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Review

Valuing vaccines: Deficiencies and remedies☆

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ABSTRACT

Current evaluation models for the value of vaccines typically account for a small subset of the full social and economic benefits of vaccination. Health investments yield positive economic benefits via several channels at the household, community, and national levels. Underestimating, or worse, not considering these benefits can lead to ill-founded recommendations regarding the introduction of vaccines into immunization programs. The clear and strong links between health and wealth suggest the need to redesign valuation frameworks for vaccination so that the full costs may be properly weighed against the full benefits of vaccines.

1. Introduction

Conducting economic analyses of medical interventions such as vaccination is not a routine exercise for many in the public health field and may even seem suspect. However, an economic lens is sensible, promising, and practical for evaluating strategies to reduce disease through the development and delivery of effective vaccines. Vaccination is costly, but evidence from a growing body of research suggests that the costs of failing to vaccinate are even higher.

This article summarizes recent research that focuses on identifying and estimating the full economic and social benefits of vaccine-driven health improvements. Looking at vaccination with an economic lens is meaningful because it communicates in the language of decision makers who have the power of the purse: ministers of finance, ministers of planning, central bank governors, economic advisers to prime ministers and presidents, investors, and CEOs.

Three points are critical to understanding this emerging approach to health impact measurement. First, the theory- and evidence-based proposition that "healthier means wealthier" provides a key intellectual foundation for conceptualizing the value of health interventions including medical devices, drugs, and vaccines. Second, vaccination can promote improvements in economic wellbeing through various channels. Third, health economists have an important role to play in operationalizing these ideas.

Until recently, economists failed to recognize the full economic benefits of health. As a result, they unwittingly undervalued many health interventions – including vaccination. Undervaluation translates into underinvestment – both in the development and the delivery of vaccines. This undervaluation seems to be substantial. Thus far the low cost of many prominent vaccines, like those for diphtheria, tetanus, and pertussis (DTP); measles; and polio [1], have mitigated the practical consequences of this bias. However, continued undervaluation is much more perilous with respect to a new generation of more costly vaccines, such as those against rotavirus, human papilloma virus, pneumococcal disease, and meningococcal B. Additional vaccine breakthroughs are currently on the horizon, most notably against Ebola and dengue, and the net social benefits of these and other vaccines are easily misjudged in the face of high costs and undervalued benefits.

Correcting these under-valuations will keep health economists very busy in the coming years as they review and revise long-held assumptions and pursue research inquiries that capture the full benefits of vaccination—vaccine by vaccine, and country by country.

2. Links between health and wealth

Scholars of economic development have long recognized that high-income populations are generally healthier populations. This pattern holds for different income measures, different health measures, and at different time points. For decades, macroeconomists adhered to the view that the positive cross-country association between income and health reflected causality running from

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income to health. This is a logical presumption given that when people have more money, they tend to have better nutrition and access to safe water, sanitation, more and better health care, and better psychosocial resources like community recreation facilities.

However, about 15 years ago some macroeconomists began to wonder whether improved health could be a significant driver of economic growth. That proposition is also plausible: a healthier workforce tends to be more and better educated, energetic, and productive with better fertility control and a stronger propensity to save money for the future. This kind of workforce is attractive to foreign investors.

Macroeconomists were lamentably slow in exploring the directionality of the health-income relationship; however, microeconomists have long understood the connections between health and economic growth. For example, in 1962, Selma Mushkin published an article entitled "Health as an investment" in a top economics journal [2]. She presented numerous ideas about the economic benefits of health, which spawned a considerable body of research that treated health as a form of human capital, akin to knowledge and skill.

The reverse link from health to income has been the subject of much rigorous statistical and econometric analysis, especially over the last decade. That research supports the finding that health is an exceedingly robust and powerful predictor of income growth and also of poverty alleviation. For example, a 10-year gain in life expectancy translates into as much as 1 additional percentage point of annual growth in income per capita [3], which when compared with the average 2–3% annual growth per capita in a world economy is quite significant.

Further, a 1-percentage point gain is meaningful because a 10-year increase in life expectancy is well within the grasp of many countries. It is only half of the increase in life expectancy the world has enjoyed during the past 50 years [4], and it is also half of the life expectancy improvement that several leading European demographers are projecting for many wealthy industrial countries during this century. Additionally, a 1-percentage point change is noteworthy because of compound interest, which magnifies the effect of that 1-percent boost when maintained over time.

Taken as a whole, these ideas and evidence of the potent synergy between health and income help explain the strong presence of health in ongoing discussions about the post-Millennium Development Goals agenda. They also figure prominently in the much-heralded final report of *The Lancet* Commission on Investing in Health entitled "Global Health 2035: A World Converging within a Generation" [5]. These concepts elevate health to the same importance as basic education as a fundamental instrument of economic growth and development.

The parallel between health and education offers some useful insights. Education was severely neglected as a public investment prior to the publication of studies on its costs and benefits. The costs of education encompass tuition and fees as well as the opportunity cost of foregoing an income while attending school. The benefits are mainly the higher productivity and income of students after they leave school and enter the workforce.

A key figure in this line of research was George Psacharopoulos, a University of Chicago–trained economist working at the World Bank. He made a career of collecting and synthesizing studies on the return on investment in education for different countries, different demographic groups, and different timeframes. Psacharopoulos noticed that these studies uniformly suggested that education offered a return on investment that was high by any reasonable financial standard. He helped leverage this compelling observation into a colossal boost in education lending, grant funding, and spending policy at the World Bank and in many countries.

Development economists have started to focus on the investment value of health spending just as they previously came to focus on the investment value of education spending. Leveling the playing field between health spending and other social priorities raises the prospect of significant expansions of the health sector.

One noteworthy benefit of such potential expansions is the possibility of virtuous spirals in which improvements in health lead to improvements in income, which lead to further improvements in health and so on. In other words, through a process of cumulative causality, interventions that promote health can serve as fuel for economic growth and development. By the same token, a costly and vicious downward spiral can also gain momentum through adverse health and income shocks that are met with complacency.

Gro Brundtland, former Prime Minister of Norway and former head of the World Health Organization (WHO), summarizes the basic points well. In launching the report of the WHO Commission on Macroeconomics and Health in late 2001, Brundtland stated, "During the 1980s, investments in health were increasingly seen by economists as an add-on that developing countries could only afford after having reached a middle-income level. I was convinced this was wrong: you need a two-pillar approach. A healthy population is a prerequisite for growth as much as a result of it" [6]. Increased and improved research on the full benefits of vaccination thus offers policymakers the foundation necessary to leverage health interventions as sustainable and indispensable components of development strategies.

3. Vaccination as a driver of both health and wealth

Given the rigorous evidence that health promotes wealth, economic evaluations of health interventions should consider and account for the full set of economic benefits that follow from those interventions. Doing so is nothing more than proper accounting, which is the prudent and responsible way to allocate funds to promote public wellbeing.

My research on the value of vaccination began 10 years ago while David Canning and I were attempting to explore, at the request of Tore Godal, the economic case for including vaccination as the pilot for Gordon Brown's International Finance Facility—an innovative mechanism for financing development. We scoured the literature and found it to be replete with books and articles that focused heavily on two benefits: avoided medical care costs and avoided income loss associated with parental absenteeism from work. Economists routinely mention and analyze health gains associated with vaccination, but they rarely attempt to monetize them.

Avoided costs of care and lost income are indisputable benefits of a vaccination program. The problem is that these are just two components of a much wider set of overall benefits that vaccination can confer on vaccinated children, their parents, and their communities—a set of benefits that are rarely addressed in the economic literature.

For example, healthy children have better school attendance. They also attend school for more years and learn more each year they are enrolled. Vaccinated children also tend to avoid the long-term sequelae associated with certain childhood diseases, such as neurological impairments, hearing loss, and various other physical disabilities [7]. This suggests higher productivity and earnings as adults. The health gains also suggest utilitarian value, above and beyond their implications for productivity and earnings.

With respect to older family members, parents and grandparents tend to be healthier themselves if their children and grandchildren are healthy. They also have lower rates of absenteeism and fewer episodes of low productivity related to illness, fatigue, and the mental burden of caring for sick children.

Society also derives benefits from vaccinated, healthy kids. These benefits relate to herd effects, reduced usage of antibiotics and slower development of antibiotic resistance, reduced