

D5.1 Report on existing PM training and curriculum development initiatives in Africa

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EXECUTIVE SUMMARY

The **EU-Africa PerMed** project has the final objective of integrating African countries into ICPeMed (International Consortium of Personalised Medicine), as a means to contribute to a successful implementation of Personalised Medicine in the global context.

The main objective of this work package is to facilitate and increase personalised medicine (PM) research collaboration between Europe and Africa through training and capacity building activities.

This can be achieved through four actions:

1. Supporting translation of PM research into practice through education and training activities directed towards African researchers and other key actors in the field of PM (e.g. clinicians, private practitioners, policy makers, etc.).
2. Harmonizing PM practices in research, implementation and funding and disseminate standards in PM research
3. Disseminating good practice examples in relation to the implementation of PM approaches.
4. Facilitating bi-regional Europe & Africa research networks for synergies and interdisciplinary competencies.

The project will facilitate also the participation of African funding agencies in future calls of the ERA PerMed, explaining the concept of the ERA-Net as funding programme, how it is organized and how African countries can participate and benefit from joining international research consortia.

CONTENTS

1- INTRODUCTION and OBJECTIVES	3
2 METHODOLOGY	3
1.- The stakeholder mapping exercise.	4
2.- The Stakeholder Workshop consultation.	4
3.- Consortium Survey.....	4
3- RESULTS	6
A.- European Countries	7
B.- African Countries	17
C.- Global linked initiatives	27
4- CONCLUSIONS AND NEXT STEPS	31

1- INTRODUCTION and OBJECTIVES

In order to achieve these objectives, the different training actions and material will be developed taking into account real needs from the African health research community, that have been collected during the mapping phase and with the collaboration of African project partners who are directly participating in capacity building activities.

The issue of PM capacity building is being discussed during the different workshops that are being organized in WP2 and WP3 and is being addressed in their surveys.

Based on the feedback received from African researchers and other relevant stakeholders, recommendations for future actions are included in this report.

The impact of this WP will be analysed with the following Key Performance Indicators: Number of training courses performed, Number of participants in the on-site training and number of participants of the online training.

A preliminary list of relevant target groups for the engagement on the training and capacity building activities has been consolidated by the WP2 and WP3 activities, as the EU Africa PerMed Stakeholder workshop. This list will be refined, regularly updated and complemented with new contacts identified during the different workshops and other internal activities by all the consortium members during the project's lifetime. The different target groups are selected in order to align with the main objectives of the project and its expected impacts.

The purpose of this deliverable is to define and identify ongoing initiatives in the African continent, to gain insight as to what activities related to PM they are doing, what are their main needs, opportunities for cooperation with Europe and specific areas in which collaboration in capacity building would be of mutual interest.

2- METHODOLOGY

Results of the identification exercise and relevant initiatives identified will be shared through the project website and through other communication channels.

We will decide the template structure (table or flyer) depending on the characteristics of the final information collected.

Relevant initiatives will be contacted and invited to participate in project activities, especially those foreseen in WP3 and WP4. Specifically, the project will make a special effort to disseminate among identified health research networks the ICPeMed Best Practise Recognition annual calls, which are open to non-European participation. Through this task, we will share the appropriate information to facilitate the applications from the PM scientific community in African countries. In order to identify impactful Best Practice examples, we will focus efforts on identifying ongoing activities in the African continent that are focused on ensuring that research results are translated into efficient medical practices ad example, with the possibility to participate on the new research calls in Personalised Medicine.

We have prepared three kinds of consultations for the WP5 mapping activities.

1.- During the Stakeholders' Survey shared in 2021, three questions were included for collecting information about the current training activities related to PM

2.- The second consultation took place during the first Stakeholder Workshop February 2022

3.- A survey sent to the Consortium Members.

1.- The stakeholder mapping exercise.

It was undertaken by Work Package 2 (WP2, Task 2.3) utilizing the networks of the EU-Africa Consortium, stakeholders were identified and mapped according to their relevance to Personalised Medicine (PM) in Africa. A survey was sent to the identified stakeholders. The questions relating to capacity building and training included in this survey were:

1.- Are there any training activities on PM in your country/region? (these could also be degrees, or components of degrees, at universities and Technikons)

2.- If yes, can you give details of any training activity you may be aware of.

3.- From your perception, what are the priority training needs for PM experts in your country? These needs may include, but are not limited to, clinical genetic programmes, bioinformatics, genomics data science and health systems among other relevant PM areas

All the information regarding this questionnaire can be consulted on the D2.2. Report: The EU-Africa PerMed stakeholder mapping report, Appendix 1¹

2.- The Stakeholder Workshop consultation.

This second consultation took place within the first Stakeholder Workshop February 2022, where during the first day session “Overlook of Personalised Medicine in Africa” the following questions were asked to the participants:

- Which training areas relevant to advancing personalized medicine do you have in your country?

- What are the priority trainings areas for personalized medicine in your country?

3.- Consortium Survey

The survey was sent to the Consortium members . It was prepared and disseminated among all consortium members via email, to collect information on training and capacity building initiatives in their countries and regions.

1 Are there Personalised Medicine training activities in your region/country?
during last three years.

2 Name the organisation(s) that is/are organizing and link to website

3 What areas are covered of the training programme? (multiple answers possible)

a. Informatics/bioinformatics/data management for personalised medicine

b. Genomics and genetic analysis for personalised medicine

¹ <https://www.euafrica-permed.eu/project-deliverables/>

- c. Clinical trial design and management for personalised medicine
 - d. Implementation of personalised medicine in the healthcare system
 - e. Others, please specify
- 4 Which of the following medical field are covered in the training programme? (multiple answers possible)
- a. Infectious diseases
 - b. Immune disease (including transplantation, autoimmune diseases)
 - c. Cardiovascular disease (including hypertension)
 - d. Diabetes (and other metabolic diseases)
 - e. Cancer
 - f. Neurological diseases
 - g. Mental health disorders
 - h. Other non-communicable diseases
 - i. Rare genetic diseases
 - j. Others, please specify
- 5 Research Area:
- 6 Networking interest

3- RESULTS

In this chapter we have include the list of results of the EU-AFRICA Stakeholder Consultation about Capacity building and training activities on PM.

The collected information is divided in three main subheadings, the two firsts related to European and African countries, and the last related to Global linked initiatives. This last section, included Identified examples of successful health research networks in Africa, such as the Human Heredity and Health in Africa initiative (H3Africa), research training networks, such as the Consortium for Advanced Research Training in Africa CARTA, funding programmes aimed at supporting health research training and networking in Africa (i.e. Wellcome Trust DELTAS program, GSK Africa OpenLab), as well as a clinical genetics training program offered by the SAMRC extramural unit in Precision medicine.

A.- European Countries

Question	ANR, FRANCE					
Are there Personalised Medicine training activities in your region/country?	Yes					
(2020-2021)	Yes					
2022	Yes					
Name the organisation(s) that is/are organizing	DIU Diagnostic de précision et médecine personnalisée	DIU – médecine personnalisée et pharmacogénomique Université Paris Sorbonne	DU Planification chirurgicale et médecine personnalisée : du traitement de l'image à la gestion des risques Université de Paris	Master Médecine Personnalisée en Transplantation	Master Precision Health	Master Fundamental and clinical oncology, towards precision medicine
Link to website (if possible)	https://www.sensgene.com/medias/fichiers/voir_lafiche_du_diu_medecine_personnalisee.pdf	https://fc.sorbonne-universite.fr/nos-offres/diu-medecine-personnalisee-et-pharmacogenomique/	https://odf.u-paris.fr/fr/offre-de-formation/diplome-d-universite-1/sciences-technologies-sante-STs/du-planification-	https://www.unistra.fr/etudes/decouvrir-nos-formations/par-type-de-diplomes/master/master/cursus/ME102?tx_unistarof_pi1%5Bprof-course%5D=FRUAI0673021VCOEN11302&cHash=fea695aa76dabdaeb4fc9aff82d6089c	https://masterbiologie-sante.univ-lille.fr/master-2/parcours-pph	https://masterbiologie-sante.univ-lille.fr/en/parcours-po-en

			chirurgicale-et-medecine-personnalisee-du-traitement-de-l-image-a-la-gestion-des-risques-JP8FDG68.html		
<p>What areas are covered of the training programme? (multiple answers possible)²</p> <p>a. Informatics/bioinformatics/data management for personalised medicine</p> <p>b. Genomics and genetic analysis for personalised medicine</p> <p>c. Clinical trial design and management for personalised medicine</p> <p>d. Implementation of personalised medicine in the healthcare system</p> <p>e. Others, please specify</p>	A, B, ELSI aspects	A, B, C, Health economics, Market access	Imagery, Modelling, Surgery, 3D Printing	A, B, D, Precision Health	A, B, C, D

<p>Which of the following medical field are covered in the training programme? (multiple answers possible)</p> <ul style="list-style-type: none"> a. Infectious diseases b. Immune disease (including transplantation, autoimmune diseases) c. Cardiovascular disease (including hypertension) d. Diabetes (and other metabolic diseases) e. Cancer f. Neurological diseases g. Mental health disorders h. Other non-communicable diseases i. Rare genetic diseases j. Others, please specify 	All	All	Surgery	B	All	Cancer
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Question	Spain
Are there Personalised Medicine training activities in your region/country?	YES
during last years (2020-2021)	YES
during 2022	YES
Name the organisation(s) that is/are organizing	MANY: ISCIII, UPV, CIBERER; ROCHE INSTITUTE
Link to website (if possible)	ISCIII: https://masterbioinformatica.com/ UPV: MasterUPV

ITALY

From Italy, we have included examples of collaboration on research and training on the two main priority topics: Oncology and Infectious Disease.

1.-Example of collaboration between Italian Research and Health cure institution and the Bugando Medical Centre (BMC) in Mwanza, Tanzania: With the "Twinning Covenant and Declaration of Intent" signed May 13, 2008, , it was sanctioned a cooperation between the two institutions. Since then, we have launched a number of scientific activities and training. Among these, the realization of an Oncology Unit at the Hospital of Mwanza. The BMC project involves the construction a new building for the disciplines in oncology, with 120 inpatient beds, a Surgical Oncology, Pathological Anatomy, Diagnostic and Nuclear Medicine services.

Since 2010, IRST's medical and non-medical personnel are carrying out voluntary activities to support the local team.

The collaboration between BMC and IRST has also materialized with the launch of numerous epidemiological research projects, including a screening campaign to prevent uterus and breast cancer in Mwanza's area. Equally important is the path for the supply of anti-cancer drugs. A pavilion in which Radiotherapy, Diagnostic Imaging and Laboratory of Biosciences will be placed, is also in the process of being completed. It is also being created the electronic platform "Share and meet", which will be used to implement cultural, technological and scientific welfare cooperation between the two institutes.

Medical Oncology Educational Program in Sub-Saharan Africa: The poor awareness about cancer in both the general population and healthcare personnel prompted us to create a project that would provide medical and nursing staff with essential information to facilitate the the management of the disease. In view of the fact that few literature data are available on educational programs in oncology in sub-Saharan Africa, we felt that it would be important to report our experience of the impact of our educational program on the staff of hospital based in a low-income country. We performed a retrospective study to verify the changes

that occurred in clinical practice following educational interventions in a Tanzanian cancer center In 2000, a cancer institute and a cancer volunteer association (Associazione Vittorio Tison) based in northeast Italy, working in collaboration with Tanzanian political and health authorities, opened a Pathology Laboratory (considered to be a core element of a cancer care and control programme) and subsequently a Medical Oncology Unit at the Bugando Medical Center (BMC) in Mwanza, the largest referral hospital in the Lake zone of North-West Tanzania [8, 9]. The partnership led to the creation of the Mwanza Cancer Project, sponsored by both Italian organizations [8].

From an educational point of view, the main intervention took the form of a five-year period of training in oncology (2004–2008) in Italy offered to a Tanzanian physician and was completely funded by Associazione Vittorio Tison. Thanks to their economic support, the physician was able to gain valuable, practical experience in the routine activities of the Department of Medical Oncology of our institute (IRST IRCCS), whilst also studying for a Specialization in Medical Oncology at Ferrara University. Thanks to a Memorandum of Understanding established in 2008 between BMC and the Italian partnership, an Oncology Day Hospital and Inpatient Ward were subsequently opened at BMC in Mwanza under the responsibility of the same oncologist.

IRST provides drugs, normally paid for by patients, free of charge to BMC. A team of rotating volunteers from IRST, comprising of physicians, pharmacists, nurses, data managers, began to visit BMC. They brought their own expertise to the courses organized on medical oncology, biology, technical aspects and correct preparation of cytotoxic agents, and data management for clinical trials. The visiting teams went to the hospital every 3–4 months, as agreed by Dr. Nestory Masalu, Director of the BMC Oncology Unit. Together, they decided on how to best structure the time spent at the

center. The visitors also documented their stay by collecting data and information on the impact of the medical education program.

2.-Research collaboration agreement between Mangosuthu University of Technology, Durban, South Africa, and Istituto Nazionale Tumori- IRCCS G. Pascale focus on developing anticancer drugs for prostate cancer. This agreement followed the hosting of a Researcher of Mangosuthu University at Pascale as visiting scientist within the TRIALECT program. In details the collaboration is focus on design/screening of androgen receptor antagonists (i.e. drugs targeting the ligand binding domain) and their biological activities. A third party, Atomwise, a start-up Machine Learning company based in USA, collaborate in the project.

3.- Examples of research collaboration field of Infectious disease

Project title	Project description	End Date	ISS scientific responsible	Coordinating Institution	African Country(ies)	African Institution(s)	Main funding agency
A client-centred model of Antiretroviral Therapy Delivery in southern Tigray. A Pilot study - CASA 3			Raffaella Bucciardini				Italian Agency for Development Cooperation
A training and operational research to improve retention in care of HIV people in Tigray, Ethiopia – CASA-Project phase 2.	The CASA project intends to contribute to the long-term therapeutic success by improving the retention in care through training and research (cohort study of HIV patients on ART).	2020-12-01	Raffaella Bucciardini	Istituto Superiore di Sanità	Ethiopia	Tigray Health Bureau, Mekelle University	Italian Agency for Development Cooperation
Be free! Community and health system integration to promote young people free from HIV and stigma	Reduction of new HIV infections, AIDS-related mortality, stigma and HIV discrimination among adolescents and young people, particularly women, KP and Internal Displaced People (IDPs).	2022-01-01	Marco Simonelli	Servizio Volontario Internazionale - SVI	Kenya	Women Fighting AIDS in Kenya – WOFAK; Girl Child Network – GCN Kenya	5% Global Fund Initiative AICS - Italian Agency for Cooperation and Development
Ex vivo activity of antimalarial compounds on Plasmodium falciparum gametocytes and their mosquito transmission efficiency	The project studies the effect of drugs specific for the male and female gametocytes of P. falciparum in blocking parasite transmission from naturally	2021-12-31	Pietro Alano	Centre National de Recherche et Formation sur le Paludisme (CNRFP), Ouagadougou, Burkina Faso	Burkina	Centre National de Recherche et Formation sur le Paludisme (CNRFP), Ouagadougou, Burkina Faso	Centre National de Recherche et Formation sur le Paludisme (CNRFP)

	infected individuals to laboratory mosquitoes.						
ISS/DMI – ENI/NAOC COOPERATIVE PROPOSAL FOR THE IMPLEMENTATION OF A MALARIA DIAGNOSTIC QUALITY CONTROL PROJECT AND A DRUG RESISTANCE SURVEILLANCE ACTIVITY IN NIGERIA	The project activities include: i) Refresher Courses on the Malaria Diagnostic (on site); ii) Molecular Epidemiology Investigation on Drug Resistance in Nigeria; iii) Training on job and EQA	2021-12-31	Carlo Severini	ISS	Nigeria	NAOC (Nigerian Agip Oil Company)	ENI
MediLabSecure (MLS)	Preventing biological risks increased by environmental and climate change in the Mediterranean, Black Sea and Sahel regions by strengthening institutional capacities in the context of One Health	2022-01-06	Silvia Declich	Institut Pasteur	Algeria, Burkina, Egypt, Libya, Mali, Mauritania, Morocco, Niger, Senegal, Tunisia	° Public Health Institutions, Research Institutes and Universities of the involved countries •IPD, Dakar, Senegal •IP Madagascar •IP Bangui, Central African Republic •CERMES, Niger •Centre Muraz, Burkina Faso	EC DGDEVCO
Network of European and African Researchers on Antimicrobial Resistance (NEAR-AMR)	The NEAR-AMR represents a group of experts in antimicrobial resistance from leading institutions, located throughout Europe and	2022	Patrizia Spigaglia	Liverpool School of Tropical Medicine - UK	Egypt, Ghana, Kenya, Liberia, Malawi, South Sudan, Tanzania, Uganda		JPIAMR

	Africa, encompassing a One Health approach to AMR						
New generation drugs against Plasmodium falciparum transmission for malaria eradication	The project aims to develop innovative cell based assays to test libraries of chemical compounds on the P. falciparum stages responsible for the human-to-mosquito transmission of the malaria parasites	2021-12-31	Pietro Alano	Istituto Superiore di Sanità	South Africa	University of Pretoria Council for Scientific & Industrial Research Pretoria	Ministry of Health Italy
Origin and development of maturing gametocytes of Plasmodium falciparum in deep tissues and peripheral circulation	The projects aims to study the host/parasite cellular-molecular interplay of the P. falciparum transmission stages in their maturation in the human bone marrow of asymptomatic infected individuals.	2022-03-31	Pietro Alano	University of Health and Allied Sciences, Ho, Ghana	Ghana	University of Health and Allied Sciences, Ho, Ghana	The Royal Society UK - Future Leaders – African Independent Research
Pilot Ultrasound Survey of Human Cystic Echinococcosis in Livestock-Keeping Communities of Northern Tanzania	Cross-sectional ultrasound-based prevalence study of human cystic echinococcosis in Maasai communities of Northern Tanzania	0000-00-00	Francesca Tamarozzi	University of Glasgow (Francesca Tamarozzi as Affiliate Researcher in UoG)	Tanzania	Kilimanjaro Clinical Research Institute, (Kilimanjaro Christian Medical Centre) Moshi Tanzania	ESCMID (European Society of Clinical Microbiology and Infectious Diseases)

Prevention of invasive Group B Streptococcus diseases in young infants: a pathway for the evaluation and licensure of an investigational maternal GBS vaccine (PREPARE)	Network of African (Uganda, Malawi, South Africa) and European sites (UK, Italy, France, Netherlands) to advance the understanding of the immunogenicity and efficacy of GBS candidate vaccines	2020-09-30	Roberta Creti	St. George's Hospital Medical School, London, United Kingdom	Malawi, South Africa, Uganda	Makerere U. –Johns Hopkins U. (MU-JHU) Research Collaboration, Uganda; Wits Health Consortium (PTY) LTD, South Africa; Malawi Liverpool-Wellcome (MLW) Trust Clinical Research Program	EDCTP
Prevention of mother-to-child transmission of HIV: an analysis of maternal retention and of infants health in the first year after delivery	Observational study enrolling one cohort of HIV-infected mothers and their children and a contemporary cohort of HIV-negative mothers with their HIV-unexposed children in Malawi.	2021-07-02	Marina Giuliano	Istituto Superiore di Sanità	Malawi	DREAM Program, Community of S. Egidio, Malawi	5% Global Fund Initiative AICS - Italian Agency for Cooperation and Development
Safety and efficacy of Dolutegravir and EFV400 for pregnant and breast feeding women: a randomized non-inferiority clinical trial (PREGART)	To provide evidence based recommendations for safe and effective first line ART regimens for PMTCT and treatment of HIV infected pregnant and breast feeding women living in resource limited settings.	2024-05-31	Marco Simonelli	Hawassa University Ethiopia	Ethiopia, Uganda	Hawassa University Ethiopia, Makerere University Uganda	EDCTP

Stop TB e TB/HIV in Angola: Migliorare l'Accesso alle cure per la TB e HIV potenziando la qualità diagnostica e la gestione dei pazienti nella Provincia di Luanda	Supportare le autorità sanitarie nel miglioramento della qualità dei servizi di diagnosi e gestione dei pazienti affetti da TB e co-infezione TB/HIV e il potenziamento del sistema raccolta dati.	2020-05-31	Marco Simonelli	Cuamm Medici con l'Africa	Angola	Direzione Provinciale di Salute di Luanda (DPSL) - Direcção Provincial de Saúde de Luanda e ADPP Angola - Ajuda de Desenvolvimento de Povo para Povo Angola	5% Global Fund Initiative AICS - Italian Agency for Cooperation and Development
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B.- African Countries

1.- Are there any training activities on pm in your country/region? (these could also be degrees, or components of degrees, at universities and technikons)

3.1) if yes, can you give details of any training activity you may be aware of:

- **ALGERIA**
 - *Master and Doctorate Degree in Biotechnology and Molecular Pathology Master and Doctorate Degree in Biotechnology and Health*
- **BOTSWANA**
 - *Courses related to PM are offered at the University of Botswana*
- **EGYPT**
 - *It exists as part of postgraduate or undergraduate studies (mostly in relation to pharmacogenomics), example:*
http://catalog.aucegypt.edu/preview_course_nopop.php?catoid=29&coid=67279 Some specific centers in Egypt provides relevant training/degrees such as the Center of Excellence for Stem Cells Research and Regenerative Medicine and the Center for Genomics at Zewail University
https://www.zewailcity.edu.eg/main/content.php?lang=en&alias=cesc_mission
- **KENYA**
 - *Medical training in national universities*
- **NIGERIA**
 - *The MSc training in Molecular Biology and Genomics at Redeemer's University offers that focus on PM.*
 - *Project - based training modules within the H3Africa Consortium such as the Neurobiobank ELSI project*
 - *Training on sequencing and the use of Next Generation Sequencer to increase capacity to genomic medicine*
- **SOUTH AFRICA**
 - *Integrated into clinical genetics and genetic counselling degrees*

- *The topic is addressed during formal tertiary education programs (e.g. BSc, MBChB) and postgraduate programs. It is mostly offered as a module and not a stand-alone course. We have the latest next-generation diagnostic, sequencing, and tagging facilities. This training is offered independently, as well as part of degree programs. University of Cape Town Computational Biology postgraduate programme University of the Western Cape Bioinformatics training modules Several PM programmes available at other universities – Wits, University of Pretoria, University of KwaZulu-Natal, Stellenbosch University. Elements of PM are included in medical curricula and in science curricula. MSc and PhD research projects in several departments include a focus on PM. At the Wits SBIMB, we run a 3 day course on PM for clinicians and scientists. The H3Africa BioNet offers many Bioinformatics courses. <https://www.h3abionet.org/training/courses-and-events> An online PM course is run for nurses, with the intention to expand it to other healthcare workers. (AGMT) Clinicians can specialize in Medical Genetics (4 years post medical degree training) and register as a specialist with the HPCSA. We have 2 Universities that offer MSc degrees in Genetic Counselling. Natural Science faculties offer biochemistry and genetics courses. Medical schools offer limited training in this area.*
- **TANZANIA**
 - *Bioinformatics training, Laboratory training*
- **TUNISIA**
 - *Conferences debates by The city of Sciences (<http://www.cst.rnu.tn/fr/article/conference-a-la-cite-des-sciences-autour-du-theme-de-la-genomique-medicale-a-la-medicine-personnalisee-549?id=549>) Some training given by Institut Pasteur of Tunis (http://www.pasteur.tn/index.php?option=com_content&view=article&id=391:de-la-genomique-medicale-a-la-medecine-personnalisee&catid=41:actualites&Itemid=147)*
 - *Master degree in genomics medicine Master degree in Bioinformatics*
- **ZIMBABWE.**
 - *In 2021, the Chinhoyi University of Technology (CUT) in collaboration with the African Institute of Biomedical Science and Technology (AIBST) started an MSc in Genomics and Precision Medicine. The 2-year program has 9 students in its first intake - one from Benin, 2 from Nigeria, 3 from Kenya and 3 from Zimbabwe.*

2.- From your perception, what are the priority training needs for pm experts in your country? these needs may include, but are not limited to, clinical genetic programmes, bioinformatics, genomics data science and health systems among other relevant pm areas.

- *ALGERIA Genomic/ Proteomic Metabolomic Bio-Informatic Bioethic*
- *BOTSWANA Bioinformatics, genomics data sequencing*
- *BURKINA FASO 1. Train in individualized drug formulations 2. Clinical genetic programmes 3. Health Systems Strengthening 4. Bioinformatics 5. Knowledge transfer of current technology in PM*
- *CAPE VERDE Considering the few human resources specialized in the areas of interest to the PM, I think it would be necessary to carry out a comprehensive training program that encompasses all these areas. Initially, more basic formations that would later evolve into more complex ones.*
- *GHANA Clinical genetics, bioinformatics genomics data science*
- *EGYPT Data science, health systems, clinical genetic programs*
- *ETHIOPIA Clinical genetic programs, health systems data management, bioinformatics, emergency health care system, health infrastructure management and utilization*

- *KENYA Priority training needs include clinical genetic programmes, genomics, bioinformatics and clinical genetic programmes*
- *MALI Clinical genetic programmes, bioinformatics, genomics data science, Pharmacokinetics, Pharmacogenomics*
- *NAMIBIA 1. Train in individualized drug formulations 2. Clinical genetic programmes 3. Health Systems Strengthening 4. Bioinformatics 5. Knowledge transfer of current technology in PM. It includes genomic data science, Bioinformatics and clinical genetics*
- *NIGERIA Advanced cell and Molecular Biology, Functional Genomics, Research Techniques, Bioinformatics, Pharmacogenomics, Bioethics and Biosafety*
- *NIGER :Clinical genetics, bioinformatics, genomic data science and health systems*
- *SOMALIA Bioinformatics data and health system strengthening trainings*
- *SOUTH AFRICA :*
 - *Individuals are still too focused on academic research and not translation into economic innovation. Perhaps this is because research funds are available, and there is a lack of insight/risk taking/investment in driving applied research. Training needs should be transformative from academic into operationalization. There is rather a need for better coordinated research strategies and an integrated electronic health system which will assist in demonstrating the need for a PM strategy to the government and also to facilitate research by providing access to longitudinal patient data. Qualified and capable clinical geneticists, genetic counsellors, bioinformaticians and molecular scientists are produced but career opportunities are limited.*
 - *Training in genomics and data science , Biostatistics, statistical genetics, and bioinformatic training and health system. Clinical genetics training. Neuropsychiatric genetics training and immunology. Training of genetics nurses, genetics counselors, medical geneticists, medical scientists, bioinformaticists, biostatisticians and forensic scientists*
 - *Basic cell biology/molecular biology at MSc and PhD level*
 - *Training of medical professionals who can operate at the interface of technology, science, data interpretation and patient engagement • centers of PM excellence where scarce resources concentrate • clear focus areas where PM is implemented with a clear understanding of utility and cost/benefit, not driven by mega Genomics programs that sound great but may remain elusive • ongoing training and education, physically and virtually, in all areas, to create a cohort of Precision Medicine practitioners – who can work together in a virtually networked manner*
 - *Our clinical genetics services are inadequate to serve the entire country currently. Universities have adequate specialized services for research.*
 - *The traditional disciplines mentioned are in place. However PM should be seen as broader than that and nuclear medicine based diagnostic imaging is a good alternative where a patient dose and tolerance for a therapeutic drug can be individually determined prior to treatment*
 - *Clinical genetics and data science*
- *TANZANIA:*
 - *Laboratory based training, clinical genetics, bioinformatics, genetic counseling and ELSI*
 - *1. Genomics 2. Bioinformatics 3. Human genetics and clinical genetics including genetic counselling. 4. Big data management 5. Statistics with a focus on genetic/genomic data*
- *TUNISIA*

- 1. Genomics 2. Bioinformatics 3. Human genetics and clinical genetics including genetic counselling. 4. Big data management 5. Statistics with a focus on genetic/genomic data
- Health systems, policy making related to research in health, governance, leadership
- ZIMBABWE
 - Clinical Genetic programs including genetic counseling, Electronic health Records Systems to support PM, Bioinformatic and genomic data science to support PM programs.

General Answers from South Africa

N	Question	SOUTH AFRICA
1	Are there Personalised Medicine training activities in your region/country?	Yes
	during last years (2020-2021)	Yes
	during 2022	Yes
2	Name the organisation(s) that is/are organizing	SAMRC , SANBI, Wits University , University of Cape Town , University of Stellenbosch , H3ABioNety,KRISP, CPGR
	Link to website (if possible)	Refer to Sheet 1
3	What areas are covered of the training programme? (multiple answers possible) a. Informatics/bioinformatics/data management for personalised medicine b. Genomics and genetic analysis for personalised medicine c. Clinical trial design and management for personalised medicine d. Implementation of personalised medicine in the healthcare system e. Others, please specify	a,b,d,e
4	Which of the following medical field are covered in the training programme? (multiple answers possible) a. Infectious diseases b. Immune disease (including transplantation, autoimmune diseases) c. Cardiovascular disease (including hypertension) d. Diabetes (and other metabolic diseases) e. Cancer f. Neurological diseases g. Mental health disorders h. Other non-communicable diseases i. Rare genetic diseases j. Others, please specify	a, b, c, d, e, h
5	Research Area:	Pharmacogenomics, Genetic susceptibility to cancer and epigenetics, Screening, differential diagnosis and pharmacogenetics of NCDs including cardiovascular disease and cancer; COVID-19 / Long Covid ;Data model to support pathogen genomics data management, storage and re-use.
6	Networking interest	High Network Interest

One practical aspect is that there are not any description of training on clinical trial , Neurological diseases, Mental health disorders and rare genetic disease.

South Africa Training related PM courses

N	Traning Course	Name of Institution	Link	Key Stakeholder
1	The Sydney Brenner Institute for Molecular Bioscience Short Course in Precision Medicine in Africa	University of the Witwatersrand, Johannesburg.	https://www.wits.ac.za/events-archive/health-events/2017/precision-medicine-in-africa.html	Michele Ramsay, Amanda Krause, Zane Lombard, Shelley Macaulay, Noelene Kinsley, Nadia Carstens
2	National Introduction to Bioinformatics Course	South African National Bioinformatics Institute	https://www.sanbi.ac.za/workshops-and-courses/	
3	H3ABioNet's Introduction to Bioinformatics course (IBT);Next Generation Sequencing Bioinformatics Course 2022;16S rRNA Microbiome Intermediate Bioinformatics Training 2021	H3ABioNet	https://h3abionet.org/training/courses-and-events	
4	Bioinformatics Course Outlines in South Africa	NobleProg South Africa	https://www.nobleprog.co.za/bioinformatics-training	
5	The Master of Science in Medicine in the field of Genomic Medicine	University of the Witwatersrand, Johannesburg.	https://www.wits.ac.za/course-finder/postgraduate/health/mscmed-genomic-medicine/	
6	CERI & KRISP Talks: Embracing novel technologies in a pandemic: Experience of real-time genomics and big data analysis in Africa over the past 2 years, STIAS, Breakaway Room, Wallenberg Centre, University of Stellenbosch, February, 2022	KRISP	https://www.krisp.org.za/training.php	
7	Foundation in Omics (FIO);	CPGR	https://www.cpgr.org.za/training/	
8	Implementation of PM in Health Care System /Pharmacogenomics & Drug Metabolism	University of Cape Town	http://www.idm.uct.ac.za/Seminars_Archive	Stefan Barth ;Collet Dandara

9	Postgraduate student training in Dept of Pathology/ MPhil (Cancer Science) Programme is scheduled for 22 – 31 March 2022	Stellenbosch University	https://www.sun.ac.za/english/pgstudies/Documents/MHS%20Faculty/Programmes/Master%207s%20degrees/Master%20of%20Philosophy%20(MPhil)/MPhil%20in%20Cancer%20Science.pdf	Maritha Kotze
10	Genomic surveillance to support the SADC region	South African Medical Research Council . Unit Bioinformatics(SA MRCBU), South African National Bioinformatics Institute (SANBI) University Western Cape (UWC)	Full text: SAMRC Bioinformatics Unit rolls out data analytics training for genomic surveillance to support the SADC region	

N	Name	Name of Institution	Personalised Medicine training activities in your region/country?	Training Activities during the year 2020-2021	During the year 2022	Link to website (if possible)	Areas e covered ²	medical field are covered ³	Research Area:	Networking interest
1	Stefan Barth	University of Cape Town	Yes	Yes	Yes	http://www.idm.uct.ac.za/Seminars_Archive	Implementation of PM in Health Care System	Cancer		
2	Collet Dandara	University of Cape Town	Yes	Yes	Yes	http://www.humangenetics.uct.ac.za/hg/research/pharmacogenomics	a. Informatics/bioinformatics/data management for Personalised medicine b. Genomics and genetic analysis for Personalised medicine	Infectious diseases, Cardiovascular disease (including hypertension), Cancer, and Rare genetic diseases	Pharmacogenomics, Genetic susceptibility to cancer and epigenetics	

² (multiple answers possible) a. Informatics/bioinformatics/data management for personalised medicine

b. Genomics and genetic analysis for personalised medicine c. Clinical trial design and management for personalised medicine d. Implementation of personalised medicine in the healthcare system

e. Others, please specify

³ (multiple answers possible) a. Infectious diseases b. Immune disease (including transplantation, autoimmune diseases) c. Cardiovascular disease (including hypertension)

d. Diabetes (and other metabolic diseases)

e. Cancer f. Neurological diseases g. Mental health disorders h. Other non-communicable diseases

i. Rare genetic diseases j. Others, please specify

3	Maritha Kotze	Stellenbosch University	Yes, for example a bi-annual Molecular Pathology module 64637875 to be held this year from 8-18 March 2022	Postgraduate student training in Dept of Pathology, Stellenbosch University ; The Cancer Epidemiology module of the MPhil (Cancer Science) Programme is scheduled for 22 – 31 March 2022. .		a,b,c	a, b, c, d, e, h		Screening, differential diagnosis and pharmacogenetics of NCDs including cardiovascular disease and cancer; COVID-19 / Long Covid
4	Nicola Mulder	H3ABioNet	Yes	Yes -Next Generation Sequencing Bioinformatics Course 2020;Introduction to Git and Github 30 Nov 2021	Next Generation Sequencing Bioinformatics Course 2020;Introduction to Git and Github 30 Nov 2021	https://h3abionet.org/training/courses-and-events	Informatics/Bioinformatics/ Data management for PM	a, b, c, d, e, h	

5	Allan Chirstoffells	The South African Medical Research Council extramural Bioinformatics Unit (SAMRCBU) based at the South African National Bioinformatics Institute (SANBI) at the University of the Western Cape (UWC)	Yes	Yes - Genomic surveillance to support the SADC region	Yes - Genomic surveillance to support the SADC region	Full text: SAMRC Bioinformatics Unit rolls out data analytics training for genomic surveillance to support the SADC region	Informatics/Bioinformatics/ Data management for PM		Data model to support pathogen genomics data management, storage and re-use.	Yes
6	Chris Vorster	North West University	Yes. Focus is not quite personalized medicine,. metabolomics is becoming very applicable	Yes	Yes		Inherited metabolic diseases Rare diseases Metabolomics Small molecule profiling Omics	Rare genetic diseases and rare inheirted metabolic diseases	Inherited metabolic diseases Metabolomics and applied metabolomics Functional medicine Biostatistics Nanotechnology	Yes

C.- Global linked initiatives

1.- Global Health EDCTP3 programme ⁴

The Global Health EDCTP3 programme will focus on all stages of clinical evaluation, but particularly later stage (phase III and phase IV) studies, including product-focused implementation studies, in recognition of their growing importance as bottlenecks in application of interventions. It will have a particular focus on vulnerable population groups, including children, adolescents, pregnant and lactating women, older persons, and people with co-morbidities (including non-communicable conditions). Currently, these groups are often excluded from clinical trials of new products and therefore do not benefit initially when new interventions become available

Capacity building on infectious diseases is an integral part of Global Health EDCTP3-funded studies. International networking, North–South, South–South and North-North, will be promoted to foster the exchange of knowledge and expertise. In addition, specific funding will be provided to improve the technical infrastructure for health research of countries in sub-Saharan Africa. Furthermore, these initiatives are nurturing African scientific leadership, building technical capacity and research skills, and strengthening the ethics and regulatory capacities of countries in sub-Saharan Africa.

Mainly on research, the objective of capacity building will be to develop individuals, institutions, and societies (individually and collectively) to perform research effectively, efficiently, and in a sustainable manner. Projects should leave a tangible legacy and reduce dependency on external resources.

Global Health EDCTP3 emphasises the urgent need to assess novel delivery mechanisms for innovative biomedical methods of infectious diseases prevention, including antimicrobial based interventions, broadly neutralising antibodies, and vaccines. Effective implementation of such innovations will require innovative people centred and community-oriented approaches. While studies of biological susceptibility remain important, understanding human behaviour, including uptake and adherence of novel HIV prevention methods, is paramount.

2.- European Partnership for EU-Africa Global Health⁵

The partnership aims to deliver new solutions reducing the burden of infectious diseases in sub-Saharan Africa, and strengthen research capacities for preparedness and response against re-emerging infectious diseases in sub-Saharan Africa and globally. The aims by 2030 are these main points, license at least 2 new health technologies tackling infectious diseases; and, have supported at least 100 research institutes in 30 countries for effective and rapid research response to develop diagnostics, treatments and vaccines against re-emerging epidemics.

In this line, the research for health will respond to local health needs and prioritises the safety and health of all affected populations. One of the activities is to promote the exchange of ideas,

⁴ The Global Health EDCTP3 Joint Undertaking, Strategic Research and Innovation Agenda
https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/ec_rtd_edctp3-sria-2022.pdf

⁵

https://ec.europa.eu/info/sites/default/files/research_and_innovation/funding/documents/edctp3_draft_proposal_14_august_2020.pdf

information, and people between institutions in Europe and those in Africa. Personal support schemes will play a key role in developing the next generation of African scientific leaders. The capacity development part of the Partnership will have a strong focus on research training (master’s and PhD) and a comprehensive range of postdoctoral and fellowship schemes, as well as on needs-driven short-term training, mentoring, and exchange. In addition to supporting training in practical research techniques, study design, and research conduct, develop expertise in laboratory and research institution management are needed. It will also develop researchers’ skills in other key areas of scientific practice, including biostatistics, applying for grants, preparation of manuscripts, and other aspects of scientific communication. To increase sustainability of local research capacities arising from its support, it will be open to strengthening the capacities of national health research authorities to continue supporting researchers and research institutions after the end of Partnership funding, including through co-funding mechanisms. It is important to highlight the link with the other partnerships in the following graph, mainly with the European Partnership (EP) on Personalised Medicine.

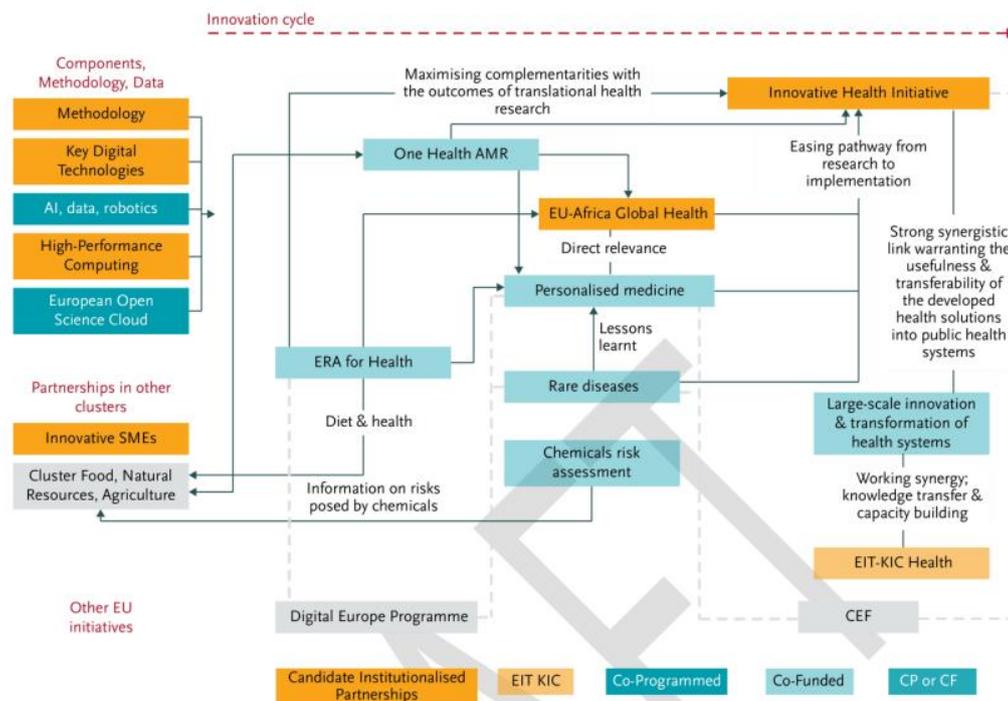


Figure 3: EU partnerships and initiatives related to the EDCTP3/EU-Africa Global Health Partnership

3.. Africa CDC is a specialized technical institution of the African Union established to support public health initiatives of Member States and strengthen the capacity of their public health institutions to detect, prevent, control and respond quickly and effectively to disease threats. The Regional Collaborating Centres (RCCs) serve as hubs for Africa CDC surveillance, preparedness and emergency response activities and coordinate regional public health initiatives by Member States in consultation with Africa CDC headquarters. Administratively, Africa CDC is designed to operate a decentralized

model that allows it to work with National Public Health Institutes (NPHIs) of Member State through five Regional Collaborating Centres located in Egypt, Gabon, Kenya, Nigeria, and Zambia, for the Northern Africa, Central Africa, Eastern Africa, Western Africa, and Southern Africa regions, respectively. Africa CDC strengthens the capacity and capability of Africa's public health institutions as well as partnerships to detect and respond quickly and effectively to disease threats and outbreaks, based on data-driven interventions and programmes. The language of events is on English and French. Ad example, the related Pathogen Genomic Surveillance in Africa Series- April 13th, 2022 04.00- 05:00 PM EAT.⁶

4.- AORTIC : The African Organization for Research and Training in Cancer (AORTIC) has an AORTIC's virtual education and training platform as part of AORTIC's leading efforts dedicated to building capacity for cancer control in Africa. The launching took place in Abuja Nigeria during an AORTIC regional conference organized in partnership with Nigeria's Ministry of Health. The platform is designed to facilitate and support training initiatives in oncology for health care workers, helping build human capacity for cancer control in Africa for the 21st century and beyond. Courses with certificates offered on the platform will highly complement other cancer education and training efforts by AORTIC and partners. AORTIC will offer certificate courses via this platform but also provide links to partner platforms with complementary online education and training content. The Virtual Platform is open to all AORTIC members. A needs assessment in terms of courses on offer is currently underway. AORTIC the premier (or model) cancer organization for cancer education and training innovation and distinction for Africans globally⁷.

Their main objectives are: The implementation of Centres of Excellence in Cancer Education & Training that addresses all areas of cancer control continuum (Middle East and North Africa; East Africa; South Africa; West Africa; Central Africa); improve human capacity building and workforce diversity through the education and training of multidisciplinary specialists and diverse professionals including community health extension workers for the prevention surveillance, early detection, diagnosis and treatment of cancer; develop curriculum for specialty training, certificate courses and postgraduate training program; develop workshops and modules to train laboratory physicians and radiologists in molecular diagnosis and imaging; develop workshops and modules to train haematologists, psycho-oncology, pharmacists and clinical oncologists on drug use and guidelines; develop diploma and postgraduate oncology nursing programs to establish /enhance contribution of this professional group to cancer management and control in the region. workshops and modules to train nurses in oncology; Develop innovation in inter professional cancer education in collaboration with African universities; Develop workshops and modules in bio-ethics, health economics, and health law. Their suggested topics for further initiatives are sum up in the following bullet points:

- Promoting the notion of respect for persons in the African healthcare setting .
- Decreasing the global cancer divide (80 versus 5% prevention & control resource split)
- Conducting ethical bio-medical in Africa, for equitable research funding to study the so-called "diseases of the developing world"
- Access to affordable and safe essential medicines – Analgesics and primary cancer drugs
- Partner with international and continental organizations to organize regional meetings.

⁶ <https://africacdc.org/event/africa-pgi-webinar-series-on-pathogen-genomic-surveillance-in-africa-2/>

⁷ <https://aortic-africa.org/education-training-committee/>

- Provide opportunities for educating and training non-health professionals about cancer prevention and control, including the media/journalists, artists, social scientists, educators, agriculture professionals, nutritionists, advocates, survivors, physical education professionals etc.

BIG Cat is a premier initiative by the African Organization for Research and Training in Cancer (AORTIC) to build capacity for cancer research in Africa. The goal of BIG Cat program is to aid the next generation of African cancer researchers to base their careers in their home countries and institutions, and to contribute to the overall expansion of capacity for research and training in Africa by generating evidence that will guide practice and policy

5.-African Society of Human Genetics (AfSHG)⁸. The AfSHG aims to equip the African scientific community and policymakers with the information and practical knowledge they need to contribute to the field of genetics research and to attract global attention to the efforts of African scientists. Series of reviews on human evolutionary genetics reflecting a journey through time by featuring studies on the genomes of ancient and extant humans in, and recently from Africa.

The H3Africa Initiative aims to facilitate a contemporary research approach to the study of genomics and environmental determinants of common diseases with the goal of improving the health of African populations. To accomplish this, the H3Africa Initiative aims to contribute to the development of the necessary expertise among African scientists, and to establish networks of African investigators. The vision of H3Africa is to create and support a pan-continental network of laboratories that will be equipped to apply leading-edge research to the study of the complex interplay between environmental and genetic factors which determines disease susceptibility and drug responses in African populations. Data generated from this effort will inform strategies to address health inequity and ultimately lead to health benefit in Africa. To achieve this, the following issues must be addressed: Ensuring access to relevant genomic technologies for African scientists; Facilitating integration between genomic and clinical studies. Facilitating training at all levels, and particularly in training research leaders; Establishing necessary research infrastructure. The following diseases and programs (list not final) were suggested for consideration:

- Communicable diseases: Tuberculosis; Human African trypanosomiasis (HAT); Cancer due to infectious agents
- Noncommunicable diseases: Sickle cell disease; Hypertension/stroke; Type 2 diabetes mellitus; Cancer
- Pharmacogenomics
- New and innovative ideas⁹

6.- Africa Pathogen Genomics Initiative (Africa PGI)¹⁰

The Africa CDC Institute of Pathogen Genomics (IPG) was launched in November 2019 to support the adoption and implementation of pathogen genomics and bioinformatics in national public health institutes (NPHIs) across Africa. They organize Face-to-face Trainings (in-person training courses or workshops that allow participants to actively learn and practice pathogen surveillance and characterization); Short-term Needs based Trainings (virtual and/or onsite trainings accorded to the national public health and/or academic institutes of the Member States upon request to receive technical support on genomics surveillance and characterization); and, Virtual Trainings (include video

⁸ <https://academic.oup.com/hmg/issue/30/R1>

⁹ https://h3africa.org/wp-content/uploads/2018/05/h3africa_whitepaper.pdf

¹⁰ <https://ipg.africacdc.org/initiatives/africa-pathogen-genomics-initiative-africa-pgi>

webinars or virtual hands-on modules. In the latter, trainees meet virtually to discuss pathogen genomics research with each other and the trainers/preceptors. Virtual trainings may be conducted through a series of online modules that can timely and cost-effectively meet the increasing demand for more flexible training, especially in low-and-middle income countries and during disease outbreaks). One of the Institute of Pathogen Genomics' flagship initiatives is the Africa Pathogen Genomics Initiative (Africa PGI), a new partnership that aims to strengthen laboratory systems and enhance disease surveillance by equipping the continent's public health institutions with the tools, training and data infrastructure to fully leverage critical genomic sequencing technologies. This new initiative will establish a cross-continent, integrated disease surveillance network, including capacity building in 20+ NPHIs to maximize the benefits of next-generation sequencing tools towards driving genomic-based public health action. This laboratory network will help identify and inform research and public health responses to COVID-19, other emerging epidemic threats and endemic diseases that disproportionately affect Africa, such as Malaria, Tuberculosis, HIV, Cholera, and other infectious diseases.

4.- CONCLUSIONS AND NEXT STEPS

Following the results of these consultations, we have noted a high difficulty to understand clearly whether our initiative is appropriate to disseminate the concept of Personalised Medicine among African researcher or not.

So, we have decided to keep a flexible programme with a continuous feedback after every training event.

We will take into consideration the number of applicants, the real number of participants, the interactive participation and we will send a short survey of feedback to analyse if we are working in the appropriate line for achieving a successful impact.

For this reason, it has been decided this starting organization with virtual training events as webinar and virtual round tables before the organization of our face to face big event.

The Webinar will be topic specific (oncology, infectious diseases, Cancer due to infectious agents, cardiovascular and chronic diseases) and also focus on transversal aspects PM_ related as Pharmacogenomics, ELSI, Data Sharing and Release of Data , collaboration with industry, and the needed Patient and Citizens Engagement.

The Summer school or interactive workshops will be focus on Standards for PM clinical research, including clinical trials; ethical legal and social issues relating to PM. However, it is flexible and the final decision will be adapted to the priorities feedback form African regions.

During the preparatory phase of this project our principal target for the capacity building and training activities was considered to be the researchers involved on Personalised Medicine, but following the consultations and internal discussions within the consortium, it is evident we have to involve also the main decision makers or high-level policy makers and funding agencies on Research. These actors are the gatekeepers to PM research and implementation, and having them sufficiently informed to make decisions on PM is key for the successful integration of PM into the research and healthcare agendas.

So, we will try to organize different webinars through the different actors involved on research activities and funding research activities. And for this, the technical level of the webinars and training activities will be different according to the selected target audience.

In particular, the “Summer school” on “Adoption and integration of standards in PM research” will be tailored to the current status of PM research in the African continent. The use of standardized methodologies and harmonized practices in research is key for multinational and multiregional collaboration. It helps to ensure that there is a common language and a common understanding around research approaches and findings, and simplifies sharing and pooling results, enhancing opportunities for collaboration and helping to avoid duplicated efforts and wasted resources. As PM gradually becomes more prevalent in the African research and healthcare arenas, it is key that best practices in research methods be introduced and implemented as early as possible.

There is also a diverse knowledge on PM among the Africa regions. Some of them are considering as more priority a good practical training on clinical care and lab facilities .

After the selection of priorities, it has been noted that the field of neurology and psychiatry is not considered in the training activities already ongoing and linked to PM. Also, there are not described training on clinical trial organization and preparation.

Other issue is the language used to disseminate the information. It becomes necessary to involve not only English community but also French-language countries. Taking into account that the translation of technical talks is not easy, the webinar will be done some in French and some in English language.

Briefly, next programmed webinar activities are starting with :

- 1.- Webinar «Oncology: Personalised Medicine approach »: 1st Webinar of a series of webinars and training activities with the objective to support the translation of Personalised Medicine research into practice and to create network between European and African researchers 17th May 2022
- 2.- On line Round Table «The challenges of PM Ethics and Regulations: From Principles to Practice», June 2022
- 3.- Webinar:” Value of the PM for start-ups”, July 2022

At the end of our training initiatives, we expect to have facilitated the access to new scientific PM Resources, Knowledge, and Skills for the different stakeholders, for example:

- 1.- African PM related research Organizations :

They will improve the knowledge on the community’s health problems and understands how PM implementation can help to solve it; knowledge about existing European organizational structure on PM research; How to conduct research on this field; how to find funding to conduct this research, and create the needed relationships with other community members mainly through cross-disciplinary training opportunities

- 2.- Decision-Makers :

They will increase the relation with other national and international PM related decision-makers , and will understands the PM research needs and ELSI related ; will increase the Awareness of PM health care system approach through the provided scientific data, in appropriate formats, form the identified research projects.

