted to purchase laboratory supplies, consumables, and reagents for qPCR, for automated extraction using Chemagic, cDNA synthesis, DNA library preps for NGS, and sequencing kits.

Equipment

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	294,768.95	18,656.72	0.00	23,987.20	0.00	0.00	337,412.87

Equipment narration

We request a budget to purchase equipment for the study. This is for upgrading and strengthening the genomic infrastructure in countries under the consortium.

Travel

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	37,791.54	35,977.92	32,334.51	35,953.14	34,290.61	35,484.40	211,832.12

Travel narration
We are requesting funds to support local travel for the day-to-day coordination of the project. This includes site visits during project implementation. Support to attend local and international conferences.

Communications

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	40,279.32	25,550.82	16,738.32	11,850.82	7,452.07	29,778.31	131,649.66

Communication narration
We are requesting funds to support communication between the investigating team in each country. This includes purchase of airtime for the team, and calling during the implementation of the project. Publicizing the study in the media just to name a few..

Office support costs

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	105,984.42	73,926.12	89,443.93	83,019.80	99,274.65	23,925.09	475,574.01

Office support costs narration
This line Includes non-specified administrative materials to ensure day-to-day functionality; Cellphone and data allowances for communication; Sample shipments services, maintenance of the project acquired equipment's.

Indirect costs

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	116,376.37	70,526.88	73,691.80	76,440.39	75,571.83	41,055.82	453,663.09

Indirect costs narration

This cost includes the project overhead cost requested by the countries' institutions. For example, office space, covers expenses in utilities for existing facilities (e.g. water and electricity); Insurance Communications expenses (e.g. phones, etc.); Administrative office supplies; General financial management staff; Institutional legal support; Information technology support.

Catalyst awards (additional funds)

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	37,500.00	237,500.00	100,000.00	0.00	0.00	0.00	375,000.00

Catalyst awards narration

To support innovative initiatives, such as Clinical intelligence (A broad spectrum, from laboratory management to clinical intelligence and experimental data analysis using artificial intelligence). Design thinking (To focus on creating effective solutions to challenges in various areas of research: Laboratory animal sciences, insectary, diagnostics, drug development, etc, using appropriate methodologies and exploring user-centered approaches, with the aim of promoting value creation and scientific development. Modelling for public health decision (Modern public health research and practice can utilize models to better understand and manage dynamic processes - from optimal decision-making in healthcare delivery and design of clinical trials, to prediction and control of infectious disease outbreaks, to mitigating the effects of drug overdoses) and One Health training focuses on developing competence for the application of molecular biology and analytical epidemiology to understand and manage risk associated with infectious diseases.

Fellowship awards (additional awards)

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	0.00	200,000.00	200,000.00	100,000.00	100,000.00	0.00	600,000.00

Fellowship awards narration

The fellowship is budgeted to support academic training for 10 Masters fellowships, 10 PhD fellowships, and 5 Postdoctoral researchers cumulatively from the 5 Sub-Saharan African Countries as indicated in the concept note.

Exchange awards (additional funds)

	Year 1 (USD)	Year 2 (USD)	Year 3 (USD)	Year 4 (USD)	Year 5 (USD)	Year 6 (USD)	Total (USD)
Costs	0.00	80,500.00	69,500.00	0.00	0.00	0.00	150,000.00

Exchange awards narration

This budget line will be used for training of the study staff and young researchers on Next Generation Sequencing and bioinformatics analysis; In Cell culture training for phenotypes in vitro and in vivo experiments. The budget will also be allocated to perform training on wastewater collection and processing, training on IATA Dangerous Goods Regulations (IATA DGR), and to receive local graduate students for internships and exchange programs.

Programme Total

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Materials and consumables	123,359.16	135,328.68	132,663.00	121,859.61	91,338.87	23,827.29	628,376.61
Equipment	294,768.95	18,656.72	0.00	23,987.20	0.00	0.00	337,412.87
Travel	37,791.54	35,977.92	32,334.51	35,953.14	34,290.61	35,484.40	211,832.12
Personnel	290,496.69	286,903.90	312,814.30	324,488.73	338,810.79	207,407.48	1,760,921.89
Communications	40,279.32	25,550.82	16,738.32	11,850.82	7,452.07	29,778.31	131,649.66
Office Support Costs	105,984.42	73,926.12	89,443.93	83,019.80	99,274.65	23,925.09	475,574.01
Catalyst awards	37,500.00	237,500.00	100,000.00	0.00	0.00	0.00	375,000.00
Fellowship awards	0.00	200,000.00	200,000.00	100,000.00	100,000.00	0.00	600,000.00
Exchange awards	0.00	80,500.00	69,500.00	0.00	0.00	0.00	150,000.00
Indirect costs	116,376.37	70,526.88	73,691.80	76,440.39	75,571.83	41,055.82	453,663.09
Total	1,046,556.45	1,164,871.04	1,027,185.86	777,599.69	746,738.82	361,478.39	5,124,430.25

Appendices

- 1) Lead Applicant CV - CV_Inacio_Mandomando_EPSILON_Virology_31JAN2024_final.pdf
- 2) Lead Institution letter of support - Letter of support_EPSILON_FM-FS.pdf



EPSILON Initiative Call for Applications

Curriculum Vitae Format

Name: Inácio Mandomando

Current Research Organisation: Fundacao Manhica

Employment History

Provide details of your employment in chronological date order (most recent first), including your current position:

Date (month/year) From To		Name of employer and position Include a brief description of your current position	Appointment Type E.g. permanent/fixed-term, full/part-time etc.
Jan/2021	Currently	Fundacao Manhica, Coordinating Researcher & Coordinator of Bacterial, Viral and Neglected Tropical Diseases Research Area. Some of his duties include overall coordination of the research group activities, including strategic leadership; fund raising (conceptualize, design new research projects and applying for funding); identifying new institutions for networking; oversee the implementation of study protocols (Scientific, ethical and regulatory clearance, field implementation); communicate with sponsors and partners; review and approve technical and financial reports; train junior researchers.	Permanent, full-time
Jan/2013	Dec/2020	Fundacao Manhica, Manhiça Senior Research Fellow	Permanent, full-time
Jan/2013	Dec/2016	Fundacao Manhica, Deputy Director for Science	Permanent, full-time
Mar/2010	Dec/2012	Center for Vaccine Development (CVD) – University of Maryland, Baltimore (MD, USA) & Department of Pediatrics, University of Virginia School of Medicine, Charlottesville (VA, USA), Postdoctoral Fellow, under the same mentorship	Fixed-term, full-time
May/2009	Feb/2010	Fundacao Manhica, Research Scientist	Permanent, full-time
Sep/2004	Apr/2009	Fundacao Manhica, Head of Laboratory Department & Training Fellow (Pre-Doctoral Studies)	
Feb/2002	Sep/2004	Fundacao Manhica, Head of Laboratory Department	Permanent, full-time

Nov/2000	Jan/2002	Fundacao Manhica, Laboratory Technologist	Permanent, full-time
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Funding History

Please provide details of your research funding in chronological date order (most recent first):

Date (month/year) From To		Name of grant held	Position held E.g. PI, Co-I, RA	Amount Awarded	Did this pay for your full salary?
Ongoing projects					
Jan/2024	Apr/2026	Using Minimally Invasive Tissue Sampling to Determine Causes of Death among Adults with HIV in the HAART Era	Site PI	1,483,982	No
Nov/2023	Dec/2024	Serosurveillance of <i>Salmonella</i> Typhi and non-typhoidal <i>Salmonella</i> (NTS) in Mozambique - SeroTyphi; Funding: B&MGF (grant INV-063932)	PI	178,696 USD	No
Jun/2023	May/2027	Age-descending, randomized, placebo-controlled Phase 2 trial in three sites in sub-Saharan Africa to assess the safety and immunogenicity of a parenteral Trivalent <i>Salmonella</i> (S. Enteritidis/S. Typhimurium/S. Typhi Vi) Conjugate Vaccine (TSCV) versus placebo; Funding: Wellcome Trust through University of Maryland, Baltimore	Site PI	886,009.77 USD	No
Jan/2016	Jun/2024	Child Health and Mortality Prevention Surveillance (CHAMPS) Network; Funding: B&MGF (grant: INV-009109) through Emory Global Health Institute; Emory University	Site PI	21,218,188 USD	Yes

Sep/2022	Aug/2027	Development and validation of a quantitative point-of-care test for the measurement of severity biomarkers to improve risk stratification of fever syndromes and enhance child survival (EChiLiBRiST – Enhancing Children’s Lives with Biomarkers for Risk Stratification and Triage); Funding Horizon Europe (Agreement: 101057114)	Site PI	1,778,024.85 EUR	No
Feb/2022	Jan/2026	Sewage monitoring – a new, resource-efficient method for population-based surveillance of antibiotic resistance; Funding: Wellcome Trust through University of Gottenburg	Site PI	798,029 USD	No
Sep/2022	Dec/2024	Ending COVID-19 Variants of Concern through cohort studies – END-VOC; Funding: European Health and Digital Executive Agency (HaDEA)	Site PI	101,063 EUR	No
Completed projects					
Feb/2022	Dec/2022	Vaccine Effectiveness and Preparedness; B&MGF	Site PI	163,661.22 USD	No
Jan/2021	Apr/2022	Collaboration between World Health Organization, Country Office of Mozambique and Fundação Manhiça on COVID-19 Surveillance in rural Mozambique for prompt and effective response; WHO Mozambique CO	PI	143,923 USD	No
Dec/2020	Aug/2022	COVID-19 Surveillance in rural Mozambique for prompt and effective response (MOZCOVID); Funding: EDCTP2 grant	PI	500,000 EUR	No

		RIA2020EF-3005-MozCOVID			
Oct/2018	Sep/2023	Towards the interruption of transmission of soil-transmitted helminths: Clinical research development of a fixed-dose co-formulation of ivermectin and albendazole – STOP; Funding: EDCTP2 RIA2017NCT-1845-STOP	Site PI	724,194.04 EUR for the site (4,899487.64 EUR overall)	No
Mar/2018	Jun/2020	Countrywide Mortality Surveillance for Action (COMSA) in Mozambique startup; B&MGF	PI	2,022,647 USD	No
Oct/2017	Sep/2018	Measuring final HIV mother-to-child transmission rates in rural Southern Mozambique – METRO; CDC Atlanta	PI	239,007.45	No
Jan/2017	Mar/2019	Avaliação do impacto da introdução da vacina contra Rotavírus em crianças menores de 5 anos no distrito da Manhica; FNI-245	Co-PI	5,717,250 MZN	No
Oct/2016	Oct/2020	Evaluation of the Impact Rotavirus Vaccine Introduction in Mozambique; USAID Mozambique	PI	396,576.15 USD	No
Jan/2016	Mar/2019	Continued validation of the minimally invasive tissue sampling (MITS) tool for cause of death investigation in young children and development of a training and research center for post-mortem investigations (CaDMIA-plus); B&MGF (OPP1128001)	Co-PI	1,261,584 USD	No
Jan/2015	Dec/2018	Surveillance of Rotavirus in Children Younger than 5 years in Manhica	PI	452,770 USD	No

		District, Mozambique; GAVI through CDC Atlanta			
Jan/2015	Mar/2016	Non- Typhoid <i>Salmonella</i> carriage in a Mozambican district with high HIV prevalence; NIH	Co-PI	30,324 USD	No
Apr/2014	Jul/2016	HIV Incidence Testing Using Multiple Biological Specimens; B&MGF	Co-PI	191,000 USD	No
Aug/2013	Apr/2016	Caracterização molecular de <i>Escherichia coli</i> Enteropatogénica associada a mortalidade em crianças menores de 5 anos de idade com diarreia moderada a severa no distrito da Manhiça, Sul de Moçambique; FNI	PI	2,115,750 MZN	No
Aug/2013	Apr/2014	Caracterização dos factores de virulência de <i>Escherichia coli</i> enteroagregativa associado infecções extra-intestinais em crianças no hospital distrital da Manhiça	PI	2,436,000 MZN	No
Jan/2013	Nov/2015	Development of novel gastrointestinal biomarkers for use in HIV incidence determination in a Sub Saharan African setting; B&MGF	PI	187,027 USD	No
Jan/2013	Jun/2014	Projecte de reforç de les activitats del Pla Nacinal de control de VIH/SIDA del Ministeri de Salut de Mocambic a l"Hospital Distrital de Manhica-Mocambic; ACCD	PI	59,500.00 EUR	No
Sep/2011	Aug/2013	Analysis of colonization with <i>Staphylococcus aureus</i> of mothers and their infants; Bundesministerium für Bildung und Forschung (BMBF)	PI	27,780 EUR	No
Jun/2010	Mar/2017	Infection Biology and Epidemiology of	PI	325,756 EUR	No

		Staphylococci and Staphylococcal Diseases in Infectious Diseases; Deutsche Forschungsgemeinschaft			
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Prizes and Awards

Please detail any prizes or awards in the table below:

Date (month/year)	Details
Nov/2023	Mozambican Veterinarians Board – OMVM prize in recognition of services to Public Health

Career Breaks & Flexible Working

Applicants should make clear any substantive periods of absence from research within their application. Details of career breaks or flexible working will only be used to make appropriate adjustments when assessing an individual's track record, productivity and career progression.

Date (month/year)		Details
From	To	

Contributions to development of individuals & wider research community

Applicants should detail how their previous work has contributed to both the development of individuals and the wider research community

In addition to publishing more than 190 articles in international peer-reviewed journals, over the years, the applicant has contributed to the development and training of multiple Mozambican and international researchers by supervising, directing and co-directing the PhD theses, master's and bachelor's degrees research projects/theses and by participating as an examiner for the presentations and defenses. Below some of these contributions are highlighted:

- Sep 2022 to date: Director of Augusto Messa Jr.'s PhD thesis (to be defended in September 2025). Investigating the role of the gut microbiome in the treatment response in soil-transmitted helminth infections. Universitat de Barcelona, Barcelona, Spain.
- Aug 2019 to date: Co-director of Filomena Manjate's PhD thesis (to be defended in 2024). Molecular Epidemiology of non-typable Rotavirus strains circulating in rural Manhiça District, 2008 – 2019. Universidade Nova de Lisboa, Lisboa, Portugal
- Aug 2018 to Jan 2024: Co-director of Marcelino Garrine's PhD thesis (defended Jan 25, 2024). Molecular Epidemiology of *Staphylococcus aureus* in rural Mozambique. Universidade Nova de Lisboa, Lisboa, Portugal
- Nov 2019. Co-Director of Sozinho Acácio's PhD thesis (completed). Diarrheal disease in children aged 0-59 months in Mozambique: Risk factors and associated mortality. Universitat de Barcelona, Barcelona, Spain.
- Dec 2018. Co-director of Delfino Vubil's PhD thesis (completed). Spotlight on the virulence, antibiotic resistance and epidemiology of *Shigella* spp. Universitat de Barcelona, Barcelona, Spain
- Dec 2013. Co-director of Tacilta Nhamossa's PhD thesis (completed). The epidemiology of diarrhoea: Determination of the burden, aetiology and consequences of diarrheal disease in children aged 0-59 months in Manhiça District, Mozambique. Universitat de Barcelona, Barcelona, Spain

External independent examiner

- Jan 2024: Independent Examiner of the PhD thesis: Management of Undernutrition in children under five years of age with diarrhea in Mozambique, 2015-2021. Instituto de Higiene e Medicina Tropical (IHMT), Universidade Nova de Lisboa, Portugal
- April 2021: External evaluator for Master's Degree Thesis: Molecular Epidemiology of Antibiotic Resistant *Shigella* spp. Implicated in Community-Acquired Acute Diarrhoea at Bawaila Hospital, Lilongwe Malawi (A PHIRI). Kwazulu Natal University, Durban, South Africa.

- Jul 2020: External examiner of PhD thesis by Aly Muadica. Epidemiología molecular y factores de riesgo de protistas enteroparásitos asociados a diarrea en poblaciones pediátricas sintomáticas y asintomáticas en España y Mozambique. Universidad Complutense de Madrid, Madrid, Spain

Applicant also serves as member of multiple scientific committees

- Jan 2023 – present: American Society for Microbiology Country Ambassador to Mozambique
- May – Oct 2022: Served as expert to the Quadripartite (Food and Agriculture Organization of the United Nations [FAO], the World Organisation for Animal Health [OIE], the United Nations Environment Programme [UNEP] and the World Health Organization [WHO] to develop One Health Priority Research Agenda on Antimicrobial Resistance
- 2018 – present: Member of External Scientific Committee of the “Centro de Investigação em Saúde de Angola (CISA)”, Angola
- 2017 – present: Accredited Researcher at University of Barcelona, Barcelona, Spain to supervise and mentor PhD Students
- 2014 – 2019: Accredited Researcher at University of KwaZulu Natal, Durban, South Africa to Supervise Masters and PhD students on the NORAD programme
- 2014- Mar 2015: Served as expert for Scientific Strategic Advisory Group for *Cryptosporidium* convened by the Bill and Melinda Gates Foundation.
- 2019 – present. Member of American Society of Tropical Medicine and Hygiene (ASTMH)
- July 5, 2016: Invited as expert for the European & Developing Countries Clinical Trials Partnership (EDCTP) Stakeholders meeting on Diarrhoeal Disease, Amsterdam, Netherlands.
- 2014 – present: Member of Society for Laboratory Medicine
- 2013 – present: Member of American Society for Microbiology
- 2012 – present: Member of Academy of Science of Mozambique

Additional Information

Please provide any further details you wish to bring to the attention of the reviewers; this may include career/research disruption from the COVID-19 pandemic

Manhiça, 29th January, 2024

To: **Science for Africa Foundation**

N/Ref.CISM/0051/05/2024

Dear Sirs

This letter is written to officially support the application with the title “Genomic surveillance for enhanced preparedness of emerging outbreaks through an integrated One Health and wastewater-based epidemiological approach in sub-Saharan Africa”, being submitted by Dr. Inácio Mandomando as a concept note for the first stage of the proposal for Epidemic Science Leadership & Innovation Networks (EPSILON) Initiative (call 2024).

The *Centro de Investigação em Saúde da Manhiça (CISM)* is a research institution in Mozambique, whose main mission is to conduct biomedical research in health priority areas to protect and improve the population’s health. CISM aspires to be a center of excellence in biomedical research that continuously generates evidence to guide public health policy, not only in Mozambique but also in other countries in the world. In this context and understanding that the development of innovative preventive strategies to provide data on emerging, zoonotic diseases through an integrated one health and wastewater-based epidemiology applying genomic surveillance for detecting and characterizing pathogens that are of public health significance is a key priority research area for CISM. We strongly support the application submitted which may help to improve pandemic preparedness and response in Mozambique and in the sub-Saharan Africa in general. CISM is managed by Fundação Manhiça, a private-not for profit foundation for public utility.

This ambitious project will be conducted as a consortium among five African institutions including CISM, The Next Generation Sequencing Unit of the University of The Free State (South Africa), The Enteric Pathogens and Water Research Laboratory-Institute of Primate Research (Kenya), The Center for Vaccine Development Mali – CVD-Mali (Mali) and the Hararghe Health Research Partnership (Ethiopia), composed of multidisciplinary teams, with extensive experience in conducting clinical epidemiological studies, genomic and environmental surveillances, and this experience will contribute to the exchange of experiences and build new capacities in terms of laboratory methods and the training of young researchers among the consortium and thus leave behind a legacy transcending the study itself.

We hope that this support letter will positively contribute to the outcome of this application.

Yours sincerely,



Francisco Saúte,
Director General