BUILDING LINKS BETWEEN EUROPE AND AFRICA IN PERSONALISED MEDICINE

EU+Africa PerMed

saMRC advancinglife

THE EU-AFRICA PERMED PROJECT 2ND EU-AFRICA PERMED STAKEHOLDER WORKSHOP

PERSONALIZED MEDICINE IN NORTH AFRICA REGION: CURRENT STATUS IN MOROCCO

PR. ELMOSTAFA EL FAHIME :
FUNCTIONAL GENOMIC PLATFORM / CNRST / RABAT

INTERNATIONAL CONVENTION CENTRE IN CAPE TOWN, SOUTH AFRICA. 20 -21 FEBRUARY 2023

Status of Personalized Medicine in Morocco based on the six pillars outlined below.

1. RESOURCES: Production of human sequence DATA sets , shared in Public database. Project for Large-scale production of genomic data sets
2. Sequencing and genotyping Platforms and Innovation Center for Technology Development
3. COMPUTATIONAL SCIENCE : AI and Digital Sequence Information
4. TRAINING : In Genomic and Bioinformatic
5. EDUCATION : FS / FMP/ engineering school
6. Ethical, legal and social implications (ELSI)

Translating genome-based knowledge into health benefits

1 Resources: Generation of human sequence DATA , shared in Public database Contribution

> OMICS. 2021 Apr;25(4):213-233. doi: 10.1089/omi.2021.0004. Epub 2021 Apr 1.

Human OMICs and Computational Biology Research in Africa: Current Challenges and Prospects

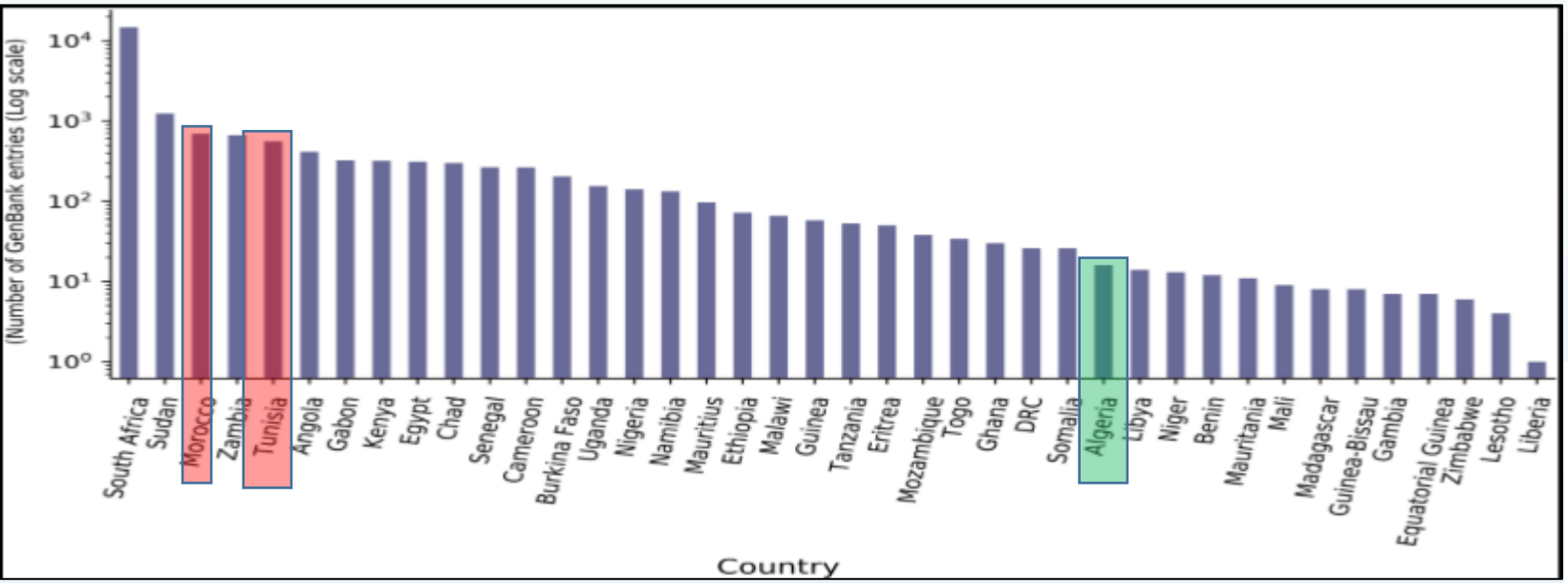


FIG. 2. Representation of Human genomic sequences with African origins in NCBI nucleotide database. Only entries with "country" qualifiers were mined from the database. A total of 21,456 human genome entries (sequences of some target loci) have been submitted by these African countries.

BMC Genomic Data

Home About Articles Submission Guidelines Join The Board

Research article | Open Access | Published: 21 September 2020

Identification of single nucleotide variants in the Moroccan population by whole-genome sequencing

Lucy Crooks, Johnathan Cooper-Knock, Paul R. Heath, Ahmed Bouhouche, Mostafa Elfahime, Mimoun Azzouz, Youssef Bakri, Mohammed Adnaoui, Azeddine Ibrahimi, Saaïd Amzazi & Rachid Tazi-Ahnini

BMC Genetics **21**, Article number: 111 (2020) Cite this article

2908 Accesses | **1** Altmetric | Metrics

Case report | Open Access | Published: 27 February 2018

Exome sequencing reveals a novel *PLP1* mutation in a Moroccan family with connatal Pelizaeus-Merzbacher disease: a case report

Jaber Lyahyai, Bouchra Ouled Amar Bencheikh, Siham C. Elalaoui, Maria Mansouri, Lamia Boualla, Alexandre Dionne-Laporte, Dan Spiegelman, Patrick A. Dion, Patrick Cossette, Guy A. Rouleau & Abdelaziz Sefiani

Case Reports > Case Rep Genet. 2018 Nov 15;2018:8635698. doi: 10.1155/2018/8635698. eCollection 2018.

Genetic Analysis of Undiagnosed Juvenile GM1-Gangliosidosis by Microarray and Exome Sequencing

Ahmed Bouhouche [1,2], Houyam Tibar [1], Yamna Krioual [3], Mohammed Jiddane [4], Imane Smaili [1], Naima Bouslam [1], Ali Benomar [1,2], Mohamed Yahyaoui [1], Elmostafa El Fahime [2,5]

Comparative Study > J Mol Neurosci. 2021 Jan;71(1):142-152. doi: 10.1007/s12031-020-01635-3. Epub 2020 Jun 16.

Gene Panel Sequencing Identifies Novel Pathogenic Mutations in Moroccan Patients with Familial Parkinson Disease

Imane Smaili [1], Christelle Tesson [2], Wafa Regragui [1,3], Hélène Bertrand [2], Mounia Rahmani [1,3], Naima Bouslam [3], Ali Benomar [1,3], Alexis Brice [2], Suzanne Lesage [2], Ahmed Bouhouche [4,5]

1 **Resources: Generation of human sequence DATA , shared in Public database Contribution**

Molecular Genetics & Genomic Medicine
Open Access

Mol Genet Genomic Med. 2016 Nov; 4(6): 588–598.
Published online 2016 Nov 10. doi: 10.1002/mgg3.255
PMCID: PMC5118203
PMID: 27896281

Genetics and genomic medicine in Morocco: the present hope can make the future bright

Khadija Belhassan,[✉1] Karim Ouldim,[1] and Abdel Aziz Sefiani[2]

Table 1. Twenty years of cytogenetics molecular cytogenetics and molecular biology in Morocco.

Disease	Diagnosis method
Constitutional chromosomal abnormalities	Cytogenetic and molecular cytogenetics
Williams syndrome	Cytogenetic and molecular cytogenetics (FISH)
Digeorge syndrome	Cytogenetic and molecular cytogenetics (FISH)
Prader Willi and Angelman syndromes	Cytogenetics molecular cytogenetics and molecular biology (methylation status of 15q11.2)
Chronic myeloid leukemia	Cytogenetic and molecular cytogenetics
Chronic myeloid leukemia	Molecular biology of (BCR/ABL: by RT-PCR)
Myeloproliferative syndromes	Molecular biology (V617F mutation in JAK2 gene)
Myelofibrosis with myeloid metaplasia, essential thrombocythemia	Molecular biology of (Exon 9 of CALR gene)
Familial Mediterranean fever	Molecular biology (MEFV gene)
Autosomal recessive Limb-Girdle muscular dystrophy type 2C	Molecular biology (SGCG gene/525 delT mutation)
Muscular dystrophy Duchenne and Becker type	Molecular biology
Spinal muscular atrophy	Molecular biology
Deafness due to connexin 26 anomalies	Molecular biology of (GJB2 gene/35delG mutation)
Factor V Leiden mutation	Molecular biology
Beta-thalassemia and hbb-related diseases	Molecular biology of (Moroccan recurrent mutations)
Cystic fibrosis	Molecular biology of (Exon 10 of CFTR gene)
Attenuated familial adenomatous polyposis	Molecular biology of (MYH gene/Moroccan recurrent Mutations)
Mucopolysaccharidosis type 1	Molecular biology of (IDUA gene/c.3233C>G mutation)
Glycogen storage disease type IA	Molecular biology of (Moroccan recurrent mutations)
Xeroderma pigmentosum	Molecular biology of (XPC gene/c.1643_1644delTG mutation)
Hyperoxaluria	Molecular biology of (AGXT gene/p.Ile244Thr mutation)
Achondroplasia and hypochondroplasia	Molecular biology of (FGFR3 gene)
Hemochromatosis	Molecular biology of (HFE gene: C187G and G845A mutations)
Male infertility	Molecular biology of Y chromosome deletions (AZF)
Nephronophtisis	Molecular biology of (recurrent deletion of NPHP1 gene)
Familial hypercholesterolemia	Molecular biology (Moroccan recurrent mutations)
Pharmacogenetics	Molecular biology analysis of IL28B gene
Molecular diagnosis of male infertility associated with large-headed multiflagellar polyploid spermatozoa	Molecular biology (AURKC gene: c.144delC mutation)

1

Resources: Generation of human sequence DATA , shared in Public database Contribution

An official website of the United States government Here's how you know

NIH National Library of Medicine
National Center for Biotechnology Information

GTR: GENETIC TESTING REGISTRY

Morocco

GTR Home > **Laboratories** > Functional Genomic Platform

Functional Genomic Platform

Functional Genomic Platform, FGP_CNRST
Centre National pour la Recherche Scientifique et Technique (CNRST)
Department: UATRS-Biology

Submissions in ClinVar
Add to preferred labs

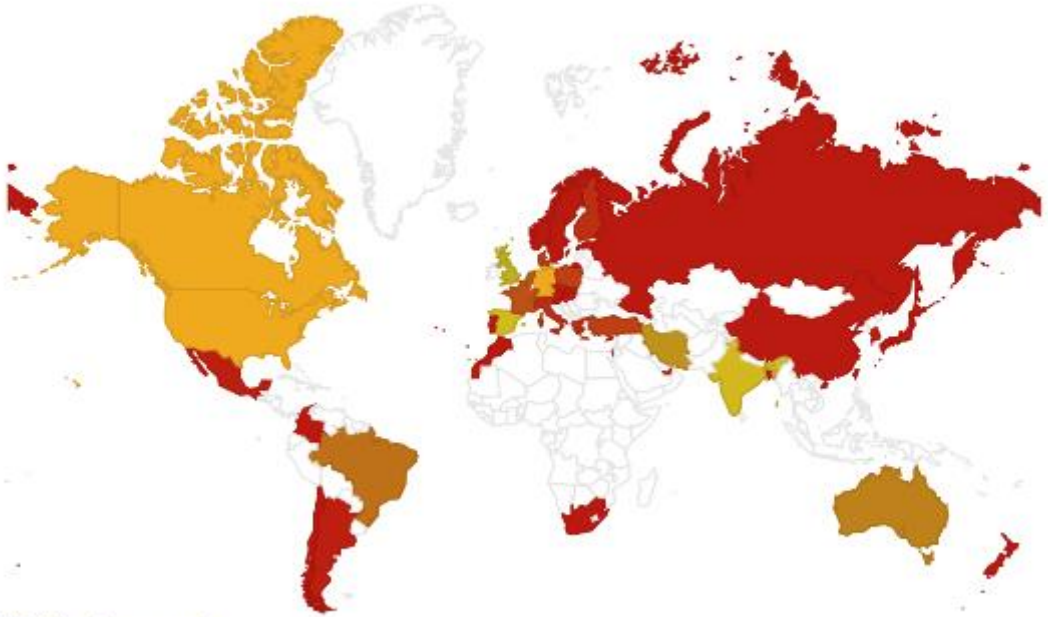
Angle avenues des FAR et Allal El Fassi, Hay Ryad,, B.P. 8027 N.U.
Rabat, Morocco 10102
Phone: 212537569800
Email: elfahime@cnrst.ma
Online Contact: http://www.cnrst.ma/index.php/fr/unites-et-services/mutualisation-et-services/uatrs
Website: http://www.cnrst.ma/index.php/fr/unites-et-services/mutualisation-et-services/uatrs

Affiliated with:
research center, http://www.cnrst.ma/index.php/fr/

GTR Data

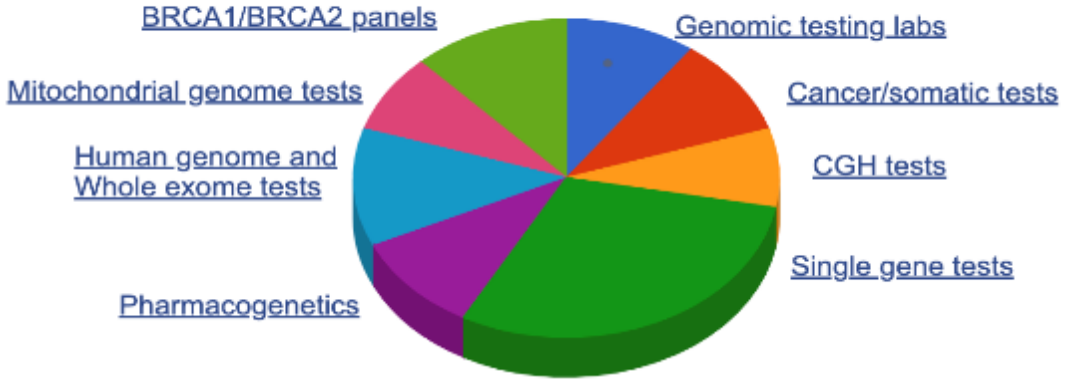
FTP: Download GTR data and documents

Worldwide Lab Participation in GTR



GTR labs by country

Find GTR Content



Medical Genetics in Morocco: new perspectives

MOHAMMED VI POLYTECHNIC UNIVERSITY

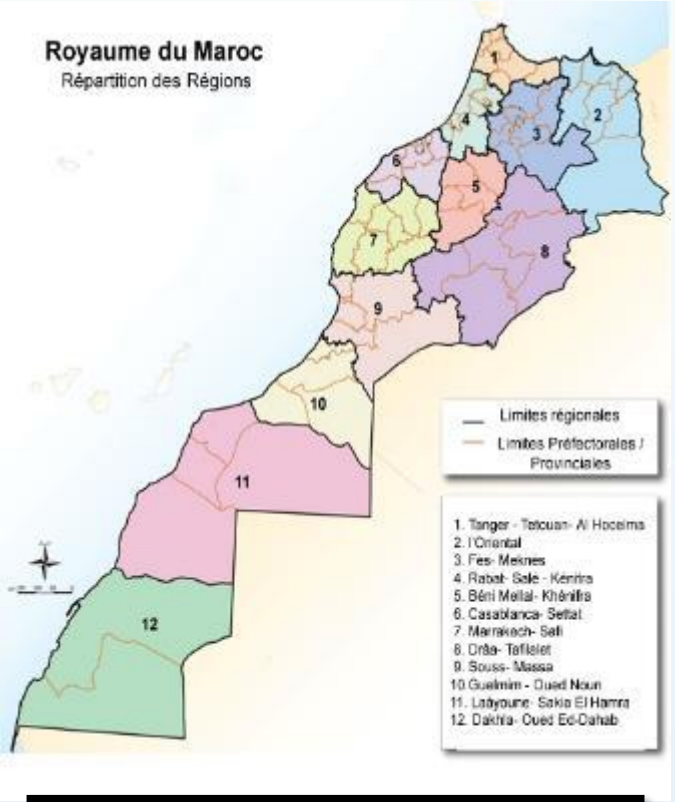
UNIVERSITÉ MOHAMMED VI DES SCIENCES DE LA SANTÉ CASABLANCA

UNIVERSITÉ INTERNATIONALE ABULCASIS DES SCIENCES DE LA SANTÉ
جامعة الزهراوي الدولية لعلوم الصحة

CHU Tanger-Tétouan-Al Hoceima

INH Institut National d'Hygiène — Rabat

Mohammed VI — Marrakech



CHU Casablanca — Institut Pasteur du Maroc Casablanca

CHU Oujda

CHU Hassan II Fès

Institut Pasteur du Maroc

7 Medical Genetic Center at University Hospital Center and INH and PIM

Molecular Genetics & Genomic Medicine
Open Access

Mol Genet Genomic Med. 2016 Nov; 4(6): 588–598.
Published online 2016 Nov 10. doi: 10.1002/mgg3.255
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Genetics and genomic medicine in Morocco: the present hope can make the future bright

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Table 2

Nongovernmental institutions offering services for patients with genetic conditions

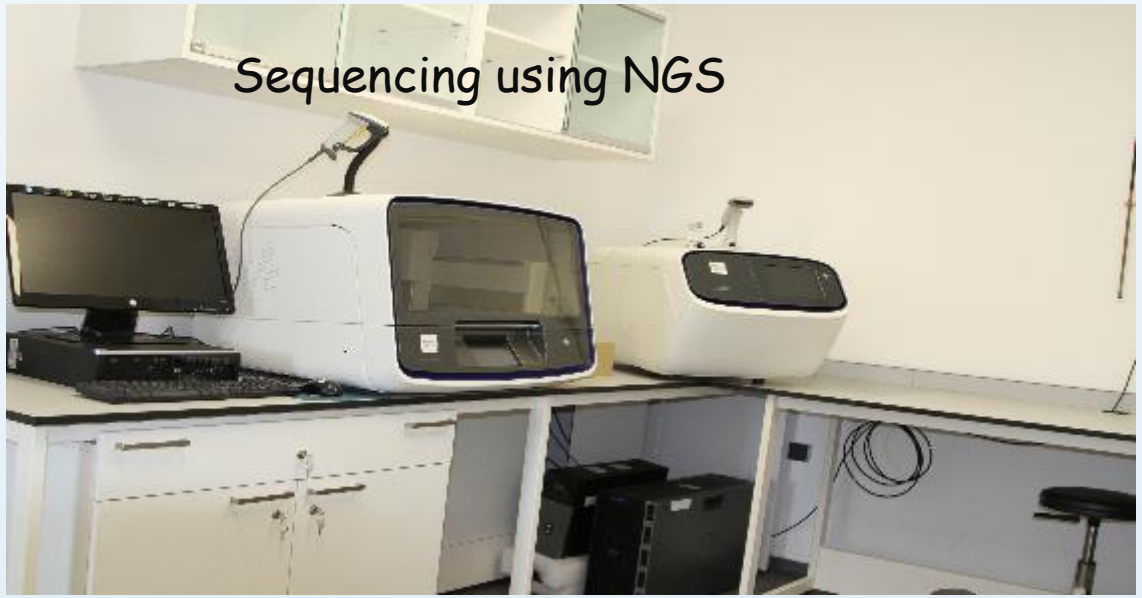
Association	Targeted population
Moroccan society of medical genetics	Population with genetic conditions
Moroccan society of clinical chemistry and medical biology(SMCC-BM)	Population with metabolic conditions
Mirror association for autistic child	Population with autism
Hemophilic Moroccan association	Population with hemophilia
Moroccan association of autoimmune and systemic diseases (AMMAIS)	Population with autoimmune and systemic diseases
Overcome autism association	Population with autism
Pediatrics Moroccan association	Children including those with primary immune deficiency
Pediatric ORL Moroccan association	Population including congenital deafness
Moroccan association against myopathy (AMM)	Population with myopathies

Centre National pour la Recherche Scientifique et Technique

Plateaux Techniques
UATRS
Division du CNRST

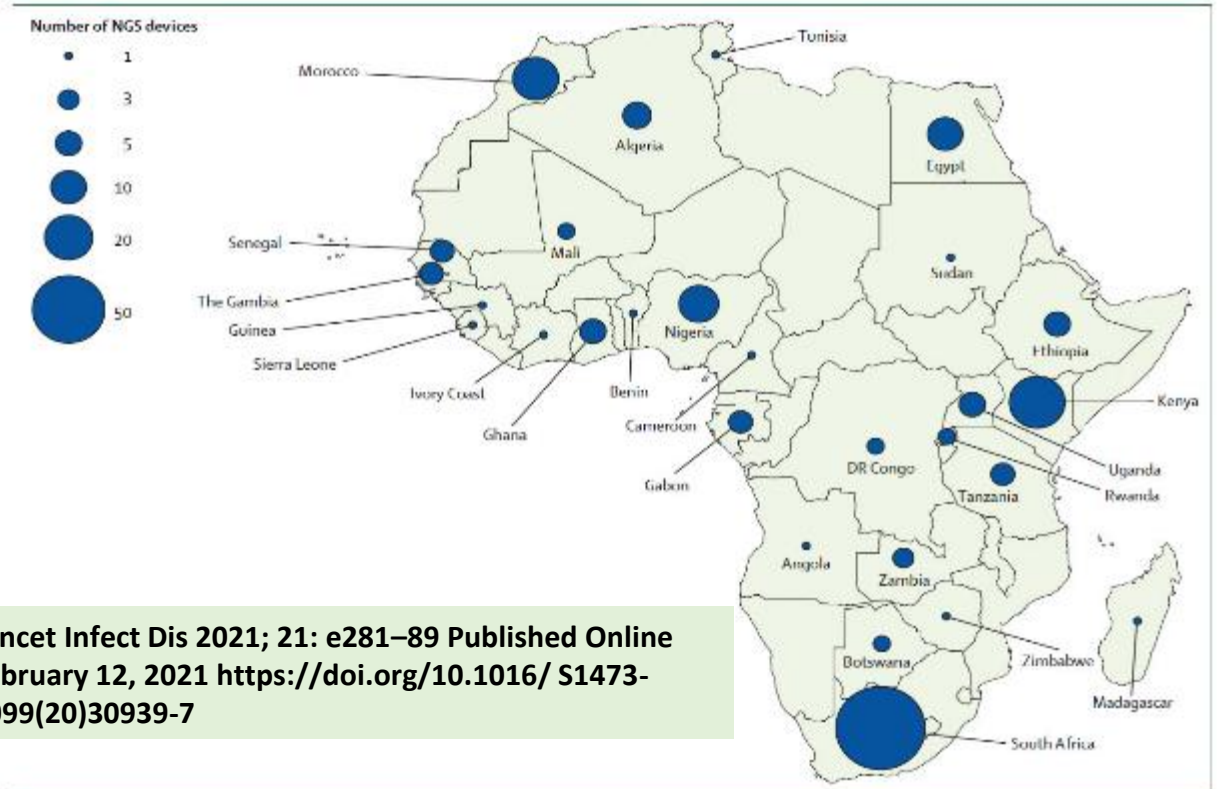
Au service de l'excellence scientifique

FGP- NEW Infrastructure: Since 2018



NGS SEQUENCING CAPACITY in Morocco : Technology and Number
Torrente / ThermoFisher Ions : 29
Illumina : 6
Oxford nanopore : 4
MGI : 1





Lancet Infect Dis 2021; 21: e281–89 Published Online February 12, 2021 https://doi.org/10.1016/ S1473-3099(20)30939-7

Figure 1: Next-generation sequencing capacity in Africa
The circles show the number and distribution of NGS devices on the continent. Data was obtained primarily from manufacturers of the most used NGS equipment—ie, Illumina (Illumina, CA, USA), Oxford Nanopore (Oxford Nanopore Technologies, Oxford, UK), and Ion Torrent (Thermo Fisher Scientifics, MA, USA). However, these data might not be conclusive as they might not include equipment donated or bought outside Africa. Overall, we identified a total of 206 NGS devices in Africa, which includes South Africa (79), Kenya (28), Morocco (18), Nigeria (13), Egypt (10), Algeria (6), Ethiopia (5), Ghana (5), Uganda (5), Gabon (4), The Gambia (4), Senegal (4), Tanzania (4), Zambia (3), Botswana (2), Mali (2), the Democratic Republic of the Congo (2), Rwanda (2), and one each for Angola, Benin, Cameroon, Cote d'Ivoire, Guinea, Madagascar, Sierra Leone, Sudan, Tunisia, and Zimbabwe. NGS=next-generation sequencing.

- MASCIR (Moroccan fondation of Advanced Science and Research): the development of diagnostic kits for specific forms of cancer, autoimmune conditions, and infectious diseases;

VOCATION

"Innovate to build our future"

The MAScIR Foundation is a non-profit association related to Mohammed VI Polytechnic University. Created in 2007, it aims to promote and develop technological research centers in the fields of materials and nanomaterials, biotechnology, microelectronics, and life sciences. Its work is oriented towards applied research and innovation to meet market needs.

MAScIR has cutting-edge scientific platforms and a high level of human capital. Its researchers operate in different innovative and complementary fields. From mines to renewable energies, via health and transport, the research carried out at MAScIR focuses on the current and future needs of industry, agriculture and economic operators in general.

The MAScIR Foundation also aims at promoting the results of its research and its invention patents, through technology transfer, the creation of spin-offs and start-ups in order to contribute to the emergence in Morocco of a knowlwdge based economy.

MOLDIAG, SPIN-OFF DE LA FONDATION MASCIR FINALISE UNE OPERATION D'EXPORTATION EN AFRIQUE AU PROFIT DU CDC AFRICA

14 novembre 2022

MOLDIAG, SPIN-OFF DE LA FONDATION MASCIR FINALISE UNE OPERATION D'EXPORTATION EN AFRIQUE AU PROFIT DU CDC AFRICA Après une première opération d'exportation de 5000 tests de diagnostic du Covid-19 pour l'institut...

BIOTECHNOLOGY: GREEN AND BIOMEDICAL

Immunology

- Flowcytometer
- (FacsCalibur)
- Microplate reader (Multiskan)
- CO2 incubators (Thermo)
- Laminar flow hoods
- Centrifuges

Molecular Biology

- RT/PCR
- PCR hoods
- Centrifuges
- Thermo-cyclers
- Spectro-photometers
- Bio-analyser
- Nanodrop

Mammalian Cell Culture

- Laminar flow hoods
- Incubateur a CO2 (Thermo)
- Centrifuges
- Bioréacteurs
- Roller Deck & Incubateur
- Inverted microscope
- LN2 storage

Plant Cell Culture & Biomasse

- Phytotron
- Incubators/ agitators (Sartorius)
- Photo-bioreactor (Sartorius)
- Photo incubator
- Inverted microscope inverse
- Fluorescence Microscope
- GC/MS
- Ionic analyzer (Skalar)

Microbiology

- Agitator/ Incubators
- Laminar flow hoods
- Incubators
- Compteur de colonies
- Microscopes
- BioLog

Basic support

- Ti Sapphire Laser
- Helium Cadmium Laser 442nm, Blue Laser
- Spectrograph / Monochromator
- Solar simulator

2 Technological Development Center : Platforms and Innovation Center

La Cité de l'Innovation de Fès

Historique

Le Centre Universitaire Régional d'Interface (CURI) adossé à l'Université Sidi Mohamed Ben Abdellah (USMBA) de Fès, dont la réalisation a nécessité un coût de 26,5 millions de DH, a été inauguré le 19 janvier 2007 par sa majesté le roi Mohammed 6.

En Juillet 2011, l'université a signée avec l'état une convention qui a pour objet la redynamisation du CURI adossé à l'USMBA en l'érigeant en une Cité de l'Innovation de Fès «CIF», la « CIF » a comme objectifs, d'une part de valoriser les résultats de la recherche scientifique, des moyens d'expérimentation et d'analyse de l'USMBA au profit du tissu socio-économique et d'autre part, de faire profiter les entreprises des savoirs et des connaissances issus de l'université

La cité de l'innovation

Cité de l'Innovation de Rabat

Cité de l'Innovation et de la Recherche & Développement - UHP settat

Cité d'e l'innovation Souss Massa

4,5 ★★★★½ (29) · Centre d'affaires à Agadir

Université Cadi Ayyad (Présidence, Marrakech)

Centre National pour la Recherche Scientifique et Technique

MARWAN network (Moroccan Academic and Research Wide Area Network), is the National Education and Research Network created in 1998.

- Ressources disponibles
- Applications Installées
- Comment Utiliser
- Exemple de scripts

HPC

Le CNRST met à disposition des chercheurs Marocains une infrastructure de calcul haute performance (HPC) accessible à distance.

Cette infrastructure est composée de 38 nœuds qui offrent les capacités suivantes :

- 1672 CPU Cores (165 TFlops) • 396 TB Storage
- 10.4 TB de Mémoire • 4 GPUs

Ces nœuds sont interconnectés par un réseau de très faible latence (OPA) à 100 Gbps .Un système de fichiers parallèle est implémenté. Pour faciliter l'accès haute performance grâce à des IOPS simultanées par plusieurs tâches d'une application parallèle.Cette infrastructure est connectée au réseau MARWAN par un lien de 5 Gbps ce qui assure une fluidité dans l'utilisation et les transferts des données depuis les Universités.

MaGrid

Moroccan caclul grid

Grille de calcul Marocaine

La Grille de Calcul Marocaine **MaGrid** a été mise en place en 2006. Elle offre à la communauté scientifique marocaine des moyens de calcul performants et une grande capacité de stockage des données.

Les certificats numériques pour l'utilisation de MaGrid et aussi des autres grilles de calcul à l'échelle internationale sont émis par MaGrid CA qui est membre accrédité EUGridPMA depuis 2007.

MaGrid compte parmi ses utilisateurs des chercheurs affiliés à des domaines de recherche variés: Chimie théorique, Bio-informatique, Physique médicale, Mathématiques, Météorologie, Sciences de la matière, Physique des Hautes Energies ...

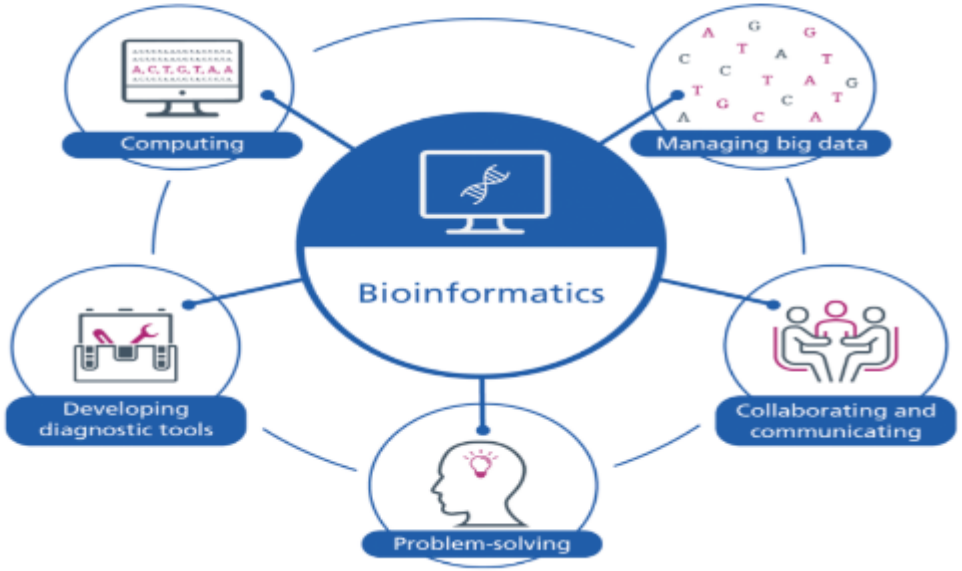
Africaine Genome Center

MOHAMMED VI POLYTECHNIC UNIVERSITY

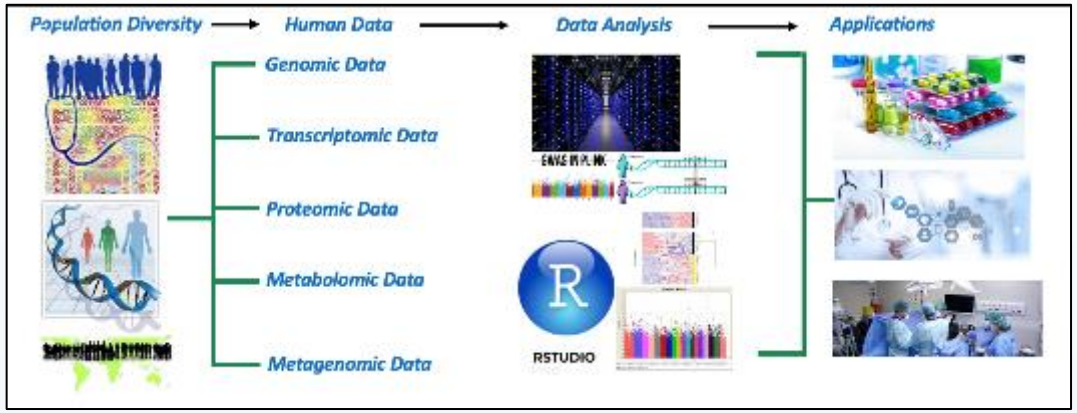
ABOUT THE LAB

A CENTRAL LAB TURNING HUMAN RESOURCES INTO ASSETS

Mohammed VI Polytechnic University (UM6P) is an international higher education institution established to put research and innovation at the service of education and development for Morocco and the African continent. The African Genome Center (AGC) aims to promote research and education in genomics, proteomics and bioinformatics in agriculture, environment, human health and food. The Bioinformatics Laboratory conducts research in bioinformatics, computational biology, and computational chemistry. The lab also provides bioinformatics consulting and data management services to AGC, UM6P researchers and their collaborators. Our laboratory addresses bioinformatics needs at the national and African levels. The African Genome Center has state-of-the-art NGS sequencers and mass spectrometry. In addition, UM6P recently acquired the largest high-performance computing (HPC) cluster in Africa. We aim to leverage these resources to centralize the bioinformatics needs internally and at the African level, and to develop innovative research and training programs.



4 TRAINING : In Genomic and Bioinformatic



Institut Pasteur du Maroc

Title of the International RIIP Course 2020 :

"Metagenomics and Health"

Characteristic of the course:

There is a growing interest in microbiome and metagenomics research, across Morocco and Africa, to advance practical applications both for human health and the environment. The development of next generation sequence (NGS) technology has led to rapid advances in microbiome study. The main aim of this course is to provide participants with cutting-edge fundamental theory and practical applications of metagenomics.

This short-course on the bioinformatics of analyzing the microbiome aims to give an overview of conducting a microbiome study, present the most important techniques, resources, tools and applications of metagenomics for health and the environment. The course will cover analysis both using both 16S rRNA gene (16S) sequences and shotgun (WGS) sequencing.

NGS Analysis for Monogenic Disease in African Populations

12–13 December 2022

Rabat, Marocco (AfSHG) and the Moroccan Society of Human Genetics (SM2GH)

- Third meeting on the valorisation of the scientific results **Rabat, November 7th – 9th 2005**
- International course entitled "Genome Biology and Biotechnology", **December 5th – 8th,2005**
- Fifth International Course: "Computational genomics", **April, 05th – 09th, 2010**
- Sixth International Course: "Computational genomics", **April, 01th – 05th, 2013**
- International Course entitled : "Biostatistiques & Datamining", **April, 08th – 10th, 2014**

Institute of Cancer Research

IRC/ISSB-P Advanced Course On Cancer Biology And Therapy

statistics :
Universities 20 (12 Public/8 Private)
Faculties of Medicine 14 (8 Public/6 Private)
Faculties of Pharmacy 11 (7 Public/ 4 private)

http://ensias.um5.ac.ma › article › master-de-recherche-...

Master de recherche en Bioinformatique et Modélisation des ...

Master de recherche en **Bioinformatique** et Modélisation des systèmes complexes appliquée à la santé. Face aux défis de la médecine de précision, l'ENSIAS en ...

https://master.uae.ma › public › pdf › FIL3 PDF

Bio-Informatique et Sciences des Données (BISD) - http ...

Ce **master** vise à préparer des étudiants qualifiés pour une meilleure initiation à la recherche et au développement dans le domaine de la recherche appliquée. La ...

https://www.ofpptmaroc.com › master-informatique

Master Bioinformatique à FST de Settat - OFPPT MAROC

Le master « **Bioinformatique** » est une **formation** qui s'étale sur deux années et s'adresse aux titulaires d'un diplôme scientifique bac+3.

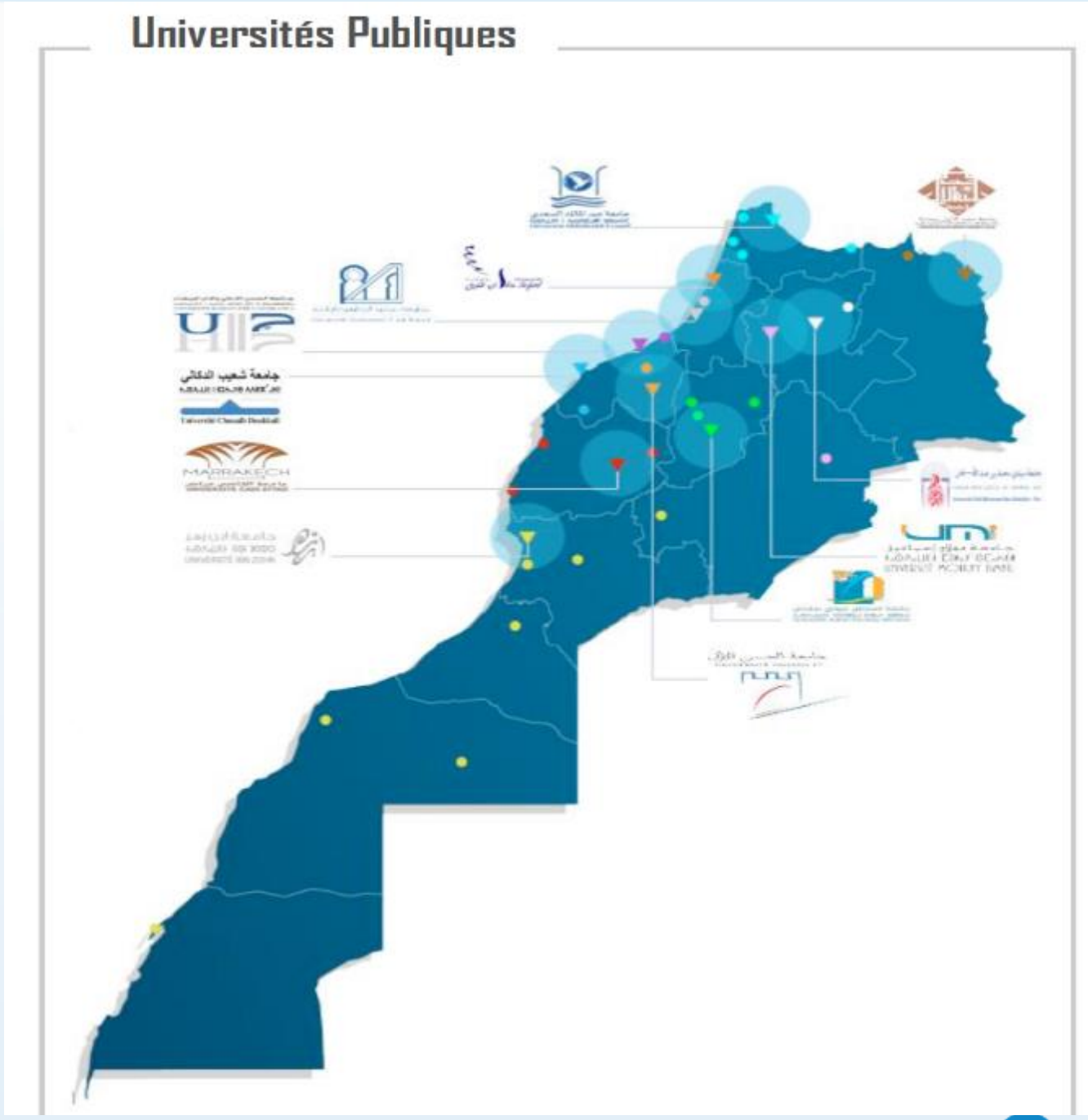
ENSIAS

MASTER EN BIOTECHNOLOGIE MÉDICALE

https://esgb.um6ss.ma › ingenieur-genie-bio-informatique

Ingénieur Génie bio-informatique

Génie **Bio-Informatique** · PRÉSENTATION · ADMISSIONS · PROGRAMMES · MODALITÉS D'ACCES · DÉBOUCHÉS · STRUCTURE DE LA **FORMATION**.



Formations académiques : FS / FMP/ Ecole d'Ingénieur/ IS

MOHAMMED VI POLYTECHNIC UNIVERSITY

Ai movement
INTERNATIONAL ARTIFICIAL INTELLIGENCE CENTER OF MOROCCO

AI MOVEMENT

Ai movement, le centre international d'intelligence artificielle du Maroc, est un centre d'excellence en Intelligence Artificielle qui a pour vocation de favoriser l'émergence d'un savoir-faire marocain en Intelligence Artificielle et en Sciences des Données. C'est à la fois :

Un outil d'articulation et de consolidation de différentes actions ayant trait au domaine de l'IA, avec comme ambition de faire du Maroc un hub régional d'IA impactant pour son écosystème, sur les plans stratégiques, éducatifs et industriels.

Un levier pour anticiper et accompagner les évolutions et les transformations relatives à l'Intelligence Artificielle et aux Sciences des Données dont le but d'apporter des solutions innovantes, opérationnelles, résilientes et éthiques aux problématiques de la société, de l'environnement, du marché, de l'économie et de la technologie.

6 Ethical, legal and social implications (ELSI)

The evaluation of new genetic and genomic tests and technologies, and effective oversight of their implementation, to ensure that only those with confirmed clinical validity are used for patient care.

Academic Ethics Committees: 1/University
Project for the creation of a National Ethics Committee.

Revue Ethique & Numérique, Volume 1, Numéro 1, Mars 2020.

Comment instaurer la médecine de précision ? Pour une alliance entre intelligence artificielle et modélisation conceptuelle

Éthique et Numérique

Dr. Jean-Pierre LLORED*, Dr. Anass BOUCHNITA*

Contacts :

jean-pierre.llored@centralesupelec.fr
anass.bouchnita@austin.utexas.edu

Résumé : Cet article propose des arguments en faveur d'une alliance entre IA et modélisation conceptuelle en vue d'instaurer une médecine de précision. Ses arguments sont illustrés par un cas d'étude concernant la réaction des patients aux anticoagulants. En mobilisant bio-informatique et épistémologie, il développe des éléments de réflexion sur les apports possibles et les limites d'une telle alliance.

National commission for the protection of personal data

Genomic data protection legislation project

Communiqué de presse du 19/04/2022: Protection de la donnée génomique

المملكة المغربية
Royaume du Maroc
CNDP

Tweeter | Partager | J'aime 1 | Partager

Le génome est une donnée à caractère personnel très sensible. Les techniques de séquençage nouvelle génération (NGS), de plus en plus utilisées, produisent des informations numériques dites génomiques dont la manipulation et l'exploitation doivent permettre et favoriser les efforts de recherche visant à mieux connaître l'être humain en vue d'améliorer ses conditions de vie, tout en préservant les termes de sa vie privée.

Questionnaires: Summary of needs and gaps

IV- The priority training needs for pm experts in Morocco

- Bioinformatics and Genomics data sciences.
- clinical genetic programs, bioinformatics, genomics data … health s… s among other relevant PM areas.
- understanding of gene-environment interactions, et… , pharma…
- To my opinion, the priority training that needs … perts in M… clinical genetic programs, Oncogenetics, new genetic technologies, bioinformatics, genomics dat…
- From my perception priority needs f… rts includ… ethical as…
- bioinformatics, genomic data, … intellige…
- Using NGS in oncology
- In addition to clinical … priority n… include da… and stor… a on genomic data, transforming data into values
- Training in … enetics, M… ology techn… interpr… enomics data.
- We have … levels of … physician… person… is no priority, all these areas of training are necessary.
- To develo… personali… ne in Moro… a need … the specialty of oncology. Example we carried out on a study on the specialty … ecology in … d we fo… veral specialties can treat women with gynecological cancer (gynecologist… gists, surge… re the ab… oned programs and training, the professionals in Morocco require collaborations, …rtnerships … es with … nters, also require access to data banks and access to diagnostic products at a lower price.
- All of them: genetic … is, bioinf… enomics data science and health systems.
- Bioinformatics for whole geno… e sequencing data analysisTool and pipeline development
- Omics data science
- Creation and strengtheni… e human and material capacities of clinical investigation centers (CIC) for translational researchTeaching the healthcare workforce about genomic medicine and other areas of precision medicine oncology endocrinology

Bioinformatic

Medical Genomic and genetic

Pharmacogenetic et Pharmacogenomic

Precise Oncology

Needs for PM implementation

- Diagnostic and screening test (PCR/qPCR / Sanger: NGS etc…)
- Treatment (targeted or tailor-made)
- Practice (standardisation of treatment protocol)
- Organization Structural (a center or a care unit)
- Program (STD/AIDS/Cancer prevention)
- Policy (Health Financing Strategy / Laws)

- Integrated PM into National Programs and funding strategies
- Prepare hospital structures for PD applications (Diagnosis/prognosis/targeted therapy, etc…..,
- Human Resource Qualifications: Based on Medical Genetics
- Public Health Laboratory Accreditation
- Integration of IS (BM laboratory, for MP, etc.)
- Biobanks
- Clinical investigation centers

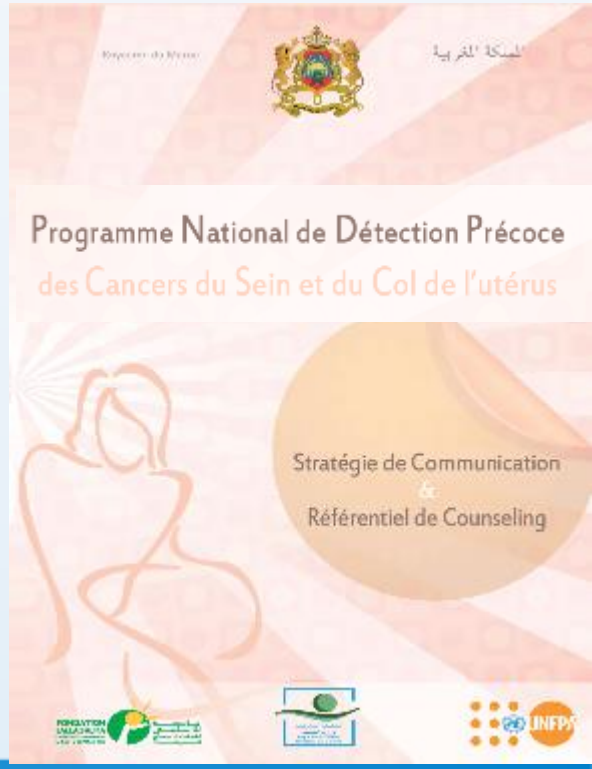
ROYAUME DU MAROC
Ministère de la Santé

المملكة المغربية
وزارة الصحة

PLAN « SANTÉ 2025 »
3 Piliers / 25 Axes / 125 Actions

Santé
Le détail du projet de loi-cadre relatif au système de santé national (document)

La réforme du système de santé national repose sur l'amélioration de l'offre de soins, sur la restructuration de l'administration pour une bonne gouvernance, sur la revalorisation des ressources humaines et sur la digitalisation.



Role Of Knowledge Societies and Associations

- SMGM: Société Marocaine de Génétique Médicale
- SMOG : Société Marocaine d'Oncogénétique
- SM2GH:Sociètè Marocaine de Gènomique et Gènètique Humaine
- Moroccan Oncogenetics Network-MOON)

- Promote the development of PM
- Raising awareness among decision makers about the potential benefits of personalized medicine
- Promoting the integration of the genetic dimension and advice throughout the health journey of patients of all ages
- Develop information and continuous training for actors in Omics Science
- Support research in OMICs domains.
- Set up collaborations with oncogenetics associations in other countries, as well as with other national and international associations in the field of oncogenetics
- Be an interlocutor for health professionals, families, patient associations and the public on genetic predispositions and predictive medicine in relation to different diseases