

# Economic implications of switching rotavirus vaccine products in Palestine's immunization program



Photo: PATH / Arjan Bhat

**Switching from one vaccine product to another can have a significant impact on a country's budget. For Palestine's rotavirus vaccination program, a switch paid off.**

The Palestinian Ministry of Health (MOH) introduced the rotavirus vaccine ROTARIX® in its routine immunization program in 2016. Two years later, the MOH decided to switch to ROTAVAC®, a rotavirus vaccine made in India. Given the lower price of ROTAVAC, such a move might seem like a clear choice. In reality, the overall cost of vaccination programs is influenced by a variety of vaccine characteristics, such as the packaging volume and number of doses required. When comparing the health and economic value of different vaccine products, assessing multiple criteria beyond just price allows countries to account for the economic implications of all vaccine characteristics.

This switch therefore provided a unique opportunity to compare the overall costs, impact, and cost-effectiveness of both rotavirus vaccines in a public-sector setting. The resulting analysis, conducted by PATH and partners, found that both vaccines have a high probability of being cost-effective compared to no vaccination in Palestine.<sup>1</sup> But when compared to ROTARIX, ROTAVAC was cost-saving.

The Palestinian MOH's switch to ROTAVAC was the first use of the vaccine outside of India, and this study provides compelling evidence to validate the government's decision to switch to this lower-cost rotavirus vaccine. The study's findings may also be useful for other countries that are considering a switch, particularly middle-income countries that finance their own immunization programs.

## BACKGROUND

**Rotavirus causes about one-third of child deaths due to diarrhea globally. Worldwide, 185,000 rotavirus deaths were estimated in 2017, and each year millions of children require home treatment and/or hospitalization.<sup>2</sup> Mild infections can be treated with oral rehydration therapy, but children with severe rotavirus diarrhea urgently need intravenous fluids or else risk dying from dehydration. In many low- and middle-income countries, this type of urgent care can be difficult to access, making rotavirus vaccination critical to saving children's lives.**

The World Health Organization (WHO) recommends that all national immunization programs include rotavirus vaccine.<sup>3</sup> To date, more than 100 countries worldwide have introduced rotavirus vaccines,<sup>4</sup> many of which have observed swift and significant declines in diarrhea hospitalizations and deaths.<sup>5</sup> For almost a decade, countries had the choice of two globally available rotavirus vaccines: ROTARIX and RotaTeq®. Then, in 2018, WHO prequalified two additional rotavirus vaccines developed in India, ROTAVAC and ROTASIL®,<sup>6</sup> enabling procurement by global agencies and broadening country choice.

Before rotavirus vaccine introduction, the Palestinian territory of Gaza and West Bank reported 23 percent prevalence rates of diarrheal illnesses among children younger than six months of age, the highest rate in the region.<sup>7</sup>

When the Palestinian MOH introduced ROTARIX in 2016, the Rostropovich-Vishnevskaya Foundation (RVF), a global development and research organization that promotes the health and well-being of children, provided support for vaccine procurement, training, and oversight.<sup>8,9</sup> In 2018, financial responsibility for rotavirus vaccine procurement was transferred to the Palestinian government, which elected to shift from ROTARIX to ROTAVAC because of its lower price per dose.

Given the cost implications of other vaccine characteristics beyond price per dose—such as number of doses required, volume, cold chain footprint, packaging, and training requirements—questions remained about the long-term cost-effectiveness of this switch decision for the Palestinian immunization program.

## METHODS

**Working in partnership with RVF and the Palestinian MOH, PATH conducted a study to assess the cost, impact, and cost-effectiveness of the Palestinian rotavirus vaccination program.**

Specifically, the study evaluated the economic implications of the change in vaccine product, accounting for the different characteristics of ROTARIX and ROTAVAC. The primary differences examined between products include the number of doses required, price per dose, wastage, in-country logistics, and the health system cost of delivery per dose.

In order to assess the introduction, procurement, supply chain, and service delivery costs related to each vaccine, PATH and its partners conducted primary and secondary data collection. The team then used UNIVAC, a validated impact and cost-effectiveness tool, to project the costs and benefits of rotavirus vaccination over a 10-year period comparing the use of ROTARIX versus no vaccination; ROTAVAC versus no vaccination; and ROTAVAC versus ROTARIX.

## RESULTS

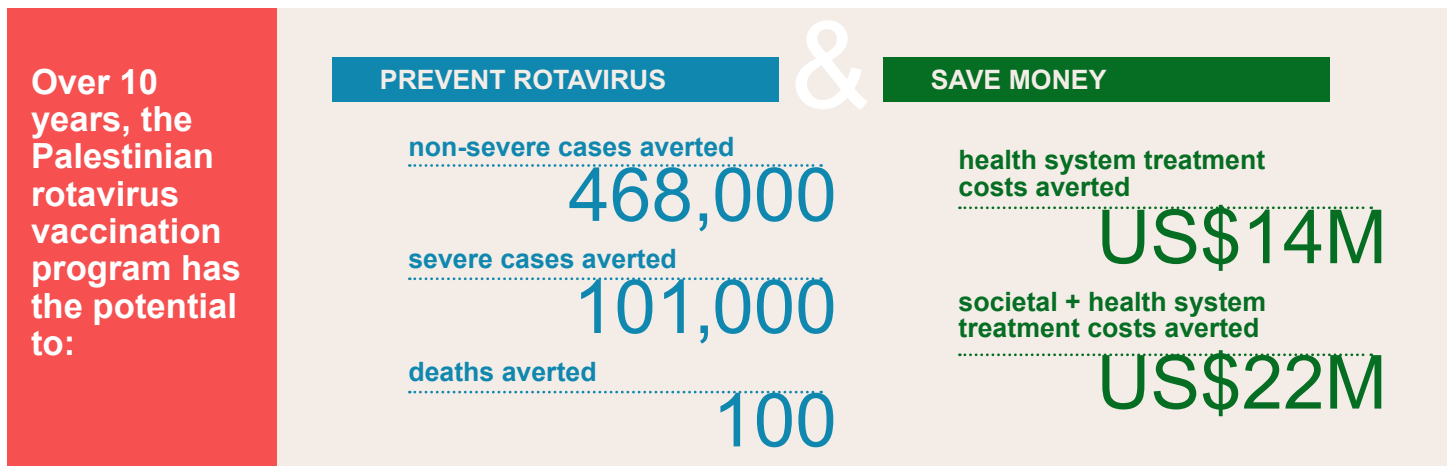
**The analysis generated data on the program costs and resulting health system savings of ROTARIX and ROTAVAC, enabling a comparison of the cost-effectiveness of each vaccine in the Palestinian immunization program. Overall, both ROTARIX and ROTAVAC had a high probability of being cost-effective interventions compared to no rotavirus vaccine.**

When accounting for averted healthcare-related costs for households, using either vaccine is a cost-saving intervention, highlighting the economic burden rotavirus represents for households and the Palestinian health system.

When comparing the two vaccine products, the results found that switching from ROTARIX to ROTAVAC was also cost-saving due to the lower vaccine price and programmatic costs per dose for ROTAVAC, even when accounting for the additional dose per full course that ROTAVAC requires.

### Vaccine impact

While both ROTARIX and ROTAVAC have been shown to be efficacious in a multitude of clinical trials, no studies have directly compared their effectiveness in the same setting. This study assumed similar effectiveness for the two vaccines, rendering the estimated health and treatment cost savings benefits equally applicable for both ROTARIX and ROTAVAC. Over 10 years, the Palestinian rotavirus vaccination program—using either vaccine—has the potential to avert approximately 468,000 non-severe rotavirus cases, 101,000 severe rotavirus cases, and about 100 deaths throughout Gaza and the West Bank. This represents potential savings on treatment costs of approximately US\$14 million for the health system and approximately \$22 million when considering costs for both the health system and families.



## Vaccination program costs

The total cost of the vaccination program over a 10-year span varies depending on which vaccine and vaccine price are considered. The vaccine price itself was lower for ROTAVAC, but the choice of vaccine product also has several potential implications for delivery costs due to differences in the number of doses required, packaging, storage conditions, and stability. In order to account for these cost implications, the team examined the costs of each of these delivery elements.

For supply chain and service delivery costs, the cost per dose was lower for ROTAVAC than ROTARIX, partly due to its smaller volume per dose. Because ROTAVAC requires three doses while ROTARIX only requires two doses, however, the total delivery cost per course favored ROTARIX. ROTAVAC also comes in 5- and 10-dose vials compared to the single-dose vial for ROTARIX, leading to a likelihood of higher wastage rates with ROTAVAC.

Overall, however, the lower cost of procuring ROTAVAC (i.e., the lower price) outweighed these delivery cost considerations. The total vaccination program costs therefore favored ROTAVAC over ROTARIX.

## Cost-effectiveness ratios

Cost-effectiveness is measured using an incremental cost-effectiveness ratio (ICER)—or cost to avert one lost year of healthy life, known as a disability-adjusted life-year (DALY). ICERs can be determined from a health system perspective (i.e., costs and benefits for the government) or from a societal perspective (i.e., costs and benefits for the government plus costs for families and the overall economy).

Compared to no vaccination program, Palestine's rotavirus vaccination program ICER estimate from the health system perspective was \$1,254 per DALY averted with ROTARIX and \$353 per DALY averted for ROTAVAC—both within established cost-effectiveness thresholds. From the societal perspective, both vaccines were cost-saving compared to no vaccination program (i.e., the ICER was less than zero for both vaccines, meaning the vaccine would result in a net economic gain). Assuming a similar health impact of both vaccines and with lower vaccination program costs for ROTAVAC, switching from ROTARIX to ROTAVAC was a cost-saving alternative for the Palestinian MOH.

## Cost per DALY averted

	Health system perspective	Societal perspective
ROTARIX vs No Vaccine	\$1,254	cost-saving
ROTAVAC vs No Vaccine	\$353	cost-saving
ROTAVAC vs ROTARIX	cost-saving	cost-saving

price assumptions: ROTAVAC at \$1/dose, ROTARIX at \$4/dose

## Sensitivity analysis

All economic analyses contain a degree of uncertainty due to assumptions made on some of the input parameters. To account for this uncertainty, the team ran sensitivity analyses covering a range of more and less favorable “what if” scenarios. For example, how would the results change if the actual rotavirus disease burden were higher or lower than the input data supposed? Scenarios were also tested for higher and lower vaccine efficacy, health system costs, and vaccine price for ROTAVAC. The sensitivity analysis found that Palestine's rotavirus vaccination program using either vaccine would remain cost-saving or cost-effective under all scenarios, and compared to no vaccination program, except one: a very low burden of disease. ROTAVAC remained economically favorable over ROTARIX in all scenarios, further validating the MOH's decision to switch.

## CONCLUSIONS AND IMPLICATIONS FOR OTHER COUNTRIES

**Due to the lower vaccine price and programmatic costs per dose for ROTAVAC, switching from ROTARIX to ROTAVAC was cost-saving for the Palestinian Ministry of Health. This finding validates the MOH's decision to switch vaccines from a financial perspective.**

As this analysis shows, introducing or switching to newer rotavirus vaccine products such as ROTAVAC may be a more cost-effective or cost-saving option. This study illustrates the value of systematically assessing multiple criteria beyond vaccine price when comparing the health and economic value of different products.

Such an approach helps ensure that vaccine product choices will fully account for all characteristics—including product packaging and formulation, number of doses required per course, cold chain volume, cost of delivery, and wastage rates—that may have a significant impact on the overall cost of a vaccination program over time.

Comprehensive information on the costs and cost-effectiveness of vaccination programs helps inform and validate country decision-making, enables better budget planning, and improves sustainability. This information can also help encourage vaccine manufacturers to consider all relevant characteristics that may affect program costs when developing vaccines.

However, economic considerations are only one aspect of decision-making. Countries may choose a non-economically preferred vaccine due to other considerations, such as cold chain implications, feasibility, acceptability, or supply.

## References

- 1 Debellut F, Jaber S, Bouzya Y, et al. Introduction of rotavirus vaccination in Palestine: An evaluation of the costs, impact, and cost-effectiveness of ROTARIX and ROTAVAC. *PLoS One*. 2020;15(2):e0228506.
- 2 Institute for Health Metrics and Evaluation. GBD Results Tool. Available at: <http://ghdx.healthdata.org/gbd-results-tool>.
- 3 World Health Organization. Rotavirus vaccines WHO position paper—January 2013. *Weekly Epidemiological Record*. 2013;88(5):49–64.
- 4 International Vaccine Access Center. Johns Hopkins Bloomberg School of Public Health. VIEW-hub—Current vaccine introduction status. Available at: <https://view-hub.org>. Accessed 21 August 2020.
- 5 Patel MM, Parashar US, eds. Real World Impact of Rotavirus Vaccination. *Journal of Infectious Diseases*. 2011;30(1).
- 6 World Health Organization. WHO prequalified vaccines. 2020. Available at: [https://www.who.int/immunization\\_standards/vaccine\\_quality/PQ\\_vaccine\\_list\\_en/en/](https://www.who.int/immunization_standards/vaccine_quality/PQ_vaccine_list_en/en/). Accessed 21 August 2020.
- 7 Alnawajha SK, Bakry GA, Aljeesh YI. Predictors of acute diarrhoea among hospitalized children in Gaza Governorates: a case-control study. *Journal of Health, Population and Nutrition*. 2015;33(1):1–8.
- 8 Rostropovich-Vishnevskaya Foundation. Rotavirus vaccination for babies in the West Bank and Gaza fully sustained. Available at: <https://rostopovich.org/en/rotavirus-vaccination-for-babies-in-the-west-bank-and-gaza-fully-sustained/>. Accessed 21 August 2020.
- 9 Rennert WP, Hindiyeh M, Abu-Awwad FM, Marzouqa H, Ramlawi A. Introducing rotavirus vaccine to the Palestinian territories: the role of public-private partnerships. *Journal of Public Health*. 2019;41(1):e78–e83.

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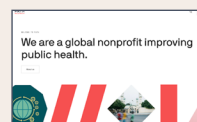
Ultimately, vaccination with any rotavirus vaccine is likely to be cost-effective for many countries. Providing as much information as possible so that countries can make the best choice for their context helps to ensure that more children are protected from vaccine-preventable diseases for years to come.

## ADDITIONAL RESOURCES



Full study publication

<https://doi.org/10.1371/journal.pone.0228506>



PATH website

[www.path.org](http://www.path.org)



PATH's Defeat Diarrheal Disease (DefeatDD) Initiative

[www.DefeatDD.org](http://www.DefeatDD.org)



PATH's Rotavirus Vaccine Cost Calculator

[www.path.org/resources/rotavirus-vaccine-cost-calculator/](http://www.path.org/resources/rotavirus-vaccine-cost-calculator/)



Rostropovich-Vishnevskaya Foundation

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