

Supplementary Appendix

Statistical Appendix

We used the following general form to model controlled interrupted time series analysis each of the nine outcome indicators:

$$\text{Log}(Y_{it}) = \text{Log}(P_i) + \beta_0 + \beta_1 \text{Time}_t + \beta_2 \text{Impt} + \beta_3 \text{Time}_t * \text{Impt} + \beta_4 \text{Post}_t + \beta_5 \text{Time}_t * \text{Post}_t + \beta_6 \text{FCP}_{it} + \beta_7 \text{EVD_FCP}_{it} + \beta_8 \text{Time}_t * \text{FCP}_{it} + \beta_9 \text{Time}_t * \text{EVD_FCP}_{it} + \beta_{10} \text{FCP}_{it} * \text{Impt} + \beta_{11} \text{EVD_FCP}_{it} * \text{Impt} + \beta_{12} \text{Time}_t * \text{Impt} * \text{FCP}_{it} + \beta_{13} \text{Time}_t * \text{Impt} * \text{EVD_FCP}_{it} + \beta_{14} \text{FCP}_{it} * \text{Post}_t + \beta_{15} \text{EVD_FCP}_{it} * \text{Post}_t + \beta_{16} \text{Time}_t * \text{FCP}_{it} * \text{Post}_t + \beta_{17} \text{Time}_t * \text{EVD_FCP}_{it} * \text{Post}_t + v_{0i} + \epsilon_{it}$$

Y_{it} are the health service indicators, time represents the study period at month t (i.e. 1, 2, 3...). Since the number of visits in a given facility depends on the size of the catchment population, we included the logarithm of each facility's catchment population in 2017 $\text{Log}(P_i)$ as an offset. To account for heterogeneity of clinic visit volumes, we incorporated a random effect to allow clinic's intercepts to vary (v_{0i}). Impt is an indicator representing whether the FCP had been implemented at time t (i.e. 1 or 0), and $\text{Time} * \text{Impt}$ represents the monthly trend following the beginning of the implementation of the FCP at time t . FCP is an indicator representing clinics i that are in the health zones under the coverage of the FCP and EVD_FCP is an indicator representing facilities i that are in the health zones reported at least 1 EVD cases and received the FCP. The parameters of interest are β_{10} and β_{11} , which indicate any immediate change in the level of the outcome following the beginning to the FCP implementation in the health zones covered under the policy and those affected by EVD relative to the control health zones; and β_{12} and β_{13} , which indicates any differences in the trend of the outcome when the FCP was in effect, relative to the other control health zones. The parameters β_{14} and β_{15} indicate any immediate change in the level of the outcome following the end of FCP implementation compared with facilities in the control health zones, and β_{16} and β_{17} indicates any changes in trend after the FCP and EVD outbreak ended, relative to facilities in the control health zones.

Additionally, we used the combination of estimate parameters from the two-level mixed-effects negative binomial model to estimate the absolute change of each outcome comparing with counterfactual estimates. We applied bootstrapping method to construct confidence intervals around the absolute changes in outcome. We simulated data based on the estimates with normally distributed error using bootstrap statistics with 10,000 resamples within each group. For the analysis, we used SAS GLIMMIX procedure, and STRATA statement in PROC SURVEYSELECT to sample with replacement.

Figure S1. Mean monthly rate of clinic visits for diarrhea in health zones by intervention groups and control in Equateur province, January 2017 to January 2019.

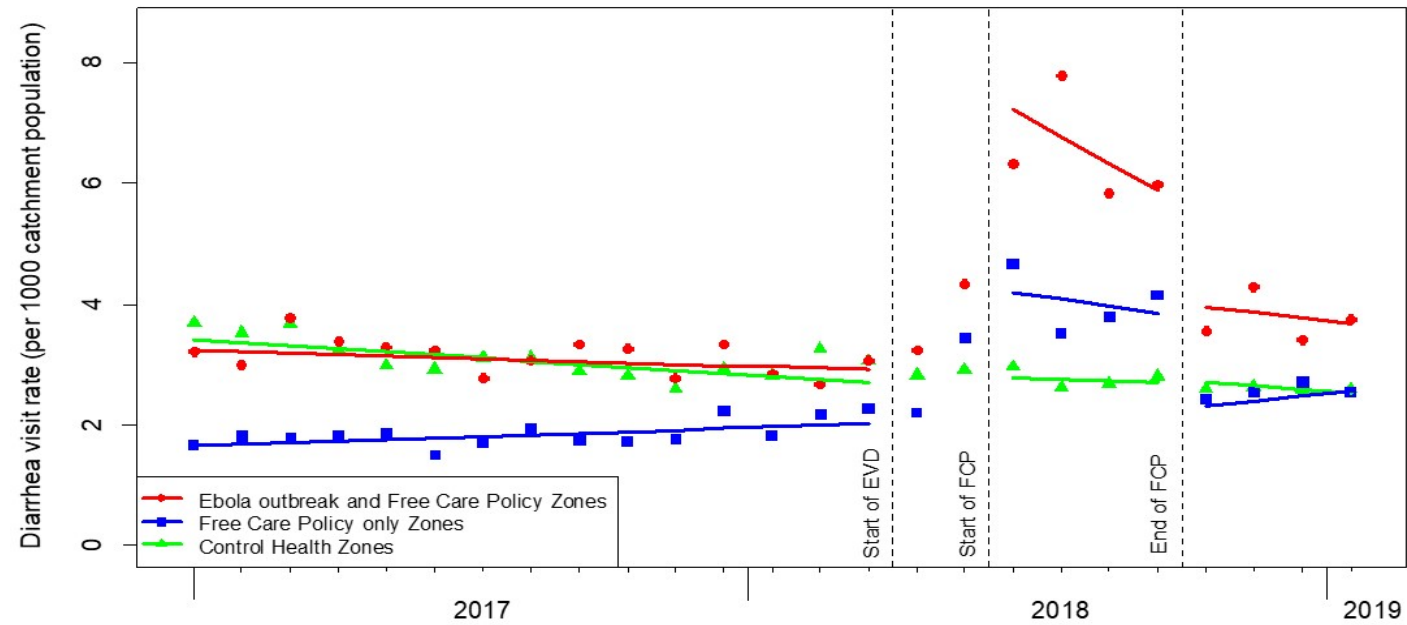
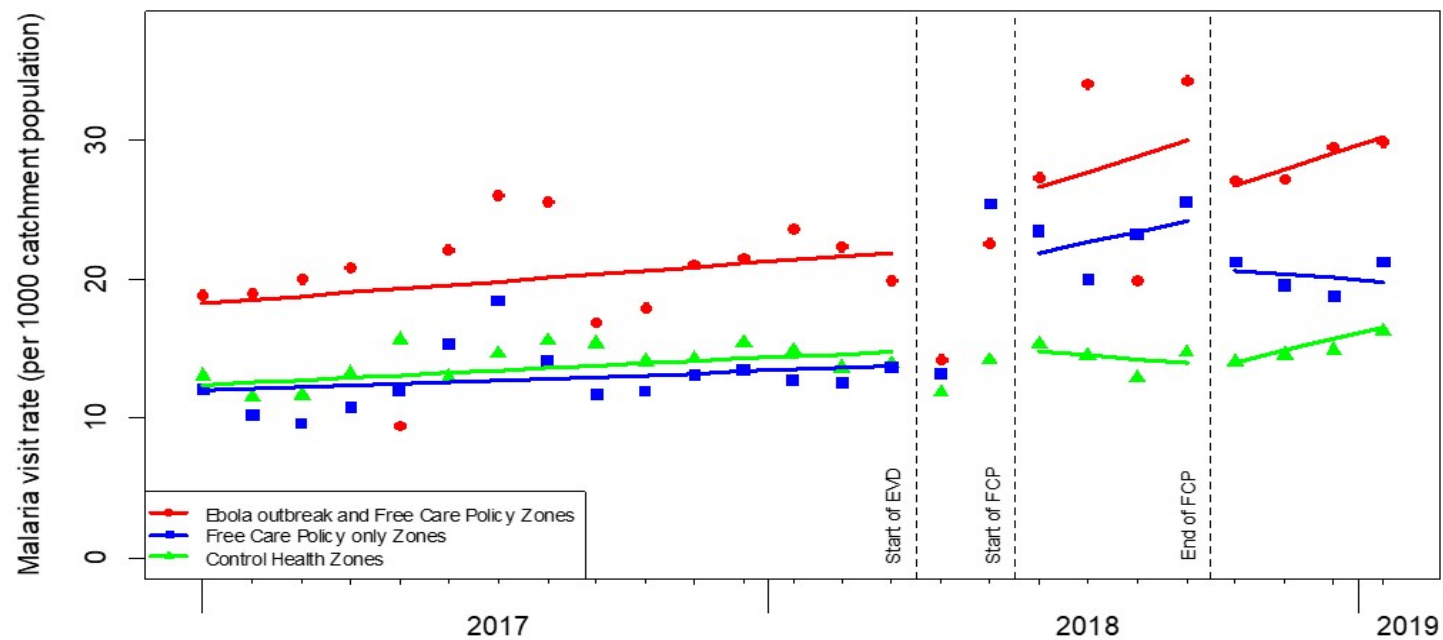


Figure S2. Mean monthly rate of clinic visits for malaria in health zones by intervention groups and control in Equateur province, January 2017 to January 2019.



Note: Ebola outbreak and free care policy health zones contain health centres from the Bikoro health zone only.

Figure S3. Mean monthly rate of first antenatal care visit in health zones by intervention groups and control in Equateur province, January 2017 to January 2019.

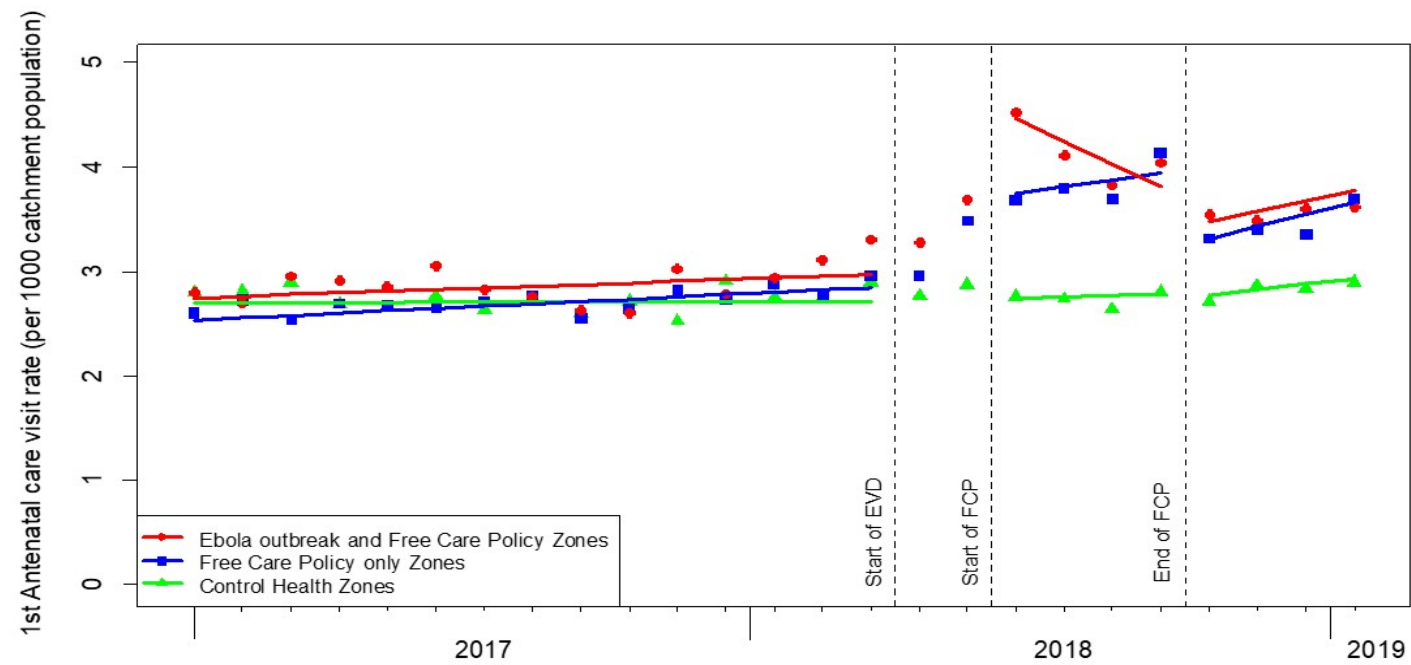


Figure S4. Mean monthly rate of fourth antenatal care visit in health zones by intervention groups and control in Equateur province, January 2017 to January 2019.

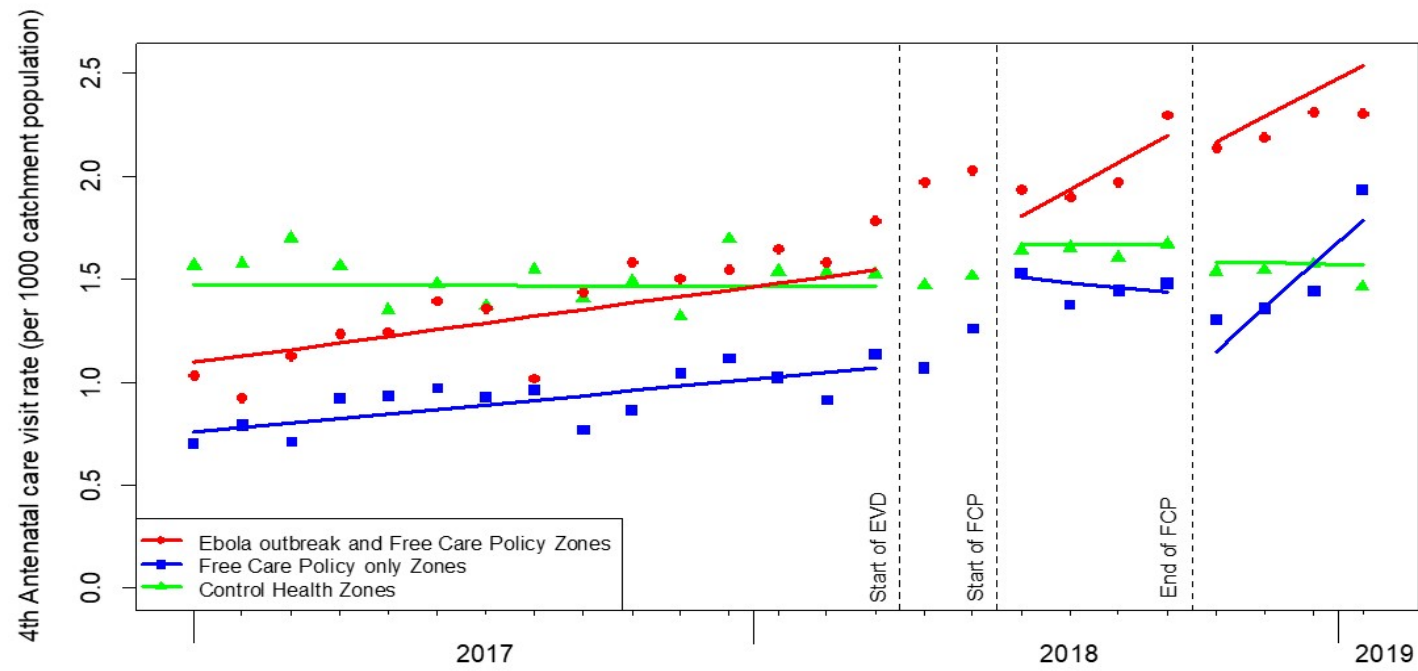


Figure S5. Mean monthly rate of postnatal visit within 6 days of birth in health zones by intervention groups and control in Equateur province, January 2017 to January 2019.

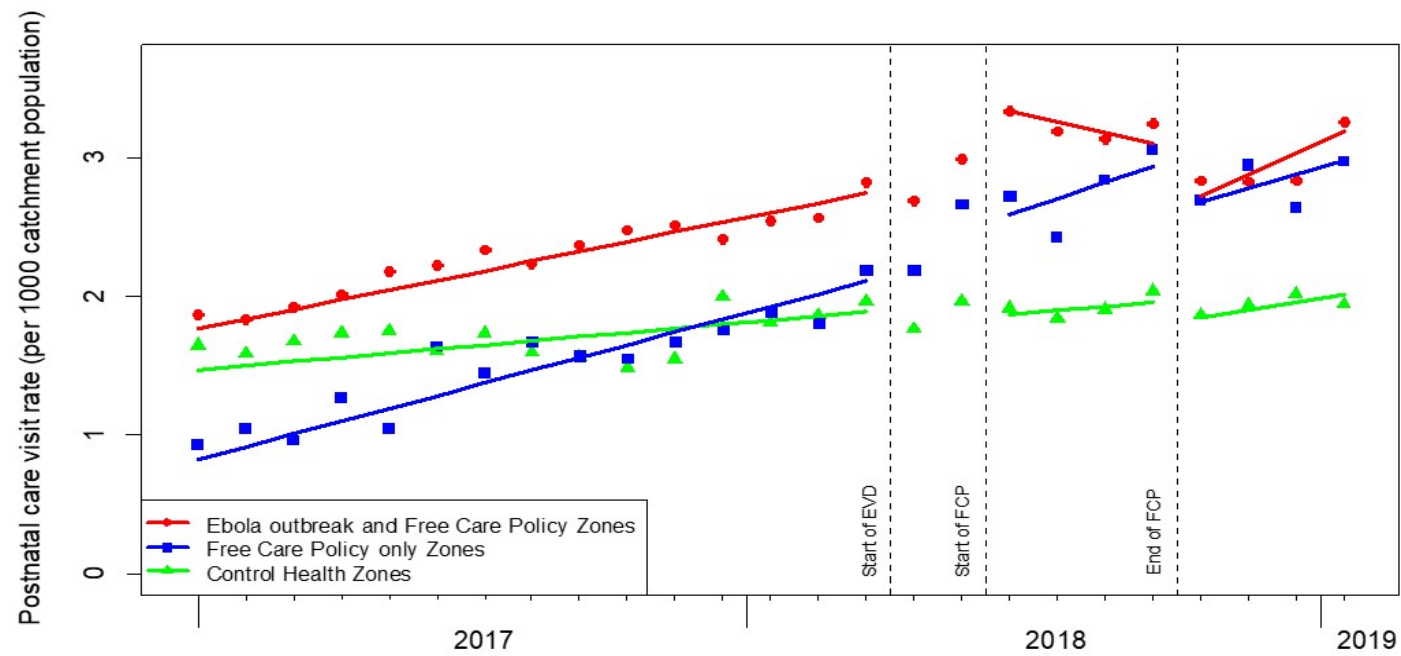
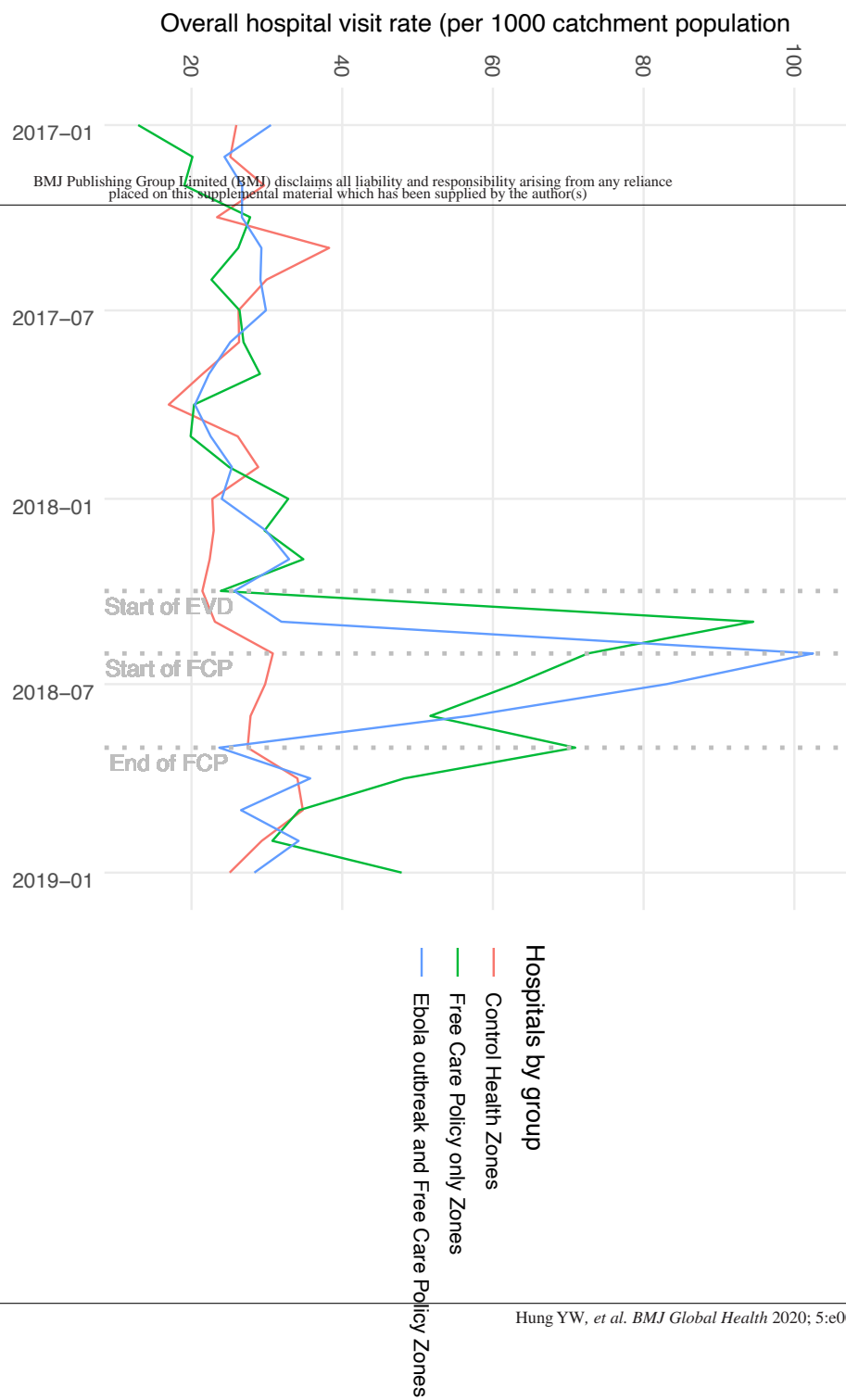


Figure S6. Mean of total outpatient visits by hospital reported on DHIS2 by intervention groups and control in Equateur province, January 2017 – January 2019.



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Table S1a. Facilities reported through DHIS2 by health zone in Equateur province for each indicator and number of health centres included in analytic sample in manuscript

Health zone	Intervention or control	Number of Health Centres	Catchment population	Total visit		Pneumonia diagnosis		Institutional deliveries		DTP 1st dose	
				Number included	% included	Number included	% included	Number included	% included	Number included	% included
Bikoro	EVD & FCP	21	153510	19	90%	18	86%	18	86%	1	5%
Iboko		17	113065	14	82%	14	82%	14	82%	0	0%
Wangata		29	156644	9	31%	8	28%	9	31%	10	34%
Bolenge		14	91147	10	71%	4	29%	9	64%	9	64%
Ingende	FCP only	20	167046	19	95%	11	55%	17	85%	2	10%
Mbandaka		22	162551	12	55%	12	55%	12	55%	12	55%
Ntondo		15	69483	7	47%	4	27%	5	33%	0	0%
Basankusu		27	290348	15	56%	16	59%	14	52%	12	44%
Bolomba	Control	29	296402	27	93%	23	79%	28	97%	27	93%
Bomongo		16	128274	6	38%	2	13%	3	19%	0	0%
Djombo		14	117146	12	86%	10	71%	4	29%	1	7%
Irebu		8	38554	3	38%	0	0%	2	25%	1	13%
Lilanga Bobangi		14	86204	9	64%	6	43%	9	64%	6	43%
Lotumbe		18	119610	7	39%	6	33%	5	28%	0	0%
Lukolela		15	140834	9	60%	6	40%	8	53%	6	40%
Mampoko		13	88974	12	92%	12	92%	13	100%	3	23%
Monieka		14	82104	9	64%	7	50%	8	57%	8	57%

Note: EVD: Ebola virus disease; FCP: free care policy; DTP: diphtheria, pertussis, and tetanus vaccine.

Table S1b. Facilities reported through DHIS2 by health zone in Equateur province for each indicator and number of health centres included in analytic sample in the appendix

Health zone	Interventi on or control	Number of Health Centres	Catchment population	Diarrhea diagnosis		Malaria diagnosis		ANC 1		ANC 4		PNC (within 6 days)	
				Number included	% included	Number included	% included	Number included	% included	Number included	% included	Number included	% included
Bikoro	EVD & FCP	21	153510	18	86%	8	38%	11	52%	11	52%	18	86%
Iboko		17	113065	12	71%	0	0%	3	18%	3	18%	14	82%
Wangata		29	156644	6	21%	0	0%	9	31%	8	28%	8	28%
Bolenge	FCP only	14	91147	7	50%	10	71%	9	64%	7	50%	9	64%
Ingende		20	167046	11	55%	0	0%	17	85%	17	85%	11	55%
Mbandaka		22	162551	10	45%	1	5%	13	59%	12	55%	13	59%
Ntondo		15	69483	3	20%	4	27%	5	33%	4	27%	5	33%
Basankusu		27	290348	15	56%	16	59%	16	59%	15	56%	13	48%
Bolomba	Control	29	296402	25	86%	27	93%	28	97%	28	97%	27	93%
Bomongo		16	128274	3	19%	5	31%	3	19%	3	19%	3	19%
Djombo		14	117146	10	71%	6	43%	4	29%	4	29%	2	14%
Irebu		8	38554	0	0%	2	25%	2	25%	2	25%	2	25%
Lilanga		14	86204	9	64%	9	64%	9	64%	7	50%	8	57%
Bobangi													
Lotumbe		18	119610	5	28%	6	33%	5	28%	4	22%	2	11%
Lukolela		15	140834	5	33%	9	60%	8	53%	8	53%	8	53%
Mampoko		13	88974	12	92%	7	54%	13	100%	13	100%	10	77%
Monieka		14	82104	9	64%	8	57%	9	64%	8	57%	8	57%

Note: EVD: Ebola virus disease; FCP: free care policy; ANC 1: first antenatal care visit; ANC 4: fourth antenatal care visit; PNC: postnatal care.

Table S2a. Parameter estimates for effect of FCP on rates of visits for diarrhea and malaria in the Equateur province, DRC, from January, 2017, to January, 2019.

	Diarrhea diagnosis			Malaria diagnosis		
	IRR/Est	p-value	95% CI	IRR/Est	p-value	95% CI
Effect of FCP						
Immediate difference between facilities in intervention areas vs. control (level)						
EVD and FCP	2.4	<0.001	(1.8-3.3)	1.1	0.72	(0.69-1.7)
FCP only	2.0	<0.001	(1.5-2.7)	1.5	0.02	(1.1-2.1)
Gradual difference between facilities in intervention areas vs. control (slope)						
EVD and FCP	0.94	0.19	(0.85-1.0)	1.1	0.36	(0.93-1.2)
FCP only	0.95	0.27	(0.86-1.0)	1.1	0.31	(0.95-1.2)
Post-FCP						
Immediate difference between facilities in intervention areas vs. control (level)						
EVD and FCP	0.68	0.02	(0.49-0.93)	0.85	0.49	(0.54-1.3)
FCP only	0.61	0.004	(0.43-0.85)	0.80	0.21	(0.56-1.1)
Gradual difference between facilities in intervention areas vs. control (slope)						
EVD and FCP	1.0	0.58	(0.91-1.2)	0.94	0.54	(0.77-1.1)
FCP only	1.1	0.47	(0.91-1.2)	0.92	0.29	(0.79-1.1)
Effect of user fee exemption policy - Absolute change compared to pre-EVD						
EVD and FCP	4.0		(2.6-5.9)	2.7		(1.7-4.4)
FCP only	2.0		(1.2-3.2)	6.9		(4.3-11.0)

Note: EVD: Ebola virus disease; FCP: free healthcare policy; IRR: incidence rate ratio; Est: estimate of absolute change per 1000 catchment population.

Table S2b. Parameter estimates for effect of FCP on rates of first antenatal visit, fourth antenatal visit, and postnatal visit within 6 days of birth in the Equateur province, DRC, from January, 2017, to January, 2019.

	1st ANC			4th ANC			PNC (within 6 weeks)		
	IRR/Est	p-value	95% CI	IRR/Est	p-value	95% CI	IRR/Est	p-value	95% CI
Effect of FCP									
Immediate diff between facilities in intervention areas vs. control (level)									
EVD and FCP	1.5	<0.001	(1.2-1.8)	0.9	0.40	(0.64-1.2)	1.3	0.12	(0.94-1.7)
FCP only	1.3	0.002	(1.1-1.5)	1.2	0.21	(0.91-1.5)	1.1	0.40	(0.85-1.5)
Average monthly diff between facilities in intervention areas vs. control (trend)									
EVD and FCP	0.95	0.1	(0.89-1.0)	1.0	0.42	(0.94-1.2)	0.95	0.23	(0.87-1.0)
FCP only	1.0	0.85	(0.95-1.0)	0.96	0.37	(0.89-1.0)	0.97	0.52	(0.89-1.1)
Post-FCP									
Immediate diff between facilities in intervention areas vs. control (level)									
EVD and FCP	0.93	0.53	(0.75-1.2)	1.0	0.90	(0.73-1.4)	0.95	0.75	(0.72-1.3)
FCP only	0.87	0.13	(0.73-1.0)	0.81	0.13	(0.61-1.1)	0.95	0.72	(0.71-1.3)
Average monthly diff between facilities in intervention areas vs. control (trend)									
EVD and FCP	1.0	0.35	(0.95-1.1)	0.97	0.66	(0.84-1.1)	1.0	0.59	(0.92-1.2)
FCP only	1.0	0.83	(0.94-1.1)	1.1	0.04	(1.0-1.3)	0.99	0.89	(0.88-1.1)
Effect of user fee exemption policy - Absolute change compared to pre-EVD									
EVD and FCP	1.3		(0.96-1.6)	0.07		(0.04-0.12)	0.33		(0.21-0.53)
FCP only	0.8		(0.64-1.0)	0.31		(0.20-0.49)	0.08		(0.04-0.14)

Note: EVD: Ebola virus disease; FCP: free healthcare policy; ANC: antenatal care; PNC: postnatal care; IRR: incidence rate ratio; Est: estimate of absolute change per 1000 catchment population.