Vaccine 37 (2019) 2871–2881

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Conference report

Global vaccinology training: Report from an ADVAC workshop

Philippe Duclos [a,*], Lindsay Martinez [b], Noni MacDonald [c], Edwin Asturias [d], Hanna Nohynek [e], Paul-Henri Lambert [a], on behalf of all participants of the Global Vaccinology Training Workshop

[a] University of Geneva, Centre de Vaccinologie, 1 rue Michel Servet, 1211 Geneva 4, Switzerland
[b] Independent consultant, 13 Chemin Maurice Ravel, CH-1290 Versoix, Switzerland
[c] Dalhousie University, Division Pediatric Infections, IWK Health Centre, 5850/5980 University Ave, PO Box 9700, Halifax, Nova Scotia B3H 4R2, Canada
[d] University of Colorado School of Medicine, 13199 E. Montview Blvd, Suite 310, 80045 Aurora, United States
[e] National Institute for Health and Welfare Department of Vaccines and Immune Protection, 166 Mannerheimintie, P.O. Box 30, FI-00271 Helsinki, Finland

ARTICLE INFO

Article history:
Received 21 December 2018
Received in revised form 18 February 2019
Accepted 25 February 2019
Available online 18 March 2019

Keywords:
Vaccinology
Vaccines
Vaccinology training
Advanced vaccinology training
Global
Workshop

ABSTRACT

At a workshop on 7–8 November 2018 the leaders of 26 advanced vaccinology courses met to carry out an extensive review of the existing courses worldwide, in order to identify education gaps and future needs and discuss potential collaboration. The main conclusions of the workshop concerned: opportunities for strengthening and expanding the global coverage of vaccinology training; evaluation of vaccinology courses; updating knowledge after the course; how to facilitate post-course 'cascade' training; developing and sharing best practices; the application of online and innovative approaches in adult education; and how to reduce costs and facilitate wider access to vaccinology training. The importance of collaboration and information exchange through networks of alumni and between courses was stressed. A web platform to provide information about existing courses for potential applicants is needed. Lack of sustainable funding is a constraint for vaccinology training and needs to be addressed.

1. Introduction

In response to the need for specialized training in vaccinology worldwide, in 2000 the ADVAC program was launched as a partnership between the University of Geneva and the Mérieux Foundation. Since then, ADVAC has organized annual international training courses in advanced vaccinology (hence the acronym), and several other organizations in various countries have also provided training in advanced vaccinology. Some authors have flagged the importance of vaccinology training and remaining gaps and underlined the need for synergies between courses [1–3]. Yet there had not been any assessment of the collective impact of these programs, or any attempt to organize formal international collaboration. Hence ADVAC took the lead and organized a workshop to review, with leaders of current vaccinology courses, the current status of advanced vaccinology training around the world and its future development (Annex 1).

The workshop was held on 7–8 November 2018 at the Les Pensières Center for Global Health in France. It brought together the leaders of 26 vaccinology courses (listed in Annex 2) representing 14 global, 8 regional/sub-regional, and 4 national programs. A total of 39 vaccinology courses had been identified via an internet search, by the ADVAC scientific committee and through word-of-mouth. The leaders of 27 courses were invited to participate in the workshop, of whom 26 attended. In the selection, preference was given to currently available courses, geographic diversity, and low- and middle-income country representation. For the purpose of this workshop, infectious disease and pre-degree courses, courses focused on a single topic, e.g. vaccine safety or on basic on-the-job training, and periodic vaccinology conferences and symposia were not included. In preparation for the workshop, representatives of the 26 courses completed a standard questionnaire covering the content of their course, its format, periodicity, participants, funding, and other parameters (see Annex 3). A detailed analysis of this information will be the subject of a separate publication.

The workshop consisted of plenary discussions facilitated by introductory presentations (see Annex 4); this article reports the key points from the presentations and the outcome of the group's discussions.

* Corresponding author at: Centre de Vaccinologie, Université de Genève, 1 rue Michel Servet, 1211 Geneva 4, Switzerland.
E-mail addresses: Philippe.Duclos@unige.ch, philippe.duclos@k-net.fr (P. Duclos), lindsay-martinez@bluewin.ch (L. Martinez), noni.macdonald@dal.ca (N. MacDonald), Edwin.asturias@childrenscolorado.org (E. Asturias), hanna.nohynek@thl.fi (H. Nohynek), Paul.Lambert@unige.ch (P.-H. Lambert).

https://doi.org/10.1016/j.vaccine.2019.02.062
0264-410X/

2. Objectives

The specific objectives of the workshop were to: perform a landscape analysis of the existing vaccinology courses, focusing on advanced training; examine the organizational and financial structure of vaccinology training globally; define target audience (s), education gaps and future needs; consider how best to facilitate post-course 'cascade' training; identify best practices for vaccinology training; promote the use of modern educational best practices and technologies to optimize training; examine options to reduce costs and facilitate wider access to training materials; and explore opportunities for collaboration and synergy between training programs.

3. Overview of existing vaccinology courses

Global vaccinology-specific courses began around the turn of the century, with limited increase in the number of courses until 2006, since when there has been a steady increase. As of mid-2018, almost 9500 trainees had attended in-person courses represented at the workshop, and 9800 had taken one of the online courses. The courses varied in their target audiences, objectives, content, format, length and periodicity. Of the 26 courses, 14 represented at the workshop addressed global audiences and 12 were provided for regional/sub-regional or national participants. Geographically, access to vaccinology courses was very uneven, with large gaps in several parts of the world, particularly countries in the Middle East and eastern European regions. Most courses were designed for public health personnel at the graduate, post-graduate or continuing education levels. The breadth and depth of the course contents appeared to vary substantially. The courses represented were either MSc or short post advanced degree courses. The majority (23/26) were in-presence courses that include lectures, workshops, case studies, and exercises and, for some, homework and site visits. The others were online courses using e-modules (one with a blended approach including discussion groups). The duration of short in-presence courses varied from 3 days to 2 weeks; most were held annually, others biennially. There was high demand as illustrated by the number of applicants for courses. As courses serve a range of audiences, from vaccine developers to policy makers, the course content is variable. Most courses are designed for in-service candidates but some provide pre-service training.

Most in-presence courses have selection criteria for applicants. Some, but not all, of the national and online courses also select their participants. Wide access, without candidate selection, is more common with the online courses. For university or other formal continuing education, accreditation exists for some courses, particularly those within a university degree course, but whether accreditation is available for all courses was not clear.

Most courses are conducted in English, which excludes participants from many countries. More courses available in French, Russian, Mandarin Chinese, Spanish and other languages are needed. In many settings language barriers also preclude any 'cascade' training to disseminate knowledge to other personnel involved with immunization programs. It was considered that having training modules available in appropriate languages could encourage more post-course cascade training and might also encourage vaccinology content in undergraduate medical, nursing and other relevant course curricula.

It was noted that, regrettably, medical and nursing degree curricula generally do not include much, if any, vaccinology content, or provide outdated inaccurate information. The lack of vaccinology training in large areas of the world is also of great concern, as in the regions noted above and in many low- and middle-income countries. Post-course training activities were carried out in 12 of the represented courses, and alumni networks were set up in only 9 courses. Interaction and networking with other participants from different backgrounds was a highly valued feature for several of the courses.

Funding for the organization of courses and the participation of trainees is problematic for most courses, particularly for in-presence training. Currently most funding is provided by the Bill & Melinda Gates Foundation, private industry, and registration fees. There is very little financial support from governments. Some courses offer fellowships to support the participation of trainees, in particular from low- and middle-income countries. Recruitment and availability of lecturers and tutors, and logistic factors for participants, are additional constraints.

During discussion of this overview the following points were noted. It was considered that more evaluation of courses, including the tutors, would be helpful. The need for course networking, collaboration and structured education in vaccinology was emphasized. Innovative approaches to reduce costs and facilitate course delivery are needed, such as 'hybrid' courses combining in-presence and on-line content, and 'travelling' courses whereby the same or similar courses are given sequentially in different countries/regions by the same tutors. If funding from private sector sources is considered/received, particularly from vaccine manufacturers, this needs to be arranged in a transparent manner and with safeguards to exclude conflicts of interest.

4. Current and future needs in vaccinology training

From the public health perspective, vaccinology training is needed to promote the appropriate use of vaccines (appropriate schedules, target groups and vaccine products) and optimize the effectiveness of immunization programs (appropriate vaccination strategies, increased coverage and demand, avoidance of adverse effects due to program errors, etc.). The group agreed that national immunization programmatic decisions must take into account numerous factors and this requires a high level of technical knowledge in addition to understanding of the local setting, including awareness of the national legal and funding framework for vaccination. Although the latter cannot be covered specifically in global or regional courses such courses can underline the importance of such knowledge. Communication skills are also necessary to convey targeted accurate information about vaccines and their impact, including effectiveness and safety, and promote trust among all sectors of the population. Health-care workers need to be well prepared to respond to questions from vaccinees, parents, and those who are vaccine-hesitant. Regular updating is essential as programs face changing situations (introduction of new vaccines, inclusion of new target groups as expected in life course vaccination, changes in vaccination coverage, disease outbreaks, antimicrobial resistance, humanitarian crises), the increasingly high rate of turnover of immunization program managers in many countries, and the need to counteract misinformation from anti-vaccine organizations and individuals. Hence the need for access to advanced vaccinology courses globally, regionally and nationally continues and is likely to grow.

Biotechnology companies which bring innovative methods for the design and production of new vaccines require understanding of the disease burden and vaccine landscape, and collaboration with vaccinology experts. The design of new vaccines involves assessment of the key features that a vaccine should have in order to meet safety, immunological and efficacy requirements, and the balance between them. There is a need for tools to predict the human response and the influence of the host and the environment, and innovative ways to simplify the regulatory pathway

for new vaccines. Networking and collaboration are necessary to achieve these objectives. Advanced vaccinology courses can increase the breadth of knowledge needed to optimize this thinking within industry.

For the development and introduction of new vaccines, manufacturers rely upon well-trained local scientists who can generate local data for evidence-based decision making and understand the entire process of development, registration, introduction and distribution, particularly in low- and middle-income countries. Participants agreed that there is a need for more vaccinology training programs in those countries and more technology transfer in order to enhance this process. Guidance is needed on local preclinical and clinical vaccine assessment, and the preparation of dossiers for approval of trials as well as regulatory requirements for post-licensure surveillance of the new products.

During discussion there was consensus on the following general points: need for education about vaccines at all levels from high-school children to university under- and post-graduates (including health-care workers, regulators and vaccine industry staff), and the importance of collaboration between industry, academia and public health.

It was agreed that a set of rules of engagement in vaccinology courses for different stakeholders, with regard to potential conflict of interest, would be helpful. A system for certification of the approved basic content of courses should be set up. The importance of networking was stressed, both between courses and between alumni, bringing added value in shared knowledge and expertise. The content of courses should be based on routine needs assessments and tailored to meet the specific needs of the trainees and the context; courses should include basic scientific knowledge about vaccines and relevant technical competences linked to provide a holistic perspective. Regulators should be involved in vaccinology training, and concerted action is needed to have vaccinology modules included in medical, paramedical, pharmacy, midwifery and nursing curricula. The financial sustainability of training courses is an ongoing challenge, particularly in the context of planning for the future work force. Efficient coordination of global vaccinology training activities would require management by a secretariat; however, this would depend on commitment and assured funding.

There was agreement on the following specific points. Courses and training materials, including those for post-course cascade training, are needed in different languages in addition to English, and training materials must be kept up-to-date and revisions noted. Short courses are necessary, and in demand, for professionals who have very limited available time. The importance of effective communication for the success of immunization programs, and the need to include media training in vaccinology courses, were stressed. Ways to reach wider audiences effectively and efficiently need to be explored, including online distribution of e-learning materials, and encouraging post-course trainees to act as sources of reliable information and advocacy for vaccination. The existence of currently available courses should be made more widely known. Collaboration with industry was encouraged (how best to benefit from the link needs to be considered) and arrangements such as multi-company funding could be applied in situations where funding by a single company may be problematic.

5. Innovation and best practices in continuing adult education

Instructional design approaches for effective learning have been identified and applied extensively in continuing medical and health science education. Lessons learnt from successful continuing education programs for adults should be considered in the design, content and conduct of vaccinology courses [4–6].

Factors in the success of continuing education programs include: a practice-based needs assessment; the use of interactive learning methods; ongoing (longitudinal) learning activities; content which is relevant to the learner's practice; learning activities that address barriers to practice; and commitment to change. Predisposing (finding out about the trainees in advance), enabling (reference to practical applications) and reinforcing (reflective exercises, follow-up interviews and reminders, feedback) can enhance the impact of training courses [7–9]. The generally accepted principles on which best practice in continuing adult education, and criteria for accreditation, are based include assessment of learning needs, measurable outcomes, inclusion of 25% active learning, and evaluation based on stated outcomes. Scientific evidence shows that adults are more likely to learn if the course is relevant to their work and focused on problem solving, and if they are actively involved, value previous experience, retain responsibility for their learning, and if they have opportunities to interact with their peers and apply what is learned [4–6,10].

Innovative approaches to adult education, coupled with a range of online distance learning tools which can be designed for the general public or for specific audiences, can increase and extend learning opportunities. Distance-learning strategies are becoming widely applied in continuing adult education, and could be adopted more extensively in global vaccinology training [11].

The advantages and opportunities of distance-learning include: flexibility for students; saving time and travel costs; adaptability for niche subject training worldwide; absence of time constraints allowing deeper learning; can be automated; can enable easy interaction between students and tutors; can facilitate collaborative work and easy updating of content and activities. A wide range of information technologies (IT) tools and platforms are available, some at little or no cost; others at higher costs. However there are challenges associated with distance-learning, including: the need for adequate IT competence by tutors; understanding of the different role for tutors who must accept shared control with other professionals; dependency on the IT system and internet bandwidth and stability; staying focused on teaching goals (IT is only a tool); keeping students interested and involved; keeping tutors motivated; adaptation of exams and control of students during exams; and as the online environment even when dedicated and password secured, is not necessarily secure and comments could potentially be accessed and misused, e.g. by anti-vaccine groups. The cost of distance-learning depends on the technology used and the intensity of tutoring.

In discussion it was concluded that for course format, the best option, if feasible, would be a combination of in-class training with distance-learning components, and that the presence of the tutor is essential. This blended approach is preferred by both tutors and students. Such courses could also enhance both in-class learning and post-course cascade training.

6. Evaluation of vaccinology courses and participation

Advanced vaccinology courses serve several main groups: graduate and post-graduate students; practicing health-care professionals such as immunization program managers, field staff, physicians, nurses and pharmacists; and those who develop and implement policy, in particular National Immunization Technical Advisory Group (NITAG) members. In discussing whether existing courses meet the needs of these specific audiences, several gaps were noted. Currently there is insufficient follow-up and impact assessment of courses, and evaluation of participants and tutors. It is unclear at which stage after the course its impact can be optimally assessed and this should be given more consideration. Long-term follow-up is difficult and expensive, and for short courses

impact is difficult to measure. Accreditation by universities for within-course vaccinology modules is valuable but not always provided and should be encouraged [8,12].

An electronic evaluation tool is used by some courses. Such a tool, if accessible to other courses, could assist and improve the evaluation of vaccinology courses, and encourage systematic evaluation of all courses. The tool would need to be sufficiently flexible to adapt to different circumstances and needs, and the method/format scientifically sound and useful. Evaluation would provide useful feedback after courses, including lessons to learn from any unsuccessful courses.

There is a need to encourage participants from countries from which currently there are no applicants for vaccinology training, and to develop courses and training materials in different languages in addition to English. In many low- and middle-income countries there is a lack of well-trained local scientists who could support technology transfer, vaccine development and program operations. Participation of NITAG members and staff from regulatory authorities should also be encouraged. If online advertising of courses is used, a minimal set of necessary information for applicants needs to be ensured.

Recruitment of participants is done in various ways (referrals, through alumni, word-of-mouth, print and online course marketing). Communication by word-of-mouth tends to generate more applications from the same countries and institutions. More involvement of immunization partners (WHO, academic institutions, other networks such as the Global NITAG Network) should be encouraged. However, balancing oversubscription and attraction of new participants needs to be considered. Some participants attend several vaccinology courses, and some former participants request to attend the same course again, which if permitted may limit access for new participants.

7. Updating knowledge after the course

As developments in biological and medical sciences bring new knowledge, they also bring new challenges for alumni of vaccinology courses. Alumni need to be aware of advances in relevant research and new applications of vaccination in disease control and medical practice. The field of vaccinology is extending from its traditional focus on infectious diseases to include vaccination in the management of a range of chronic non-communicable conditions, and the application of vaccination to reduce the use of antibiotics in order to limit the global impact of antimicrobial resistance. Counteracting vaccine hesitancy by effective communication of accurate information, especially on vaccine effectiveness and safety, is increasingly important but few current courses address this topic. Frequent updating is essential but less than half of courses have a strategy for post-course updating. To increase the dissemination of up-to-date knowledge about vaccinology, more use could be made of online options and alumni networks. Repeat attendance at a global course is not necessarily the most efficient approach.

The importance of maintaining the involvement of alumni after the course was stressed in several sessions. Alumni networks play an important role in ongoing education and should be further developed. Networking between alumni from different courses would be an important asset, and possible mechanisms for this purpose should be explored. It was noted that linking the alumni effectively would require time but need not be expensive if networking is organized back-to-back with scientific and other meetings.

Current and potential sources of online information on vaccinology include MOOC (massive open online course) offering free access and interactive participation, other updated courses, permanent access online to updated resources, alumni associations that share information, and attendance at meetings/workshops. The use of recorded lectures may be considered, but public sharing of lectures online would require attention to the rights of the authors. Responsibility for organizing/facilitating post-course training and information exchange is not currently defined or organized. Post-course support could include international workshops, clear identification of available specialized courses, global sharing of online resources, and access to communication tools and professionals. Funding is necessary for some of these options, and may present a barrier for alumni who wish to attend another vaccinology course. Peer support, coaching and mentoring, and online practice laboratories are helpful in keeping alumni engaged and involved after a course.

Alumni face a number of challenges in their efforts to update their knowledge. They have limited time and availability outside the work schedule, and funding may be problematic. The current vaccinology courses and materials may not cover all of the desired topics, or even 'hot' topics. A vast amount of information on vaccines is available online but it can be difficult to find what is wanted. To facilitate post-course learning, courses should teach the participants how to look for information efficiently.

8. Opportunities for collaboration between vaccinology courses

During this discussion session, there was agreement that there is a definite need for a webpage (e-Portal) listing all existing advanced vaccinology courses worldwide to provide information for those seeking advanced vaccinology training. Standardized information for all relevant courses worldwide (graduate and post-graduate courses) should be provided by each course organizer and kept up to date, with date of latest checking/updating noted. The information should include the location, dates, summary of the objectives and content, and a link to the course website. The site should be easy to find by online search via key words (including vaccinology, vaccines, immunization training, vaccinology training).

There was strong support for the establishment of a network to link vaccinology courses worldwide, in order to facilitate contact, information exchange and collaboration. The network should be sustainable and flexible, with a secretariat and information exchange platform to coordinate and move forward the agreed actions. Short and long term goals should be defined and a roadmap prepared. Guidelines for courses should be developed, based on a needs assessment and with elements that are useful for different target audiences. Opportunities should be sought for sharing of tutors and delivering the same or similar courses in different countries. Training of trainers could be facilitated by guidelines on how this cascade training should be done.

Initially, the network could be set up informally with rotation of the focal point to facilitate interaction, and involvement of volunteers who contribute to the work. Coordination and collaboration could be facilitated by regular contact between course leaders through periodic teleconferences/webinars, e.g. every six months, to update participants on new developments and challenges, and annual or biennial meetings of course leaders if funding permits.

Once established and functioning, the network would require dedicated staff and assured funding to manage and maintain the network's website. Arrangements for more sustainable funding than presently exists for vaccinology training need to be identified and explored.

9. Conclusion

The workshop succeeded in carrying out an extensive, though not exhaustive, review of current training in advanced vaccinology.

Needs and opportunities were identified for strengthening and expanding the global coverage of vaccinology training, developing and sharing best practices, and the application of online and innovative approaches in adult education. The importance of collaboration and information exchange through networks of alumni and between vaccinology courses was stressed together with the need to provide useful information about existing courses for potential applicants. Encouraging candidates from under-represented regions and countries was recognized as a priority, and the need for training materials in different languages. Creation of a web platform for information about available vaccinology training was proposed and strongly supported. Lack of sustainable funding is an ongoing constraint for vaccinology training and needs to be addressed.

Acknowledgement and funding

This Global Vaccinology Training Workshop was supported by the Bill & Melinda Gates Foundation, Seattle, WA, USA (Grant OPP48961)

Annex 1. List of participants

Rachel AFAAYO, East Africa Centre for Vaccines and Immunization, Uganda;
Lizzelott ANDERSSON, Carlos Slim Foundation, with endorsement of the National Autonomous University of Mexico, Mexico;
Sandra ANGELE, Fondation Mérieux, France;
Narendra ARORA, Child Foundation/INCLEN, India;
Rebecca ASHFIELD, University of Oxford/Jenner Institute, UK;
Edwin ASTURIAS, University of Colorado, USA;
Amanda SHORTELL BEAL, Bill & Melinda Gates Foundation, USA
Anuradha BOSE, Christian Medical College, India;
Béhazine COMBADIERE, INSERM, France;
Sue Ann COSTA CLEMENS, Institute for Global Health-University of Siena, Italy;
Clare CUTLAND, University of the Witwatersrand, South Africa;
Carine DOCHEZ, University of Antwerp, Belgium;
Philippe DUCLOS, University of Geneva, Switzerland;
Amy FINAN, Sabin Vaccine Institute, USA;
Adam FINN, University of Bristol, UK;
Veronica GAMBILLARA FONCK, Limmatech Biologics, Switzerland;
Benjamin KAGINA, University of Cape Town, South Africa;
Ndeye Coumba Touré KANE, Université de Dakar, Sénégal;
Jean-Louis KOECK, Direction Centrale du Service de Santé des Armées, France;
Jean-Pierre KRAEHENBUHL, Health Sciences E-training Foundation, Switzerland;
Paul-Henri LAMBERT, University of Geneva, Switzerland;
Ann LINDSTRAND, World Health Organization, Switzerland;
Julia Anne LYNCH, International Vaccine Institute, Korea;
Noni MACDONALD, Dalhousie University, Canada;
Oliver Ombeva MALANDE, Africa Centre For Vaccines and Immunization, Kenya;
Lindsay MARTINEZ, Freelance Consultant, Switzerland;
Claude MERIC, Freelance Consultant, Switzerland;
Liudmila MOSINA, WHO Regional Office for Europe, Denmark;
Rudzani MULOIWA, University of Cape Town, South Africa;
Hanna NOHYNEK, National Institute for Health and Welfare, Finland;
Bénédicte PANSIER, Fondation Mérieux, France;
Jade PATTYN, University of Antwerp, Belgium;
Stéphane PAUL, Université Jean Monet, France;
Armelle PHALIPON, Institut Pasteur, France;
Audino PODDA, GSK Vaccines Institute for Global Health, Italy;
Lance RODEWALD, Chinese Center for Disease Control and Prevention, China;
Anthony SCOTT, London School of Hygiene and Tropical Medicine, UK;
Keipp TALBOT, Vanderbilt University Medical Center, USA;
Suresh TIKOO, University of Saskatchewan, Canada;
Jane TIPPING, Faculty of Medicine, University of Toronto, Canada;
Pierre VAN DAMME, University of Antwerp, Vaccine and Infectious Diseases Institute, Belgium;
Likui WANG, University of Chinese Academy of Sciences, China;
Ine WOUTERS, University of Antwerp, Belgium.

Annex 2. List of vaccinology courses surveyed

Advanced Course of Vaccinology (ADVAC), Mérieux Foundation and the University of Geneva;
Advanced Vaccinology Course in India (INDVAC), Christian Medical College, Vellore;
African Leadership in Vaccinology Expertise (ALIVE) MSc in Vaccinology, The University of the Witwatersrand, Johannesburg;
Afro-ADVAC-African Advanced Vaccinology course, African Leadership in Vaccinology Expertise (ALIVE), The University of the Witwatersrand, Johannesburg;
Annual African Vaccinology Course (AAVC), University of Cape Town;
Chinese Vaccinology Course (CNVAC), Medical School, University of Chinese Academy of Sciences;
Ciro de Quadros Vaccinology Course for Immunization Managers in Latin America, Sabin Vaccine Institute;
Clinical Vaccinology Course, National Foundation for Infectious Diseases (NFID);
Cours international francophone de vaccinologie (CIFV), Université de Bordeaux - Service de santé des armées - Groupe d'études en préventologie;
Diplôme International Inter Universitaire de Vaccinologie (DIUI), University of Dakar;
Summer course on vaccinology for students, Antwerp University;
ECAVI Vaccinology Course for Health Professionals, East Africa Centre for Vaccines and Immunization;
Epidemiological Evaluation of Vaccines: Efficacy, Safety and Policy, London School of Hygiene & Tropical Medicine;
Indian Advanced Vaccinology Course and Essential Vaccinology Course organized by the Child Health Foundation and the International Clinical Epidemiology Network (INCLEN);
International Vaccinology Course, Institut Pasteur Paris;
International Vaccinology Course, International Vaccine Institute, Seoul;
Latin American Online Vaccinology Course (DILVAC), Carlos Slim Foundation;
Master of Advanced Studies of Vaccinology (IMVACC), University of Lausanne;
Master in Vaccinology and Pharmaceutical Clinical Development, University of Siena, Institute for Global Health;
MOOCS vaccinology, Institut Pasteur, Paris;
Regional Vaccinology Course for African countries, WHO AFRO and The Network for Education and Support in Immunisation (NESI);
Vaccinology in Africa MSc Level Course, Jenner Institute, University of Oxford;
TropEd Advanced Vaccinology Course, Institute of Tropical Medicine and International Health and Charité University, Berlin;

University of Oxford Vaccinology programme (Human and Veterinary Vaccinology, Clinical Development and Biomanufacturing), Jenner Institute and University of Oxford;
Vaccinology and Immunotherapeutics, University of Saskatchewan;
Vaccinology Summer School (vaccines for infectious diseases and cancer), Leiden University Medical School.

Annex 3. Questionnaire on vaccinology courses

1. Name of the course

2. Organizing institutions
   2.1 Main organizing institution(s)

   2.2 Other institution(s) collaborating in the course

3. Person in charge of the course and contact details (email, addresses and telephone numbers). Please specify if course administrative responsibility is different from academic responsibility and in which case, please provide names and contact details for both

4. Funding sources

   4.1. For the course organization

   4.2. To support the participation of the students

5. Year when the course was established

6. Type of training and duration (i.e. short course, MSc, other graduating training, post graduate specialized course)

7. Target audience

8. Frequency with which the course is held and or date of the last 5 courses

9. Number of students attending each course

10. Total number of students that have attended the course since its inception

11. Number of students usually applying for the course

12. Is the course national, regional or global in nature?

13. Distribution of participants (please provide indication based on detailed overall statistics if available or on the latest course)

13.1 By region and country

13.2. By economic status of countries (using the World Bank classification -- low income, middle income, high income) https://blogs.worldbank.org/opendata/new-country-classifications-2016

13.3. By affiliation of participants: academia, industry, public health, regulatory authorities, other (please specify), students not yet in job setting

13.4. By education: MD, RN, MSc, PhD, DVM, others……

14. Educational prerequisite for participants if any

15. Trainees selection process

16. Trainees evaluation process during the course if any

17. Country (ies) where training is held

18. Language(s) in which the course is held

19. Main objectives of the course and general topics covered (please attach the latest course programme)

20. Format of training (plenary lectures, work groups, e-learning,…)

21. Course evaluation process

22. Process to advertise for the course

23. Link to course website

24. Availability of activities aimed at updating the knowledge of participants after the course
Yes No
If yes please describe in the box below,

25. Existence of an alumni network
Yes No

26. What are the major challenges that you are facing in the organization of the course?

27. Please add any additional information that you think may be useful to share

Annex 4. Agenda Global Vaccinology Training Workshop, 7–8 November 2018, Les Pensières, Veyrier-du-Lac

Time	Session Day 1: Wednesday, 7 November 2018	Presenters	Co-Chairs
09:00	**Welcome - Introduction - Objectives for the meeting**	Philippe Duclos	
09:15	**Introduction of participants**		
09:35	**SESSION 1: Landscape analysis of major current vaccinology courses** Summary presentation: 20 min. Questions on the specific courses: 15 min. Discussion on challenges encountered by the various courses: 30 min.	Edwin Asturias	Pierre VanDamme/Narendra Arora
10:40	**Coffee/Tea break**		
11:00	**SESSION 2: Definition of the current and forecast of future needs in vaccinology training** Presentations: Industry 15 min. Biotechs 10 min. Public Health 15 min. Discussion: 50 min.	Audino Podda Veronica Gambillara Ann Lindstrand	Pierre VanDamme/Narendra Arora
12:30 – 14:00	**Lunch**		
14:00-14:40	**SESSION 3: Identification of remaining gaps** General discussion around the identification of remaining gaps including regional ones and ways to facilitate establishment of additional courses and cascade training: 40 min.		Edwin Asturias/Hanna Nohynek
14:40-16:00	**SESSION 4: Best practices on Health Sciences Education applicable to Vaccinology** Presentation: Instructional design approaches and application of trends and innovations on continuing medical and health sciences education, 30 min. Discussion: 60 min.	Jane Tipping	Noni MacDonald/Armelle Phalipon
16:00	**Coffee/Tea break**		
16:20-18:10	Presentation: E-learning: opportunities and challenges, 20 min. Discussion: 30 min. Evaluating courses, trainees and courses impact Discussion: 50 min.	Claude Meric	Noni MacDonald/Armelle Phalipon

Time	Day 2: Thursday, 8 November 2018	Presenters	Co-Chairs
08:30	**SESSION 5: Dissemination of information on individual courses (web ..)** Discussion: 30 min.		Benjamin Kagina/Amy Finan
09:00	**SESSION 6: Post trainings updating of knowledge** Presentation: Needs and means in post trainings updating of knowledge, 15 min. Discussion: 1 h	Stéphane Paul	Benjamin Kagina/Amy Finan
10:15	**Coffee/Tea break**		
10:35	**SESSION 7: What collaboration between vaccinology courses** Discussion on need and opportunities for collaboration: 1h 40 min.	Discussion by themes All participants	Hanna Nohynek/Edwin Asturias
12:15	**Lunch**		
13:30	Continued Discussion: 1h	Discussion by themes All participants	
14:30	**SESSION 8: Establishment of a web platform of information on Vaccinology Training** Discussion: 30 min.	All participants	Rebecca Ashfield/Anuradha Bose
15:00	**Summary of the meeting** Presentation 15 min. Additional comments by all	Noni MacDonald	
15:25	**Closure of the meeting**		

References

[1] Lambert PH, Podda A, et al. Education in vaccinology: an important tool for strengthening global Health. Front Immunol. 2018;24(9):1134. Epub 2018 May 24.

[2] Vorsters A, Tack S, Hendrickx G, Vladimirova N, Bonanni P, Pistol A, et al. A summer school on vaccinology: responding to identified gaps in pre-service immunisation training of future health care workers. Vaccine 2010;28 (9):2053–9.

[3] Rath B, Muhlhans S, Gaedicke G. Teaching vaccine safety communication to medical students and health professionals. Curr Drug Saf 2015;10(1):23–6.

[4] Caffarella RS, Daffron SR. Planning programs for adult learners: practical guide. 3rd ed. John Wiley & Sons; 2013. 464p. ISBN 978-0-470-77037-5.

[5] Knowles MS. The adult learner. A neglected species (4e). Houston: Gulf Publishing; 1990.

[6] Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. Med Teach 2013;35(11): e1561–72. https://doi.org/10.3109/0142159X.2013.828153.

[7] Davis D, Davis N. Selecting educational interventions for knowledge translation. CMAJ 2010;182(2):E89–93.

[8] Cervero RM, Gaines JK. The impact of CME on physician performance and patient health outcomes: an updated synthesis of systematic reviews. J Contin Educ Health Prof 2015;35(2):131–8. https://doi.org/10.1002/chp.21290.

[9] Marianopolous SS, Dorman T, Ratanawongsa N, et al. Effectiveness of continuing medical education. Rockville (MD): Agency for Healthcare Research and Quality (US); 2007. p. 1–69 [Evidence reports/technology assessments, No. 149] https://www.ncbi.nlm.nih.gov/books/NBK38259/.

[10] Mann KV. Thinking about learning: implications for principle-based professional education. J Contin Educ Health Prof 2002;22(2):69–76.

[11] Dean PJ, Stahl MJ, Sylwester DL, Peat JA. Effectiveness of combined delivery modalities for distance learning and resident learning. Quart Rev Distance Educ 2001;2(3):247 [ISSN 1528-3518 Retrieved February 13, 2019] https://www.learntechlib.org/p/92787/.

[12] Moore DE, Green JS, Gallis HA. Achieving desired results and improved outcomes: integrating planning and assessment throughout learning activities. J Contin Educ Health Prof 2009;29(1):1–15. https://doi.org/10.1002/chp.20001.