# A Course on Vaccinology for Clinical and Public Health Practice: Policy Symposium and Workshop

## 18th–21st November 2019

Translational Health Science and Technology Institute (THSTI), Faridabad, India

Prepared by Health Intervention and Technology Assessment Program

# Abbreviations

| Abbreviation | Definition |
|---|---|
| AAR | After-action review |
| ADP | Access and Delivery Partnership |
| BMGF | Bill and Melinda Gates Foundation |
| CMC | Christian Medical College |
| EPI | Expanded Programme on Immunization |
| eVIN | Electronic vaccine intelligence network |
| HIT | Herd immunity threshold |
| HITAP | Health Intervention and Technology Assessment Program |
| HPV | Human papillomavirus |
| HTA | Health technology assessment |
| HTAIn | Health Technology Assessment in India |
| ICER | Incremental cost-effectiveness ratio |
| ICL | Imperial College London |
| iDSI | International Decision Support Initiative |
| ITAGI | Indonesian Technical Advisory Group for Immunization |
| ITT | Intention-to-treat |
| JIPMER | Jawaharlal Institute of Postgraduate Medical Education and Research |
| LMIC | Low- and middle-income country |
| LSHTM | London School of Hygiene and Tropical Medicine |
| MI4A | Market Information for Access to Vaccines |
| MMR | Measles, mumps and rubella |
| NEDL | National essential drug list |
| NGO | Non-governmental organisation |
| NHF | National Health Foundation |
| NTAGI | National Technical Advisory Group for Immunization in India |
| NUS | National University of Singapore |
| NVC | National Vaccine Committee |
| NVI | National Vaccine Institute |
| PGIMER | Post Graduate Institute of Medical Education and Research |
| QALY | Quality-adjusted life years |
| PP | Prevention and promotion |
| RITAG | Regional Immunization Technical Advisory Group |
| SAGE | Strategic Advisory Group of Experts |
| RCT | Randomised control trial |
| THSTI | Translational Health Science and Technology Institute |
| TSE | Total Systems Effectiveness |
| UHC | Universal Health Coverage |
| UNDP | United Nations Development Programme |
| UNICEF | United Nations Children's Fund |
| VAERS | Vaccine Adverse Event Reporting System |
| WHA | World Health Assembly |
| WHO | World Health Organization |

# Contents

# Executive Summary

The Health Intervention and Technology Assessment Program (HITAP), Thailand co-organised a course titled, 'Vaccinology for Clinical and Public Health Practice", on 18-21 November 2019, at the Translational Health Science and Technology Institute (THSTI) in Faridabad, India. This course was structured as a one-day policy symposium on 18 November and a three-day workshop on 19-21 November, and was co-organised by THSTI, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), London School of Hygiene and Tropical Medicine (LSHTM), National University of Singapore (NUS) and HITAP. This event was co-funded by THSTI, the International Decision Support Initiative (iDSI) and the Access and Delivery Partnership (ADP).

This course was organised at the request of Prof. Rakesh Aggarwal, the Director of JIPMER and Prof. Gagandeep Kang, the Executive Director of THSTI and Professor at the Christian Medical College (CMC) in Vellore, India. The main objective of the course was to build technical capacity of stakeholders in the field of vaccinology through the workshop and share global experiences on how vaccine policies can be prioritised for decision makers through the policy symposium. The symposium covered topics such as decision-making and resource mobilisation, using evidence and strengthening technical capacity, emerging issues in vaccinology, and regional and global initiatives in vaccines. Meanwhile the workshop covered topics such as epidemiology and surveillance, vaccine trials and efficacy, and health economics of vaccines. The workshop employed various means of engaging with participants including a role-play and practical exercises among others.

The event hosted a total of 62 participants, half of whom were from India, while the rest came from Ghana, Tanzania, Malawi, Timor Leste, Nepal, Indonesia, Thailand, Vietnam, Lao PDR, and the UK. The teaching faculty comprised academics, Program Managers, and policy makers from several national and international institutions and organisations. Overall, the participants found the course to be very useful and complementary to their current work. Subsequently, HITAP received requests for hosting such courses in other countries in Asia and Africa as well as supporting work on prioritisation of vaccines.

# Introduction

The International Decision Support Initiative (iDSI), a global network of priority setting institutions, has been working with partners in India to institutionalise Health Technology Assessment (HTA) and Universal Health Coverage (UHC), supported by the Bill and Melinda Gates Foundation (BMGF) India Office. The support has been led by iDSI core members, Imperial College London (ICL) and the Health Intervention and Technology Assessment Program (HITAP), Thailand.

The Access and Delivery Partnership (ADP), hosted by the United Nations Development Programme (UNDP), supports countries strengthen their capacities and health systems to expand access to appropriate health technologies. ADP has been partnering with HITAP in various countries in South-east Asia to support capacity building in HTA.

As such, HITAP has developed numerous partnerships with autonomous academic institutions and provided internship opportunities, training workshops, technical advice to their ongoing HTA studies. Additionally, HITAP has been supporting collaborations between Indian researchers and policy makers as well as international HTA networks. These engagements aim to raise awareness on the need for HTA to realise an efficient health system and, subsequently, build the knowledge and technical capacity of such institutions to conduct HTA studies.

This purpose of this report is to provide comprehensive information regarding this course, starting from the inception and the objectives, to summarising the proceedings of the course, feedback received, lessons learned and outcomes. The supporting information is provided in the Appendices.

# Background

## Inception of the Course

In 2018, HITAP partnered with the Christian Medical College (CMC), Vellore, to provide technical support to two research teams working on rotavirus and typhoid cost of illness studies, with the plan to conduct cost-effectiveness studies for the vaccines of choice. As part of this collaboration, HITAP conducted an introductory workshop on HTA on 6-9 May 2019 at CMC, Vellore with partners from Mahidol University and the Post-Graduate Institute of Medical Education and Research (PGIMER).

At the end of the workshop, HITAP was approached with a request to host a course on vaccinology, by Prof. Rakesh Aggarwal and Prof. Gagandeep Kang, who are both prominent figures in the space of vaccine in India and abroad, with affiliations at the Regional Immunization Technical Advisory Group (RITAG), the National Technical Advisory Group for Immunization in India (NTAGI), the Strategic Advisory Group of Experts (SAGE) on Immunization, Wellcome Trust, and others. In recent years, the RITAG has identified regional capacity in HTA to be limited and one that needs to be strengthened to prioritise spending in vaccines. With this background, HITAP participated in a RITAG meeting held in July 2019 in Delhi, India, to share the experience of using HTA for vaccines. Furthermore, information on the planned course was shared, for which HITAP received a high interest to participate. The main objective of the course would be to build the technical capacity of stakeholders in the field of vaccinology through a training workshop and share global experiences on how vaccine policies may be prioritised for decision makers through a policy symposium.

To this end, HITAP reached out to the London School of Hygiene and Tropical Medicine (LSHTM) and the National University of Singapore (NUS), who in the past have jointly held a similar training course on vaccines, to collaborate and co-organise this course on 'Vaccinology for Clinical and Public Health Practice', on 18-21 November 2019, comprising a one-day policy symposium and a three-day workshop. Each organising institution brought deep and complementary experience in training, capacity strengthening and clinical and policy-relevant research in the field of vaccinology.

## Objectives of the Course

Vaccination is the most effective tool in preventing many infectious diseases and vaccines are often a highly cost-effective way to make drastic mortality and morbidity reductions. The advent of Gavi immunisation support along with other conducive factors has allowed low- and middle-income countries (LMICs) to make huge advances in vaccine adoption and coverage over the last two decades. The last two decades have also been a "golden age" for the development of new vaccines. However, vaccine coverage advances have been stagnating and many of the vaccines licensed in this era have highly complex immunological, ecological and economic effects.

Planning the effective use of vaccines requires a new generation of public health professionals with multi-disciplinary skills who are able to understand issues around the immunological mechanism, safety, efficacy, effectiveness, population impact, effects on microbiological ecology, delivery, cost-effectiveness and public trust of vaccines. Developing capacity within LMICs for research and for the institutionalisation of evidence-informed policy on immunisation is increasingly important as countries look to the future beyond Gavi support when LMICs must govern and finance immunisation policies independently, in an effective and financially sustainable way.

Hence, the objectives of the course were to (i) increase the scientific and technical knowledge related to vaccines of the stakeholders involved in evidence generation process, (ii) inform the role of HTA in optimising scarce resources and how to implement it in the vaccine space, (iii) understand the political economy of vaccine policy at the national, regional and global levels, the issues surrounding them and to share the best practices, and finally (iv) learn from partners and identify means for collaboration to make vaccine policy a priority for decision makers. The course was co-funded by THSTI, iDSI and ADP.

The agenda, list of attendees and photos from the event can be found in Appendix 1. Agenda, Appendix 2. List of Attendees and Appendix 3. Photos respectively.

# Summary of Proceedings

## Symposium

### Introduction to the Course

Prof. Gagandeep Kang, the Executive Director of THSTI opened the one-day policy symposium on 18 November with a welcome speech as the local host of the event. Upon providing the background on the inception of the course, she highlighted the progress made in the vaccine space with significant rise in coverage in LMICs and how vaccines are still the most effective tool for prevention of many infectious diseases and are often a highly cost-effective way to make drastic mortality and morbidity reductions. However, she raised her concerns over the recent stagnation in coverage rates, globally, and that the vaccine community is only just starting to ponder the issues that lie outside the ambit of routine child immunisation, for e.g. challenges in maternal immunisation, global supply of human papillomavirus (HPV) vaccine, etc. Furthermore, there are other areas such as malaria and dengue that require more of a regional approach and relevant stakeholders must engage and be involved in the decision-making process and be well-equipped with the appropriate evidence. Finally, she informed that the participants for this course were carefully selected for two purposes, (i) to build the technical expertise and (ii) to have an open dialogue to discuss the present and future challenges facing the vaccine community.

The policy symposium was itself divided into four sessions covering important issues like empowering policy makers, generating and leveraging evidence to increase resources, emerging issues in vaccines, and initiatives that are supporting the introduction of vaccines. The topics covered in these sessions are briefly explained below:

### Decision-Making and Resource Mobilisation for National Immunisation Program

The main objective of this session was to share experience on how vaccine policies can be made a priority for decision makers when competing for resources with other areas of public health.

Prof. Rakesh Aggarwal opened this session with a brief introduction on the steps that are involved in introducing a new vaccine including the identification of the disease epidemiology, establishing efficacy and cost-effectiveness, finding resources, designing and implementing programs, and finally making decisions. However, he was very quick to point out the challenges that may be faced during each step, including the awareness of disease, technical capacity, vaccine hesitancy and acceptability, lack of resources, among others.

Dr. Somsak Chunharas, the President of the National Health Foundation (NHF), Thailand, and the former Deputy Health Minister of Public Health, Thailand, then shared lessons from Thailand on creating a system that works to advocate for vaccines. Thailand has a separate budget for vaccine under the Prevention and Promotion (PP) program which is a part of the overall UHC budget and is around 15% of the overall budget for the Universal Coverage Scheme but covering all three public insurance schemes. He advocated for countries to adopt evidence-based, participatory and transparent process for policy analysis that leads to vaccine recommendations and thus request for budget allocation. The process guideline created by HITAP was shared in this regard, to exemplify how such credible technical process arms the vaccine community to advocate for the resources needed to introduce new and sustain the supply of existing vaccines.

Finally, Prof. Samsu Djauzi, from the Indonesian Technical Advisory Group for Immunization (ITAGI) shared the role and functions of ITAGI which included providing technical resource and guidance to national policy makers and program managers to make evidence-based decisions. And such guidance should enable policy makers to prioritise and address barriers in budgeting & financing, supply chain management, integration of EPI strategies at all service levels, data management, and finally monitoring coverage.

The key message from the discussion was to minimise the influence of political, pharmaceutical and anti-vaccine groups by ensuring a multisectoral decision-making process where stakeholders share a consistent scientific and technical message based on global consensus but prioritised at the nation level.

## Technical Capacity and Using Evidence to Inform Vaccine Policy Development

The main objective of this session was to inform the types of evidence that are important for decision makers and how the stakeholders involved can be empowered to produce and utilise such evidence to inform vaccine policy development.

Dr. Nakorn Premsri, Director of National Vaccine Institute (NVI) in Thailand, informed that policies on vaccine introduction are developed by the Thai Ministry of Public Health under the advice of NITAG under National Vaccine Committee (NVC), where main decision criteria include disease burden, public health impact, vaccine safety and efficacy. However, the decision to add the vaccine to the National Essential Drug List (NEDL), also called the National List of Essential Medicines (NLEM), is made by the NEDL sub-committee, which further requests for data on cost-effectiveness and budget impact.

Prof. Gagandeep Kang shared her concerns that the Indian NITAG does not hold statutory authority in policy making like in the case of Thailand, and therefore, decisions are repeatedly made without a process that is multisectoral and driven by evidence. She then strongly suggested the need to give the institutions the power whose decision would be mandatorily implemented. At the moment, technical decision recommended by the Indian NITAG are not always followed by decision makers. Dr. Shankar Prinja from PGIMER, Chandigarh also echoed this argument and suggested that recommendations made by such technical bodies need to be legally binding. He was optimistic and showed how recommendations made the technical hubs are being translated into policy and action by the Health Technology Assessment in India (HTAIn) unit, in the space of HTA. He also suggested regularly educating decision makers on the types of evidence required, its usefulness, and also the timeline to generate it, such that the efforts made by the technical bodies are realised and appreciated.

The key message from the discussion was the need for a robust decision-making group that is characterised as 'credible', 'accountable', and 'checks and balances'. It was noted that it is important to provide such groups with sufficient authority so that their recommendations are legally binding and are realised by policy makers through a mandate.

## Emerging Issues in Vaccines

The main objective of this session was to highlight the key emerging issues in vaccines globally, and the mitigation strategies using case-studies.

Prof. David Heymann from LSHTM brought out many cases to the fore including the Nipah virus transmission from bats to humans from date palm sap, the cases of dengue and polio vaccines, and finally, Ebola. With the Nipah virus, he raised an important question that a vaccine may not always be necessary or feasible, especially when the evidence collected is not nearly enough to convince policy makers. Similarly, he highlighted the trade-offs and difficult decisions that need to be made knowing the vaccine may benefit a few (infected) and may adversely affect many (non-infected), as in the case of Dengvaxia®. In such cases, he suggested making decisions based on risk benefit analysis, whenever possible. With the Ebola case, he highlighted that sometimes eradicating a disease may require a totally 'out of the box' approach, as the exponential outbreak was not being explained or controlled through the usual epidemiological channels, but was eventually solved through an anthropological study where the ceremonial and burial practices were identified as the key transmitter and barrier.

Dr. Yot Teerawattananon from HITAP, used a case study of HPV vaccine in Thailand to highlight the issues of shortages after a year of its introduction. The primary cause being the support from the World Health Organization (WHO) for a 'gender-neutral' vaccination program including boys and increasing advocacy for homosexual men, leading to the issue of rising demand and sluggish supply will become a global issue if not dealt with promptly. He advised policy makers to follow the evidence which suggests that the net benefit from displacing the supply from girls to boys and homosexual men is negative, when looking at preventing genital wart versus preventing cervical cancer. Therefore, using the vaccines for girls only would be the most cost-effective use of HPV vaccines and reducing the burden on patients and the overall health system. He also called on the global community to strengthen the supply side policies to meet the rising demand.

Dr. Arindam Ray from the Gates Foundation identified 'vaccine hesitancy' as a reason for the stagnating coverage rates and decreasing effectiveness of existing vaccines. He referenced the Vaccine Adverse Event Reporting System (VAERS), to represent the evolution of public perception on vaccines. He explained that once there is a disease outbreak, the vaccine coverage increases to curb the spread of the disease. The increase in vaccine coverage also results in an increase in adverse events which in turn causes the public to lose confidence in the vaccine, and we observe a reduction in coverage and a recurrence of outbreaks. The return of outbreaks leads to a rise in confidence regarding in the efficacy of vaccines, with coverage increasing once again and ultimately the disease becomes eradicated. With this he explained even the smallest adverse event may result in a massive delay to eradication, leaving the public in a wide demand spectrum, from 'I refuse all vaccines', and 'I accept all vaccines' to everything in between. Tackling hesitancy, he advised, therefore requires strategies that are contact specific i.e. who is refusing, and problem specific i.e. what is reason behind it.

## Regional and Global Initiatives to Support the Introduction of Vaccines

The main objective of this session was to share the regional and global initiatives that are being undertaken by countries and global players in the field to support the introduction of new and sustaining the supply of existing vaccines.

Dr. Saskia Den Boon from the WHO opened the session by announcing that UHC is central to the immunisation agenda 2030 that will be country-owned and priorities will be driven by evidence. To support this, a total of 50 World Health Assembly (WHA) Resolutions have been issued on the access to quality global vaccine supply. She introduced a new initiative, Market Information for Access to Vaccines (MI4A) to inform global and local access strategies on collection and quality control of price/procurement/demand/supply data, technical assistance, guidelines/tools, in dept global market analysis, information sharing ecosystem, and enhancing affordability. Furthermore, she introduced the concept of Total Systems Effectiveness (TSE) with the vision and mission to enhance country uptake of vaccines and strategies appropriate for their context and priorities by optimizing equitable coverage, using TSE frameworks on barrier, decision-support, and innovation.

Dr. Bhrigu Kapuria from UNICEF highlighted that the Expanded Programme for Immunization (EPI) in India being fully government-owned and that the role of UNICEF starts from planning and supporting decision-making using global, regional and local level evidence. Then further support is provided on the implementation from the rollout to expansion either through a campaign or a routine immunisation program. Finally, monitoring the program to help steer it in the direction and sustain the program.

Mr. Manish Pant from UNDP highlighted UNDP's current efforts to support the mandate and agenda run by the WHO and UNICEF, with primary focus on health systems strengthening. He shared information on a unique initiative made by UNDP through the use of latest innovation in the supply chain management i.e. the electronic Vaccine Intelligence Network (eVIN). It is already being implemented in India and is under pilot in other countries across Asia and Africa.

Ms. Maya Malarski from the Center for Global Development (CGD) informed how iDSI works with countries to set priorities based on their need and resources. iDSI has been actively engaged in India by providing technical assistance, and trainings to national and state-level governments and academic institutions to build the local capacity to make decisions in vaccines and beyond. It has further helped set up the national costing database by collaborating with local academic institutions and the WHO, which will allow policy makers to make informed decisions using the locally generated evidence.

# Workshop

## Epidemiology and Surveillance

**Epidemiological concepts related to vaccination** (content by Dr. Clarence Tam, presented by David Heymann): This lecture began by introducing the basic concepts in vaccinology for e.g. explaining how vaccines work and the immunological basis for vaccination. Then, the concept of basic reproductive number ($R_0$) was defined to explain the population infection dynamics and herd immunity threshold (HIT). $R_0$ was defined as the average number of secondary cases arising from a single primary case in a totally susceptible population. And that is depends on the biology of the pathogens, duration of infectiousness, infectious dose, population density, population missing patterns, and therefore, can vary between populations. The lecture demonstrated how to formulate and estimate the $R_0$, with larger value implying greater transmissibility i.e. potentially epidemic. The lecture ended with a key message that $R_0$ answers how effective does a new vaccine have to be to control/estimate a disease to reach the HIT, which was defined as the fraction of the population that needs to be protected to control the disease. Therefore, estimating $R_0$ early on is key to planning any disease control programs.

**Surveillance and burden estimation** (Prof. David Heymann): This lecture introduced the methods to estimate the burden of disease, monitor and evaluate vaccination activities. The lecturer clearly defined incidence and prevalence, showed how to estimate both and explained what could be inferred from each. Several reporting methods, their advantages and disadvantages, and appropriateness for use in different scenarios were discussed, including (i) routine case/statutory reporting, (ii) serological profiling or sero-surveillance. Similarly, several surveillance methods were discussed using examples including an active environmental polio surveillance, open sewage in Asia, global influenza surveillance network, and others. The discussion revolved around using correct estimation methods to help prioritise which vaccine to use, and the best ways to monitor coverage, and identify patterns to solve problems in vaccination use.

**Herd immunity and other indirect effects of vaccination** (Prof. Paul Fine): This lecture aimed to discuss the question of protection of who and against what; hence, the difference between vaccination and immunisation was introduced as a foundational concept. He then used the household $2^0$AR (Attack Rate) studies to distinguish between the types of protection a vaccine may provide, starting from 'exposure' that may lead to 'infection', which may either lead to infectiousness or disease. This led to the concept of 'indirect protection' of vaccination through herd effect, herd immunity, and community effect, which can be observed if a disease incidence declined by more than uptake multiplied by the vaccine efficacy. A case study, "herd immunity conferred by killed oral cholera vaccine in Bangladesh", was used to demonstrate how such indirect protection may be estimated using a clustered randomised trial. Finally, the downsides of such indirect protection were pointed out including, (i) age shift – where infection is delayed but incidence may increase if disease severity increases with age, and (ii) freeloaders – where the reduction in risk among the non-vaccinated leads to complacency and ultimately increases the population incidence of disease.

## Vaccine Trials and Vaccine Efficacy

**Vaccine efficacy** (Dr. Clarence Tam): The workshop session on vaccine efficacy acted as an introduction to the concepts of efficacy in vaccinations, as well as how vaccine efficacy can be measured in a variety of settings including through randomised control trials (RCTs), case-control studies, household studies and screening methods. The session also touched upon considerations for trial and study design to avoid confounding and collider bias, to ensure that vaccine efficacy is accurately measured.

**Vaccine trials – Phase I, II and III trials and safety** (Dr. A P Dubey): This session detailed the regulatory processes, guidelines and requirements for the development of vaccines, from preclinical to post-licensure. Dr. A P Dubey explained the purpose for each clinical trial phase, and how the eligible population, trial duration and population size would be expected to differ in each phase. He also explained the additional requirements and considerations for vaccination trials. As vaccinations are primarily given to healthy individuals, there are additional ethical considerations for vaccination trials that would not apply for clinical trials of pre-existing conditions. For example, it would be unethical to deliberately expose trial participants to the pathogen the

vaccine is designed to counter, especially when some participants may be in receipt of a placebo vaccine. Therefore, the trial duration will need to be long enough to detect whether there the vaccine has statistically significantly reduced incidence of the disease; the required trial period could be very long if the incidence of the disease is low.

**Analytic issues in vaccine trials, including sample size calculations** (Prof. Peter Smith): The session focussed on two key statistical aspects of vaccination trials: determining the required size of a vaccine trial and statistical assessment and reporting procedures of Phase III trials. Prof. Peter Smith explained the interdependence of statistical significance, statistical power and trial population size. Furthermore, participants learned how to calculate the required sample size of a trial to have a defined power to detect a pre-specified vaccine efficacy. Prof. Peter Smith introduced the concept of a non-inferiority trial and how it differs from a superiority trial, he also explained the difference between per-protocol and intention-to-treat (ITT) analyses when reporting trial results.

**Post-licensure evaluation lecture and practical session** (Dr. Clarence Tam): The session demonstrated the importance of post-licensure and post-implementation monitoring of vaccination coverage and efficacy. Effective monitoring of vaccination coverage allows countries to set benchmarks for performance, identify geographical areas or population subgroups which have good or suboptimal performance and maintain political/financial/public support for the vaccination programme.

Vaccination efficacy depends on vaccine potency (immunogenicity), vaccine administration (cold chain and immune competence. Therefore, monitoring of vaccine effectiveness allows countries to identify any issues that arise (e.g. due to manufacturing issues, poor cold chain systems or strain replacement, mutations and antigenic drift). The session covered a variety of different screening or monitoring methods and their strengths and weaknesses.

Following the lecture, there was a practical group exercise where participants were asked to select a country and vaccine for which they would devise a strategy for post-licensure monitoring programme of vaccine effectiveness, coverage and safety. Participants were encouraged to think about the practical considerations of their strategy and how they could detect any issues with the routine immunisation programme. The groups then presented their strategies to the other groups before receiving feedback on their proposal. The groups considered a range of different vaccine contexts, such as measles, mumps and rubella (MMR) vaccination in Thailand, rotavirus vaccination in India and malaria vaccination in Ghana.

## Health Economics

**Economics of vaccines** (Prof. Mark Jit): The aim of this session was to understand the motivation for conducting economic evaluations of vaccination programmes and the basic methods that are used to estimate the costs and benefits. The session also introduced participants to the advantages and disadvantages of different types of economic evaluation methods. As this was an introductory session, basic economic concepts such as scarcity and opportunity cost were explained as these provide a basis for cost-benefit and cost-effectiveness analyses. Externalities are also an essential concept for vaccinations, as the costs and benefits of vaccination are borne by people other than those who directly produce and consume vaccines (for example, people can benefit from herd immunity even if they are not actually vaccinated themselves). General health economic concepts such as quality-adjusted life years (QALYs) and incremental cost-effectiveness ratios (ICERs) and direct/indirect costs were explained, and it was explained how these concepts can be used in an economic evaluation to inform decision-making.

**Modelling vaccine preventable diseases** (Prof. Mark Jit): In contrast to the economics of vaccines session, the modelling vaccine preventable diseases session focussed less on concepts and theory, and more on practical implementation and modelling of vaccines. This session provided an understanding of how simple compartmental models can be constructed for infectious diseases and how basic and net reproduction numbers are used in modelling. There was also a practical element to this session where participants constructed a simple dynamic epidemiological and vaccination measles model in Microsoft Excel.

### Policy

**Influenza virus for vaccine role-play** (Prof. David Heymann): To demonstrate the function of the WHO with respect to vaccines, David Heymann organised a role-play session based on a real-life example. As a background, the political mechanisms (resolutions, regulations and treaties) of the WHO were explained. As part of the role-play, participants were given characters to play such as representatives from the WHO, vaccine manufacturers, Non-governmental organisations (NGOs) and Ministries of Health.

What followed was a negotiation between the stakeholders, in a situation where a minister of health in a country with an outbreak of a new strain of flu was attempting to negotiate access to a vaccine at a fair price. The complex and competing interests in the negotiation process effectively illustrated the difficulties in the decision-making process to combat infection outbreaks.

**Transforming the vaccine supply chain in India** (Mr. Manish Pant): A Government of India initiative, eVIN aims to improve policy-making with respect to vaccine procurement, delivery and planning networks in India. There can be many problems that arise in the vaccine supply chain, for example if vaccines are not stored at the correct temperature (including during transit) then they may not be safe to use. eVIN uses smartphone technology to monitor vaccines and provide real time feedback, it can also be used for stock management to ensure that districts maintain sufficient vaccine supplies. eVIN makes the supply chain system more accountable, aims to streamline procurement and consumption timelines and improve human resource reporting capacity. The technical innovation that eVIN represents may be of use in other countries in the future.

**Vaccine acceptance** (Dr. Naveen Thacker): The session by Naveen Thacker focussed on the behavioural science underpinning vaccine acceptance, and the approaches or strategies towards promoting vaccine acceptance. As an introduction, the vaccination behaviour continuum or spectrum was introduced – this framework explained the range of attitudes towards vaccines. From individuals who actively demand vaccines, to those who passively accept, to those who are hesitant. Of vaccine hesitant individuals, some may accept, some may delay their uptake, and others outright refuse to be vaccinated. Vaccine hesitancy is a huge risk to public health (the WHO highlighted vaccine hesitancy as one of the top ten threats to global health in 2019), and vaccine hesitancy messaging can be spread very effectively and quickly over the internet. There are many contributing factors to vaccine hesitancy beyond confidence in the safety of vaccines themselves – vaccine hesitancy can be driven by access, affordability and awareness too. However, when it comes to dealing myths associated with vaccine safety, medical staff need to be equipped with the skills to challenge these effectively and promote confidence in vaccinations in order to achieve sustained high vaccination coverage.

## Engagement with Participants

The workshop employed different means of actively engaging with participants. Sessions were open to questions and answers and participants had a chance to partake in a role play, make presentations and participate in practical exercises in a range of sessions. Throughout the workshop, a half hour interactive session was dedicated to recap and test the participants on learnings from the previous day using a series of quiz questions on Menti, an online platform, led by Prof. Mark Jit. This gave the participants a chance to reflect and ask questions for clarification.

# Evaluation

Feedback from the attendees was collected after the event, a summary of their feedback is provided below. There were 64 responses recorded, and 89.1% of respondents stated that they agreed or strongly agreed that the content of the event was well prepared and enhanced their knowledge regarding the topic of vaccinology. 89.1% of attendees also said that they would be able to apply the knowledge that they gained from the event in their jobs. However, we suspect that 100% of attendees either agreed or strongly agreed with these questions, as the 10.9% who reported strong disagreement to questions 1-3 in the evaluation questionnaire (summary data can be found in Appendix 4. Evaluation Form Data) may have done so in error given the responses to other questions in the survey: the attendees who answered this way to the first three questions later stated that they would recommend the course to their colleagues. In fact, in total 100% of the attendees said they would recommend the course to their colleagues. The attendees particularly enjoyed the practical sessions such as the modelling exercise and the interactive plays organised by Dr. Clarence Tam and Prof. David Heymann. All of the sessions were deemed to be useful, and the most common response to the question "Which session did you find least useful and why?" was that there were no such sessions and that all sessions were useful. If this course is repeated in the future, participants suggested that it would be helpful if there were more interactive sessions.

# Lessons Learned

Following completion of the event, HITAP staff conducted an after-action review (AAR) to reflect upon any successes, difficulties and key learnings from the event to ensure that future activities can benefit from this experience. The main topics that were covered are detailed below.

**Learning outcomes:** The course attracted a large number of attendees, and they were extremely engaged, vocal and eager to share their knowledge and experiences from their respective countries – the feedback from the attendees was also very positive and demonstrated that the quality of the course surpassed expectations. The content of the course was broad and applicable to the attendees' work and the quality of the teaching during the workshop was exceptional. The symposium also benefitted from having a range of high-quality speakers from a diverse array of organisations.

**Environment:** Air pollution caused a major issue for the planning of the symposium and workshop. Shortly before the conference, New Delhi had declared a public health emergency and the air quality was still substantially worse than normal in New Delhi by the time of the event. At short notice, masks were acquired for all attendees, travel arrangements were adjusted to minimise exposure to the environment and medical emergency arrangements in case of an adverse reaction were organised.

**Structure of event:** As a result of the heightened air pollution, travel arrangements were adjusted at a late stage and more sessions were delivered by video conference than were originally intended. Video conference-led sessions tend to be less engaging and are more prone to audio-visual technical issues. Additionally, due to logistical issues, the symposium was held before the workshop however, ideally, the symposium would have been following the workshop to ensure that there was a commonality of understanding across the covered topics for all attendees.

**Coordination:** The event was co-organised by HITAP and four other organisations, based in four countries, which was a novel arrangement. Therefore, there were lots of key learnings related to the effective delivery of an event of this type and how to divide responsibilities between organisers.

# Outcomes

Through this workshop, HITAP has formed a new partnership with THSTI and strengthened its existing partnerships with JIPMER, LSHTM, and NUS. Furthermore, it received the opportunity to engage with representatives from several governments and organisations, who participated either as speakers or participants. During the workshop, it was evident that this course is highly valuable to all stakeholders in the vaccine space, and therefore, a saw a high demand for the event to be replicated.

As immunisation continues to remain a priority worldwide in lowering the burden of disease and becomes a more crucial component of UHC, HITAP may look to organise a similar course either in Asia or Africa, to build the technical capacity of LMICs in achieving just that.

Furthermore, HITAP also provided support to Thai and researchers from the region to attend the event, helping to build capacity in the region. Blog posts by the researchers, discussing their reflections from the event can be found in Appendix 4. Evaluation Form Data.

# Appendices

## Appendix 1. Agenda

### Agenda: Policy symposium

### 18st November 2019

| Time | Session Title | Description | Speakers |
|---|---|---|---|
| **09:00 – 09:30** (30 mins) | 1. Introduction | Opening remarks/purpose of the symposium<br>Overview of the day (agenda)<br>House-keeping rules<br>Introduction activity | Keynote speaker: Prof. Gagandeep Kang, THSTI |
| **09:30 – 10:45** (1 hr 15 mins) | 2. Decision making and resource mobilisation for the national immunisation programme | What are the barriers to introducing vaccines?<br>Are UHC policies complementing vaccine policy? If yes, how can policy makers leverage UHC to advance vaccine policy? If not, how can we make it supportive of vaccine policy?<br>How can one work with Ministries of Finance to increase prioritisation for vaccines?<br>What are the innovative policies currently being used for financing vaccines in countries?<br>How can one make vaccines a priority for healthcare payers when competing with other disease areas such as cancer and Anti-Microbial Resistance (AMR)? | Chair: Prof. David Heymann, LSHTM<br><br>Panellists:<br>Dr. Somsak Chunharas, National Health Foundation, Thailand<br>Prof Samsu Djauzi, Indonesian Technical Advisory Group on Immunization (ITAGI)<br>Prof. Rakesh Aggarwal, JIPMER |

| Time | Session Title | Description | Speakers |
|---|---|---|---|
| **10:45 – 11:15**<br>(30 mins) | **BREAK** | | |
| **11:15 – 12:30**<br>(1 hr 15 mins) | 3. Technical capacity and using evidence to inform vaccine policy development | What kind of evidence is important for decision makers?<br>How can one empower decision makers to make best use of the evidence available and enhance their knowledge on HTA?<br>How can one build capacity of technical teams supporting country National Immunization Technical Advisory Groups (NITAGs)? | Chair: Prof. Rakesh Aggarwal, JIPMER<br><br>Panellists:<br>Dr. Nakorn Premsri, National Vaccine Institute, Thailand Dr. Shankar Prinja, PGIMER<br>Prof. Gagandeep Kang, THSTI |
| **12:30 – 13:30**<br>(1 hr) | **LUNCH** | | |
| **13:30 – 14:45**<br>(1 hr 15 mins) | 4. Emerging issues in vaccines in Asia | What are the emerging issues that need to be tackled by practitioners in the field of vaccines?<br>Panellists will draw on case studies that may include:<br>Global supply of HPV vaccine<br>Polio eradication<br>Testing of malaria vaccine | Chair: Prof. Gagandeep Kang, THSTI<br><br>Panellists:<br>Prof. David Heymann, LSHTM<br>Dr. Yot Teerawattanon, HITAP<br>Dr. Arindam Ray, Bill and Melinda Gates Foundation |

| Time | Session Title | Description | Speakers |
|---|---|---|---|
| **14:45 – 15:15**<br>(30 mins) | **BREAK** | | |
| **15:15 – 16:30**<br>(1 hr 15 mins) | 5. Regional and global initiatives to support introduction of vaccines | The role of global players such as WHO, UNICEF, and more recently iDSI in the introduction of vaccines<br>What are the lessons we can learn from countries which have received support from Gavi?<br>What are the challenges faced by countries transitioning from Gavi support such as Bhutan and Indonesia? And the support required to mitigate the risks faced i.e. financial, technical, logistical?<br>What are the safe-guarding tools that are currently available to avoid such risks? | Chair: Prof. Mark Jit, LSHTM<br><br>Panellists:<br>Dr. Saskia Den Boon, WHO<br>Dr. Bhrigu Kapuria, UNICEF<br>Ms. Maya Malarski, CGD<br>Dr. Manish Pant, UNDP |
| **16:30 – 17:00**<br>(30 mins) | 6. A way forward/closing remarks | Future collaboration and moving forward | Chairs: Prof. Rakesh Aggarwal, JIPMER/Prof. Gagandeep Kang, THSTI |

## Agenda: Workshop

## 19th – 21st November 2019

| Time | 19th Nov (Tuesday) | Time | 20th Nov (Wednesday) | Time | 21st Nov (Thursday) |
|---|---|---|---|---|---|
| **09:00 – 09:30** (30 mins) | Opening remarks<br>Introduction activity<br>Agenda overview<br>***(Prof. Rakesh AggarwaL, JIPMER, Prof. David Heymann, LSHTM***<br>***Prof. Mark Jit, LSHTM)*** | **09:00 – 09:30** (30 min) | Recap<br>Day overview<br>Exercise<br>***(Prof. Mark Jit, LSHTM)*** | **09:00 – 09:30** (30 min) | Recap<br>Day overview<br>Exercise<br>***(Prof. Mark Jit, LSHTM)*** |
| **09:30 – 10:15** (45 mins) | Epidemiological concepts related to vaccination<br>***(Dr. Clarence Tam, NUS)***<br>*Lead by Prof. David Heymann* | **09:30 – 10:30** (1 hr) | Modelling vaccine preventable diseases<br>***(Prof. Mark Jit, LSHTM)*** | **09:30 – 10:30** (1 hr) | Post-licensure evaluation<br>***(Dr. Clarence Tam, NUS)***<br>*[Video conference]* |
| **10:15 – 11:45** (30 mins) | **BREAK** | **10:30 – 11:00** (30 mins) | **BREAK** | **10:30 – 11:00** (30 mins) | **BREAK** |
| **11:45 – 1230** (45 mins) | Vaccine efficacy<br>***(Dr. Clarence Tam, NUS)***<br>*[Video conference]* | **11:00 – 12:30** (1 hr 30 mins) | Practical on modelling vaccine preventable diseases<br>[Computer Lab]<br>***(Prof. Mark Jit, LSHTM)*** | **11:00 – 12:30** (1 hr 30 mins) | Practical on post-licensure evaluation<br>***(Dr. Clarence Tam, NUS)***<br>*Lead by Prof. Mark Jit* |

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|---|---|---|---|---|---|
| **12:30 – 13:30** (1 hr) | **Lunch Break** | **12:30 – 13:30** (1 hr) | **Lunch Break** | **12:30 – 13:30** (1 hr) | **Lunch Break** |
| **13:30 – 14:30** (1 hr) | Surveillance and burden estimation ***(Prof. David Heymann, LSHTM)*** | **13:30 – 14:30** (1 hr) | Getting vaccines to where needed ***(Dr. Manish Pant, UNDP)*** | **13:30 – 14:30** (1 hr) | Economics of vaccination ***(Prof. Mark Jit, LSHTM)*** |
| **14:30 – 15:00** (30 mins) | **BREAK** | **14:30 – 15:30** (1 hr) | Vaccine acceptance ***(Dr. Naveen Thacker, International Pediatric Association)*** | **14:30 – 15:30** (1 hr) | Herd immunity and other indirect effects of vaccination ***(Prof. Paul Fine, LSHTM)*** *[Video conference]* |
| **15:00 – 16:00** (1 hr) | Vaccine trials - phase I, II, III and safety ***(Dr. A P Dubey)*** | **15:30 – 16:00** (30 mins) | **BREAK** | **15:30 – 16:00** (30 mins) | **BREAK** |
| **16:00 – 17:30** (1 hr 30 mins) | Influenza virus for vaccine (lecture & role play) ***(Prof. David Heymann, LSHTM)*** | **16:00 – 17:30** (1 hr 30 mins) | Statistical and reporting issues related to vaccine trials ***(Prof. Peter Smith, LSHTM)*** *[Video conference]* | **16:00 – 17:00** (1 hr) | Evaluation form/Closing remarks via panel discussion ***(Dr. Yot Teerawattananon, Dr. Saskia den Boon)*** |

## Appendix 2. List of Attendees

| S.No | Name | Country | Organisation |
|---|---|---|---|
| 1 | Yogesh Gurav | India | National Institute of Virology, India |
| 2 | Shalu Jain | India | Department of Health Research, India |
| 3 | Nidhi Bhatnagar | India | Maulana Azad Medical College, India |
| 4 | Anish T S | India | Government Medical College, Thiruvananthapuram |
| 5 | Malaisamy Muniyandi | India | National Institute for Research in Tuberculosis, India |
| 6 | Isabel Frost | UK | Center for Disease Dynamics Economics and Policy, Amity University India |
| 7 | Alvira Z Hasan | India | Johns Hopkins Bloomberg School of Public Health |
| 8 | Brian Asare | Ghana | Ministry of Health, Ghana |
| 9 | Krissana Nurat | Thailand | National Vaccine Institute, Thailand |
| 10 | Nantasit Luangasanatip | Thailand | Mahidol-Oxford Tropical Medicine Research Unit, Thailand |
| 11 | Chonnikarn Khunchuay | Thailand | National Vaccine Institute, Thailand |
| 12 | Lerdrit Leelathorn | Thailand | Vaccine Preventable Diseases Division, Department of Disease Control, Thailand |
| 13 | Tejaswini Deshmukh | India | National Institute of Virology, India |
| 14 | Indah Hartati | Indonesia | Ministry of Health, Indonesia |
| 15 | John Ekow Otoo | Ghana | Ministry of Health, Ghana |
| 16 | Anuradha Mishra Tripathy | India | National Institute of Virology, India |
| 17 | Ngwegwe BululaA | Tanzania | Ministry of Health, Tanzania |
| 18 | Siana Mapunjo | Tanzania | Ministry of Health, Tanzania |
| 19 | Sitanshu Sekhar Kar | India | JIPMER, India |
| 20 | Phetsavanh Chanthavilay | Lao PDR | Institute of Research and Education Development, Lao PDR |
| 21 | Eva Herlianawaty | Indonesia | Ministry of Health, Indonesia |
| 22 | Sri Wahyuni | Indonesia | Ministry of Health, Indonesia |
| 23 | Tuyet Le Thi Thanh | Vietnam | Vabiotech, Vietnam |

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| 24 | Thi Thuy, Ta | Vietnam | Vabiotech, Vietnam |
| 25 | Mphatso Mtenje | Malawi | Ministry of Health, Malawi |
| 26 | Lumbani Munthali | Malawi | Ministry of Health, Malawi |
| 27 | Michael Rockson Adjei | Ghana | Ministry of Health, Ghana |
| 28 | Awnish Singh | India | NTAGI Secretariat, India |
| 29 | Satya Pavan Kumar Varma Chekuri | India | NTAGI Secretariat, India |
| 30 | Murari Rajendra Prasad | India | WHO, India |
| 31 | Subhajit Bhattacharjee | India | WHO, India |
| 32 | Nagen Sarmah | India | WHO, India |
| 33 | Kumud Ranjan | India | WHO, India |
| 34 | Anoob Razak | India | WHO, India |
| 35 | Anand Gautam | India | WHO, India |
| 36 | Qaisar Nezami | India | WHO, India |
| 37 | Amol Bhosale | India | WHO, India |
| 38 | Sanjeev Tanwar | India | WHO, India |
| 39 | Satish Chandra D | India | WHO, India |
| 40 | Sudhir Soni | India | WHO, India |
| 41 | Deepak Kumar Kar | India | WHO, India |
| 42 | Vikram Gupta | India | WHO, India |
| 43 | Santhosh Rajagopal | India | WHO, India |
| 44 | Samarendra Biswas | India | WHO, India |
| 45 | Aniruddha Sengupta | India | WHO, India |
| 46 | Subhendu Kumar Ray | India | WHO, India |
| 47 | Vikas Sharma | India | WHO, India |
| 48 | Ashutosh Aggarwal | India | WHO, India |
| 49 | Dinesh Paul | India | WHO, India |
| 50 | S Aneja | India | WHO, India |
| 51 | Nurhandini Eka Dewi, | Indonesia | Provincial Health Office, Indonesia |
| 52 | Alfian Munthe | Indonesia | Clinton Health Office, Indonesia |
| 53 | Isti Hanifah | Indonesia | Clinton Health Office, Indonesia |

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| 54 | Abhiyan Gautam | Nepal | WHO, Nepal |
| 55 | Pasang Rai | Nepal | WHO, Nepal |
| 56 | Rahul Pradhan | Nepal | WHO, Nepal |
| 57 | William Reuben | Tanzania | Ministry of Health, Tanzania |
| 58 | Muhammad Henri | Indonesia | Ministry of Health, Indonesia |
| 59 | Nivedita Gupta | India | WHO, India |
| 60 | Pritaporn Kingkaew | Thailand | HITAP, Thailand |
| 61 | Wilailak Saengsri | Thailand | HITAP, Thailand |
| 62 | Juthamas Prawjaeng | Thailand | HITAP, Thailand |

## Appendix 3. Photos

Figure 1. Infectious disease outbreak role-play exercise

Figure 2. Policy symposium


Figure 3. Interactive groupwork exercise

## Appendix 4. Evaluation Form Data

Summary of select indicators:

| | Responses (n) | | |
|---|---|---|---|
| | The content of the event was well prepared | This event enhanced my knowledge about the topic | I will apply the knowledge gained from this event in my future activities |
| Strongly Agree | 37 | 38 | 38 |
| Agree | 20 | 19 | 19 |
| Neutral | 0 | 0 | 0 |
| Disagree | 0 | 0 | 0 |
| Strongly Disagree | 0* | 0* | 0* |

Number of respondents: 64

*7 responses of "Strongly Disagree" were excluded as these were assumed to be in error as the participants stated they would also recommend the course to a friend.

## Appendix 5. Communication Outputs

- English language blog prepared by Dr. Phetsavanh Chanthavilay and Nantasit Luangasanatip
- Thai language blog prepared by Lertrit Leelathorn and Dr. Chonnikan Kwan-chuay
- Video testimony from participants