

Supplement table 1. Results of the segmented mixed-effects linear models for Antenatal care in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-90.54	-145.63	-35.46	0.001
Seasonality (Reference: January)				
February	-4.88	-5.57	-4.19	0.000
March	1.40	0.56	2.24	0.001
April	-1.22	-2.18	-0.26	0.013
May	-1.18	-2.16	-0.21	0.017
June	-7.22	-8.21	-6.23	0.000
July	-8.16	-9.18	-7.14	0.000
August	-5.66	-6.65	-4.67	0.000
September	-8.31	-9.28	-7.35	0.000
October	-0.66	-1.60	0.27	0.166
November	-4.45	-5.35	-3.55	0.000
December	-11.99	-12.73	-11.24	0.000
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	102.96	88.68	117.25	0.000
Hospital	423.76	402.12	445.39	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	108.95	91.12	126.78	0.000
Ashanti Region	-16.13	-70.00	37.74	0.557
Bono Region	12.07	-47.42	71.56	0.691
Bono East Region	46.26	-16.01	108.52	0.145
Central Region	10.81	-43.91	65.54	0.698
Eastern Region	-14.31	-67.70	39.07	0.599
Greater Accra Region	47.71	-7.75	103.17	0.092
North East Region	13.36	-52.69	79.41	0.692
Northern Region	28.06	-27.43	83.54	0.322
Oti Region	-1.92	-63.45	59.61	0.951
Savannah Region	-8.32	-69.23	52.58	0.789
Upper East Region	0.34	-55.13	55.82	0.990
Upper West Region	-26.52	-81.65	28.61	0.346
Volta Region	-35.64	-91.53	20.24	0.211
Western Region	7.73	-47.62	63.09	0.784
Western North Region	0.60	-57.89	59.08	0.984
Change over time	0.33	0.28	0.38	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	-9.84	-11.74	-7.95	0.000
Impact during April - July	1.86	1.19	2.53	0.000
Impact during August - November	-1.02	-2.08	0.04	0.058

Supplement table 2. Results of the segmented mixed-effects linear models for Facility deliveries in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-27.15	-40.98	-13.31	0.000
Seasonality (Reference: January)				
February	-1.56	-1.94	-1.17	0.000
March	3.73	3.25	4.22	0.000
April	5.56	5.00	6.13	0.000
May	7.21	6.62	7.79	0.000
June	3.76	3.15	4.36	0.000
July	1.24	0.62	1.87	0.000
August	0.18	-0.43	0.78	0.568
September	2.46	1.88	3.05	0.000
October	5.16	4.60	5.71	0.000
November	2.72	2.19	3.24	0.000
December	0.56	0.14	0.98	0.009
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	16.01	11.36	20.66	0.000
Hospital	87.81	81.43	94.19	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	24.37	19.21	29.53	0.000
Ashanti Region	-0.26	-13.22	12.71	0.969
Bono Region	1.15	-82.39	84.70	0.978
Bono East Region	10.92	-4.52	26.37	0.165
Central Region	34.03	3.85	64.22	0.027
Eastern Region	2.95	-10.30	16.21	0.662
Greater Accra Region	10.71	-2.83	24.25	0.121
North East Region	22.21	2.91	41.52	0.024
Northern Region	17.79	3.94	31.64	0.012
Oti Region	4.82	-10.84	20.48	0.546
Savannah Region	2.95	-12.27	18.17	0.704
Upper East Region	7.18	-6.79	21.15	0.313
Upper West Region	0.56	-13.60	14.71	0.939
Volta Region	-2.78	-16.55	10.99	0.692
Western Region	45.70	-37.95	129.34	0.284
Western North Region	-0.93	-61.46	59.60	0.976
Change over time	0.03	-0.01	0.06	0.098
Effects of COVID-19 pandemic				
Immediate impact in April	-1.76	-2.84	-0.69	0.001
Impact during April - July	0.67	0.28	1.07	0.001
Impact during August - November	-0.83	-1.46	-0.20	0.010

Supplement table 3. Results of the segmented mixed-effects linear models for Postnatal care in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-16.96	-28.75	-5.18	0.005
Seasonality (Reference: January)				
February	-1.28	-1.57	-1.00	0.000
March	3.05	2.70	3.39	0.000
April	4.52	4.13	4.92	0.000
May	5.65	5.24	6.05	0.000
June	2.98	2.57	3.39	0.000
July	0.87	0.44	1.30	0.000
August	-0.24	-0.66	0.17	0.245
September	1.28	0.88	1.68	0.000
October	3.63	3.24	4.02	0.000
November	1.56	1.18	1.93	0.000
December	-0.10	-0.41	0.21	0.531
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	15.28	11.93	18.63	0.000
Hospital	79.97	75.20	84.74	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	18.09	14.21	21.97	0.000
Ashanti Region	-8.16	-19.58	3.27	0.162
Bono Region	2.90	-9.87	15.67	0.656
Bono East Region	7.33	-6.19	20.85	0.288
Central Region	5.82	-6.05	17.69	0.337
Eastern Region	0.13	-11.34	11.59	0.983
Greater Accra Region	4.07	-7.76	15.89	0.500
North East Region	3.79	-11.56	19.15	0.628
Northern Region	4.97	-6.84	16.78	0.409
Oti Region	-2.86	-16.33	10.62	0.678
Savannah Region	-2.93	-16.13	10.27	0.664
Upper East Region	2.96	-9.38	15.29	0.638
Upper West Region	-3.62	-16.03	8.79	0.567
Volta Region	-5.95	-18.07	6.16	0.335
Western Region	1.69	-10.26	13.65	0.781
Western North Region	2.26	-10.33	14.86	0.725
Change over time	0.06	0.04	0.08	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	-0.93	-1.71	-0.16	0.018
Impact during April - July	0.51	0.24	0.79	0.000
Impact during August - November	-0.45	-0.88	-0.02	0.041

Supplement table 4. Results of the segmented mixed-effects linear models for Penta 1 in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-7.01	-12.58	-1.43	0.014
Seasonality (Reference: January)				
February	-0.57	-0.72	-0.43	0.000
March	-0.64	-0.82	-0.45	0.000
April	-0.85	-1.07	-0.64	0.000
May	-0.13	-0.36	0.09	0.244
June	-0.03	-0.27	0.20	0.771
July	0.57	0.33	0.81	0.000
August	0.78	0.55	1.01	0.000
September	0.00	-0.23	0.22	0.973
October	0.30	0.08	0.51	0.006
November	0.32	0.12	0.52	0.001
December	0.12	-0.03	0.28	0.123
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	12.85	10.93	14.77	0.000
Hospital	60.78	57.36	64.20	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	18.47	15.13	21.81	0.000
Ashanti Region	1.32	-3.30	5.95	0.576
Bono Region	0.37	-6.39	7.13	0.915
Bono East Region	1.09	-4.22	6.41	0.686
Central Region	4.55	-1.26	10.36	0.125
Eastern Region	-1.96	-6.68	2.76	0.415
Greater Accra Region	8.85	3.92	13.77	0.000
North East Region	5.16	-1.43	11.75	0.125
Northern Region	9.42	4.25	14.58	0.000
Oti Region	0.22	-5.63	6.08	0.940
Savannah Region	2.13	-4.13	8.40	0.505
Upper East Region	-3.68	-8.77	1.41	0.156
Upper West Region	-7.07	-12.26	-1.88	0.008
Volta Region	-5.48	-10.54	-0.42	0.034
Western Region	0.29	-5.52	6.10	0.923
Western North Region	-1.25	-7.76	5.26	0.707
Change over time	-0.05	-0.06	-0.03	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	0.94	0.54	1.35	0.000
Impact during April - July	-0.05	-0.21	0.10	0.483
Impact during August - November	0.05	-0.19	0.29	0.667

Supplement table 5. Results of the segmented mixed-effects linear models for Pentavalent vaccine coverage in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-8.43	-12.92	-3.95	0.000
Seasonality (Reference: January)				
February	-0.56	-0.69	-0.43	0.000
March	-0.67	-0.84	-0.50	0.000
April	-0.72	-0.92	-0.52	0.000
May	-0.13	-0.34	0.08	0.227
June	-0.09	-0.31	0.13	0.441
July	0.45	0.22	0.68	0.000
August	0.74	0.52	0.96	0.000
September	0.08	-0.13	0.29	0.456
October	0.52	0.33	0.72	0.000
November	0.62	0.44	0.80	0.000
December	0.20	0.06	0.34	0.005
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	14.98	13.50	16.46	0.000
Hospital	56.07	53.33	58.81	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	19.41	16.72	22.10	0.000
Ashanti Region	1.81	-1.93	5.54	0.343
Bono Region	-0.71	-4.98	3.56	0.744
Bono East Region	1.38	-2.92	5.67	0.529
Central Region	2.41	-1.64	6.45	0.243
Eastern Region	-1.62	-5.43	2.18	0.403
Greater Accra Region	9.33	5.40	13.26	0.000
North East Region	5.80	0.47	11.13	0.033
Northern Region	9.97	5.79	14.15	0.000
Oti Region	0.44	-4.29	5.17	0.856
Savannah Region	2.42	-2.65	7.50	0.349
Upper East Region	-3.80	-7.92	0.31	0.070
Upper West Region	-7.03	-11.23	-2.83	0.001
Volta Region	-5.40	-9.47	-1.32	0.009
Western Region	0.02	-4.03	4.07	0.993
Western North Region	-1.44	-5.90	3.01	0.524
Change over time	-0.05	-0.06	-0.04	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	-0.91	-1.27	-0.55	0.000
Impact during April - July	0.36	0.21	0.50	0.000
Impact during August - November	-0.49	-0.71	-0.26	0.000

Supplement table 6. Results of the segmented mixed-effects linear models for Measles 1 in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	-2.19	-5.88	1.49	0.243
Seasonality (Reference: January)				
February	-0.24	-0.39	-0.09	0.002
March	-0.05	-0.24	0.13	0.566
April	-0.30	-0.51	-0.09	0.004
May	-0.03	-0.24	0.18	0.799
June	-0.83	-1.04	-0.61	0.000
July	-0.80	-1.02	-0.58	0.000
August	-0.69	-0.91	-0.48	0.000
September	-0.88	-1.09	-0.67	0.000
October	-0.01	-0.21	0.20	0.953
November	0.23	0.04	0.43	0.019
December	-0.13	-0.29	0.03	0.124
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	12.34	11.14	13.54	0.000
Hospital	39.42	37.18	41.67	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	14.70	12.50	16.90	0.000
Ashanti Region	-1.06	-4.09	1.98	0.494
Bono Region	-2.02	-5.48	1.44	0.253
Bono East Region	-0.17	-3.66	3.32	0.923
Central Region	1.93	-1.34	5.21	0.246
Eastern Region	-3.20	-6.30	-0.10	0.043
Greater Accra Region	11.61	8.39	14.83	0.000
North East Region	1.35	-2.97	5.67	0.540
Northern Region	4.91	1.53	8.30	0.004
Oti Region	-2.00	-5.83	1.84	0.307
Savannah Region	-1.55	-5.67	2.56	0.460
Upper East Region	-6.01	-9.36	-2.67	0.000
Upper West Region	-7.90	-11.35	-4.45	0.000
Volta Region	-6.29	-9.61	-2.98	0.000
Western Region	-1.49	-4.77	1.78	0.372
Western North Region	-2.81	-6.40	0.79	0.126
Change over time	-0.03	-0.05	-0.01	0.001
Effects of COVID-19 pandemic				
Immediate impact in April	-1.46	-1.87	-1.06	0.000
Impact during April - July	0.87	0.73	1.01	0.000
Impact during August - November	-1.31	-1.53	-1.08	0.000

Supplemental table 7. Results of the segmented mixed-effects linear models for Vitamin A in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	45.48	27.61	63.35	0.000
Seasonality (Reference: January)				
February	3.19	1.03	5.36	0.004
March	7.74	5.06	10.43	0.000
April	9.53	6.44	12.62	0.000
May	17.42	14.29	20.55	0.000
June	14.79	11.49	18.09	0.000
July	17.60	14.01	21.18	0.000
August	25.89	22.40	29.38	0.000
September	35.56	32.07	39.05	0.000
October	31.64	28.10	35.19	0.000
November	31.55	27.79	35.31	0.000
December	22.82	19.32	26.32	0.000
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	23.77	15.03	32.50	0.000
Hospital	98.12	85.01	111.22	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	39.46	27.66	51.27	0.000
Ashanti Region	-49.09	-64.56	-33.61	0.000
Bono Region	-35.09	-74.02	3.85	0.077
Bono East Region	-42.60	-64.37	-20.83	0.000
Central Region	-59.40	-119.00	0.20	0.051
Eastern Region	-60.97	-125.98	4.04	0.066
Greater Accra Region	-25.00	-43.23	-6.76	0.007
North East Region	-17.60	-38.69	3.48	0.102
Northern Region	-28.46	-45.08	-11.85	0.001
Oti Region	-11.03	-32.25	10.19	0.308
Savannah Region	-43.28	-62.60	-23.96	0.000
Upper East Region	-53.52	-70.80	-36.24	0.000
Upper West Region	-58.67	-76.22	-41.12	0.000
Volta Region	-36.57	-62.70	-10.45	0.006
Western Region	-78.58	-143.25	-13.90	0.017
Western North Region	-79.96	-180.48	20.56	0.119
Change over time	-0.57	-0.66	-0.48	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	-7.81	-13.71	-1.92	0.010
Impact during April - July	-3.60	-5.71	-1.49	0.001
Impact during August - November	6.08	2.71	9.45	0.000

Supplement table 8. Results of the segmented mixed-effects linear models for Outpatients in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Intercept	103.61	-125.70	332.93	0.376
Seasonality (Reference: January)				
February	-24.56	-28.57	-20.55	0.000
March	-21.91	-26.87	-16.95	0.000
April	-21.87	-27.56	-16.17	0.000
May	16.39	10.59	22.19	0.000
June	35.32	29.39	41.24	0.000
July	55.41	49.28	61.54	0.000
August	32.15	26.23	38.08	0.000
September	-10.05	-15.81	-4.29	0.001
October	100.49	94.89	106.09	0.000
November	80.67	75.33	86.01	0.000
December	-26.52	-30.89	-22.15	0.000
Facility type (Reference: CHPS)				
Health Center/Clinic/Maternity Home	534.71	466.51	602.91	0.000
Hospital	3184.51	3078.89	3290.13	0.000
Region (Reference: Ahafo Region)				
Government Health Facility	220.38	134.85	305.90	0.000
Ashanti Region	-444.85	-672.10	-217.61	0.000
Bono Region	-3.18	-250.93	244.57	0.980
Bono East Region	-2.64	-259.21	253.93	0.984
Central Region	-201.83	-429.07	25.41	0.082
Eastern Region	-201.92	-423.64	19.81	0.074
Greater Accra Region	-213.28	-450.25	23.68	0.078
North East Region	-188.84	-510.94	133.27	0.250
Northern Region	-370.19	-611.53	-128.84	0.003
Oti Region	-348.56	-605.95	-91.16	0.008
Savannah Region	-325.19	-596.82	-53.55	0.019
Upper East Region	-139.94	-373.01	93.12	0.239
Upper West Region	-366.76	-599.89	-133.63	0.002
Volta Region	-360.85	-592.89	-128.80	0.002
Western Region	-230.00	-459.06	-0.93	0.049
Western North Region	-268.53	-510.50	-26.56	0.030
Change over time	0.66	0.37	0.95	0.000
Effects of COVID-19 pandemic				
Immediate impact in April	-144.22	-155.39	-133.05	0.000
Impact during April - July	8.18	4.19	12.16	0.000
Impact during August - November	5.20	-1.12	11.51	0.107

Supplement table 9. Regional-level impact of COVID-19 pandemic on Antenatal care in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	-7.73	-22.66	7.19	0.310
Impact during April - July	5.54	0.22	10.86	0.041
Impact during August - November	-4.00	-12.31	4.32	0.346
Ashanti				
Immediate impact in April	-6.48	-22.17	9.22	0.419
Impact during April - July	-2.29	-7.88	3.31	0.423
Impact during August - November	2.18	-6.57	10.92	0.626
Bono				
Immediate impact in April	8.65	-8.64	25.94	0.327
Impact during April - July	-8.42	-14.59	-2.26	0.007
Impact during August - November	5.59	-4.06	15.23	0.256
Bono East				
Immediate impact in April	1.24	-16.96	19.44	0.894
Impact during April - July	-5.41	-11.88	1.06	0.102
Impact during August - November	6.00	-4.11	16.11	0.245
Central				
Immediate impact in April	3.34	-12.58	19.26	0.681
Impact during April - July	-6.16	-11.83	-0.49	0.033
Impact during August - November	6.94	-1.92	15.81	0.125
Eastern				
Immediate impact in April	2.64	-12.87	18.16	0.738
Impact during April - July	-3.33	-8.86	2.20	0.238
Impact during August - November	1.30	-7.34	9.93	0.768
Greater Accra				
Immediate impact in April	-42.16	-58.25	-26.07	0.000
Impact during April - July	0.77	-4.96	6.50	0.792
Impact during August - November	1.64	-7.32	10.60	0.720
North East				
Immediate impact in April	6.01	-13.28	25.29	0.542
Impact during April - July	-0.27	-7.14	6.61	0.939
Impact during August - November	-3.56	-14.36	7.23	0.517
Northern				
Immediate impact in April	-15.13	-31.25	0.99	0.066
Impact during April - July	-0.85	-6.59	4.89	0.772
Impact during August - November	0.25	-8.73	9.23	0.956
Oti				
Immediate impact in April	9.95	-7.93	27.84	0.275
Impact during April - July	-5.27	-11.65	1.11	0.105
Impact during August - November	4.36	-5.60	14.33	0.391
Savannah				
Immediate impact in April	10.30	-7.39	27.99	0.254
Impact during April - July	-5.51	-11.82	0.80	0.087
Impact during August - November	3.82	-6.06	13.70	0.449
Upper East				
Immediate impact in April	3.11	-12.99	19.21	0.705
Impact during April - July	-3.96	-9.70	1.78	0.176
Impact during August - November	2.38	-6.60	11.35	0.604
Upper West				
Immediate impact in April	8.17	-7.80	24.14	0.316
Impact during April - July	-4.11	-9.80	1.58	0.157
Impact during August - November	1.73	-7.17	10.63	0.704
Volta				
Immediate impact in April	-2.54	-18.82	13.74	0.760
Impact during April - July	-4.35	-10.16	1.45	0.141
Impact during August - November	3.69	-5.38	12.76	0.425
Western				
Immediate impact in April	2.01	-14.08	18.10	0.807
Impact during April - July	-5.81	-11.55	-0.08	0.047
Impact during August - November	5.68	-3.28	14.64	0.214
Western North				
Immediate impact in April	6.35	-10.63	23.33	0.463
Impact during April - July	-5.39	-11.44	0.67	0.081
Impact during August - November	5.57	-3.89	15.03	0.249

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 10. Regional-level impact of COVID-19 pandemic on Facility deliveries in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	-0.15	-6.22	5.93	0.962
Impact during April - July	0.34	-1.91	2.59	0.768
Impact during August - November	0.21	-3.30	3.72	0.908
Ashanti				
Immediate impact in April	-1.92	-8.31	4.47	0.556
Impact during April - July	-0.14	-2.50	2.22	0.906
Impact during August - November	-0.46	-4.15	3.23	0.807
Bono				
Immediate impact in April	25.85	-14.77	66.47	0.212
Impact during April - July	-3.26	-18.30	11.79	0.672
Impact during August - November	0.13	-23.39	23.65	0.991
Bono East				
Immediate impact in April	-2.07	-9.69	5.55	0.595
Impact during April - July	-0.53	-3.35	2.28	0.710
Impact during August - November	0.82	-3.58	5.21	0.716
Central				
Immediate impact in April	-8.97	-23.91	5.97	0.240
Impact during April - July	87.76	82.30	93.23	0.000
Impact during August - November	-120.55	-129.07	-112.04	0.000
Eastern				
Immediate impact in April	-2.49	-9.03	4.04	0.455
Impact during April - July	0.51	-1.91	2.92	0.680
Impact during August - November	-1.73	-5.50	2.04	0.368
Greater Accra				
Immediate impact in April	0.17	-6.44	6.78	0.960
Impact during April - July	-0.85	-3.29	1.59	0.495
Impact during August - November	-0.71	-4.52	3.11	0.717
North East				
Immediate impact in April	-0.16	-9.71	9.39	0.974
Impact during April - July	-1.87	-5.41	1.67	0.300
Impact during August - November	3.63	-1.92	9.18	0.200
Northern				
Immediate impact in April	-1.29	-8.12	5.53	0.711
Impact during April - July	-0.07	-2.59	2.45	0.957
Impact during August - November	1.02	-2.91	4.95	0.611
Oti				
Immediate impact in April	-0.46	-8.24	7.32	0.908
Impact during April - July	-0.31	-3.17	2.55	0.831
Impact during August - November	-0.25	-4.71	4.20	0.911
Savannah				
Immediate impact in April	-2.70	-10.15	4.76	0.478
Impact during April - July	0.48	-2.28	3.25	0.731
Impact during August - November	-1.14	-5.47	3.18	0.604
Upper East				
Immediate impact in April	-1.21	-8.09	5.68	0.731
Impact during April - July	-0.37	-2.91	2.17	0.774
Impact during August - November	0.78	-3.19	4.75	0.700
Upper West				
Immediate impact in April	-1.14	-8.15	5.87	0.750
Impact during April - July	-0.02	-2.60	2.57	0.991
Impact during August - November	-0.50	-4.54	3.54	0.808
Volta				
Immediate impact in April	-2.59	-9.40	4.22	0.456
Impact during April - July	0.49	-2.02	3.01	0.700
Impact during August - November	-1.65	-5.57	2.28	0.410
Western				
Immediate impact in April	2.25	-38.38	42.87	0.914
Impact during April - July	-4.99	-20.04	10.06	0.516
Impact during August - November	0.88	-22.64	24.40	0.941
Western North				
Immediate impact in April	9.13	-19.95	38.21	0.538
Impact during April - July	0.40	-10.48	11.28	0.943
Impact during August - November	1.76	-15.07	18.60	0.837

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 11. Regional-level impact of COVID-19 pandemic on Postnatal care in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	0.49	-4.79	5.78	0.855
Impact during April - July	0.61	-1.27	2.49	0.524
Impact during August - November	1.61	-1.34	4.56	0.285
Ashanti				
Immediate impact in April	-0.58	-6.16	5.00	0.839
Impact during April - July	-0.06	-2.04	1.92	0.951
Impact during August - November	-1.97	-5.09	1.14	0.214
Bono				
Immediate impact in April	0.22	-5.99	6.43	0.944
Impact during April - July	-0.99	-3.20	1.22	0.381
Impact during August - November	-0.53	-4.00	2.94	0.763
Bono East				
Immediate impact in April	1.36	-5.24	7.95	0.687
Impact during April - July	-0.44	-2.78	1.91	0.716
Impact during August - November	-0.53	-4.22	3.16	0.778
Central				
Immediate impact in April	-1.91	-7.71	3.88	0.517
Impact during April - July	-0.41	-2.47	1.64	0.694
Impact during August - November	-2.71	-5.94	0.53	0.101
Eastern				
Immediate impact in April	-2.45	-8.03	3.14	0.390
Impact during April - July	0.30	-1.68	2.28	0.765
Impact during August - November	-2.90	-6.01	0.22	0.068
Greater Accra				
Immediate impact in April	1.00	-4.74	6.74	0.732
Impact during April - July	-0.32	-2.36	1.72	0.760
Impact during August - November	-2.85	-6.05	0.35	0.081
North East				
Immediate impact in April	-0.45	-7.98	7.07	0.906
Impact during April - July	-1.06	-3.74	1.61	0.435
Impact during August - November	0.20	-4.00	4.41	0.925
Northern				
Immediate impact in April	-2.49	-8.24	3.25	0.396
Impact during April - July	0.28	-1.76	2.32	0.788
Impact during August - November	-1.42	-4.62	1.78	0.385
Oti				
Immediate impact in April	-0.16	-6.76	6.44	0.963
Impact during April - July	-0.15	-2.48	2.19	0.901
Impact during August - November	-2.02	-5.67	1.64	0.280
Savannah				
Immediate impact in April	-1.74	-8.15	4.67	0.594
Impact during April - July	-0.07	-2.35	2.21	0.955
Impact during August - November	-2.06	-5.65	1.53	0.261
Upper East				
Immediate impact in April	-1.37	-7.40	4.66	0.655
Impact during April - July	-0.87	-3.01	1.27	0.426
Impact during August - November	0.06	-3.30	3.41	0.973
Upper West				
Immediate impact in April	-1.34	-7.41	4.73	0.665
Impact during April - July	-0.45	-2.60	1.71	0.684
Impact during August - November	-1.46	-4.85	1.93	0.399
Volta				
Immediate impact in April	-2.83	-8.77	3.10	0.349
Impact during April - July	0.52	-1.59	2.62	0.631
Impact during August - November	-3.13	-6.43	0.18	0.064
Western				
Immediate impact in April	-2.02	-7.86	3.81	0.497
Impact during April - July	-0.14	-2.21	1.93	0.892
Impact during August - November	-2.78	-6.03	0.47	0.094
Western North				
Immediate impact in April	-3.13	-9.25	2.98	0.315
Impact during April - July	0.20	-1.98	2.37	0.860
Impact during August - November	-2.36	-5.78	1.05	0.175

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 12. Regional-level impact of COVID-19 pandemic on Penta 1 in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	0.24	-1.98	2.46	0.832
Impact during April - July	-0.02	-0.88	0.83	0.960
Impact during August - November	0.27	-1.05	1.60	0.685
Ashanti				
Immediate impact in April	-0.18	-2.53	2.16	0.878
Impact during April - July	0.29	-0.61	1.19	0.524
Impact during August - November	-0.52	-1.91	0.88	0.469
Bono				
Immediate impact in April	5.16	1.76	8.57	0.003
Impact during April - July	-1.35	-2.65	-0.05	0.042
Impact during August - November	2.06	0.04	4.08	0.045
Bono East				
Immediate impact in April	0.57	-2.12	3.25	0.678
Impact during April - July	0.12	-0.91	1.16	0.815
Impact during August - November	-0.22	-1.82	1.38	0.789
Central				
Immediate impact in April	2.45	-0.50	5.40	0.103
Impact during April - July	-0.81	-1.94	0.32	0.158
Impact during August - November	0.07	-1.67	1.82	0.935
Eastern				
Immediate impact in April	0.03	-2.35	2.42	0.978
Impact during April - July	0.08	-0.84	0.99	0.872
Impact during August - November	-0.34	-1.76	1.08	0.636
Greater Accra				
Immediate impact in April	0.98	-1.54	3.50	0.447
Impact during April - July	0.41	-0.55	1.38	0.400
Impact during August - November	-1.65	-3.14	-0.16	0.029
North East				
Immediate impact in April	1.21	-2.14	4.57	0.479
Impact during April - July	0.10	-1.18	1.39	0.878
Impact during August - November	-0.01	-1.99	1.98	0.995
Northern				
Immediate impact in April	1.23	-1.38	3.84	0.356
Impact during April - July	-0.08	-1.09	0.92	0.873
Impact during August - November	0.39	-1.16	1.94	0.623
Oti				
Immediate impact in April	-0.64	-3.61	2.33	0.672
Impact during April - July	0.36	-0.78	1.50	0.535
Impact during August - November	-0.51	-2.27	1.26	0.574
Savannah				
Immediate impact in April	2.03	-1.15	5.21	0.211
Impact during April - July	-0.40	-1.63	0.82	0.516
Impact during August - November	0.72	-1.18	2.63	0.457
Upper East				
Immediate impact in April	0.96	-1.62	3.54	0.466
Impact during April - July	-0.32	-1.32	0.67	0.521
Impact during August - November	0.27	-1.27	1.80	0.734
Upper West				
Immediate impact in April	1.19	-1.46	3.83	0.379
Impact during April - July	-0.27	-1.28	0.75	0.603
Impact during August - November	0.26	-1.31	1.83	0.744
Volta				
Immediate impact in April	0.52	-2.04	3.08	0.689
Impact during April - July	0.02	-0.97	1.00	0.975
Impact during August - November	-0.54	-2.06	0.98	0.487
Western				
Immediate impact in April	3.15	0.20	6.10	0.036
Impact during April - July	-1.06	-2.19	0.07	0.065
Impact during August - November	0.82	-0.93	2.56	0.359
Western North				
Immediate impact in April	1.25	-2.04	4.54	0.458
Impact during April - July	-0.98	-2.25	0.28	0.127
Impact during August - November	1.02	-0.94	2.97	0.308

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 13. Regional-level impact of COVID-19 pandemic on Penta 3 in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	1.36	-0.78	3.49	0.213
Impact during April - July	-0.29	-1.12	0.55	0.500
Impact during August - November	0.45	-0.84	1.73	0.497
Ashanti				
Immediate impact in April	-2.47	-4.72	-0.22	0.032
Impact during April - July	0.66	-0.22	1.54	0.141
Impact during August - November	-0.84	-2.20	0.51	0.223
Bono				
Immediate impact in April	-1.66	-4.23	0.91	0.205
Impact during April - July	0.21	-0.80	1.21	0.688
Impact during August - November	-0.48	-2.02	1.06	0.542
Bono East				
Immediate impact in April	-1.83	-4.42	0.76	0.166
Impact during April - July	0.43	-0.58	1.43	0.407
Impact during August - November	-0.41	-1.96	1.14	0.605
Central				
Immediate impact in April	-0.84	-3.28	1.59	0.498
Impact during April - July	0.46	-0.49	1.41	0.345
Impact during August - November	-1.07	-2.54	0.39	0.151
Eastern				
Immediate impact in April	-1.82	-4.12	0.47	0.119
Impact during April - July	0.50	-0.40	1.39	0.278
Impact during August - November	-0.67	-2.05	0.71	0.342
Greater Accra				
Immediate impact in April	-5.15	-7.55	-2.76	0.000
Impact during April - July	1.77	0.84	2.69	0.000
Impact during August - November	-2.60	-4.02	-1.17	0.000
North East				
Immediate impact in April	-3.70	-6.94	-0.45	0.026
Impact during April - July	0.63	-0.63	1.89	0.327
Impact during August - November	-1.03	-2.97	0.90	0.296
Northern				
Immediate impact in April	-2.85	-5.36	-0.34	0.026
Impact during April - July	0.73	-0.25	1.71	0.143
Impact during August - November	-0.51	-2.02	1.00	0.507
Oti				
Immediate impact in April	-2.30	-5.15	0.54	0.113
Impact during April - July	0.67	-0.44	1.78	0.235
Impact during August - November	-0.75	-2.46	0.96	0.389
Savannah				
Immediate impact in April	-0.87	-3.94	2.19	0.576
Impact during April - July	0.07	-1.12	1.27	0.905
Impact during August - November	0.42	-1.44	2.27	0.660
Upper East				
Immediate impact in April	-2.80	-5.28	-0.32	0.027
Impact during April - July	0.47	-0.49	1.44	0.336
Impact during August - November	-1.05	-2.54	0.44	0.167
Upper West				
Immediate impact in April	-2.22	-4.76	0.33	0.088
Impact during April - July	0.48	-0.51	1.47	0.344
Impact during August - November	-0.83	-2.35	0.70	0.288
Volta				
Immediate impact in April	-1.89	-4.35	0.56	0.131
Impact during April - July	0.63	-0.32	1.59	0.193
Impact during August - November	-0.92	-2.39	0.55	0.221
Western				
Immediate impact in April	-1.62	-4.07	0.83	0.195
Impact during April - July	0.60	-0.35	1.55	0.218
Impact during August - November	-1.08	-2.55	0.39	0.149
Western North				
Immediate impact in April	-2.35	-5.04	0.34	0.087
Impact during April - July	0.63	-0.41	1.68	0.234
Impact during August - November	-1.20	-2.82	0.41	0.143

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 14. Regional-level impact of COVID-19 pandemic on Measles 1 in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	-0.52	-2.92	1.88	0.671
Impact during April - July	0.49	-0.37	1.35	0.267
Impact during August - November	-0.64	-2.00	0.72	0.354
Ashanti				
Immediate impact in April	-1.27	-3.80	1.27	0.327
Impact during April - July	0.41	-0.50	1.32	0.376
Impact during August - November	-0.59	-2.02	0.85	0.423
Bono				
Immediate impact in April	-0.35	-3.22	2.52	0.811
Impact during April - July	-0.08	-1.11	0.95	0.881
Impact during August - November	-0.09	-1.71	1.53	0.917
Bono East				
Immediate impact in April	0.39	-2.51	3.29	0.793
Impact during April - July	0.20	-0.85	1.24	0.713
Impact during August - November	-0.03	-1.66	1.61	0.974
Central				
Immediate impact in April	0.55	-2.17	3.27	0.692
Impact during April - July	0.25	-0.73	1.23	0.619
Impact during August - November	-0.77	-2.31	0.76	0.323
Eastern				
Immediate impact in April	-0.60	-3.18	1.99	0.651
Impact during April - July	0.28	-0.65	1.21	0.560
Impact during August - November	-0.46	-1.92	1.00	0.533
Greater Accra				
Immediate impact in April	-3.88	-6.60	-1.16	0.005
Impact during April - July	1.18	0.20	2.15	0.018
Impact during August - November	-1.55	-3.07	-0.03	0.045
North East				
Immediate impact in April	-2.25	-5.88	1.37	0.223
Impact during April - July	0.67	-0.63	1.97	0.310
Impact during August - November	-1.36	-3.40	0.68	0.190
Northern				
Immediate impact in April	-2.72	-5.53	0.08	0.057
Impact during April - July	0.53	-0.48	1.54	0.305
Impact during August - November	-0.98	-2.57	0.61	0.227
Oti				
Immediate impact in April	-1.01	-4.18	2.16	0.531
Impact during April - July	0.42	-0.72	1.57	0.467
Impact during August - November	-0.49	-2.28	1.30	0.590
Savannah				
Immediate impact in April	-1.41	-4.84	2.03	0.422
Impact during April - July	0.00	-1.24	1.23	0.995
Impact during August - November	0.15	-1.81	2.10	0.883
Upper East				
Immediate impact in April	-1.00	-3.77	1.78	0.481
Impact during April - July	0.52	-0.48	1.52	0.309
Impact during August - November	-1.25	-2.81	0.32	0.119
Upper West				
Immediate impact in April	-0.89	-3.77	1.99	0.544
Impact during April - July	0.29	-0.75	1.33	0.582
Impact during August - November	-0.76	-2.39	0.87	0.360
Volta				
Immediate impact in April	0.14	-2.63	2.91	0.923
Impact during April - July	-0.07	-1.06	0.93	0.892
Impact during August - November	-0.01	-1.57	1.55	0.987
Western				
Immediate impact in April	-0.04	-2.77	2.70	0.978
Impact during April - July	0.59	-0.39	1.58	0.239
Impact during August - November	-1.02	-2.56	0.53	0.197
Western North				
Immediate impact in April	-0.67	-3.66	2.32	0.660
Impact during April - July	0.38	-0.69	1.46	0.483
Impact during August - November	-0.83	-2.52	0.85	0.332

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 15. Regional-level impact of COVID-19 pandemic on Vitamin A in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	3.04	-14.41	20.50	0.732
Impact during April - July	-2.25	-8.40	3.91	0.475
Impact during August - November	-3.71	-13.36	5.95	0.452
Ashanti				
Immediate impact in April	-10.76	-30.89	9.38	0.295
Impact during April - July	-1.20	-8.33	5.92	0.741
Impact during August - November	10.02	-1.10	21.13	0.077
Bono				
Immediate impact in April	-82.66	-142.08	-23.24	0.006
Impact during April - July	1.83	-17.64	21.30	0.854
Impact during August - November	4.04	-25.36	33.45	0.788
Bono East				
Immediate impact in April	-26.69	-55.73	2.35	0.072
Impact during April - July	-2.70	-13.01	7.61	0.608
Impact during August - November	10.62	-5.29	26.52	0.191
Central				
Immediate impact in April	-27.10	-122.88	68.68	0.579
Impact during April - July	-9.34	-40.84	22.16	0.561
Impact during August - November	11.64	-34.49	57.78	0.621
Eastern				
Immediate impact in April	-23.25	-119.50	73.01	0.636
Impact during April - July	-9.46	-43.22	24.30	0.583
Impact during August - November	49.64	-2.41	101.70	0.062
Greater Accra				
Immediate impact in April	-17.29	-40.42	5.84	0.143
Impact during April - July	-3.45	-11.67	4.76	0.410
Impact during August - November	20.09	7.19	32.98	0.002
North East				
Immediate impact in April	-0.72	-35.37	33.92	0.967
Impact during April - July	11.57	0.46	22.69	0.041
Impact during August - November	-9.51	-25.73	6.71	0.250
Northern				
Immediate impact in April	-2.42	-24.61	19.78	0.831
Impact during April - July	-6.58	-14.43	1.27	0.100
Impact during August - November	21.71	9.42	34.00	0.001
Oti				
Immediate impact in April	-24.70	-53.45	4.04	0.092
Impact during April - July	2.67	-7.49	12.84	0.606
Impact during August - November	11.07	-4.64	26.77	0.167
Savannah				
Immediate impact in April	-23.86	-50.40	2.68	0.078
Impact during April - July	7.82	-1.41	17.05	0.097
Impact during August - November	2.48	-11.87	16.84	0.734
Upper East				
Immediate impact in April	-0.51	-23.37	22.36	0.965
Impact during April - July	-2.95	-11.04	5.14	0.475
Impact during August - November	6.89	-5.71	19.49	0.284
Upper West				
Immediate impact in April	-4.87	-28.43	18.70	0.686
Impact during April - July	-3.91	-12.18	4.36	0.354
Impact during August - November	7.05	-5.81	19.91	0.283
Volta				
Immediate impact in April	-50.48	-91.88	-9.08	0.017
Impact during April - July	-1.62	-15.09	11.85	0.814
Impact during August - November	7.03	-12.90	26.96	0.489
Western				
Immediate impact in April	-11.64	-132.10	108.82	0.850
Impact during April - July	-2.36	-41.20	36.48	0.905
Impact during August - November	6.34	-50.08	62.75	0.826
Western North				
Immediate impact in April	-3.85	-167.32	159.61	0.963
Impact during April - July	-2.72	-59.17	53.73	0.925
Impact during August - November	5.26	-79.62	90.14	0.903

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.

Supplement table 16. Regional-level impact of COVID-19 pandemic on Outpatients in Ghana

	Coefficients*	95% CI		P-value
		Lower	Upper	
Reference group: Ahafo				
Immediate impact in April	-86.42	-165.21	-7.62	0.032
Impact during April - July	-23.34	-52.09	5.41	0.112
Impact during August - November	40.27	-4.54	85.08	0.078
Ashanti				
Immediate impact in April	-121.71	-206.06	-37.35	0.005
Impact during April - July	37.35	6.50	68.20	0.018
Impact during August - November	-41.00	-89.10	7.10	0.095
Bono				
Immediate impact in April	-40.30	-132.33	51.73	0.391
Impact during April - July	39.43	5.76	73.11	0.022
Impact during August - November	-40.29	-92.76	12.18	0.132
Bono East				
Immediate impact in April	-39.93	-134.97	55.10	0.410
Impact during April - July	25.04	-9.79	59.87	0.159
Impact during August - November	-27.06	-81.33	27.21	0.328
Central				
Immediate impact in April	-45.88	-130.36	38.59	0.287
Impact during April - July	22.50	-8.41	53.41	0.154
Impact during August - November	-25.61	-73.79	22.56	0.297
Eastern				
Immediate impact in April	-5.63	-88.16	76.90	0.894
Impact during April - July	24.95	-5.22	55.13	0.105
Impact during August - November	-39.12	-86.16	7.91	0.103
Greater Accra				
Immediate impact in April	-475.58	-563.14	-388.03	0.000
Impact during April - July	86.17	54.15	118.18	0.000
Impact during August - November	-52.84	-102.76	-2.92	0.038
North East				
Immediate impact in April	-71.26	-190.94	48.41	0.243
Impact during April - July	70.94	27.14	114.74	0.002
Impact during August - November	-82.93	-151.19	-14.67	0.017
Northern				
Immediate impact in April	-31.80	-121.26	57.65	0.486
Impact during April - July	32.47	-0.32	65.26	0.052
Impact during August - November	-19.93	-71.04	31.18	0.445
Oti				
Immediate impact in April	63.38	-31.51	158.27	0.190
Impact during April - July	10.94	-23.90	45.78	0.538
Impact during August - November	-15.74	-70.04	38.55	0.570
Savannah				
Immediate impact in April	29.77	-70.79	130.32	0.562
Impact during April - July	32.91	-4.01	69.83	0.081
Impact during August - November	-54.82	-112.59	2.96	0.063
Upper East				
Immediate impact in April	-63.21	-149.67	23.25	0.152
Impact during April - July	57.05	25.37	88.73	0.000
Impact during August - November	-67.73	-117.16	-18.31	0.007
Upper West				
Immediate impact in April	28.86	-57.60	115.33	0.513
Impact during April - July	34.09	2.43	65.76	0.035
Impact during August - November	-61.11	-110.52	-11.70	0.015
Volta				
Immediate impact in April	-62.74	-148.94	23.46	0.154
Impact during April - July	25.47	-6.07	57.02	0.114
Impact during August - November	-24.41	-73.59	24.77	0.331
Western				
Immediate impact in April	14.15	-70.94	99.24	0.744
Impact during April - July	13.60	-17.55	44.75	0.392
Impact during August - November	-17.51	-66.10	31.08	0.480
Western North				
Immediate impact in April	76.64	-12.76	166.04	0.093
Impact during April - July	7.84	-24.95	40.64	0.639
Impact during August - November	-9.81	-60.93	41.32	0.707

*The analysis includes fixed effect control variables for i) monthly indicator, ii) facility type, iii) facility authority, iv) region and i) time trends. Two random effects for facility-level intercept and time trends were also added in the model.