Appendix 1: Supplemental methods and results for **"Estimating time-varying transmission and oral cholera vaccine effectiveness in Haiti and Cameroon, 2021-2023"**

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Section 1: Additional Tables

Table 1: Descriptive and modeled analyses from the literature, Cameroon and Haiti

	Cameroon	Haiti
2017 % with access to improved water source[1]	73.95 (71.24-76.90)	68.29 (66.32-70.19)
2017 % with access to improved sanitation[1]	52.93 (51.05-55.11)	51.50 (50.31-52.79)
2017 under-5 mortality per 1,000 live births[2]	73.5 (60.5-87.0)	59.3 (50.0-71.0)
2019 one-dose MCV coverage[3]	67.8 (59.2-75.2)	71.6 (65.1-77.4)
% of children with diarrhea taking ORT[4]	19.91 (11.95-31.05)	39.05 (29.17-49.41)
2017 mean years education: female 15-49[5]	7.77 (6.72-8.79)	6.42 (5.70-7.05)
2017 difference in mean years education males to females 15-49 years[5]	0.66 (0.48-0.93)	0.71 (0.66-0.88)
2019 under-5 diarrhea prevalence[6]	43.17 (31.79-58.94)	48.51 (44.42-52.28)
2019 under-5 stunting prevalence[7]	33.07 (26.41-40.55)	23.79 (18.91-29.41)
2019 under-5 wasting prevalence[7]	6.30 (4.31-8.94)	6.25 (3.21-10.41)
2019 under-5 underweight prevalence[7]	12.77 (9.94-16.33)	12.93 (9.70-17.25)
2019 under-5 severe wasting prevalence[7]	1.13 (0.67-1.77)	0.85 (0.38-1.65)
2022 Corruption Perceptions Index[8]	26 / 100	17 / 100
2022 GDP per capita[9]	$1588.5	$1748.3
2015 Healthcare Access and Quality Index[10]	44.4 (35.0-53.3)	38.5 (33.7-43.5)
Gini Index[11]	46.6	41.1
2018 Wellcome Global Monitor: Trust in neighbors[12]	44%	67%
2018 Wellcome Global Monitor: Trust in government[12]	51%	46%
2018 Wellcome Global Monitor: Trust in scientists[12]	49%	62%
Vaccine Confidence Project: Vaccines are important[13]	82.98% (71.83-91.84)	91.18% (82.80-97.49)
Vaccine Confidence Project: Vaccines are safe[13]	56.50% (42.46-72.76)	62.33% (43.10-77.75)
Vaccine Confidence Project: Vaccines are effective[13]	63.24% (45.55-83.46)	71.80% (51.30-88.96)
2020 Average precipitation in depth (mm per year)[14]	1,604	1,440
Population density (people per sq. km of land area)[15]	58	415
Percent of population exposed to high flood risk[16]	19.1	17.5

MCV= Measles containing vaccine; ORT = Oral rehydration therapy; GDP = Gross domestic product

Improved water access includes piped water and other improved sources; Improved sanitation access includes sewer and septic as well as other improved sources. For the Corruption Perceptions Index, a lower score indicates more corruption. Gini data were most recently available for 2014 in Cameroon and 2012 in Haiti. Wellcome Global Monitor trust data use “A lot” or “some” trust as survey answers indicating trust. Vaccine confidence data from modeled estimates using 2018.500 time point and “strongly agree”.

Table 2: Number and percent of vaccine effectiveness observations outside 0% or 100%, Cameroon and Haiti

	Cameroon (n=196 data points)	Haiti (n=302 data points)
Upper 95% CI estimates	3 (1.5%)	2 (0.7%)
Lower 95% CI estimates	24 (12.2%)	3 (1.0%)
Median estimates	5 (2.6%)	2 (0.7%)

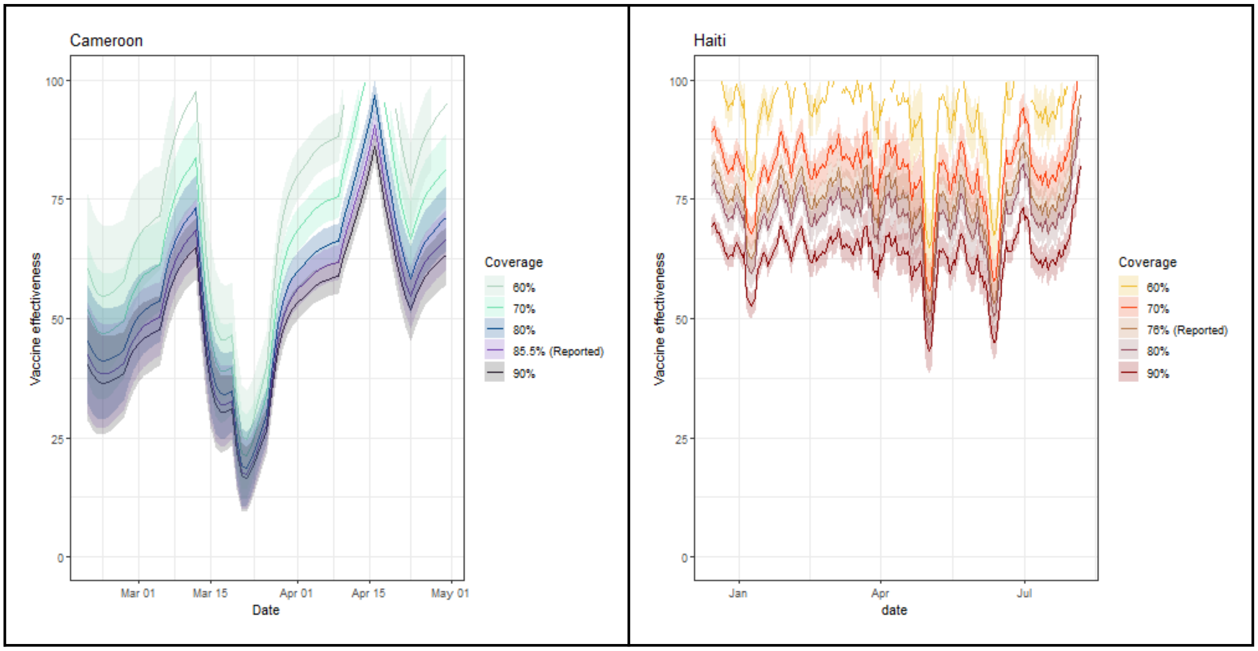
Section 2: Sensitivity Analyses

In order to understand the impact of our assumptions on our findings, we changed our assumptions in a number of ways, each independently while holding all other variables constant.

Artificially changing OCV coverage to understand impact on vaccine effectiveness, Cameroon and Haiti

For our main analysis, we used reported coverage figures for OCV1 campaigns in Cameroon and Haiti. Given that these estimates are highly localized to the targeted locality and do not reflect the coverage status in the whole country, we explored how changing coverage from 60% OCV1 coverage to 90% OCV1 coverage would impact OCV1 effectiveness in each Cameroon and Haiti. When assuming coverage was at 60% rather than the reported 85.50% and 76.00% in Cameroon and Haiti, respectively, vaccine effectiveness was 76.48% (15.24-122.29%) and 95.23% (66.66-108.07%). Assuming coverage of 90%, in contrast, revealed vaccine effectiveness estimates of 50.99% (10.16-81.52%) in Cameroon and 63.49% (44.44-72.05%) in Haiti.

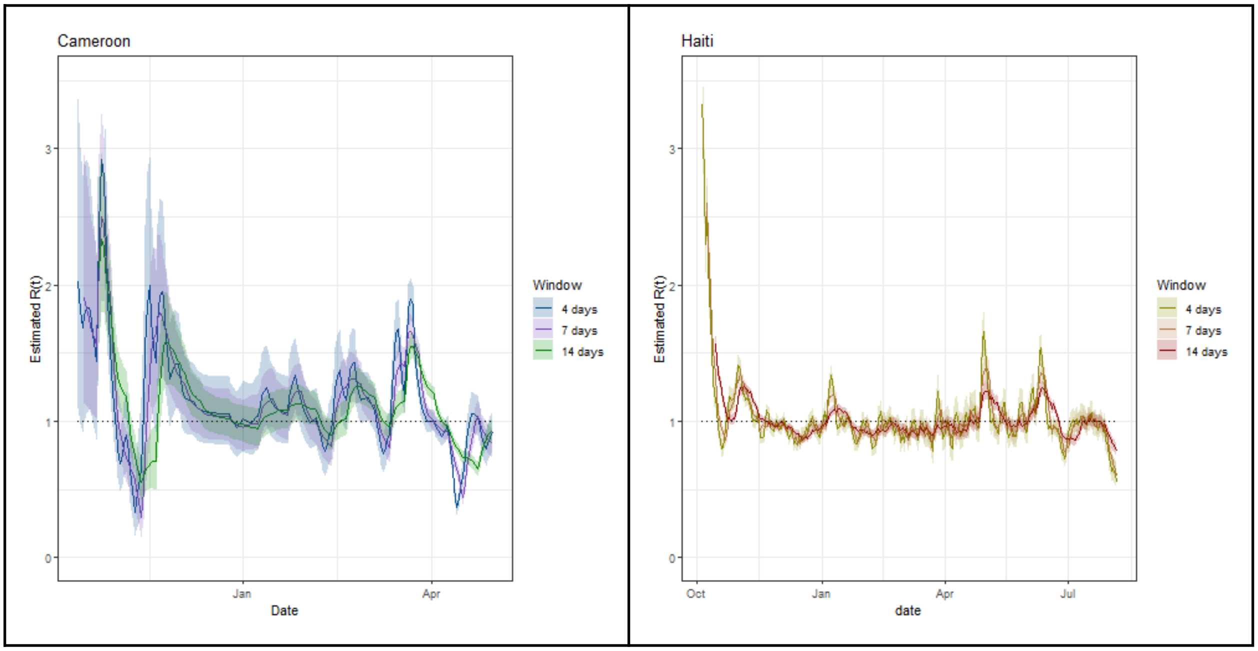
Figure 1: Impact of changing our assumptions of OCV1 coverage on vaccine effectiveness



Exploring alternate R_t windows in EpiEstim, Cameroon and Haiti

While we chose a R_t window of one-week to optimize the relationship between too much statistical noise with smaller windows and too much smoothing with larger windows, we explored additional time windows: four days and two weeks. While the shorter window had higher initial R_0 values and the longer window had fewer days under R_t=1, qualitatively the patterns across all three windows analyzed were relatively consistent.

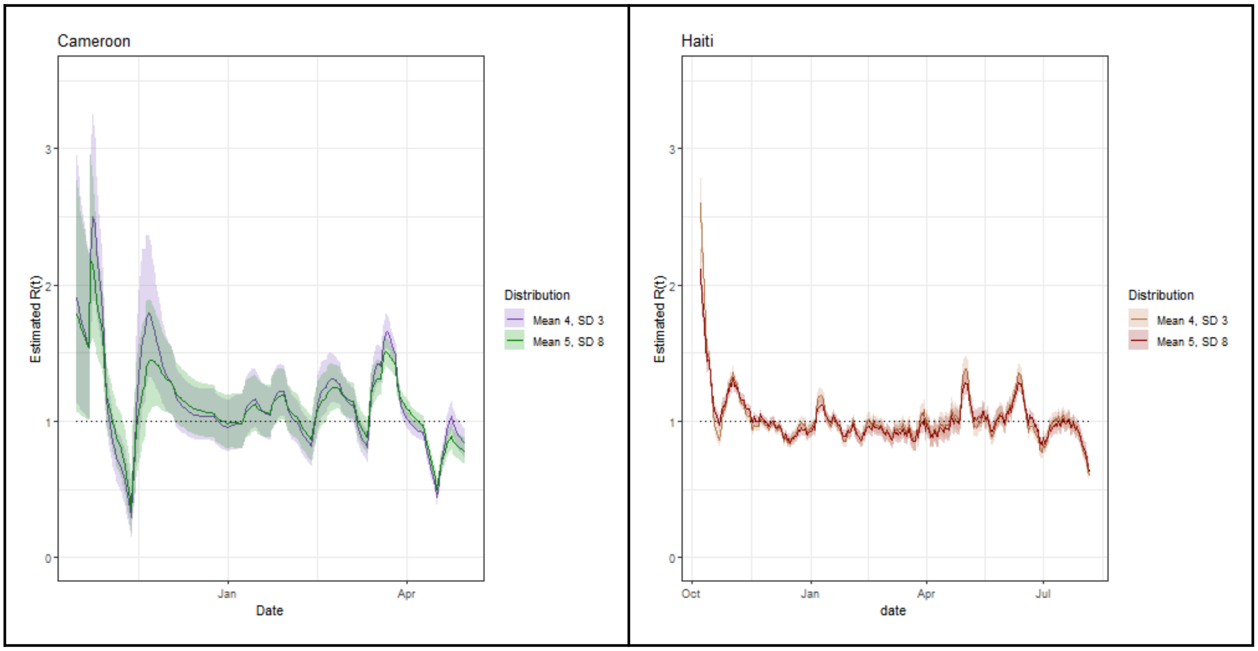
Figure 2: Impact of changing the length of the time window on R_t



Exploring alternate SI parameters in EpiEstim, Cameroon and Haiti

For our SI we used a gamma distribution with a mean of 4 days and a SD of 3 derived from previous studies of cholera among household contacts[17] and historic investigations of cholera[18] and used among previous EpiEstim analyses.[19,20] However, studies in humanitarian and crisis settings used a slightly higher and wider distribution with a mean of 5 and a standard deviation of 8.[21–23] We modified our analysis to use this wider distribution and qualitatively found similar results between the two distributions, with the narrower SI having slightly higher peaks and lower troughs, but generally highly similar patterns.

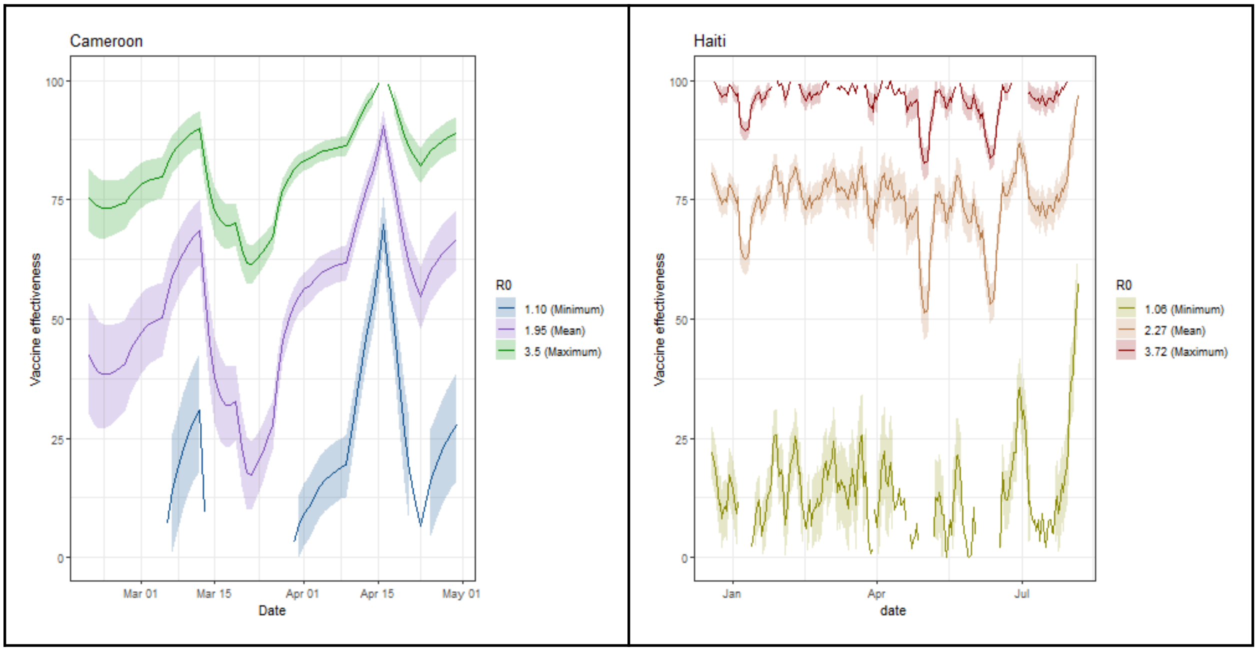
Figure 3: Impact of changing the SI on R_t



Exploring alternate values of R_0 on vaccine effectiveness, Cameroon and Haiti

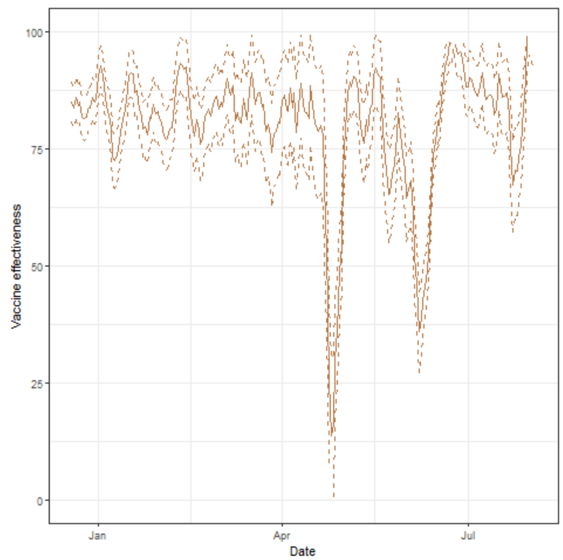
In our main analysis, we used averages of all reported regional and local data for R_0 for our two countries. For our sensitivity analysis, we considered the minimum reported R_0 (1.10 Cameroon / 1.06 Haiti) and maximum reported R_0 (3.5 Cameroon / 3.72 Haiti) in each location. In contrast to the changes to the window and the SI which had few qualitative impacts on our findings, changing R_0 drastically altered the vaccine effectiveness estimates. Using the minimum R_0 value in each Cameroon in Haiti resulted in median estimates of vaccine effectiveness of 19.41% (6.40-61.39%) and 12.22% (1.61-35.78%), respectively, while using the maximum R_0 value in each country resulted in average vaccine effectiveness of 83.08% (62.29-97.69%) and 96.97% (83.88-99.70%) for each Cameroon and Haiti.

Figure 4: Impact of changing R_0 on OCV1 effectiveness



In Haiti where the OCV1 campaign was very localized to the Ouest and Centre departments, we conduct a sensitivity analysis using daily cholera data published by department by Haiti's Ministry of Health (MSPP)[24] to understand how localized data influence our results. We consider the vaccine effectiveness in the Ouest department of Haiti using digitized daily cholera data (digitized using WebPlotDigitizer[25]) from October 1, 2022 to August 5, 2023, using reported OCV1 coverage at 69.90%.[26,27,24] This analysis suggests a median vaccine effectiveness of 83.11% (95% UI: 36.20-97.26%) over the entire vaccination period after December 19, 2022, almost 10% higher than the point estimate at the national level, though the confidence interval was wider and overlapped with the national level analysis.

Figure 5: Focusing on Ouest department for vaccine effectiveness in Haiti



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