The risk of the resurgence of vaccine preventable diseases in lower-middle income countries

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Vaccination is widely recognized as one of the world's most successful and cost-effective public health interventions. Over the last 40 years, the burden of vaccine-preventable diseases has decreased significantly (**Figure 1**). However, notwithstanding the progress that has been made, lower-middle income countries (lower-MICs – defined in **Figure 1**) continue to have a substantial burden of vaccine-preventable diseases and their vaccination coverage is lagging behind that of upper-middle income countries (**Figure 1**).[1, 2]

Despite their importance, vaccination programmes within many lower-MICs are facing unprecedented financial challenges and they do not have access to the same level of support available to low-income countries.[1, 3, 4] This is in part because the transition from low to lower-middle income status results in reduced access to many sources of international healthcare aid: in fact, international aid accounts for 33% of healthcare spending in low-income countries but only 3% in lower-MICs.[5] In the case of Gavi, a major vaccine programme donor, once a country's average per capita gross national income (GNI) over the previous three years rises above US$1,580, their support is phased out over a five year transition period.[6, 7] In 2016, 16 countries were in this transition period,[6] affecting a population of nearly 500 million. Concerningly, over the next few years, middle-income countries that are ineligible for Gavi support will harbour the greatest burden of vaccine-preventable diseases and the highest number of unvaccinated children.[1] Recently, Gavi's board agreed to extend their transition period for Nigeria and Bill Gates has provided additional financial support.[4] However, other countries may not be as fortunate.

Anti-vaccination movements and vaccine hesitancy are also becoming a growing threat to vaccination programmes in lower-MICs.[1, 8, 9] How and why these movements have developed is poorly understood, but they are likely being driven by increased access to internet-based unofficial (and misleading) health information.[8] The consequences of this misinformation can be especially severe in lower-MICs, as evidenced by the huge outbreak of measles in Vietnam in 2014 (30,000 suspected cases and at least 146 deaths) that followed a loss of faith in the government's vaccine programme linked to unverified reports of vaccines causing severe adverse events.[10]

The extent of the challenges facing vaccination programmes in lower-MICs is beginning to be recognised. The World Health Organization has convened a Task Force to develop a coordinated strategy to enhance sustainable access to vaccines in middle-income countries.[1, 11] But there is an urgent need for the global health research community to also act more, and

provide policy-makers with the necessary data and tools to confront and resolve these challenges.

For example, epidemiological research and serosurveillance can be used to estimate the true levels of vaccination coverage and immunity at national and sub-national scales, which typically cannot be accurately inferred from nationally reported vaccination coverage. In high-income countries, serum banks, and epidemiological analysis have been used to ascertain where and which age-groups to target in vaccination campaigns. Applying similar approaches in lower-MICs will allow limited resources to be targeted to where they are most needed.

Social science research will be essential for investigating the most effective strategies to combat vaccine hesitancy.[12] Solutions will likely vary between different countries and even within countries.[13] Health economic research is also needed to define the cost-effectiveness of vaccination programmes for local policymakers and for quantifying the potential health and economic consequences of drops in vaccination coverage.

In short, the growing challenges facing vaccination programmes in many lower-MICs could undermine their huge public health impact. Disease outbreaks are likely to be become increasingly common, with the potential to be much larger than those experienced by high-income countries, given the higher transmission of many vaccine-preventable diseases in these settings. Their occurrence would be a significant barrier to the achievement of several global health goals. It is imperative that the global health research community and its funders respond more to these issues and assist vaccine programmes and policy-makers in overcoming them.

Declaration of interests
We declare no competing interests.

Figure 1: The estimated disability-adjusted life year (DALY) burden of several vaccine-preventable diseases and the reported DTP3 coverage over time. *The DALY estimates were taken from Global Burden of Disease 2016 study,[14] and the DTP3 coverage data were taken from the World Health Organization.[2] GNI; Gross National Income.*

References

1. World Health Organization. Global Vaccine Action Plan. Monitoring, Evaluation & Accountability. Secretariat Annual Report 2017. 2017. http://www.who.int/immunization/global_vaccine_action_plan/web_gvap_secretariat_report_2017.pdf?ua=1.
2. World Health Organization. Global Health Observatory (GHO) data: Diphtheria-tetanus-pertussis (DTP3) immunization coverage. http://www.who.int/gho/immunization/dtp3/en/.
3. Makinen M, Kaddar M, Molldrem V, Wilson L. New vaccine adoption in lower-middle-income countries. *Health Policy and Planning* 2012; **27**(suppl_2): ii39-ii49.
4. The Lancet Global Health. #VaccinesWork… don't they? *The Lancet Global Health* 2018; **6**(5): e469.
5. Dieleman J, Campbell M, Chapin A, et al. Evolution and patterns of global health financing 1995-2014: development assistance for health, and government, prepaid private, and out-of-pocket health spending in 184 countries. *The Lancet*; **389**(10083): 1981-2004.
6. Gavi. Transition process. https://www.gavi.org/support/sustainability/transition-process/.
7. Gavi's Transition Policy: Moving From Development Assistance To Domestic Financing Of Immunization Programs. *Health Aff (Millwood)* 2016; **35**(2): 250-8.
8. Dube E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert review of vaccines* 2015; **14**(1): 99-117.
9. Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: A systematic review of published literature, 2007–2012. *Vaccine* 2014; **32**(19): 2150-9.
10. Roberts L. In Vietnam, an anatomy of a measles outbreak. *Science* 2015; **348**(6238): 962.
11. World Health Organization. The Middle Income Country Strategy. http://www.who.int/immunization/programmes_systems/sustainability/mic_strategy/en/.
12. Cobos Muñoz D, Monzón Llamas L, Bosch-Capblanch X. Exposing concerns about vaccination in low- and middle-income countries: a systematic review. *International Journal of Public Health* 2015; **60**(7): 767-80.
13. Dubé E, Gagnon D, Nickels E, Jeram S, Schuster M. Mapping vaccine hesitancy—Country-specific characteristics of a global phenomenon. *Vaccine* 2014; **32**(49): 6649-54.
14. Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2016 (GBD 2016) Results. 2017. http://ghdx.healthdata.org/gbd-results-tool.