

Estimated costs of scaled-up malaria control efforts in Ethiopia, 2005–15

Table A1.1
Population at risk for malaria by weight group in Ethiopia, 2005–15
Millions

Source: Center for National Health Development in Ethiopia 2004.

Description	Share of total population (percent)	2005	2006	2007	2008
Total population	100	73.0	75.1	77.2	77.4
Population at risk for malaria	68	49.7	51.1	52.5	52.6
<i>Weight group (percentage of population at risk)</i>					
5–<10 kg (1.9 percent)	2	0.9	1.0	1.0	1.0
10–<15 kg (6.8 percent)	7	3.4	3.5	3.6	3.6
15–<25 kg (16 percent)	16	7.9	8.2	8.4	8.4
25–<34 kg (8.3 percent)	8	4.1	4.2	4.4	4.4
≥34 kg (67 percent)	67	33.3	34.2	35.2	35.3

2009	2010	2011	2012	2013	2014	2015
81.4	83.5	85.9	89.3	91.8	94.5	97.2
55.4	56.8	58.4	60.7	62.5	64.3	66.1
1.1	1.1	1.1	1.2	1.2	1.2	1.3
3.8	3.9	4.0	4.1	4.2	4.4	4.5
8.9	9.1	9.3	9.7	10.0	10.3	10.6
4.6	4.7	4.8	5.0	5.2	5.3	5.5
37.1	38.0	39.1	40.7	41.8	43.1	44.3

Table A1.2
Total number of fever episodes by weight group in Ethiopia, 2005–15

Millions

Source: Center for National Health Development in Ethiopia 2004.

Description	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<i>Estimated fever episodes</i>											
5–<10 kg (1.9 percent) x 2 episodes	1.89	1.75	1.60	1.40	1.26	1.08	1.00	0.92	0.83	0.73	0.63
10–<15 kg (6.8 percent) x 2 episodes	6.75	6.25	5.71	5.01	4.52	3.86	3.57	3.30	2.97	2.62	2.25
15–<25 kg (16 percent) x 1.5 episodes	11.92	11.04	10.08	8.84	7.97	6.81	6.31	5.83	5.25	4.63	3.97
25–<34 kg (8.3 percent) x 1 episode	4.12	3.82	3.49	3.06	2.76	2.36	2.18	2.01	1.81	1.60	1.37
≥34 kg (67 percent) x 0.3 episode	9.98	9.24	8.44	7.40	6.68	5.71	5.28	4.88	4.39	3.87	3.32
Total	34.67	32.09	29.32	25.71	23.18	19.81	18.35	16.94	15.26	13.46	11.54
<i>Estimated malaria cases by weight group (40 percent of total fever episodes assumed attributable to malaria)</i>											
5–<10 kg (1.9 percent)	0.75	0.70	0.64	0.56	0.50	0.43	0.40	0.37	0.33	0.29	0.25
10–<15 kg (6.8 percent)	2.70	2.50	2.29	2.00	1.81	1.54	1.43	1.32	1.19	1.05	0.90
15–<25 kg (16 percent)	4.77	4.41	4.03	3.54	3.19	2.72	2.52	2.33	2.10	1.85	1.59
25–<34 kg (8.3 percent)	1.65	1.53	1.39	1.22	1.10	0.94	0.87	0.81	0.73	0.64	0.55
≥34 kg (67 percent)	3.99	3.70	3.38	2.96	2.67	2.28	2.11	1.95	1.76	1.55	1.33
Total	13.87	12.84	11.73	10.29	9.27	7.92	7.34	6.78	6.10	5.38	4.62
<i>Estimated P. falciparum cases by weight group (70 percent of total malaria cases)</i>											
5–<10 kg (1.9 percent)	0.53	0.49	0.45	0.39	0.35	0.30	0.28	0.26	0.23	0.21	0.18
10–<15 kg (6.8 percent)	1.89	1.75	1.60	1.40	1.26	1.08	1.00	0.92	0.83	0.73	0.63
15–<25 kg (16 percent)	3.34	3.09	2.82	2.48	2.23	1.91	1.77	1.63	1.47	1.30	1.11
25–<34 kg (8.3 percent)	1.15	1.07	0.98	0.86	0.77	0.66	0.61	0.56	0.51	0.45	0.38
≥34 kg (67 percent)	2.80	2.59	2.36	2.07	1.87	1.60	1.48	1.37	1.23	1.08	0.93
Total	9.71	8.99	8.21	7.20	6.49	5.55	5.14	4.74	4.27	3.77	3.23
<i>Estimated P. vivax cases by weight group (30 percent of total malaria cases)</i>											
5–<10 kg (1.9 percent)	0.23	0.21	0.19	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08
10–<15 kg (6.8 percent)	0.81	0.75	0.69	0.60	0.54	0.46	0.43	0.40	0.36	0.31	0.27
15–<25 kg (16 percent)	1.43	1.32	1.21	1.06	0.96	0.82	0.76	0.70	0.63	0.56	0.48
25–<34 kg (8.3 percent)	0.49	0.46	0.42	0.37	0.33	0.28	0.26	0.24	0.22	0.19	0.16
≥34 kg (67 percent)	1.20	1.11	1.01	0.89	0.80	0.68	0.63	0.59	0.53	0.46	0.40
Total	4.16	3.85	3.52	3.09	2.78	2.38	2.20	2.03	1.83	1.61	1.38

Table A1.3
Management of uncomplicated malaria by treatment and weight group in Ethiopia, 2005–15

Source: Center for National Health Development in Ethiopia 2004.

Description	Quantity required case (US\$)	Cost per case (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
<i>Number of weighted treatment doses of artemether-lumefantrine (ACT) required to treat uncomplicated P. falciparum malaria (millions)</i>														
5–<10 kg (1.9 percent)	6 tabs/case	NA	3.17	2.94	2.68	2.35	2.12	1.81	1.68	1.55	1.40	1.23	1.06	
10–<15 kg (6.8 percent)	6 tabs/case	NA	11.35	10.51	9.60	8.42	7.59	6.48	6.01	5.55	4.99	4.40	3.78	
15–<25 kg (16 percent)	12 tabs/case	NA	40.05	37.08	33.87	29.71	26.78	22.89	21.20	19.58	17.63	15.55	13.33	
25–<34 kg (8.3 percent)	18 tabs/case	NA	20.78	19.23	17.57	15.41	13.89	11.87	11.00	10.16	9.14	8.06	6.92	
≥34 kg (67 percent)	24 tabs/case	NA	67.09	62.11	56.74	49.76	44.86	38.34	35.50	32.79	29.52	26.04	22.33	
Total ACT doses			142.43	131.86	120.47	105.64	95.24	81.40	75.38	69.62	62.68	55.29	47.41	
<i>Number of weighted treatment doses of chloroquine required to treat P. vivax malaria (millions)</i>														
5–<10 kg (1.9 percent)	4 tabs/case	NA	0.91	0.84	0.77	0.67	0.61	0.52	0.48	0.44	0.40	0.35	0.30	
10–<15 kg (6.8 percent)	4 tabs/case	NA	3.24	3.00	2.74	2.40	2.17	1.85	1.72	1.58	1.43	1.26	1.08	
15–<25 kg (16 percent)	8 tabs/case	NA	11.44	10.59	9.68	8.49	7.65	6.54	6.06	5.59	5.04	4.44	3.81	
25–<34 kg (8.3 percent)	10 tabs/case	NA	4.95	4.58	4.18	3.67	3.31	2.83	2.62	2.42	2.18	1.92	1.65	
≥34 kg (67 percent)	10 tabs/case	NA	11.98	11.09	10.13	8.89	8.01	6.85	6.34	5.86	5.27	4.65	3.99	
Total chloroquine doses			32.52	30.10	27.50	24.12	21.74	18.58	17.21	15.89	14.31	12.62	10.82	
<i>Cost of artemether-lumefantrine tabs to treat uncomplicated P. falciparum malaria (US\$ thousands)</i>														
5–<10 kg (1.9 percent)	6 tabs/case	0.9	475.61	440.30	402.27	352.76	318.03	271.80	251.71	232.47	209.31	184.61	158.30	3,297.17
10–<15 kg (6.8 percent)	6 tabs/case	0.9	1,702.19	1,575.81	1,439.69	1,262.50	1,138.21	972.75	900.86	832.00	749.11	660.71	566.56	11,800.40
15–<25 kg (16 percent)	12 tabs/case	1.4	4,672.69	4,325.76	3,952.08	3,465.69	3,124.51	2,670.29	2,472.96	2,283.91	2,056.38	1,813.73	1,555.27	32,393.26
25–<34 kg (8.3 percent)	18 tabs/case	1.9	2,193.10	2,030.27	1,854.89	1,626.60	1,466.47	1,253.29	1,160.67	1,071.94	965.15	851.26	729.96	15,203.62
≥34 kg (67 percent)	24 tabs/case	2.4	6,708.65	6,210.55	5,674.06	4,975.73	4,485.90	3,833.78	3,550.46	3,279.05	2,952.37	2,603.99	2,232.92	46,507.47
Subtotal cost for treatment of falciparum malaria			15,752.25	14,582.69	13,322.99	11,683.28	10,533.13	9,001.90	8,336.66	7,699.37	6,932.32	6,114.31	5,243.02	109,201.92
<i>Cost of chloroquine tablets to treat P. vivax malaria (US\$ thousands)</i>														
5–<10 kg (1.9 percent)	4 tabs/case	0.036	8.15	7.55	6.90	6.05	5.45	4.66	4.32	3.99	3.59	3.16	2.71	56.52
10–<15 kg (6.8 percent)	4 tabs/case	0.036	29.18	27.01	24.68	21.64	19.51	16.68	15.44	14.26	12.84	11.33	9.71	202.29
15–<25 kg (16 percent)	8 tabs/case	0.072	102.99	95.34	87.11	76.39	68.87	58.86	54.51	50.34	45.32	39.98	34.28	713.97

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Table A1.3
Management of uncomplicated
malaria by treatment and weight
group in Ethiopia, 2005–15
(continued)

Description	Quantity required case (US\$)	Cost per case (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
			2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
25–<34 kg (8.3 percent)	10 tabs/case	0.09	44.52	41.22	37.66	33.02	29.77	25.44	23.56	21.76	19.59	17.28	14.82	308.64
≥34 kg (67 percent)	10 tabs/case	0.09	107.82	99.81	91.19	79.97	72.09	61.61	57.06	52.70	47.45	41.85	35.89	747.44
Subtotal cost of chloroquine tablets			292.66	270.93	247.53	217.07	195.70	167.25	154.89	143.05	128.80	113.60	97.41	2,028.88
<i>Subtotal cost of chloroquine syrup to treat P. vivax malaria (US\$ thousands)</i>														
All cases under age 5	32.5 ml/case	0.05	35.36	32.74	29.91	26.23	23.65	20.21	18.71	17.28	15.56	13.73	11.77	245.14
<i>Subtotal cost of prenaquine for radical treatment of P. vivax malaria (US\$ thousands)</i>														
All cases age 5 and over	14 tablets/case	0.182	628.43	581.77	531.51	466.10	420.21	359.13	332.59	307.16	276.56	243.93	209.17	4,356.56
<i>Subtotal cost for treatment of P. vivax malaria (US\$ thousands)</i>														
			956.45	885.44	808.95	709.39	639.56	546.58	506.19	467.49	420.92	371.25	318.35	6,630.57
Total cost for treatment of uncomplicated malaria (US\$ thousands)			16,708.70	15,468.13	14,131.94	12,392.67	11,172.69	9,548.48	8,842.85	8,166.86	7,353.24	6,485.56	5,561.37	115,832.49

Table A1.4
Cost of managing severe
malaria in Ethiopia, 2005–15
Dollars

Source: Center for National Health
 Development in Ethiopia 2004.

Description	Quantity required	Cost per case (US\$)	2005	2006	2007	2008	2009	2010	Total costs
			2011	2012	2013	2014	2015		
Cost of quinine, 300 mg base (at 6 ampules per day for 3 days)	18 ampules/case	2.34	681,428.4	630,834.4	576,340.7	505,408.3	455,653.9	389,414.3	
Cost of quinine, 300 mg base tablet (at 3 tablets per day for 7 days)	21 tablets/case	0.63	183,461.5	169,840.0	155,168.6	136,071.5	122,676.1	104,842.3	
Cost of hospitalization for severe malaria	Per case	30	8,736,261.8	8,087,620.7	7,388,982.9	6,479,593.5	5,841,717.2	4,992,491.3	
Total costs			9,601,151.7	8,888,295.1	8,120,492.2	7,121,073.3	6,420,047.2	5,486,748.0	
Description	Quantity required	Cost per case (US\$)	2011	2012	2013	2014	2015		Total costs
Cost of quinine, 300 mg base (at 6 ampules per day for 3 days)	18 ampules/case	2.34	360,636.6	333,067.9	299,886.0	264,499.5	226,808.3	4,723,978.5	
Cost of quinine, 300 mg base tablet (at 3 tablets per day for 7 days)	21 tablets/case	0.63	97,094.5	89,672.1	80,738.6	71,211.4	61,063.8	1,271,840.4	
Cost of hospitalization for severe malaria	Per case	30	4,623,546.2	4,270,101.8	3,844,692.9	3,391,019.2	2,907,798.9	60,563,826.5	
Total costs			5,081,277.3	4,692,841.9	4,225,317.5	3,726,730.1	3,195,671.0	66,559,645.4	

Description	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Adopt and approve the policy for implementation	15,000											
Develop treatment guidelines based on the approved policy for use by public and private health services, NGOs, and others	50,000											
Distribute and supply ACT	150,000			150,000			150,000			150,000		600,000
Public campaign to create awareness among the public; media, posters, pamphlets on ACT use and compliance	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	1,100,000
Monitor for effectiveness of ACT under field conditions and for possible side effects	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	1,650,000
Subtotal	565,000	250,000	250,000	450,000	250,000	250,000	450,000	250,000	250,000	450,000	250,000	3,550,000
Total costs	22,685,175	17,814,336	16,298,120	14,524,448	12,940,140	11,097,078	10,496,539	9,529,655	8,606,572	7,822,147	6,573,596	138,387,805

Table A1.6
Selective vector control in Ethiopia, 2005–15

Source: Center for National Health Development in Ethiopia 2004.

Description	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
<i>Long-lasting insecticide-treated bednets (millions)</i>												
Total population at risk	49.7	51.1	52.5	52.6	55.4	56.8	58.4	60.7	62.5	64.3	66.1	
Total population eligible for insecticide-treated bednets	14.9	8.6	3.9	6.7	6.0	4.3	7.2	6.1	4.8	7.8	6.6	
Number of households (population at risk/5 people)	3.0	1.7	0.8	1.3	1.2	0.9	1.4	1.2	1.0	1.6	1.3	
Number of long-lasting insecticide-treated bednets (3 per household) to reach total population at risk	8.9	5.2	2.3	4.0	3.6	2.6	4.3	3.6	2.9	4.7	4.0	
Expected coverage per year (percent)	45	60	90	100	100	100	100	100	100	100	100	
Total insecticide-treated bednets required per year based on coverage	4.0	3.1	2.1	4.0	3.6	2.6	4.3	3.6	2.9	4.7	4.0	
<i>Indoor residual spraying of houses (millions)</i>												
Population to be protect through indoor residual spraying (60 percent of the total population live in unstable transmission area)	29.8	30.7	31.5	31.6	33.2	34.1	35.0	36.4	37.5	38.6	39.7	
Number of households targeted for indoor residual spraying (population/5 people)	6.0	6.1	6.3	6.3	6.6	6.8	7.0	7.3	7.5	7.7	7.9	
Number of unit structures to be sprayed (3 unit structures per household)	17.9	18.4	18.9	18.9	19.9	20.4	21.0	21.8	22.5	23.1	23.8	
Average surface area of unit structure to be sprayed, at 100 square meters/unit structure (square meters)	1,788.0	1,839.2	1,890.3	1,894.5	1,992.7	2,043.6	2,102.9	2,184.9	2,248.2	2,313.4	2,380.5	
Insecticide required at a dose of 2.67 gm (0.00267 kg) per square meter (grams)	4.8	4.9	5.0	5.1	5.3	5.5	5.6	5.8	6.0	6.2	6.4	
Insecticide actual plus 10 percent safety margin (kilograms)	5.3	5.4	5.6	5.6	5.9	6.0	6.2	6.4	6.6	6.8	7.0	
<i>Human resource requirement for indoor residual spraying (thousands)</i>												
Number of spray persons (total houses divided by 360 person-days)	16.56	17.03	17.50	17.54	18.45	18.92	19.47	20.23	20.82	21.42	22.04	
Number of squads (1 squad per 5 spray persons)	3.31	3.41	3.50	3.51	3.69	3.78	3.89	4.05	4.16	4.28	4.41	
Number of teams or technicians (1 team per 5 squads)	0.66	0.68	0.70	0.70	0.74	0.76	0.78	0.81	0.83	0.86	0.88	
Number of supervisors (1 supervisor per 5 teams)	0.13	0.14	0.14	0.14	0.15	0.15	0.16	0.16	0.17	0.17	0.18	

Description	Cost per unit (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
<i>Cost of insecticide-treated bednets (US\$ millions)</i>													
Total cost of long-lasting insecticide-treated bednets	5	20.12	15.52	10.45	20.22	17.95	12.90	21.70	18.23	14.48	23.33	19.90	194.79
Handling, storage, and distribution cost	2	8.05	6.21	4.18	8.09	7.18	5.16	8.68	7.29	5.79	9.33	7.96	77.92
Cost of retreatment for existing retreatable insecticide-treated bednets (3 million bednets)	0.4	1.20											1.20
Subtotal for insecticide-treated bednets		29.36	21.73	14.63	28.31	25.13	18.06	30.38	25.52	20.27	32.66	27.86	273.91
<i>Cost of insecticide and spray pumps (US\$ millions)</i>													
Cost of insecticide	4.3	22.58	23.23	23.87	23.93	25.17	25.81	26.56	27.59	28.39	29.22	30.06	286.41
Spray pumps and spare parts	500	24.83	0.00	0.00	0.00	0.00	6.21	0.00	0.00	0.00	0.00	0.00	31.04
Subtotal cost of insecticide and spray pumps		47.41	23.23	23.87	23.93	25.17	32.02	26.56	27.59	28.39	29.22	30.06	317.45
<i>Cost of human power (US\$ millions)</i>													
Wage for spray persons (40 days plus 6 training days)	10	7.62	7.83	8.05	8.07	8.49	8.70	8.96	9.31	9.58	9.85	10.14	96.59
Wage for squad chiefs (40 person-days plus 6 training days)	15	2.28	2.35	2.42	2.42	2.55	2.61	2.69	2.79	2.87	2.96	3.04	28.98
Wage for technicians (40 person-days plus 6 training days)	15	0.46	0.47	0.48	0.48	0.51	0.52	0.54	0.56	0.57	0.59	0.61	5.80
Wage for supervisors (18 person-days)	20	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.60
Per diem for regional supervisors or coordinators (2 persons per region)	25	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10
Forms and stationery (per house)	0.06	0.36	0.37	0.38	0.38	0.40	0.41	0.42	0.44	0.45	0.46	0.48	4.54
Subtotal cost of human power		10.77	11.08	11.39	11.41	12.00	12.31	12.67	13.16	13.54	13.93	14.34	136.60
<i>Field equipment (US\$ millions)</i>													
Tents (4-person fly tents per team and supervisors)	2,000	1.59	1.63	1.68	1.68	1.77	1.82	1.87	1.94	2.00	2.06	2.12	20.16
Coveralls, hand gloves, goggles, buckets, soaps, and the like for spray persons, squad chiefs, technicians, and other personnel	100	2.05	2.11	2.17	2.18	2.29	2.35	2.41	2.51	2.58	2.66	2.73	26.04

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Table A1.6
Selective vector control in Ethiopia, 2005–15
(continued)

Description	Cost per unit (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Spray operation logistics (3 pickups and 2 trucks per district to transport equipment and personnel)	125,000	37.50	25.29	25.29	25.29	25.29	6.39	6.39	6.39	6.39	6.39	6.39	177.02
Spare parts and maintenance (15 percent of total cost)	18,750	5.63	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	43.56
Fuel and lubricant (per day per team and supervisor plus travel days for 300 districts)	3,000	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	9.90
Insurance for the spraying team and vehicles		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	22.00
Subtotal		49.67	35.73	35.83	35.84	36.04	17.25	17.37	17.54	17.67	17.80	17.94	298.67
<i>Larviciding using Temephos and environmental management in urban and development areas (US\$ millions)</i>													
Abate (20 barrels per region for 9 regions)	120	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.24
Environmental management through community participation	500	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	2.45
Subtotal		0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	2.73
Total cost for vector control		137.46	92.01	85.97	99.74	98.59	79.88	87.22	84.05	80.12	93.86	90.45	

Description	Quantity required	Cost per unit (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Training district health staff personnel on vector control including epidemic prevention and control (5-day sessions for 8 workers per district for 453 districts)	18,120	10	181,200	18,120	18,120	18,120	18,120	18,120	18,120	18,120	18,120	18,120	18,120	362,400
Training laboratory technicians on basic malaria microscopy (5-day sessions for 3 technicians per district)	6,795	10	67,950	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	135,900
Workshop on planning of malaria control including epidemic preparedness and malaria control in 453 malarious districts (3 persons per district for 5-day sessions)	6,795	10	67,950	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	135,900
Subtotal for in-service refresher training			558,300	49,830	49,830	49,830	49,830	109,830	49,830	49,830	49,830	49,830	49,830	1,116,600
<i>Capacity building by recruiting additional staff</i>														
Recruiting epidemiologists at the regional level (2 per region)	20	6,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	1,320,000
Recruiting 1 entomologist, 1 epidemiologist, 1 medical officer, and 1 statistician at the federal level	3	6,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	198,000
Strengthen district offices by recruiting 3 staff members for each district (1 in vector control, 1 in case management, and 1 in social mobilization or information, education, and communication)	1,359	2,820	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	3,832,380	42,156,180
Subtotal for additional staff			3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	43,674,180
<i>Retaining existing malaria staff by paying a top-up salary</i>														
Top-up salary for medical officers (base salary \$2,091 per year)	1,280	7,909	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	10,123,520	111,358,720
Top-up salary for epidemiologists (base salary \$2,091 per year)	82	7,909	648,538	648,538	648,538	648,538	648,538	648,538	648,538	648,538	648,538	648,538	648,538	7,133,918
Top-up salary for entomologists (base salary \$2,091 per year)	20	7,909	158,180	158,180	158,180	158,180	158,180	158,180	158,180	158,180	158,180	158,180	158,180	1,739,980
Top-up salary for biologists (base salary \$2,091 per year)	28	4,909	137,452	137,452	137,452	137,452	137,452	137,452	137,452	137,452	137,452	137,452	137,452	1,511,972

(continued on next page)

Table A1.8
Institutional strengthening and human resource
capacity building in Ethiopia, 2005–15
Dollars
(continued)

Description	Quantity required	Cost per unit (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Top-up salary for health officers (base salary \$2,091 per year)	631	4,909	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	3,097,579	34,073,369
Top-up salary for nurses (base salary \$836 per year)	14,160	3,164	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	44,802,240	492,824,640
Top-up salary for environment health workers (base salary \$836 per year)	1,054	2,164	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	2,280,856	25,089,416
Top-up salary for malaria technicians (laboratory, entomology, operations) (base salary \$687 per year)	2,145	1,303	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	2,794,935	30,744,285
Subtotal for in-service top-up salary			64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	704,476,300
Total cost for institutional strengthening and human resource capacity building			95,471,980	83,793,510	83,693,510	83,693,510	83,693,510	71,953,510	71,893,510	71,793,510	71,793,510	71,793,510	71,793,510	861,367,080

Table A1.9
Operational research activities in Ethiopia, 2005–15
Dollars

Source: Center for National Health Development in Ethiopia 2004.

Description	Quantity required	Cost per unit (US\$)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Funding for epidemiological, entomological, and social-behavioral surveys	4	100,000	400,000				400,000						400,000	1,600,000
Developing guidelines for treatment, indoor residual spraying, insecticide-treated bednets, epidemics, environmental management, and community-based interventions	6	20,000	120,000					120,000						240,000
Monitoring antimalarial drug efficacy studies in 14 sentinel sites	14	5,000	70,000				70,000				70,000			210,000
Monitoring insecticide resistance in 4 sites	4	10,000	40,000				40,000				40,000			120,000
Knowledge, attitude, and practices survey on health extension programs in 5 sites	5	20,000	100,000			100,000			100,000				100,000	400,000
Evaluating outcome of planned activities in 10 regions	10	20,000	200,000					200,000					200,000	600,000
Impact assessment in 10 regions	10	20,000						200,000					200,000	400,000
Total cost for operational research activities			930,000			100,000	510,000	520,000	100,000		510,000		900,000	3,570,000

Table A1.11
Summary costs of malaria prevention and control in Ethiopia, 2005–15
Dollars

Source: Center for National Health Development in Ethiopia 2004.

Category	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total costs
Management of uncomplicated malaria	16,708,703	15,468,132	14,131,939	12,392,669	11,172,687	9,548,484	8,842,851	8,166,864	7,353,240	6,485,558	5,561,366	115,832,493
Treatment of <i>P. falciparum</i> malaria	15,752,250	14,582,693	13,322,988	11,683,279	10,533,131	9,001,902	8,336,662	7,693,370	6,932,320	6,114,307	5,243,018	109,201,920
Treatment of <i>P. vivax</i> malaria	956,452	885,439	808,951	709,391	639,556	546,582	506,189	467,494	420,920	371,251	318,348	6,630,573
Management of severe malaria	9,601,152	8,888,295	8,120,492	7,121,073	6,420,047	5,486,748	5,081,277	4,692,842	4,225,318	3,726,730	3,195,671	66,559,645
Intermittent preventive treatment of malaria during pregnancy	8,800	9,064	9,336	9,616	9,904	10,202	10,508	10,823	11,148	11,482	11,826	112,709
Laboratory equipment and reagents (diagnosis)	22,111,375	17,555,272	16,038,784	14,064,832	12,680,235	10,836,876	10,036,031	9,268,832	8,345,425	7,360,665	6,311,770	134,610,097
Antimalarial drug policy change and follow-up	565,000	250,000	250,000	450,000	250,000	250,000	450,000	250,000	250,000	450,000	250,000	3,665,000
Vector control (prevention)	137,462,888	92,010,866	85,973,148	99,736,191	98,589,810	79,881,116	87,222,932	84,054,198	80,123,343	93,860,627	90,449,402	1,029,364,520
Insecticide-treated bednets	29,361,302	21,726,049	14,630,000	28,306,958	25,130,000	18,056,889	30,381,203	25,516,032	20,274,527	32,663,153	27,864,159	273,910,272
Insecticide and spray pumps	47,414,673	23,227,218	23,873,364	23,925,921	25,165,654	32,017,108	26,557,160	27,592,889	28,393,083	29,216,482	30,063,760	317,447,313
Human power (indoor residual spraying)	10,771,551	11,079,516	11,387,480	11,412,530	12,003,409	12,309,900	12,666,627	13,160,274	13,541,661	13,934,108	14,337,936	136,604,993
Field equipment	49,667,261	35,729,983	35,834,204	35,842,681	36,042,647	17,249,119	17,369,843	17,536,903	17,665,972	17,798,784	17,935,447	298,672,843
Larviciding and environmental management	248,100	248,100	248,100	248,100	248,100	248,100	248,100	248,100	248,100	248,100	248,100	2,729,100
Epidemic prevention and control	3,635,900	3,385,900	3,185,900	3,185,900	3,185,900	3,185,900	3,185,900	3,185,900	3,185,900	3,185,900	3,185,900	35,694,900
Advocacy, information, education, and communication; and behavioral change	614,000	614,000	614,000	614,000	614,000	614,000	614,000	614,000	614,000	614,000	614,000	6,754,000
Monitoring and evaluation	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	1,404,280	15,447,080
Institutional strengthening and human resource capacity building	95,471,980	83,793,510	83,693,510	83,693,510	83,693,510	71,953,510	71,893,510	71,793,510	71,793,510	71,793,510	71,793,510	861,367,080
Institutional strengthening	1,700,000	1,030,000	930,000	930,000	930,000	1,030,000	1,030,000	930,000	930,000	930,000	930,000	11,300,000
Health extension program	25,200,000	14,700,000	14,700,000	14,700,000	14,700,000	2,800,000	2,800,000	2,800,000	2,800,000	2,800,000	2,800,000	100,800,000
Refresher training for health workers	558,300	49,830	49,830	49,830	49,830	109,830	49,830	49,830	49,830	49,830	49,830	1,116,600
Capacity building by recruiting additional staff	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	3,970,380	43,674,180
Retaining malaria staff by topping up salary	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	64,043,300	704,476,300
Operational research activities	930,000			100,000	510,000	520,000	100,000		510,000		900,000	3,570,000
Program management	77,234,500	43,501,500	43,501,500	43,501,500	43,501,500	20,650,800	13,855,800	13,855,800	13,855,800	13,855,800	13,855,800	341,170,300
District level	75,624,500	42,918,500	42,918,500	42,918,500	42,918,500	20,067,800	13,272,800	13,272,800	13,272,800	13,272,800	13,272,800	333,730,300
Regional level	1,450,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	6,650,000
National level	160,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	790,000
Total cost	365,748,578	266,880,819	256,922,889	266,273,571	262,031,874	204,341,915	202,697,089	197,297,049	191,671,963	202,748,552	197,533,526	2,614,147,824

Table A1.12
Underlying assumptions for calculating requirements for malaria prevention and control in Ethiopia (organized by table)

Source: Center for National Health Development in Ethiopia 2004.

Description	Assumption	Unit or value
Administrative divisions	11 regional states and 606 districts	
Malarious districts	453 out of 606 (74.5 percent)	
<i>Underlying assumptions for table A1.1—Population</i>		
Population	Taken from projection based on 1994 census, starting in 2004	71,133,749
Population at risk for malaria	68 percent of the total population starting in 2004	48,370,949
Objective of malaria control in Ethiopia	Reduce malaria burden by half by 2010 and by a further 50 percent by 2015	
Population growth	3 percent per year	
Population by age and weight category	Age	
5–<10 kg (1.9 percent)	0–<1 year	
10–<15 kg (6.8 percent)	1–<3 years	
15–<25 kg (16 percent)	3–<10 years	
25–<34 kg (8.3 percent)	10–<15 years	
≥34 kg (67 percent)	≥15 years	
<i>Underlying assumptions for table A1.2—Number of fever episodes and malaria cases</i>		
Number of fever episodes per year per person by age category		
5–<10 kg (1.9 percent)	2 episodes	
10–<15 kg (6.8 percent)	2 episodes	
15–<25 kg (16 percent)	1.5 episodes	
25–<34 kg (8.3 percent)	1 episodes	
≥34 kg (67 percent)	0.3 episodes	
Total number of fever episodes per year in the population at risk	30 percent of all population at risk	
Proportion of fever episodes attributable to malaria	40 percent of all febrile episodes	
Proportion of <i>P. falciparum</i> malaria	70 percent of all malaria cases	
Proportion of <i>P. vivax</i> malaria	30 percent of all malaria cases	
Yearly reduction of fever morbidity as malaria treatment and prevention improves	10 percent less of the population at risk during the preceding year plus the added population at risk in that year	
<i>Underlying assumptions for table A1.3—Antimalarial drugs and case management</i>		
Unit price for full treatment doses of artemether-lumefantrine per case of uncomplicated <i>P. falciparum</i> malaria by age and weight		
5–<10 kg (1.9 percent)	6 tablets/case	\$0.90 per case
10–<15 kg (6.8 percent)	6 tablets/case	\$0.90 per case
15–<25 kg (16 percent)	12 tablets/case	\$1.40 per case
25–<34 kg (8.3 percent)	18 tablets/case	\$1.90 per case
≥34 kg (67 percent)	24 tablets/case	\$2.40 per case

(continued on next page)

Table A1.12	Description	Assumption	Unit or value
Underlying assumptions for calculating requirements for malaria prevention and control in Ethiopia (organized by table) <i>(continued)</i>	Unit price for full treatment doses of chloroquine per case of uncomplicated <i>P. vivax</i> malaria by age and weight		
	5–<10 kg (1.9 percent)	4 tablets/case	\$0.036/case
	10–<15 kg (6.8 percent)	4 tablets/case	\$0.036/case
	15–<25 kg (16 percent)	8 tablets/case	\$0.072/case
	25–<34 kg (8.3 percent)	10 tablets/case	\$0.090/case
	≥34 kg (67 percent)	10 tablets/case	\$0.090/case
	Unit cost of chloroquine syrup for treatment of <i>P. vivax</i> malaria cases under age five (17 percent of all <i>vivax</i> malaria cases)	32.5 ml/case	\$0.05/case
	Unit cost of premaquine for radical treatment of <i>P. vivax</i> malaria cases over age five (83 percent of all <i>vivax</i> malaria cases)	14 tablets/case (1 tablet/day for 14 days)	\$0.182/case
	Percentage of severe malaria cases	3 percent of <i>P. falciparum</i> cases	
	<i>Underlying assumptions for table A1.4—Treatment for severe malaria</i>		
Unit cost per full treatment of severe malaria case using quinine 300 mg base (6 ampules per day for 3 days)	Box of 100 ampules (\$13) 18 ampules/case	\$2.34/case	
Unit cost of follow-up treatment for severe malaria case using quinine 300 mg tablets (3 tablets per day for 7 days)	Tin of 1,000 tablets (\$30) 21 ampules/case	\$0.63/case	
Cost of hospitalization for severe malaria		\$30/case	
<i>Underlying assumptions for table A1.5—Intermittent preventive treatment of malaria</i>			
Total female population in high-transmission area (this changes every year proportional to population growth, that is, by 3 percent)	2,500,000 in 2005		
Proportion of women at childbearing age in stable (high) transmission areas	44 percent		
Percent of pregnant women to receive two doses of intermittent preventive treatment with sulphadoxine-pyrimethamine	5 percent		
Percentage of those pregnant who may be HIV positive to receive a monthly dose of sulphadoxine-pyrimethamine	5 percent		
<i>Underlying assumptions for table A1.5—Diagnosis</i>			
Proportion of cases to be diagnosed at health services with laboratory facilities	30 percent of cases	\$0.40/case diagnosed	
Microscopes provided to hospitals and district health centers	3 microscopes/district	\$2,120/microscope	
Rapid diagnostic tests to be used at peripheral health facilities where there is no microscopy and at the community level	70 percent of clinical episodes	\$0.61/rapid diagnostic test kit	

Table A1.12
Underlying assumptions for calculating requirements for malaria prevention and control in Ethiopia (organized by table)
(continued)

Description	Assumption	Unit or value
<i>Underlying assumptions for table A1.6—Long-lasting insecticidal bednets</i>		
Long-lasting insecticidal bednets		\$5/net
Cost of handling and distribution of long-lasting insecticidal bednets		\$2/net
All future bednets will be long-lasting insecticidal bednets		
Target to scale up insecticide-treated bednets	Increase from a target of 45 percent coverage with insecticide-treated bednets in 2005 to 100 percent coverage by 2007 and maintain 100 percent coverage until 2015 for all people living in malarious areas	
At-risk population eligible for insecticide-treated bednets	30 percent of at-risk population	
Coverage for following year	Those without insecticide-treated bednets in preceding year plus new population at risk added because of population growth	
Total number of households	Total population at risk divided by 5	
Long-lasting insecticidal bednets per household	3 long-lasting insecticidal bednets per household	
Frequency of replacement of long-lasting insecticide-treated bednets	Replacement every four years (bednets distributed in 2004 will be replaced by 2008, bednets of 2005 will be replaced by 2009, and so on)	
<i>Underlying assumptions for table A1.6—Indoor residual spraying and larviciding</i>		
Total price of insecticide		\$5/kg of insecticide
Cost of indoor residual spraying is fully covered by the government; however, because of financial constraints, coverage with indoor residual spraying is limited to only about 25 percent of epidemic-prone areas		
At-risk population protected by indoor residual spraying	60 percent of at-risk population	
Number of households to be sprayed	Total population at risk eligible for indoor residual spraying, divided by 5	
Sprayable surface area per household	About 120 m ² on average	
Amount of insecticide (DDT) required	Total surface area to be sprayed multiplied by required standard dosage of 2.67 gm/m ² with 10 percent safety margins	
Indoor residual spraying cycle	30 working days/year	
One spray person sprays 360 units in one cycle	At 12 unit structures/day	
Total spray persons needed	Total number of unit structures targeted to be sprayed divided by an output of one spray person (12 unit structures per person per day x 30 working days)	
Total spray days	46 days (30 working days + 10 market and Sundays + 6 training days)	

Table A1.12	Description	Assumption	Unit or value
Underlying assumptions for calculating requirements for malaria prevention and control in Ethiopia (organized by table) <i>(continued)</i>	Personnel	5-person squads of spray people	
	One spray team	5 squads per team	
	Field equipment such as tents and fly tents	One tent for each squad, team leader, and supervisor and multiplied by total number of squads, teams, and supervisors	
	Safety protection materials such as coveralls, huts, hand gloves, goggles, buckets, soap, and so on, calculated for each spray person, squad chief, team leader, and supervisor		
<i>Underlying assumptions for table A1.8—Health extension package and refresher training of existing health workers</i>			
	A total of 30,000 health extension workers will receive training for 8 days on malaria prevention and control through 2009; thereafter, through 2015, an estimated 1,000 health extension workers will be trained each year		\$10/day
	A total of 150,000 community health workers and community health promoters will receive training for 8 days on malaria prevention and control through 2009; thereafter, through 2015, an estimated 5,000 community health workers and community health promoters will be trained each year		\$10/day
	Provision of one motorcycle to each health extension worker is assumed through 2009; thereafter, a replacement for 25 percent of the motorcycles is assumed through 2015.		\$5,000/ motorcycle
	Health extension workers, community health workers, and community health promoters are first-level service providers at community level		
	Two health extension workers, 5 community health workers, and 5 community health promoters would be assigned for a village of 5,000 people		
<i>Underlying assumptions for table A1.10—Program management</i>			
	Two trucks and three pickups per district are required to transport spray equipment, insecticide supervisory personnel, and so on		
	15 percent spare parts and maintenance and 25 percent replenishment is considered every 5 years		

Notes

Chapter 1

1. Transmitted from person to person through the bite of a female *Anopheles* mosquito, malaria is an infection of red blood cells in human populations caused by protozoa of the genus *Plasmodium*. Four species of *Plasmodium* infect humans: *Plasmodium falciparum*, *P. vivax*, *P. malariae*, and *P. ovale*. Of these four species, *P. falciparum* infection is the main cause of mortality from malaria throughout the tropics and subtropics, especially in tropical Africa (Snow and Gilles 2002). Only about 10–20 percent of the world's cases of *P. vivax* infection occur in Africa, south of the Sahara, with significantly low incidences across the central belt of this continent due to the Duffy negative trait (Mendis and others 2001).

2. The other founding partners of Roll Back Malaria include the World Bank, the United Nations Children's Fund, and the United Nations Development Programme. Since its inception, more than 90 multilateral, bilateral, nongovernmental, and private sector organizations have become actively engaged with the initiative.

3. All dollar amounts are U.S. dollars unless otherwise indicated.

Chapter 2

1. Trape and his colleagues (1998) reported that the emergence and development of chloroquine resistance resulted in a 2.1- to 5.5-fold increase in mortality risk among children 0–9 years old in several populations in the Sahel.

Chapter 4

1. HRP2 is a water soluble protein produced by asexual stages and young gametocytes of *P. falciparum*.

2. pLDH is a soluble glycolytic enzyme produced by sexual and asexual states of all four *Plasmodium* parasites infecting humans.

Chapter 5

1. See www.INDEPTH-Network.net for full inventory of sites.

Chapter 7

1. See www.transparency.org/ for further information.
2. For further details on the Equator Principles see www.equator-principles.com/.
3. These are available at www.theglobalfund.org/.

Chapter 8

1. See www.measuredhs.com for further information.
2. See www.childinfo.org for further information.

Chapter 9

1. See www.ipti-malaria.org for further information.
2. *Sporozoite* is the parasite stage that is transmitted from mosquitoes to people.
3. *Merozoite* is the parasite stage that is initially released from the infected liver cell and rapidly invades and replicates in circulating red blood cells.

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