# Report TRANSVAC Stakeholder Workshop

## Brussels – 7 October 2011

To maintain the success and growth of the vaccine sector in Europe, it is important to foster a positive environment and initiate supportive policies to sustain Europe's lead in the vaccine field.

Vaccines are not only important for public health, but also for Europe's technological, social and economic development.

During a first meeting held in Brussels in October 2010, TRANSVAC Stakeholders recognised that there was a problem concerning the slow and incomplete transfer of research findings into practice, partly due to a lack of recognition of achievements in vaccine translational research. They made the recommendation, among others, to increase support to translational vaccine research in Europe. Among the suggestions to improve the situation are the establishment of new evaluation systems to improve peer review of translational research and improvement of education and training in vaccinology and vaccine development.

To this end, TRANSVAC organised a workshop in Brussels on October 7th, the first in a series of workshops aiming at establishing a roadmap to strengthen vaccine research and development (R&D) in Europe. This first "think-tank" workshop focused on two main topics: evaluation of translational research; and education and training in vaccinology.

Each of these topics was introduced by presentations which described the current context and/or gave examples of current initiatives. Most of the time was devoted to discussions in working groups, to:

- Explore potential evaluation systems and criteria that could lead to a better recognition of achievements in translational vaccine research, and potential incentives to make translational vaccine research attractive to young and bright academic researchers;
- Define the needs and gaps in education and training in vaccinology in Europe and explore how best to respond to these challenges.

## Promotion of Translational Vaccine Research

### Evaluation of translational research

The process of translating basic scientific discoveries to clinical applications – from the bench to phase II clinical trials – and ultimately to public health improvements, has emerged as an important, but difficult, objective in biomedical research. As stressed during the 2010 TRANSVAC Stakeholder Meeting, vaccine development is a lengthy and iterative process, best described as a "translation continuum", taking more than 10 years and requiring significant resources and expertise.

Translational research is not attractive to scientists working in the public sector: it is tougher than basic research; presents higher risks; requires multiple collaborations and partnership with industry; and is poorly valued. While basic research often leads to breakthroughs or paradigm-shifts, applied research would often represent an incremental improvement to current processes. The development gap is often filled by many small advances; technical improvements that include scale-up procedures; standardisation of biological and non-biological elements; assays and their validation; consistency of operations; optimisation of physicochemical and biological variables to increase yield; and decrease costs. These are generally not considered as 'scientific' advances and are poorly rewarded in the academic sector.

### Evaluation of research is based on publications

Journal publication is the basis for evaluation of public research; however, its norms are often difficult to achieve for translational research. High level scientific journals have been rather reluctant to publish such purely technical research. This is the reason why the journal *Vaccine* was founded in 1981 by Ray Spier - so as to have a place to publish work on the developmental aspects of scale-up and process optimisation in vaccine development.

Systems for assessing the quality of research are mainly based on publication metrics. Citation index and impact factors are the basis of evaluation. Each paper has a citation index which is a measure of the number of times the paper is referred to in the reference lists of other papers. The total number of times each paper in the journal is cited over a year divided by the number of papers determines the impact factor.

Numbers of downloads and ranking of the journals can also be used as also indicators. Downloads are the number of times a paper is downloaded as a .pdf. For *Vaccine*, the Impact Factor is 3.5, while the number of downloads is 2,000,000. Out of the 1,850 Elsevier journals, *Vaccine* is ranked 27 by downloads, 400 or so by citations and 800 by impact factor. According to Ray Spier, Impact factors are popularity indicators, while downloads depict more real values. Funding agencies are increasingly using the number of downloads or a mixt of these indicators for their evaluations.

## Developments in translational research

Awareness as to the need of support for clinical and translational research emerged in the early 2000s, when Elias Zerhouni, Director of the National Institutes for Health (NIH) witnessed that much of the progress in basic science that had implications for human health was not being translated. He was worried that translational and clinical research was "hampered by increases in costs and complexity, a dearth of information systems, and increases in the regulatory burden"; many promising young scientists were turning away from applied research and that product development in pharmaceutical and biotechnology companies was on the decline. To address these concerns, he proposed a series of initiatives that provide mechanisms for high-risk strategies, interdisciplinary research, and public-private partnerships, including "Innovator Awards" that provide support to young scientists with prospects for making seminal biomedical

research advances [Zerhouni 2003; 2005]. This acknowledgment also applies to vaccine research, which is by definition translational.

Journals devoted to translational research have been created and several initiatives have been launched. Translational medicine is also a main strategic goal for the European Commission (EC) that has launched programs such as the European Advanced Translational Research InfraStructure in Medicine (EATRIS) research infrastructure, Innovative Medicines Initiative (IMI), or TRANSVAC research infrastructure specifically for vaccines. Moreover, the EC promoted the establishment of national initiatives aimed at translational research.

### New journals devoted to translational research

Except for *Nature Biotechnology,* created in the 1980's (as *Bio/Technology*), which publishes new concepts in technology/methodology of relevance to the biological, biomedical, agricultural and environmental sciences as well as covers the commercial, political, ethical, legal, and societal aspects of this research (impact factor: 31.1 in 2010), journals devoted to 'translational medicine', have been launched only recently: *Science Translational Medicine* (monthly), started in October 2009, (impact factor: 3.511); the *American Journal of Translational Research* (Quarterly), started in January 2009; *Progress in Molecular Biology and Translational Science,* started in 2008 (impact factor 0.308); *Clinical and Translational Science* (bimonthly), started in 2008 (impact factor 1.558); *Translational Research: the Journal of Laboratory and Clinical Medicine* (monthly), started in 2006 (impact factor: 2.763).

## Recent national initiatives in translational research in Europe: several examples

### United Kingdom

The United Kingdom (UK) has multiple commitments to translation through the National Institute for Health Research (NIHR); Research Councils; the Technology Strategy Board; and charities, notably the Wellcome Trust. Translational vaccine research has been the focus of two main funding bodies: the Medical Research Council (MRC) and the Wellcome Trust, who both work closely with the NIHR and the Technology Strategy Board.

Since the inception of MRC's translational programmes, over £75 million have been committed to more than 140 projects. As part of its Translational Research Strategy, the MRC is launching a major new funding stream – the ***Developmental Pathway Funding Scheme (DPFS)*** - that may be followed by clinical support through the Developmental Clinical Studies (DCS) scheme to help strengthen the translation of fundamental research towards patient benefit. The DPFS does not fund discoveries of new causes or risk factors of disease, biomarkers, drug targets, biomaterials or research tools, but takes these as starting points and supports their application to improve healthcare and benefits for patients. Projects supported by the DPFS must have clearly defined milestones, outcomes and future value. The endpoints of the project, if successfully attained, should reasonably enable the project to attract further support, if required, to allow the project to meet its clinical aim.

***The DCS*** are early stage clinical studies aimed at proof of concept. While much of the application and assessment process for DCS is the same as for research grants, such projects should be milestone driven with "go, no-go" decisions being taken at each milestone. This enables projects to be supported when later stages of the work are dependent on the success of earlier stages.

***UK National Institute for Health Translational Initiatives.-*** UK Secretary of State for Health announced £775 million for the NIHR's 5-year open competition for Biomedical Research Centres and Units (BRCs and BRUs) starting April 2012. In 2010/11, the NIHR spent over £210 million on research grants of short-term clinical relevance. Much of this has been translational funding. For example, a rapid response call for H1N1 pandemic flu funded 14 studies.

Launched in 2007, the UK's ***Technology Strategy Board*** (TSB) aims to further the UK's industrial innovation capacity. It works in concert with UK Research Councils to assure the seamless translation of ideas from concept to product. The primary funding recipients are companies that can partner with universities either directly with TSB funding, or through a joint TSB/Research Council collaboration.

For start-ups and spin-outs, the TSB can offer support with business angels, venture capital and other mentors. Science Parks can benefit from TSB support. Pre-start-up university ventures may be supported so as to transition from academic research team to new company. There are three types of grants: proof of market; proof of concept; and development of prototype. Knowledge Transfer Partnerships are a TSB tool that allows companies to access university-based talent and training, translating these into new corporate outcomes.
A recent example of TSB Research Council support is the joint funding with the Biotechnology and Biological Sciences Research Council (BBSRC); MRC; and the Engineering and Physical Sciences Research Council (EPSRC) of the "Nutrition for Life" programme. While vaccines are not currently on the agenda, the case should, nevertheless, be made.

***The Wellcome Trust*** was a precursor, and as early as 1997, launched incentives for translational research, the aim being to advance the development of an innovation to the point where it becomes attractive for others - venture capital firms, industry or public-private partnerships - to take up the challenge of producing a product for the market. It is currently providing translation awards (up to £20 million annually); strategic translations awards (up to £20 million annually); health innovation challenge fund (£20 million annually), and seeding drug discovery (£22 million annually) funding. During 2009/10, 17 inventions arose from Wellcome Trust Translation Awards, compared to seven in the previous year. Overall, nearly one-third (30%) of Wellcome Trust grants ending during 2009/10 reported engagement with policy makers and healthcare professionals. As in previous years, grants supporting 'Populations and Public Health' research were most likely to have engaged with policy makers and health professionals, both during and as a result of their research (67%) [Wellcome Trust Annual report 2010].

## Germany

Translational research has involved both the federal states (Länder) and the Federal governments. They may join forces to establish regional centres, called "BioRegions". Germany has focused most of its translational commitment on the Helmholtz Centres, backed by specific Ministry for Education and Research (BMBF) initiatives. Unlike the basic research ethos of the Max-Planck centres, the Helmholtz Centres are translational. Two of them are devoted to health research: the Helmholtz Centre for Environmental Health (GSF) and the Helmholtz Centre for Infection Research in Braunschweig.

***The Helmholtz Centre for Infection Research***, originally the German Society for Biotechnology (GBF), was renamed in 2006 at which time the focus of work swung to infection. The Helmholtz Centre for Infection Research (HZI) is organised in the form of a GmbH (or "Ltd."). The shareholders of the HZI are the Federal Republic of Germany (90%) and the two federal states of Lower-Saxony (9%) and Saarland (1%). This is enhanced by third-party funding mostly from the Ministry of Education and Research, the German Research Foundation and EC 7$^{th}$ Framework Programme (FP7) funding. It works in partnership with the German Centre for Infection Research (DZIF), a network of outstanding research institutions initiated by the BMBF.

## France

France is currently reorganising the structure and strategy of research funding in institutes and universities. Research will slowly be transferred from Research Council Laboratories (RCL) to university laboratories as in the Anglo-Saxon model. The main RCLs with vaccine interests are National Institute of Health and Medical Research (INSERM), and to a lesser extent National Centre for Scientific Research (CNRS), and Atomic Energy Commission – with strong life-sciences activity (CEA). INSERM's tech transfer halfway house, Inserm Transfert, is instrumental in bridging the gap from research to commercialisation. In the area of vaccinology, INSERM has had the largest impact of the RCLs, although both CNRS and CEA have been involved in this research, too.

The Institut Pasteur is a Foundation with public and private charitable contributions. Historically, the Institut Pasteur has been a world leader in vaccinology. From the outset, the Paris-based headquarters of the Institut Pasteur was translational in philosophy. Arguably, the Institut Pasteur has lost sight of this imperative as it became a renowned centre for fundamental research in molecular biology. Over the years, the Institut Pasteur has worked closely with Pasteur-Mérieux serums & vaccins (now Sanofi-Pasteur), but that link is now more tenuous as is the infrastructure for vaccine research in the Institut Pasteur. The Institut Pasteur was one of the original leaders in HIV research, but now much of the HIV vaccine activity is conducted outside the Institut Pasteur, in INSERM laboratories, for example.

The French National Alliance for Life Sciences and Health (aviesan) groups the main stakeholders of life and health sciences in France, including INSERM, CNRS, CEA and the Institut Pasteur; and universities and university hospitals. It was set up in 2009, in response to the

commitment to ramp up French research performances by fostering its consistency, creativity and excellence. This mission calls for scientific coordination of the main research themes – which concern all organizations – as well as operational coordination of projects, resources and funding.

Translational vaccine research has been supported by national initiatives such as the "Pôles de Compétitivité" (initial budget: € 2 billion over a 10-year- period, starting November 2010) and the "Laboratoires d'excellence" (a vaccine centre is planned).

***Pôles de Compétivité***. - In much the same way as Technology Innovation Centres are aimed to improving national competitiveness in the UK, les Pôles de Compétitivité - with a similar budget - will do the same for France. Les Instituts de Recherche Technologique (IRT) are national centres of excellence in areas of interest, usually but not always, concentrated on one physical site.

The IRT LyonBiotech will be centred in Lyon with secondary activity in Paris at the Institut Pasteur. The emphasis of this IRT is on infectious disease research. Corporate partners include bioMérieux; Sanofi-Pasteur; Danone; Institut Pasteur and many others. LyonBiotech will initially be backed with €700 million of which €200 million will come from central government and €50 million from the Rhône-Alpes Région. The Lyon-based IRT will be formally launched before the end of 2011.

***Laboratoires d'excellence.-*** This initiative is seen as being complementary to the IRT. Whereas the IRT is a major infrastructure initiative, the laboratoires d'excellence are designed to give translational strength to existing laboratories. With initial funding of €100 million for 100 projects and a capital of €1 billion to cover operating costs, these laboratories should soon be self-sustaining (comment: not sure if current interest rates will do so!). The project was announced in April 2010 for a kick-off in late 2011.

One of the first proposals is for the creation of a Vaccine Research Institute (VRI) targeted at HIV and the viral hepatitis. This project, managed by the university of Paris-Est Créteil Val de Marne, will create a network of laboratories near Paris and in Bordeaux and Strasbourg. Just how far down the translational pathway this will go is as yet unclear.

In the framework of the 'investissements d'avenir', the 'health and biotechnology' actions, with a funding of € 1.55 billion for six calls with the aims, among others, to support integrated and comprehensive approaches of the biological systems; solve technological and methodological issues; foster innovation based on biological engineering; foster public-private partnerships, and induce economical activities.

## Evaluation systems: a few examples

Funding agencies have established criteria and indicators of for evaluation of project applications and research.

## Project evaluation

The criteria used for evaluation of projects submitted in the framework of translational programmes address the need that the proposal is seeking to address and its adequacy with national and European strategies; the expected impact of the project and valorisation strategy; the rationale for the proposed solution and its scientific and innovative quality; the robustness of the design, methodology, analysis and development plans; the resources requested and collaborations with the scientific community and with industrial partners. Milestones have to be defined, with "go, no-go' decisions to be taken at each milestone, when later stages of the work are dependent on the success of earlier stages.

| **Key evaluation criteria for translational research applications** | |
|---|---|
| **Need / Medical importance / Significance of the project** | How important are the needs, questions, or gaps in knowledge that are being addressed? Are they significant (in terms of health burden, biological importance, gaps in knowledge)?<br>What is the adequacy with national and European strategies? |
| **Translational potential** | What is the valorisation strategy? What is the expected impact in terms of generation of new knowledge, enabling technologies, product development, health and socio-economic impact, education programmes? Is there a realistic "window of opportunity", i.e., is there a chance to introduce a new advancement into practice? |
| **Innovation and methodology** | What is the supporting evidence for the proposed solution? Have major scientific, technical or organisational challenges been identified and anticipated and how will they be tackled? How appropriate and innovative are the general plans or specific methods? Are the methods and study-design appropriate and competitive with the best in the field? Is the project management plan appropriate? |
| **Feasibility** | Is the proposed development plan realistic? What are the prospects for good scientific progress? Does the team have access to the necessary assets to deliver the plan?<br>How clearly have the authors identified the milestones and the next steps that would result if their objectives for this study were met? How feasible and likely are these plans?<br>Are the funds requested essential for the work, and do the importance and scientific potential justify funding on the scale requested? |
| **Resources** | Are the funds requested essential for the work and do the importance and scientific potential justify funding on the scale requested?<br>What are the collaborations with the scientific community? With industrial partners? Is there an appropriate intellectual property strategy in place to optimise the chances of downstream partnering? |

## Performance assessment - Evaluation of progress

The Wellcome Trust has developed a series of high-level indicators of progress in translational research that are based on both quantitative and qualitative information, to provide an overview of how and where their support is making a difference. They use six outcome measures (discoveries, applications of research, engagement, research leaders, research environments, and influence) and 12 indicators of progress, which are reported against annually [Wellcome Trust Strategic Plan, 2010-20].

| Outcome measures | Indicators of progress |
|---|---|
| **Discoveries** | - Significant advances in the generation of new knowledge and understanding<br>- Contributions to discoveries with tangible impacts on health |
| **Application of research** | - Contributions to the development of enabling technologies, products and devices<br>- Uptake of research into policy and practice |
| **Engagement** | - Enhanced level of informed debate on biomedical science issues<br>- Significant engagement of key audiences in biomedical science, and increased audience reach |
| **Research leaders** | - Development of a cadre of research leaders<br>- Evidence of significant career progression among those supported |
| **Research environment** | - Key contributions to the creation, development and maintenance of major research resources<br>- Contributions to the growth of centres of excellence |
| **Influence** | - Significant impact on science funding and policy developments<br>- Significant impact on global research priorities |

In a paper recently published in Science Translational Medicine by Robert Pozen and Heather Kline (3 August 2011), a detailed framework is proposed for performance assessment of translational research organisations, based on key performance indicators and metrics by which to track progress towards.

Seven measures are proposed: funding; talent; creation; validation; dissemination; external uptake, and collaboration. The relative importance of each dimension may vary among translational research organisations (TROs) that may decide to de-emphasise one or more dimensions in light of their goals, and are encouraged to develop their own key performance indicators and metrics when appropriate.

These criteria, proposed for the evaluation of translational medical research, could be adapted to the field of translational vaccine research.

One point that was particularly discussed during the TRANSVAC workshop was the issue of negative results. Negative results are usually not published and not considered (or unfavourably considered) for assessment of research. All agreed that, unless they are due to a poor study design, they may be rich in information and should be made available – and be considered favourably.

## Incentives

The funding mechanisms from national public-sector research agencies have been effective in fostering basic research, primarily through investigator-initiated programs. However, these mechanisms are not optimal for attracting new talent to vaccine research, fostering innovation in vaccine discovery, establishing links with industry or providing long-term multidisciplinary commitment. Translational research programmes need to be expanded to connect basic science with existing vaccine-development tools. Building on successful examples, new translational-research funding mechanisms and incentives should be instituted.

Funding for translational research has generally been limited to 3-5 year programmes that primarily support small academia consortia and lack many of the industrial-style disciplines needed for vaccine discovery and development. Young investigator awards could be set up for vaccine research. These awards would attract the best new scientists to the challenges of vaccine R&D by offering 5–7 years of salary and flexible funding. Developing such grants would require stakeholders, including public-sector research agencies and non-profit foundations to invest in young scientists as components of multidisciplinary teams, rather than relying on traditional investments in specific projects [Koff W, Nature 2010].

Public institutions need to be able to (attractively) offer innovation technology expertise, and have the opportunity to offer attractive academic career paths and competitive salaries. The lack of these attractive perspectives in the academic sector leads to a brain drain from public to private, and those who start working in the industry rarely reverse to academic positions.

The wide variety (and complexity) of vaccine products and their production processes require technologies, expertise, production infrastructure and regulatory insight. The workshop participants stressed that development stages should be planned at an early stage of research, an integrated approach be adopted, and collaboration with regulatory agencies and industry be instituted at an early stage. Regulatory agencies are responsible for ensuring that vaccines released for public distribution are evaluated properly and meet international standards of efficacy and safety; they provide general recommendations for regulatory pathways for industry to use in the development of vaccines. Academic scientists working in the early phases of vaccine R&D are not familiar with regulatory issues. It is, however, crucial that their research addresses issues that are important for regulatory authorities, and is carried out with validated methods, so that their results can be translated into products. They would benefit from advice from regulatory authorties, in order adapt their research to the requirements .

Mechanisms to enhance biopharmaceutical investment, particularly in process development for vaccines, could include advanced market commitments, intellectual-property incentives, and direct public-sector support for vaccine R&D.

But above all, insisted the TRANSVAC participants, the best incentive for translational vaccine research is the creation of a favourable environment where the value of vaccination in public health is recognised, vaccines are perceived as a common good, and vaccine research as the best approach to address public health needs; where communication and collaboration with regulatory authorities and industry are possible at an early stage, which means that intellectual property and conflict of interest issues are addressed and solved at an early stage.

## ACTION POINTS

## I. Translational research:

### Evaluation of translational vaccine research

- Define criteria for evaluation of vaccine translational research projects
    - Development and later steps to be integrated from the beginning
    - Milestones to be defined
- Define the main criteria for evaluation of vaccine translational research organisms /scientists
- Value negative results as a critical input for further steps (e.g. publications)
- Identification of outside experts on relevant issues

### Incentives

- For young investigators:
    - Prizes for translational research
    - Longer funding periods, particularly for early stages of development
    - Young investigator awards offering 5-7 years of salary and flexible funding (cf. W. Koff)
- Attractive academic career paths and competitive salaries
- Favorable environment:
    - Consolidate relationship with later stage partners - Interface with industry and regulatory before phase I clinical trials
    - Create collaborations, partnerships and networks of excellence
    - Strengthen communication and vaccine advocacy
        - Tailored messages for specific target groups
        - Recognition of vaccination in public health
        - Vaccines perceived as a common good
        - Vaccine research as the best approach to address public health needs
        - Improve post-marketing communication on vaccines
- Mechanisms to enhance biopharmaceutical investment in process development for vaccines:
    - Provide industry with evidence that projects are worth taking to the market and that consortia are working together , avoiding duplication
    - IMI-type funding to bring industry and academics together

- *Advanced market commitments*
- *Intellectual property incentives*
- *Direct public sector support for vaccine R&D*

# Education and Training in Vaccinology

## Vaccinology: a multidisciplinary field

Vaccinology is a special field due to its true multidisciplinary nature. It includes immunology, microbiology, epidemiology, infectious diseases, paediatrics, clinical development; biotechnology (cell culture, fermentation, recombination technology), production processes, lyophilisation, preservation, shipping, cold chain, quality control, quality assurance, supply chain management; public health and economics; sociology; ethics; communication; and more.

During the TRANSVAC Workshop, Health Sciences eTraining Foundation (HseT), a non-profit organisation dedicated to web-based learning and teaching activities in the field of health sciences, with the Institut Pasteur, presented an example of e-Learning and e-training in vaccinology.

e-Teaching provides novel pedagogical approaches and tools to help trainers make the most of their teaching. Through institution-specific websites, e-Training offers customised curricular content and learning activities targeting different audiences. They offer the advantage of providing curricula that can be reviewed by learners in a self-directed way, at a distance, or in combination with face-to-face training (blended); it provides a highly interactive, self-paced education: Access is available anytime, anywhere around the globe; it is traceable through powerful student-tracking systems and can be updated on demand.

Vaccinology was not recognised as a specific field of its own. Some aspects of vaccinology are included in various curricula: medicine; biological sciences; pharmaceutical sciences; nursing; midwifery; biotechnology. But until recently vaccinology was not taught as a stand-alone course.

The first chair in vaccinology in Europe was created in 2000 at the University of Geneva, and the first comprehensive course in vaccinology (Advanced Vaccinology Course, ADVAC) was established in 2000, both of them with the support of the Fondation Merieux. Since then, initiatives in vaccinology education have been emerging.

## The current context

In Europe, there are currently several curricula specialising in vaccinology:

- Post-graduate courses leading to university diplomas in vaccinology

### Two-year Masters programs

- A two-year **Masters program** in vaccinology and pharmaceutical clinical development, jointly sponsored by the University of Siena Medical School and Novartis Vaccines and Diagnostics, Siena, was established in 2009. It provides

graduates in medicine with training in all aspects of developing vaccines, from basic research to health authority approval and beyond, and prepares students for a career in academia, public health or vaccine clinical development, or within the pharmaceutical industry.

- A two-year Masters II "Professionnalisant" in Cellular and Molecular Infectiology and Vaccinology is delivered at the University of Tours (France). It educates graduated students in vaccine R&D, clinical trials and regulation and prepares to positions in industry, clinical trial centres or regulatory agencies.

- A two-year **Masters II program** in vaccinology is to be established in France for graduates in medicine and pharmaceutical industry managers, as part of a project of a Vaccine Research Institute (VRI), a network of several universities coordinated by the Paris-Creteil University.

### One-year post-graduate programs:

- Diplome Inter-Universitaire (DIU): a one-year post-graduate program validated by an inter-university diploma in vaccinology, organised by the Universities of Lyon-1 and Paris, for medical doctors, pharmacists, veterinarians and scientists. Both residential and e-Learning.

- International Francophone Vaccinology Course, first organised in 2006 by the University of Bordeaux in partnership with the French Army Health Services and the support of the French Society of Exotic Pathology, for scientists, medical doctors, pharmacists and other francophone health personnel involved in vaccine research and/or clinical development; design and implementation of vaccination programs; surveillance of vaccine-preventable diseases; evaluation of vaccine efficacy; pharmacovigilance, or vaccine administration. A one-year program delivering a university diploma.

- The Institut Pasteur/CNAM[i] Vaccinology Course, created in 2006, is a one-month residential course in combination with e-learning and personalised tutoring. This course is dedicated to medical post-graduates or professionals. It is delivered within the framework of the Masters in Epidemiology and Public Health (EPI), is open to candidates with a medical or scientific training background who are interested in all aspects of this new discipline: medical and public health students, scientific Master II and PhD students (immunology, Microbiology), physicians, pharmacists, veterinarians and other health professionals. It delivers an Institut Pasteur /university diploma that gives credits for doctoral students.

- Vaccinology modules giving credits for undergraduate or graduate students

- The University of Antwerp launched a summer school on vaccinology in 2009 with the establishment of a scientific chair in evidence-based vaccinology. It benefits from the support of World Health Organization (WHO) and the EC. It is a one-week course for undergraduate health care students (students in human and veterinary medicine, nursing and midwifery).

- University of Oxford provides a Vaccinology Programme for professional development: a five-day (master's level course) on human and veterinary vaccinology; and a two-day course on clinical vaccine development and vaccine biomanufacturing.

- The London School of Hygiene and Tropical Medicine provides a Human and Veterinary Vaccinology course. It is a five-day module for Master's level courses.

- The Institute of Tropical Medicine and International Health, Charité - Universitätsmedizin Berlin delivers a module of one week plus three days for assignment writing and tutoring, as part of the Master of Science Programme in International Health. It is a flexible, modular degree programme for full-time and part-time students in Europe and overseas within the tropEd Network.

- The University of Tampere (Finland) delivers a five-day course in vaccinology as an integrated module in the Tampere Graduate Program in biomedicine and Biotechnology, jointly administered by the Institute of Biomedical Technology (IBT) and the School of Medicine.

➢ Professional development / Continuing education in vaccinology

- The Advanced Vaccinology Course (ADVAC), established in 2000, is a two-week international training program organised by the Fondation Mérieux and the University of Geneva, together with other partners (Centre for Disease Control, NIH, WHO, European Society for Paediatric Infectious Diseases, European Centre of Disease Prevention and Control, National Foundation for Infectious Diseases); it benefits from financial support from the EC and the Bill & Melinda Gates Foundation, and an unrestricted grant from the vaccine industry. ADVAC addresses decision-makers from academia, industry, governmental and non-governmental agencies in all fields related to vaccines and vaccination. ADVAC has been entitled to deliver Continuing Medical Education (CME) credits by the European Accreditation Council for Continuing Medical Education (EACCME); these credits can also be validated in USA.

- The European Programme for Intervention Epidemiology Training (EPIET) provides training and practical experience in intervention epidemiology at the national centres for surveillance and control of communicable diseases in the European Union (EU) and includes one module in vaccinology.

There is also a variety of courses in vaccinology around the world: in the USA, Canada, Australia. In India, a two-week course in vaccinology is delivered by the Institut Pasteur of India; a 10-day course IND-VAC is organised by the Christian College, Vellore, with support from the Department of Biotechnology of India; the Norway Research Council; PATH, and Indian organisations. In Korea, the International Vaccine Initiative (IVI) provides a six-day vaccinology course. In South Africa, Wits Faculty of Health Sciences established a vaccinology chair and the University of Cape Town provides an annual one-week African Vaccinology Course for EPI managers, medical doctors, nurses, public health practitioners, and scientists in Africa who work in the field of vaccinology. In francophone Africa, a new course in vaccinology has been established through cooperation between the University of Bordeaux and francophone African universities.

**Learning activities developed by the HSeT/Institut Pasteur on "Immunology online: Basic and clinical immunology and vaccinology."**

| Approach | Source material | Skills | Activities |
|---|---|---|---|
| **Case-based learning** | Clinical cases | Problem solving,<br>Conceptual understanding,<br>Communication | Web learning<br>Group discussion |
| **Article-based learning** | Scientific or clinical articles | Conceptual understanding<br>Writing experimental protocols<br>Communication | Web learning<br>Group discussion |
| **Protocol based learning** | Clinical protocols | Writing clinical protocols<br>Conceptual understanding<br>Problem solving | Web learning<br>Group discussion |
| **Standard Operating Procedure (SOP) based learning** | SOP (e.g., lab) | Lab expertise<br>Conceptual understanding<br>Writing SOPs | Web learning<br>Group discussion<br>Lectures |
| **Virtual lab** | 3D working spaces | Good Clinical Laboratory Practice (GCLP) implementation<br>Problem solving<br>Lab assay expertise | Web learning<br>Group discussion |
| **Virtual microscopy** | Scanned histology & pathology annotated slides | Histology & pathology expertise | Web learning<br>Group discussion |

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|---|---|---|---|
| | | Diagnostic skills | |

Concept Heidelberg, on behalf of the European Compliance Academy (ECA) develops in-house, on-site and e-trainings on Good Manufacturing Practice (GMP), that give an overview over the comprehensive national and international regulations as well as on relevant GMP guidance's for specific environments. The programme also takes into account site specific issues or instructions (SOPs) as well as current causes. While Basic Trainings provide GMP fundamentals, Special Trainings help to advance knowledge or to gain knowledge in specific areas.

# How big is the gap in education and training in vaccinology? How to fill the gap?

Recognising that education is one of the cornerstones of the Knowledge Triangle, participants in the TRANSVAC workshop identified domains where education and training in vaccinology should be strengthened.
The TRANSVAC stakeholders therefore deem it critical to strengthen knowledge in vaccinology for:

- Health care professionals who advise their patients on vaccination and administrate vaccines;
- Public health officers and decision-makers who have to define and implement vaccination programs;
- Scientists in the public or private sector, working in the design and development of new vaccines, or improvement of existing vaccines.

The workshop participants deemed it of critical importance, in spite of the recent initiatives, that the education of health care personnel as well as in education and training of students specialising in vaccinology was of the highest priority.

## 1. Health care workers

- A survey carried out in the framework of the Vaccine Safety, Attitudes, Training and Communication (VACSATC) EU-project in medical schools, universities and nursing institutions in Belgium, Bulgaria, Italy, Romania, Slovenia, Spain, and Sweden, showed that fewer than 60% of students reported to have received training in current safety issues and controversies in vaccinology. Only 44% indicated that they received training on how to communicate with patients and parents about vaccination; only 50% of the students reported receiving practical training in administering vaccines. These gaps were confirmed by the curriculum managers. Even if vaccination/immunisation is a learning objective in their curriculum, vaccinology is not taught in a stand-alone course in any of the covered curricula. In total, 58 different courses were mentioned that covered some aspects of vaccination. Microbiology, infectious diseases, immunology, epidemiology and paediatrics were the most frequent ones. Training on vaccinology items is spread over several years and courses in the curriculum. About 37% of medical students and 38% of nursing students do not feel confident enough to communicate about vaccine risks and benefits; >85% of the students expressed the need for more training on immunisation [Vosters et al, Vaccine2010]. These results led to the organisation of the summer course on vaccinology of the University of Antwerp.

Although a few vaccinology modules have been established recently, this was considered as insufficient. This lack in vaccinology training is even more acute in Eastern Europe. The working groups recommended the development of modules in vaccinology be integrated into the curriculum of health care workers (medicine, veterinary, pharmacy, nursing and midwifery students).

### 2. Specialist training in vaccinology

The working groups also noted gaps in postgraduate education and training in vaccinology. They recommended the development of Masters – and PhDs – in vaccinology, combining a broad vaccinology basis and various combinations of specialised modules, including modules of applied vaccinology.

It was proposed that this education in vaccinology be based on a network of European vaccinology centres (centres of excellence) with vaccinology chairs and partnerships with industry. Since vaccinology requires a suitable combination of education (knowledge), practical training (know-how) and experience, such curricula require collaboration with industry for students. It was recognised that finding an industrial partner willing to offer training may be very challenging. Conflicts of interest and issues linked to the intellectual property may represent important bottlenecks that preclude formal industry-academic partnerships. There is a need to build trust and partnerships between academia and industry.

Another issue is to train the trainers and to attract top-level scientists in the public domain. As already mentioned above, public institutions need to propose attractive academic career paths and competitive salaries. The need for support of the media to help create the necessary favourable environment was also mentioned. This issue was not further discussed, but proposing modules in vaccinology for (science) journalists could be considered. Also, better education of the population on vaccines could be considered through strengthening education of school teachers in charge of health education in schools.

Combining e-learning and e-training with residential courses and personalized tutoring was highly recommended.

## ACTION POINTS

### I.- Education and training

- Create vaccinology chairs and European and National vaccine centres of excellence
- Strengthen expertise in innovation technology in the public sector
- Create vaccinology modules adapted to the various targets:
    - Vaccinology to be part of the medical / health care workers curriculum
    - Create masters and PhD schools in vaccinology – networks of excellence in vaccinology
    - Create broad basis in vaccinology and specialised modules. Create modules of applied vaccinology

  - Create modules to "train the trainers"
  - *Create modules for journalists (in collaboration with schools for scientific journalists)*
  - *Modules for school teachers?*
- Define modules to be part of the various curricula
- Include training(know-how) in the education (knowledge) in vaccinology
  - Include long-term training in Contract Manufacturing Organisations (CMOs).
  - Build partnerships between academia and industry - Build trust between academia and industry:
    - Problems of conflicts of interest and intellectual property to be solved
- European College of Physicians to oversee and validate European diplomas in vaccinology
- Education and training needs to be complemented with attractive career pathways in vaccinology (in the public sector)
- Strengthen continual professional education / specific courses for those already in the field (e.g. ADVAC?)

## Follow-up

The recommendations made by the participants of this workshop will be used by the specific working groups on the two subjects: 1) vaccine translational research and 2) training in vaccinology. These working groups will aid in the development of a European Roadmap for Vaccine Research and Development under the coordination of the TRANSVAC consortium. This endeavour will start early 2012.

A second workshop is planned for April 2012. Please visit the website www.transvac.org for updates and information.

[i] Cnam = Conservatoire national des arts et métiers –