PASTEUR NETWORK
2019-2020 KEY FIGURES

33 members in 25 countries on 5 continents

17
WHO Collaborating Centres

9
new collaborative projects

34
ACIP & PTR programs (12 ACIP and 22 PTR*)

33
projects coordinated with the COVID-19 Task Force*

110
people awarded an international scholarship*

18
International courses funded**

3
International research units formed*

5,377
scientific papers published every year on average by the members of the Pasteur Network, either independently or jointly with others. 2019: 5,054 — 2020: 5,700****

1,193
scientific papers submitted and available online through HAL-RIF, the Pasteur Network’s platform for submitting and consulting scientific publications free of charge

*Inter-Pasteurian Concerted Actions (ACIP) - Transversal Research Programs (PTR); Programs coordinated and/or funded by the Institut Pasteur.
**By the Pasteur Network association.
***Publications from the Scopus database, including 1,651 involving the Fiocruz and 1,218 involving the Institut Pasteur (Paris).
****Publications from the Scopus database, including 2,024 involving the Fiocruz and 1,260 involving the Institut Pasteur (Paris).
The Pasteur Network, formerly known as the Institut Pasteur International Network, has been working to improve public health for more than 130 years. Louis Pasteur was determined that his discoveries in vaccination and microbiology should be freely available to the international medical community. Today, the network he founded is present in 25 countries across five continents.

The Institut Pasteur was inaugurated on 14 November 1888, following an international appeal for funds, 17 months after its establishment by decree. One year later, the international renown of Louis Pasteur drew students from Europe and even further afield to enrol in the world’s first ever microbiology course.

The Institut Pasteur quickly fulfilled its ambition of taking its advances in science abroad. Albert Calmette went on to establish the Institut Pasteur de Lille in 1899. Its mission was to widely transmit (the Institut Pasteur de Tunis).

By the 1960s, the Pasteur Network already had around 20 members. By 1970, the network had 33 members, including one associate member, the Pasteur Institute (Paris) to share scientific knowledge and technological resources, giving priority to education.

In 2019, the network had 33 members, including one associate member, the Pasteur Institute (Paris) to share scientific knowledge and technological resources, giving priority to education.

The network is also about to inaugurate a new institute in Conakry, the Institut Pasteur de Guinée. Located next to Gamal Abdel Nasser University, the building will be home to three research units, an insectarium, a biobank, a diagnostics platform and several laboratories.

In June 2015, a tripartite agreement was signed between the University of São Paulo, the Fiocruz (Oswaldo Cruz Foundation) and the Institut Pasteur de Guinée. Located next to Gamal Abdel Nasser University, the building will be home to three research units, an insectarium, a biobank, a diagnostics platform and several laboratories. Construction started in August 2019 and the first team arrived in September 2020. The official opening will take place when public health conditions improve.

Timeline showing the accession of Pasteur Network members with their current names.

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Pasteur Network is a worldwide network of 33 members, united by Pasteurian missions and values, which contribute to the improvement of global health.
NATIONAL AND INTERNATIONAL TECHNICAL EXPERTISE

The Pasteur Network houses many of the top international, national and regional health laboratories.

National and regional reference laboratories are recognized by national health authorities for their expertise in the field of diagnostics. Moreover, national reference centers act as monitoring centers for transmissible diseases in their host countries.

In the WHO’s definition, “WHO collaborating centres” (WHOCC) are research institutes, university or academic departments designated by the Organization to carry out activities in support of national and international health programs.*

This table shows the laboratories provided by the members in the Pasteur Network database** and on the WHO website*, excluding COVID-19 data, available starting on page 19.

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**Pasteur Network – 2019-2020 Report**

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* https://www.who.int/about/collaboration/collaborating-centres
** August 2021.
*** www.pasteur.fr/fr/sante-publique/CNR/les-cnr
**** Regional Emerging and Dangerous Pathogens Laboratory Network (EDPLN).
***** ASEAN+3 Macroeconomic Research Office.

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PASTEUR NETWORK MEMBERS

<table>
<thead>
<tr>
<th>WHOCC</th>
<th>REGIONAL REFERENCE LABORATORIES</th>
<th>NATIONAL REFERENCE LABORATORIES</th>
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<tbody>
<tr>
<td>Oswaldo Cruz Foundation</td>
<td>Global health and South-South cooperation, public and environmental health, pharmacological policies, training of health technicians, histopathology, boosting the capacity of human milk banks</td>
<td>Cutaneous leishmaniasis, schistosomiasis, malaria, dengue, Chagas disease, filariasis, viral hepatitis, hantavirus, rickettsia, AIDS, anthrax, histoplasmosis, BK virus, Mycobacterium tuberculosis, Graft-versus-host disease, primary immunodeficiency diseases, HIV, syphilis, and allergic diseases</td>
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<tr>
<td>Institut Pasteur (Paris)</td>
<td>Human African trypanosomiasis biobank, enteroviruses and viral vectors, bacterial meningitis, malaria, food origin, botulism, salmonella, plague</td>
<td>Amaranth bacteria and botulism, whooping cough and other bordetella infections, corynebacteria of the alveolus complex, Escherichia coli, Shigella, Salmonella, viral hemorrhagic fever, hantavirus, leptospirosis, diarrhea, mesothelioma and ankylosing spondylitis, Meningococci and Neisseria meningitidis, influenza, plague and other yersiniosis, rabies, vibrios and cholera, respiratory viruses (including influenza)***</td>
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<tr>
<td>Institut Pasteur d’Algerie</td>
<td>Tegumentary leishmaniasis, schistosomiasis, malaria, dengue, Chagas disease, filariasis, viral hepatitis, hantavirus, rickettsia, AIDS, anthrax, histopathological diagnosis of infectious diseases, bacterial enteric infections, yellow fever, influenza, legionnaire, hydrocephalus, leprosy, systemic mycoses, plague,</td>
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<td>Institut Pasteur in Iran</td>
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<td>Institut Pasteur in Mba Trang</td>
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<td>Institut Pasteur de Nouvelle-Caledonie</td>
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<td>Institut Pasteur in Saint-Petersburg</td>
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<td>Institut Pasteur de Tunis</td>
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<td>Institut Pasteur du Maroc</td>
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<tr>
<td>National Institute of Hygiene and Epidemiology (Vietnam)</td>
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<td>HIKU-Pasteur Research Pole</td>
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<td>Sciensano (Belgium)</td>
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</table>

* | WHO Collaborating Centre for Poliomyelitis, Measles, and Rubella |
** | Member of WHO Emerging and Dangerous Pathogens Laboratory Network (EDPLN)**** |
*** | Treponematoses, HIV |
**** | Treponematoses, HIV |

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Influenza (National Influenza Center – NIC), Arbovirus laboratory, Respiratory virus laboratory, Entersirus laboratory.
The Pasteur Network is present in 25 countries across every continent. Working in numerous areas of endemic disease, the network has clearly shown that it has a key role to play in supporting local populations through the One Health approach. In addition to the independent public or private organizations that make up the network, this unique cooperative model draws on a wider scientific community, fully committed to pulling together to address local and international health priorities, following a solidarity spirit.

With a prominent presence in areas of endemic or epidemic disease, the Pasteur Network is active in the struggle against infectious agents. Drawing on its expertise, the network is seeking to improve human health through its four core missions:

• biomedical research;
• public health;
• training;
• innovation and technology transfer.

These activities are based on local capacity building, respecting human rights and the environment. They are conducted with the will to promote cooperation with the wider scientific community, all fully committed to pulling together to address local and international health priorities, following a solidarity spirit.

The members of the Pasteur Network have adopted the One Health approach. In this way, they promote a global view of health challenges, taking account not only of human and animal health, but also of the ecosystems in which diseases occur. The Pasteur Network’s diversity is a major asset for conducting programs using this approach.

The 33 members are united by more than their missions; they share the Pasteur values set out in the Pasteur Values Charter signed by all network members.

These values include humanism, universality, rigour and dedication, freedom of initiative, knowledge transfer and free access to information.

Lastly, scientific solidarity, meeting national and international needs, contributing to education and engagement with global public health issues are the pillars of the network’s work, illustrated by its response to the COVID-19 pandemic.

For more information: Pasteur-network.org

The priorities in the 2019-2023 strategic plan include building a more structured framework for the Pasteur Network (formerly the Institut Pasteur International Network), encouraging greater participation and improving efficiency.

The Pasteur Network has played a major role in the response to the COVID-19 crisis, setting up international programs and sharing human and material scientific resources. I would like to take this opportunity to praise the collegial spirit of the members of the Pasteur Network, who joined forces quickly and effectively to combat a virus that led to global upheaval on a scale that had not been seen since the Spanish Flu in 1918.

The Institut Pasteur lent its support to many projects in cooperation with the other members of the Pasteur Network (see pages 24-25 for more details) – thanks in large part to the generosity of the public. However, when the first cluster of cases was reported in January 2020, SARS-CoV-2 also reminded us of the importance of the Pasteurian values of humanism and dedication.

Being Pasteurian means holding firm to the network’s convictions, based on reason and fact, and leading by example. As lessons are learnt from the pandemic, network members are firm in their determination to address the health challenges of the future.

Stewart Cole, President of the Institut Pasteur
President of the Pasteur Network Foundation

The commitment of the Pasteur Network’s 33 members to their Pasteurian values is stronger than ever.

Pierre-Marie Girard, Vice-President, Department of International Affairs of the Institut Pasteur
A SHARED SCIENTIFIC STRATEGY SETS THE PRIORITIES FOR THE COORDINATED ACTION OF THE PASTEUR NETWORK

The Pasteur Network Scientific Steering Committee (formerly COS-RIIP) was established in August 2019. Meeting for the first time in February 2020, the committee reiterated the four strategic priorities identified in 2017 for the network, to create a bold scientific strategy for a prominent global health player.

The role of the Scientific Steering Committee is to define scientific strategy for the Pasteur Network. It has 10 members, 8 of whom are appointed from the network’s research community and 2 from the international scientific community. It examines opportunities for partnerships between the members, decides which actions take priority and recommends how to implement them.

Meeting for the first time on 17 and 18 February 2020, the committee singled out education and training in the life sciences as a top priority for the network with the introduction of the “Pasteur International Courses” label (see page 45). It also confirmed the four strategic pillars of the network’s scientific strategy formulated in 2017:

1. Explore the principal endemic or emergent zoonoses based on a One Health approach, drawing on its global footprint which gives it exceptional access to extensive diversity.

2. Study vector-borne infectious disease focusing on the biology of vector insects and pathogen-vector interactions, concentrating especially on innovative vector control strategies.

3. Explore the risk of infection in the first years of life, particularly in marginalized and migrant populations, for whom childhood, adolescence and maternity are periods of high risk for development pathologies and infectious agents.

4. Study the impact of ageing and longevity on health in the context of the epidemiological transition underway in most countries. The study of chronic diseases such as metabolic syndromes, cancer and neurodegenerative conditions is part of this priority.

As research institutes as well as healthcare facilities, the network’s members provide a wide range of services for populations. No fewer than 15 network members have opened their doors to vaccinate people as either a preventive measure or after exposure (to rabies, for example) as well as carrying out awareness and prevention campaigns.

Diagnostic tests for infectious diseases, which also contribute to the surveillance of these diseases (see pages 6 and 7 on reference laboratories for more information), medical biology analyses and microbiological analyses of water and foodstuffs are also part of the activities carried out within the network to ensure the improvement of human health, alongside research activities.

In addition, the laboratories and their sampling centers see patients every day. Many are open 24/7 for urgent sample analysis and speedy delivery of test results to patients. This service contributes substantially to the improvement of patient care and to the public health mission of the Pasteur Network.

For example, 26,000 patients a year come to the Institut Pasteur du Cambodge for post-exposure anti-rabies vaccination after being bitten by an animal suspected of having rabies. This is the only therapy available to avert fatalities from rabies. This institute opened a third vaccination center in Kampong Cham in 2019, further strengthening its efforts against rabies. The “IPC” vaccination protocol (devised by the institute) is the first post-exposure rabies vaccination schedule administered over a short period (one week). It is currently recommended by the WHO.

THE INSTITUT PASTEUR INTERNATIONAL NETWORK BECOMES THE PASTEUR NETWORK

A new system of governance has been established for the former "Institut Pasteur International Network" and its 33 members, legally represented by an association since 2011, and chaired by the Institut Pasteur’s President, Stewart Cole.

Ten years on, the network is adopting a more participatory, balanced governance and a more structured business model. The Articles of Association of the association representing the Pasteur Network have been amended. A Sheltered Foundation has also been established, based at the Institut Pasteur, to serve as a financial body for the network. The organizational structure and new identity of the Pasteur Network reflect a continued commitment to tackling diseases, especially infectious and emerging diseases, through a One Health approach based on international solidarity and the development of a single voice.

Pasteur Network: a global scientific community with shared values and a future-oriented approach

The Pasteur Network is now looking forward with a strategy of consolidation aimed at optimizing the network’s impact on global health. On Tuesday 8 June 2021, the new organizational structure, which was previously presented and approved on 4 June at the meeting of the Institut Pasteur Board of Governors was adopted. It is designed to represent all the Pasteur Network members more fairly and to facilitate a concerted approach to the major challenges of the 21st century such as the response to the COVID-19 pandemic.

Pasteur Network: shared governance and a stronger business model

To this end, a Sheltered Foundation has been established at the Institut Pasteur in order to develop a more efficient, structured business model. The foundation will contribute to the development of the Pasteur Network through capacity-building and infrastructure-strengthening measures.

As well as working to consolidate and increase funding for the Pasteur Network, which has a seed fund, the foundation will now take the lead in the major international programs it supports, which are intended to strengthen the capacities and infrastructure of its founders and partners. It also manages funds that encourage mobility (the Calmette & Yersin program and 4-Year Research Groups - 4YRG) and cooperation within the Pasteur Network (Pasteur International joint Research Unit – PJU).

For more information: pasteur-network.org

The Pasteur International Network association is changing and will now be known as the Pasteur Network association, after the network that it represents legally. Its Articles of Association will also be amended in order to develop a more balanced, participatory system of governance. The association is the representative body for the Pasteur Network; it is responsible for setting up and coordinating research projects involving several members, and for leading the network at regional and interregional level. To give the regions a greater voice, two representatives are now elected for each region, increasing the number of representatives to 8 (including the President), compared with 5 previously (see graph on opposite page).

These changes will enable the association to act in cooperation and in perfect synergy with the foundation set up to serve the Pasteur Network members. All these changes are reflected in the network’s new visual identity and its new name. Network members, association and foundation will now use the same brand, “Pasteur Network”.

PASTEUR NETWORK KEY DATES

1888
First Inauguration of the Institut Pasteur

1927
Network Directors’ Meeting increased by France in Senegal

1990
The network becomes the Institut Pasteur International Network and Associated Institutes

1993
Signature of the General Scientific Cooperation Declaration

2006
Signature of the Declaration of common Pasteurian values and the Pasteurian values charter

2011
Creation of the Pasteur International Network association to represent the network

2021
Establishment of the Pasteur Network Foundation and amendment of the Articles of Association to reflect the name change: Pasteur Network

GOVERNANCE

ASSOCIATION

Executive Director
Nominated by the President and Vice-President

President
Elected from the eight regional representatives on the Board

Vice-President
President of the Institut Pasteur (Paris)

8 regional representatives, incl. the President
- 2 Americas
- 2 Africa
- 2 Asia-Pacific
- 2 Euro-Mediterranean

Vice-President
2/3 co-opted external association members

SHELTERED FOUNDATION UNDER THE AEGIS OF THE INSTITUT PASTEUR

Executive Director
Nominated by the President after consulting with the Executive Committee

President
President of the Pasteur Network association, from a region

Vice-President
President of the Pasteur Network association, from a region

Regional representatives, incl. the Vice-President
- 2 Americas
- 2 Africa
- 2 Asia-Pacific
- 2 Euro-Mediterranean

President
1 representative of the Institut Pasteur (Paris)

Directors or representatives of the founders: Pasteur Network members

Management Committee
Directors or representatives of the founders: Pasteur Network members

Strategy Committee
Main patrons and contributors
HIGHLIGHTS OF 2019

Here is a selection of highlights based on reports from network members. This is not an exhaustive list, but you will find more information on members’ websites and in their annual reports.

APRIL 2019

Ivory Coast

REGIONAL BIOBANK INAUGURATED IN IVORY COAST

The Ambassador of France to Ivory Coast, Minister for Higher Education and Scientific Research and the ECWAS representative.

The Regional Biobank of countries belonging to the Economic Community of West African States (ECOWAS) was inaugurated on 25 April 2019. Located at the Institut Pasteur de Côte d’Ivoire at the Adiopodoumé (Abidjan-Dabou) site, the biobank is housed in the Institut’s Biological Resources Center. It keeps high-risk microorganisms used for research in a safe and secure location.

For more information: (in French): http://pasteur.ci/index.php/homepage/actualitees/item/494-ceremonie-dinogura-

MAY 2019

Madagascar

CHARACTERIZING THE PLAGUE EPIDEMIC IN MADAGASCAR

Researchers from the Institut Pasteur de Madagascar and the Institut Pasteur (Paris), in collaboration with the Malagasy Ministry of Public Health, the WHO and international experts, described the extent of the 2017 epidemic of pneumonic plague in Madagascar and the dynamics of transmission. The work showed that the pulmonary form was dominant and accounted for 78% of the 2,414 notified suspected clinical cases.

DOI:10.1016/j.chom.2019.04.013

Cell Host & Microbe, June 2019,

The effectiveness of seasonal H3N2 influenza vaccines can be compromised when antigenic changes arise. Researchers at the HKU-Pasteur Research Pole discovered that a specific mutation in the seasonal flu vaccine could prevent the emergence of an antigenic mutation. This research is important for the development of future vaccines.

DOI:10.1371/journal.pntd.0007270

Plos Neglected Tropical diseases,

JUNE 2019

China

PREVENTING DISRUPTIVE MUTATIONS IN THE FLU VACCINE

JULY 2019

France (New Caledonia)

LAUNCH OF WORLD MOSQUITO PROGRAM

First mosquito released in Nouméa (New Caledonia).

A paper published by the Friedrich-Loeffler-Institut, jointly with the Institut Pasteur de Guinée, shows that pigs can be hosts for Ebola virus. Antibodies found in their blood suggest that they could play a role in transmitting the virus. The study provides important insights into the Ebola virus cycle.

DOI: 10.1016/S1473-3099(19)30311-1

The Lancet Infectious Diseases, September 2019,

The Lancet Infectious Diseases, May 2019, DOI: 10.1111/liv.13687

For more information: https://www.pasteur.fr/en/home/brigade-biobanque-regionale-des-pays-de-la-cedeao

VACCINE

STUDY OF ANTIMICROBIAL RESISTANCE BY NGS

In the seasonal flu vaccine could prevent the emergence of an antigenic mutation. This research is important for the development of future vaccines.

DOI: 10.1016/j.chom.2019.04.013

Cell Host & Microbe,

MAY 2019

Canada

NEW SPECIES OF LEPTOSPIRA

A team of researchers at the Armand-Frappier Sante Biotechnologies Research Centre team and their collaborators published a paper on the discovery of 30 species of Leptospira. The infectious strains of this bacterium are responsible for leptospirosis.

An analysis of these environmental strains led to a more detailed classification and helped identify the specific genomic features of the infectious strains.

The Lancet Infectious Diseases, May 2019, DOI: 10.1016/S1473-3099(19)30311-1

For more information: https://www.thelancet.com/pastepasteur/article/PIIS1473-3099(18)30730-8/

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Lancet Infectious Diseases, May 2019, DOI: 10.1111/liv.13687

MAY 2019

Guinea

THE PLAGUE EPIDEMIC IN MADAGASCAR

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DOI:10.1016/S1473-3099(18)30730-8/

Plos Neglected Tropical diseases,

JUNE 2019

Belgium

STUDY OF ANTIMICROBIAL RESISTANCE BY NGS

The Scienzo National Reference Centers for human clinical microbiology received BELAC (the Belgian accreditation body) accreditation in July 2019. It enables them to conduct routine sequencing of bacterial isolates using high-throughput next-generation sequencing (NGS) to detect clusters of antimicrobial resistance in clinical isolates.

DOI:10.1016/j.chom.2019.04.013

Cell Host & Microbe, June 2019,

The Lancet Infectious Diseases, May 2019, DOI: 10.1016/S1473-3099(18)30730-8/

Lancet Infectious Diseases, May 2019, DOI: 10.1111/liv.13687

For more information: https://www.thelancet.com/pastepasteur/article/PIIS1473-3099(18)30730-8/

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Influenza (flu)

Flu virus (influenza)

A/TeXAS/1/77 (H3N2). Leptospira bacteria.

MAY 2019

Cambodia

RESIST-2, A NEW ANTI-RABIES PROTOCOL

An observational cohort study by the Institut Pasteur du Cambodge and the Institut Pasteur (Paris) confirmed the efficacy of the new post-exposure vaccine protocol for rabies developed in the Pasteur Network. Post-exposure vaccination will now be administered over one week instead of four.

This improved protocol has already been adopted by the WHO.

DOI: 10.1371/journal.pntd.0007270

Plos Neglected Tropical diseases,

OCTOBER 2019

Guinea

FOR MORE INFORMATION: https://www.pasteur.fr/en/home/brigade-biobanque-regionale-des-pays-de-la-cedeao

Traces of Ebola virus in pigs

First mosquito released in Nouméa (New Caledonia).

A paper published by the Friedrich-Loeffler-Institut, jointly with the Institut Pasteur de Guinée, shows that pigs can be hosts for Ebola virus. Antibodies found in their blood suggest that they could play a role in transmitting the virus. The study provides important insights into the Ebola virus cycle.

DOI: 10.1111/liv.13687

The Lancet Infectious Diseases, September 2019,
Pasteur Network – 2019-2020 Report

HIGHLIGHTS

OF 2019-2020

NOVEMBER 2019

Cameroon

51ST DIRECTORS’ MEETING IN YAOUNDÉ

The International network’s Directors’ Meeting held its 51st meeting from 12 to 15 November 2019. The Pasteur Center in Cameroon hosted the meeting for the first time.

On 12 November, the country’s Minister for Health, Doctor Malachie Mana Ndou, officially opened a new building at the Pasteur Center in Cameroon, funded by the Cameroon government. The Minister was the guest of honor. The network’s Directors were also able to visit a symposium held at the Pasteur Center in Cameroon.

DECEMBER 2019

Canada

MIMOTOPES TO STUDY IG M REACTIVITY

Researchers from the Department of Microbiology at the St Jude Children’s Research Hospital have described a quasi-complete library of IgM mimotopes. The library can be used to analyze the dynamics and reactivity of the public human immunoglobulin M (IgM) repertoire by structurally studying the interactions.

Published in Immunology Reports, September 2019.
DOI: 10.31006/imm.2019.0739

JUNE 2020

France (Guiana)

ANTI-MALARIAL RESISTANCE IN AMAZONIA

Following the appearance in Asia of a mutation of the parasite responsible for malaria making it resistant to the anti-malarial drug, artemisinin, researchers at the Institut Pasteur de la Guayane looked into anti-malarial resistance in Amazonia. They found the same mutation, but of independent origin. The mutation also slowed the parasite’s growth rate indicating that it may be resistant to other anti-malarial in the future.

Published in Malaria Journal, May 2020.
DOI: 10.7965/jb.m.5.0115

JUNE 2020

Central African Republic

ANOTHER COUNTRY “FREE OF WILD POLIO VIRUS”

Announced on 17 June 2020 by the WHO country bureau, the Central African Republic was declared “free of wild polio virus” by the Regional Certification Commission for the African Region. The poliomyelitis data provided by the WHO regional reference laboratory based at the Institut Pasteur de Bangui confirmed the absence of cases of wild polio virus have been detected since 1 December 2011.

Published in Scientific Reports, October 2020.
DOI: 10.15256/sr.2020.603-5604

JULY 2020

Cameroon

NEW MOLECULES TO TREAT MALARIA

The malaria research laboratory at the Pasteur Center in Cameroon, in collaboration with the University of Buea, discovered a new class of anti-malarial agents with multiple modes of action using molecular hybridization techniques. This discovery is particularly important given that the compound is effective on multi-resistant strains and on all asexual stages of the parasite.

Published in Scientific Reports, October 2020.
DOI: 10.15256/jb.m.5.0115

NOVEMBER 2020

France

MOLECULAR DISCOVERY IN ALZHEIMER’S DISEASE

Researchers at the Institut Pasteur de Lille have discovered altered gene expression in some regions of the brain, such as the hippocampus, in the early stages of Alzheimer’s disease (the main cause of dementia in the elderly). The findings shed more light on the molecular process of the early stages of the disease and could lead to identifying therapeutic targets.

Published in Aging and Mechanisms of Disease, November 2020.
DOI: 10.15256/jb.m.5.0115

NOVEMBER 2020

Cambodia – France – Senegal

Aedes aegypti MORE SUSCEPTIBLE TO ZIKA VIRUS

A collaborative research program between a number of different laboratories including five run by members of the Pasteur Network, including the Institut Pasteur (Paris), the Institut Pasteur de la Guadeloupe, the Institut Pasteur de la Guyane, the Institut Pasteur du Cambodge and the Institut Pasteur de Dakar, has shown enhanced susceptibility of the Aedes aegypti mosquito to Zika virus, which explains its capacity to pick up and transmit the virus after a “domestic” form evolved. This discovery, together with the global expansion of Aedes aegypti explains the emergence of the arbovirus.

Published in Nature Communications, November 2020.
DOI: 10.1038/s41467-020-19826-2

NOVEMBER 2020

Greece – France

NEW MODEL OF BRAIN INFECTION

The Institut Pasteur and the Hellenic Pasteur Institute are the authors of a paper highlighting the role of lipoproteins in the ability of Group B streptococci, the bacteria that cause meningitis, to cross the blood-brain barrier. Their work on drosophila and murine models has identified new mechanisms used by the pathogens to infect the brain.

Published in Scientific Reports, October 2020.
DOI: 10.15256/jb.m.5.0115

DECEMBER 2020

Bulgaria

ELUCIDATION OF THE MECHANISM OF ACTION OF L DONOVANI

The NHR Armand-Frappier Santé Biotechnologie Research Centre has shown that the Leishmania donovani parasite behind visceral leishmaniasis triggers a vast, but selective, reprogramming of the host cell translational activity early during infection. Some of these changes may be implicated in host defence mechanisms and others are part of parasite-driven survival strategies.

Published in The EMBO Journal, June 2020.
DOI: 10.15256/euroscience.603-5604

JUNE 2020

France (Guiana)

MAYARO VIRUS IN GUIANA

The Institut Pasteur de la Guayane, working with the Laboratory for Urgent Response to Biological Threats (CIFR) at the Institut Pasteur (Paris), characterized the circulation of Mayaro virus, an emerging arbovirus. The teams assessed the risk of transmission to humans — a challenging task given its cross-reactivity with chikungunya virus. The researchers found solid evidence of an important sylvatic cycle for MAVW with higher seroprevalence in forests.

Published in Malaria Journal, June 2020.
DOI: 10.7965/jb.m.5.0115

NOVEMBER 2020

France (Guiana)

MAYARO VIRUS IN GUIANA

Aedes aegypti female raised at the vector research center of the Institut Pasteur de la Guayane.

A collaborative research program between a number of different laboratories including five run by members of the Pasteur Network, including the Institut Pasteur (Paris), the Institut Pasteur de la Guadeloupe, the Institut Pasteur de la Guyane, the Institut Pasteur du Cambodge and the Institut Pasteur de Dakar, has shown enhanced susceptibility of the Aedes aegypti mosquito to Zika virus, which explains its capacity to pick up and transmit the virus after a “domestic” form evolved. This discovery, together with the global expansion of Aedes aegypti explains the emergence of the arbovirus.

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Molecular Discovery in Alzheimer’s Disease

Researchers at the Institut Pasteur de Lille have discovered altered gene expression in some regions of the brain, such as the hippocampus, in the early stages of Alzheimer’s disease (the main cause of dementia in the elderly). The findings shed more light on the molecular process of the early stages of the disease and could lead to identifying therapeutic targets.

Published in Aging and Mechanisms of Disease, November 2020.
DOI: 10.15256/jb.m.5.0115
SEPTEMBER 2019
Korea
SYMPOSIUM ON PREPARING FOR EMERGING THREATS
The Institut Pasteur Korea organized a symposium entitled “Pasteur Network Fighting Emerging Threats” on 25 September 2019, attended by network members in the Asia-Pacific region and from the Institut Pasteur (Paris). The symposium focused on vector-borne flaviviruses that cause diseases like dengue and discussed ways to counter emerging threats.

Mobilize
Pasteur Network members have demonstrated unprecedented mobilization in response to the COVID-19 pandemic. Joining forces with the national authorities in their home countries, they played a key role on the frontline in diagnostics and surveillance. The network pooled its knowledge and research findings.
When the COVID-19 pandemic hit in 2020, national health authorities had to quickly put in place a massive and rapid response encompassing surveillance, research and protection of populations. Most members of the Pasteur Network became key players in diagnostics and surveillance, supporting their own national governments in their COVID-19 strategies.

Faithful to its Pasteurian values and its missions of general interest, the Pasteur Network members have naturally mobilized with their respective national authorities to fight the COVID-19 pandemic. Mutualization was the cornerstone of their strategy as they shared their expertise, their research. They also pooled equipment orders to protect people health.

ESTABLISHING AND PROVIDING ACCESS TO DIAGNOSIS

When faced with previously unknown viruses, it is crucial to know the viral sequences to be able to develop diagnostic tests. As early as 17 January 2020, the HKU-Pasteur Research Pole developed the first primers to detect SARS-COV-2, one of the first laboratories to succeed in doing so. With the Berliner Charité, it was the first laboratories to succeed in doing so. With the Berliner Charité, it was the first laboratories to succeed in identifying the virus. The Institut Pasteur de Dakar volunteered to help other institutes in Africa with sequencing. The same happened in Asia, where the HKU-Pasteur Research Pole played a key role with network members in Africa, Europe, South-East Asia and beyond, paving the way for rapid diagnosis.

TRAINING IN DIAGNOSTICS FOR VIRUS SURVEILLANCE

The CIBU at the Institut Pasteur (Paris) also organized trainings in diagnostics and quality control for laboratories in 23 countries that asked for assistance in validating their initial diagnostics to confirm the first positive cases (see page 28). At the same time, the Institut Pasteur de Dakar (which was designated the Global Reference Laboratory for SARS-COV-2 by the WHO) (see page 23), not only analyzed all diagnostic tests in Senegal, but also trained representatives of laboratories in 15 African countries. Laboratories were ready to identify the first positive cases before the outbreak in their countries. As a result, when the time came, their national health authorities were able to rely on them to effectively monitor virus circulation.

SUPPORT FOR THE ACTIVITY AND MISSIONS OF REFERENCE LABORATORIES, COORDINATED BY THE INSTITUT PASTEUR (PARIS)

Designated as reference laboratories by their national health authorities, most of the network’s members were propelled to the heart of the fight against COVID-19. The granting of this mandate has unfortunately not always been accompanied by a sufficient operating budget to enable them to accomplish this mission.

At the same time, the medical analysis laboratories, vaccination centers and other service activities of the institutes have been significantly slowed down due to a lack of sufficient staff or user attendance. Thus, the sustainability of these institutions, despite being major public health actors in their countries, is considerably weakened.

Amadou Alpha Sall, President of the Pasteur Network, General Administrator of the Institut Pasteur de Dakar

A COLLECTIVE RESPONSE ON A SCALE NEVER SEEN BEFORE

“All the members of the Pasteur Network have played a frontline role in their home countries. Faced with a completely new situation, they had to learn on the run as they fought the spreading pandemic. The network quickly set up a number of actions in the 33 structures around the globe. The diversity of the members and the different political, health and environmental ecosystems in which they operate proved to be a clear advantage for the Pasteur Network. More united than ever, the members showed exemplary community spirit in working together. For example, the Institut Pasteur de Dakar volunteered to help other institutes in Africa with sequencing. The same happened in Asia, where the HKU-Pasteur Research Pole played a key role with an immediate proposal to share primers to help with diagnostics. The Institut Pasteur acted as a catalyst, setting up a large-scale logistics platform to get equipment to where it was needed. The story of these scientific advances is one of cooperative endeavor. Members stepped up their efforts and mobilized resources as never before, a clear sign of the trend towards stronger synergies between members. The change in governance not only reflects the shared Pasteurian values, but is also a measure of the dedication of the entire network to working together as part of an international human community.”

When the COVID-19 pandemic hit, national health authorities were able to rely on them to effectively monitor virus circulation.

* The Institut Pasteur (Paris), the Institut Pasteur de Dakar, the Institut Pasteur du Cambodge, the Pasteur.

** The Pasteur Network Paris, the Pasteur Network Dakar, the Pasteur Network.
A MOBILIZATION RECOGNIZED BY THE WHO

The Institut Pasteur de Dakar, the Fiocruz (Oswaldo Cruz Foundation) Respiratory Viruses and Measles Laboratory, the Institut Pasteur (Paris) and the Institut Pasteur du Cambodge were designated members of the WHO Global Reference Laboratory Network for COVID-19.

This move accelerated work on SARS-CoV-2 across the Pasteur Network’s four regions. The WHO reference laboratories strengthen the diagnostic capacity of the structures on the ground in the WHO regions. They also perform confirmatory testing of unexpected results on samples sent by regional laboratories and monitor which variants are circulating.

Watch the video: The Institut Pasteur de Dakar, reference laboratory at the heart of the COVID-19 response in Senegal

https://www.youtube.com/watch?v=6UQwDqg_xq4&list=PLkkV17fytFlPQT76TorT47rtNTh9GQI_Y&index=19

Thanks to the financial support of the Agence française de Développement (AFD) and the European Commission (DG-DEVCO), historical funders of the Institut Pasteur (Paris), an exceptional budget has made it possible to provide emergency support to some of the institutes in the network via various initiatives set up alongside existing projects such as ECOMORE II and MediLabSecure.

Coordinated by the Institut Pasteur’s Department of International Affairs, the initiatives aimed to ensure the continuity of the activities of the reference laboratories by:

- supplying reagents and consumables in sufficient quantities to test the local population, but also laboratory equipment and personal protective equipment for the staff that comply with safety standards;
- strengthening the human resources of front-line laboratories;
- promoting the training of laboratory staff and the transfer of skills (External Quality Assessment, sequencing and more);
- helping to set up and develop laboratory diagnostics in many countries, particularly:
  - in Sub-Saharan Africa (Guinea, Madagascar, Niger, Central African Republic and Senegal) through the “Support to several Pasteur Institutes in Sub-Saharan Africa” project;
  - in South-East Asia, through the ECOMORE II program (Cambodia, Laos PDR, Myanmar, Philippines and Vietnam);
  - as well as in many countries belonging to the MediLabSecure 2 network and beyond, through the Centers of Excellence Initiative (Albania, Algeria, Bosnia, Burkina Faso, Cameroon, Egypt, Guinea, Jordan, Kosovo, Lebanon, Libya, Macedonia, Morocco, Mauritania, Montenegro, Niger, Palestine, Central African Republic, Democratic Republic of the Congo, Rwanda, Serbia, Tunisia and Turkey).

A MOBILIZATION RECOGNIZED BY THE WHO

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Given the urgency of this unprecedented health situation, a response was swiftly organized by the Pasteur Network, in collaboration with the Institut Pasteur (Paris). The latter created a Coronavirus “Task Force” to respond as effectively as possible to the spread of the virus. The Institut Pasteur (Paris) issued a call for projects through the task force and no fewer than 33 network projects were selected and funded.

Projects submitted for the call for projects came from every network region and targeted a range of subjects from the knowledge of the virus to clinical studies and development of tests and diagnostic tools. Here is the list of the 33 projects selected:

<table>
<thead>
<tr>
<th>Project</th>
<th>Pasteur Network member(s) involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccination approach – Propylaxis and vaccine candidates</td>
<td>Stephan Angelidou, Institute of Microbiology</td>
</tr>
<tr>
<td>Biology of SARS-CoV-2 - Knowledge of the virus and its pathogenesis</td>
<td>Institut Pasteur du Laos, National Institute of Health and Epidemiology, Institut Pasteur de Dakar, Chine, Shanghai – Chinese Academy of Sciences</td>
</tr>
<tr>
<td>Tracking the origin and transmission of SARS-CoV-2 in Lao PDR and Vietnam</td>
<td>Institut Pasteur (Paris), Institut Pasteur du Laos</td>
</tr>
<tr>
<td>Characterisation of variable systemic and mucosal immunity during SARS-CoV-2 infection and recovery</td>
<td>Institut Pasteur (Paris), HKU Pasteur Research Centre</td>
</tr>
<tr>
<td>Evaluation of anti-SARS-CoV-2 antibody effector functions in a Cambodian patient cohort</td>
<td>Institut Pasteur du Cambodge, Institut Pasteur (Paris)</td>
</tr>
<tr>
<td>Investigation of SARS-CoV-2 mechanism of pathogenicity using organoids produced from human-induced pluripotent stem cells (hiPSC)</td>
<td>Institut Pasteur (Paris), Institut Pasteur du Cambodge</td>
</tr>
<tr>
<td>Study of the innate immunity and adaptive response in early stages of COVID-19 infection protecting African children against severe clinical manifestations: investigation in Madagascar and in Central African Republic</td>
<td>Institut Pasteur de Madagascar, Institut Pasteur du Bénin</td>
</tr>
<tr>
<td>Arthropods and SARS-CoV-2 transmission and dissemination</td>
<td>Institut Pasteur du Dakar, Institut Pasteur (Paris), Institut Pasteur du Maroc</td>
</tr>
<tr>
<td>Peptide Immunophenotyping of the B and T cell immune responses of COVID-19 patients against SARS-CoV-2 structural proteins</td>
<td>Institut Pasteur de Madagascar, Institut Pasteur du Dakar</td>
</tr>
<tr>
<td>Development of tests and diagnostic tools</td>
<td>Institut Pasteur du Cambodge, Institut Pasteur (Paris), Institut Pasteur du Maroc, Scientific Platform Pasteur-ISP</td>
</tr>
<tr>
<td>Development of SARS-CoV-2 low-cost diagnostic platform based on reverse-transcription loop-mediated isothermal amplification (RT-LAMP): A solution for a rapid response of high laboratory diagnostic demand in virus outbreaks in the Pasteur Network</td>
<td>Institut Pasteur du Cambodge, Institut Pasteur (Paris), Institut Pasteur du Maroc, Scientific Platform Pasteur-ISP</td>
</tr>
</tbody>
</table>

Researchers at the Institut Pasteur examined the attack strategy of the virus under a scanning electron microscope. This image shows a sample of cultured bronchial cells coated in blue-green. SARS-CoV-2 is shown in orange. Photo published in September 2020.

2524
FOCUS ON HOW SARS-COV-2 AFFECTS THE CENTRAL NERVOUS SYSTEM

Although the effect of human coronaviruses on the brain has been suspected since 1967, it was brought into sharp relief by the COVID-19 pandemic. Researchers at the INRS - Armand-Frappier Santé Biotechnologie Research Centre in Canada and the Fiocruz in Brazil have joined forces with other Brazilian institutes to study the damaging effects of SARS-COV-2 on the central nervous system.

In 2016, British and Quebecois teams, including Professor Talbot’s team at the INRS - Armand-Frappier Santé Biotechnologie Research Centre, demonstrated a link between a human coronavirous strain and a case of encephalitis. Their study, published in the New England Journal of Medicine®, focused on an 11-year old child who died from inflammation of the brain (encephalitis). Pierre Talbot has a long history of research into coronaviruses. He was the first to show that these viruses can invade the central nervous system (the brain and spinal cord).

Research on this virus family accelerated with the outbreak of the COVID-19 pandemic. The Armand-Frappier Santé Biotechnologie Research Centre published an article on the neuroinvasive capacities of coronaviruses – and specifically of SARS-CoV-2 – in its “Neuroviral Investigators” network as early as January 2020. This ability to invade the central nervous system may be responsible for the loss of smell experienced by many patients. Nevertheless, the study underlines that this specific effect may be due to the close proximity of the olfactory neurons to the sensitive neurons of the nasal cavity, the mucous membranes targeted by coronaviruses. However, the risk of invasion of the rest of the brain is low, even in immuno-depressed patients, who are more susceptible to developing encephalitis with severe consequences.

In September, another study was published on this topic with the Fiocruz Center for Health Technology Development (CDTS/ Fiocruz), the Institute of Virology of the Federal University of Rio de Janeiro (UFRJ). It showed that, in young children, SARS-CoV-2 weakens the blood-brain barrier that protects the brain from a range of pathogens, allowing viruses to penetrate the brain and cause lesions.**

Therapeutic pathways are already being studied, as described in the findings recently published by the INRS in the Journal of Virology.***

The virulence of the COVID-19 virus or its capacity to multiply can be modulated by cleavage of its Spike protein and Type 1 Interferon, which is a primary controller of infection of the nervous system, pointing to potential future therapeutic options.

INTERVIEW

Gonzalo Moratorio, Head of the Experimental Evolution of Viruses Laboratory, Institut Pasteur de Montevideo

Pilar Moreno, Senior Researcher, Experimental Evolution of Viruses Laboratory, Institut Pasteur de Montevideo

How did the Institut Pasteur de Montevideo mobilize in the fight against COVID-19 at the local and regional level? Uruguay successfully navigated the COVID-19 health crisis during the first 9 months of the epidemic, with only 9,700 confirmed COVID-19 cases and less than 100 deaths. This was due to the rapid response of the scientific community, which allowed a rapid increase of testing capacity from hundreds to thousands of tests per day that was critical to implement the TETRIS (test, trace and isolate) strategy recommended by the World Health Organization. The Institut Pasteur de Montevideo (IPMon) had a central role in the fight against COVID-19, re-directing its infrastructure as well as its human and economic resources with our laboratory (Experimental Evolution of Viruses) leading all these actions.

Consequently, during the first semester of 2020 the IPMon turned into the main public diagnostic center of Uruguay. Importantly, in this network we carried out more than 40% of the tests in our country until August 2020.

Why and how did you develop a new diagnostic test? What were the steps involved in the process? We developed an affordable molecular multiplex kit to detect SARS-CoV-2. This kit has many advantages: it is independent from commercial kits, it has high sensitivity and specificity, is adaptable to all qPCR machines and it has the potential to be optimized for SARS-CoV-2 variants of regional circulation. This methodology was transferred, free of charge, to research institutes, public hospitals and academic laboratories all around the country, creating a “Nationwide COVID-19 diagnostic laboratory network” where we also trained people. Importantly, we set up a network that allowed us to perform real time genomic surveillance as well as environmental monitoring (waste water and surfaces).

What are the differences between your kit and a PCR test? How? By designing and multiplexing probes that target two SARS-CoV-2 genomic regions and one human gene as sampling control. At that moment, as far as we know, this was the first test that in only one tube, one patient was fully analyzed.

How? Because at the beginning of the pandemic, the same war we are facing now to get vaccines, was mainly due for testing capacity. For example, on June 3rd the editorial of Nature Biotech published “This COVID-19 Testing debacle”. Thus, we took advantage of being the last to get hit and we rapidly generated our own molecular test. How? By designing and multiplexing probes that target two SARS-CoV-2 genomic regions and one human gene as sampling control. At that moment, as far as we know, this was the first test that in only one tube, one patient was fully analyzed.

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This kit was also very useful to perform real time genomic surveillance as well as environmental monitoring (waste water and surfaces).

* https://www.nih.gov/pas/ch1/105926606-0354598-ac1c
** https://www.mdpi.com/1999-4915/12/1/14/htm
**** https://www.biorxiv.org/content/10.1101/2020.09.11.293951v1
***** https://www.nejm.org/doi/full/10.1056/NEJMc1509458#t=article
****** https://www.mdpi.com/1999-4915/12/1/14/htm
******* https://www.biorxiv.org/content/10.1101/2020.09.11.293951v1
********* https://www.mdpi.com/1999-4915/12/1/14/htm
*********** https://www.mdpi.com/1999-4915/12/1/14/htm
************ https://www.biorxiv.org/content/10.1101/2020.09.11.293951v1
The year 2020 marked a period of collaboration and mutual assistance between Pasteur Network members in the fight against coronavirus. Protocols, reagents and positive controls were distributed to institutions in 30 countries by RT-PCR kits distributed in cooperation with the Pasteur Network as early as February within the network and in the MediLabSecure network (see sidebar). They helped detect the first cases in a dozen or so countries, including Morocco and Algeria. MediLabSecure also offered training in diagnostics and external audit control of molecular diagnostics of COVID-19. Finally, it provided emergency assistance to institutions that needed it to sequence the first strains and variants of SARS-CoV-2 isolated, leading to new cooperative ventures, for example with the Institut Pasteur de Tunis or the CERMES Niger. The CIBU and the Institut Pasteur d’Algérie organized training on sequencing with the MinION for a number of network members, including the experts at the Institut Pasteur d’Algérie and the Institut Pasteur de Tunis. The CIBU also provided auditing and consulting services to the laboratory of Virology at the Institut Pasteur d’Algérie, particularly their P3 laboratory. Sanger and MinION sequencing protocols were sent out to the network institutes interested in variant surveillance, with remote technical support. The CIBU also assisted with staff training. It sent six technicians and engineers to the Institut Pasteur de la Guadeloupe to work on molecular diagnostics over a nine-week period in mid-2020. Lastly, a clinical trial was conducted jointly with the Institut Pasteur de la Guadeloupe to assess a rapid RT-LAMP test for COVID-19, developed through a partnership between the CIBU and industry. 

**MEDILABSECURE 2 AGAINST COVID-19**

As leader of the human virology component of the European MediLabSecure project, the CIBU has supported beneficiary countries’ SARS-CoV-2 diagnostic capabilities. The MediLabSecure project seeks to strengthen surveillance networks for emerging vector-borne diseases (transmitted by ticks and mosquitoes) in 22 beneficiary countries around the Mediterranean and extending to the Black Sea and Sahel regions (see page 40). The MediLabSecure 2 teams have directly been involved in the SARS-CoV-2 epidemic response from the beginning, through support to national reference laboratories to scale up diagnostic capabilities (sharing protocols, sending primers and reagents, confirming the first diagnostic tests before the first cases were recorded in the country). The MediLabSecure project provided support to strengthen the surveillance and laboratory capabilities of health care workers through the development of distance learning for hospital-based case management (see web link) and an impact study conducted in hospitals in five African countries (see page 36).

MedilabSecure delivers training in Algeria.

**INTERVIEW**

Melika Ben Ahmed, Head of the Clinical Immunology Laboratory, member of the Infection Transmission, Control and Immunobiology Laboratory, Institut Pasteur de Tunis

**Chaouki Benabdessalem**, Instructor, member of the Infection Transmission, Control and Immunobiology Laboratory, Institut Pasteur de Tunis

How did your laboratory at the Institut Pasteur de Tunis contribute to the COVID-19 response in Tunisia?

As soon as the first cases of COVID-19 were recorded in Tunisia in March 2020, the staff at the Infection Transmission, Control and Immunobiology Laboratory, headed up by Prof. Barbuscins at the Institut Pasteur de Tunis responded quickly. A tripartite agreement between the Institut Pasteur de Tunis, the H4U-Pasteur Research Pole and the Institut Pasteur (Paris) was turned into a program known as “EASI”. It was funded – thanks to the generosity of the public – by the call for projects issued by the COVID-19 Task Force of the Institut Pasteur (Paris) and open to Pasteur Network members. Our program aimed to lay the groundwork for the REPAIR program (see page 30) by developing and validating ELISA serological tests based on the S-RBD and N proteins of SARS-CoV-2. One of the two ELISA tests developed was used in a survey of seroprevalence in Tunisia in May 2021, during the country’s severe third wave of the pandemic. 10,000 samples were taken across the country and the study found a high degree of heterogeneity between regions. On average nationally, 30% of Tunisians had been in contact with SARS-CoV-2, but some regions were affected far more severely than others.

Can you describe how these tests work?

The Institut Pasteur de Tunis’s team first produced large quantities of both the S-RBD and N protein in E. coli. The team then developed, standardized and validated the ELISA IgG and IgM tests. The tests delivered high performance levels, with a sensitivity and specificity of about 95%. A 10-person team worked non-stop on the project for 10 months during lockdown.

How has collaboration with the members of the Pasteur Network in the REPAIR program (mainly in the Africa region) advanced the development of these tests? What were the benefits of this collaborative effort?

REPAIR is a collaborative project that embodies the network members’ commitment to pull together and work in close collaboration, exchanging information and resources to address the challenges of the pandemic. We made our serological tests available to the African partners from the Pasteur Network for them to conduct test validation and for their own sero-epidemiological studies.

The N and S-RBD recombinant proteins, positive and negative serums, anti-IgG human secondary antibodies and the test protocols were sent through the Pasteur Institute to the eight partners that requested them. To take the Institut Pasteur de Tunis is currently assisting several partners to develop ELISA tests at various sites. A video tutorial was also shared. Five partner institutes (the Pasteur Institute of Bangui, the Pasteur Institute of Madagascar, the Institut Pasteur d’Algérie, the Pasteur Institute of Dakar, and the Pasteur Center in Cameroon) have tested the recombinant proteins and their feedback is positive.

**How did your laboratory at the Institut Pasteur de Tunis contribute to the COVID-19 response in Tunisia?**

**How has collaboration with the members of the Pasteur Network in the REPAIR program (mainly in the Africa region) advanced the development of these tests? What were the benefits of this collaborative effort?**

**For more information:**

TO BETTER UNDERSTAND SARS-COV-2 IN AFRICA: REPAIR PROJECT

In order to better understand the circulation and transmission of SARS-CoV-2 and its variants the REPAIR project involves all the Pasteur Network’s members in Africa. It takes advantage of the environmental, social and economic specificities of each country and each geographical area to understand the impact of the epidemic.

The ten Pasteur Network members in Africa (Tunisia, Algeria, Morocco, Senegal, Ivory Coast, Guinea, Niger, Central African Republic, Cameroon, Madagascar) have set up a collaborative research program named REPAIR (Pasteurian International Research in Epidemiology: Africa) to better understand the SARS-CoV-2 epidemic on the African continent. Coordinated by the Pasteur Network association and supported by the French Ministry of Europe and Foreign Affairs, REPAIR is organized around 5 work packages focused on: the development of diagnostic tests and the assessment of their performance in the countries; the estimation of the viral spread and finally the study of the acceptability of social and public health measures.

COORDINATED AND SYSTEMATIC TRACKING OF VARIANTS

Through the shipping of full sequencing equipment and the training for their use, the ten member institutes of REPAIR have been provided with MinIon sequencers allowing the molecular characterization of the epidemic as well as the identification of dangerous variants.

ESTIMATING THE IMPACT OF THE EPIDEMIC ON POPULATIONS

With the geographical, social, economic, and ethical diversity of the populations studied in these ten countries, it will be possible to better understand the various immune responses according to the infectious history of the individuals. Afterwards, it will be possible to model the circulation and spread of the virus and correlate it to the peculiarity of the countries. Serological and molecular data will predict, among others, the impact of vaccination on the pandemic.

For more information: See the REPAIR page on the website, pasteur-network.org

INTerview

Dr. Sara Eyangoh, Head of Science
Pasteur Center in Cameroon

How has the Pasteur Center in Cameroon (CPC) responded to the COVID-19 crisis?

The CPC wasted no time in addressing the crisis. Its response to COVID-19 was up and running on 1 February 2020. Cameroon was thus one of the very first countries in Africa to have the capability to diagnose suspected cases. After a few false positives, the CPC detected the first coronavirus infection (imported from France) on 5 March 2020. To date, there have been more than 81,870 confirmed cases in Cameroon and 1,331 deaths*. The CPC was the only laboratory authorized for PCR testing for the entire country.

The workload built up straightaway and, despite 24/7 shifts, there were delays in producing test results and, despite 24/7 shifts, there were delays in producing test results and, despite 24/7 shifts, there were delays in producing test results and, despite 24/7 shifts, there were delays in producing test results and, despite 24/7 shifts, there were delays in producing test results and, despite 24/7 shifts, there were delays in producing test results. After a while, the CPC was able to model the epidemic and correlate it to the peculiarity of the countries. Serological and molecular data will predict, among others, the impact of vaccination on the pandemic.

How has your center benefited from working with the Institut Pasteur de Dakar, the WHO Global Reference Laboratory for COVID-19 for the Africa region and the regional lead?

Belonging to the Pasteur Network has been a huge advantage: the Pasteur Center in Cameroon was able to quickly secure supplies of reagents from the Institut Pasteur (Paris) and the HKU-Pasteur Research Pole. On a regional level, staff received training at the Institut Pasteur de Dakar, the WHO Global Reference Laboratory for COVID-19 diagnostics is the need for a biosafety cabinet, which is not a requirement for tuberculosis applications. Several laboratories that have GeneXpert to detect tuberculosis bacteria cannot use it for COVID-19 testing.

The challenge was ensuring continuity of operations while planning the use of the machines.

* As of 5 August 2021.

How did your center implement GeneXpert — normally used to screen for tuberculosis — for COVID-19 diagnostics?

GeneXpert was introduced gradually as there was a limited supply of tests available. The first batch of 5,000 tests received by Cameroon were allocated to the two regions with GeneXpert as their only diagnostic platform. Then supply was extended to the CPC National Tuberculosis Reference Laboratory and to the Regional Tuberculosis Reference Laboratories on the coast and in the north-west. The main limit on the large-scale use of GeneXpert for COVID-19 diagnostics is the need for a biosafety cabinet, which is not a requirement for tuberculosis applications. Several laboratories that have GeneXpert to detect tuberculosis bacteria cannot use it for COVID-19 testing.

The challenge was ensuring continuity of operations while planning the use of the machines.
They were subsequently designated as national reference laboratories for COVID-19 for their unprecedented mobilization.

The network members in the region lost no time in developing protocols for molecular diagnostics of SARS-CoV-2 to get screening up and running. This was the case for the Institut Pasteur du Cambodge and the Institut Pasteur du Laos, both designated as first-line laboratories for COVID-19 diagnosis by their respective health authorities.

The Institut Pasteur du Cambodge worked closely with the Cambodian Centers for Disease Control and Prevention to report suspected cases, while facilitating data management, reporting and contact tracing alongside its research activities. This commitment resulted in its recognition by the WHO in April as a reference laboratory for COVID-19.

Observing a low number of reported cases of SARS-CoV-2 infection, the health authorities of Lao PDR have mandated the Institut Pasteur du Laos to perform a seroprevalence study including more than 3,000 participants in order to understand whether there was an undetected circulation of SARS-CoV-2 in the country. At the same time, the institute has continued its research with, for example a program on the origin and transmission of the virus in the country’s wildlife.


Watch the video: The Institut Pasteur du Cambodge puts its resources to work to beat COVID-19: https://www.youtube.com/watch?v=VdQgQkECDUu&list=PLUV1vTHgPqZ76fTr1r1Nh90GdJ&index=18

The three network members in Vietnam – the National Institute of Hygiene and Epidemiology (NIHE), the Institut Pasteur in Ho Chi Minh City and the Institut Pasteur in Nha Trang – were also designated as national reference laboratories for COVID-19.

As such, the NIHE ran several studies on COVID-19, analyzing the first 100 days of control of SARS-CoV-2 in Vietnam, and identifying the factors associated with the length of hospital stay.

Concurrently the Institut Pasteur in Ho Chi Minh City studied the clinical characteristics and genome sequence of SARS-CoV-2 in the country’s first two COVID-19 patients. To cope with the increased workload as a result of reference laboratories designation, specific capacity building initiatives have been put in place with institutional support from backers, in addition to existing programs, such as ECOMORE II (see page 40) to boost their ability to fulfil their mission.

We kept working with members of the network afterwards, like with the Institut Pasteur de Tunis for the EARS-ELISA Assays development for SARS-CoV-2 project funded by the Institut Pasteur COVID-19 Task Force. It allows obtaining crucial serological data on infection attack rates and assessing the development of population immunity, all essential pillars to estimate disease severity and effectiveness of control measures, which are currently lacking in most places.

SOUTH-EAST ASIA: RECOGNITION BY LOCAL AUTHORITIES

Geographically close to the initial center of the virus outbreak, Pasteur Network members in South-East Asia rapidly deployed operational support to their national health authorities. They were subsequently designated as national reference laboratories for COVID-19 for their unprecedented mobilization.

In Hanoi and Nha Trang, the National Institute of Hygiene and Epidemiology (NIHE) and the Institut Pasteur in Nha Trang were designated as national reference laboratories for COVID-19.

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Can you explain the response developed by the HKU-Pasteur Research Pole for COVID-19 with details of the protocol that you put in place?

If we were to mention just three major advances on COVID-19 made by the HKU-Pasteur Research Pole, what would they be?

Of course, I would mention the development of sensitive molecular diagnostic tests in early January 2020, as well as those for serological studies. We made both platforms freely available to all to participate in the international effort. These tests are key tools for detecting COVID-19 patients and for better understanding of this new disease.

After that, the team led by Chris Mok, in collaboration with the Scripps Research Institute, studied the fine molecular and structural basis of antibody recognition of the Spike protein by the cellular receptor and antibody recognition by the immune system. The key findings reported in these two publications reveal critical differences between the receptor binding domains of SARS-CoV-2 and SARS-CoV that result in cross-reactive, but not cross-protecting antibodies in infected individuals. These observations are very important in the perspective of developing a safe and effective vaccine against SARS-CoV-2 with broad coverage.

Simultaneously, Sophie Valkenburg’s team has taken an unbiased approach by obtaining a more complete landscape of antibody responses to a panel of SARS-CoV-2 proteins in COVID-19 patients. They made key discoveries that point to a combination of three viral proteins (termed N, ORF3b and ORF8) that identify all COVID-19 patients even at early time points after onset of symptoms. This discovery will have many important implications for serology assays, vaccine development and understanding of immune response and pathogenesis.

How was the cooperation with other members of the Pasteur Network organized following the development of your SARS-CoV-2 detection protocol?

We know how important identification is in the early stage so, of course, we shared the protocol to the Pasteur Network members, and other institutes who asked for it. Especially in developing countries, like Cambodia, Vietnam, Madagascar and Senegal, where the network is well-established. We shared our protocols and diagnostic reagents (including controls) with 170 laboratories in 77 countries by end-April 2020. My laboratory also serves as a WHO COVID-19 Reference Laboratory. These all illustrate our leading role in pandemic preparedness.

We kept working with members of the network afterwards, like with the Institut Pasteur de Tunis for the EARS-ELISA Assays development for SARS-CoV-2 project funded by the Institut Pasteur COVID-19 Task Force. It allows obtaining crucial serological data on infection attack rates and assessing the development of population immunity, all essential pillars to estimate disease severity and effectiveness of control measures, which are currently lacking in most places.

INTERVIEW

Leo Poon Lit Man, Co-Director, HKU-Pasteur Research Pole, Division Head, Division of Public Health Laboratory Sciences, University of Hong Kong

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Americas

URUGUAY

COMPLETE SEQUENCING OF THE VIRUS TO UNDERSTAND ITS ORIGIN

To understand the strain’s origin of the virus circulating in Uruguay, researchers at the Institut Pasteur de Montevideo sequenced the 10 strains found in the country. As the data were compiled, they drew comparisons between local sequences to identify genetic similarities. They found that seven possibly came from Spain.

For more information: pasteur.uy/en/

BRAZIL

THE FIOCRUZ PLAYS AN ACTIVE ROLE IN THE RESPONSE TO COVID-19 IN THE AMERICAS

The Fiocruz, a Pasteur Network member in South America, was designated a WHO COVID-19 Reference Laboratory for SARS-CoV-2. For more information, go to: https://fiocruz.tghn.org/coronavirus/fiocruz-COVID-19/

BRAZIL

ACE2 ROLE IN SEVERE FORMS OF COVID-19

Researchers working with the Scientific Platform Pasteur-USP analyzed more than 700 pulmonary transcriptome samples of COVID-19 patients with comorbidities. They found a higher expression of ACE2 (angiotensin converting enzyme 2), which is crucial for infection and increases susceptibility to developing more severe forms of the disease.

The Journal of Infectious Diseases, June 2020; DOI: 10.1093/infdis/jiaa332

BELGIUM

ANALYSIS OF WASTEWATER TO MAP THE SPREAD OF THE VIRUS

Driven by Sciensano within the Human Infectious Diseases Direction, the Food Pathogens Department has coordinated the establishment of a network of three wastewater testing laboratories to monitor and map COVID-19 as an early detection system for SARS-CoV-2 circulating in the Belgian population. Detection of variants in wastewater is also under investigation.


FRANCE

A “REPOSITIONABLE” DRUG ABLE TO CURB REPLICATION OF THE VIRUS IDENTIFIED

Researchers at the Institut Pasteur de Lille have tested the active ingredients already in use for other diseases that may respond effectively to COVID-19. Their work, in collaboration with APTEEU, a biotech company, tested more than 2,000 molecules and found one that was particularly effective against SARS-CoV-2. A clinical trial is planned for 2021.

For more information: https://coronavirus.pasteur-lille.fr/recherche-COVID-19/

FRANCE

DIAGNOSTIC TEST FOR PATIENTS

In the second half of January 2020, the National Reference Center (CNR) for viral respiratory infections at the Institut Pasteur developed a test to directly detect SARS-CoV-2 using a molecular biology method known as RT-qPCR. This test was used to diagnose the first patients in France and subsequently rolled out in hospitals. It was the standard to develop other PCR tests in France.


COVID-19 HIGHLIGHTS IN 2020

Here is a selection of highlights based on reports from network members. This is not an exhaustive list, but you will find more information on members’ websites and in their annual reports.
KOREA
SCREENING FOR DRUG DISCOVERY
The Institut Pasteur Korea has screened thousands of drugs either on the market or in clinical development to study their potential effectiveness against COVID-19. Two anticoagulants, nafamostat and camostat, used to treat chronic pancreatitis, show potent antiviral efficacy and will enter clinical trials.

For more information: https://www.ip-korea.org/community/release_view.php?page=3&board=press&seq=2838

CAMBODIA
VIDEO: THE INSTITUT PASTEUR DU CAMBODGE MOBILIZED TO COUNTER COVID-19
The WHO designated the Institut Pasteur du Cambodge a WHO COVID-19 Reference Laboratory. See what this means for the Institute's work.

Watch the video: https://www.youtube.com/watch?v=8dgrGjlEcDU&t=6s

LAO PDR
LOW NUMBER OF CASES CONFIRMED BY SEROPREVALENCE STUDY
In 2020 when many countries around the world struggled with a large burden of COVID-19 cases, Lao PDR stood out as a country with low reported numbers of SARS-CoV-2 infections. Was it due to a low circulation of the virus or to an inadequate surveillance system? To answer this question, a seroprevalence study was conducted by the Institut Pasteur du Laos, in collaboration with the Institut Pasteur (Paris) among 3,000 people in Lao PDR. The results, published in the Lancet Regional Health - Western Pacific, showed that there was no unseen circulation of SARS-CoV-2 in Lao PDR in 2020.


CHINA
ANTI-COVID SURFACE COATING
Researchers at the HKU-Pasteur Research Pole and Virginia Tech have demonstrated that a surface coating containing copper oxide bound with polyurethane can inactivate SARS-CoV-2 in an hour, reducing the viral count by 99.9%. The surface coating can be easily applied to common materials such as metal, glass and door handles to reduce the risk of spreading the virus by indirect contact.

ACS Applied Materials & Interfaces, 13 July 2020. DOI: 10.1021/acsami.0c11425

IN THE REGIONS
RISKS FOR AFRICAN HEALTHCARE PROFESSIONALS
In May 2020, MediLabSecure teams launched a multicentric surveillance and impact study in 4 African countries: Burkina Faso and Niger (members of the MediLabSecure network), Central African Republic and Madagascar (members of the Pasteur Network); a fifth country, Cameroon* (also a member of the Pasteur Network), will participate in the study as well. This study aims to identify the key epidemiological characteristics in the dynamic of infection among healthcare workers in contact with COVID-19 patients, when managing the first cases, through a longitudinal follow-up. One of the objectives is to inform Public Health decision-makers on the potential impact of SARS-CoV-2 infection**.


* Thanks to the support of the Coronavirus Task Force at Institut Pasteur (Paris) thanks to the generous support of the European Commission through the EU Instrument contributing to Stability and Peace and the CBRN CoE initiative.

** Study financed by the European Commission through the EU Instrument contributing to Stability and Peace and the CBRN CoE initiative.


Watch the video: https://www.youtube.com/watch?v=6UQwDqg_xq4&t=1s

SENEGAL
THE INSTITUT PASTEUR DE DAKAR DESIGNATED A REFERENCE CENTER
The Institut Pasteur de Dakar has been recognized as a regional reference center for sequencing and diagnosis partly thanks to its sequencing platform. This recognition was granted by the WHO as a reference laboratory for COVID-19, but also by the African Center for Disease Control and Prevention (CDC Africa) and the West African Health Organization (WAHO). The Institut Pasteur de Dakar inaugurated its diaTROPIX rapid diagnostic test production platform in November 2020. It is designed to diagnose COVID-19, as well as neglected tropical diseases, at affordable prices to resource-limited countries in Africa.


Watch the video: https://www.youtube.com/watch?v=6UQwDqg_xq4&t=1s

ASIA-PACIFIC
The Institut Pasteur de Dakar, IMI (Immunophysiopathology and Infectious Diseases) Center technicians conducting serological analysis for COVID-19.

Virologist Narjis Boukli and her colleague Dr. Pharath Lim at work in their laboratory at the Institut Pasteur du Cambodge.

The Institut Pasteur de Dakar, IMI (Immunophysiopathology and Infectious Diseases) Center technicians conducting serological analysis for COVID-19.
Scientists are looking into the possibility that a failure of the dopamine pathways may be implicated in severe forms of COVID-19. Indeed, the DopaDecarboxylase (DDC) gene shows a statistically significant coexpression link with the ACE2 locus encoding the SARS-CoV-2 receptor. The DDC enzyme synthesizes dopamine that acts as both a neurotransmitter and an immunoregulator. DDC and ACE2 are both negatively regulated by the lack of oxygen produced by SARS-CoV-2 which leads to inflammation. To study this failure, Niki Vassilaki, a researcher at the Hellenic Pasteur Institute, set up the Dopahypocov project as one of the 33 Pasteur Network projects funded by the Institut Pasteur. Her team conducted a study on a cohort of Greek, Moroccan and Vietnamese patients. Four members of the network are taking part in this research, the Hellenic Pasteur Institute, the Institut Pasteur du Maroc, the Institut Pasteur in Ho Chi Minh City and the Institut Pasteur (Paris), together with the National and Kapodistrian University of Athens. The collaborative project aims to identify patients who will require rapid treatment by identifying aggravating factors for the disease as well as discovering new drugs.

AFROSCREEN, TO STRENGTHEN SEQUENCING CAPACITY

The Agence française de Développement (AFD) and the ANRS | Maladies infectieuses émergentes, in partnership with the Institut Pasteur,IRD, and laboratories across 13 African countries, are launching the joint AFROSCREEN project. This project meets an urgent need for surveillance of the development of SARS-CoV-2 variants and other emerging pathogens by bolstering laboratory genomic sequencing capacity. The €10 million program has two main objectives:

• to bolster the sequencing capacity of laboratories in 13 African countries - Benin, Burkina Faso, Cameroon, Ghana, Guinea, Ivory Coast, Senegal, and Togo.
• to monitor patterns of spread by combining this effort with the implementation of preventive measures to control and limit the circulation of variants. It will run for a two-year period, and should make it possible to carry out approximately 34,000 sequences and 54,000 screening PCR tests, using 25 laboratories.


Beyond the shared Pasteurian values, the members of the Pasteur Network carry out capacity building projects together. They also benefit from international courses, training and mobility programs as well as opportunities for young researchers such as the 4-year Research Groups (G4).
CAPACITY-BUILDING PROJECTS
SHARING EXPERTISE IN THE FIELD

The SARS epidemic in 2006 and Ebola in 2014 made clear the need to strengthen national public health capacity to monitor, control and respond to future emerging or re-emerging epidemics. Thus, network members are collaborating on multi-center programs over several years to develop surveillance and monitoring systems with local actors.

MEDIласSЕСURЕ 2

The globalization of transportation, environmental disruptions such as urbanization and deforestation are all factors that favor the emergence and spread of vector-borne diseases. Because mosquitoes and ticks know no borders, the MediLabSecure project strengthens the capacities of 25 countries located around the Mediterranean basin, the Black Sea and the Sahel. The objective is to prevent diseases transmitted by these two insects by strengthening a network of laboratories in human and animal health as well as public health institutions, through a global and unified approach known as One Health. Coordinated by the Institut Pasteur, the project is funded by the European Union as part of the Initiative for CBRR centers of excellence. After the launch of the second phase in 2019, including five Sahelian countries, training of experts to strengthen disease detection capacities were organized, advocacy materials for the One Health approach were developed, as well as numerous mosquito identification tools.

For more information: https://www.medilabsecure.com/

RESER

The national reference centers and laboratories provide expertise in the microbiology and pathology of infectious agents. They play a role in epidemiological surveillance and trigger alerts when they detect the emergence of a pathogen. The pilot phase of the Réseau d’Étude et de Surveillance des pathogènes Emergents (RESER) from 2018 to 2019 sought to bolster bacteriological referencing and surveillance at the national reference centers of nine institutes in the Pasteur Network (Cameroon, Central African Republic, Ivory Coast, Guadeloupe, Madagascar, Morocco, Niger, Senegal and Tunisia).

RESER organized training and courses delivered by experts, primarily national reference centers at the Institut Pasteur (Paris). Phase 2 of RESER kicked off in 2020 expanding the program’s reach to new countries and new topics, such as emerging antibiotic-resistant bacteria. A course will be held at the Institut Pasteur de Dakar with both theoretical and practical components, followed by in situ training by national reference center experts to assess how learning from phase 1 of the project is being applied. Phase 2 is funded by the Pasteur Network association and LabEx.

For more information: ecomorse.org

ECOMORЕ II

ECOMORE II Project or ECOconomic development, ECOsystem MDifications, and emerging infectious diseases Risk Evaluation is funded by the Agence française de Développement (AFD) and coordinated by the Institut Pasteur. Ongoing in five countries in South-East Asia, it brings together the Institut Pasteur du Laos, the National Institute of Hygiene and Epidemiology in Vietnam, the National Health Laboratory in Myanmar, and the Research Institute for Tropical Medicine in the Philippines. Launched in 2017, this second stage of the One Health project ECOMORE aims to better understand the anthropogenic ecological changes responsible for the emergence of infectious diseases (urbanization, agricultural intensification, land use, population movements) and to measure the health risks for local communities. Strategies have also been put in place to improve patient care and to raise awareness among key players at the national and regional levels.

For more information: https://research.pasteur.fr/fr/project/ebos-surry-project/
TRAINING AND MOBILITY IN THE PASTEUR NETWORK

The Pasteur Network encourages men and women in the international scientific community to take part in training and improve their scientific skills throughout their careers. Through training and programs to promote mobility, they reinforce their long-term commitment to public service.

A COMMITMENT TO KNOWLEDGE

Reiterated as a priority in its strategic plan, training is a key part of the actions pursued by the Institut Pasteur, which finances some Pasteur Network programs. Trainings are available to students, experienced researchers and technicians, and are delivered in special centers in the network: Cameroon, Niger, Ivory Coast, Cambodia, Korea and Montevideo etc. It can take several forms, including internships, courses, thesis funding and seminars led by network scientists. Continuous professional training is a key ingredient in building the scientific capacities of the Pasteur Network.

A COMMITMENT TO MOBILITY

The opportunity to take up positions in other countries is a major asset of the network. Dedicated mobility programs allow the staff members to move around within this global network, thereby reinforcing the exchange of skills.

CONCRETE COMMITMENTS

These two commitments, turned into actions, strengthen the capacities of the Pasteur Network each and every year. They are confirmed by ever increasing figures (see graph opposite).

TRAINING AND MOBILITY IN THE PASTEUR NETWORK

<table>
<thead>
<tr>
<th>Training programs and mobility opportunities</th>
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<tbody>
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<td>• CALMETTE &amp; YERSIN program</td>
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<tr>
<td>• Grants “Fondation Pierre Ledoux Jeunesse Internationale”</td>
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<td>• Mission of the new Pasteurians within the Pasteur Network</td>
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KEY FIGURES

<table>
<thead>
<tr>
<th>Recipients of the CALMETTE &amp; YERSIN program:</th>
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<tbody>
<tr>
<td>Grants co-financed by the Institut Pasteur Department of International Affairs and partners:</td>
</tr>
<tr>
<td>Grants for taking courses (14 in 2019 and 6 in 2020)</td>
</tr>
<tr>
<td>Internship grants, including 18 3-year doctoral grants and 6 2-year postdoctorate grants</td>
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<tr>
<td>3-month missions for new recruits</td>
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<tr>
<td>110 scientists and students benefited from an international grant in 2019-2020</td>
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<tr>
<td>Grants from the “Fondation Pierre Ledoux Jeunesse Internationale”</td>
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<tr>
<td>Grants from the Department of International Cooperation of the Principality of Monaco</td>
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SCIENCE SHOP AT THE INSTITUT PASTEUR DE TUNIS

The “Science Ensemble” Science Shop at the Institut Pasteur de Tunis was set up in 2017 as part of the European InSPIRES program, “Ingenious Science shops to promote Participatory Innovation, Research and Equity in Science”. It is a device that takes place within universities or research institutions to co-construct research projects with local associative actors in order to meet the needs expressed by civil society. The aim is to come up with innovative solutions to social problems in the areas of health, the environment and vulnerable populations. These outcomes will be used by associations to develop their advocacy with decision-makers. Organizations submit their needs through an annual online submission. A selection committee made up of scientists, civil society representatives and the “Science Ensemble” team then selects projects. Since 2017, “Science Ensemble” has coordinated 10 collaborative projects, including two cross-border and cross-cutting projects, on a wide range of issues such as health risks for scavengers, prevention of stigma experienced by people living with HIV, development of type-2 diabetes and high blood pressure in rural areas or early detection of hearing disorders in children.

For more information: http://www.pasteur.tn/index.php?option=com_content&view=article&id=748&Itemid=8

Pasteur Network – 2019-2020 Report
In 2019, the Pasteur Network association and the Institut Pasteur launched the official Pasteur International Courses (PIC) label through its departments of Education and International Affairs. The label certifies the training programs, workshops and MOOCs (Massive Open Online Courses) in the network. All the training provided under this unique label meets the same world-class standards. It certifies the quality standards and requirements specific to the Institut Pasteur, which are essential for preparing students and scientific or medical staff for the new public health challenges.

The PIC label guarantees not only the excellence of the topics covered in the courses, but also the high quality of procedures to recruit participants, as well as the supervision, infrastructure, the partnerships created and final evaluations. Training courses carrying this quality label may also attract students and researchers at all stages of their career, as well as laboratory technicians and professionals. The label will also contribute to valorize the trainees who followed these courses. In practice, courses that apply for the PIC label are submitted to an external panel for evaluation. The first pre-labellations began in September 2021, preparing the global health leaders of tomorrow.

For more information: pasteur-network.org/en/what-we-do/pic-label/

Training is a core mission of the Pasteur Network and every year courses are held in different network countries, funded by the network association. These international courses are selected for their scientific excellence in order to train the staff of the network members. Here is the list of courses selected in 2019 and 2020. Courses that had been planned for 2020 were rescheduled to 2021 because of the pandemic.

### 2019

<table>
<thead>
<tr>
<th>COURSE TITLE</th>
<th>ORGANIZER(S)</th>
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<tbody>
<tr>
<td>Systèmes d’Information géographique appliqués à l’épidémiologie : introduction au logiciel QGIS 2</td>
<td>F. Rakotomanana</td>
<td>Institut Pasteur de Madagascar</td>
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<tr>
<td>Vector Insects and Transmission of Pathogen Agents</td>
<td>M. Patino</td>
<td>Institut Pasteur de Laos</td>
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<tr>
<td>Third International Course on Viruses and Human Cancer</td>
<td>JF. Veriany</td>
<td>Institut Pasteur in Italy</td>
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<td>Workshop on Surveillance and Control of Babies</td>
<td>H. Bourhy</td>
<td>Institut Pasteur du Maroc</td>
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<tr>
<td>International Ethical standards applied to biomedical research</td>
<td>S. Ouchhi</td>
<td>Institut Pasteur de Tunis</td>
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<tr>
<td>Genome editing in mammals using CRISPR tools</td>
<td>M. Crispo</td>
<td>Institut Pasteur de Montevideo</td>
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<tr>
<td>Redox Chemistry and Biology of Thiol</td>
<td>M. Comini</td>
<td>School of Medicine, School of Chemistry and School of Science, Universidad de la Republica, Montevideo</td>
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<tr>
<td>Bactériologie et santé publique</td>
<td>P. Martinez, Lago</td>
<td>Institut Pasteur du Maroc</td>
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<tr>
<td>Proteome Analysis by Mass Spectrometry</td>
<td>R. Duran</td>
<td>Institut Pasteur de Montevideo</td>
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<tr>
<td>HKU-Pasteur Cell Biology Course</td>
<td>R. Bruzzone</td>
<td>HKU-Pasteur Research Pole</td>
</tr>
<tr>
<td>Data analysis using Stata</td>
<td>Y. Modic</td>
<td>National Institute of Hygiene Epidemiology, Rome</td>
</tr>
<tr>
<td>Second workshop on translational venomics medicine challenging human envenoming issues - exploring &amp; exploiting snake &amp; scorpion venoms &amp; antivenoms</td>
<td>N. Oukkach</td>
<td>Institut Pasteur du Maroc</td>
</tr>
<tr>
<td>The business of managing sciences: Scientific Management and Leadership skills for IPIN Scientific Research Infrastructures</td>
<td>S. Shorte</td>
<td>Institut Pasteur Korea</td>
</tr>
<tr>
<td>Visualization for Data Science (VDS)</td>
<td>P. Guettet</td>
<td>Institut Pasteur de Tunis</td>
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<tr>
<td>The First International Course on Molecular Cancer Genetics</td>
<td>JF. Veriany</td>
<td>Canc Biopharm Foundation</td>
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<tr>
<td>Identification et Surveillance épidémiologique des Résistances aux Antibiotiques</td>
<td>J. Lavi</td>
<td>Institut Pasteur du Maroc</td>
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<tr>
<td>Metagenomics and Health</td>
<td>S. Ferri</td>
<td>Institut Pasteur du Maroc</td>
</tr>
<tr>
<td>Appui des sciences sociales dans la préparation et la réponse aux dimensions sociales des épidémies</td>
<td>C. Malemo</td>
<td>Institut Pasteur de Madagascar</td>
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</tbody>
</table>
What kind of opportunity does a G4 give a scientist at the start of their career?

The G4 program is a great opportunity to begin a career as an independent researcher within the Pasteur Network. One of the challenges of being an early-career researcher is making the transition from a post-doc to a group leader—especially when it comes to getting independent funding to help recruit and build a team and support a research program.

One of the amazing benefits of the G4 program is that it funds the creation of an independent group while also making it part of the host institution and the Pasteur Network. This balance between independence, integration and collaboration is a very attractive proposition.

A G4 also encourages collaboration and multidisciplinary, cross-cutting approaches. This environment has helped to establish our research agenda while also creating new opportunities for collaboration and fascinating research avenues.

What is your background and how does the G4 fit in?

My training is in parasitology, in particular the genetics and genomics of malaria parasites, with an emphasis on the use of experimental genetics to gain insight into the main processes that influence virulence: parasite invasion, drug resistance and immune escape. Our main G4 project aims to understand how the genetic diversity of vaccine candidate antigens influences vaccine efficacy. We use field approaches combined with laboratory methods to understand how specific mutations influence parasite invasion and immune evasion, whether the antibodies are naturally acquired or vaccine-induced. In the G4 program, I have been able to bring these unique aspects of malaria research to the dynamic and world-renowned Institut Pasteur de Dakar, which has long been recognized for its contributions to malaria epidemiology and entomology. Starting a research group concentrating on combining Plasmodium genomics, experimental genetics and malaria vaccinology in Africa really is a dream come true.

How did you put together your research team?

I have always enjoyed doing science in a “team” atmosphere. So, I’m looking for young African scientists who are committed to making a difference in Africa. Young people who are creative and innovative, who are not afraid to think outside the box, who want to work together to solve the many challenges we face—both scientific and logistical.

On our G4 team we have researchers with a wide range of experience: technicians, master’s students, PhDs and post-doctorates. I am extremely fortunate to have such talented, passionate and dedicated young African scientists on our team working to improve understanding and treatments for malaria in Senegal and around the world.
Scientific platforms, tools and incentives foster collaboration and innovation across the Pasteur Network, furthering world class research built on the human and technical expertise of the network’s members.
INNOVATIVE TECHNOLOGICAL TOOLS

To fulfill its missions for the benefit of the populations, the Pasteur Network harnesses extensive technological expertise. Scientific platforms or innovative tools distributed across the network encourage technical collaboration between members in order to optimize and share resources for the advancement of science.

THE “OMICs” SPACE, A TOOL TO PROCESS RESULTS

The “Omic” center consists of two facilities, the Biomics hub and the Department of Computational Biology giving the Pasteur Network big data capability. Mathematical modeling, statistics and computer science are all subjects dealt with by this multidisciplinary and transversal department. Working jointly with members of the Pasteur Network, its "informatics and biostatistics hub" is considered as a reference platform in bioinformatics, in addition to the training courses that are provided around the world, such as the one that took place in October 2019 at the Institut Pasteur d’Algérie.

MOBILE LABORATORIES, A TOOL TO GET TO HARD-TO-REACH PLACES

Inaugurated on September 19, 2019, the mobile laboratory operated by the Institut Pasteur de Madagascar was funded by the United States Agency for International Development (USAID). It is especially valuable for monitoring malaria, plague and measles. This type of fully equipped and independent facility is used for on-the-ground testing and research to improve surveillance and epidemic response capability.

SCREENING PLATFORMS TO DISCOVER NEW DRUG CANDIDATES

Screening platforms help to identify molecules and new drug candidates to treat studied pathologies. The elucidation of pathological mechanisms is also possible thanks to numerous tests performed by these techniques involving the simultaneous reaction between a large number of molecules (over 500,000) and cell cultures. For example, the Institut Pasteur Korea and the Institut Pasteur de Lille both have screening units.

For more information:
https://www.pasteur-cayenne.fr/lab-recherche/nos-equipes/uem/vectopole/
https://www.pasteur-lille.fr/centre-de-recherche/platfrommes-technologiques/
https://www.ip-korea.org/RDP/lab_screening.php
https://pasteur-fili.fr/centre-de-recherche/plateformmes-technologiques/

VECTOPOLE, A TOOL TO STUDY VECTOR INSECTS

The Émile Abonnenc Amazonian VectoPole at the Institut Pasteur de la Guyane carried out molecular taxonomy and surveillance as part of its study of vector insects. It seeks to gain insights into the mechanisms of action and behavioral changes in mosquitoes that carry arboviruses.

At the height of the COVID-19 crisis, the Institut Pasteur de la Guyane inactivated Anopheles darlingi larvae bred at the Institut Pasteur de la Guyane VectoPole.

For more information:
http://www.ip-korea.org/RDP/lab_screening.php
https://pasteur-fili.fr/centre-de-recherche/plateformmes-technologiques/
https://www.ip-korea.org/RDP/lab_screening.php
https://pasteur-fili.fr/centre-de-recherche/plateformmes-technologiques/

SEQUENCING PLATFORMS TO READ GENOMES

The network holds various tools for the essential work of genome sequencing, including NGS and MinION at the Omics hub and at other member facilities. For instance, the Institut Pasteur in Dakar has sequenced, allowing the molecular characterization of the SARS-CoV-2 virus, during its diffusion in time and space and the tracking of dangerous variants. For instance, the Institut Pasteur in Dakar is a recognized regional sequencing platform for COVID-19.

For more information:
https://research.pasteur.fr/en/our-missions/research/department-computational-biology/analyse-de-lapport-de-cette-technologi/
https://www.pasteur-bangui.org/8-novembre-2019-implementation-a-linstitut-pasteur-de-

MOLECULAR ANTHROPOLOGY, A TOOL TO STUDY HUMAN GENES

MOLECULAR ANTHROPOLOGY, A TOOL TO STUDY HUMAN GENES

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MOLECULAR ANTHROPOLOGY, A TOOL TO STUDY HUMAN GENES

For more information:
http://www.ip-korea.org/RDP/lab_screening.php
https://pasteur-fili.fr/centre-de-recherche/plateformmes-technologiques/

MOBILE LABORATORIES, A TOOL TO GET TO HARD-TO-REACH PLACES

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For more information:
http://www.pasteurmg.santepublique-inauguration-du-laboratoiremobile-de-l-institut-pasteur-demadagascar/

PINTET, A BIO-RESOURCE SHARING TOOL

Born out of the ambition to combine micro-organism collections with the analysis of methods, Pintet is a project that brings together the Institut Pasteur and Pasteur Network expert laboratories. Pasteur International Bioresources Network is a collaborative program that involves many different entities for sharing biological data in the interests of public health, biological research and for industrial applications across the network.

For more information:

HAL-RIP TO SHARE KNOWLEDGE

HAL-RIP is an open archiving system for published and unpublished work for Pasteur Network members. The open access platform is designed to make it easier for members to share their work and to file it freely (scientific papers, theses, conference reports, book chapters and more).

For more information:
https://halrip.archives-ouvertes.fr/
ACIP & PTR, CALLS FOR INCENTIVE PROGRAMS

Aimed at scientists from the Institut Pasteur and the Pasteur Network, the Inter-Pasteurian Concerted Actions (ACIP) and the Transversal Research Programs (PTR) are annual calls for projects managed by the Department for Scientific Programming and Incentive Actions (SPAIS) from the Institut Pasteur (Paris). Included in the Institut Pasteur’s strategic plan, these incentive programs aim to encourage and strengthen scientific collaboration between Pasteurian teams.

From December to February every year, Pasteur Network members can submit their research projects to the Institut Pasteur’s Department for Scientific Programming and Incentive Actions. Selected programs receive funding for two years, from 1 October of the year they were submitted. 34 projects funded, including:
> 12 ACIP
> 22 PTR

ACIP, ENCOURAGING COLLABORATION

The main aim of Inter-Pasteurian Concerted Actions (ACIP) is to set up new collaborative projects by strengthening links between Pasteurian teams, especially in the field of public health. Projects submitted under this program must explore innovative scientific hypotheses to obtain preliminary results with the potential to lead to bolder and more ambitious prospects.

PTR, PROMOTING MULTIDISCIPLINARY AND AMBITIOUS RESEARCH PROJECTS

Transverse research programs (PTR) encourage the development of multidisciplinary, innovative and ambitious research projects which leverage cutting-edge technologies. These Institut Pasteur funding tools promote synergies to strengthen collaboration and further the careers of young scientists.

For more information: https://www.pasteur.fr/en/international/international-calls/incentive-programs

INTERVIEW

Teca Galvao,
Scientific coordinator of ACIP 358-2020: Evolution of regulatory interactions through the lens of antibiotic selective pressure (EvoSP), Functional Genomics and Bioinformatics Laboratory, Fiocruz

What reasons prompted you to apply for ACIP funding?

Antibiotic resistance is a serious emerging public health threat, and some estimates project that by 2050 more people will die from bacterial infections than from cancer. Research for understanding resistance is essential for the development of new treatments and control initiatives: understanding the problem is part of the solution. It is not known how bacteria resistant to polymyxins, a last resort class of antibiotics, can survive. Together with Ariel Mechaly, an expert on the proteins involved in polymyxin resistance at the Institut Pasteur (Paris), and Ana Paula Assf from the Fiocruz, whose laboratory is part of the Brazilian resistance surveillance network, we set out in a collaboration to discover the molecular details that enable survival in the presence of these antibiotics. Early results were exciting and ACIP funding seemed like an excellent way to ensure the project could be carried out.

How did you design your project?

Just like in a population of people, there is diversity in a population of bacteria. So if a single bacteria in a patient has a change, a mutation, that gives it a greater chance to survive, then it will be selected, over other, susceptible, bacteria. In bacteria resistant to polymyxins, the mutations happen in proteins that we know have mechanisms for capturing and transmitting signals by associating changes in their structure and stability to their activity. It is assumed that the mutations change proteins’ behavior and lead to resistance, but – how? Given the powerful techniques available, it was clear that studying how the mutations change activity, structure, and stability would reveal the mechanisms of resistance as well as give insights into how these proteins function.

How does collaboration with other members of the Pasteur Network contribute to your project and your team?

My team aims to understand how mutations in certain proteins make bacteria resistant to antibiotics. This work is connected to the Fiocruz’s mission to serve the public health system as the mutations studied come from bacteria isolated from patients in points of care, and may reflect lineages widespread across Brazil or even the world. The teams in this ACIP project are experts in looking at comparing the properties of the normal and mutant proteins, such that we can understand what antibiotics and evolution have done to them. The teams at the Institut Pasteur (Paris) and the Institut Pasteur de Montevideo master techniques for taking snapshots (X-ray crystallography and HDX-MS) or “short videos” (NMR) of proteins, showing different poses that reflect activity. These methods will reveal how these molecular machines change activity and structure, yielding resistant bacteria.
PIUs, COLLABORATIVE INTERNATIONAL RESEARCH

Pasteur International joint research Units (PIUs) are virtual research units involving up to three international teams, with at least one based at the Institut Pasteur. Over a five-year period, their aim is to strengthen partnerships with leading scientific institutions and boost their profile through both the quality of the scientific research and ability to raise substantial funding.

Built around scientific projects selected through a call for projects, these international units leverage the mobility of scientists from each partner structure, while also paving the way towards more dialog with local universities and research institutes.

For more information and to download an application: https://www.pasteur.fr/en/international/international-calls/pasteur-international-joint-research-unit-piu

CURRENT PIUs

**Since 2016**

Malaria Translational Research Unit (MTRU)
Evolution and adaptation of Plasmodium parasites to their host.
- Jean-Christophe BARALE, Institut Pasteur (Paris) and
- Benoît WITKOWSKI, Didier MENARD, Institut Pasteur du Cambodge.

Integrative Microbiology of Zoonotic Pathogens Unit (IMZA)
Leptospirosis and the persistence of leptospires in the environment.
- Mathieu PICARDEAU, Institut Pasteur (Paris), and
- Alejandro BUCH escapes, Institut Pasteur de Montevideo.

Inflammation and Leishmania Infection Unit (ILIU)
Study of interactions between Leishmania parasites and their host.
- Gérard SPAETH, Institut Pasteur (Paris), and
- Guangxun MENG, Institut Pasteur of Shanghai - Chinese Academy of Sciences.

Vaccinomics Unit
Understanding the immunological mechanisms involved in heterogeneity of vaccine response.
- Anavaj SAKUNTABHAI, Institut Pasteur (Paris), and
- Fumihiko MATSUDA, Kyoto University, Japan.

Since 2017

Artificial Virus Evolution Unit (AVEU)
Study of the natural evolution of viruses with synthetic biology.
- Marco VIGNIuzzi, Institut Pasteur (Paris), and
- Benjamin TENJEVER, Icahn School of Medicine at Mount Sinai, United States.

Since 2018

Mucosal Immunology Laboratory (MIL)
Genetic, environmental and local microbiome factors involved in respiratory immune response.
- Lars ROGGE, James DI SANTO, Institut Pasteur (Paris), and
- Ken ISHI, Institute of Medical Sciences at the University of Tokyo (IMSUT), Japan.

Since 2021

Emergence, persistence and spread of plague
Understanding how Yersinia pestis evolves and compare how it interacts in different hosts in Madagascar to find out when and how new clones can emerge.
- Javier PIZZARO-CERDA, Institut Pasteur (Paris), and
- Bossini SEBBANE, Institut Pasteur de Lille, Hellenic Pasteur Institute.

Neurodegenerative diseases
Pathogenic mechanisms and Parkinson's Disease.
- Chiara ZURZOLI, Institut Pasteur (Paris) and
- Rebecca MATSAIS, Hellenic Pasteur Institute.

Artificial Intelligence for image-based drug discovery & development (AiDD)
Developing innovative methods based on AI/machine-learning technologies for drug discovery.
- Christophe ZIMMER, Institut Pasteur (Paris) and
- Spencer SHORTE, Institute Pasteur Korea.

**INTERVIEW**

Chiara Zurzolo,
Laboratory of Membrane Traffic and Pathogenesis, Department of Cell Biology & Infection, Institut Pasteur (Paris)

**Rebecca Matsas,**
Laboratory of Cell and Molecular Neurobiology – Stem Cells, Department of Neurobiology, Hellenic Pasteur Institute

**PIU “Study of the pathogenic mechanisms and the spread of Parkinson’s disease”**

**What is your joint scientific project?**

Neurodegenerative diseases affect millions of people worldwide with increasing incidence as the population ages and therefore constitutes a major area of concern. Therapies that stop or slow disease progression are still lacking, mainly due to incomplete understanding of the underlying mechanisms, particularly those that occur early and are potentially initiating. This is an important issue considering that most neurodegenerative conditions have a long prodromal phase before symptoms are manifested. Our project aims to investigate such early cellular and molecular mechanisms that eventually lead to neurodegeneration, using the paradigm of Parkinson’s disease (PD). To this end, we will take advantage of patient-derived induced pluripotent stem cell-based models that display disease-associated phenotypes, such as protein aggregation, defective synaptic connectivity and axonal neuroapthology. We will investigate not only neuronal pathology, but also neuron-glial interactions, particularly the protective or detrimental role of astrocytes in pathology.

How does the creation of a PIU meet your expectations for this collaboration?

Chiara Zurzolo’s laboratory at the Institut Pasteur (Paris) focuses on understanding fundamental cell biology processes, such as protein sorting and intracellular trafficking in neuronal cells, and on elucidating the mechanisms of protein and organelle exchanges between cells, with the aim of understanding how these pathways are altered in and contribute to the pathogenesis of neurodegenerative diseases. Rebecca Matsas’ laboratory at the Hellenic Pasteur Institute has applied cell reprogramming technologies to create patient-derived induced pluripotent stem cell-based models of PD both 2D cellular systems and 3D brain organoids, aiming to understand early events in neurodegeneration. Creating synergies by combining resources and expertise, the two teams wish to understand how protein misfolding and propagation occurs in Parkinson disease. They try to figure out whether this is a triggering event or the consequence of broader cellular dysfunction at multiple levels. The PIU enhances their collaboration towards accelerating the development of novel tools and the discovery of new findings, assists in identifying gaps, multiples impact and enhances visibility.

How are scientific exchanges organized within your “virtual” research unit – or PIU – and how important are they to your research project?

Due to restrictions posed by the COVID-19 pandemic and institutional lockdown at both ends, scientific exchanges have so far taken place through virtual meetings. Entering the next phase whereby laboratories will be fully functional, we envisage exchanges of young post-doctoral fellows and students that will travel for mutual transfer of technology and scientific expertise as well as access to available infrastructure. This is an important aspect for the success of the PIU.
PARTNERS AND CONTRIBUTORS, VITAL SUPPORT FOR THE PASTEUR NETWORK

Ongoing collaborations, partnerships and support are essential for the members. They also help the Pasteur Network’s work to thrive and flourish. Here are some examples from around the world.

MINISTRIES AND GOVERNMENT AGENCIES IN FRANCE AND ABROAD

- Chinese Academy of Sciences (CAS)
- African Academy of Sciences (AAS)
- Agence française de développement (AFD)
- Agence nationale de la recherche (French National Research Agency, ANR)
- French National Agency for Research on AIDS and Viral Hepatitis | Emerging Infectious Diseases (ANRS | MIE)
- Japanese International Cooperation Agency (JICA)
- Africa Centers for Disease Control and Prevention (Africa CDC)
- American Centers for Disease Control (CDC)
- Assistant Secretary for Preparedness and Response within the Department of Health and Human Services (ASPR/DHHS)
- Expertise France
- French Ministry of Europe and Foreign Affairs (MEAE)
- French Ministry of Higher education, Research and Innovation (MESRI)
- US Agency for International Development (USAID)
- Department of International Cooperation, Government of the Principality of Monaco
- Ministries of Health and Research in the host countries of Pasteur Network members

RESEARCH INSTITUTIONS

- All Aviesan member institutions
- Center national d’études spatiales (French National Space Center, CNES)
- Griffith University (Australia)
- Japanese Research Institute for Science and Technology (Riken)
- Monash University (Australia)
- National Center for Global Health and Medicine (Japan)
- The Peter Doherty Institute for Infection and Immunity (Australia)
- Hong Kong University (China)
- University of São Paulo (Brazil)
- Tokyo and Kyoto universities (Japan)

INTERNATIONAL ORGANIZATIONS

- European Commission
- European & Developing Countries Clinical Trials Partnership (EDCTP)
- Global Alliance for Vaccines & Immunisation (GAVI)
- Global Fund
- National Institutes of Health (NIH)
- World Health Organization (WHO)
- United Nations Food and Agriculture Organisation (UN FAO)

FOUNDATIONS, ASSOCIATIONS AND NGO

- African Society for Laboratory Medicine (ASLM)
- Agence universitaire de la francophonie (AUF)
- Bill & Melinda Gates Foundation
- Monaco Scientific Center (CSM)
- Drugs for Neglected Diseases Initiative (DNDI)
- Fondation de France
- Médecins du Monde
- Pierre Latteux Jeunesse Internationale Foundation
- Fondation Prince Albert II de Monaco
- Rotary International Foundation and district 1660 Rotary clubs
- SUEZ Foundation
- Total Foundation
- JANSSEN HORIZON
- MSD
- Nutricia Research Foundation
- Odyssey Reinsurance Company
- São Paulo Research Foundation (FAPESP)
- Welcome Trust

Thanks

We would like to thank all the collaborators working in the Pasteur Network, particularly those who allowed us to use their photo and/or who contributed to this report, which will increase the visibility of the network. We would also like to thank Françoise Barré-Sinoussi, honorary president of the Pasteur Network, together with the staff of the Pasteur Network association and the Department of International Affairs of the Institut Pasteur, for their day-to-day commitment.

We also take the opportunity to address our sincere thanks to all the teams at the Institut Pasteur (Paris) for their support and cooperation as well as to all the partners, institutions and donors, present and future, whose continuous support contributes to the development of cooperation programs within the Pasteur Network in the service for population health.
Pasteur Network
33 members in 25 countries
United for Global Health

pasteur-network.org

Institut Pasteur
25-28, Rue du Docteur Roux
75724 Paris Cedex 15

www.pasteur.fr