**Proposal: Next steps on influenza vaccine public health value quantification**

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**Objective:** Quantify the cost-effectiveness of seasonal influenza vaccines in exemplar countries

**Background:** In HICs, influenza vaccine programs have been shaped by model-based evaluations of the health and economic impact of vaccination 1–4. However, there has been less exploration of the role of seasonal vaccination in middle-income countries (MIC) 5,6 and even less in low-income countries (LIC). Recently however, National Immunization Technical Advisory Groups (NITAGs) in Kenya and Thailand have discussed seasonal influenza vaccination, with the latter basing their discussions on a cost-effectiveness evaluation 6,7. In Kenya, we have worked with local analysts to build a cost-effectiveness model of seasonal influenza vaccination 8. However, neither of the available models examine the next generation of seasonal vaccines which could have greater breadth and duration of protection, and hence enable different vaccination strategies.

Cost-effectiveness evaluations are based on mathematical models of influenza transmission and vaccine action. Simple models that look only at effects of vaccines on vaccinees can be used as approximations to evaluate limited strategies such as vaccination of clinical risk groups or pregnant women. However, to comprehensively evaluate population-based strategies for influenza vaccination – as was done in Thailand – requires transmission dynamic models that can project the full (direct and indirect) health and economic impact of vaccines. Unfortunately, these are relatively difficult to implement, especially for LMIC analysts.

To give a complete picture of influenza vaccine impact we will extend an existing transmission model for cost-effectiveness of current seasonal vaccines to deliver results on next-generation vaccines with higher efficacy and/or multi-season efficacy. We will also implement and fit the transmission model to a second country, ideally Thailand, and calculate the cost-effectiveness of current and future seasonal influenza vaccines. This model was built with locally-based analysts in Kenya and we propose that the Kenya work continues in-country. We have good contacts with the local and international analysts who built the model to inform decisions by the Thai NITAG and hence will be able to build on the work they did.

The project will consider vaccination of different age groups or risk groups, and aims to determine the optimal target groups coverage and timing, based on a range of plausible vaccine characteristics and costs. It will allow comparison of vaccine impact and cost-effectiveness profiles for two distinct countries, with different epidemiological and characteristics.

Hence our model will be a good starting point both for a global evaluation of influenza vaccine cost-effectiveness, as well as a global public good that can be adapted by LMIC analysts to address vaccine questions in their own country.

**Specific aims:**

1. Fit a dynamic transmission model to seasonal influenza data from Thailand
   1. Determine cost-effectiveness of seasonal influenza vaccination with current vaccines and compare to status quo by calculating incremental cost-effectiveness ratios
   2. Develop model to include improve seasonal vaccines, and multi-season vaccines
   3. Complete cost-effectiveness evaluation including health and societal costs, and direct and indirect effect of vaccines
2. Extend dynamic modelling work on seasonal influenza vaccines in Kenya to include improved seasonal vaccines and multi-season vaccines
   1. Determine incremental cost-effectiveness ratios compared both with no vaccine (current situation) and standard seasonal vaccines
   2. Complete cost-effectiveness evaluation including health and societal costs, and direct and indirect effect of vaccines

**Outcomes:**

1. Policy brief to funders detailing the impact that next generation seasonal influenza vaccines could have and appropriate strategies in exemplar LMICs.
2. Open source transmission model that can be adapted to other countries
3. Journal articles on cost-effectiveness of improved seasonal vaccines in Kenya in Thailand

**References**

1 Baguelin M, Flasche S, Camacho A, Demiris N, Miller E, Edmunds WJ. Assessing Optimal Target Populations for Influenza Vaccination Programmes: An Evidence Synthesis and Modelling Study. *PLoS Med* 2013; **10**: e1001527.

2 Thommes EW, Ismaila A, Chit A, Meier G, Bauch CT. Cost-effectiveness evaluation of quadrivalent influenza vaccines for seasonal influenza prevention: a dynamic modeling study of Canada and the United Kingdom. *BMC Infect Dis* 2015; **15**: 465.

3 Hodgson D, Baguelin M, van Leeuwen E, *et al.* Effect of mass paediatric influenza vaccination on existing influenza vaccination programmes in England and Wales: a modelling and cost-effectiveness analysis. *Lancet Public Health* 2017; **2**: e74–81.

4 Tuite AR, Fisman DN, Kwong JC, Greer AL, Kwong J. Optimal Pandemic Influenza Vaccine Allocation Strategies for the Canadian Population. *PLoS ONE* 2010; **5**: e10520.

5 Ott JJ, Klein Breteler J, Tam JS, Hutubessy RCW, Jit M, de Boer MR. Influenza vaccines in low and middle income countries. *Hum Vaccines Immunother* 2013; **9**: 1500–11.

6 Meeyai A, Praditsitthikorn N, Kotirum S, *et al.* Seasonal Influenza Vaccination for Children in Thailand: A Cost-Effectiveness Analysis. *PLOS Med* 2015; **12**: e1001829.

7 Dawa J, Chaves SS, Ba Nguz A, *et al.* Developing a seasonal influenza vaccine recommendation in Kenya: Process and challenges faced by the National Immunization Technical Advisory Group (NITAG). *Vaccine* 2019; **37**: 464–72.

8 Dawa J, Emukule GO, Barasa E, *et al.* Seasonal influenza vaccination in Kenya: an economic evaluation using dynamic transmission modelling. *BMC Med* 2020; **18**: 223.

**Responses to questions**

***1. We need actual $ amount in front of each of these lines for September through February and from March to August***

Month 1 – month 6: approx. $125,000

Month 7 – month 12: approx. $125,000

Project to begin once the contract is signed

***2. What exactly can be accomplished between Sept-February and March-August respectively***

**Month 1-6**

**Tasks**

Extend dynamic transmission model to include incremental and transformative vaccines

Fit a dynamic transmission model to data from Kenya

Collate costs for proposed vaccination programmes

Test effect of different vaccine efficacy, duration of protection, coverage and target groups

Compare vaccine impact of these different vaccine characteristics and strategies

**Deliverables:**

Slideshow/brief report showing vaccine impact and costs of incremental and transformative vaccination at different vaccine efficacy, coverage, and target groups, in Kenya

**Month 7-12**

**Tasks**

Extend work to a second country e.g. Thailand

Calculate cost effectiveness of incremental and transformative vaccines at different vaccine efficacy, duration of protection, coverage and target groups, comparing to no vaccination (current situation)

Include comparison of different cost-per-dose for candidate vaccines

Include health and if possible societal costs of vaccines, and direct and indirect effect of vaccination

**Deliverables:**

Slideshow/brief report showing potential cost effectiveness of incremental and transformative vaccination at different vaccine efficacy, coverage, and target groups in both exemplar countries