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The Impact of a One-Dose versus Two-Dose Oral Cholera Vaccine Regimen in Outbreak Settings: A Modeling Study

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ABSTRACT

Background: In 2013, a stockpile of oral cholera vaccine (OCV) was created for use in outbreak response, but vaccine availability remains severely limited. Innovative strategies are needed to maximize the health impact and minimize the logistical barriers to using available vaccine. Here we ask under what conditions the use of one dose rather than the internationally licensed two-dose protocol may do both.

Methods and Findings: Using mathematical models we determined the minimum relative single-dose efficacy (MRSE) at which single-dose reactive campaigns are expected to be as or more effective than two-dose campaigns with the same amount of vaccine. Average one- and two-dose OCV effectiveness was estimated from published literature and compared to the MRSE. Results were applied to recent outbreaks in Haiti, Zimbabwe, and Guinea using stochastic simulations to illustrate the potential impact of one- and two-dose campaigns. At the start of an epidemic, a single dose must be 35%–56% as efficacious as two doses to avert the same number of cases with a fixed amount of vaccine (i.e., MRSE between 35% and 56%). This threshold decreases as vaccination is delayed. Short-term OCV effectiveness is estimated to be 77% (95% CI 57%–88%) for two doses and 44% (95% CI −27% to 76%) for one dose. This results in a one-dose relative efficacy estimate of 57% (interquartile range 13%–88%), which is above conservative MRSE estimates. Using our best estimates of one- and two-dose efficacy, we projected that a single-dose reactive campaign could have prevented 70,584 (95% prediction interval [PI] 55,943–86,205) cases in Zimbabwe, 78,317 (95% PI 57,435–100,150) in Port-au-Prince, Haiti, and 2,826 (95% PI 2,490–3,170) cases in Conakry, Guinea: 1.1 to 1.2 times as many as a two-dose campaign. While extensive sensitivity analyses were performed, our projections of cases averted in past epidemics are based on severely limited single-dose efficacy data and may not fully capture uncertainty due to imperfect surveillance data and uncertainty about the transmission dynamics of cholera in each setting.

Conclusions: Reactive vaccination campaigns using a single dose of OCV may avert more cases and deaths than a standard two-dose campaign when vaccine supplies are limited, while at the same time reducing logistical complexity. These findings should motivate consideration of the trade-offs between one- and two-dose campaigns in resource-constrained settings, though further field efficacy data are needed and should be a priority in any one-dose campaign.

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