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Christiane Gerke, Armelle Phalipon, Frédéric Tangy

Human Vaccines & Immunotherapeutics

ISSN: 2164-5515 (Print) 2164-554X (Online) Journal homepage: https://www.tandfonline.com/loi/khvi20

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To cite this article: Christiane Gerke, Armelle Phalipon & Frédéric Tangy (2018) Bringing vaccinology to the world, Human Vaccines & Immunotherapeutics, 14:9, 2105-2106, DOI: 10.1080/21645515.2018.1490379

To link to this article: https://doi.org/10.1080/21645515.2018.1490379

HUMAN VACCINES & IMMUNOTHERAPEUTICS
2018, VOL. 14, NO. 9, 2105–2106
https://doi.org/10.1080/21645515.2018.1490379

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MEETING REPORT

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Institut Pasteur, Paris, France

The 2017 ISV Annual Congress was held in Paris at the Institut Pasteur on 5–7 October 2017. Founded by Louis Pasteur in 1888, Institut Pasteur is one of the most famous historical places and globally leading organizations dedicated to research in prevention and treatment of infectious and non-infectious diseases throughout the world. Since its inception, 10 Institut Pasteur scientists have been awarded the Nobel Prize for Medicine. With a network of 33 institutes worldwide, the Institut Pasteur operates in four main areas: scientific and medical research, public health and health monitoring, teaching and education, and business development and technology transfer.

As local co-organizer for the 2017 ISV congress, the Institut Pasteur brought the ISV community back to the roots where vaccines and vaccine science were invented more than a century ago. Since then, the Institut has developed vaccines against rabies, tuberculosis, yellow fever and hepatitis B, and created the world's first microbiology course. After 130 years, vaccine research is still at the forefront of Institut Pasteur's agenda. Today, the Institut is positioning itself for another century of breakthroughs by establishing a collaborative approach to vaccinology. A "Major Federating Program (*Grand Programme Fédérateur, GPF*)" was created in 2013 with focus on vaccinology. It aims to draw novel multidisciplinary approaches in vaccine research from basic science, accelerate preclinical vaccine candidates, increase the visibility of vaccine research at Institut Pasteur, and strengthen opportunities for industrial and public partnerships. To achieve these goals, the GPF provides an intramural funding system with competitive calls to stimulate new collaborations between multiple teams at the Institut Pasteur in Paris and the International Network, a supportive environment with relevant functions for vaccine development, as well as internal and external expert advice. Increasing these initiatives, the Institut Pasteur was honored to accept the opportunity to collaborate with ISV.

Furthermore, with focus on its mission on teaching and education, the Institut Pasteur has developed an international Vaccinology Course and a Massive Open Online Course (MOOC) in Vaccinology to share and promote knowledge and education in this evolving field. The organization of the 2017 ISV Annual Congress at Institut Pasteur coincided with the 10-year anniversary of the Vaccinology Course. In the context of this anniversary, the Institut Pasteur committee organized a session dedicated to vaccinology education to emphasize the need for teaching this complex multidisciplinary discipline around the world and to give an overview of some of the main existing courses. In addition, 4 young vaccinologists selected among the 246 alumni of the Institut Pasteur international vaccinology course presented their current work.

During the first part of the session, four international vaccinology courses were presented, and their directors discussed their content, organization, and differences.

Paul Henri–Lambert (*University of Geneva, Geneva, Switzerland*) presented the ADVAC (Advanced Course of Vaccinology, http://advac.org) organized by the Fondation Mérieux and the University of Geneva, a two-week training program held every year at Les Pensières, Annecy, France, and dedicated to decision-makers, including academia, industry, governmental and non-governmental agencies, in all fields related to vaccines and vaccination, with lectures given by over 60 top-level international lecturers and working group supervisors. It was discussed to organize a meeting in November 2018 gathering the directors of Vaccinology courses worldwide to build-up the future of the training of this discipline.

Adrian Hill (*The Jenner Institute, Oxford, UK*) presented the Vaccinology in Africa Courses (http://www.jenner.ac.uk/vaccinology-in-africa-course). These five-day courses are jointly organized by the Jenner Institute, the University of Oxford and the host African research institute, and supported by the Jenner Vaccine Foundation and other partners. The courses are specifically aimed at students, researchers, and professionals who are resident in Africa, and cover the main aspects of vaccinology, the vaccine development process, bio-manufacturing, regulatory and ethical issues. The courses have an exceptional faculty of academic and industrial speakers, and resonate with the 'One Health' agenda by highlighting human and veterinary links and synergies between the two fields from scientific, technological and regulatory perspectives. The courses are fully funded for successful applicants and covers travel within the African region, accommodation and meals.

Armelle Phalipon and Frédéric Tangy (*Institut Pasteur, Paris, France*) presented the Institut Pasteur international Vaccinology Course (http://www.pasteur.fr/en/vaccinology). This four-week course offers an integrated overview of vaccinology, from public health data and scientific results justifying the development of a vaccine up to its delivery to the populations

CONTACT Christiane Gerke christiane.gerke@pasteur.fr 25-28 Rue du Docteur Roux Paris, Paris 75724 Cedex 15, France.

in the context of industrialized and developing countries. The course also includes methodology workshops based on a partnership with the HSeT Foundation which has developed an e-learning website dedicated to the course. Participants are mainly medical and public health students, PhD students, scientists, physicians, pharmacists, and veterinarians. Fellowships are available to help students to participate. In addition, a Vaccinology MOOC was created in 2015 to propose to a very large audience a series of 36 sessions of 10 minutes each given by the lecturers of the Vaccinology Course of Institut Pasteur.

Jean−Pierre Kraehenbuhl (*HSeT, Epalinges, Switzerland*) presented IMVACC, a web−based international master in vaccinology (http://imvacc.org). Hosted by the University of Lausanne (UNIL), IMVACC is developed by the Swiss Vaccine Research Institute (SVRI) and the Health Sciences e-Training Foundation (HSeT) in collaboration with the Lausanne University Hospital (CHUV). IMVACC comprises one year of on-line teaching on vaccinology followed by a six months to one year specialization internship in a vaccine-related activity (industry, basic or translational research, regulatory affairs, etc.) including the preparation of a master's thesis. Graduates will gain a broad knowledge of how vaccines are designed, developed, manufactured and implemented through public health programs.

In the second part of the session, four young vaccinologists, alumni of the Institut Pasteur Vaccinology course, presented their current work and explained how the course helped them in building their career.

Lorena M. Coria (*Instituto de Investigaciones Biotecnológicas, Instituto Tecnológico de Chascomús, Buenos Aires, Argentina*) presented her work on the bacterial protein U-Omp19 from *Brucella* spp. as a potential vaccine adjuvant. U-Omp19 was previously shown to have protease inhibitor activity. By inhibiting main gastrointestinal proteases, this protein protects co-delivered antigens administered by oral route, thus increasing their immunogenicity. U-Omp19 also possesses immunostimulatory properties, such as induction of the recruitment and activation of antigen presenting cells (APC). In this presentation, emphasis was put on the capacity of U-Omp19 to also limit the proteolytic capacity of APCs and epithelial cells, therefore increasing co-administered Ag half-life inside these cells. These data might have an interesting impact in the design of new oral vaccines against infectious diseases.

"I attended the Vaccinology course in 2012 during my PhD thesis on the development of new vaccine adjuvants. Nowadays, I have obtained a position as Assistant Researcher at the National Scientific and Technical Research Council (CONICET) and I am also a teaching assistant of Molecular Immunology at the University of San Martin. The Vaccinology Course offered me an integrative view of the design, development and commercialization of vaccines contributing to a better understanding of vaccines world. I found it very motivating to have the possibility to share experiences with people from different areas (academia, teaching and enterprises) and to discuss together different ways to overcome the major issues in the vaccine development".

Ajibola Omokanye (*Mucosal Immunobiology and Vaccine Center -MIVAC- University of Gothenburg, Sweden*) presented new findings about the viral protein M2e, which is considered an attractive component of a universal influenza A vaccine. The canonical view is that antibodies against M2e are the prime effectors of protection. During this talk, evidence was provided showing that multifunctional memory M2e-specific $CD4^+$ T cells can be induced in the lungs of mice and critically contribute to protection against infection. Unexpectedly, memory M2e $CD4^+$ T cells were shown to be effective helper cells and strongly accelerated not only M2e- but also hemagglutinin-specific IgG production by activated naive B cells. These findings emphasize the importance of considering this protein for the development of a universal flu vaccine.

"In addition to a fantastic schedule of lectures, I found the knowledge exchange amongst international participants, with differing technical expertise, invaluable. The course provided an excellent foundation prior to commencing a 4-year doctoral research program in pandemic vaccine development".

Rafael de Freitas e Silva *(Bernhard-Nocht Institut of Tropical Medicine, Hamburg, Germany, State University of Pernambuco, Brazil*, and the Oswaldo Cruz Foundation, Brazil) reported his study on development of a vaccine against human leishmaniasis. Activated $CD4^+$ and $CD8^+$ T cells, producing and secreting IFN-γ are the best correlates of protection so far. Using *in silico* approaches combining modern sequence and protein structure algorithms applied to the whole predicted proteome from *L. braziliensis*, he presented the identification of conserved potential immunogenic epitopes with high affinity for both human MHC I and MHC II. This study opens the perspective for the development of a vaccine against leishmaniasis.

"I attended the Vaccinology course in 2014, while starting my PhD thesis at the Oswaldo Cruz Foundation (Brazil) on cutaneous leishmaniasis. The course was essential for me to get a better understanding of all the aspects, from disease epidemiology and antigen discovery to clinical trials and pipeline for production. I highly appreciated the opportunity to meet experts in the field and create my network with the participants of the course coming from abroad. I consider the course as key in my motivation to pursue a career in the field of vaccines against neglected diseases".

Chandrakant Lahariya (*Public Health Expert, New Delhi, India*) presented the recent advancements in the number of vaccine delivered in the national Immunization Program run by the Indian government. The country still has high under 5-year-olds and infant mortality rates. Thanks to policy dialogue and advocacy started late 2010 with key policy makers and program managers at union and state levels, by early 2017 a total of 6 new vaccines against Hepatitis B, *Haemophilus influenzae* type b, pneumococcal infections, rotavirus, measles (second dose) and rubella were introduced. This illustrates that with a high level of political ownership, institutional mechanisms can be strengthened for introducing health interventions.

"I have continued to advise the Ministry of Health, Government of India on health systems strengthening and new vaccines introduction after attending the course. The training I received has strengthened my skills to provide effective technical advice to policy makers and technical experts. In fact, in the process for decision-making to introduce new vaccines in my country, my capacity to combine my public health and clinical background with the new knowledge in vaccinology made the difference. To be noticed, I received an award from the Govt. of India for my key role in new vaccine introduction and health systems strengthening".