

Reassessing the value of vaccines



This online publication has been corrected. The corrected version first appeared at thelancet.com/lancetgh on May 22, 2014

In May, 1974, WHO launched the Expanded Programme on Immunization—the global programme to immunise children worldwide with a set of (at the time) six core vaccines. 40 years on, the GAVI Alliance has brought us together, a group of 29 leading technical experts in health and development economics, cognitive development, epidemiology, disease burden, and economic modelling to review and understand the broader outcomes of vaccines beyond morbidity and mortality, to identify research opportunities, and to create a research agenda that will help to further quantify the value of this effect.

What is the value of immunising every child with all 11 vaccines that WHO now recommends,¹ beyond the prevention of illness and death? The full benefits of childhood vaccination could reach well into a child's life, through adulthood, into the wider community, and, ultimately, the national economy.² Some evidence of these benefits has already been generated, but gaps in knowledge remain.

For example, preliminary research suggests that a 5-year improvement in life expectancy can translate into 0.3–0.5% more annual growth added to income per head.³ Similarly, results of research done in Bangladesh show that the benefits of antibodies from maternal tetanus vaccinations passing from a mother to her unborn child can lead to gains of about 0.25 years of schooling for children whose parents did not attend school.⁴ And findings from the Philippines showed that vaccinations induced improvements in test scores in children,⁵ which had a return on investment as high as 21% when translated into the earning gains of adults.⁶

Meanwhile in South Africa, researchers have shown a significant association between coverage of measles vaccination and the level of school-grade attainment in sibling-pairs, after controlling for intrinsic factors such as birth order, education levels of parents, and household wealth.⁷ This research suggests that, on average, 1 year of schooling is gained for every six children vaccinated against measles. But evidence to link health inputs and wealth outcomes needs to be further assessed and investigated.

Vaccines are usually given when the rate of brain development is at its peak, which can benefit cognitive development through prevention of illness and its

neurological complications (eg, encephalitis). But so far, the only evidence for this model is based on observational studies; such studies are an important first step, but more work is needed. Similarly, evidence for the positive links between vaccines and the educational attainment of children, or how improvements in child survival can lead to lower fertility rates, exists but needs more elaboration. And although it seems obvious that repeated infections would have a synergistic negative effect, infections are still assessed in isolation.

Similarly, there is evidence for links between improvements in survival, cognition, physical capacity, and educational attainment, and increases in workforce supply and productivity.⁸ How reductions in mortality and morbidity can boost consumption and gross domestic product (GDP) can be modelled, but to understand these links better, more research is needed.

Although it follows logically that vaccination can prevent disease and therefore reduce health-care costs, more evidence is needed. This is also the case for evidence that links loss of productivity with specific diseases. We have some evidence, but the picture remains incomplete. Follow-up studies for education and income are needed. For expediency, these studies could be done through follow-up of previous randomised controlled trials and through investigators finding clever ways to add these questions onto prospective studies, such as studies embedded in health and demographic surveillance sites.

As well as generating new data, it is important to obtain and mine data from previous studies of existing vaccines used in the Expanded Programme on Immunization. Similarly, the links between productivity and specific diseases could be made clearer through the addition of economic or other quantitative socioeconomic analyses to clinical trials of new vaccines, such as those against dengue and malaria. Also, the need for different metrics to measure the effectiveness of vaccines could be met by the use of economic approaches that include broader measures of wellbeing, such as willingness to pay and value of statistical life.² These measures are by no means perfect and are not straightforward to interpret when applied to childhood vaccination. One of the difficulties in interpretation is that it can be problematic to separate the effect of

vaccinations from other health-care interventions during assessment of costs and benefits.

Clearly, a lot of work still needs to be done, but the potential rewards are huge. Two studies have already been commissioned by GAVI to try to fill these gaps—one in Nigeria will explore issues of equity and trust (these issues can play a part in the overall effect and coverage of vaccines); the other will look for new evidence of economic benefits with vaccination in India. However, GAVI is not a research organisation. The main drive must come from the broader academic community and not simply organisations traditionally concerned with vaccines.

Mortality reduction is already reason enough to have every child on this planet fully immunised, as shown by the Millennium Development Goals and the post-2015 development agenda. Now this fight is not simply about saving lives, but about maximising the full lifetime potential of these children and the economic health of the families and countries in which they live.

*Till Bärnighausen, *Seth Berkley, Zulfiqar A Bhutta, David M Bishai, Maureen M Black, David E Bloom, Dagna Constenla, Julia Driessen, John Edmunds, David Evans, Ulla Griffiths, Peter Hansen, Farah Naz Hashmani, Raymond Hutubessy, Dean T Jamison, Prabhat Jha, Mark Jit, Hope Johnson, Ramanan Laxminarayan, Bruce Y Lee, Sharmila Mhatre, Anne Mills, Anders Nordström, Sachiko Ozawa, Lisa Prosser, Karlee Silver, Christine Stabell Benn, Baudouin Standaert, Damian Walker*

Wellcome Trust Africa Centre for Health and Population Studies, University of KwaZulu-Natal, Mtubatuba, South Africa (TB); Harvard School of Public Health, Boston, MA, USA (TB, DEB); GAVI Alliance, Geneva 1202, Switzerland (SB, PH, HJ); SickKids Center for Global Child Health, Toronto, ON, Canada (ZAB); Center of Excellence in Women & Child Health (ZAB), and Department of Community Health Sciences (FNH), Aga Khan

University, Karachi, Pakistan; Johns Hopkins University, Baltimore, MD, USA (DMB, DC); University of Maryland School of Medicine, Baltimore, MD, USA (MMB); University of Pittsburgh, Pittsburgh, PA, USA (JD); London School of Hygiene & Tropical Medicine, London, UK (JE, UG, MJ, AM); WHO, Geneva, Switzerland (RH, DE); University of Washington, Seattle, WA, USA (DTJ); University of Toronto, Toronto, ON, Canada (PJ); Public Health England, London, UK (MJ); Public Health Foundation of India, New Delhi, India (RL); Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA (BYL, SO); International Development Research Centre, Ottawa, ON, Canada (SM); Swedish Ministry for Foreign Affairs, Stockholm, Sweden (AN); University of Michigan, Ann Arbor, MI, USA (LP); Grand Challenges Canada, Toronto, ON, Canada (KS); Indepth Network and Bandim Health Project, Statens Serum Institut, Copenhagen, Denmark (CSB); GlaxoSmithKline Biologicals, Rixensart, Belgium (BS); and the Bill & Melinda Gates Foundation, Seattle, WA, USA (DW)
sberkley@gavialliance.org

We declare that we have no competing interests.

Copyright © 2014 World Health Organization; licensee Elsevier. This is an Open Access article published without any waiver of WHO's privileges and immunities under international law, convention, or agreement. This article should not be reproduced for use in association with the promotion of commercial products, services or any legal entity. There should be no suggestion that WHO endorses any specific organisation or products. The use of the WHO logo is not permitted. This notice should be preserved along with the article's original URL.

- 1 WHO. Summary of WHO position papers—recommendations for routine immunization. http://www.who.int/immunization/policy/Immunization_routine_table1.pdf?ua=1 (accessed April 7, 2014).
- 2 Jamison DT, Summers LH, Alleyne G, et al. Global health 2035: a world converging within a generation. *Lancet* 2013; **382**: 1898–955.
- 3 Bloom DE, Canning D. The health and wealth of nations. *Science* 2000; **287**: 1207–09.
- 4 Canning D, Razzaque A, Driessen J, Walker DG, Streatfield PK, Yunus M. The effect of maternal tetanus immunization on children's schooling attainment in Matlab, Bangladesh: follow-up of a randomized trial. *Soc Sci Med* 2011; **72**: 1429–36.
- 5 Bloom DE, Canning D, Shenoy ES. The effect of vaccination on children's physical and cognitive development in the Philippines. *Appl Econ* 2012; **44**: 2777–83.
- 6 Bloom DE. The value of vaccination. *Adv Exp Med Biol* 2011; **697**: 1–8.
- 7 Anekwe T, Newell M, Bärnighausen T. The impact of measles vaccination on educational attainment in rural KwaZulu-Natal. GAVI Alliance Value of Vaccines Meeting; Annecy, France; Jan 14–15, 2013.
- 8 Deogaonkar R, Hutubessy, van der Putten I, Evers S, Jit M. Systematic review of studies evaluating the broader economic impact of vaccination in low and middle income countries. *BMC Public Health* 2012; **12**: 878.