The economic and social benefits of childhood vaccinations in BRICS

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The international community has successfully promoted childhood vaccination as an essential public health intervention. This has been accomplished through efforts such as the World Health Organization's (WHO) Expanded Programme on Immunization and more recently, the establishment of the Global Alliance for Vaccines and Immunization (GAVI Alliance), a global health partnership committed to ensuring access to low-cost immunization in developing countries. While such global efforts have resulted in large increases in vaccine coverage worldwide, there is still a large population that remains uncovered. Inadequate immunization coverage is apparent among middle-income countries. As middle-income countries do not receive support from the GAVI Alliance, lack of funds may account for low coverage, and vaccine delivery in these settings may suffer from inefficiencies that have been resolved in high-income countries.[1]

The potential benefits of expanded vaccine coverage are evident among the following five emerging economies: Brazil, the Russian Federation, India, China and South Africa – often referred to as BRICS. These countries have seen high economic growth in recent years – expanding their capacity to produce, procure and provide health care. The countries represent a range of lower-middle-income (India), upper-middle-income (Brazil, China and South Africa) and high-income (Russian Federation) countries. They include the two most populous countries in the world – China and India. Collectively, BRICS have a population of nearly 239 million children under the age of five years..

BRICS vary in their financial capacity to support the introduction of new vaccines and to scale-up childhood immunization coverage in their own countries and beyond. BRICS have received resources from – and donated to – international organizations working to improve vaccination coverage. India received 130 million United States dollars (US$) from the GAVI Alliance since 2002 to improve immunization coverage. Until 2006, China received US$ 40 million from the GAVI Alliance for its immunization programme. The Governments of Brazil, the Russian Federation and South Africa have each pledged funding to the GAVI Alliance, donating between US$ 20 and US$ 80 million over one or two decades to improve vaccination coverage in other low- and middle-income countries.

Table 1. **Population, deaths from vaccine-preventable diseases and vaccine coverage in children under the age of five years, Brazil, the Russian Federation, India, China and South Africa (BRICS)**

Country	Population under five years of age, in 2012[3]	Deaths per 100 000 children			Vaccine coverage, in 2012 (%)[4]		
		Hib in 2009[5]	SP in 2009[6]	RV in 2008[7]	Hib	PC	RV
Brazil	14 563 000	12	85	5	95	89	86
Russian Federation	8 227 000	2	5	1	18	ND	ND
India	120 581 000	56	112	77	ND	NI	NI
China	88 934 000	20	31	5	NI	NI	NI
South Africa	5 525 000	20	101	56	68	81	78

Hib: *Haemophilus influenzae* type b; ND: no data; NI: not introduced; PC: pneumococcal conjugate; RV: rotavirus; SP: Streptococcus pneumonia.

New vaccine adoption

The extent of childhood vaccination among BRICS has varied widely, particularly with the introduction of three of the latest vaccines, which have been shown to be safe and effective in reducing childhood mortality and long-term disability: *Haemophilus influenzae* type b vaccine, pneumococcal conjugate vaccine and rotavirus vaccine.[2]

Brazil and South Africa stand out as success stories for the introduction and scale-up of all three of these vaccines. Both countries have used evidence-based decision-making processes to support introduction and harnessed timely political momentum to achieve high levels of coverage (Table 1).

With support from the Pan American Health Organization's negotiated vaccine prices, Brazil, like other countries in the Caribbean and Latin America, has achieved high coverage of new vaccines. Through its national expanded immunization programme, it adopted the *H. influenzae* type b vaccine in 1999, the rotavirus vaccine in 2006 and the pneumococcal conjugate vaccine in 2010. It also developed national capacity for vaccine production.[8]

South Africa self-funded the introduction of the *H. influenzae* type b vaccine in 1999. In the first few years after the introduction of this vaccine, the cases of *H. influenzae* type b disease in children under the age of one year fell by 65%.[9] South Africa was the first African country to introduce the pneumococcal conjugate vaccine, in 2009. It also introduced the rotavirus vaccine the same year. South Africa's formalized decision-making process for vaccine introduction takes into account the health impact and cost–effectiveness of new vaccines.[10]

The Russian Federation introduced the *H. influenzae* type b vaccine into its national immunization programme in 2011, but has not yet included the pneumococcal conjugate vaccine or the rotavirus vaccine. The country has the lowest burden of childhood pneumonia and diarrhoea of all BRICS countries (Table 1) but it also has the

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highest gross domestic product (GDP) per capita indicating that introduction of these vaccines could nevertheless lead to important economic savings. A recent cost–benefit analysis found that the rotavirus vaccine has the potential to prevent 148 000 cases of infection per year in the Russian Federation.[11]

Although India started a phased introduction of the *H. influenzae* type b vaccine in 2011, coverage remains low. The country has not yet included either the pneumococcal conjugate vaccine or the rotavirus vaccine in the national immunization programme despite the very high disease burden in children under the age of five years. The benefits of introducing and scaling up coverage of these vaccines would be considerable, given the large numbers of childhood illnesses and deaths that could be averted (Table 1).

China's national immunization programme does not include the *H. influenzae* type b, pneumococcal conjugate vaccine or rotavirus vaccines. But China produces its own vaccines, which are available in the private sector. While *H. influenzae* type b vaccine is widely available in the private sector, evidence suggests that unless vaccines are included in the national immunization schedule, coverage will continue to be low.[1]

Economic and social benefits of high coverage

For all BRICS countries, the potential social and economic benefits of achieving high coverage of the three vaccines are significant. In India, for example, the introduction of childhood rotavirus vaccination is projected to save nearly US$ 21 million in treatment costs per year, while the projected averted treatment costs between 2011 and 2020 for pneumococcal and *H. influenzae* type b pneumonia may be as high as US$ 1.5 billion.[12,13]

The benefits of scaling up coverage of new vaccines can also bring direct contributions, such as increased economic productivity, and increased social value of life as a healthy individual, family and community member. According to the latest literature, the value of a life-year saved in a low- or middle-income country is estimated at 1.5 times a country's GDP per capita.[14] Using the Lives Saved Tool (LiST) (http://www.jhsph.edu/departments/international-health/centers-and-institutes/institute-for-international-programs/list), we assessed the number of deaths that could be averted from improved childhood vaccination coverage. For example, if India and China eliminated all childhood deaths preventable by *H. influenzae* type b, pneumococcal conjugate vaccine and rotavirus vaccines, they would avert nearly 157 000 deaths annually (Table 2). We then estimated the economic and social benefits that could be gained from lives saved through immunization, based on numbers of deaths averted, discounted GDP per capita, and life expectancy based on published methods.[14-16] Using the latest data from 2012, we estimated that reaching 90% coverage for *H. influenzae* type b, pneumococcal conjugate vaccine and rotavirus vaccines in all BRICS countries will result in the following annual economic and social benefits: US$ 9.1 billion for India, US$ 5.8 billion for China, US$ 560 million for the Russian Federation, US$ 400 million for South Africa and US$ 18 million for Brazil (Table 2).

Through childhood vaccination, these countries have an opportunity to avert high medical treatment costs and lost wages from taking care of sick children. The economic benefits of vaccination extend far beyond the treatment costs that are usually included in cost–effectiveness analyses. Children whose lives are saved through immunization programmes not only contribute to the economy but also bring social value to the community. Vaccination, and thus improved health, can yield broad benefits in improved cognitive development, educational attainment and labour productivity.[17]

Conclusion

BRICS have considerable potential to save lives and obtain economic benefits through introducing or scaling up childhood vaccination. Brazil and South Africa have already successfully adopted three new vaccines; China, India and the Russian Federation continue to face challenges in introducing and scaling up their national coverage of these vaccines.

Brazil and South Africa have shown a strong commitment to introducing new vaccinations and capitalizing on the health and economic benefits that they provide. Further efforts by BRICS would save more lives and money. The largest of these potential benefits would be for China and India, with the introduction and scale-up of *H. influenzae* type b, pneumococcal conjugate and rotavirus vaccines in their national immunization programmes. ■

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Table 2. **Estimated annual economic and social benefits from increased *Haemophilus influenzae* type b, pneumococcal conjugate vaccine and rotavirus vaccine coverage, Brazil, the Russian Federation, India, China and South Africa (BRICS)**

Country	GDP per capita 2012 (US$)[15]	Life expectancy at birth (years)[16]	Estimated annual no. of averted deaths				Estimated annual economic and social benefits (US$)
			Hib	SP	RV	Total	
Brazil	11 359	73.8	0	25	10	35	18 162 707
Russian Federation	14 302	67.9	373	474	31	878	559 713 873
India	1 501	66.3	52 709	54 499	29 612	136 820	9 083 890 821
China	6 071	75.2	9 538	10 079	1 170	20 787	5 796 798 644
South Africa	7 525	57.1	856	319	85	1 260	398 019 961

GDP: gross domestic product; Hib: *Haemophilus influenzae* type b; RV: rotavirus; SP: Streptococcus pneumonia; US$: United States dollars.

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