Success Stories of Africa-Europe Research Collaboration in Personalised Medicine

A Two-Decade Collaboration Advancing Pharmacogenetics and Personalised Medicine in Africa

20 Years of Enduring Africa-Europe Partnership for Better Health

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Executive summary

The African-European partnership in pharmacogenetics exemplifies a sustainable and impactful model of global scientific collaboration. Rooted in over two decades of trust, mutual learning, and shared goals, this partnership has advanced personalized medicine and drug safety across Africa while enriching global pharmacogenetics research. Spearheaded by Professor Collen Masimirembwa of the African Institute of Biomedical Science and Technology (AiBST) in Zimbabwe and Professor Julia Stingl of RWTH Aachen University, Germany, the collaboration has achieved groundbreaking results, including the identification of population-specific genetic variations and the development of tailored drug therapies for African populations.

Through initiatives such as the Collaborative Pharmacogenetics Africa (CPA) and CPA Plus projects, funded under programs like the Global Health Protection Program (GHPP), the partnership has strengthened research networks, expanded training opportunities, and built long-lasting research capacity across 11 African countries. Key findings, such as the role of unique genetic markers in African populations affecting drug responses, have already informed global health practices, including WHO recommendations for safer dosing of certain medications.

This initiative highlights the importance of equitable collaboration between Africa and Europe, leveraging African genetic diversity for advancements in global pharmacogenetics. The project's long-term vision seeks to integrate its findings into national healthcare policies, fostering enduring benefits for both continents and promoting sustainable innovation in personalized medicine.

Project overview

Background

The African-European partnership in pharmacogenetics emerged from a shared vision of addressing disparities in drug efficacy and safety across diverse populations, particularly in Africa. The collaboration began over two decades ago through the efforts of Professor Collen Masimirembwa, a leader in biomedical sciences in Zimbabwe, and Professor Julia Stingl, an expert in clinical pharmacology in Germany.

From its inception, the partnership has been rooted in mutual trust, shared goals, and the recognition of the unique genetic diversity in African populations. This diversity plays a significant role in determining how individuals respond to medications, which has profound implications for drug safety and personalized medicine.

The early years of collaboration focused on identifying critical genetic variations in African populations that influence drug metabolism and treatment outcomes. This work gained momentum with the support of major funding programs, including the Global Health Protection Program (GHPP), which enabled the launch of key initiatives like Collaborative Pharmacogenetics Africa (CPA) and its extension, CPA Plus.

What started as a localized effort in Zimbabwe has since expanded to encompass 11 African countries, establishing a robust network of research partnerships. The partnership has achieved groundbreaking findings, such as identifying genetic markers linked to adverse drug reactions in antiretroviral therapies and warfarin, and has contributed to global pharmacogenetic research.

Through training programs and mentorship, the collaboration has built a new generation of African and European researchers, ensuring sustainability and capacity development. It has also influenced global health policies, such as WHO recommendations for safer drug dosing in African populations.

Today, this partnership serves as a model for equitable and impactful scientific collaboration, demonstrating how a focus on local challenges can drive global innovations in healthcare. The foundation laid by this long-term relationship continues to support advancements in personalized medicine, benefitting both African populations and the global community.

Goal

The overarching goal of the African-European partnership in pharmacogenetics is to advance personalized medicine and improve drug safety by addressing population-specific genetic variability, particularly in African populations. The partnership seeks to build sustainable research capacity, foster equitable collaborations, and translate scientific findings into healthcare policies and practices that benefit both African and global populations.

This cross-continental partnership leverages the genetic diversity of African populations to enhance our understanding and application of personalized medicine, facilitating a structured transfer of knowledge and methodologies from Europe to Africa.

The primary goals of their collaboration are to:

1. Implement personalized medicine approaches across different therapeutic areas in African settings to evaluate feasibility and effectiveness.
2. Utilize the extensive genetic diversity present in African populations to enrich the global pharmacogenetic knowledge base.
3. Reduce the time it takes to translate research findings from the bench to bedside through effective collaboration and shared methodologies.
4. Transfer and adapt successful frameworks and protocols developed in Europe to African contexts, minimizing the need to "reinvent the wheel."
5. Contribute to the development of pharmacogenetic guidelines that account for African genetic diversity, thereby influencing both European and African medical practices.
6. Encourage a reciprocal exchange of knowledge and expertise between European and African teams to enhance mutual understanding and find sustainable solutions.

Prof Masimirembwa speaks at the Symposium on Personalized Medicine for Global Health, Zimbabwe, 2019

Concretely, clinical and pharmacological PhD students from Zimbabwe, Zambia, and Malawi are trained to conduct research in drug safety, clinical pharmacology, and pharmacogenetics, aiming to improve individualized therapy for anti-infective drugs. The students collect real-world data in hospital settings on the use, individual dosages, and therapy duration of anti-infective therapies. This data is then linked to individual patient risk factors (such as drug concentration, pharmacogenetics, and known resistance patterns) to optimize anti-infective therapies as well as to prevent and combat resistance. The students focus on studying the use, dosage, and duration of these therapies in selected African hospitals. This research strengthens local regulatory expertise by examining population-specific differences in drug effectiveness and safety.

To address resource constraints, an e-learning package is being developed to train healthcare professionals in the safe and effective use of anti-infectives and to be able to reach a wider audience, in other healthcare settings.

Duration

A 20-year collaboration highlighted by the success of Collaborative Pharmacogenetics Africa (CPA) and its extension, CPA Plus (2016–2022), which advanced personalized medicine and strengthened research capacity in Africa.

Funding

The primary funding sources for the initiatives described in the story are:

- Global Health Protection Program (GHPP): Funded by the German Federal Ministry of Health, this program focuses on enhancing global health protection through collaborations, knowledge exchange, and strengthening regulatory and research capacities in areas like drug safety and quality.
- European Union Funding: While not explicitly detailed, projects like UPGx (used as a framework for the African initiatives) were funded by the European Union under the Horizon 2020 program, indicating European support for related efforts.
- Bill and Melinda Gates Foundation: Mentioned as a partner in later phases of the collaboration, supporting applied healthcare and pharmacogenetic research projects in specific African countries.
- African and European Institutions: In-kind support and resources from institutions like the African Institute of Biomedical Science and Technology (AiBST), University of Zambia, University of Malawi, and the Federal Institute for Drugs and Medical Devices (Germany).

Future collaborations may also involve additional funding from German foundations and African stakeholders as noted in the ongoing plans for growth and sustainability.

Participating partners

Over the past eight years, this collaboration on pharmacogenetics has flourished, expanding from its beginnings in Zimbabwe to now include Zambia and Malawi. With growing support, this initiative brings together a network of institutions across both continents, engaging more funders, researchers, and healthcare professionals.

- Participating Institutions in Southern Africa: University of Zambia, African Institute of Biomedical Science and Technology in Zimbabwe, and University of Malawi.
- Specialized German Institution: The Federal Institute for Drugs and Medical Devices, BfArM.
- The Global Health Protection Programme (GHPP), an initiative of the German Federal Ministry of Health focused on enhancing global health protection by fostering networking, knowledge exchange, and collaboration among German and international health stakeholders.

This collaboration has achieved significant milestones, including partnerships with global organizations such as the Bill and Melinda Gates Foundation and the use of advanced resources like the GIMS Platform, which bridges academic research with industry needs in healthcare. Practical applications of research have emerged in countries like Nigeria, Kenya, South Africa and Zimbabwe, focusing on conditions such as sickle cell disease (Nigeria), transplant surgery (Kenya), tuberculosis (South Africa), gastro-intestinal tumors and breast cancer in Zimbabwe. This is being done under a clinical feasibility protocol called iPROTECTA[1] (implementing pharmacogenetics in effective treatment and care in Africa). iPROTECTA was inspired by the European UPGx project, that was coordinated by Leiden University and run in seven European countries. The iPROTECTA project is having real-world impacts, empowering healthcare professionals to implement personalized medicine techniques directly within clinical settings

Key Personnel and Their Roles

At the heart of this collaboration are two pioneering leaders who have been instrumental in its growth and success: Professor Collen Masimirembwa, President and Chief Scientific Officer of the African Institute of Biomedical Science and Technology (AiBST) in Zimbabwe and a team from the University of the Witwatersrand in South Africa, and Professor Julia Stingl, Director of the Institute of Clinical Pharmacology at the University Hospital of RWTH Aachen, Germany. Together, who initiated this pharmacogenetics project in Zimbabwe, sparking a movement that now extends to Zambia, Malawi, South Africa, Kenya, and Nigeria and beyond.

This partnership has also received support from a range of other stakeholders, including international funding bodies and health organizations. Currently, the project is actively exploring further opportunities for growth by engaging with additional German foundations to secure support for follow-up initiatives. These efforts aim to deepen and expand the

[1] https://www.euafrica-permed.eu/wp-content/uploads/2024/02/PDF2_Collen-M-Julia-S_EU-Africa-iPROTECTA-presentation.pdf

impact of this longstanding collaboration, building on the groundwork established by Professors Masimirembwa and Stingl and their respective institutions.

Leading investigators and teams involved:

Collen Masimirembwa. African Institute of Biomedical Science and Technology, AiBST. (**Zimbabwe).**

Sydney Brenner Institute for Molecular Bioscience at the University of the Witwatersrand (**South Africa)**.

Julia Stingl. University Hospital RWTH Aachen, Institute of Clinical Pharmacology (**Germany)**.

iPROTECTA Collaborators. Multiple institutions in **Nigeria, Kenya, South Africa, and Zimbabwe.**

Cape Town University (**South Africa)**.

Malawi University **(Malawi).**

Obafemi Awolowo University **(Nigeria).**

Strathmore University **(Kenya)**

Zambia University **(Zambia)**

CPA und CPA PLUS

Combating Resistance in the Treatment of Infectious Diseases by Promoting Judicious/Rational Use of Anti-infective Drugs.

Strengthening drug safety is key to protecting health globally. Drug safety and quality is not only an African problem, but also an issue that is faced by countries all over the world and requires continuous vigilance and quality control. As seen during the Covid pandemic, some health challenges have to be tackled on a broad regional and global level to be effective.

From 2016 to 2022, CPA has promoted the training of early career researchers on the African continent. It has also facilitated collaborative studies on the optimal use of anti-infective drugs to combat and contain drug resistance. In addition, CPA PLUS, an extension of CPA, has strengthened local regulatory competence and research within the fields of clinical pharmacology and pharmacogenetics. It nurtures and consolidates networks and structures for the advancement of knowledge on judicious use of drugs and the containment of resistance.

Initiated eight to ten years ago with the UPGx project in Europe, the project CPA and CPA Plus[2] seeks to strengthen the capacity of African countries, through training programs, workshops, and collaborative research, to equip African healthcare professionals with the skills and tools needed to ensure the safe and effective use of therapies, especially anti-infectives, in their respective countries.

Funded by the German Ministry of Health under its Global Health Protection Program (GHPP), the German drug regulatory authority works, together with WHO, to collaborate with global partners like the national drug agencies and national drug quality control laboratories on critical issues around drug safety. The program is currently working in 11 African countries and focuses on ensuring that medicines produced locally are of good quality, effective, and safe for use.

Julia Stingl

Director, Institute of Clinical Pharmacology University Hospital of RWTH Aachen, Germany

Under the GHPP, CPA and CPA Plus worked with three African countries to improve their ability to regulate and analyze drugs to enable them to tackle problems like counterfeit and low-quality medicines, which are an issue worldwide, including in Europe. Each country is tackling drug safety and quality in its own area of interest, based on national health priorities. Where Nigeria had decided to focus on pain management in children with specific disease sequelae. Zimbabwe is targeting cancer patients, whereas in South Africa, the project worked with TP (Thrombophilia) patients.

Innovative approach

The innovative approach of this project lies in the long-term, sustainable Africa-Europe collaboration in pharmacogenetics, which leverages genetic diversity in African populations to enhance global pharmacogenetic knowledge and PM.

Key aspects of innovation include:

- Cross-Continental Knowledge Exchange: The partnership between African and European researchers enables the transfer of expertise from Europe to Africa, adapting successful European frameworks and methodologies, such as the UPGx project, to African contexts. This exchange accelerates the implementation of pharmacogenetic tests in clinical settings, reducing the time from research to patient care.

- Population-Specific Research: By focusing on African genetic diversity, the project addresses the unique pharmacogenetic profiles of African populations. This includes identifying how genetic variations affect drug responses, such as the differences in how warfarin and antiretroviral drugs affect African patients, which has led to improved dosing recommendations and safer treatments.

[2] https://ghpp.de/fr/projets/cpa-und-cpa-plus/

- Collaborative Innovation: The project not only strengthens research capacity in Africa but also involves African researchers in the research process, ensuring that clinical pharmacology and pharmacogenetics are embedded in local health systems. This helps build a new generation of African researchers, improving local healthcare and regulatory capacity.

"I believe that universities in Africa are making important progress in genomics. What is needed and is likely to start emerging are centres of excellence in translational research, such as the AiBST, that will translate some of the findings from the universities to products and services." Collen, 2024. *https://www.universityworldnews.com/post.php?story=20240918110117 56*

- Inclusive and Reciprocal Learning: The collaboration fosters mutual learning between Europe and Africa, encouraging a reciprocal exchange of knowledge that enriches both continents' understanding of personalized medicine. This two-way transfer of expertise helps design research that accounts for global genetic variability.
- Training and Capacity Building: The project trains early-career African researchers and healthcare professionals in drug safety, pharmacogenetics, and clinical pharmacology, enhancing local expertise in managing drug therapies and combating drug resistance. This sustainable model helps African countries build their own research infrastructure, making them less dependent on external resources in the future.
- Leveraging Genetic Diversity for Global Impact: Africa's genetic diversity is seen as a crucial resource for enhancing the global understanding of pharmacogenetics. By incorporating data from African populations, the project improves the robustness and relevance of pharmacogenetic research, influencing both African and European healthcare systems.

Main Challenges of the Collaboration

One of the significant challenges faced by the project was the variation in healthcare reimbursement policies across African countries. Treatments that were covered in one country were often not covered in another, leading to inconsistencies in patient access to therapies. Additionally, navigating the diverse regulatory frameworks presented obstacles, as each country's regulations differed considerably. To overcome these hurdles, the project team collaborated closely with local partners, adapting their approach to align with each country's specific healthcare environment.

Biobanking and data access also posed challenges in countries like Nigeria and South Africa. Questions emerged regarding ownership and access rights to the genetic samples collected for research. The team addressed these concerns through open dialogue and developed ethical guidelines to promote fair, transparent data sharing practices, ensuring respect for both contributors and the valuable genetic data involved.

Key milestones so far

Key Milestones in the Collaboration:

- Expansion to Africa: Successfully transferred the UPGx framework to African countries, beginning with pilot studies in Nigeria, Kenya, Zimbabwe, and South Africa.
- Development of Structured Approaches: Designed methodologies to implement genotyping tests at the bedside in African healthcare environments.
- Influence on Guidelines: Contributed to pharmacogenetic guidelines, such as CIPIC, with African-specific sections that address unique genetic profiles.
- Overcoming Regulatory Challenges: Navigated complex data protection laws, particularly in Europe, to build a transnational data platform compatible with AI analysis.
- Biobanking Initiatives: Engaged in the H3 Africa project, biobanking samples across Nigeria, Uganda, and South Africa, despite subsequent challenges in data and sample ownership.
- Formation of a Collaborative Network: Built a strong network of European and African researchers and institutions dedicated to advancing personalized medicine.

Professor Collen Masimirembwa highlighted the "Consortium for Genomics and Therapeutics in Africa" initiative as a platform for joint discussions and projects centered on Africa, underscoring the importance of informed consent and ethical governance within African research contexts.

Building on this collaborative foundation, the University of Zambia and GHPP CPA project partners in Zimbabwe and Germany have begun developing a Master's Program in Pharmacogenomics (MScPGx), set to launch in 2024. Additionally, the iPROTECTA initiative aims to implement pharmacogenomics testing across Africa, representing a direct outcome of efforts in CPA and CPA Plus to advance patient-specific care and treatment across the continent.

Lessons learnt

The UPGx Project established a solid foundation for pharmacogenetic research in Europe, identifying critical challenges and setting key methodologies in place. Among these challenges, the project encountered significant issues related to data protection and the complexities of national legislation, which underscored the difficulties of managing clinical data across borders. Stringent national data protection laws often exceeded European standards, creating obstacles in sharing and analyzing clinical data at the international level.

In Africa, there is a pressing need for expanded genetic sequencing efforts to discover new genetic variants, enhancing understanding of the continent's vast genetic diversity. This knowledge is vital for global pharmacogenetic advancements, as it allows researchers to investigate how specific genetic variations affect drug efficacy and side effects.

Understanding these links is essential for developing more effective, tailored treatments across diverse populations.

The project has also emphasized the importance of diversity in clinical trials. The EU-Africa PerMed project is actively working to make pharmacogenetic knowledge more accessible to the pharmaceutical industry, advocating for the inclusion of African populations in global clinical trials. Organizations like the Africa CDC, along with stakeholders such as the FDA, EMA, and WHO (resolution 75.8), are coordinating efforts to ensure clinical research worldwide becomes more inclusive of diverse population groups, accounting for genetic differences that impact both men and women.

Looking ahead, the project is poised to expand over the next three years, focusing on overcoming barriers to the application of personalized medicine in Africa. This expansion includes further research into population-specific factors affecting drug efficacy and safety and additional collaborations with European institutions and industry partners..

Expected Impact

Development of effective drugs and vaccines has to be built on research that integrates diverse ethnic populations and their genetic specificities. Including African genetic data in research is critical for creating treatments that are effective worldwide. The collaboration between Europe and Africa in pharmacogenetics brings enormous potential, as it combines European expertise with the opportunity to build local capacity in Africa. Addressing the specific challenges faced by African populations—such as regulatory barriers and genetic diversity—will be instrumental in advancing personalized medicine and improving health outcomes. Through close collaboration, shared learning, and adapting global guidelines to local contexts, both regions stand to gain significantly from this partnership.

Project leaders Profs Julia and Collen emphasize the importance of drawing from both African and European experiences in personalized medicine. While Africa's healthcare landscape presents unique challenges, such as resource limitations and regulatory complexities, the potential for impactful research is vast. With ongoing collaboration and support from international partners, Africa's participation and influence in global health research will continue to expand.

This partnership is a rich learning experience for both Europe and Africa, offering valuable insights and advancements for both sides.

Advancing the Field of Personalised Medicine

During discussions between Professors Julia Stingl and Collen Masimirembwa, the value of strong Africa-Europe collaboration in pharmacogenetics was underscored. They highlighted the potential for Africa to draw on European experiences to implement genotyping tests, which would significantly improve healthcare outcomes. Evidence from projects such as Europe's UPGx demonstrates that this model, when applied in Africa, could streamline the adoption of genotyping tests, saving both time and resources.

From an African Perspective:

This partnership has accelerated progress in personalized medicine by:

- Combining Expertise and Resources: The collaboration between European and African teams has driven exponential advancements, effectively shortening research timelines.
- Utilizing Africa's Genetic Diversity: With African populations offering roughly 200 times more genetic variability than European ones, this genetic richness enhances the depth and reliability of pharmacogenetic studies.
- Applying Proven European Models: Successful European projects, like UPGx, provided adaptable frameworks that could be implemented in Africa without delay, allowing for a smooth transfer of effective strategies.
- Shaping Global Guidelines: Insights gained from Africa's unique genetic data are increasingly informing global pharmacogenetic guidelines, making them more representative and comprehensive.
- Europe's experience in navigating complex healthcare systems and regulatory barriers has helped African partners build local capacity to manage these issues, which is essential for ensuring that pharmacogenetic research is implemented effectively.

This dynamic exchange of knowledge and methodologies has ignited innovative solutions to pharmacogenetic challenges, benefiting healthcare advancements on both continents.

From a European Perspective:

This project represents an innovative and impactful model of global research partnership, as it lies in its mutually beneficial collaboration, capacity-building efforts, focus on genetic diversity, and real-world impact on personalized medicine, all of which contribute to more effective healthcare outcomes in both African and European settings. We can identify the following key elements:

- ***Leveraging European Expertise and Models***

Europe has played a pivotal role in providing the foundational knowledge, methodologies, and models in pharmacogenetics and personalized medicine. These models adapted to the African context brought advanced technologies and methodologies to the African continent but also shortened updated research needs and gaps, allowing European teams to improve personalized medicine techniques more quickly.

- ***Strengthening Global Pharmacogenetic Research***

With genetic diversity far greater than that of European populations, African research can provide novel insights into how genetic variations influence drug responses, making personalized medicine more effective globally. This collaboration helped Europe benefit from a more comprehensive and diverse genetic database, enhancing the global understanding of pharmacogenomics.The findings and data from African populations have had a significant impact on global pharmacogenetic guidelines, making them more inclusive and reflective of global diversity, and, ensure that drug safety and efficacy are

better understood across diverse population groups, thus making these guidelines more robust and applicable globally.

- ***Improved Healthcare Outcomes in Africa, Benefiting Europe***

The collaboration is built on mutual goals of improving healthcare outcomes. For Europe, the ability to study and apply personalized medicine to African populations enriches the global pharmacogenetics field. This collaboration allows for the development of drugs and therapies that are safer and more effective for diverse populations. Europe gains valuable insights into the variability of drug responses in diverse populations. The collaboration not only benefits African nations by improving drug safety and efficacy but also benefits European researchers by expanding the scope of their research to include a broader, more diverse population base. This helps develop better global healthcare solutions.

Future steps and sustainability of the collaboration

Although this project has spanned eight years in different phases, expanding in scope and geography, this period is relatively brief in the context of research timelines. With the right collaborations, the scientists leading this initiative aim to bridge the gap between research findings and patient care more swiftly. Projects like UPGx, which progressed in Europe over a decade, helped overcome challenges in areas such as bedside genotyping and result interpretation. By applying these learnings in a structured manner and adapting them to the African context, the project hopes to accelerate the time it takes for research to benefit patients.

Acknowledgement

We would like to acknowledge all the teams involved in this collaboration, and especially Professor Collen Masimirembwa and Professor Julia Stingl, for their valuable support and contribution to preparing this success story.

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