

Supplementary Information

Supplementary Table 1. Projected additional clinical malaria cases between 1 May 2020 and 30 April 2021 for different COVID-19 scenarios in malaria endemic countries in sub-Saharan Africa. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention with amodiaquine plus sulfadoxine-pyrimethamine covering 70% of children 3–59 months of age (under 10 years in Senegal), in SMC target areas in the Sahel and, Treatment = treatment of clinical cases. The proportion of clinical cases treated varies geographically (see Methods). LLINs are only disrupted in regions where they were previously planned. Care should be taken when directly comparing the relative impact of different malaria interventions as they vary in their period of disruption (other than in the suppression scenario). Values are shown as the point estimate and 95% uncertainty interval (95% UI) rounded to the nearest million.

Malaria scenario				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
				Additional clinical malaria cases ('000,000) (95% UI)			
				(compared to a baseline estimate of 258.6 million (95% UI 195.5–321.7 million) cases in this period without malaria service interruption)			
No.	LLINs	SMC	Treatment				
1				154 (122–187)	206 (157–254)	239 (182–295)	206 (158–255)
2				151 (120–181)	184 (147–222)	214 (173–256)	184 (147–222)
3				8 (5–10)	33 (19–46)	61 (41–82)	33 (20–47)
4				10 (7–14)	46 (25–68)	79 (46–112)	47 (25–69)
5				14 (10–17)	39 (25–53)	58 (39–77)	39 (25–53)
6				147 (116–178)	197 (151–244)	250 (190–309)	198 (151–245)
7				5 (2–7)	39 (19–60)	78 (44–111)	40 (19–61)
8				16 (11–21)	54 (30–77)	87 (52–121)	54 (31–78)
9				151 (118–184)	220 (160–281)	292 (209–376)	222 (161–283)
10				143 (112–175)	211 (153–269)	283 (202–364)	212 (153–271)
11				155 (121–188)	224 (163–286)	289 (207–371)	226 (164–288)

Supplementary Table 2. Projected COVID-19 and additional malaria life-years lost between 1 May 2020 and 30 April 2021 for different COVID-19 scenarios in malaria endemic countries in sub-Saharan Africa.

Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention in SMC target areas in the Sahel and, Treatment = treatment of clinical cases. LLINs are only disrupted in regions where they were previously planned. The point estimate of deaths due to COVID-19 is from the assumption of an R_0 of 3.0, with ranges in brackets for an R_0 of 2.5 and 3.5. Values are shown as the point estimate and 95% uncertainty interval (95% UI) rounded to the nearest million.

				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
COVID-19 life-years lost ('000,000)				123 (99–140)	93 (88–120)	10 (9–12)	123 (99–140)
Malaria scenario				Additional malaria life-years lost ('000,000) (95% UI)			
No.	LLINs	SMC	Treatment	(compared to a baseline estimate of 20.4 million (95% UI 11.6–29.2 million) life-years lost in this period without malaria service interruption)			
1				12 (7–16)	19 (11–26)	23 (14–31)	19 (11–26)
2				11 (7–15)	14 (9–19)	16 (10–22)	14 (9–19)
3				1 (0.8–2)	5 (3–8)	10 (6–14)	5 (3–8)
4				2 (1–3)	9 (5–13)	15 (9–22)	9 (5–13)
5				2 (1–3)	6 (4–9)	9 (6–13)	6 (4–9)
6				11 (7–15)	18 (11–24)	24 (15–34)	18 (11–24)
7				1 (0.7–2)	8 (4–11)	15 (9–21)	8 (4–11)
8				3 (2–4)	10 (6–14)	16 (10–23)	10 (6–14)
9				12 (7–16)	22 (14–31)	34 (21–47)	23 (14–32)
10				11 (6–15)	21 (13–30)	33 (20–45)	21 (13–30)
11				12 (8–17)	24 (14–33)	34 (21–47)	24 (14–33)

Supplementary Table 3. Projected additional deaths due to malaria in Nigeria between May 2020 and April 2021 for different COVID-19 scenarios. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention in SMC target areas in Northern Nigeria. Treatment = treatment of clinical cases. LLINs and SMC campaigns are only disrupted in states where they were previously planned. Disruptions to malaria interventions last for different time periods depending on the COVID-19 scenarios as noted in Figure 1. Values are shown as the point estimate and 95% uncertainty interval (95% UI) based on 20 parameter draws, rounded to the nearest thousand.

Malaria scenario				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
				Additional malaria deaths in Nigeria ('000) (95% UI)			
				(compared to a baseline estimate of 117 (95% UI 60–174) thousand deaths in Nigeria in this period without malaria service interruption)			
No.	LLINs	SMC	Treatment	48 (26–70)	81 (44–119)	95 (51–138)	82 (45–120)
1				40 (22–58)	40 (22–58)	40 (22–58)	40 (22–58)
2				9 (5–13)	34 (18–50)	42 (22–62)	34 (18–50)
3				17 (9–25)	71 (36–106)	89 (46–132)	72 (37–107)
4				11 (6–17)	37 (19–54)	45 (24–67)	37 (19–55)
5				45 (24–66)	77 (41–112)	90 (49–131)	77 (42–113)
6				15 (8–22)	67 (34–100)	84 (44–125)	68 (35–100)
7				19 (10–29)	76 (39–113)	93 (48–139)	76 (39–113)
8				54 (29–79)	125 (66–183)	153 (82–223)	126 (67–184)
9				51 (27–74)	118 (63–174)	146 (78–214)	120 (64–175)
10				57 (31–83)	131 (70–192)	159 (86–233)	132 (71–193)
11							

Supplementary Table 4. Projected case fatality ratio of malaria and the percentage of clinical cases receiving treatment between 1 May 2020 and 30 April 2021 for different COVID-19 scenarios in malaria endemic countries in sub-Saharan Africa. Values in brackets indicate % of clinical cases treated over the year. There is a negative association between percentage of cases treated and case fatality ratios (deaths per clinical case of malaria). Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention with amodiaquine plus sulfadoxine-pyrimethamine covering 70% of children 3–59 months of age (under 10 years in Senegal), in SMC target areas in the Sahel and, Treatment = treatment of clinical cases.

				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
Malaria scenario				Case fatality ratio (deaths per clinical case, %)			
No.	LLINs	SMC	Treatment	(value in brackets indicates the % of clinical cases receiving treatment over the year)			
1				0.16 (44)	0.17 (34)	0.18 (24)	0.17 (34)
2				0.16 (47)	0.16 (46)	0.16 (47)	0.16 (46)
3				0.17 (44)	0.18 (33)	0.19 (24)	0.18 (33)
4				0.17 (42)	0.20 (20)	0.22 (0)	0.20 (19)
5				0.17 (44)	0.19 (33)	0.19 (24)	0.19 (33)
6				0.16 (45)	0.17 (34)	0.18 (24)	0.17 (34)
7				0.17 (42)	0.20 (21)	0.22 (0)	0.20 (20)
8				0.17 (41)	0.20 (20)	0.22 (0)	0.20 (19)
9				0.16 (42)	0.18 (22)	0.20 (0)	0.18 (21)
10				0.16 (42)	0.18 (23)	0.20 (0)	0.18 (21)
11				0.16 (42)	0.19 (21)	0.20 (0)	0.19 (20)

Supplementary Table 5. Projected additional malaria deaths between 1 May 2020 and 30 April 2021 for different COVID-19 scenarios in malaria endemic administrative units in sub-Saharan Africa that received seasonal malaria chemoprevention (SMC) in 2019. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention in SMC target areas in the Sahel and, Treatment = treatment of clinical cases. LLINs are only disrupted in regions where they were previously planned. Values are shown as the point estimate and 95% uncertainty interval (95% UI), rounded to the nearest thousand.

Malaria scenario				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
No.	LLINs	SMC	Treatment	Additional malaria deaths ('000) within SMC regions (95% UI) (compared to a baseline estimate of 87 (95% UI 46–127) deaths in this period without malaria service interruption)			
1				71 (42–100)	95 (56–135)	65 (39–91)	96 (56–135)
2				64 (38–91)	65 (39–92)	65 (40–91)	65 (39–92)
3				19 (10–27)	34 (19–50)	52 (30–74)	34 (19–50)
4				23 (13–34)	57 (30–83)	64 (36–92)	57 (30–84)
5				33 (19–47)	51 (28–74)	41 (23–58)	51 (28–74)
6				52 (31–74)	73 (42–104)	95 (57–134)	73 (42–104)
7				9 (5–13)	37 (19–54)	60 (33–86)	37 (20–54)
8				39 (22–56)	78 (42–114)	86 (48–123)	78 (42–114)
9				59 (34–83)	103 (59–148)	134 (80–189)	104 (59–148)
10				40 (23–56)	77 (44–110)	106 (63–150)	77 (44–110)
11				77 (45–109)	130 (74–185)	140 (83–197)	130 (75–185)

Supplementary Table 6. Projected additional malaria deaths in Nigeria between May 2020 and April 2021 for two periods of mitigated disruption: 6 months and 9 months (corresponding to a basic reproduction number for COVID-19 of 3 or 2.5, respectively). Illustrations of the different COVID-19 epidemics simulated are provided in Supplementary Figure 3. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention in SMC target areas in the Sahel and, Treatment = treatment of clinical cases. LLINs are only disrupted in regions where they were previously planned. Values are shown as the point estimate and 95% uncertainty interval (95% UI) based on 20 parameter draws, rounded to the nearest hundred.

Malaria scenario				COVID-19 scenario	
				Mitigation: 6 months	Mitigation: 9 months
				Additional malaria deaths in Nigeria (95% UI) (compared to a baseline estimate of 116,800 (95% UI 59,600–174,000) deaths in Nigeria in this period without malaria service interruption)	
No.	LLINs	SMC	Treatment		
1				81,400 (44,400–118,500)	91,700 (49,900–133,500)
2				40,100 (21,800–58,400)	39,900 (21,700–58,100)
3				33,800 (17,700–49,900)	39,900 (20,900–58,900)
4				71,300 (36,500–106,100)	85,100 (43,600–126,600)
5				36,900 (19,300–54,500)	43,200 (22,600–63,800)
6				76,900 (41,500–112,300)	86,800 (46,900–126,700)
7				67,100 (34,500–99,800)	80,000 (41,100–118,900)
8				75,700 (38,800–112,600)	89,600 (45,900–133,300)
9				124,600 (66,500–182,600)	147,000 (78,500–215,500)
10				118,400 (63,200–173,700)	140,800 (75,200–206,400)
11				130,900 (70,200–191,600)	153,900 (82,500–225,300)

Supplementary Table 7. Modelled impact of extending the age range of children targeted in seasonal malaria chemoprevention (SMC) campaigns on additional malaria deaths due to COVID-19 in regions that received SMC in 2019. Values give the number of deaths between 1 May 2020 and 30 April 2021 and only COVID-19 mitigation and suppression scenarios are presented. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), continued as normal (dark green) or whether a new strategy is considered (gold). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, Treatment = treatment of clinical cases, SMC = seasonal malaria chemoprevention in SMC target areas in the Sahel. SMC campaigns are either targeted to children younger than five years (U5, except Senegal where the baseline is under 10 years) under 10 (U10) and under 15 (U15) years of age. All campaigns are for the normal duration and are adopted with 70% coverage. LLINs are only disrupted in regions where they were previously planned. Values are shown as the point estimate and 95% uncertainty interval (95% UI), rounded to the nearest hundred.

				COVID-19 scenario	
				Mitigation	Suppression
Malaria scenario				Additional malaria deaths within SMC regions (95% UI) (compared to a baseline estimate of 86,900 (95% UI 46,400–127,400) deaths in this period without malaria service interruption)	
No.	LLINs	SMC (70% coverage)	Treatment		
1		U5		76,900 (43,700–110,000)	106,500 (63,200–149,800)
2		U10		63,400 (36,100–90,800)	100,200 (59,500–141,000)
3		U15		54,400 (31,000–77,900)	94,600 (56,200–133,100)
4		U5		36,700 (19,400–54,100)	59,700 (33,500–86,000)
5		U10		26,500 (14,000–39,100)	54,400 (30,500–78,300)
6		U15		19,100 (10,100–28,100)	49,500 (27,700–71,300)

Supplementary Table 8. Modelled impact of extending the age range of children targeted in seasonal malaria chemoprevention (SMC) campaigns on additional malaria deaths due to COVID-19 in states of Nigeria where SMC has been implemented previously. Values give the number of deaths between 1 May 2020 and 30 April 2021 and only COVID-19 mitigation and suppression scenarios are presented. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), continued as normal (dark green) or whether a new strategy is considered (gold). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, Treatment = treatment of clinical cases. SMC campaigns are either targeted to children younger than five years (U5) under 10 (U10) and under 15 (U15) years of age. All campaigns are for the normal duration and are adopted with 70% coverage. LLINs are only disrupted in regions where they were previously planned. The variable impact across states is depicted in Supplementary Figure 5. Values are shown as the point estimate and 95% uncertainty interval (95% UI) based on 20 parameter draws, rounded to the nearest hundred.

				COVID-19 scenario	
				Mitigation	Suppression
Malaria scenario				Additional malaria deaths in Nigeria within SMC regions (95% UI)	
No.	LLINs	SMC (70% coverage)	Treatment	(compared to a baseline estimate of 34,300 (95% UI 17,500–51,100) deaths in Nigeria in this period without malaria service interruption)	
1		U5		38,000 (20,300–55,700)	42,400 (22,800–62,100)
2		U10		35,000 (18,700–51,300)	39,400 (21,100–57,600)
3		U15		32,900 (17,500–48,200)	37,100 (19,900–54,200)
4		U5		21,800 (11,200–32,300)	25,000 (13,000–36,900)
5		U10		19,800 (10,200–29,500)	22,800 (11,900–33,800)
6		U15		17,900 (9,200–26,600)	20,800 (10,800–30,800)

Supplementary Table 9. Modelled impact of supplemental mass drug administration (MDA) malaria campaigns to alleviate additional malaria deaths due to COVID-19, in regions that did not receive seasonal malaria chemoprevention (SMC) in 2019. Impact is shown as additional to the modelled deaths predicted for the same time period (May 2020–April 2021) in the absence of COVID-19 and only COVID-19 mitigation and suppression scenarios are presented. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), continued as normal (dark green) or whether a new strategy is considered (gold). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, Treatment = treatment of clinical cases, MDA = mass drug administration with amodiaquine plus sulfadoxine-pyrimethamine (AQ-SP). MDA campaigns are a single round either targeted to children younger than five years (U5) or people of all ages (All ages) and distributes the drug AQ-SP to 70% of the population. MDA is simulated to be implemented at the optimal time, prior to the transmission peak for each administration unit. LLINs are only disrupted in regions where they were previously planned. Values are shown as the point estimate and 95% uncertainty interval (95% UI) based on 20 parameter draws, rounded to the nearest hundred.

Malaria scenario				COVID-19 scenario	
				Mitigation	Suppression
				Additional malaria deaths outside SMC regions (95% UI) (compared to a baseline estimate of 335,100 (95% UI 178,900–491,300) deaths in this period without malaria service interruption)	
No.	LLINs	Treatment	MDA (70% coverage)		
1				351,800 (202,100–501,400)	555,600 (330,100–781,100)
2			U5	324,700 (186,600–462,800)	524,800 (311,800–737,800)
3			All ages	162,400 (93,300–231,500)	319,800 (190,000–449,600)
4				127,200 (68,300–186,100)	250,600 (140,500–360,700)
5			U5	101,900 (54,800–149,100)	223,000 (125,100–321,000)
6			All ages	–22,400 (–12,000–32,700)–	61,800 (34,700–89,000)

Supplementary Table 10. Modelled impact of supplemental mass drug administration (MDA) malaria campaigns to alleviate additional malaria deaths due to COVID-19, in regions that did not receive seasonal malaria chemoprevention (SMC) in 2019, in Nigeria, in states where SMC is not implemented. . Impact is shown as additional to the modelled deaths predicted for the same time period (May 2020–April 2021) in the absence of COVID-19 and only COVID-19 mitigation and suppression scenarios are presented. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), continued as normal (dark green) or whether a new strategy is considered (gold). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, Treatment = treatment of clinical cases, MDA = mass drug administration with amodiaquine plus sulfadoxine-pyrimethamine (AQ-SP). MDA campaigns are a single round either targeted to children younger than five years (U5) or people of all ages (All ages) and distributes the drug AQ-SP to 70% of the population. MDA is simulated to be implemented at the optimal time, prior to the transmission peak for each administration unit. LLINs are only disrupted in regions where they were previously planned. Values are shown as the point estimate and 95% uncertainty interval (95% UI) based on 20 parameter draws, rounded to the nearest hundred. The variable impact across states is depicted in Supplementary Figure 5.

Malaria scenario				COVID-19 scenario	
				Mitigation	Suppression
No.	LLINs	Treatment	MDA (70% coverage)	Additional malaria deaths in Nigeria outside SMC regions (95% UI) (compared to a baseline estimate of 82,400 (95% UI 122,800–42,000) deaths in this period without malaria service interruption)	
1				80,500 (43,200–117,800)	103,800 (55,900–151,700)
2			U5	70,700 (37,900–103,600)	94,800 (51,100–138,600)
3			All ages	50,400 (27,000–73,700)	74,300 (40,000–108,600)
4				45,400 (23,200–67,500)	59,500 (30,800–88,200)
5			U5	38,000 (19,500–56,600)	52,800 (27,300–78,200)
6			All ages	23,100 (11,800–34,400)	37,300 (19,300–55,400)

Supplementary Table 11. The COVID-19 transmission model parameters and ranges used in the univariate and multivariate sensitivity analyses. In the univariate sensitivity analysis we take point estimates for all parameters and vary R_0 . In the multivariate sensitivity analysis we varied R_0 , social distancing, duration of hospitalisation parameters and all severity parameters. Uncertainty in the probability of requiring hospitalisation, and probability of requiring critical care given hospitalisation, and how these change with age were generated as in Verity et al (2020) ¹⁷ using samples from the joint posterior distribution of the infection fatality ratio by age in the presence of good access to care. Results of the uncertainty analysis are presented in Table 2 and Supplementary Figure 3.

Parameter varied	Point Estimate	Range	Reference
R_0	3	2.0–3.5	1-5,17,21
Probability of death if critical care required but not received	90.5%	85–95%	4
Probability of death if hospitalised with oxygen available	25%	20–30%	4
Probability of death if requiring hospitalisation with oxygen but not available	60%	50–70%	4
Probability of death if but without an available hospital bed	60%	50–70%	4
Mean Duration of Hospitalisation for non-critical cases if survive	9.5 days	66–150% of point estimate	4
Mean Duration of Hospitalisation for non-critical cases if die	7.6 days	66–150% of point estimate	4
Mean Duration in ICU if survive	11.3 days	66–150% of point estimate	4
Mean Duration in ICU if die	10.1 days	66–150% of point estimate	4
Mean Duration in Recovery after ICU	3.4 days	66–150% of point estimate	4
Reduction in contact rate following arrival of COVID-19 (and default value returned lifting of mitigation/suppression measures)	20%	10-30%	Assumed
Effectiveness of social distancing measures during the mitigation/suppression period (% reduction in contact rate)	0% (unmitigated) 45% (mitigation) 75% (suppression) 75% (suppression lift)	0% (unmitigated) 30–60% (mitigation) 60–90% (suppression) 60–90% (suppression lift)	Assumed
Period with which social distancing measures were in place (days)	0 (unmitigated) 180 (mitigated) 365 (suppression) 60 (suppression lift)	0 (unmitigated) 180–365 (mitigated) 365 (suppression) 60 (suppression lift)	Assumed

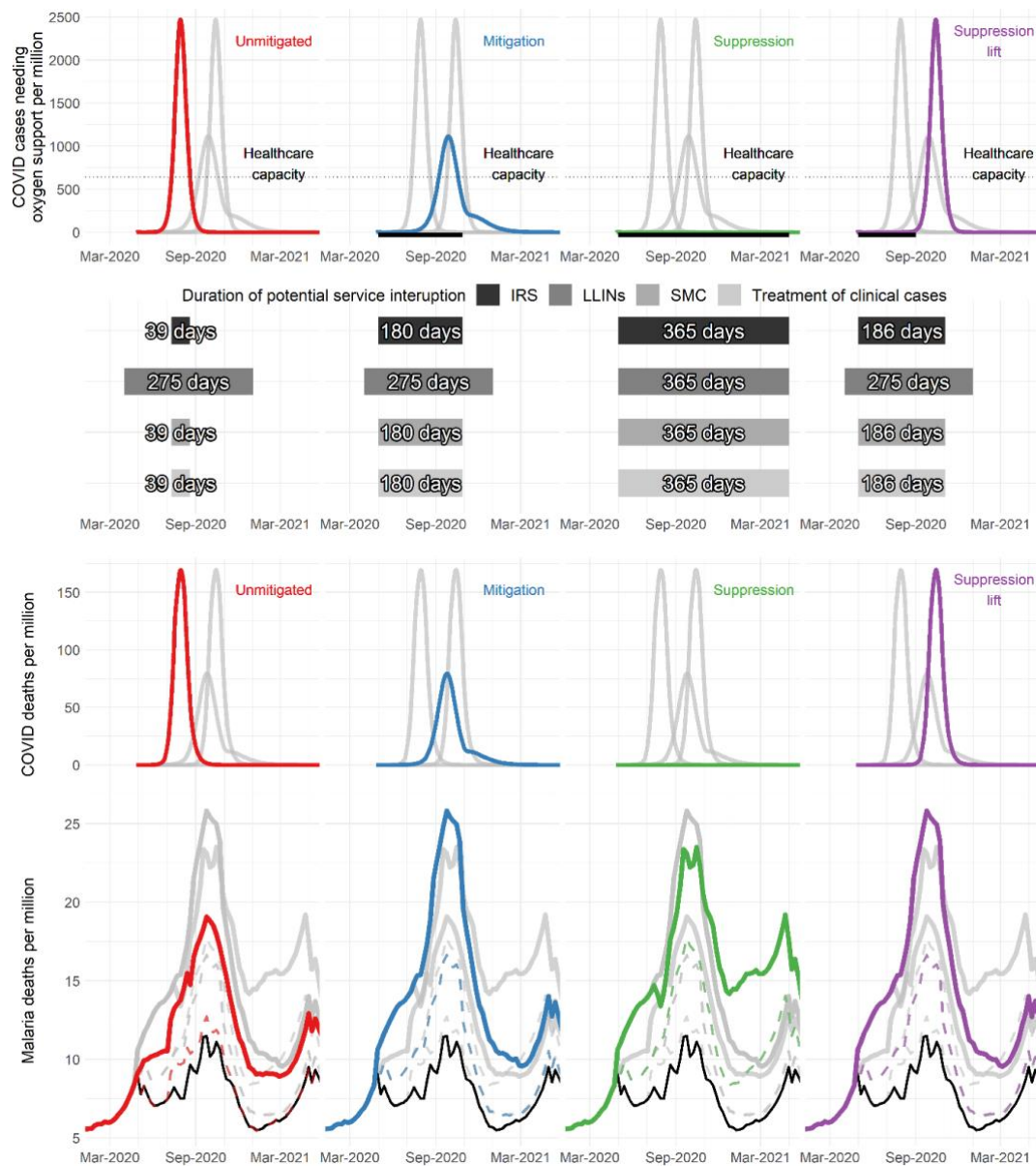
Supplementary Table 12. Results of the analysis of sensitivity of model outcome to assumptions about timing in the distribution of long-lasting insecticide treated nets (LLINs). The point estimate is the additional deaths due to malaria, using the best available information about the timing of LLIN distributions at the country level (and at the admin-1 level for Nigeria). For the country-level distributions, where information about planned campaigns was uncertain, we ran the model assuming that net campaigns occurred either in 2019 (the lower bound), or were planned for 2020 (the upper bound), and considered the range of impact for the malaria scenarios where LLIN distributions may be interrupted. The additional deaths are for the period May 2020 to April 2021 for different COVID-19 scenarios. Different combinations of malaria interventions are considered on each row, with the colour denoting whether they were halted for the period of health system interruption (red), reduced to 50% of the normal coverage level (light green) or continued as normal (dark green). LLINs = distribution of long-lasting insecticide treated nets in countries due for mass campaigns in 2020, SMC = seasonal malaria chemoprevention in SMC target areas. Treatment = treatment of clinical cases. LLINs and SMC campaigns are only disrupted in states where they were previously planned. Disruptions to malaria interventions last for different time periods depending on the COVID-19 scenarios as noted in Figure 1. Values rounded to the nearest thousand.

Malaria scenario				COVID-19 scenario			
				Unmitigated	Mitigation	Suppression	Suppression lift
				Additional malaria deaths ('000) (range)			
				(compared to a baseline estimate of 422 thousand deaths in this period without malaria service interruption)			
No.	LLINs	SMC	Treatment				
1				239 (166–498)	379 (298–709)	464 (362–824)	380 (299–712)
2				221 (145–470)	282 (184–553)	322 (208–604)	282 (184–553)
3				220 (150–471)	357 (278–677)	495 (376–862)	358 (279–680)
4				238 (172–500)	461 (403–847)	696 (577–1,165)	464 (406–853)
5				219 (156–473)	434 (378–808)	668 (551–1,125)	437 (381–814)
6				253 (189–519)	481 (428–873)	696 (590–1,164)	484 (431–878)

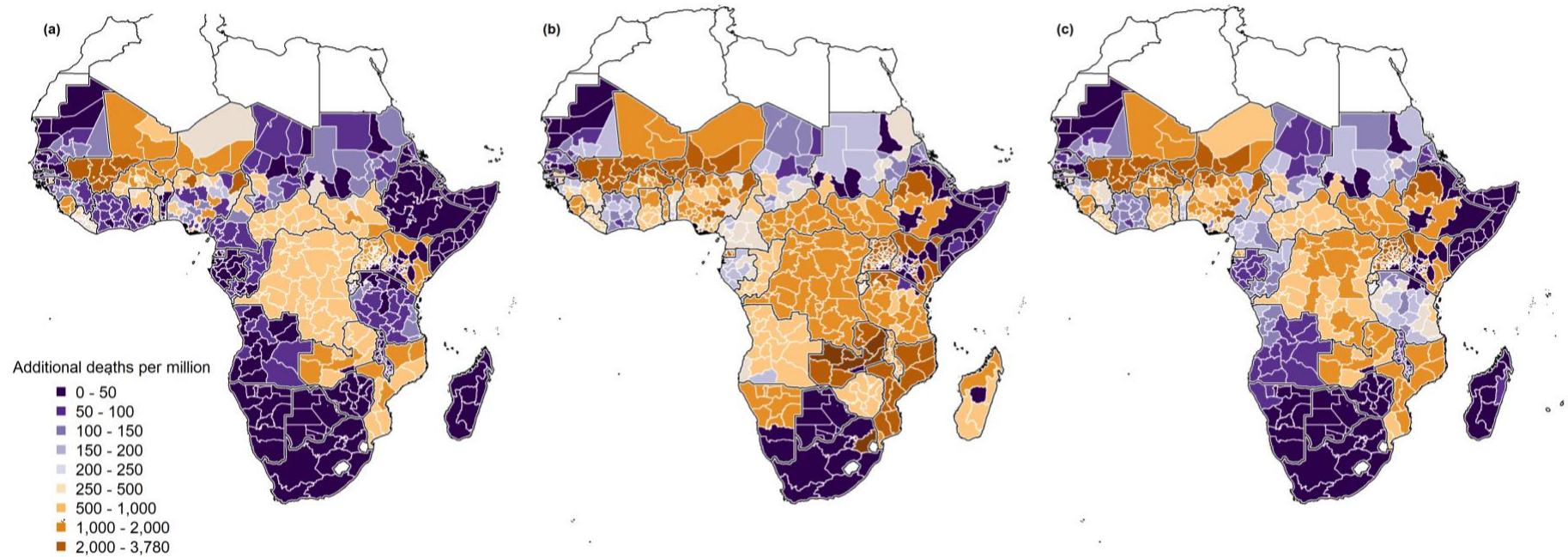
Supplementary Table 13. Summary of published studies reporting the proportion of fever in COVID-19 positive patients by age that were identified by the systematic review. The first column indicates the sample size of each study, whilst the second column reports how the group of people were identified, be it hospital case report, hospital admission, confirmed by a laboratory (came from a mixed cohort with no further details of grouping), contacts of a confirmed case or intensive care unit (ICU). The age class refers to whether those included were a neonate (<4 weeks old), a child (4 weeks < & < 18 years) or an adult (> 18 years). The age is the median age of the population examined, and the Proportion Reporting Fever is the proportion of those examined that displayed fever as a symptom.

Number of people	Description of Population	Age Class	Median Age	Proportion Reporting Fever	Reference
1	hospital case report	children	7.0	1.000	29
10	admitted to hospital	children	6.2	0.800	30
298	admitted to hospital	adults	47.0	0.644	31
291	laboratory confirmed	children	11.0	0.560	32
10944	laboratory confirmed	adults	41.0	0.710	32
1	family cluster	children	10.0	0.000	33
5	family cluster	adults	53.4	1.000	33
1	hospital case report	children	2.0	1.000	34
13	admitted to hospital	adults	34.0	0.923	34
175	admitted to hospital	adults	45.0	0.860	35
1	hospital case report	children	1.1	1.000	36
21	admitted to hospital	adults	56.3	1.000	37
99	admitted to hospital	adults	55.5	0.830	38
14	admitted to hospital	children	6.2	0.357	39
53	admitted to hospital	adults	41.5	0.604	39
15	admitted to hospital	children	9.0	0.333	40
1099	laboratory confirmed	adults	47.0	0.879	41
41	admitted to hospital	adults	49.0	0.980	42
6	admitted to hospital	children	7.0	0.500	43
1	hospital case report	children	0.5	0.000	44
1	hospital case report	neonate	0.0	1.000	45
22	admitted to hospital	children	8.0	0.640	46
5	admitted to hospital	children	3.0	0.200	47
40	admitted to hospital	adults	48.7	0.900	48
6	admitted to hospital	children	3.0	1.000	49
109	admitted to hospital	adults	55.0	0.826	50
171	contacts	children	6.7	0.415	51
115	admitted to hospital	children	7.4	0.252	52
10	admitted to hospital	children	2.5	0.300	53
26	admitted to hospital	children	10.5	0.380	53
1	admitted to hospital	adults	65.0	1.000	54
1	admitted to hospital	adults	27.0	1.000	54
1	hospital case report	neonate	30.0		55
9	admitted to hospital	children	8.0	0.333	56
6	admitted to hospital	children	4.0	1.000	57
51	admitted to hospital	adults	49.0	0.960	58
9	admitted to hospital	children	4.5	0.222	59
14	admitted to hospital	adults	42.9	0.571	59
8	ICU cohort	children	6.8	0.750	60
13	admitted to hospital	children	7.9	0.462	61
10	admitted to hospital	children	7.0	0.308	62
1	family cluster	children	12.0	0.000	63
6	family cluster	adults	33.0	0.500	63
31	admitted to hospital	children	7.0	0.650	64
138	admitted to hospital	adults	56.0	0.986	65
1	hospital case report	children	8.0	1.000	66
9	admitted to hospital	children	0.5	0.444	67

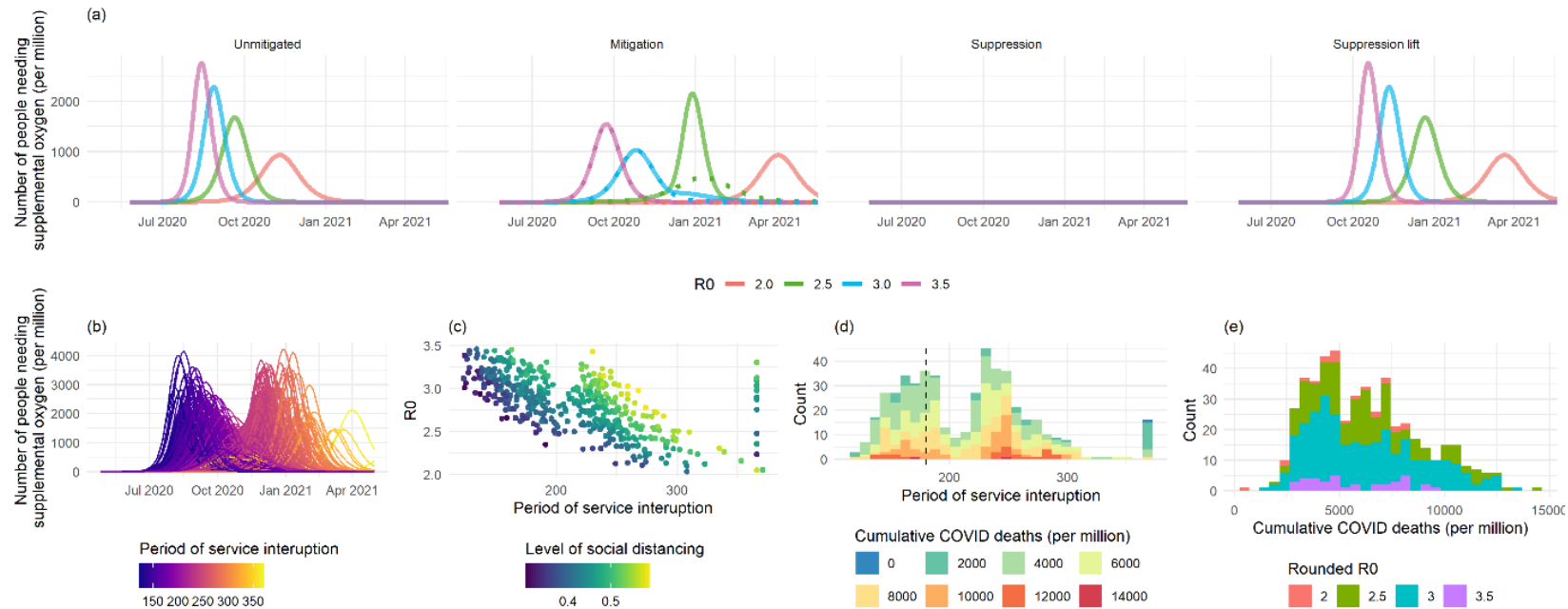
20	admitted to hospital	children	2.1	0.600	68
3	admitted to hospital	children	4.2	1.000	69
10	contacts	children	7.5	0.700	70
134	admitted to hospital	children	5.0	0.761	71
52	ICU cohort	adults	59.7	0.980	72
1	hospital case report	neonate	0.1	1.000	73
2	hospital case report	children	2.2	1.000	71
242	admitted to hospital	adults	57.0	0.917	74
1	hospital case report	children	15.0	1.000	75
8	admitted to hospital	adults	34.5	0.889	75
1	hospital case report	children	0.3	1.000	76
25	admitted to hospital	children	3.0	0.520	77
9	admitted to hospital	children	1.6	0.444	78



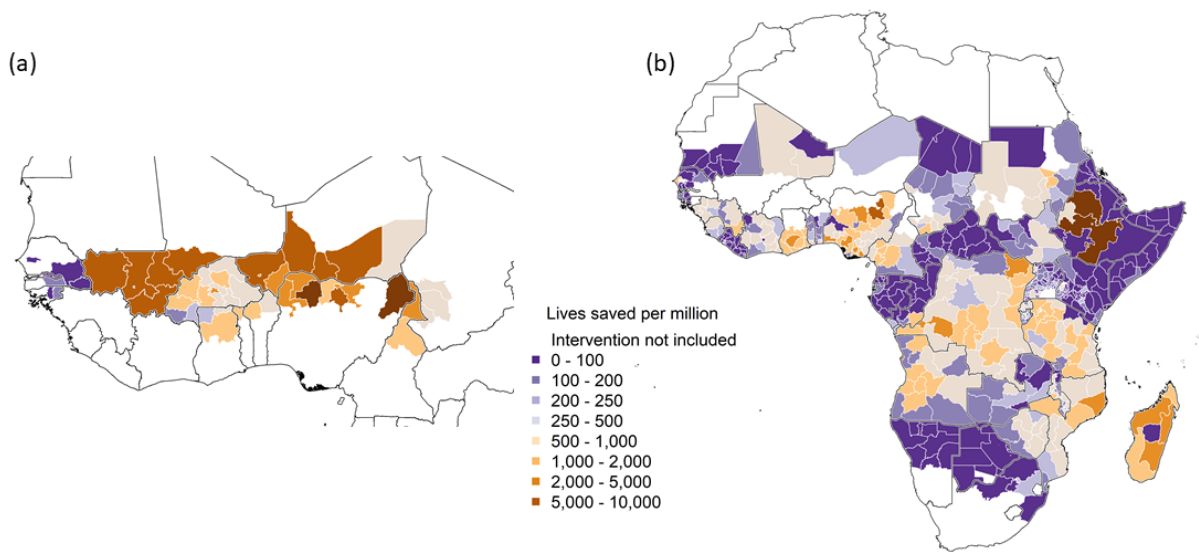
Supplementary Figure 1. Projected deaths due to COVID-19 and malaria in sub-Saharan Africa (SSA) over time for different COVID-19 scenarios. The top row shows the COVID-19 epidemic and the number of people needing oxygen support per week for four different COVID-19 scenarios – an unmitigated epidemic (red), mitigation (blue), continued suppression (green), and suppression lift (purple). The thin dotted horizontal grey line indicates estimated healthcare capacity for a typical African country. The thick black horizontal line beneath each figure shows the period when COVID-19 mitigation or suppression activities are assumed in operation. The upper middle row indicates the assumed duration of interruption where COVID-19 interventions affect different malaria prevention activities (IRS = indoor residual spraying, LLINs = mass distribution of long-lasting insecticide treated nets, SMC = seasonal malaria chemoprevention) or case management of clinical cases with the level of this disruption presented in Table 2. The lower middle row shows the predicted deaths due to COVID-19 per week in each scenario. The bottom row shows predicted malaria deaths per week for each scenario (coloured lines) and for the counter-factual with no COVID-19 induced disruption (black lines). The top coloured lines indicate a scenario when all services are reduced or cease (Table 2, row 1) whereas the bottom dashed coloured lines show the most well-managed scenario (Table 2, row 3). Grey lines in all rows show other scenarios to allow direct comparison.



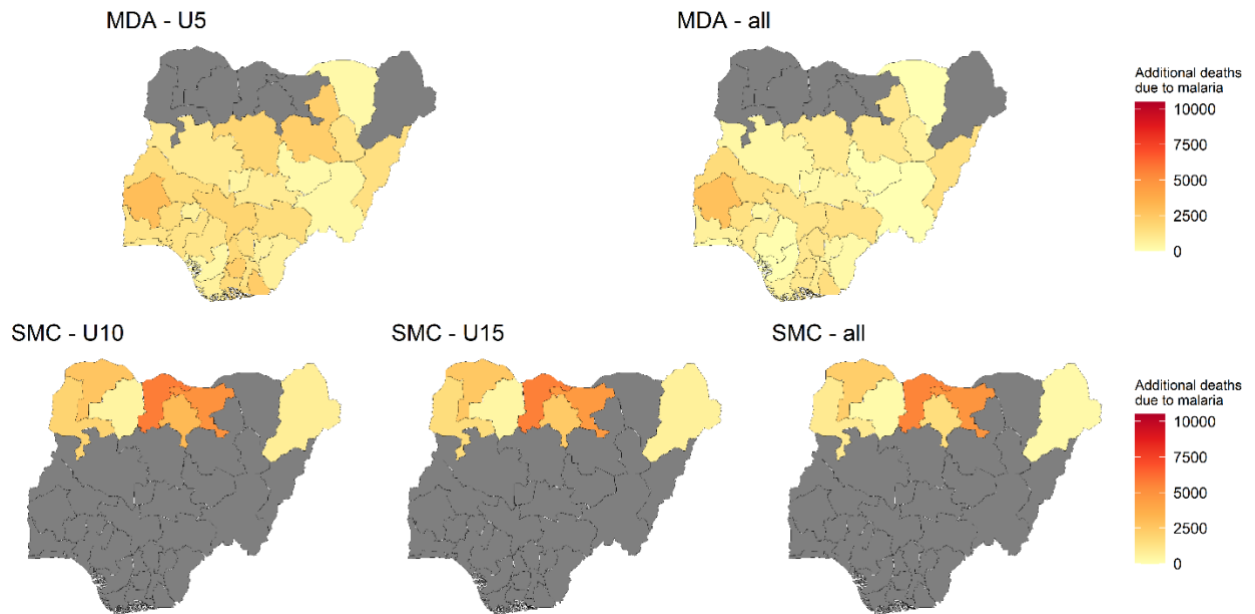
Supplementary Figure 2. Maps showing the impact of COVID-19 based interruption of malaria control activities for the (a) Unmitigated, (b) Suppression and (c) Suppression lift scenarios. As shown in Figure 2a for the COVID-19 mitigated scenario, estimated additional deaths per million people when all malaria interventions are ceased (long-lasting insecticide treated net distribution campaigns, seasonal malaria chemoprevention, and clinical treatment of cases) relative to normal service in the absence of COVID-19 for each administrative region. The different periods of service disruption are shown in Supplementary Figure 1. Maps illustrate how overall impact depend on the timing and duration of the period of service interruption and how this overlaps with malaria transmission seasons in different regions of Africa.



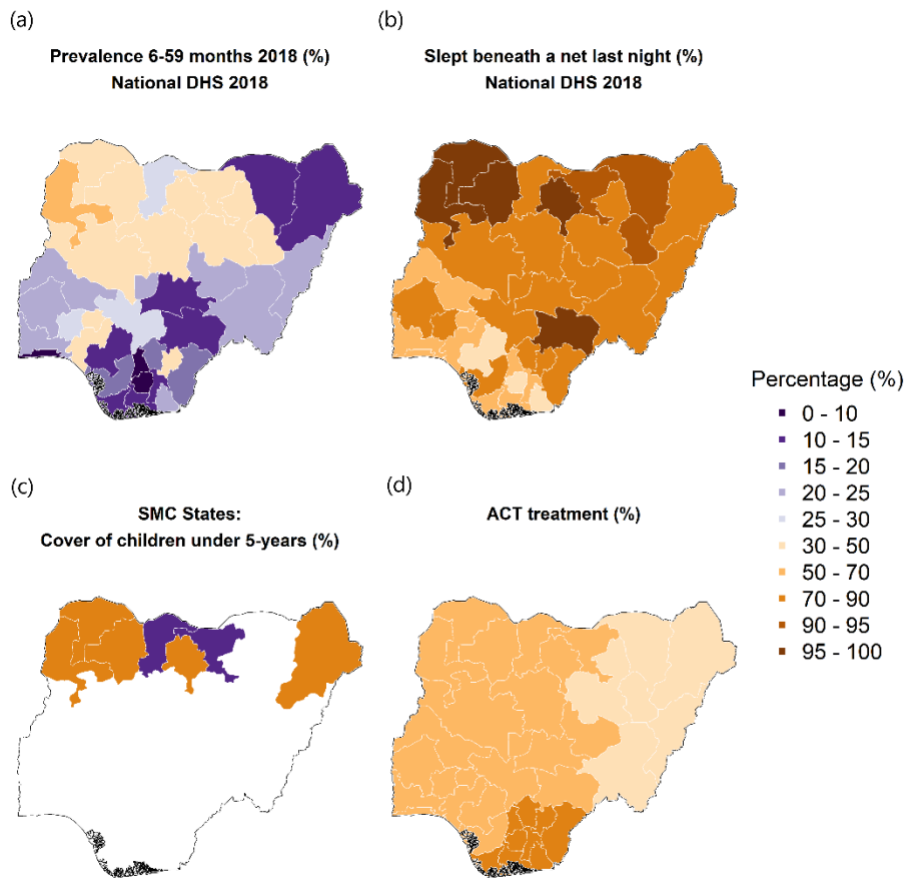
Supplementary Figure 3. Univariate and multivariate sensitivity analyses of the effect of model parameters on the magnitude and duration of COVID-19 epidemics in sub-Saharan Africa. (a) Univariate sensitivity analysis showing the differences in the number of people needing supplemental oxygen, and the duration of the epidemic for four values of R_0 (2–3.5) across the four COVID-19 intervention scenarios (using default parameters shown in Supplementary Table 11). Note that in the mitigation scenario a 6-month period of social distancing results in a rebound epidemic for R_0 values < 3.0. In this plot the dotted lines show the same runs with 12 months of social distancing measures which prevents the rebound epidemic. (b–e) Multivariate sensitivity analysis for the COVID-19 mitigation scenario using the range of parameters outlined in Supplementary Table 11. (b) Epidemic trajectories for the 500 different simulations showing the variability in the shape of the epidemic. Runs are coloured according to the potential period that malaria services might be interrupted which are estimated from the different individual epidemic curves. This period of service disruption starts from when mitigation measures are initiated and continues until the time healthcare capacity is no longer over-burdened. (c) the relationship between the assumed level of R_0 and level of social distancing during the mitigation period (% reduction in the contact rate) and the period of service interruption. Each point represents a single realisation of the 500 runs. Values where healthcare was still over capacity a year after the arrival of the epidemic are grouped at a year of service interruption. (d). A histogram showing period of potential service interruption for the 500 runs. Bar colour indicates the numbers of deaths due to COVID-19 for the different simulations and show a high number of COVID-19 deaths can occur with a short period of interruption (for example, from a high R_0) or from an epidemic that causes a longer period of disruption (for example, a low R_0 and a rebound epidemic once mitigation measures are relaxed). The period of service disruption used in the default mitigation scenario in the main paper analysis is shown with a vertical dashed line in panel (e). Histogram showing the distribution of the number of COVID-19 deaths from the 500 runs of the multivariate sensitivity analysis. This distribution of was used to generate 95% uncertainty interval estimates for COVID-19 mitigation scenario deaths in Table 1. Histogram colours show the R_0 values used in that simulation.



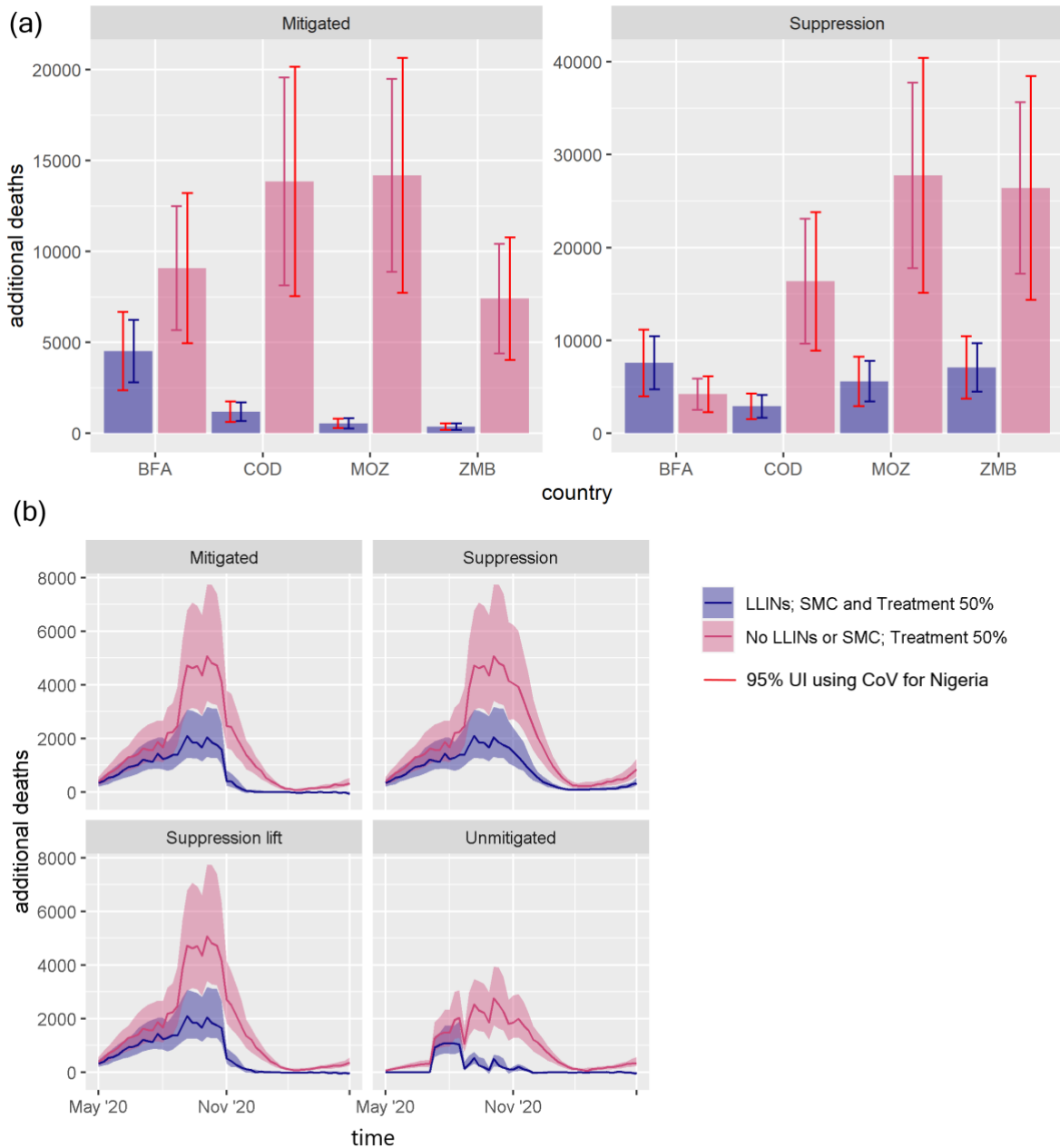
Supplementary Figure 4. Maps showing how the impact malaria mitigation strategies are predicted to vary across sub-Saharan Africa. (a) Expansion of existing seasonal malaria chemoprevention (SMC) in regions where it occurred in the Sahel where it was conducted in 2019. Colours denote additional lives saved by expanding the age of those eligible from under 5 years to under 15 years. (b) The predicted impact of mass drug administration (MDA) using a drug with a prophylactic profile of amodiaquine plus sulfadoxine-pyrimethamine for regions where SMC is not currently conducted. Both figures show scenarios where existing LLIN campaigns were maintained but routine treatment of clinical cases paused during the mitigated COVID-19 scenario.



Supplementary Figure 5. Sub-national impact of how interruption of malaria services due to a mitigation COVID-19 scenario will influence the numbers of malaria deaths in different states of Nigeria. The colour indicates the additional deaths predicted due to service interruption relative to normal service in the absence of COVID-19 for each state. Here the top row corresponds to the scenarios where net distribution is maintained and MDA is expanded, as per Supplementary Table 10, and the bottom row corresponds to scenarios where net distribution is maintained and seasonal malaria chemoprevention is expanded as per Supplementary Table 8. Grey areas denote states where this control intervention was not considered. Expansion of SMC was only evaluated in regions which undertook SMC in 2019 (bottom row) whilst MDA was considered in all other states (top row). All simulations assume that sufficient drugs are available.



Supplementary Figure 6. Nigeria-specific data inputs for the malaria model estimations. (a) Malaria prevalence by microscopy in children 6–59 months of age. (b) Percentage of children sleeping under an insecticidal net the previous night. (c) Estimates of seasonal malaria chemoprevention coverage calculated by dividing the number of doses administered by the proportion of the target age group. (d) Estimates of the percentage of child malaria cases receiving artemisinin combination therapy (ACT). Figures (a), (b) and (d) were estimated from Demographic and Health Surveys (DHS) data. All estimates were at the state level other than (d) which was presented at the regional level.



Supplementary Figure 7. Multivariate uncertainty analysis for the malaria transmission model. The true model uncertainty was quantified by calculating the additional clinical malaria cases, malaria deaths, and years of life lost due to malaria, using an additional 20 draws from the joint posterior distribution of the fitted model parameters. These simulations were performed for all 37 administrative 1 units in Nigeria, and 40 other units across four countries – Zambia (all provinces included), Mozambique, Democratic Republic of the Congo and Burkina Faso – and for each COVID-19 and malaria scenario. We used the outcomes for the Nigeria administrative units to calculate the coefficient of variation (CoV) and tested the application of a Normal approximation to compare the uncertainty intervals (UI) for the other countries. (a) Shows the 95% UI for each of the four countries (pink and purple error bars) with the Normal approximation (red bars). Results indicate that the uncertainty generated using both methods was broadly similar. (b) Illustration of how malaria parameter uncertainty influences estimates of the additional weekly deaths due to malaria in Nigeria over the year May 2020–April 2021 for each of the four COVID-19 scenarios. Two different levels of malaria service interruption are considered for each scenario, the first where LLINs and SMC are ceased and case management is reduced by 50% (pink line, Supplementary Table 1 row 1), and the second when only case management is reduced by 50% (purple line, Supplementary Table 1, row 3). The dark lines represent point estimates of the difference between the levels of malaria service interruption and no COVID-19 induced disruption whilst the shaded regions represent the 95% UIs.