



The need for rotavirus vaccines in India: Understanding efficacy and impact

More than half a million child deaths due to diarrhea occur each year worldwide. In 2013, an estimated 215,000 of these deaths were due to rotavirus. More than 20 percent (47,100) of the global total of rotavirus deaths occurred in India.¹ This makes vaccines an essential element in the fight against the deadly diarrhea and dehydration caused by rotavirus.

- ROTASIL[®] significantly reduced severe rotavirus diarrhea by more than a third – 39.5 percent over two years. Most significantly, the vaccine efficacy was nearly 55 percent against the most severe and potentially life-threatening cases of rotavirus diarrhea, which represent the highest risk of dehydration, hospitalizations, and deaths.
- Although data are not fully comparable given variations in study design, conduct, and populations, the efficacy demonstrated by ROTASIL in India appears generally comparable to the efficacy of the already licensed rotavirus vaccines in clinical studies conducted in low-resource settings, particularly for preventing the most severe cases of rotavirus diarrhea.
 - In Bangladesh, a trial conducted with Merck & Co.'s RotaTeq[®] determined the vaccine's efficacy to be 42.7 percent against severe rotavirus gastroenteritis.² Similarly, a separate study in Bangladesh with GlaxoSmithKline's Rotarix[®] demonstrated the vaccine's effectiveness to be 41.4 percent against acute rotavirus diarrhea after programmatic introduction.³
- Efficacy is only one aspect in understanding the potential impact of a vaccine; the other critical factor is the number of cases averted. Where disease burden is highest—such as in India or other countries in Asia and Africa—rotavirus vaccines will have significant public health impact in reducing the number of cases of severe disease responsible for hospitalization and death.⁴
- Impact in the real world may also be greater than that suggested by clinical studies. Where rotavirus vaccines have already been introduced, rotavirus incidence has also decreased among unvaccinated adults and children,⁵ suggesting an indirect effect.
- Because of the strong public health value, the World Health Organization recommends rotavirus vaccination in all countries and strongly recommends rotavirus vaccination in countries with high diarrhea-related mortality in children less than age five, including India.⁶
- Lower efficacy of oral vaccines is common in low-resource, high-mortality settings. This has historically been seen for orally administered vaccines against polio and cholera⁷ as well as the currently licensed rotavirus vaccines. In low-resource settings, lower efficacy of oral vaccines has been attributed to various factors, including epidemiology of transmission among the population, co-infections in the digestive system, and possible interference by maternal antibodies.⁸
- There are currently two globally available rotavirus vaccines that have been introduced in more than 90 countries worldwide. Both vaccines are effective, and the accumulated evidence shows major reductions in rotavirus-related hospitalizations and deaths in the countries where they have been introduced. Some countries have also seen major reductions in diarrhea due to any cause.
 - In the United States, vaccination has led to drops in rotavirus-related hospitalizations by as much as 86 percent.⁹
 - In Nicaragua, since the introduction of rotavirus vaccine in 2006, vaccination reduced severe rotavirus hospitalizations by 70 percent.¹⁰
 - In Mexico, all-cause diarrhea-related deaths dropped by approximately 50 percent across three regions of the country among children less than age five after the vaccine was

introduced. This significant reduction in deaths was seen among children in all socioeconomic regions of Mexico and was sustained for four continuous years.¹¹

- In Brazil, the vaccine led to 30 and 39 percent decreases in diarrhea-related deaths in 2007 and 2008, respectively, when compared to 2004 and 2005 mortality rates.¹²
- In South Africa, infant rotavirus hospitalizations fell by roughly two-thirds (61 to 69 percent) in the two years following rotavirus vaccine introduction; for children less than age five, they fell by more than half (54 to 58 percent). Additionally, all-cause diarrhea hospitalizations declined by one-third for children less than age five.¹³
- In Malawi, rotavirus hospitalization incidence declined in infants by 54.2 percent in the first three years after vaccine introduction.¹⁴
- In Ghana, rotavirus hospitalizations among children less than age five decreased by 49 percent and all-cause diarrhea hospitalizations decreased by 44 percent in the first three years after vaccine introduction.¹⁵
- While rotavirus vaccines have resulted in lowering hospitalizations in all countries where they have been introduced, in low-income countries they have also resulted in lowering the number of deaths caused by diarrhea. Given the higher burden of rotavirus diarrhea in lower-income settings, these areas have been shown to have the greatest public health benefit from rotavirus vaccines.
- Research indicates a national rotavirus vaccination program in India would significantly reduce rotavirus-related hospitalizations and deaths and that vaccination would be highly cost-effective at a range of prices. It is estimated that a national rotavirus immunization program in India could prevent approximately one-third of rotavirus deaths and significantly reduce medical treatment-related costs.¹⁶

¹ Tate JE, Burton AH, Boschi-Pinto C, Parashar UD. Global, regional, and national estimates of rotavirus mortality in children <5 years of age, 2000–2013. *Clinical Infectious Diseases*. 2016;62(Suppl 2):S96-S105.

² Zaman K, Anh DD, Victor JC, et al. Efficacy of pentavalent rotavirus vaccine against severe rotavirus gastroenteritis in infants in developing countries in Asia: A randomised, double-blind, placebo-controlled trial. *The Lancet*. 2010;376(9741):615-623.

³ Zaman K, Sack DA, Neuzil KM, et al. Effectiveness of a live oral human rotavirus vaccine after programmatic introduction in Bangladesh: A cluster-randomized trial. *PLoS Medicine*. 2017;14(4):e1002282.

⁴ Soares-Weiser K, MacLehose H, Bergman H, et al. Vaccines for preventing rotavirus diarrhoea: Vaccines in use. *Cochrane Database of Systematic Reviews*. 2012;11(CD008521).

⁵ Lopman BA, Curns AT, Yen C, Parashar UD. Infant rotavirus vaccination may provide indirect protection to older children and adults in the United States. *Journal of Infectious Diseases*. 2011;204(7):980-986.

⁶ World Health Organization (WHO). Rotavirus Vaccines: WHO Position Paper - January 2013. *Weekly Epidemiological Record*. 2013;88(5):49-64.

⁷ Qadri F, Bhuiyan TR, Sack DA, Svennerholm A-M. Immune responses and protection in children in developing countries induced by oral vaccines. *Vaccine*. 2013;31(3):452-460.

⁸ Patel M, Shane AL, Parashar UD, Jiang B, Gentsch JR, Glass RI. Oral rotavirus vaccines: How well will they work where they are needed most? *Journal of Infectious Diseases*. 2009;200(Suppl 1):S39-S48.

⁹ Tate JE, Mutuc JD, Panozzo CA, et al. Sustained decline in rotavirus detections in the United States following the introduction of rotavirus vaccine in 2006. *The Pediatric Infectious Disease Journal*. 2011;30(1):S30-S34.

¹⁰ Patel M, Pedreira C, De Oliveira LH, et al. Duration of protection of pentavalent rotavirus vaccination in Nicaragua. *Pediatrics*. 2012;130(2):e365-e372.

¹¹ Gastañaduy PA, Sánchez-Uribe E, Esparza-Aguilar M, et al. Effect of rotavirus vaccine on diarrhea mortality in different socioeconomic regions of Mexico. *Pediatrics*. 2013;131(4):e1115-e1120.

¹² Lanzieri TM, Linhares AC, Costa I, et al. Impact of Rotavirus Vaccination on Childhood Deaths From Diarrhea in Brazil. *International Journal of Infectious Diseases*. 2011;15(3):e206-e210.

¹³ Msimang VM, Page N, Groome MJ, et al. Impact of rotavirus vaccine on childhood diarrheal hospitalization after introduction into the South African public immunization program. *Pediatric Infectious Disease Journal*. 2013;32(12):1359-64.

¹⁴ Bar-Zeev N, Jere KC, Bennett A, et al. Population impact and effectiveness of monovalent rotavirus vaccination in urban Malawian children 3 years after vaccine introduction: Ecological and case-control analyses. *Clinical Infectious Diseases*. 2016;62(Suppl 2):S213-S219.

¹⁵ Armah G, Pringle K, Enweronu-Laryea CC, et al. Impact and effectiveness of monovalent rotavirus vaccine against severe rotavirus diarrhea in Ghana. *Clinical Infectious Diseases*. 2016;62(Suppl 2):S200-S207.

¹⁶ Esposito DH, Tate JE, Kang G, Parashar UD. Projected impact and cost-effectiveness of a rotavirus vaccination program in India, 2008. *Clinical Infectious Diseases*. 2011;52(2):171-177.