

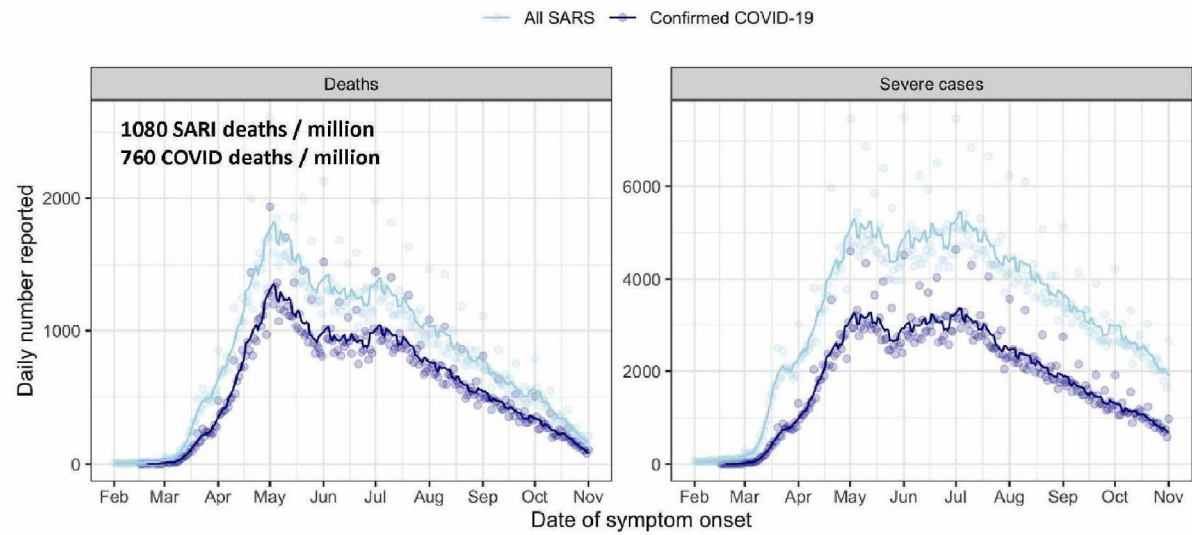
SARS-CoV-2 serosurveillance in Brazilian blood donors The Covid-IgG study

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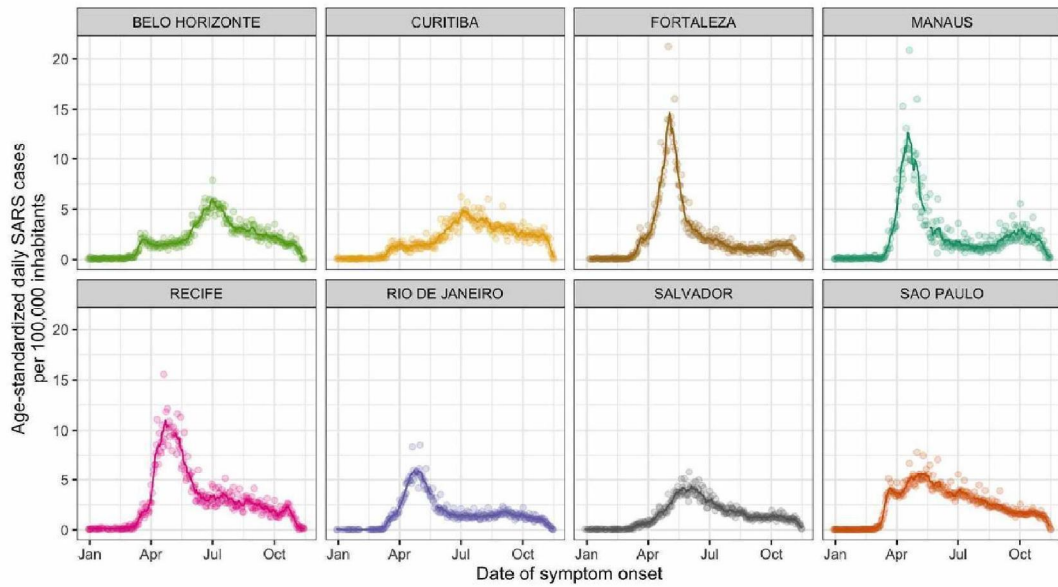
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Institute of Tropical Medicine, University of São Paulo

Overview COVID-19 situation in Brazil SIVEP-gripe surveillance system

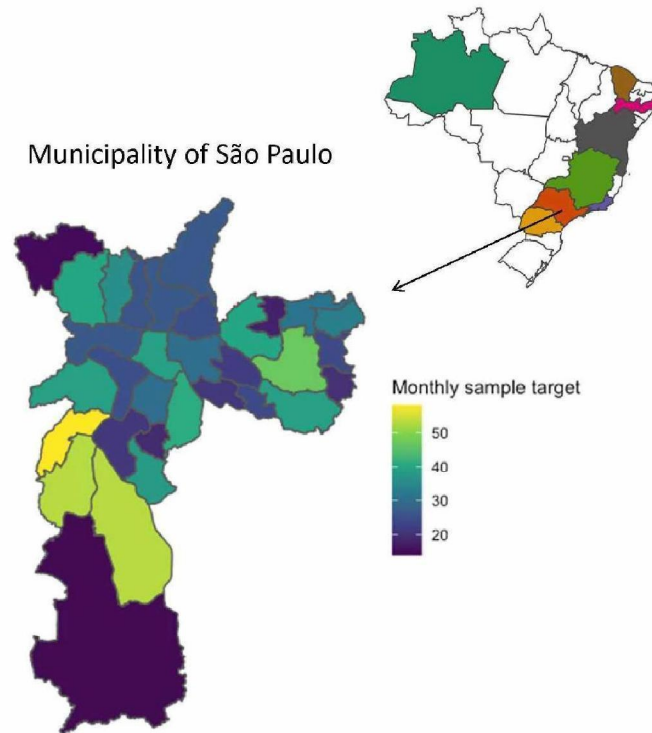


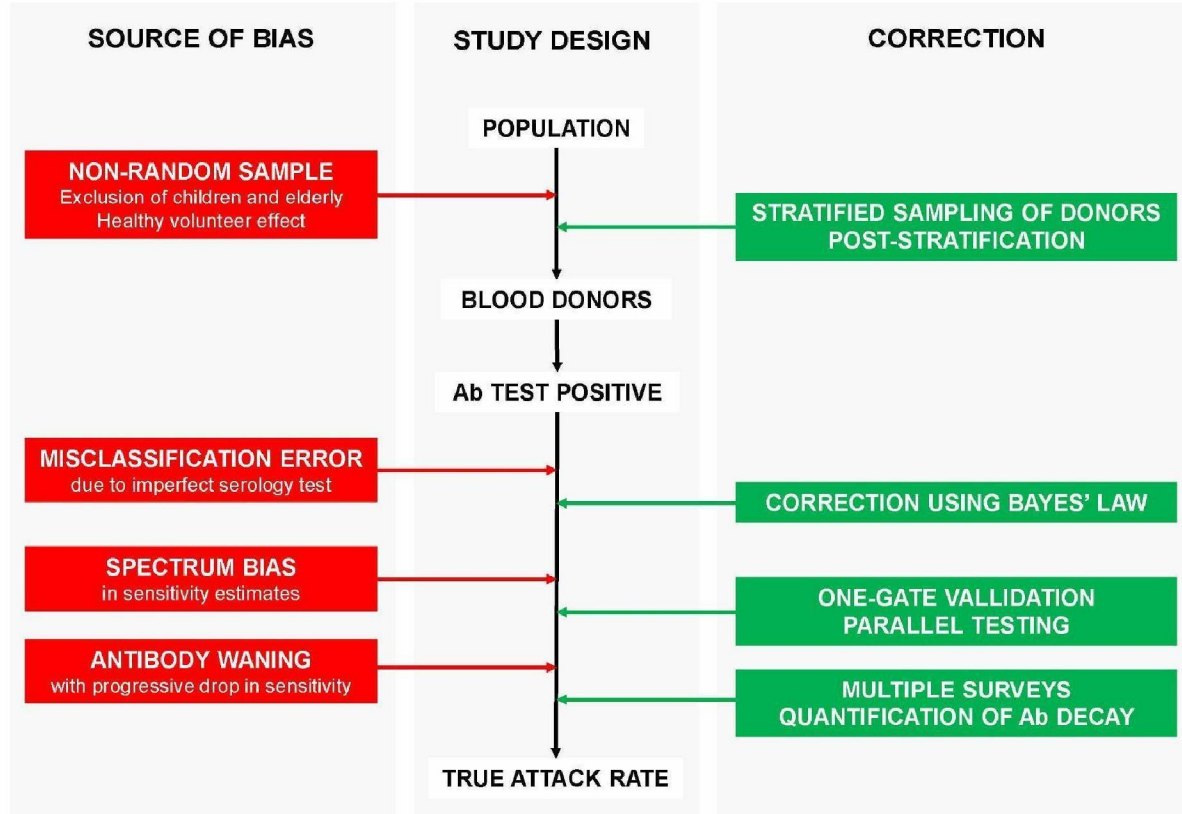
COVID-19 epidemic in eight Brazilian cities SIVEP-gripe surveillance system



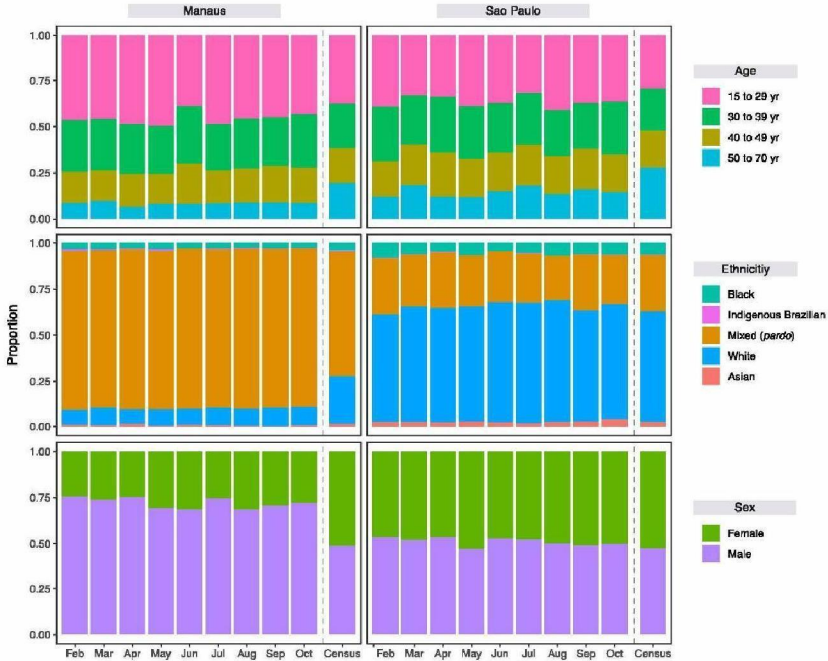
Covid-IgG study overview

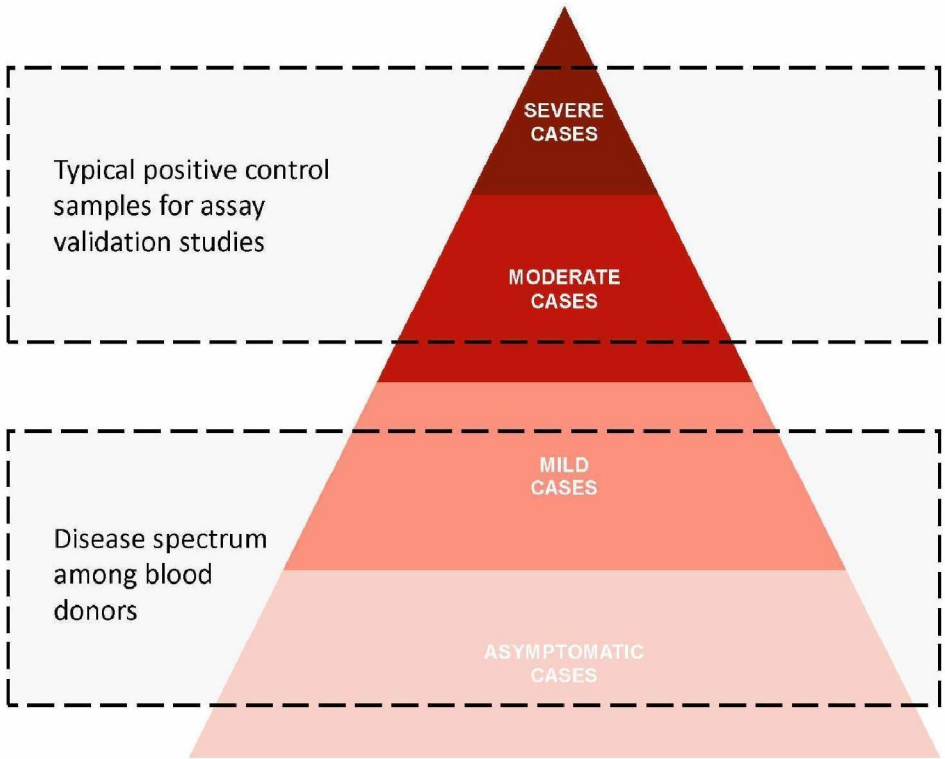
- Monthly sample of ~ 1000 blood donations (Feb-Nov)
- Geographically stratified using donor zip code
- Retrospective and real-time testing of samples
- Abbott SARS-CoV-2 IgG chemiluminescence assay



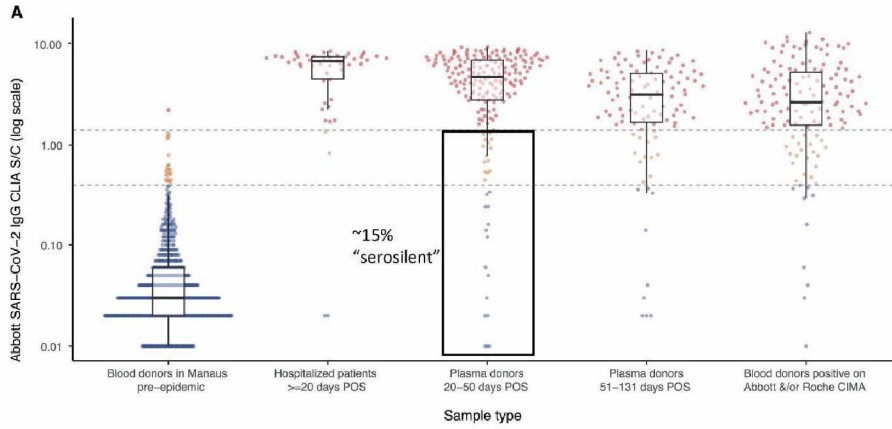


Limitations of blood donor sampling frame

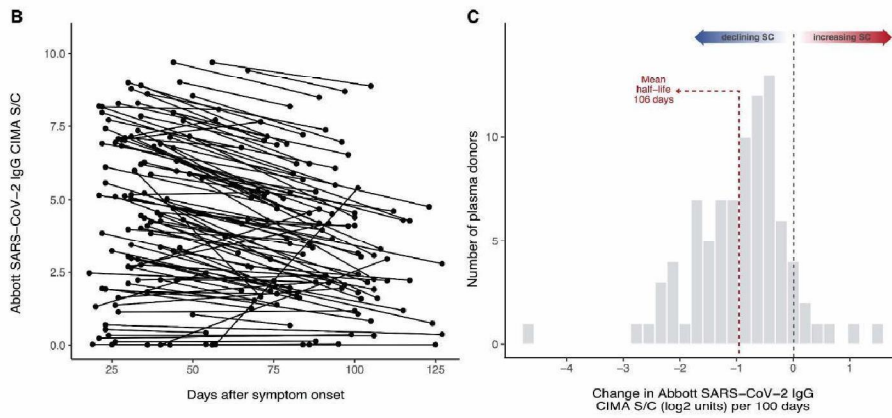




Spectrum bias

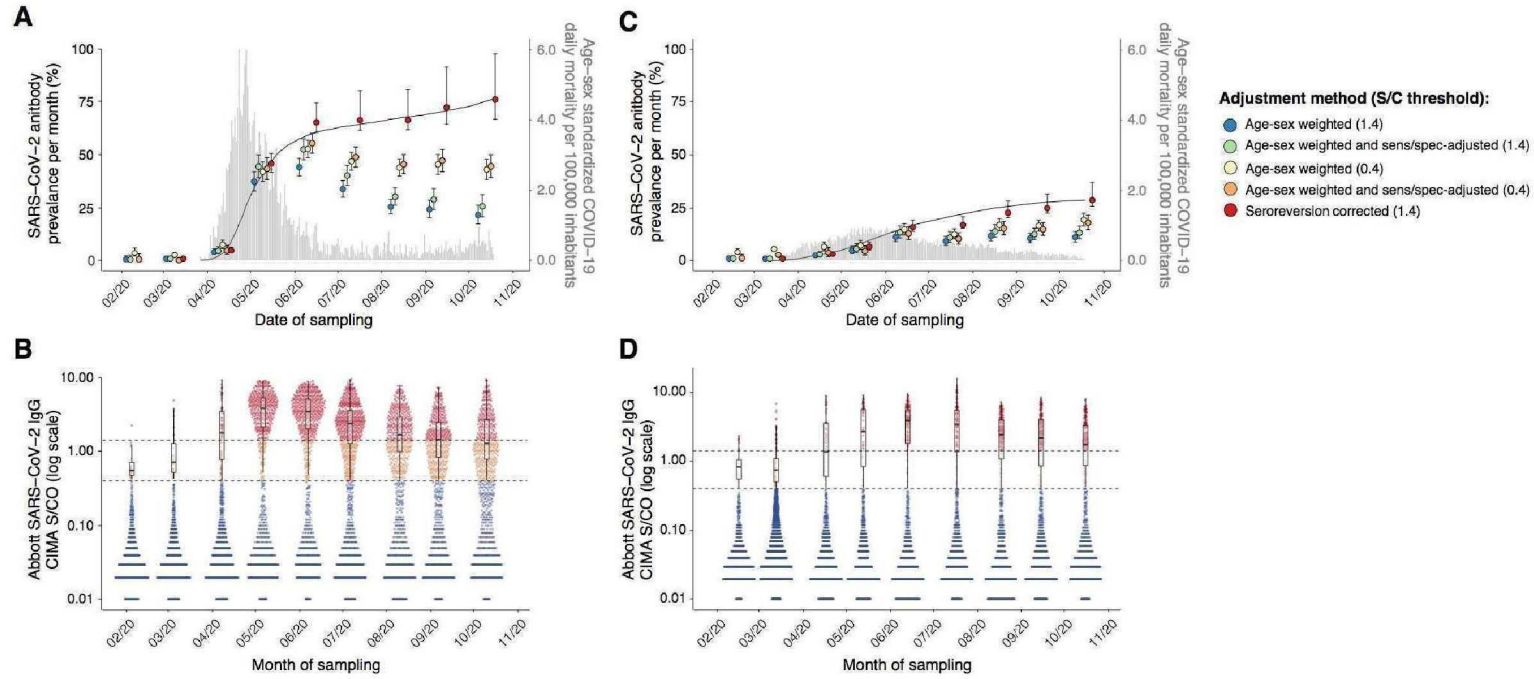


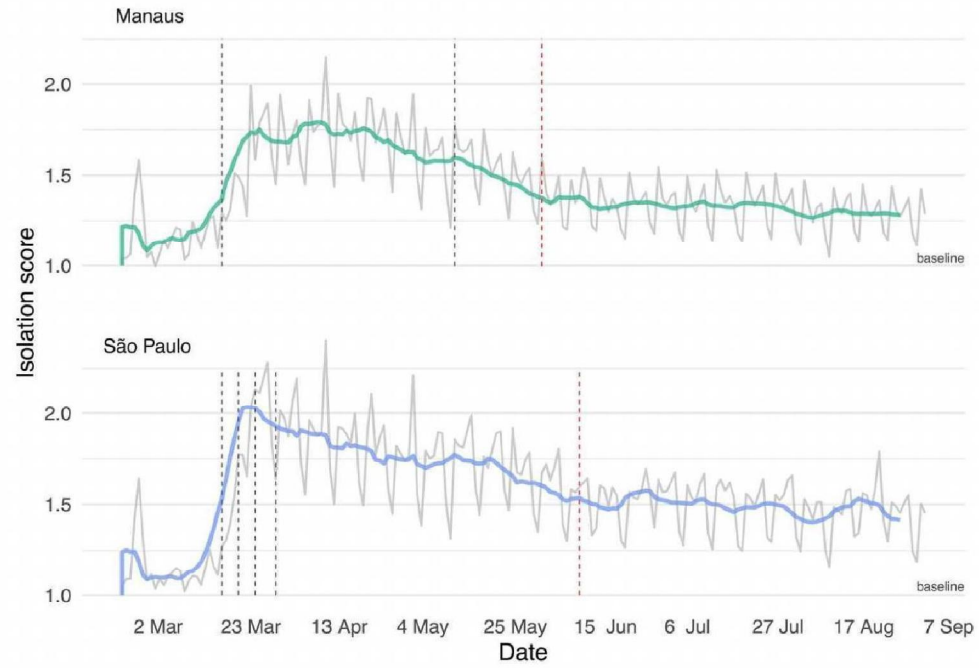
Antibody waning



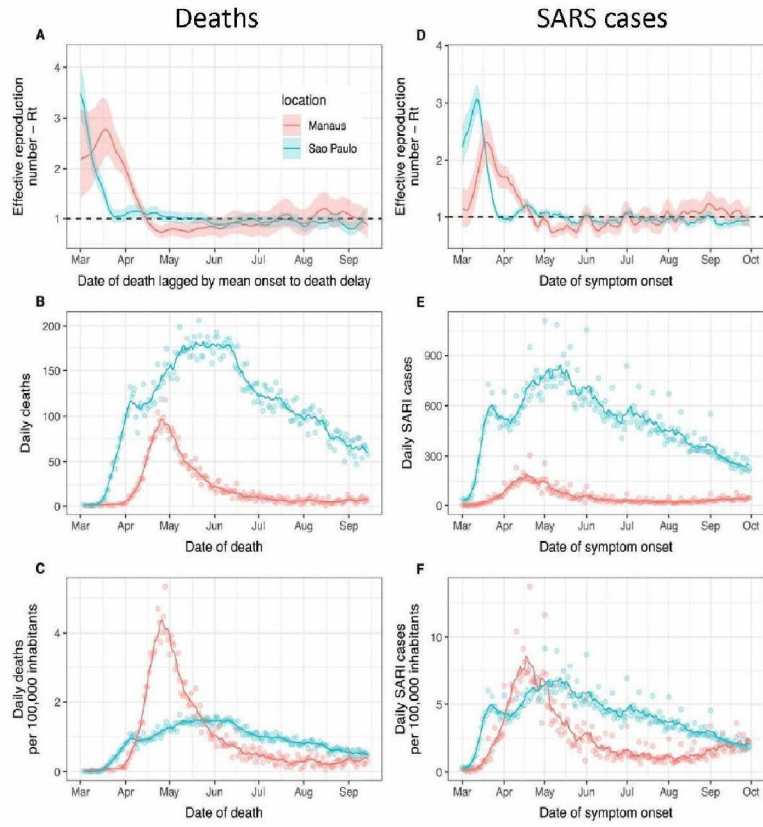
Estimates of cumulative incidence in Manaus and São Paulo

Location and sampling dates	Total samples tested	1.4 S/C threshold to define positive result				0.4 S/C threshold to define positive result				
		Positive samples	Crude prevalence % (95% CI)	Weighted prevalence (95% CI)	Sensitivity and specificity adjusted prevalence (95% CI)	Seroreversion adjusted prevalence (95% CI)	Positive samples	Crude prevalence % (95% CI)	Weighted prevalence % (95% CI)	Sensitivity and specificity adjusted prevalence % (95% CI)
Manaus										
Feb 7th-13th	821	1	0.1 (0.0-0.7)	0.4 (0.0-2.2)	0.3 (0.0-2.4)	-	27	3.3 (2.2-4.7)	3.7 (2.0-6.3)	0.4 (0.0-3.3)
Mar 6th-12th	832	6	0.7 (0.3-1.6)	0.7 (0.2-1.8)	0.7 (0.1-2.0)	0.7 (0.2-1.5)	25	3.0 (2.0-4.4)	2.6 (1.6-4.1)	0.0 (0.0-0.8)
Apr 6th-17th	829	46	5.5 (4.1-7.3)	4.1 (2.8-5.8)	4.8 (3.3-6.8)	5.0 (3.7-6.6)	84	10.1 (8.2-12.4)	7.7 (5.9-9.9)	5.0 (2.9-7.4)
May 5th-14th	901	359	39.9 (36.7-43.2)	37.4 (33.0-42.0)	44.5 (39.2-50.0)	45.9 (41.8-50.6)	413	45.9 (42.6-49.2)	42.1 (37.5-46.7)	43.4 (38.4-48.6)
Jun 5th-15th	911	422	46.3 (43.0-49.6)	44.1 (40.1-48.3)	52.5 (47.6-57.5)	65.2 (60.5-74.3)	495	54.3 (51.0-57.6)	52.7 (48.5-56.9)	55.4 (50.7-60.1)
Jul 6th-15th	1147	419	36.5 (33.7-39.4)	33.9 (30.1-37.9)	40.3 (35.7-45.0)	66.2 (61.5-80.1)	582	50.7 (47.8-53.7)	46.9 (42.7-51.1)	49.0 (44.2-53.6)
Aug 8th-19 th	881	242	27.5 (24.5-30.5)	25.5 (22.2-29.1)	30.3 (26.4-34.5)	66.2 (61.8-80.9)	426	48.4 (45.0-51.7)	44.0 (40.0-48.0)	45.6 (41.1-50.1)
Sep 5 th -14 th	868	214	24.7 (21.8-27.7)	24.4 (20.4-28.7)	29.0 (24.2-34.1)	72.2 (64.3-91.8)	417	48.0 (44.7-51.4)	45.4 (40.8-50.1)	47.3 (42.1-52.5)
Oct 10 th -17 th	882	183	20.7 (18.1-23.6)	21.7 (17.6-26.4)	25.8 (20.9-31.3)	76.0 (66.6-97.9)	393	44.6 (41.2-47.9)	43.1 (38.3-47.9)	44.6 (39.3-50.0)
São Paulo										
Feb 8th-29th	799	7	0.9 (0.4-1.8)	0.9 (0.3-1.9)	1.0 (0.3-2.1)	-	36	4.5 (3.2-6.2)	4.2 (2.9-6.0)	1.0 (0.0-2.9)
Mar 9th-21st	2454	22	0.9 (0.6-1.4)	0.8 (0.5-1.2)	0.8 (0.5-1.3)	0.8 (0.5-1.2)	149	6.1 (5.2-7.1)	5.8 (4.9-6.8)	2.8 (1.8-3.9)
Apr 8th-30th	900	27	3.0 (2.0-4.3)	2.6 (1.6-3.9)	2.9 (1.7-4.5)	3.1 (2.2-4.4)	58	6.4 (4.9-8.3)	6.8 (4.9-9.1)	4.0 (1.8-6.6)
May 8th-21st	826	44	5.3 (3.9-7.1)	5.1 (3.4-7.2)	5.9 (4.3-9.2)	6.9 (5.4-9.0)	69	8.4 (6.6-10.5)	7.5 (5.6-9.8)	4.7 (2.6-7.3)
Jun 8th-20th	880	105	11.9 (9.9-14.3)	11.6 (9.3-14.1)	13.6 (12.0-18.1)	16.1 (14.1-19.4)	135	15.3 (13.0-17.9)	15.0 (12.5-17.8)	13.1 (10.3-16.3)
Jul 13th-25th	879	84	9.6 (7.7-11.7)	9.5 (7.6-11.8)	11.2 (8.8-13.9)	17.2 (15.6-21.0)	116	13.2 (11.1-15.6)	12.8 (10.5-15.3)	10.6 (8.1-13.5)
Aug 10th-29 th	906	113	12.5 (10.4-14.8)	12.0 (9.7-14.6)	14.1 (11.4-14.3)	22.9 (20.5-28.4)	170	18.8 (16.2-21.5)	17.2 (14.5-20.1)	15.5 (12.3-18.2)
Sep 7 th -29 th	933	101	10.8 (8.9-13.0)	10.8 (8.7-13.2)	12.8 (10.4-15.6)	25.0 (22.7-31.6)	160	17.1 (14.8-19.7)	16.7 (14.2-19.5)	15.1 (12.3-18.2)
Oct 12 th -24 th	877	100	11.4 (9.4-13.7)	11.4 (9.1-14.0)	13.5 (10.7-16.6)	28.8 (25.9-37.0)	172	19.6 (17.0-22.4)	19.5 (16.6-22.7)	18.2 (15.0-21.7)

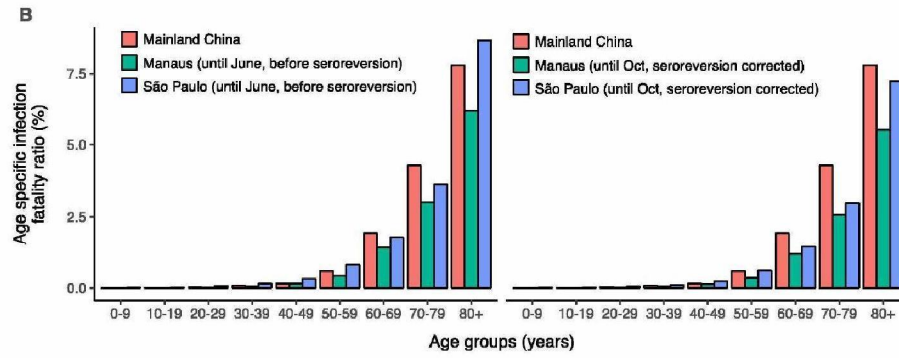
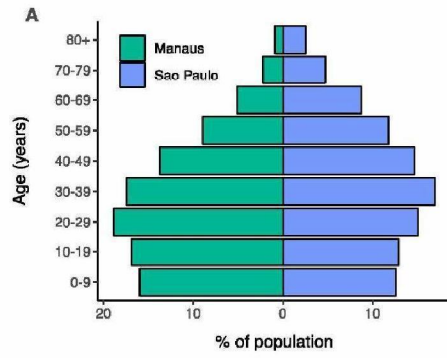




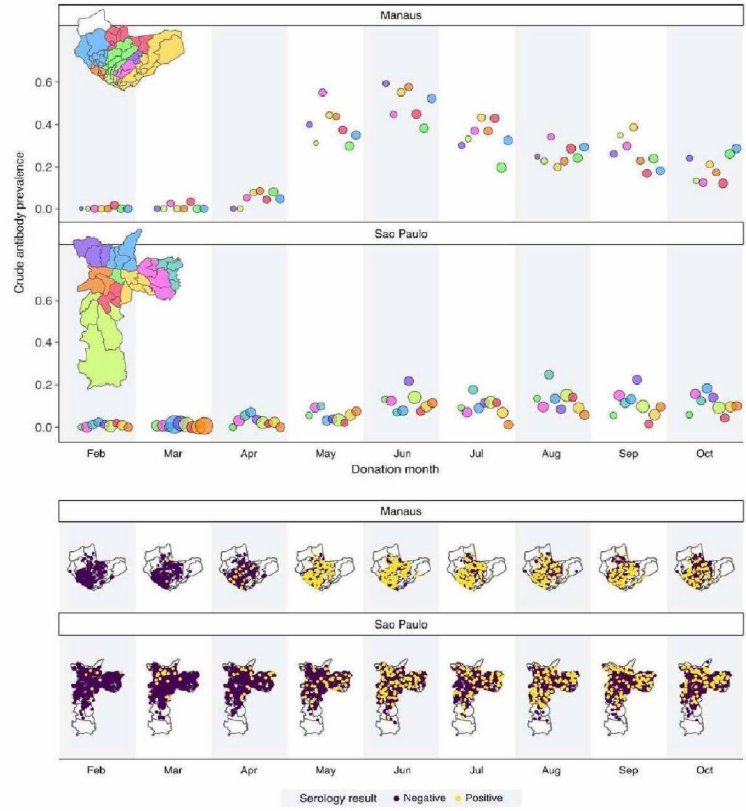
Non-pharmaceutical interventions	Manaus		São Paulo	
	Date	Source	Date	Source
Declaration of state of Emergency	16/03/2020	Decree N° 4.780	16/03/2020	Decree N° 59.283
School closure (State wide)	16/03/2020	Decree N° 42.061	16/03/2020	Decree N° 64.862
Cordon sanitaire	23/03/2020	CNM survey	X	X
Prohibition of gatherings	23/03/2020	CNM survey	18/03/2020	Decree N° 59.285
Closure of all but essential services	23/03/2020	CNM survey	23/03/2020	Decree N° 59.298
Compulsory use of face masks	11/05/2020	CNM survey	04/05/2020	Decree N° 59.384
Easing of social distancing	01/06/2020	CNM survey	15/06/2020	Decree N° 59.473
School opening	Opening gradually from 06/07/2020 starting with private schools	Decrees N° 42.461 and N° 42.330	03/11/2020	Decree N° 59.860



Population size, age structure and infection fatality ratios



Spatial distribution of donors and regional seroprevalence

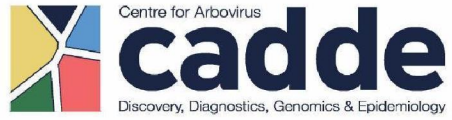


Location and sampling dates	Total samples tested	1.4 S/C threshold to define positive result				
		Positive samples	Crude prevalence % (95% CI)	Weighted prevalence (95% CI)	Sensitivity and specificity adjusted prevalence (95% CI)	Seroreversion adjusted prevalence (95% CI)
Belo Horizonte						
Feb -	-	-	-	-	-	-
Mar 9 th -31st	884	5	0.6 (0.2-1.3)	0.5 (0.2-1.3)	0.5 (0.1-1.4)	-
Apr 8 th -30th	905	4	0.4 (0.1-1.1)	0.4 (0.1-1.1)	0.4 (0.1-1.2)	-
May -	-	-	-	-	-	-
Jun -	-	-	-	-	-	-
Jul -	-	-	-	-	-	-
Aug 10 th -29th	938	64	6.8 (5.3-8.6)	6.7 (5.1-8.6)	7.8 (5.9-10.1)	-
Sep 8 th -26th	932	51	5.5 (4.1-7.1)	5.2 (3.8-6.9)	6.0 (4.3-8.1)	-
Oct 13 th -31st	953	96	10.1 (8.2-12.2)	9.1 (7.3-11.2)	10.7 (8.5-13.2)	-
Nov -	-	-	-	-	-	-
Curitiba						
Feb -	-	-	-	-	-	-
Mar 9 th -31st	966	5	0.5 (0.2-1.2)	0.5 (0.1-1.3)	0.5 (0.0-1.4)	0.4 (0.1-0.8)
Apr 8 th -30th	933	4	0.4 (0.1-1.1)	0.3 (0.1-0.8)	0.2 (0.0-0.8)	0.4 (0.2-0.9)
May 8 th -30th	953	5	0.5 (0.2-1.2)	0.4 (0.1-1.0)	0.4 (0.0-1.4)	0.6 (0.3-1.3)
Jun 8 th -27th	463	5	1.1 (0.4-2.5)	1.9 (0.4-5.5)	2.2 (0.3-6.4)	2.8 (1.2-7.0)
Jul 13 th -30th	802	13	1.6 (0.9-2.8)	1.6 (0.8-2.8)	1.8 (0.9-3.2)	3.1 (2.0-7.1)
Aug 10 th -29th	856	30	3.5 (2.4-5.0)	3.8 (2.3-5.8)	4.4 (2.6-6.7)	6.3 (4.6-10.9)
Sep 9 th -26th	974	74	7.6 (6.0-9.4)	7.9 (6.1-10.0)	9.3 (7.1-11.8)	12.7 (10.9-20.0)
Oct 13 th -31st	928	47	5.1 (3.7-6.7)	5.5 (3.9-7.4)	6.4 (4.6-8.7)	13.4 (11.5-24.8)
Nov 9 th -20th	669	38	5.7 (4.1-7.7)	5.4 (3.7-7.6)	6.3 (4.3-8.9)	15.1 (12.7-29.2)
Fortaleza						
Feb -	-	-	-	-	-	-
Mar 9 th -23rd	310	3	1.0 (0.2-2.8)	2.2 (0.4-6.6)	2.5 (0.4-7.7)	-
Apr 8 th - 23rd	137	3	2.1 (0.5-6.2)	2.2 (0.4-6.5)	2.5 (0.4-7.6)	-
May -	-	-	-	-	-	-
Jun 17 th -27th	100	40	40.0 (30.3-50.3)	41.2 (29.0-54.2)	48.7 (34.2-64.1)	-
Jul 13 th -29th	394	125	31.7 (27.2-36.6)	31.2 (26.4-36.4)	36.9 (31.2-43.0)	-
Aug 14 th -29th	610	159	26.1 (22.6-29.7)	28.3 (23.1-33.9)	33.4 (27.3-40.0)	-
Sep 7 th -27th	992	174	17.5 (15.2-20.1)	18.5 (15.1-22.3)	21.8 (17.8-26.3)	-
Oct 12 th -21st	496	62	12.5 (9.7-15.7)	12.2 (9.2-15.9)	14.4 (10.8-18.7)	-
Nov -	-	-	-	-	-	-

Location and sampling dates	Total samples tested	1.4 S/C threshold to define positive result				
		Positive samples	Crude prevalence % (95% CI)	Weighted prevalence (95% CI)	Sensitivity and specificity adjusted prevalence (95% CI)	Seroreversion adjusted prevalence (95%CI)
Recife						
Feb -	-	-	-	-	-	-
Mar 8 th -21st	1210	3	0.2 (0.0-0.7)	0.2 (0.0-0.5)	0.1 (0.0-0.5)	-
Apr 8 th -29th	1070	20	1.9 (1.1-2.9)	1.6 (0.9-2.6)	1.8 (0.9-3.0)	-
May -	-	-	-	-	-	-
Jun -	-	-	-	-	-	-
Jul 13 th -25th	146	39	26.7 (19.7-34.7)	22.8 (16.5-30.1)	26.8 (19.4-35.5)	-
Aug 10 th -30th	1308	267	20.4 (18.3-22.7)	18.3 (16.1-20.7)	21.6 (18.9-24.4)	-
Sep 7 th -27th	1333	270	20.3 (18.2-22.5)	18.4 (15.9-21.1)	21.6 (18.7-24.8)	-
Oct 12 th -31st	880	137	15.6 (13.2-18.1)	14.4 (11.6-17.6)	17.0 (13.6-20.8)	-
Nov 9 th -22nd	824	134	16.3 (13.8-19.0)	15.8 (12.9-19.5)	18.8 (15.1-23.0)	-
Rio de Janeiro						
Feb -	-	-	-	-	-	-
Mar 8 th -31st	882	1	0.1 (0.0-0.6)	0.1 (0.0-0.5)	0.0 (0.0-0.4)	0 (0-0)
Apr 8 th 30th	604	10	1.7 (0.8-3.0)	2.1 (0.8-4.4)	2.4 (0.9-5.1)	2.2 (1.0-3.6)
May 8 th -28th	371	45	12.1 (8.9-15.9)	10.9 (7.9-14.6)	12.8 (9.3-17.2)	12.7 (10.5-15.8)
Jun 8 th -28 th	311	45	14.5 (10.8-18.9)	15.0 (10.8-20.0)	17.7 (12.7-23.6)	20.4 (16.7-26.3)
Jul 15 th -21st	234	26	11.1 (7.4-15.9)	10.0 (6.6-14.3)	11.7 (7.7-16.9)	21.1 (19.6-28.4)
Aug 10 th -29th	973	171	17.6 (15.2-20.1)	16.5 (14.2-19.2)	19.5 (16.7-22.6)	30.4 (28.1-41.1)
Sep 7 th -24th	945	123	13.0 (10.9-15.3)	13.3 (10.9-16.0)	15.7 (12.8-18.9)	32.1 (30.5-46.1)
Oct 12 th -27th	631	86	13.6 (11.0-16.6)	12.5 (9.8-15.6)	14.7 (11.6-18.3)	34.7 (32.6-51.0)
Nov 9 th -16 th	654	98	15.0 (12.3-18.0)	14.9 (12.1-18.2)	17.6 (14.2-21.4)	41.4 (37.8-60.3)
Salvador						
Feb -	-	-	-	-	-	-
Mar 8 th -31st	367	2	0.5 (0.1-2.0)	0.7 (0.1-2.5)	0.7 (0.0-2.9)	0.5 (0.1-1.2)
Apr 8 th 30th	918	1	0.1 (0.0-0.6)	0.1 (0.0-0.7)	0.0 (0.0-0.8)	0.2 (0.0-0.7)
May 8 th -28th	974	36	3.7 (2.6-5.1)	3.6 (2.5-5.0)	4.1 (2.8-5.8)	4.2 (3.0-5.6)
Jun 8 th -28 th	919	121	13.2 (11.0-15.5)	12.8 (10.5-15.3)	15.0 (12.3-18.1)	16.3 (14.7-19.8)
Jul 15 th -21st	976	187	19.2 (16.7-23.0)	18.5 (15.7-21.5)	21.7 (18.5-25.3)	27.1 (23.8-32.0)
Aug 10 th -29th	964	196	20.3 (17.8-23.0)	19.5 (16.7-22.6)	23.0 (19.7-26.6)	32.8 (29.6-39.7)
Sep 7 th -24th	887	157	17.7 (15.2-20.4)	17.4 (14.6-20.4)	20.5 (17.2-24.1)	37.3 (34.2-49.9)
Oct 12 th -27th	-	-	-	-	-	-
Nov 9 th -16 th	-	-	-	-	-	-

Conclusions

- Highlights utility of blood donors for epidemic surveillance
- Large epidemics with high mortality in Manaus and São Paulo
- Manaus now above the theoretical “herd immunity” threshold
- Important sentinel to understand population immunity
- Transmission is still on-going in Manaus



5.1.2e

