

COVID-19 Correlates of Risk Analysis Report  
mock Study

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# Chapter 1

## Summary Tables

### 1.1 Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Negative Per-Protocol Cohort

Table 1. Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Negative Per-Protocol Cohort

Characteristics	Vaccine (N = 729)	Placebo (N = 130)	Total (N = 859)
<b>Age</b>			
Age < 65	349 (47.9%)	63 (48.5%)	412 (48.0%)
Age ≥ 65	380 (52.1%)	67 (51.5%)	447 (52.0%)
Mean (Range)	58.2 (18.0, 85.0)	59.1 (18.0, 85.0)	58.3 (18.0, 85.0)
<b>BMI</b>			
Mean ± SD	30.2 ± 7.2	31.4 ± 7.5	30.4 ± 7.2
<b>Risk for Severe Covid-19</b>			
At-risk	386 (52.9%)	67 (51.5%)	453 (52.7%)
Not at-risk	343 (47.1%)	63 (48.5%)	406 (47.3%)
<b>Age, Risk for Severe Covid-19</b>			
Age < 65 At-risk	179 (24.6%)	32 (24.6%)	211 (24.6%)
Age < 65 Not at-risk	170 (23.3%)	31 (23.8%)	201 (23.4%)
Age ≥ 65	380 (52.1%)	67 (51.5%)	447 (52.0%)
<b>Sex</b>			
Female	406 (55.7%)	75 (57.7%)	481 (56.0%)
Male	323 (44.3%)	55 (42.3%)	378 (44.0%)
<b>Hispanic or Latino ethnicity</b>			
Hispanic or Latino	102 (14.0%)	24 (18.5%)	126 (14.7%)
Not Hispanic or Latino	600 (82.3%)	103 (79.2%)	703 (81.8%)
Not reported and unknown	27 (3.7%)	3 (2.3%)	30 (3.5%)
<b>Race</b>			
White Non-Hispanic	355 (48.7%)	64 (49.2%)	419 (48.8%)
Black or African American	179 (24.6%)	36 (27.7%)	215 (25.0%)
Asian	65 (8.9%)	8 (6.2%)	73 (8.5%)
American Indian or Alaska Native	14 (1.9%)	2 (1.5%)	16 (1.9%)
Native Hawaiian or Other Pacific Islander	9 (1.2%)	3 (2.3%)	12 (1.4%)

*(continued)*

Characteristics	Vaccine (N = 729)	Placebo (N = 130)	Total (N = 859)
Multiracial	54 (7.4%)	11 (8.5%)	65 (7.6%)
Other	20 (2.7%)	3 (2.3%)	23 (2.7%)
Not reported and unknown	3 (0.4%)	1 (0.8%)	4 (0.5%)
Communities of Color	374 (51.3%)	66 (50.8%)	440 (51.2%)

This table summarizes the random subcohort, which was randomly sampled from the per-protocol cohort. The sampling was stratified by 24 strata defined by enrollment characteristics: Assigned treatment arm × Baseline SARS-CoV-2 naïve vs. non-naïve status (defined by serostatus and NAAT testing) × Randomization strata (Age < 65 and at-risk, Age < 65 and not at-risk, Age ≥ 65) × Communities of color (Yes/No) defined by White Non-Hispanic vs. all others (following the primary COVE trial paper).

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## 1.2 Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Positive Per-Protocol Cohort

Table 2. Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Positive Per-Protocol Cohort

Characteristics	Vaccine (N = 235)	Placebo (N = 221)	Total (N = 456)
<b>Age</b>			
Age < 65	120 (51.1%)	122 (55.2%)	242 (53.1%)
Age ≥ 65	115 (48.9%)	99 (44.8%)	214 (46.9%)
Mean (Range)	56.1 (18.0, 85.0)	57.7 (18.0, 85.0)	56.9 (18.0, 85.0)
<b>BMI</b>			
Mean ± SD	30.5 ± 7.6	29.7 ± 7.1	30.1 ± 7.3
<b>Risk for Severe Covid-19</b>			
At-risk	105 (44.7%)	90 (40.7%)	195 (42.8%)
Not at-risk	130 (55.3%)	131 (59.3%)	261 (57.2%)
<b>Age, Risk for Severe Covid-19</b>			
Age < 65 At-risk	57 (24.3%)	56 (25.3%)	113 (24.8%)
Age < 65 Not at-risk	63 (26.8%)	66 (29.9%)	129 (28.3%)
Age ≥ 65	115 (48.9%)	99 (44.8%)	214 (46.9%)
<b>Sex</b>			
Female	129 (54.9%)	117 (52.9%)	246 (53.9%)
Male	106 (45.1%)	104 (47.1%)	210 (46.1%)
<b>Hispanic or Latino ethnicity</b>			
Hispanic or Latino	27 (11.5%)	29 (13.1%)	56 (12.3%)
Not Hispanic or Latino	200 (85.1%)	184 (83.3%)	384 (84.2%)
Not reported and unknown	8 (3.4%)	8 (3.6%)	16 (3.5%)
<b>Race</b>			
White Non-Hispanic	121 (51.5%)	119 (53.8%)	240 (52.6%)
Black or African American	60 (25.5%)	46 (20.8%)	106 (23.2%)
Asian	21 (8.9%)	19 (8.6%)	40 (8.8%)
American Indian or Alaska Native	4 (1.7%)	5 (2.3%)	9 (2.0%)
Native Hawaiian or Other Pacific Islander	4 (1.7%)	4 (1.8%)	8 (1.8%)
Multiracial	11 (4.7%)	14 (6.3%)	25 (5.5%)
Other	4 (1.7%)	5 (2.3%)	9 (2.0%)
Not reported and unknown	3 (1.3%)	1 (0.5%)	4 (0.9%)
Communities of Color	114 (48.5%)	102 (46.2%)	216 (47.4%)

This table summarizes the random subcohort, which was randomly sampled from the per-protocol cohort. The sampling was stratified by 24 strata defined by enrollment characteristics: Assigned treatment arm × Baseline SARS-CoV-2 naïve vs. non-naïve status (defined by serostatus and NAAT testing) × Randomization strata (Age < 65 and at-risk, Age < 65 and not at-risk, Age ≥ 65) × Communities of color (Yes/No) defined by White Non-Hispanic vs. all others (following the primary COVE trial paper).

### 1.3 Antibody levels in the baseline SARS-CoV-2 negative per-protocol cohort (vaccine recipients)

Table 3. Antibody levels in the baseline SARS-CoV-2 negative per-protocol cohort (vaccine recipients)

Visit	Marker	Baseline SARS-CoV-2 Negative Vaccine Recipients								
		Cases*				Non-Cases/Control			Comparison	
		N	Resp rate	GMT/GMC	N	Resp rate	GMT/GMC	Resp Rate Difference	GMTR/GMCR	
Day 29	Pseudovirus-nAb ID80	47	28.5/49.6 = 57.4% (42.7%, 71.0%)	13.38 (10.74, 16.68)	730	6864.6/11181.4 = 61.4% (56.4%, 66.2%)	16.82 (15.41, 18.36)	-0.04 (-0.19, 0.1)	0.80 (0.63, 1.01)	
Day 29	Pseudovirus-nAb ID50	47	43.2/49.6 = 87.2% (73.9%, 94.3%)	59.98 (44.93, 80.06)	730	10080/11181.4 = 90.1% (86.4%, 92.9%)	65.71 (59.94, 72.02)	-0.03 (-0.17, 0.05)	0.91 (0.67, 1.24)	
Day 29	Anti RBD IgG (IU/ml)	47	49.6/49.6 = 100.0% (100.0%, 100.0%)	428.85 (253.57, 725.29)	730	11181.4/11181.4 = 100.0% (100.0%, 100.0%)	442.24 (379.90, 514.80)	0 (0, 0)	0.97 (0.56, 1.68)	
Day 29	Anti Spike IgG (IU/ml)	47	49.6/49.6 = 100.0% (100.0%, 100.0%)	204.89 (140.25, 299.33)	730	11181.4/11181.4 = 100.0% (100.0%, 100.0%)	240.27 (213.57, 270.31)	0 (0, 0)	0.85 (0.57, 1.27)	
Day 29	Anti N IgG (IU/ml)	47	47.5/49.6 = 95.7% (84.0%, 99.0%)	36.89 (21.46, 63.42)	730	10823.6/11181.4 = 96.8% (94.0%, 98.3%)	37.08 (31.32, 43.89)	-0.01 (-0.13, 0.03)	0.99 (0.56, 1.75)	
Day 57	Pseudovirus-nAb ID80	47	50/50 = 100.0% (100.0%, 100.0%)	272.97 (203.68, 365.84)	718	11090.4/11134 = 99.6% (97.3%, 99.9%)	375.97 (338.29, 417.86)	0 (0, 0.03)	0.73 (0.53, 0.99)	
Day 57	Pseudovirus-nAb ID50	47	50/50 = 100.0% (100.0%, 100.0%)	1301.02 (927.07, 1825.82)	718	11134/11134 = 100.0% (100.0%, 100.0%)	1628.04 (1437.68, 1843.60)	0 (0, 0)	0.80 (0.56, 1.15)	
Day 57	Anti RBD IgG (IU/ml)	47	50/50 = 100.0% (100.0%, 100.0%)	4259.73 (2553.51, 7106.01)	718	11134/11134 = 100.0% (100.0%, 100.0%)	4525.23 (3808.47, 5376.90)	0 (0, 0)	0.94 (0.55, 1.62)	
Day 57	Anti Spike IgG (IU/ml)	47	50/50 = 100.0% (100.0%, 100.0%)	1992.56 (1353.24, 2933.92)	718	11134/11134 = 100.0% (100.0%, 100.0%)	3112.47 (2693.47, 3596.66)	0 (0, 0)	0.64 (0.42, 0.97)	
Day 57	Anti N IgG (IU/ml)	47	48.9/50 = 97.9% (85.7%, 99.7%)	96.01 (49.53, 186.14)	718	10954.1/11134 = 98.4% (96.3%, 99.3%)	151.11 (123.29, 185.19)	-0.01 (-0.13, 0.02)	0.64 (0.32, 1.27)	

\*Cases are baseline negative per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases/Controls are baseline negative per-protocol vaccine recipients sampled into the random subcohort with no evidence of SARS-CoV-2 infection up to the time of data cut.

## 1.4 Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (vaccine recipients)

Table 4. Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (vaccine recipients)

Visit	Marker	Baseline SARS-CoV-2 Positive Vaccine Recipients						Comparison	
		Cases*			Non-Cases/Control			Resp Rate Difference	GMTR/GMCR
N	Resp rate	GMT/GMC	N	Resp rate	GMT/GMC				
Day 29	Pseudovirus-nAb ID80	0	-	-	238	845/1142 = 74.0% (65.6%, 80.9%)	32.43 (27.78, 37.85)	-	-
Day 29	Pseudovirus-nAb ID50	0	-	-	238	1102.1/1142 = 96.5% (91.6%, 98.6%)	145.36 (125.95, 167.78)	-	-
Day 29	Anti RBD IgG (IU/ml)	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	1076.27 (789.14, 1467.88)	-	-
Day 29	Anti Spike IgG (IU/ml)	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	491.93 (377.02, 641.85)	-	-
Day 29	Anti N IgG (IU/ml)	0	-	-	238	1131.9/1142 = 99.1% (97.3%, 99.7%)	97.02 (74.05, 127.11)	-	-
Day 57	Pseudovirus-nAb ID80	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	1119.73 (916.14, 1368.56)	-	-
Day 57	Pseudovirus-nAb ID50	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	5401.08 (4304.80, 6776.53)	-	-
Day 57	Anti RBD IgG (IU/ml)	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	14356.46 (10395.40, 19826.84)	-	-
Day 57	Anti Spike IgG (IU/ml)	0	-	-	238	1142/1142 = 100.0% (100.0%, 100.0%)	11916.28 (9155.17, 15510.12)	-	-
Day 57	Anti N IgG (IU/ml)	0	-	-	238	1124.8/1142 = 98.5% (95.8%, 99.5%)	509.47 (352.56, 736.21)	-	-

\*Cases are baseline positive per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases/Controls are baseline negative per-protocol vaccine recipients sampled into the random subcohort with no evidence of SARS-CoV-2 infection up to the time of data cut.

## 1.5 Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (placebo recipients)

Table 5. Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (placebo recipients)

Visit	Marker	Baseline SARS-CoV-2 Positive Placebo Recipients						Comparison	
		Cases*			Non-Cases/Control			Resp Rate Difference	GMTR/GMCR
N	Resp rate	GMT/GMC	N	Resp rate	GMT/GMC				
Day 29	Pseudovirus-nAb ID80	0	-	-	224	375.6/1074 = 35.0% (27.6%, 43.2%)	11.15 (9.90, 12.56)	-	-
Day 29	Pseudovirus-nAb ID50	0	-	-	224	825.5/1074 = 76.9% (68.4%, 83.6%)	48.57 (41.41, 56.98)	-	-
Day 29	Anti RBD IgG (IU/ml)	0	-	-	224	1074/1074 = 100.0% (100.0%, 100.0%)	348.00 (276.62, 437.80)	-	-
Day 29	Anti Spike IgG (IU/ml)	0	-	-	224	1074/1074 = 100.0% (100.0%, 100.0%)	188.56 (152.74, 232.78)	-	-
Day 29	Anti N IgG (IU/ml)	0	-	-	224	1028.4/1074 = 95.7% (89.9%, 98.3%)	26.38 (19.88, 35.00)	-	-
Day 57	Pseudovirus-nAb ID80	0	-	-	223	1072/1072 = 100.0% (100.0%, 100.0%)	280.95 (233.82, 337.59)	-	-
Day 57	Pseudovirus-nAb ID50	0	-	-	223	1072/1072 = 100.0% (100.0%, 100.0%)	1369.98 (1107.17, 1695.18)	-	-
Day 57	Anti RBD IgG (IU/ml)	0	-	-	223	1072/1072 = 100.0% (100.0%, 100.0%)	3880.48 (2938.49, 5124.45)	-	-
Day 57	Anti Spike IgG (IU/ml)	0	-	-	223	1072/1072 = 100.0% (100.0%, 100.0%)	2415.51 (1918.63, 3041.08)	-	-
Day 57	Anti N IgG (IU/ml)	0	-	-	223	1064.4/1072 = 99.3% (97.6%, 99.8%)	150.91 (108.23, 210.43)	-	-

\*Cases are baseline negative per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases/Controls are baseline negative per-protocol vaccine recipients sampled into the random subcohort with no evidence of SARS-CoV-2 infection up to the time of data cut.

**Chapter 2**

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**Graphical Descriptions of Antibody  
Marker Data**

## 2.1 Boxplots

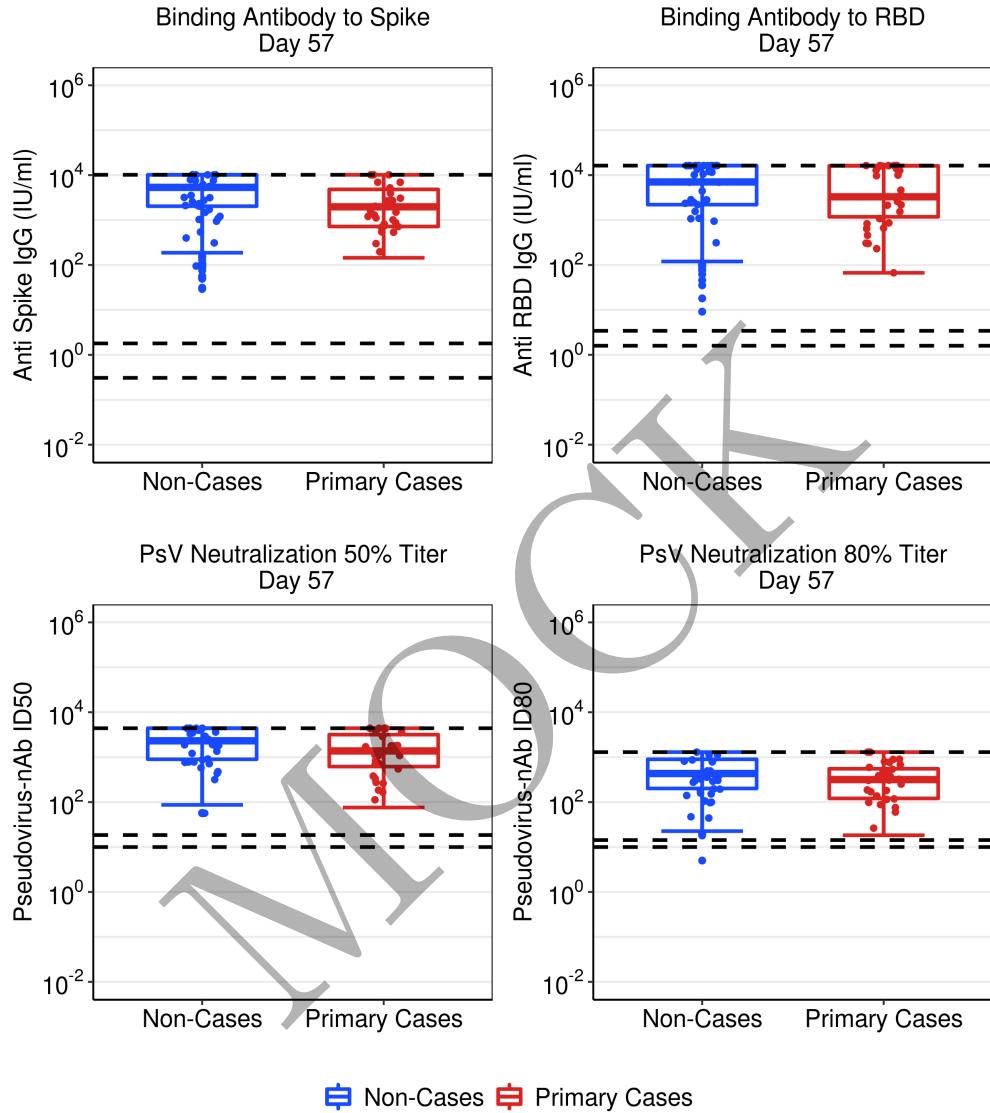


Figure 2.1: Boxplots of D57 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

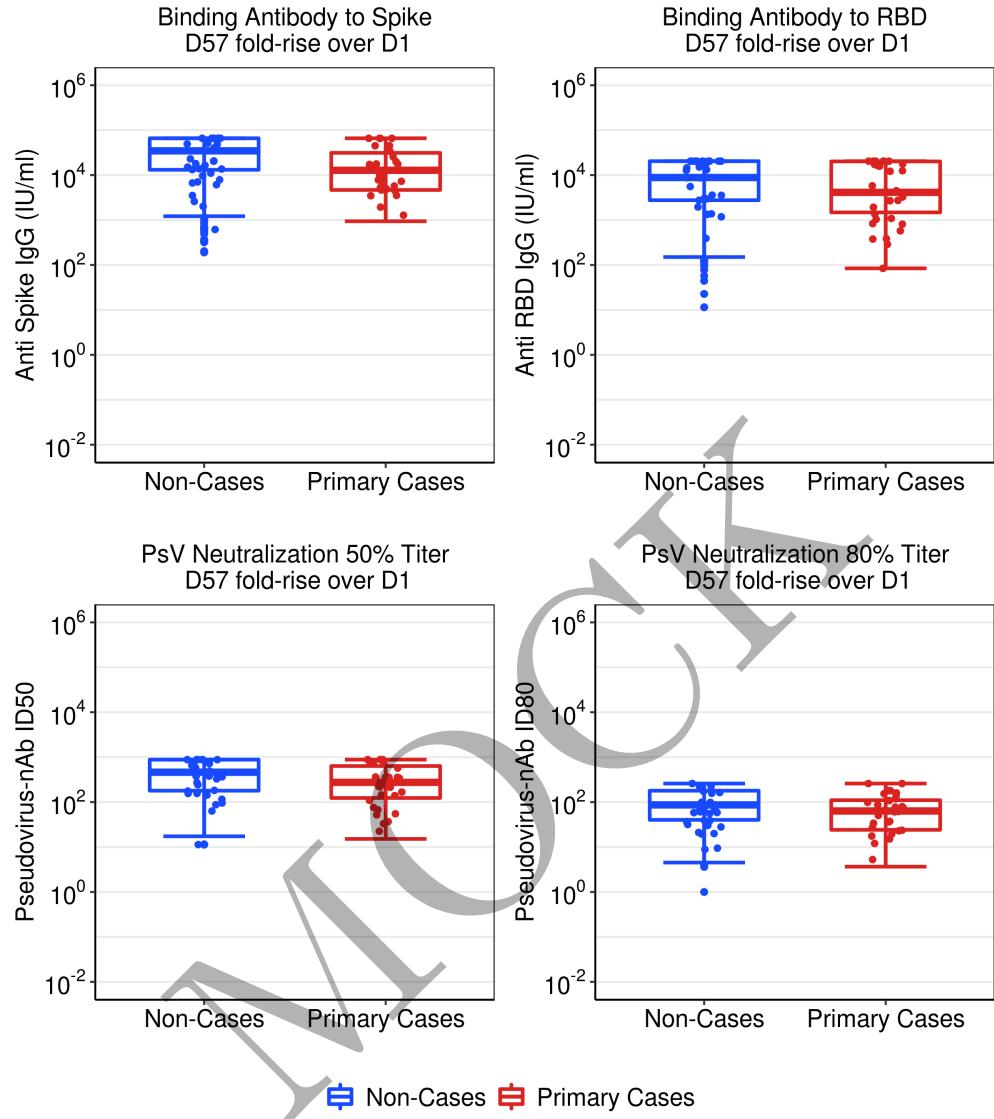


Figure 2.2: Boxplots of D57 fold-rise over D1 Ab markers: vaccine arm.

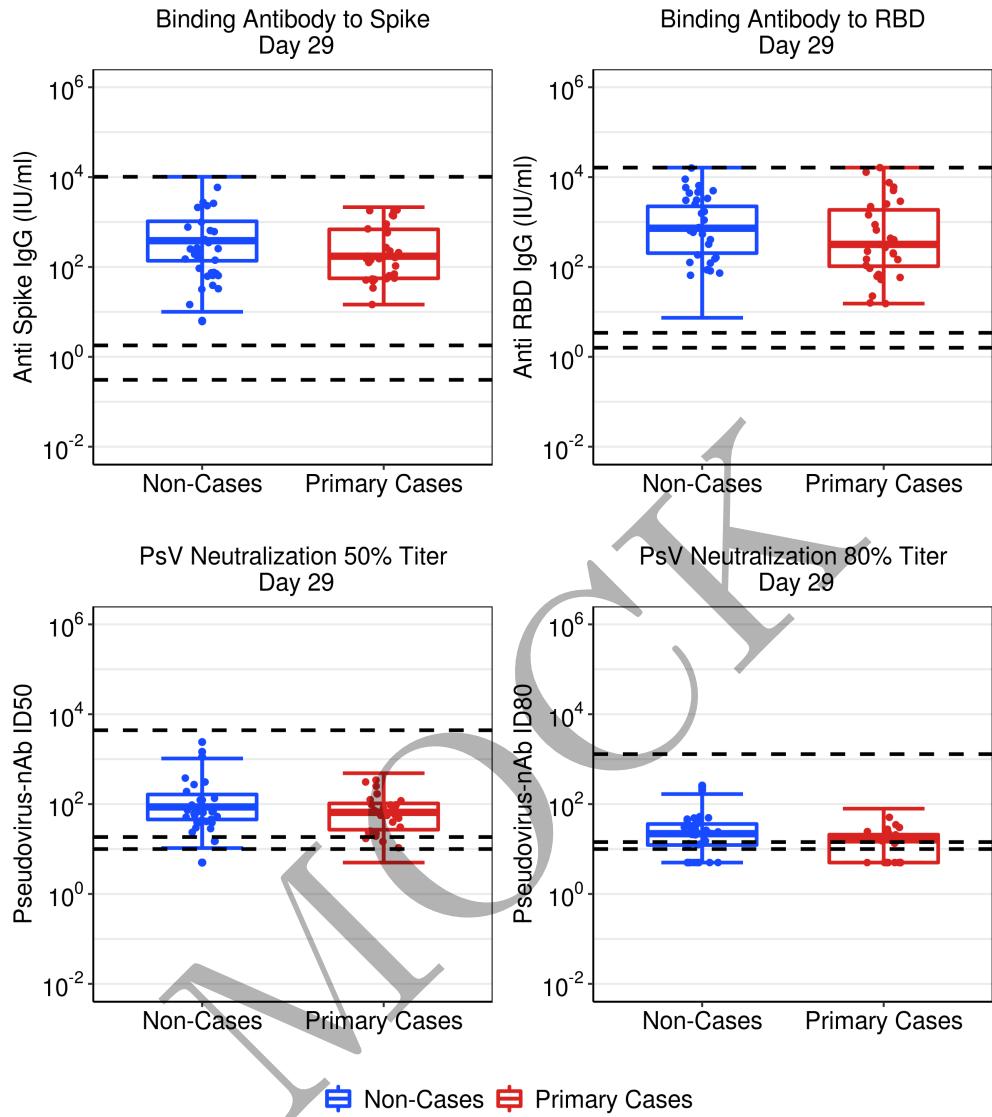


Figure 2.3: Boxplots of D29 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

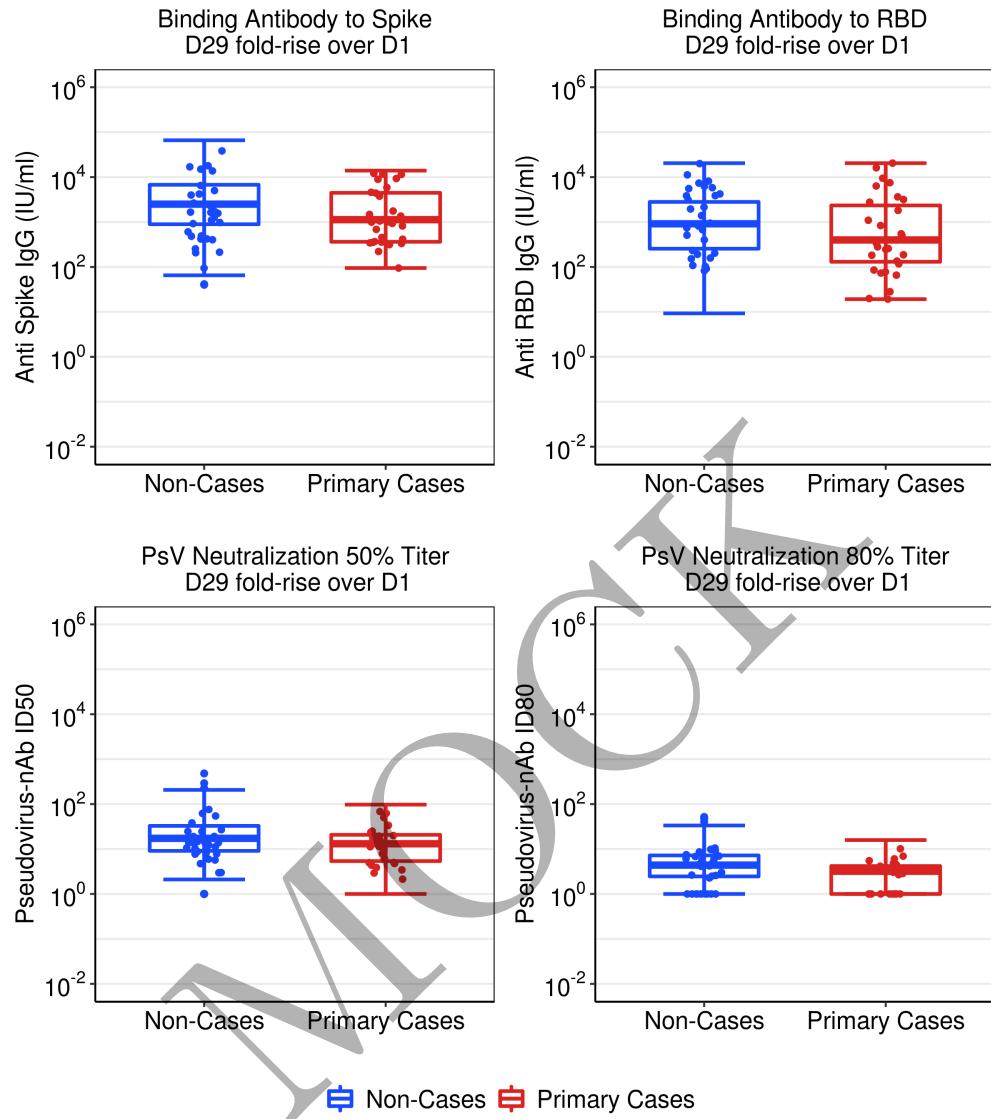


Figure 2.4: Boxplots of D29 fold-rise over D1 Ab markers: vaccine arm.

## 2.2 Weighted RCDF plots

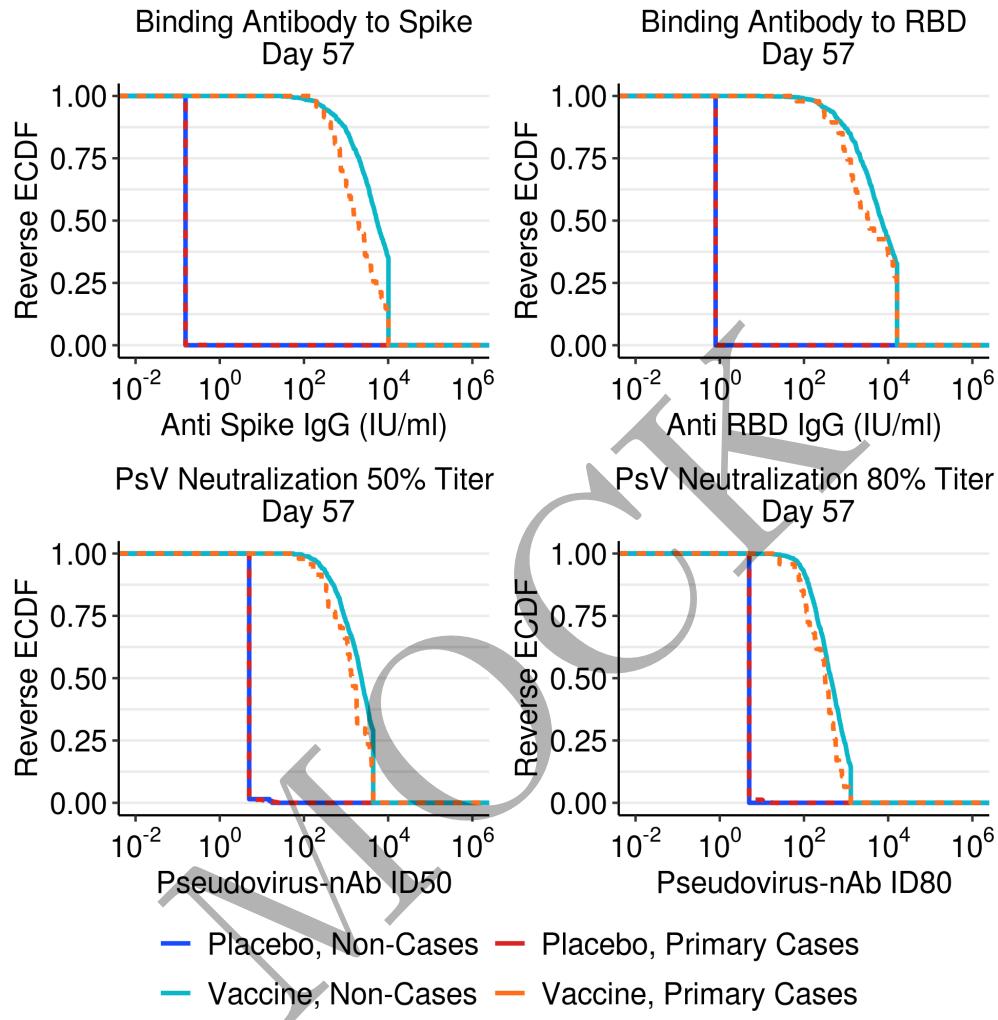


Figure 2.5: RCDF plots for D57 Ab markers by treatment arm.

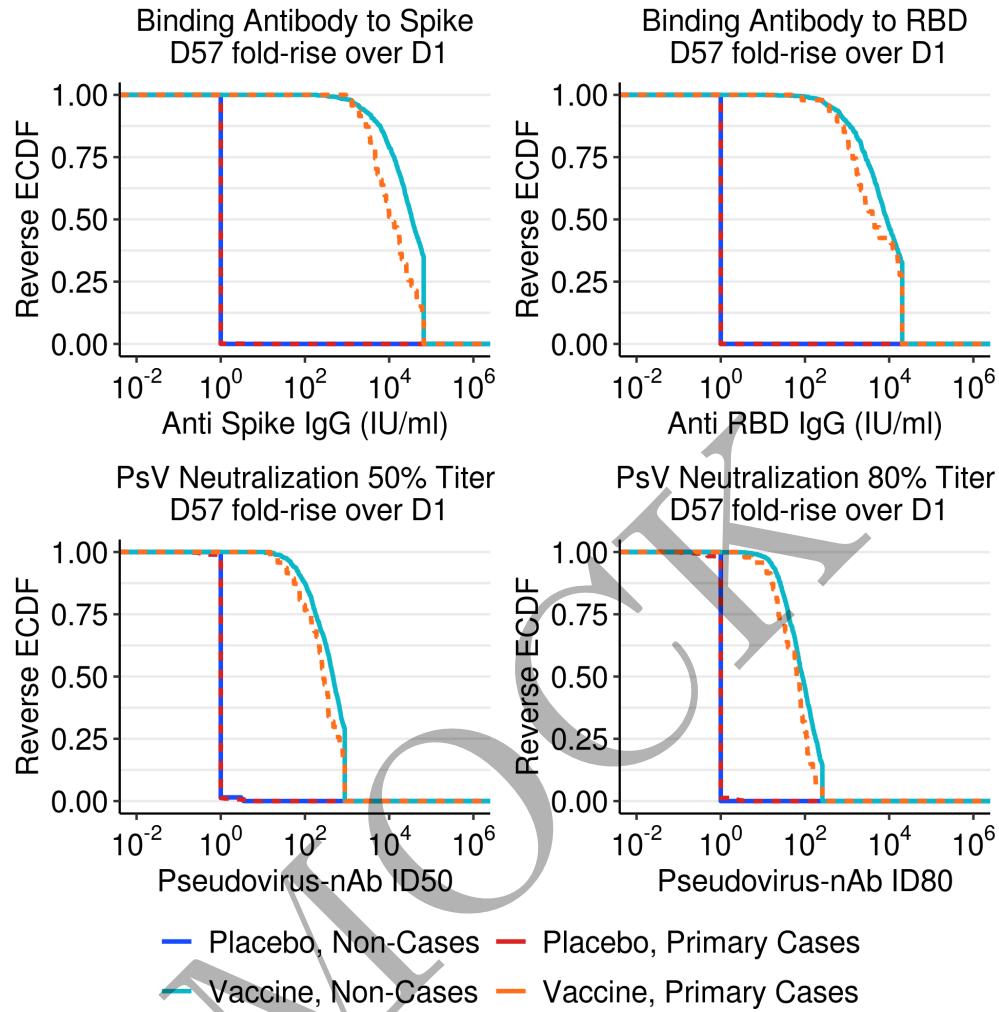


Figure 2.6: RCDF plots for D57 fold-rise over D1 Ab markers by treatment arm.

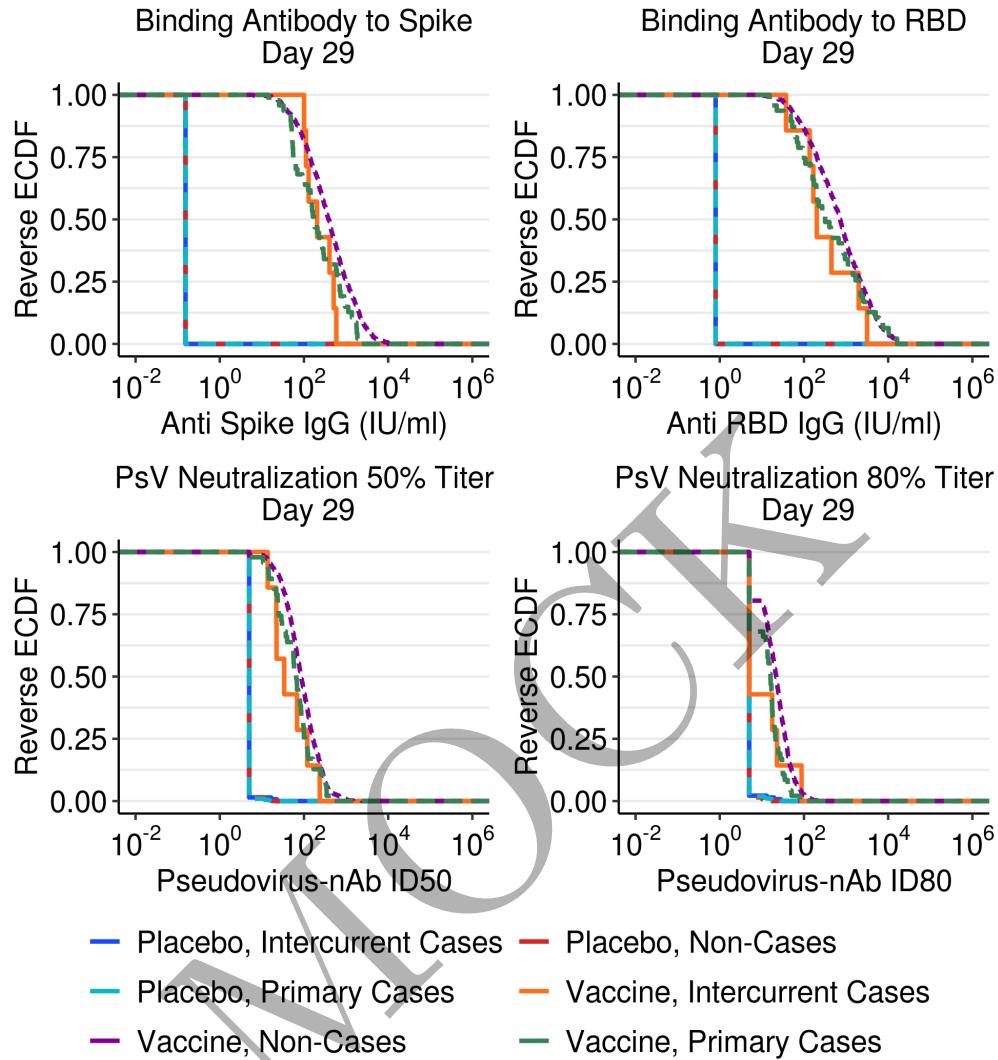


Figure 2.7: RCDF plots for D29 Ab markers by treatment arm.

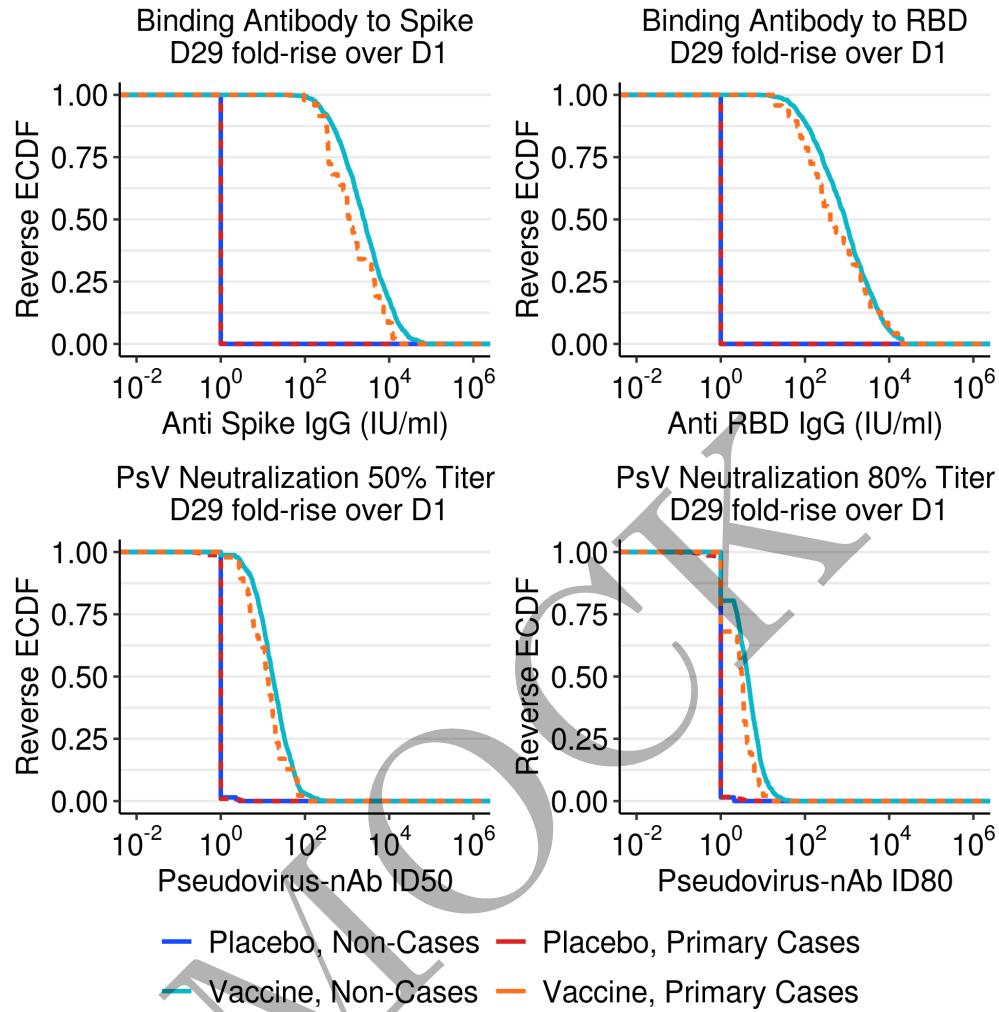


Figure 2.8: RCDF plots for D29 fold-rise over D1 Ab markers by treatment arm.

### 2.3 Weighted RCDF plots of threshold correlate concentration for vaccine efficacy

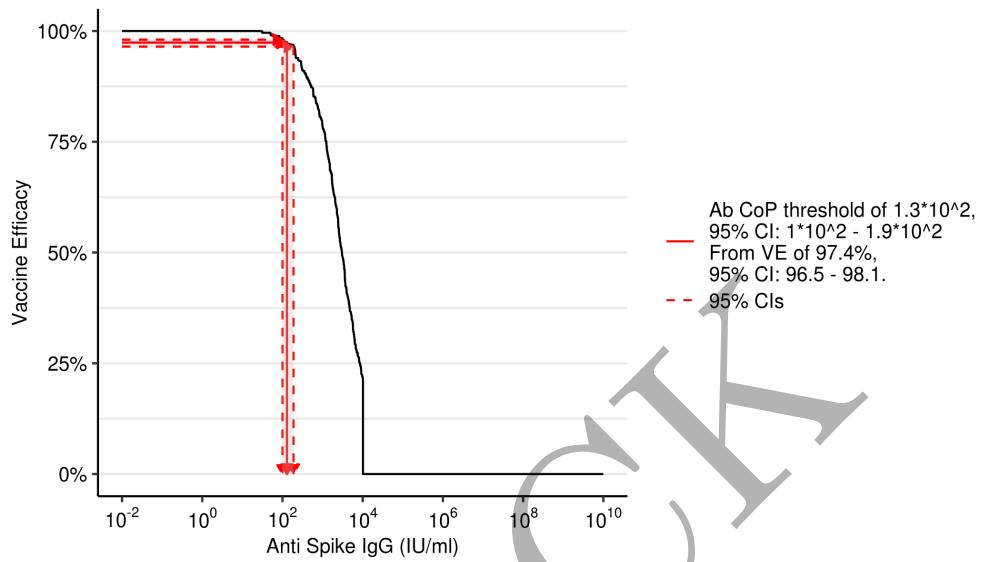


Figure 2.9: Marker RCDF of D57 anti-Spike binding Ab: vaccine arm

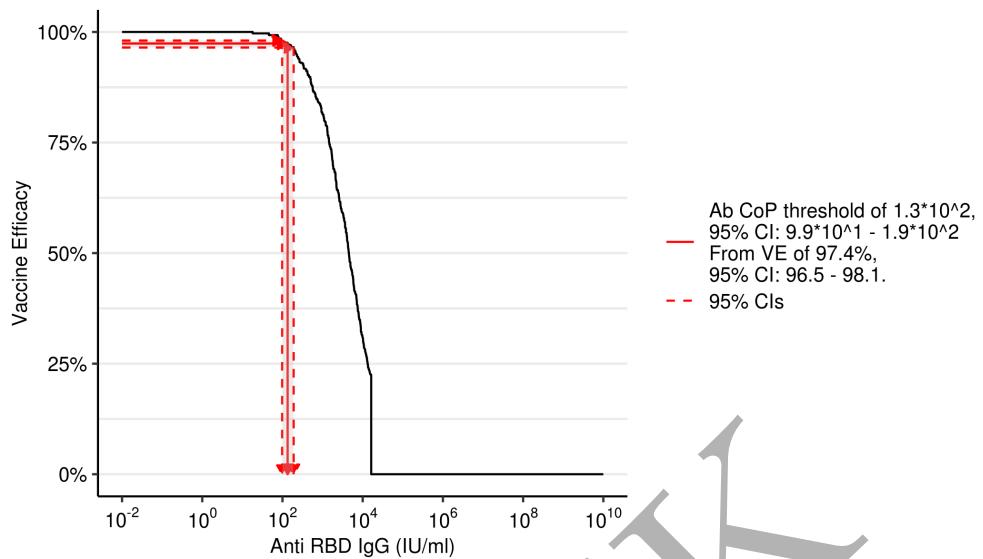


Figure 2.10: Marker RCDF of D57 anti-RBD binding Ab: vaccine arm

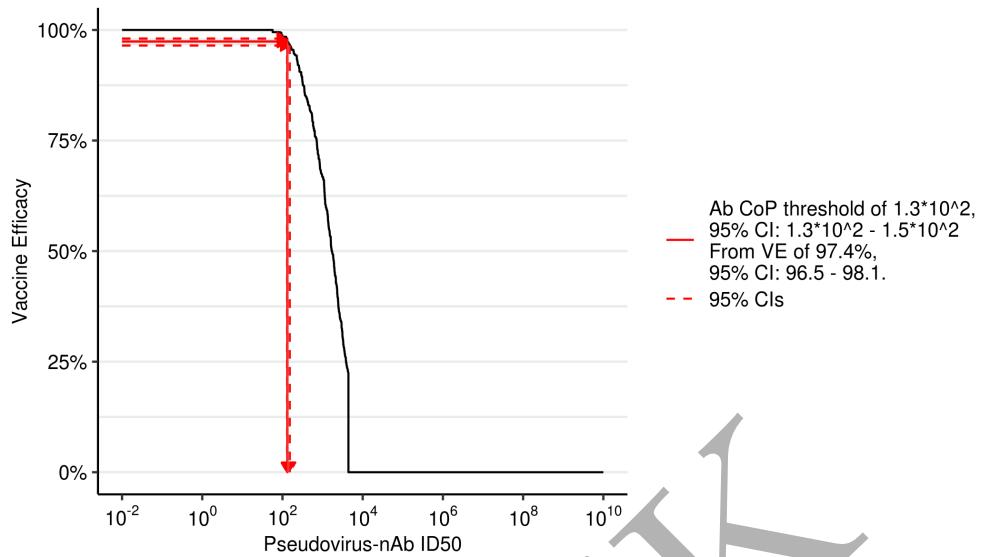


Figure 2.11: Marker RCDF of D57 PsV-nAb ID50: vaccine arm

2.3. WEIGHTED RCDF PLOTS OF THRESHOLD CORRELATE CONCENTRATION FOR VACCINE EFFICACY 45

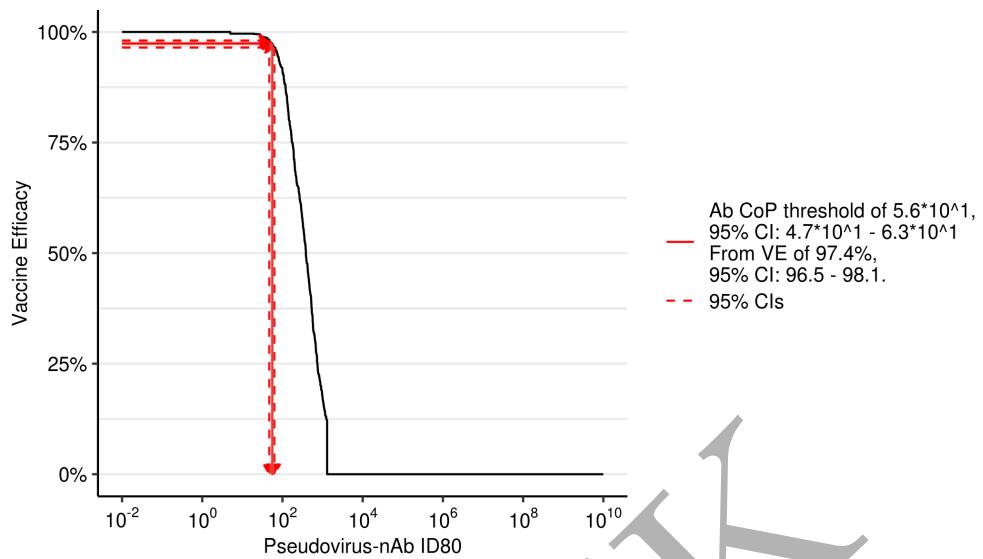


Figure 2.12: Marker RCDF of D57 PsV-nAb ID80: vaccine arm

## 2.4 Spaghetti plots

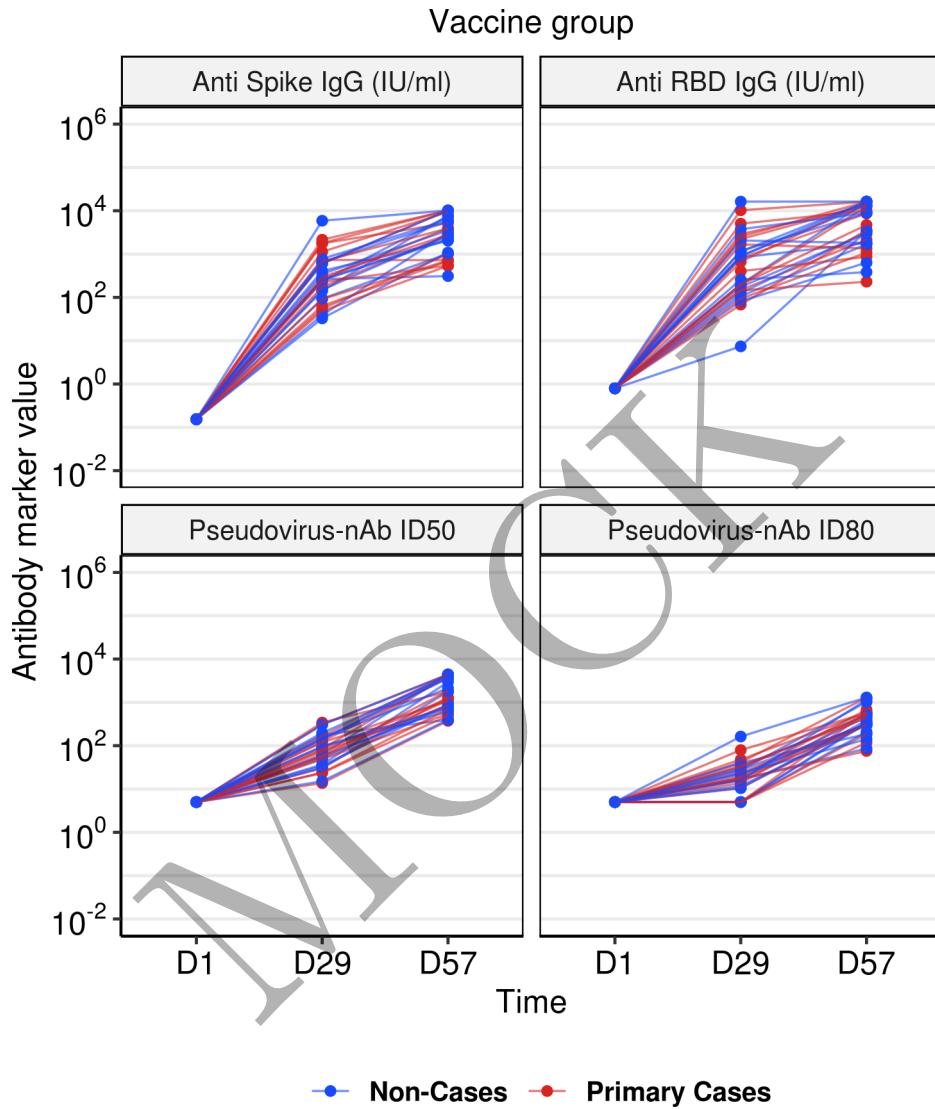


Figure 2.13: Spaghetti Plots of Marker Trajectory: vaccine arm

## 2.5 Violin and line plots

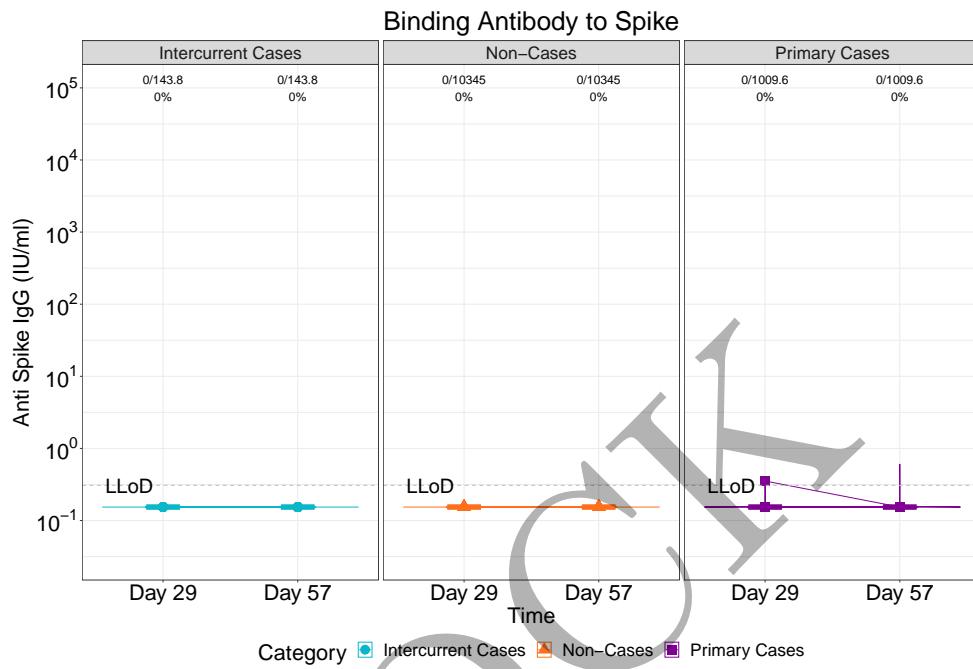


Figure 2.14: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

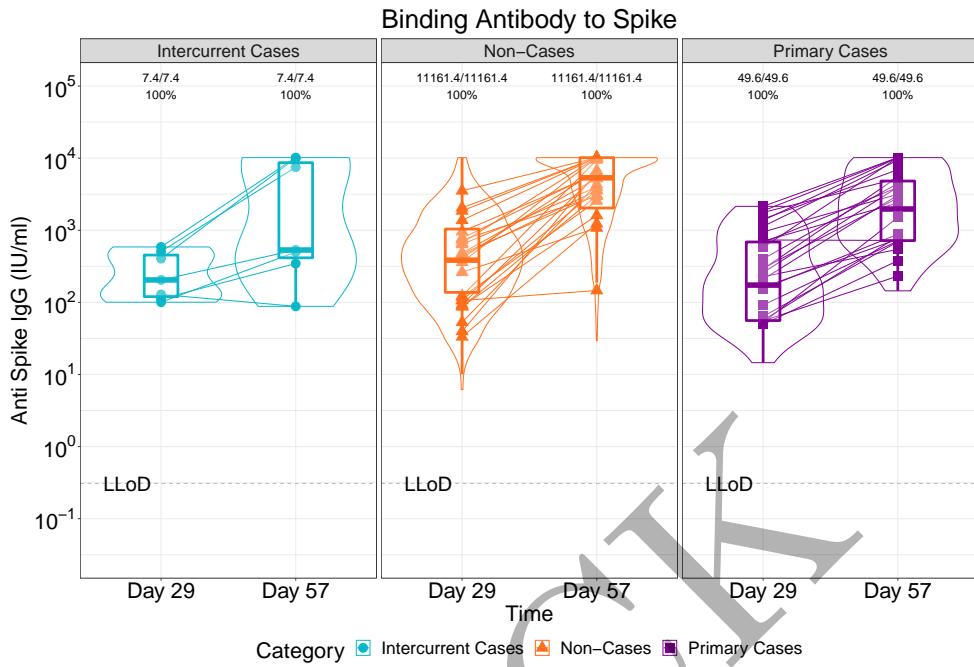


Figure 2.15: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

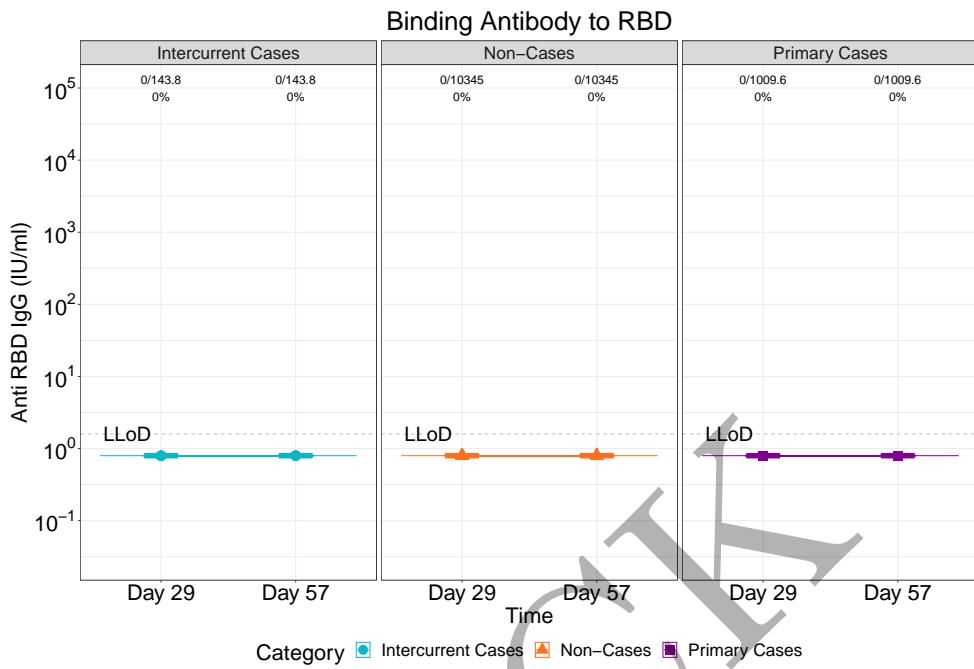


Figure 2.16: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

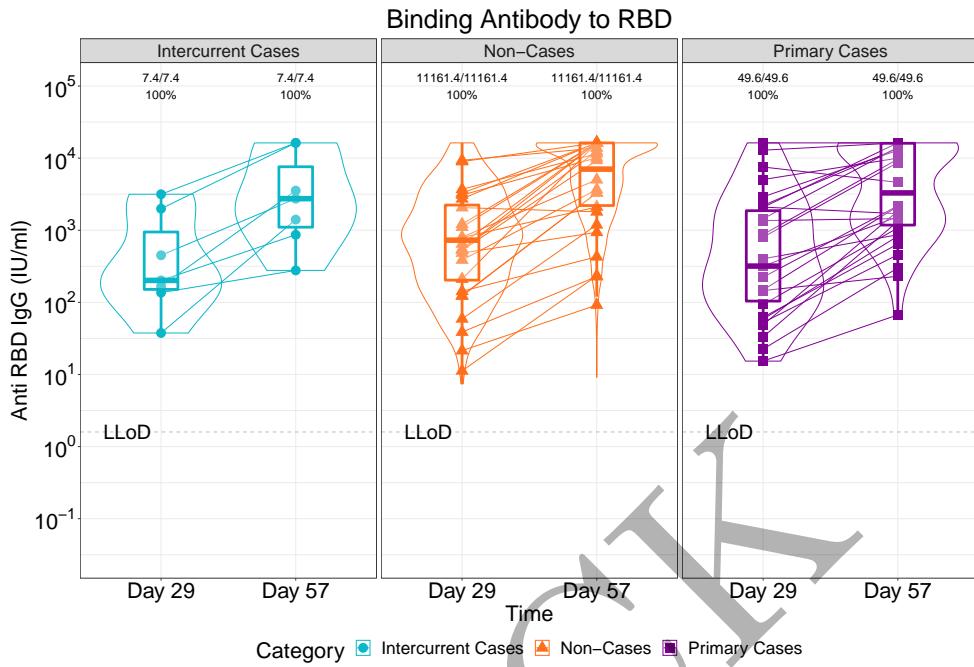


Figure 2.17: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

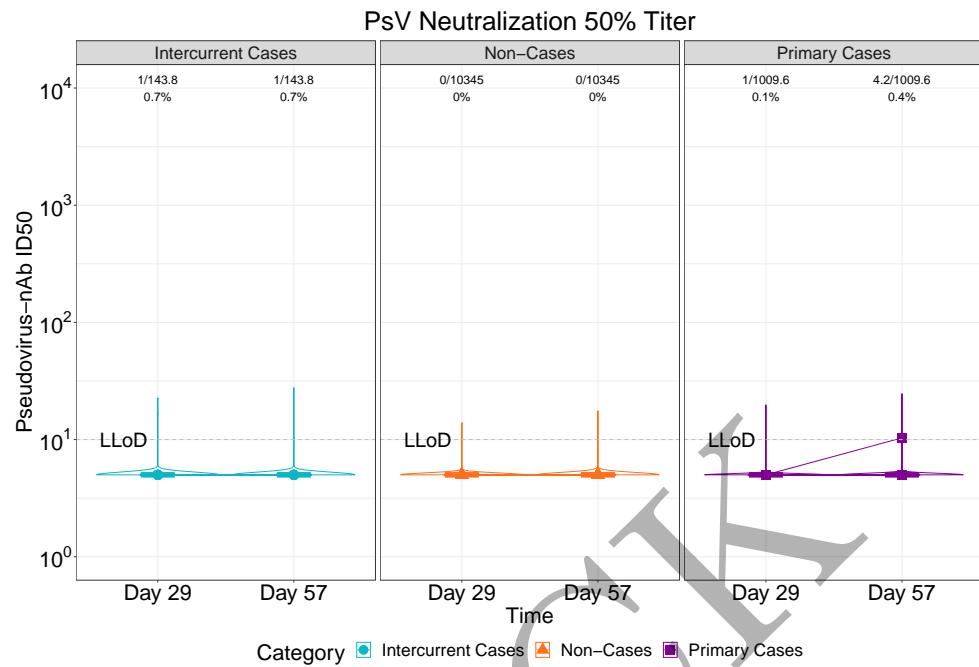


Figure 2.18: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

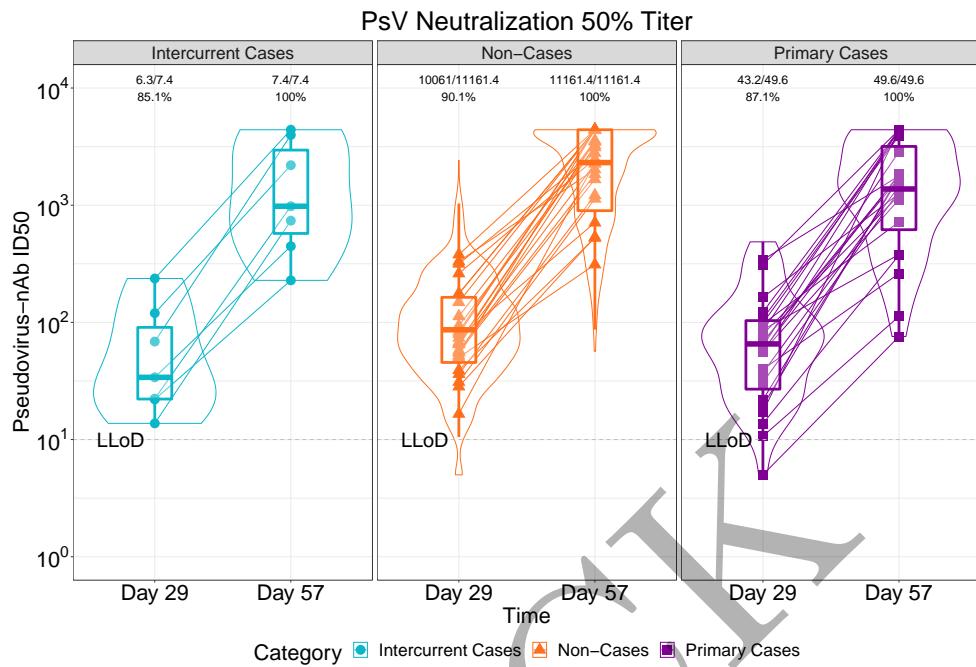


Figure 2.19: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

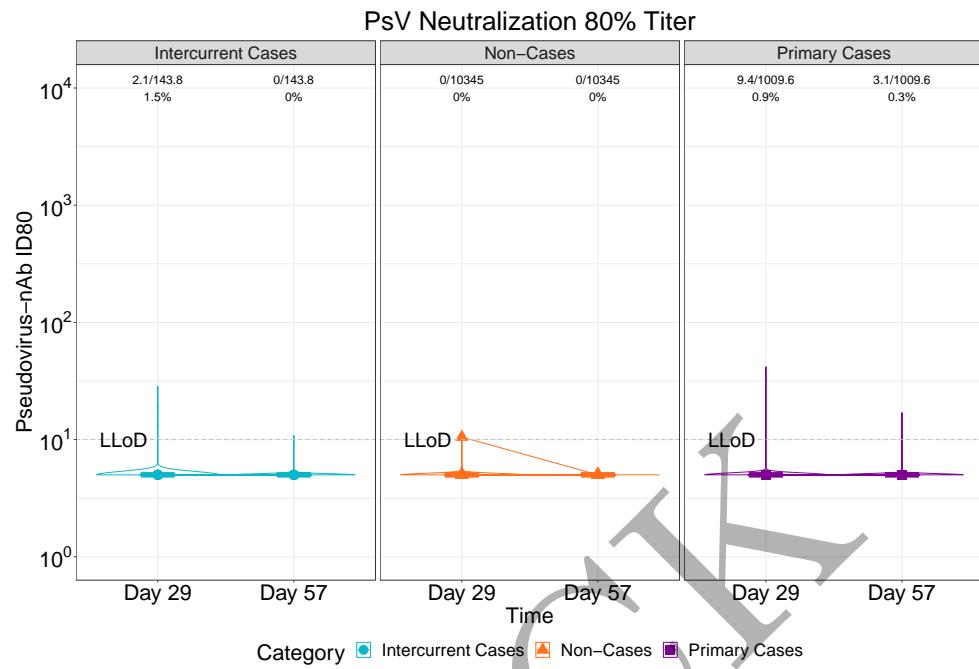


Figure 2.20: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

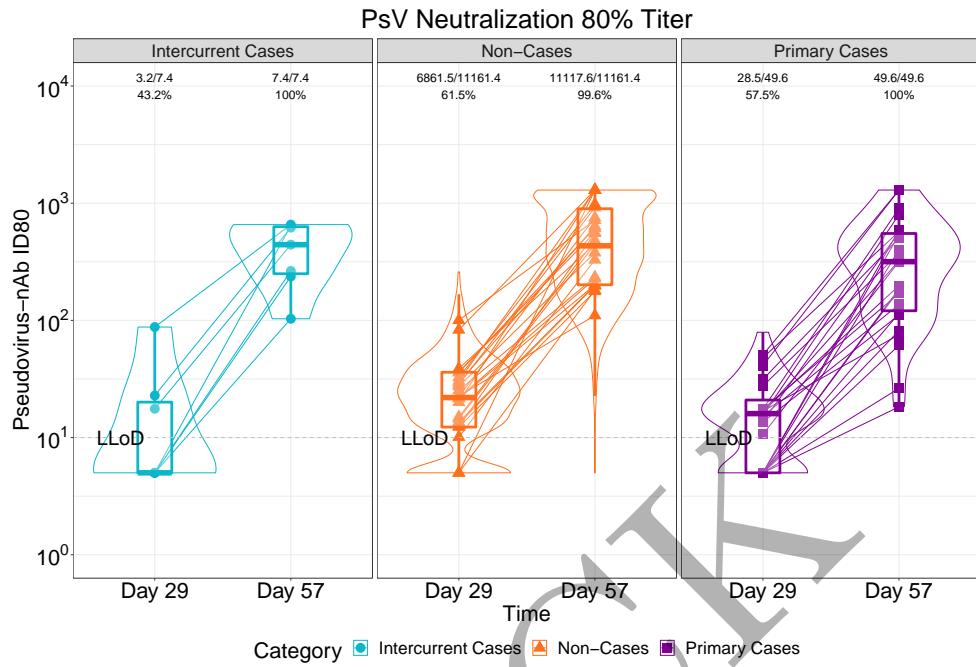


Figure 2.21: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

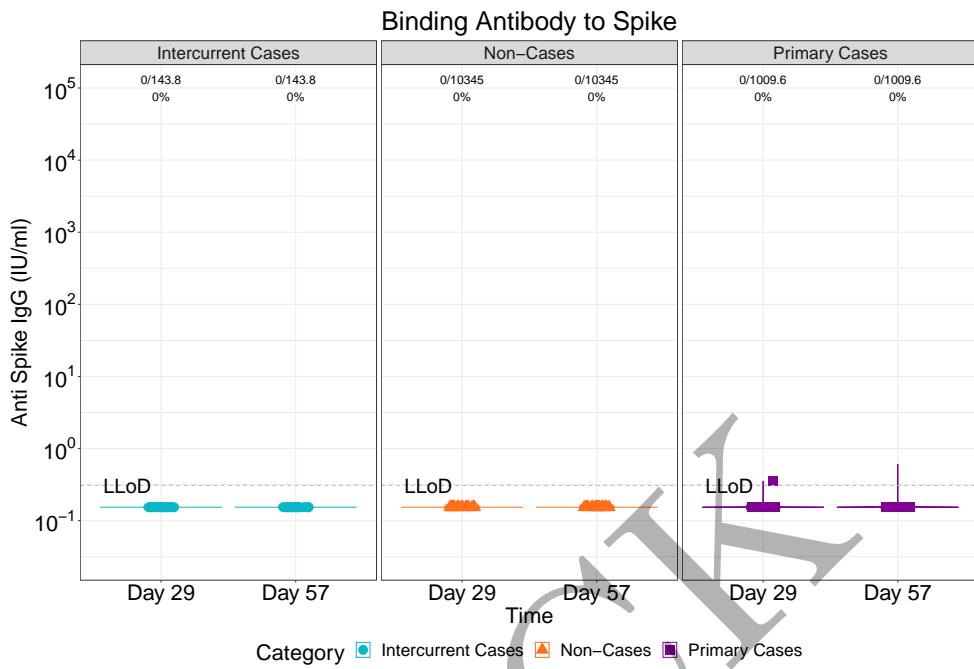


Figure 2.22: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

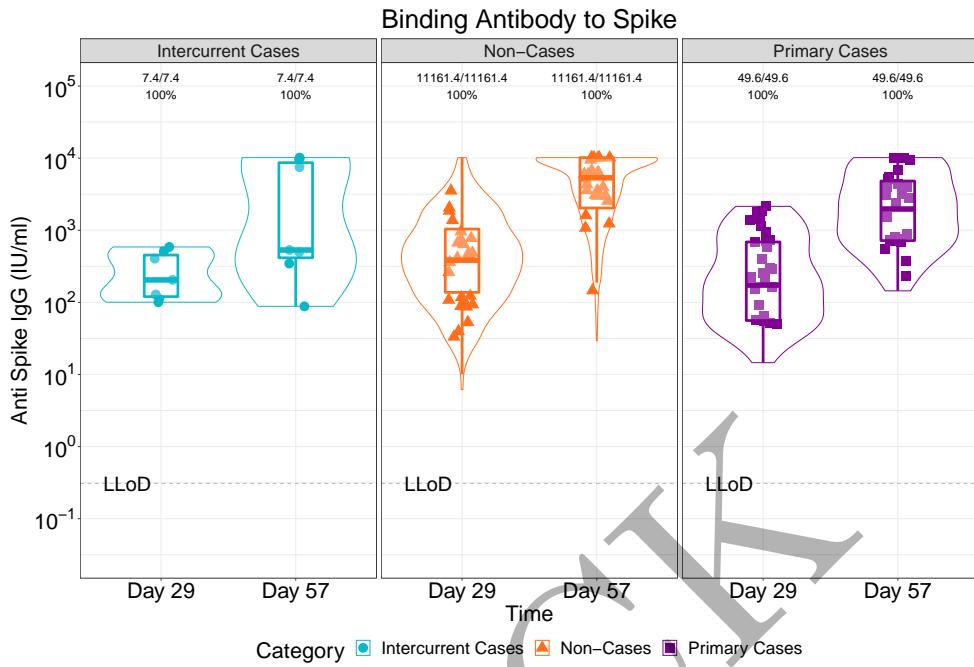


Figure 2.23: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

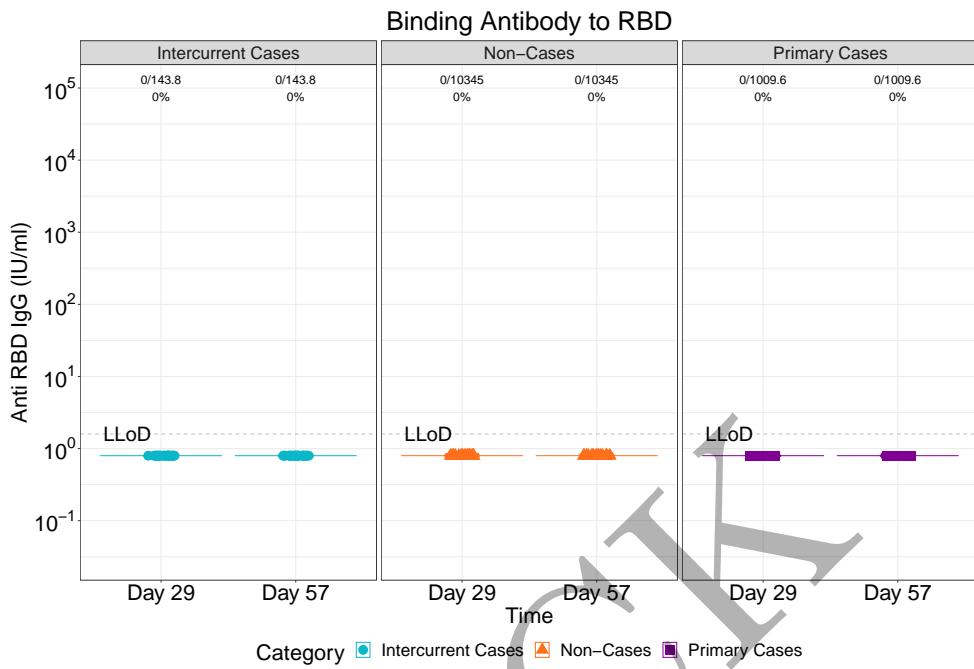


Figure 2.24: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

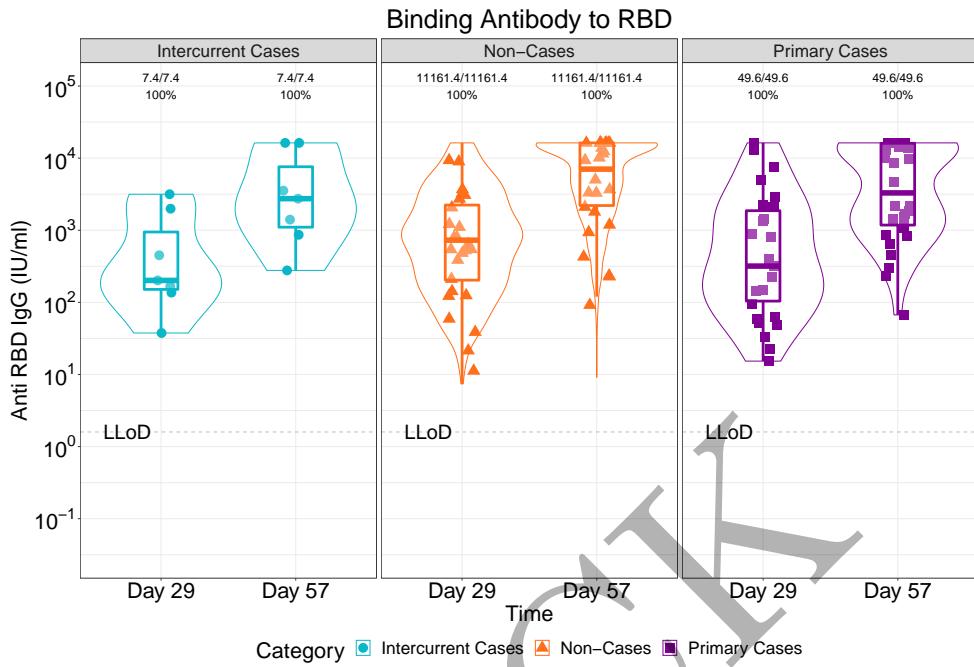


Figure 2.25: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

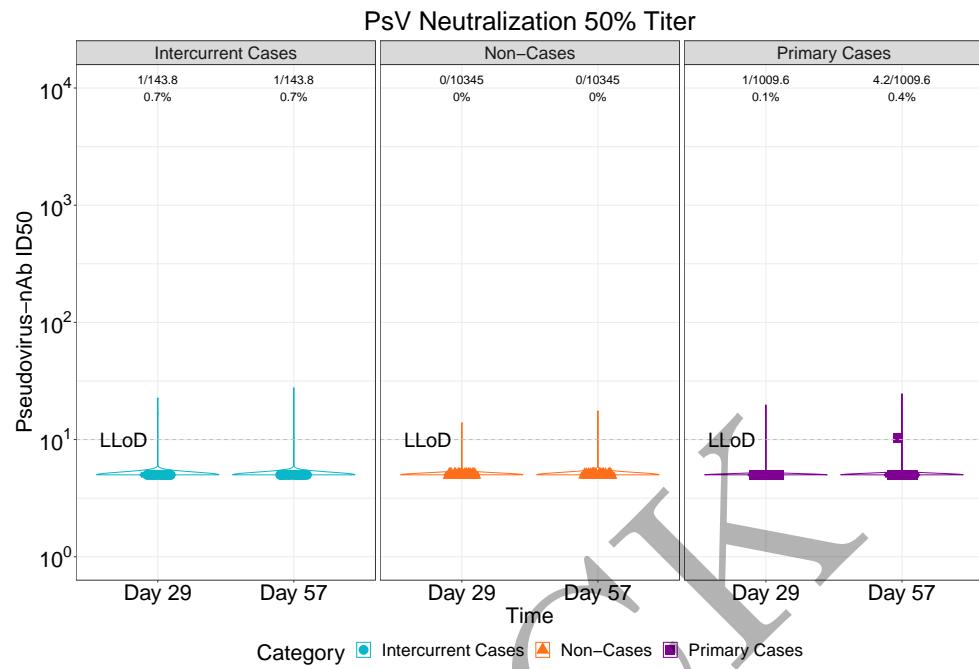


Figure 2.26: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

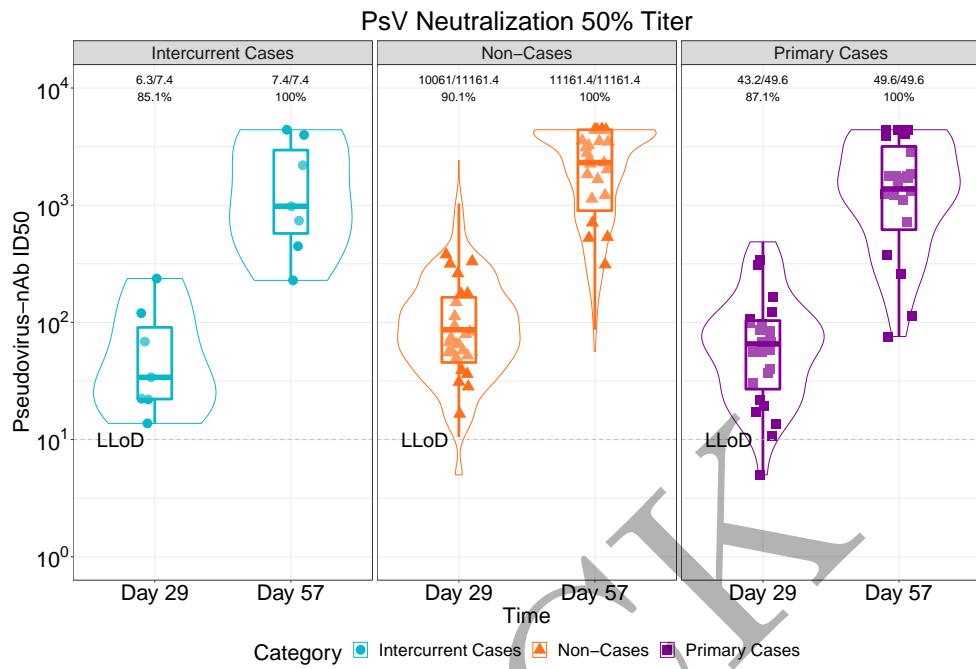


Figure 2.27: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

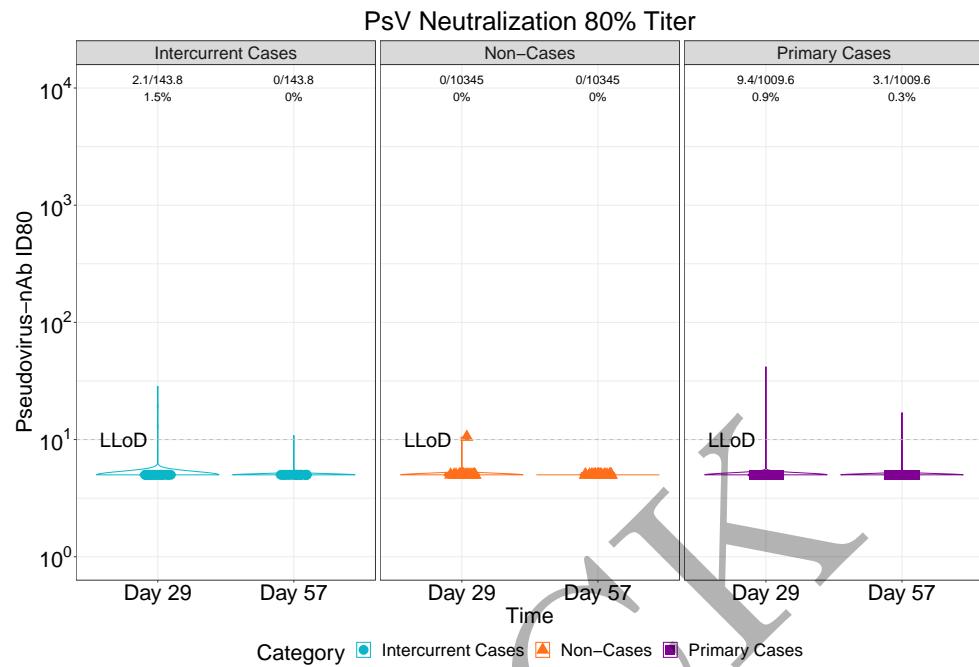


Figure 2.28: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

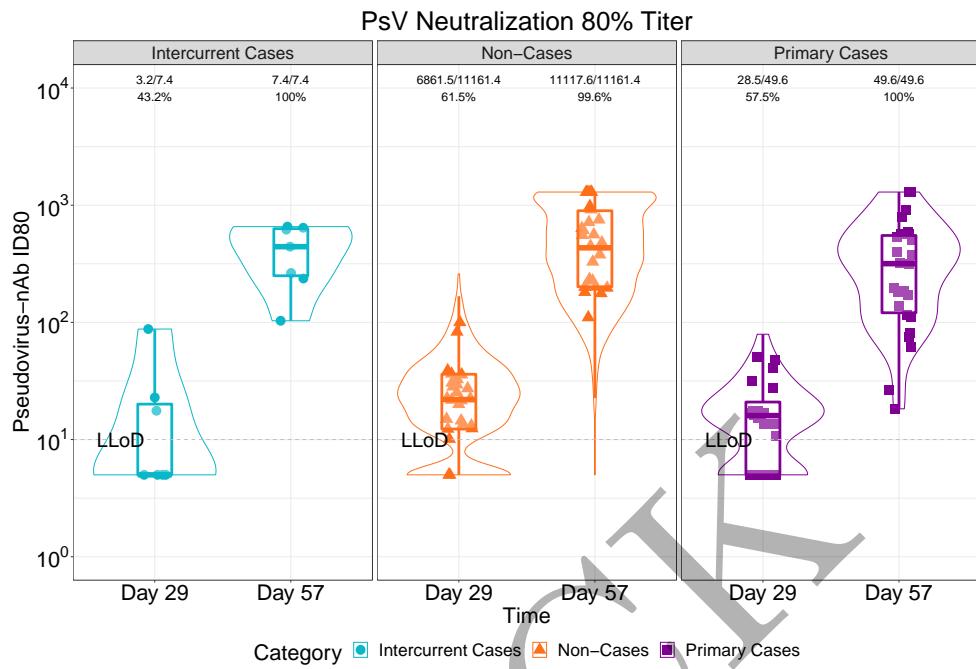


Figure 2.29: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

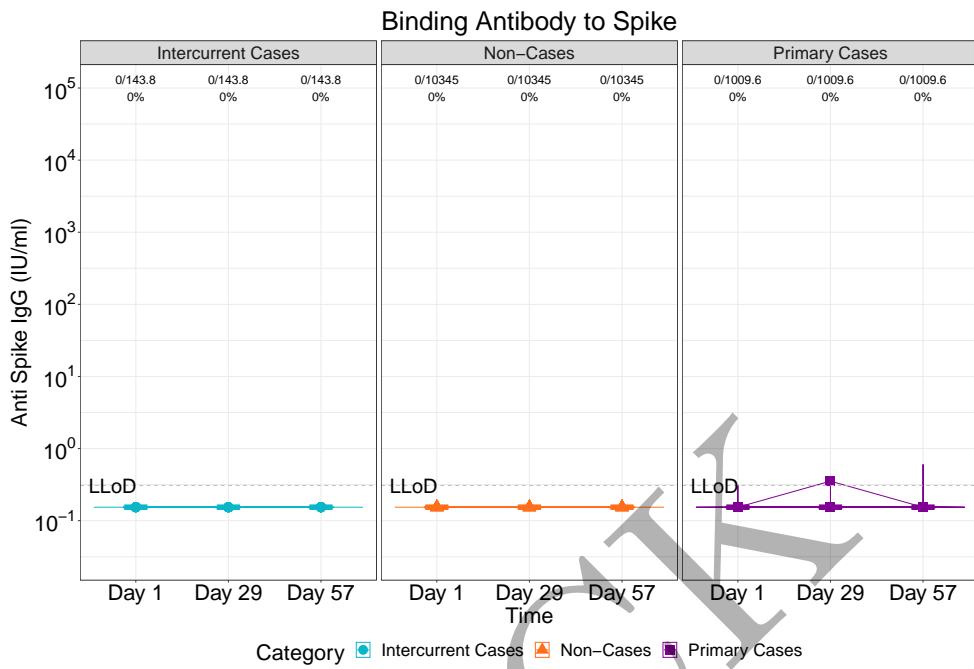


Figure 2.30: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

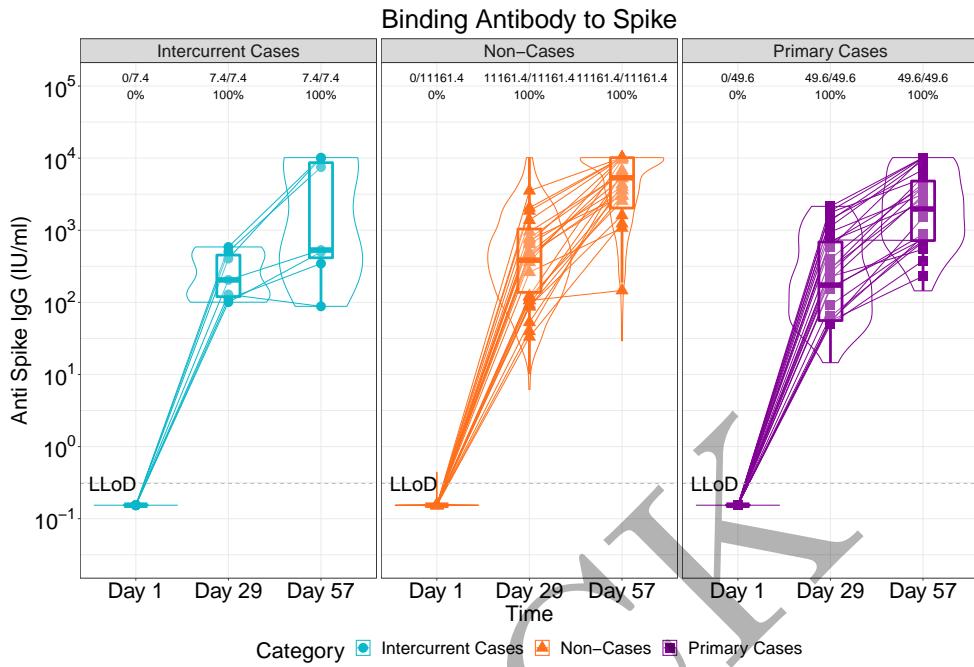


Figure 2.31: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

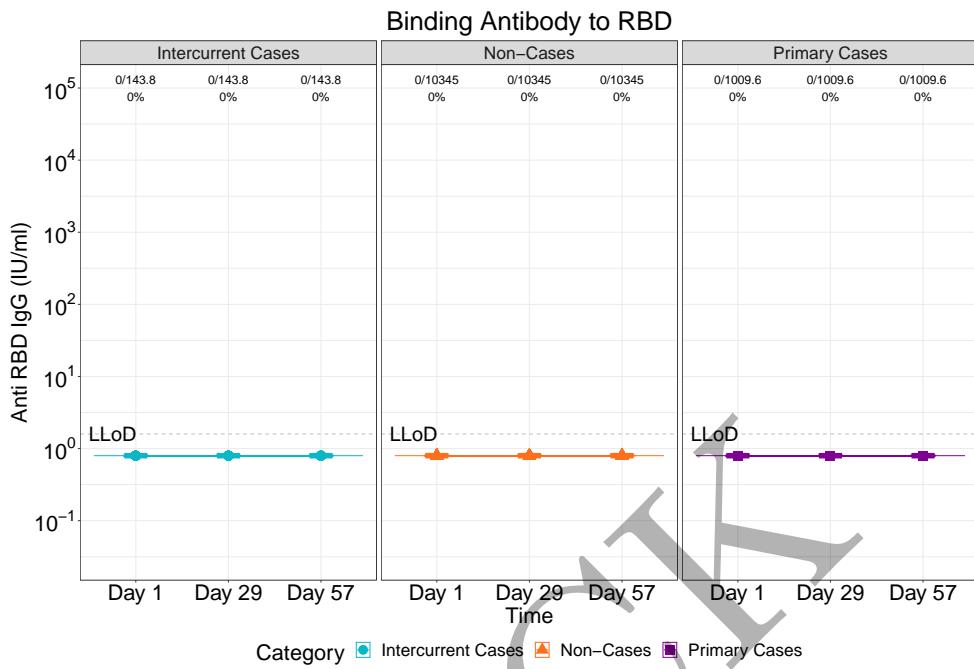


Figure 2.32: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

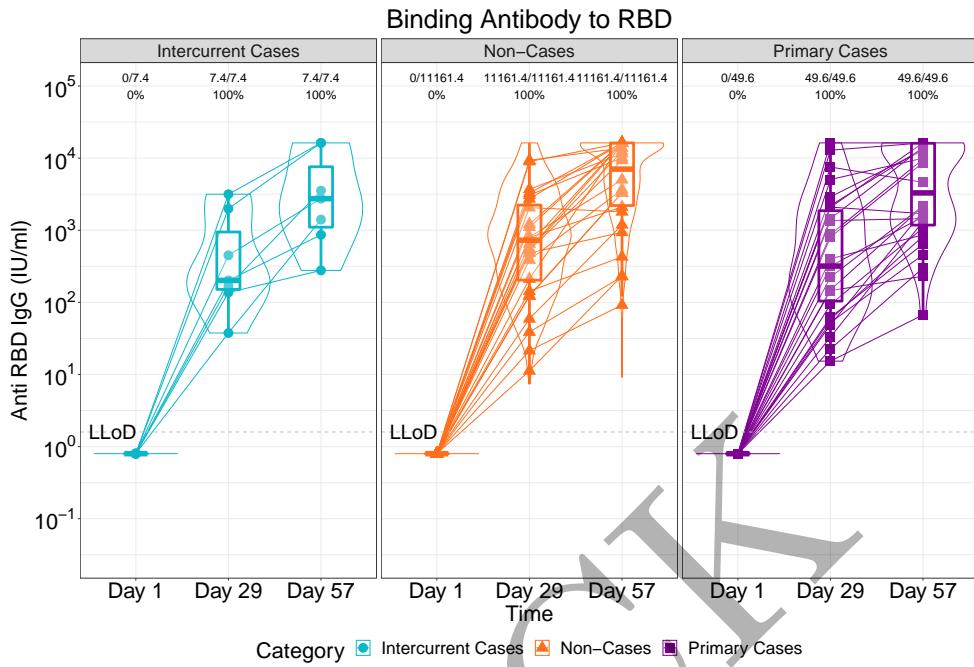


Figure 2.33: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

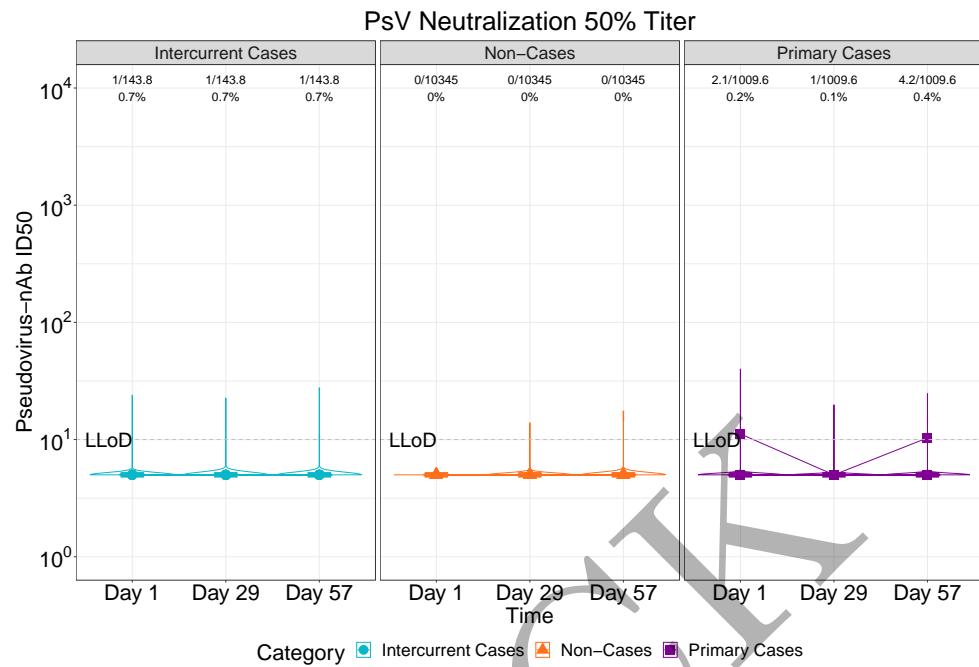


Figure 2.34: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

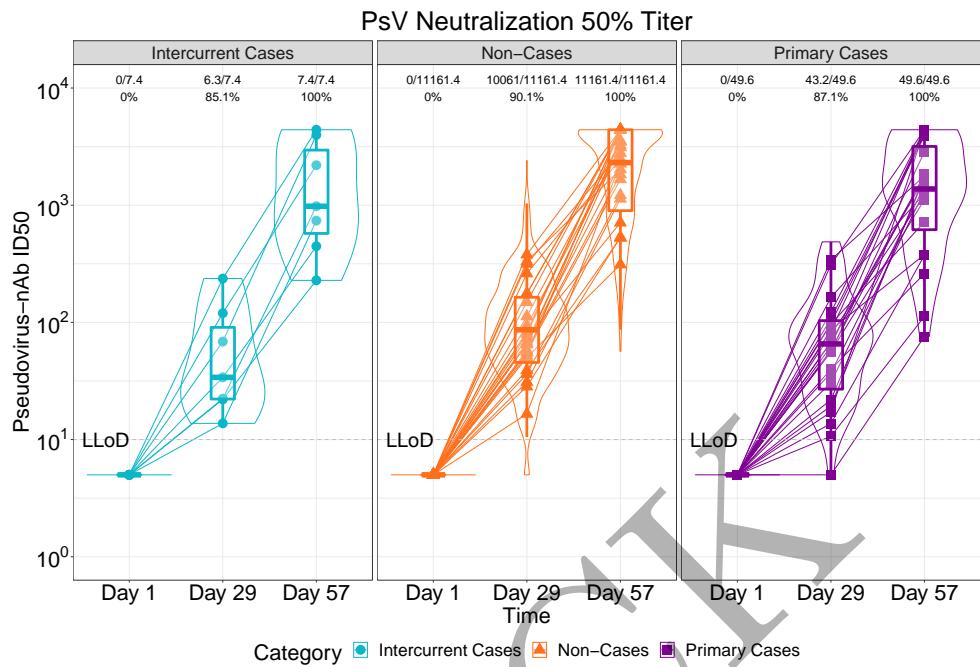


Figure 2.35: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

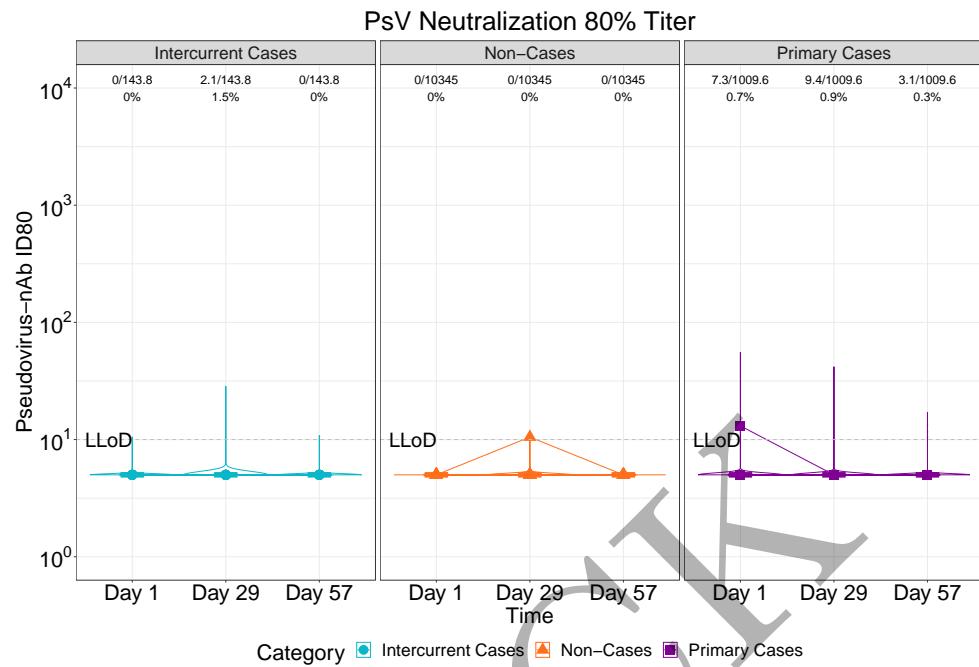


Figure 2.36: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

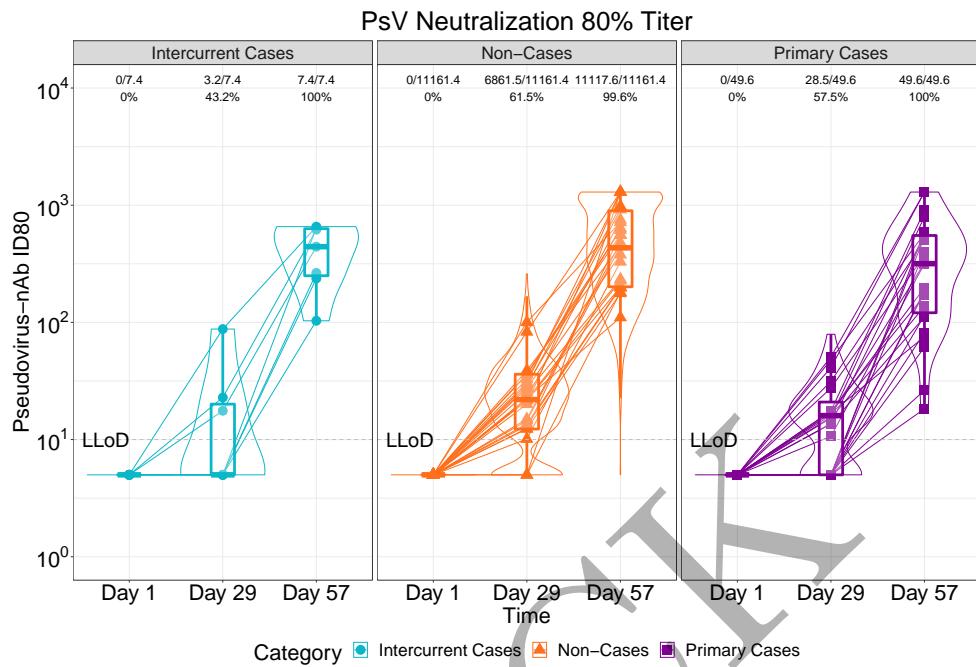


Figure 2.37: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

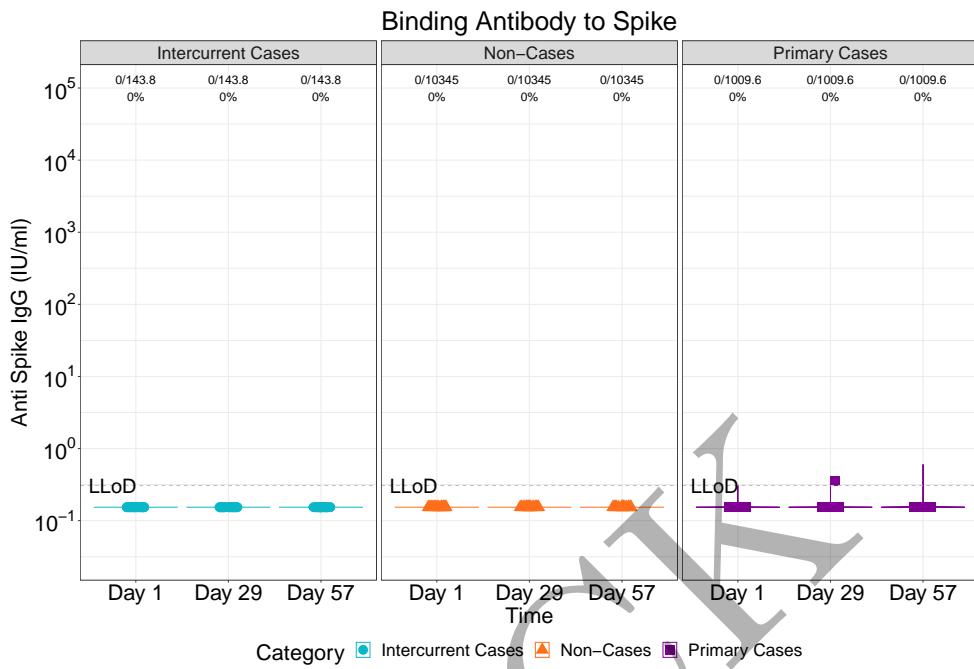


Figure 2.38: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

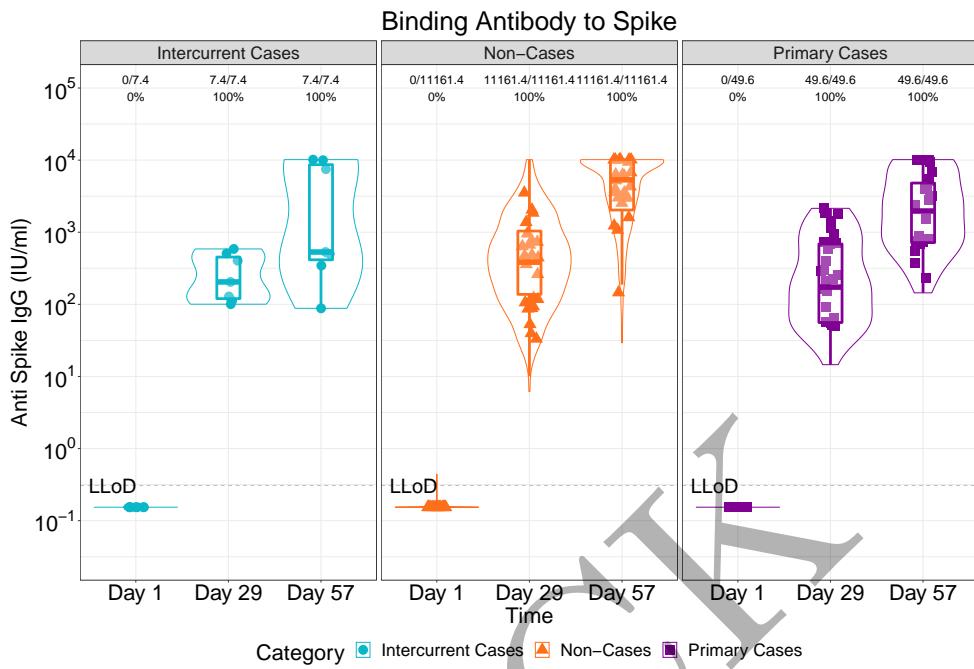


Figure 2.39: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

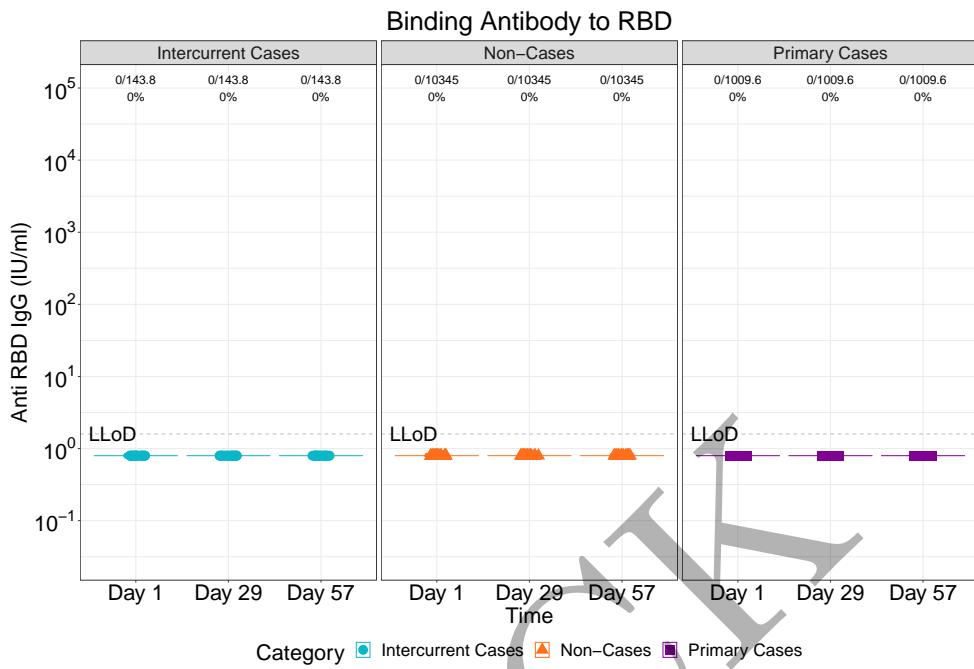


Figure 2.40: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

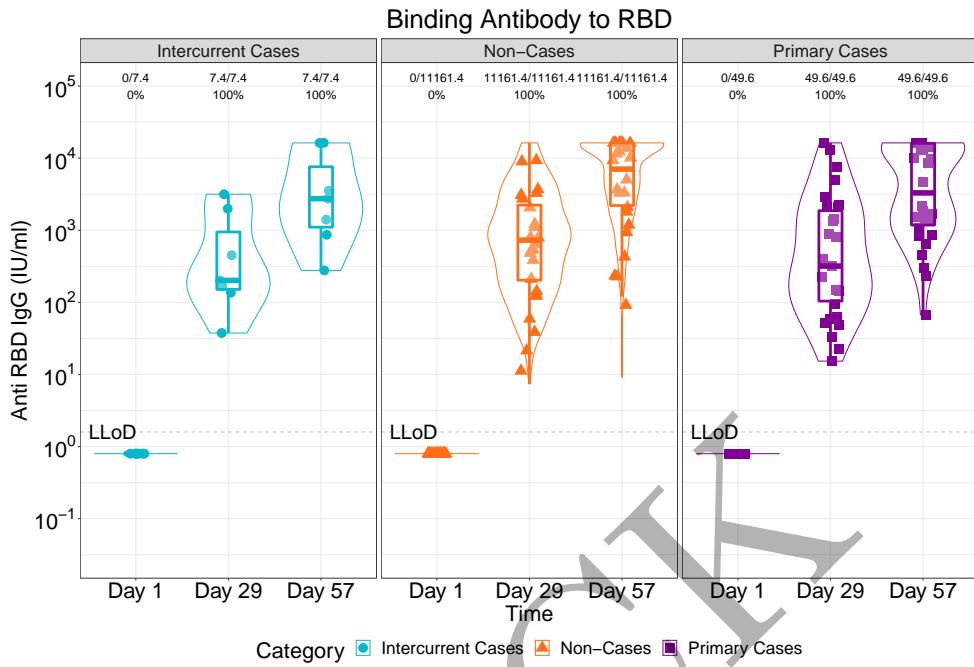


Figure 2.41: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

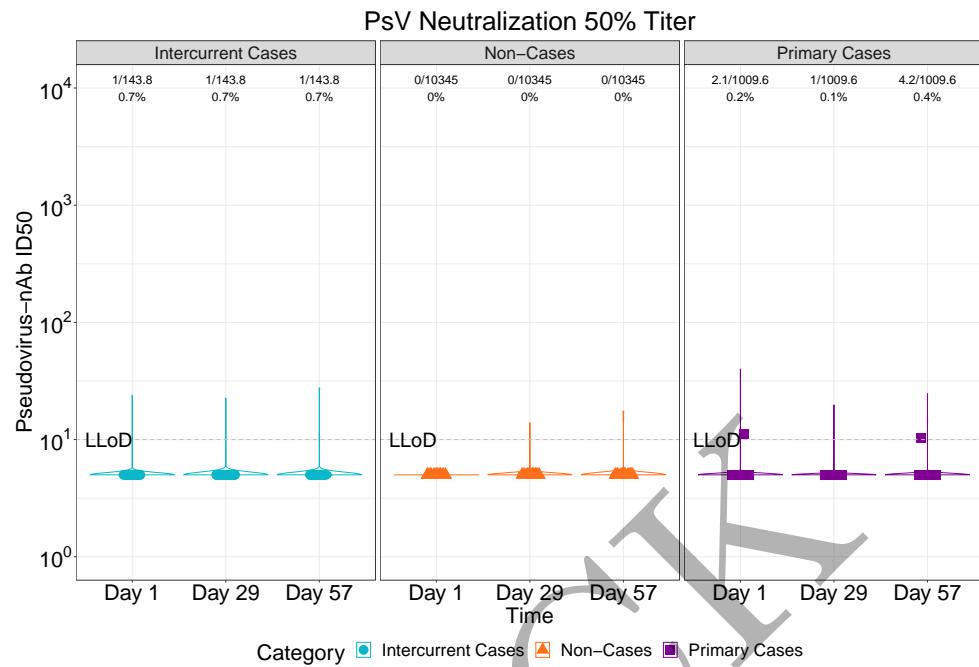


Figure 2.42: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

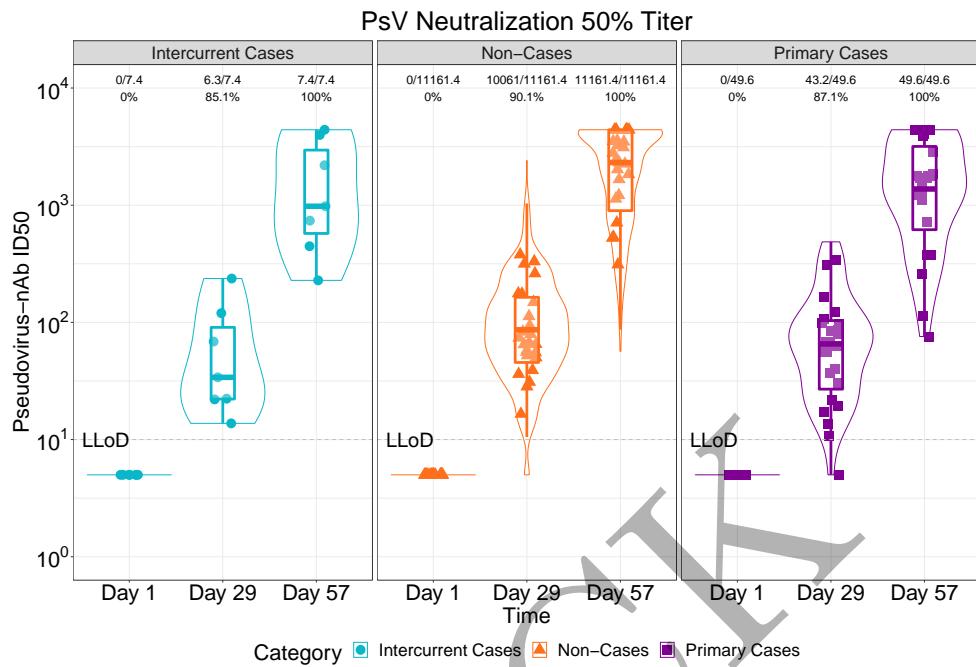


Figure 2.43: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

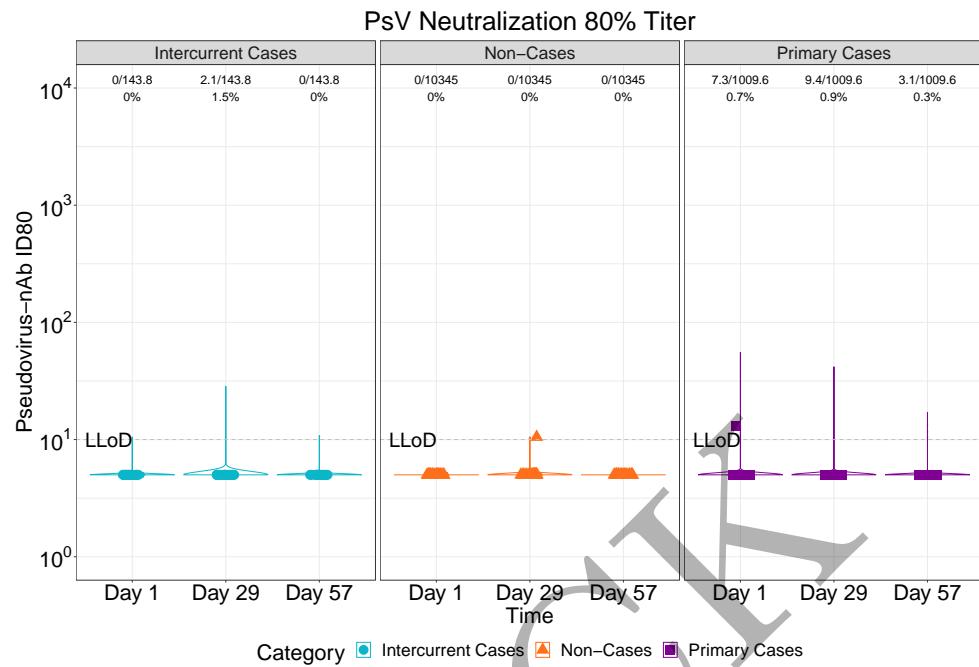


Figure 2.44: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

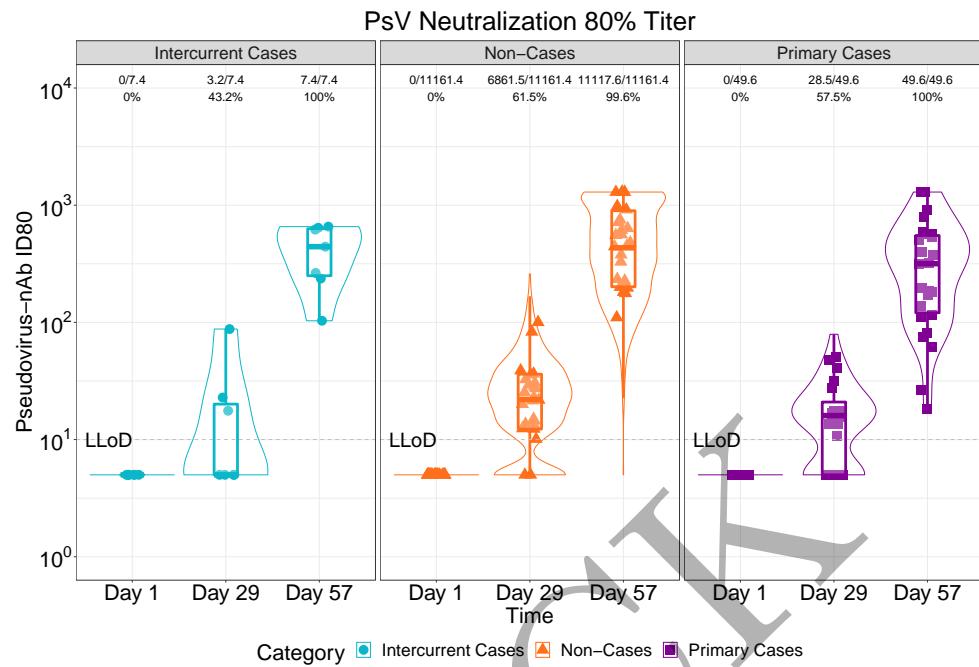


Figure 2.45: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

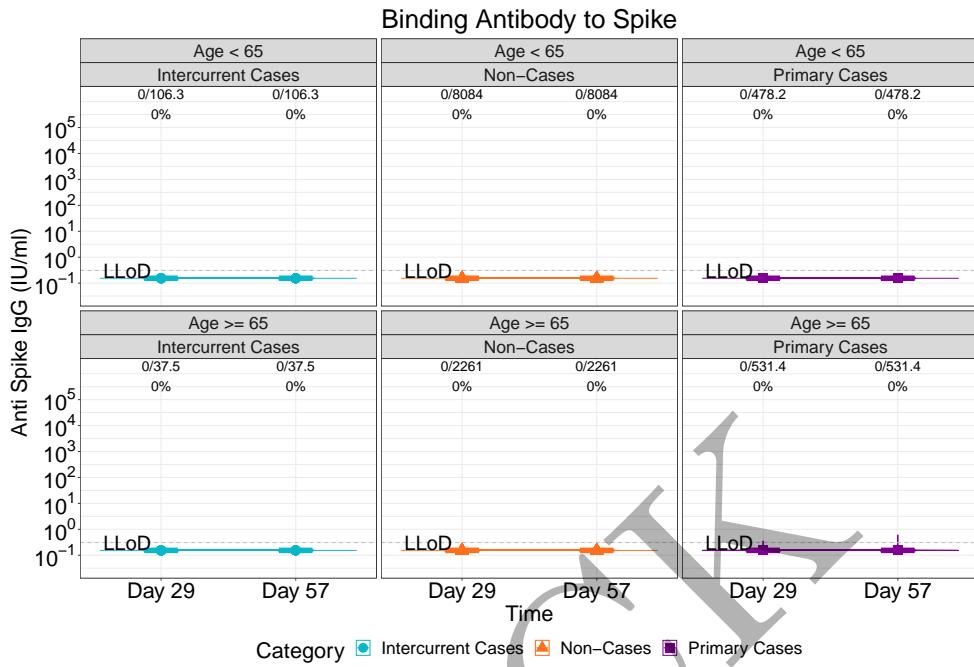


Figure 2.46: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

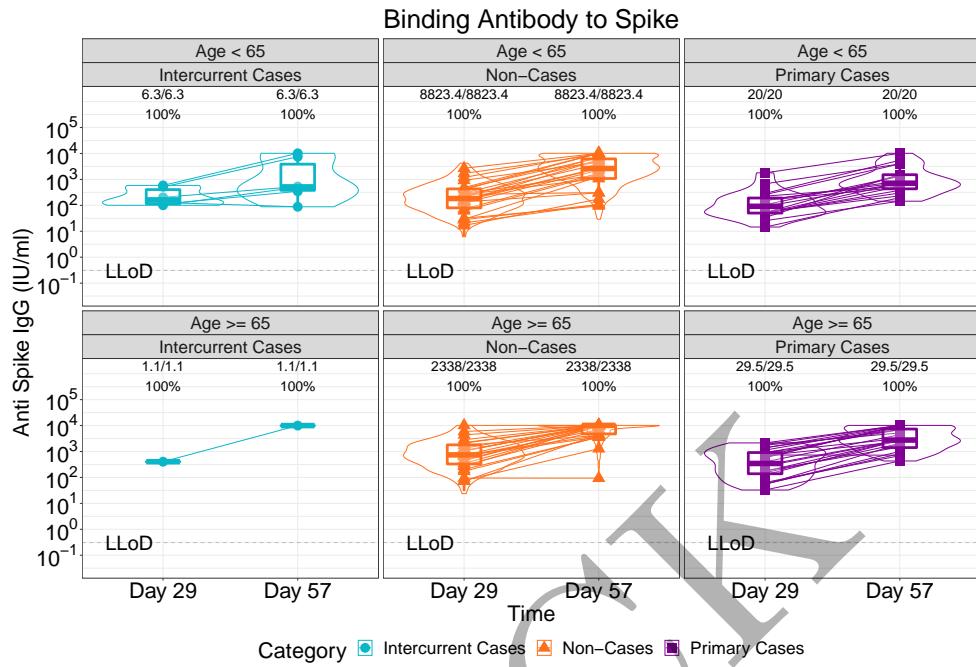


Figure 2.47: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

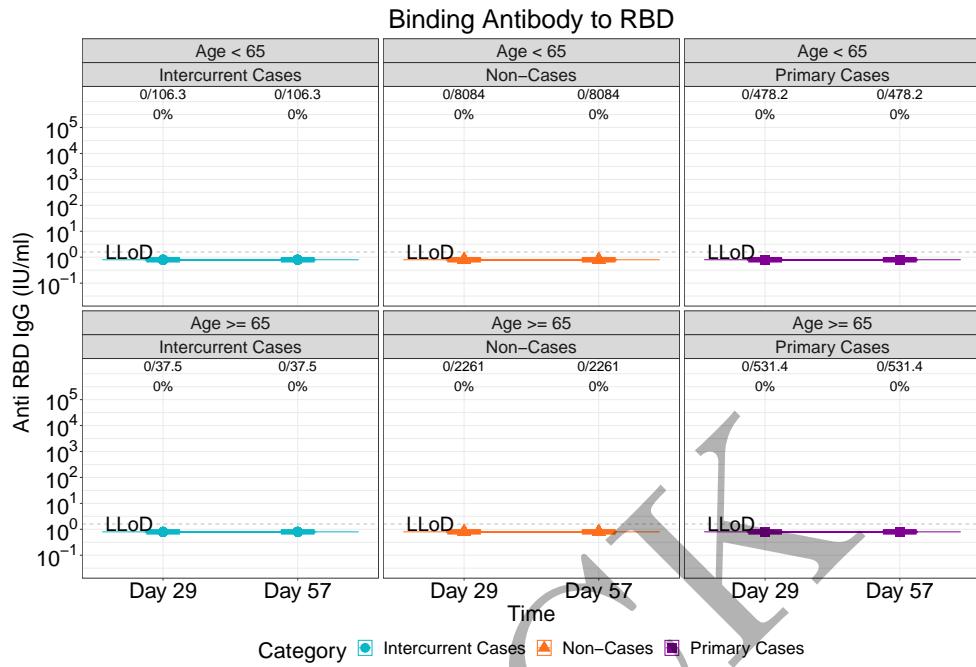


Figure 2.48: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

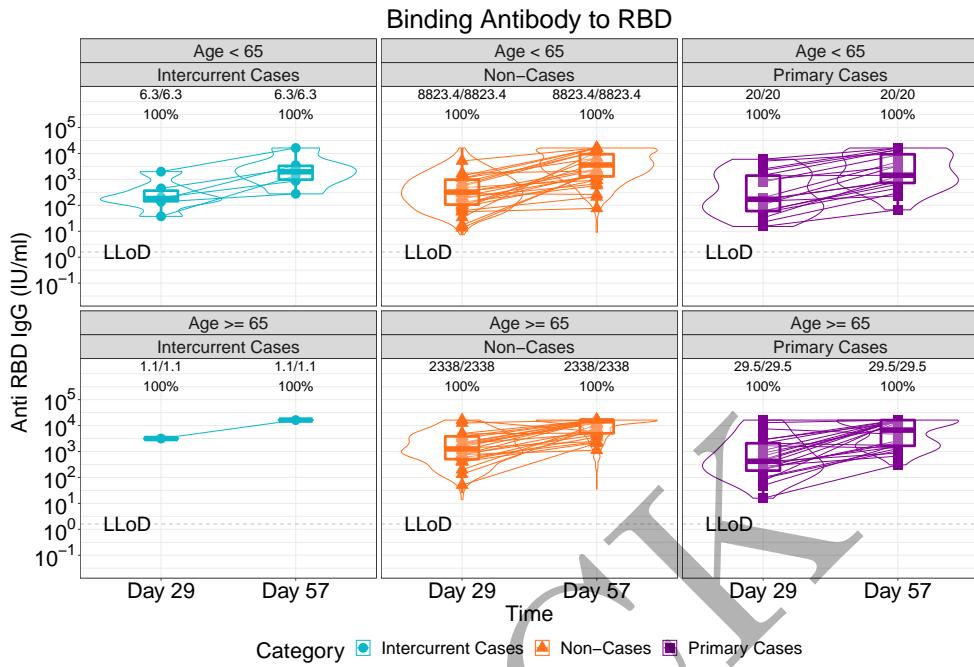


Figure 2.49: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

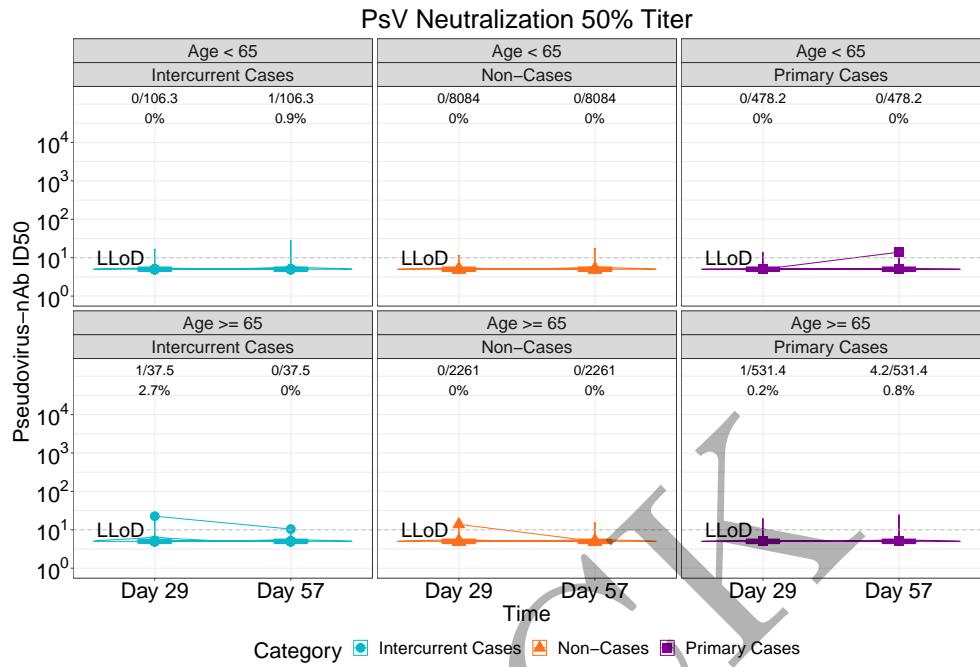


Figure 2.50: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

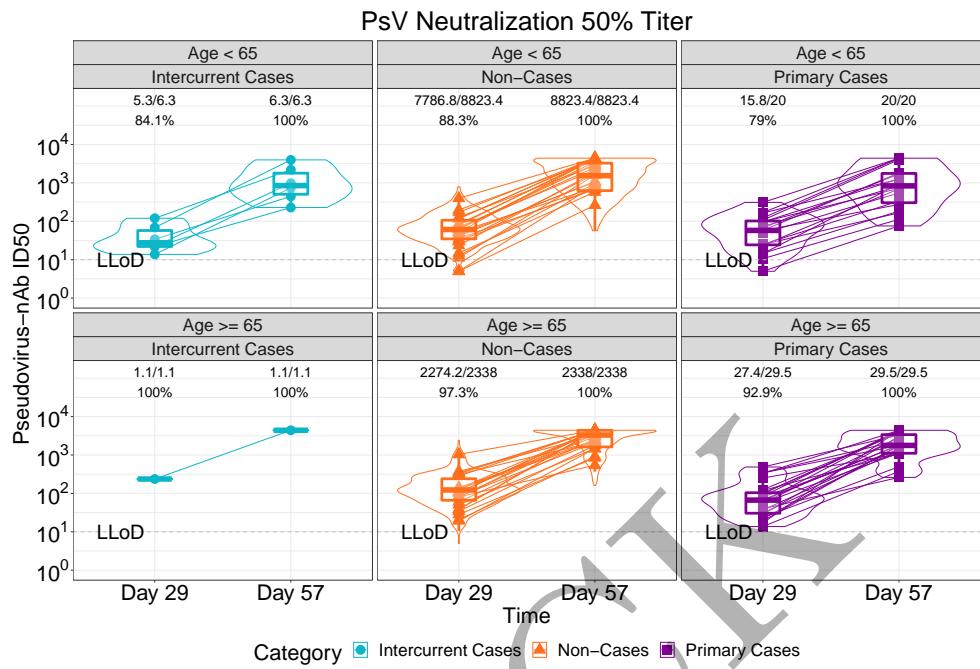


Figure 2.51: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

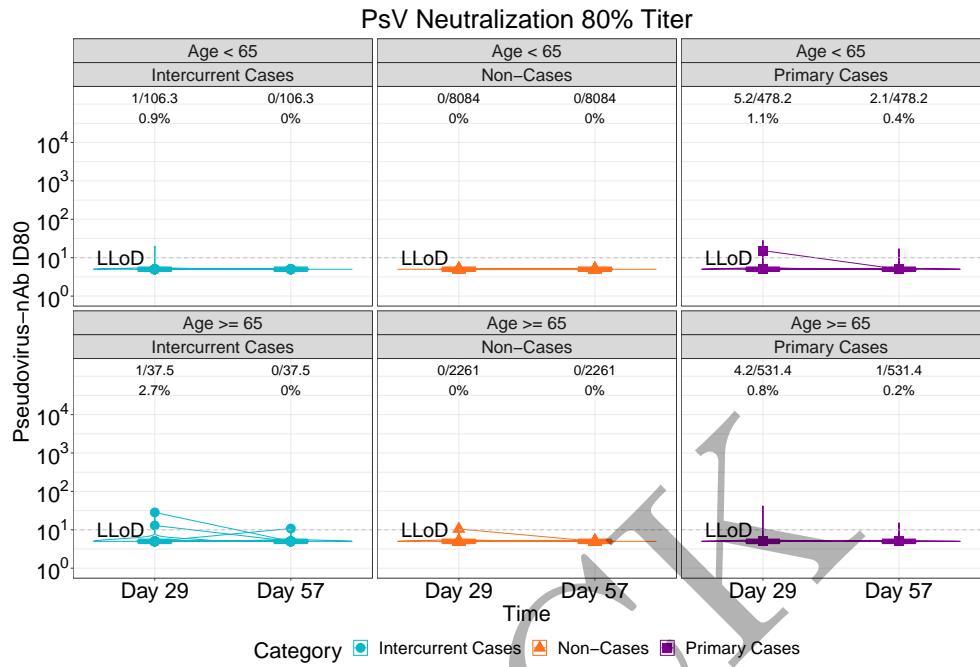


Figure 2.52: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

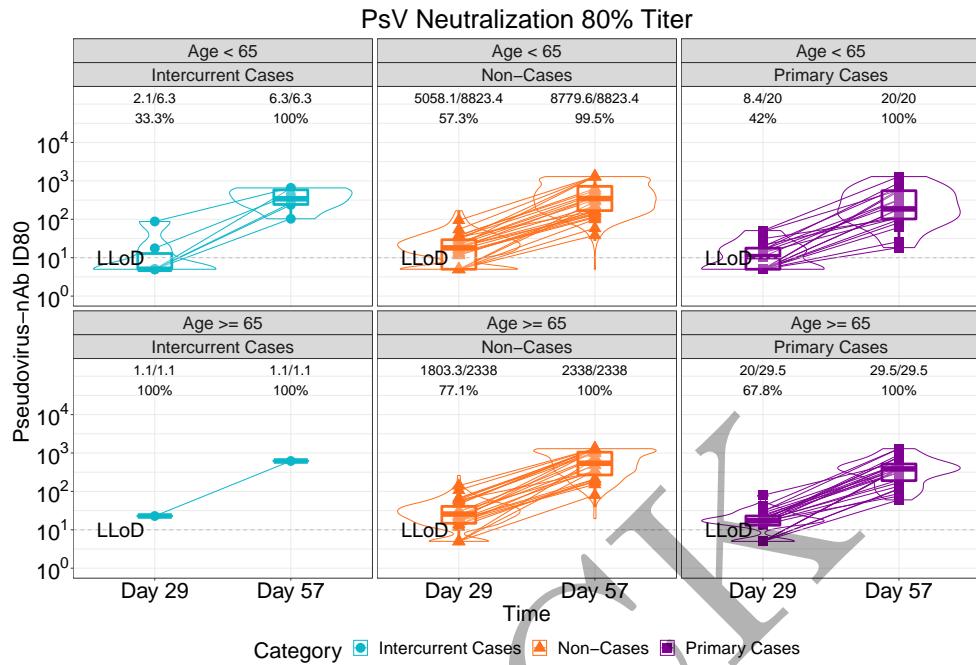


Figure 2.53: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

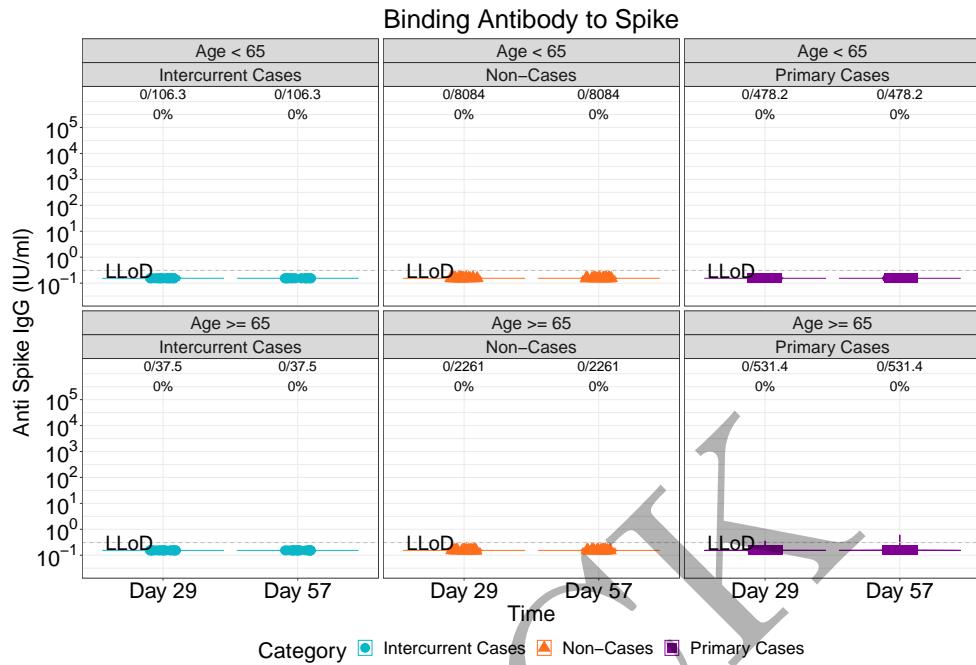


Figure 2.54: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

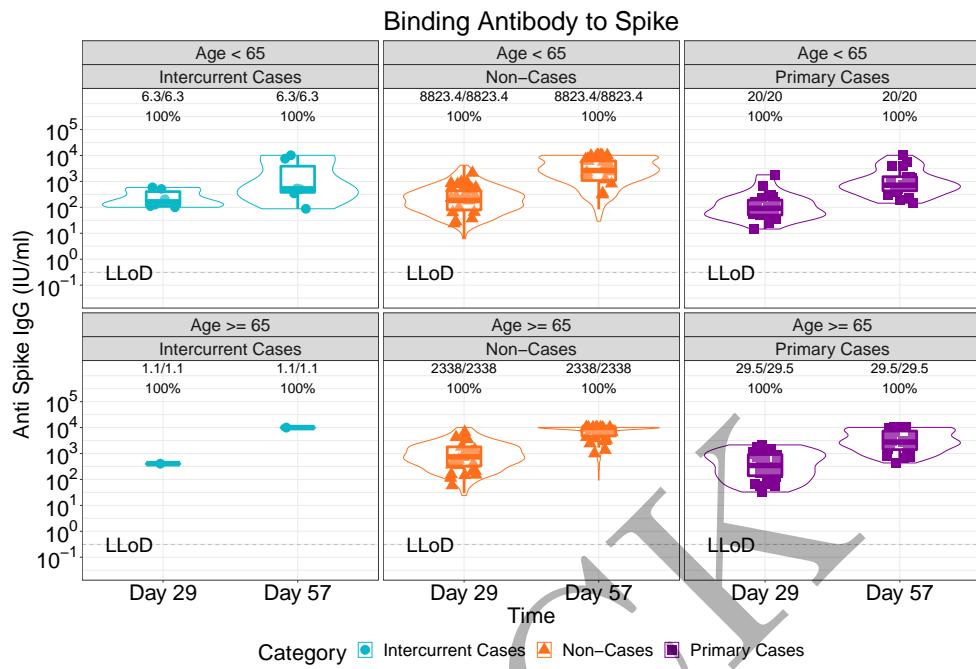


Figure 2.55: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

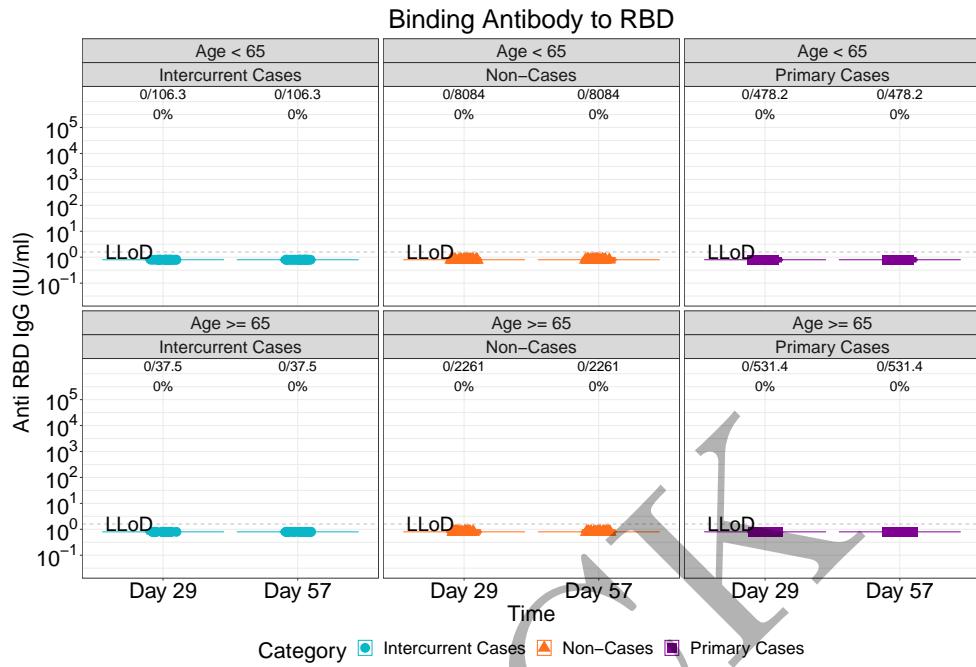


Figure 2.56: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

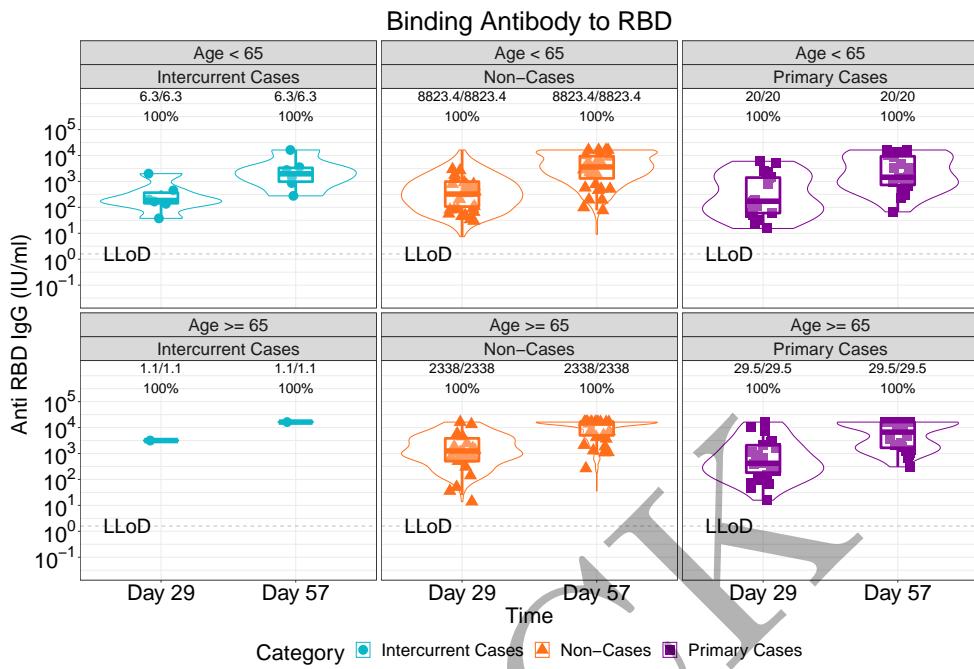


Figure 2.57: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

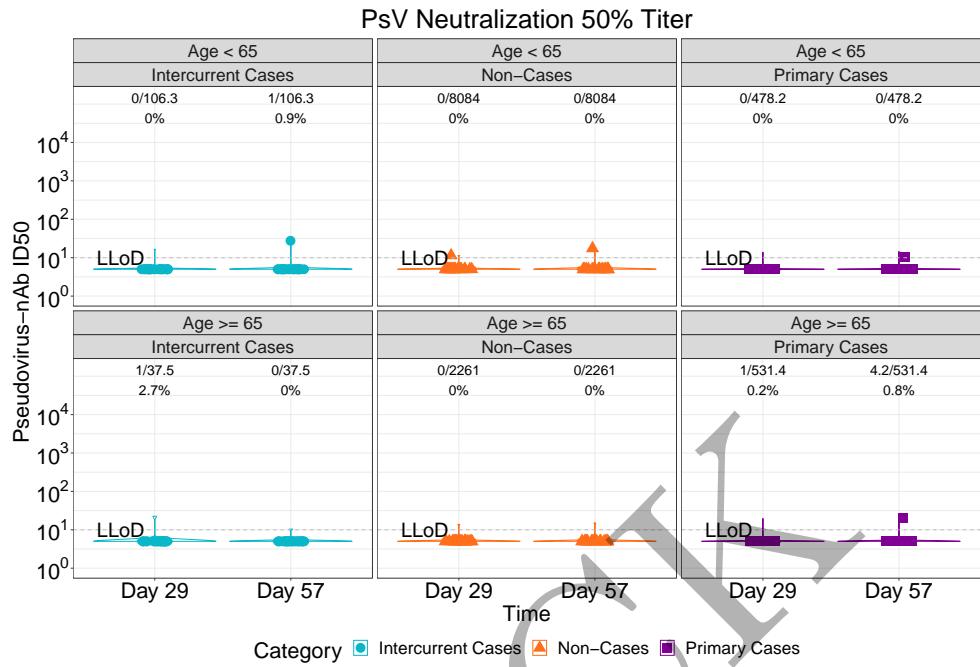


Figure 2.58: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

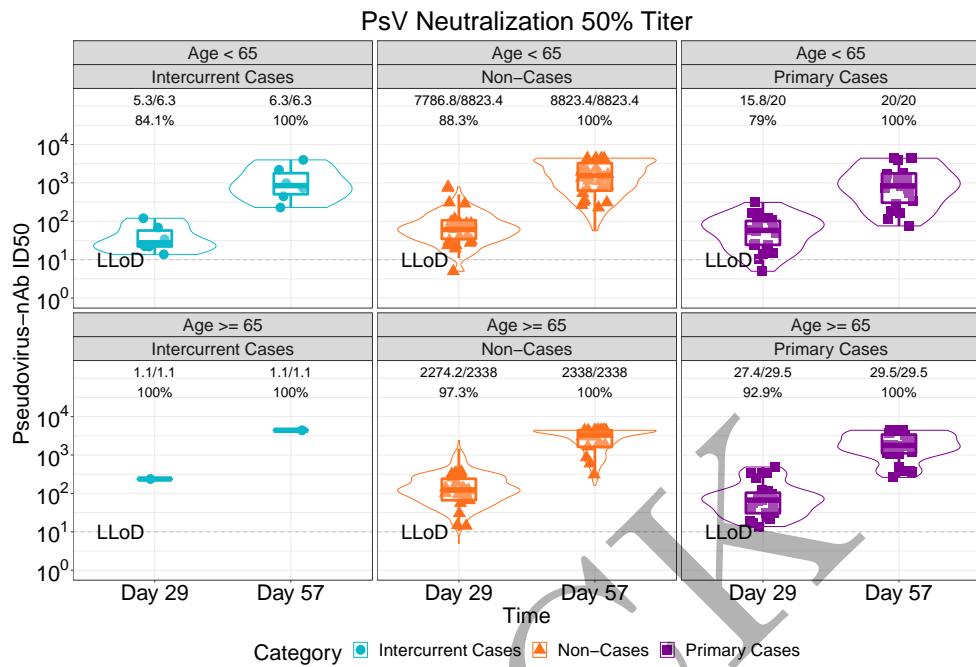


Figure 2.59: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

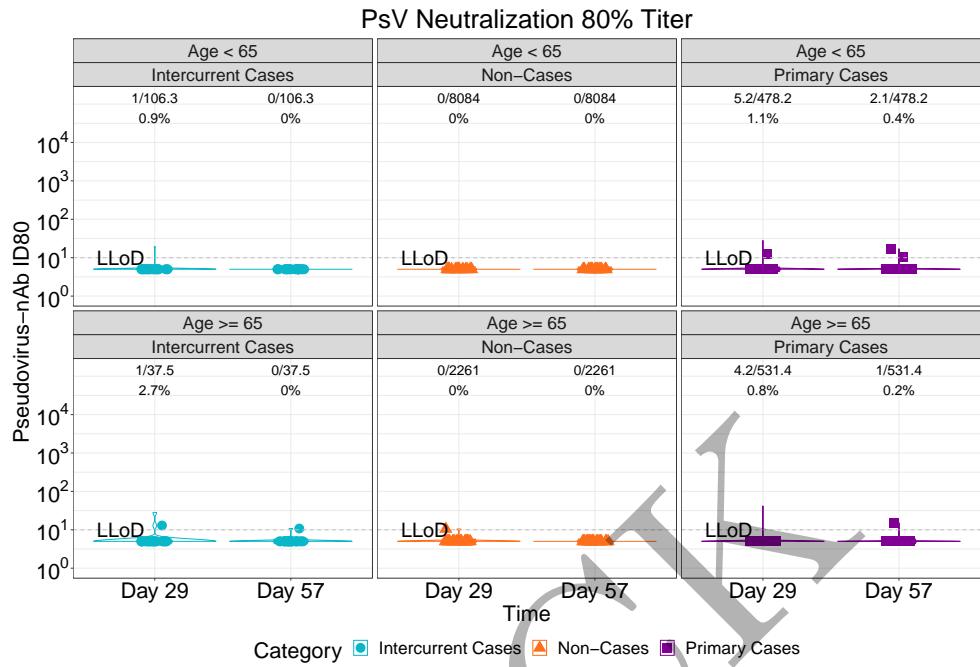


Figure 2.60: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

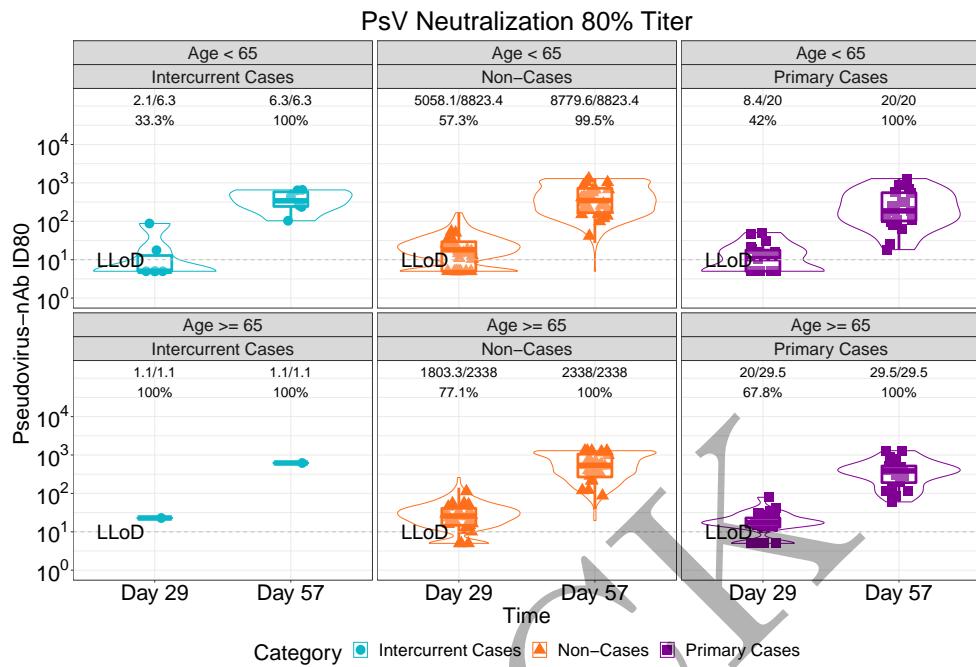


Figure 2.61: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

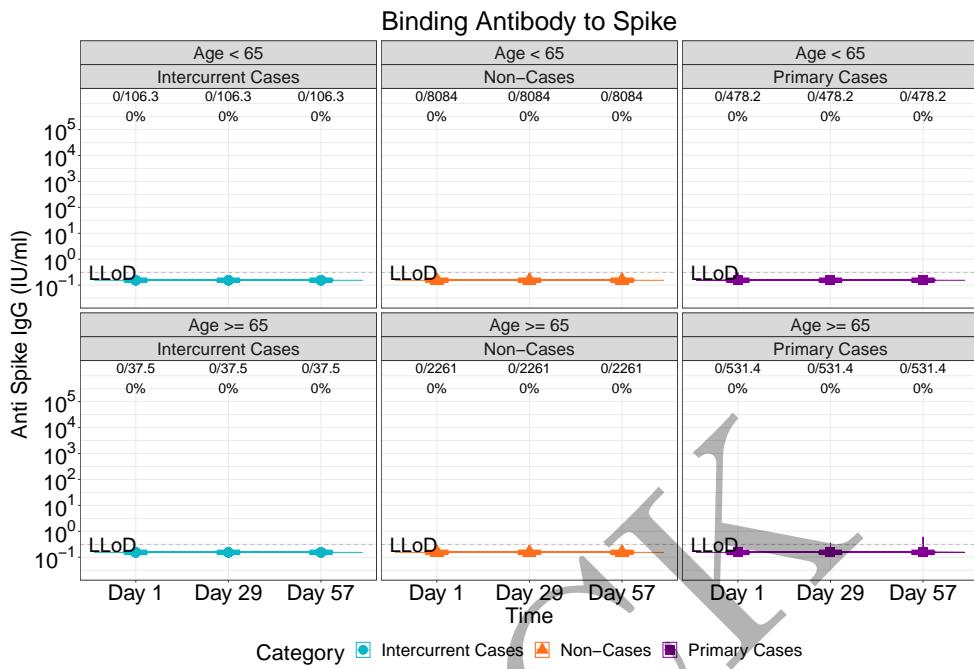


Figure 2.62: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

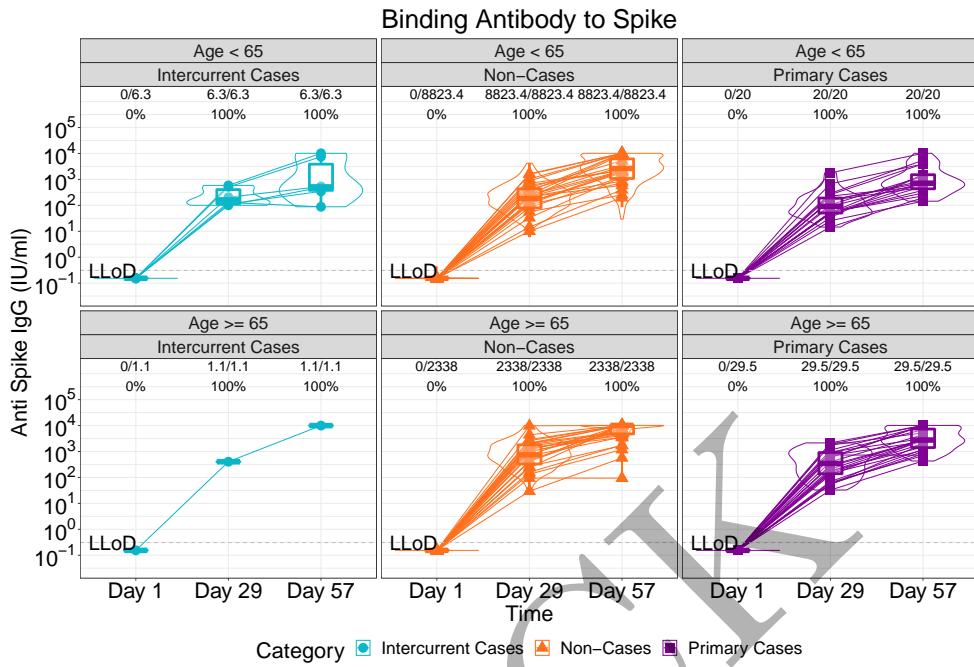


Figure 2.63: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

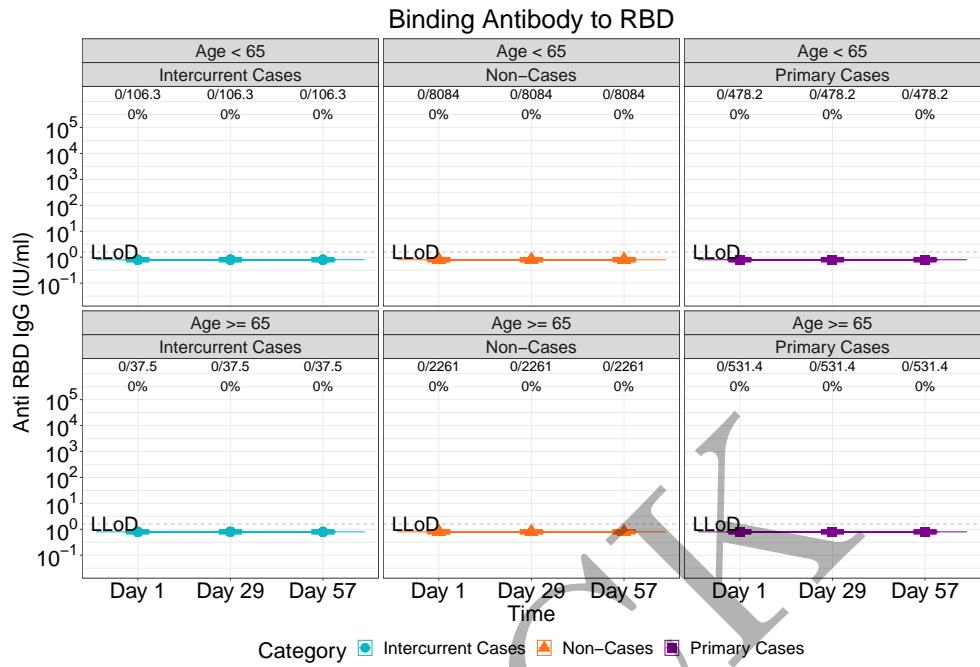


Figure 2.64: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

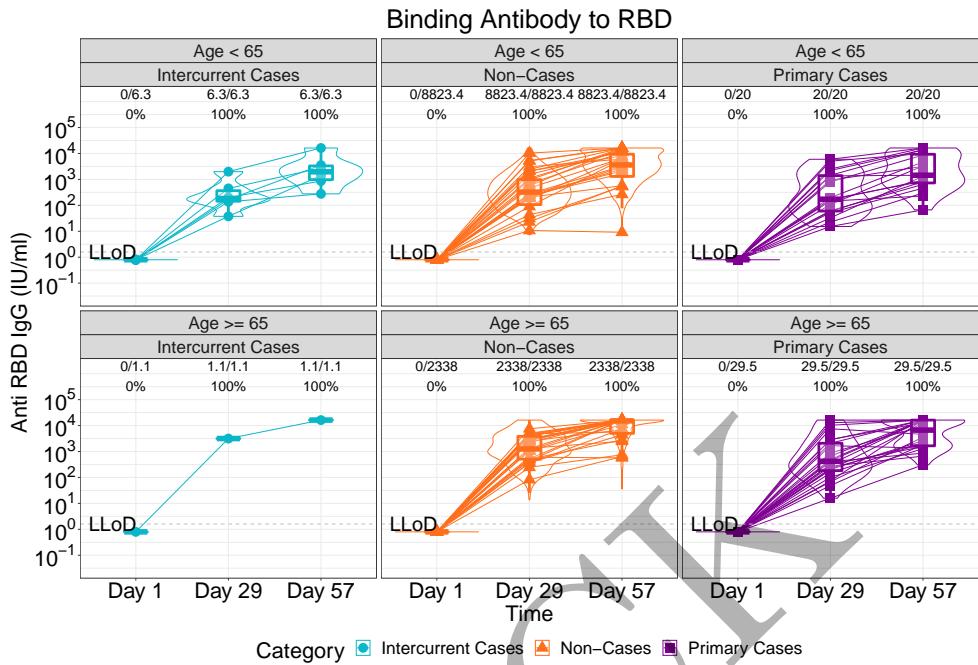


Figure 2.65: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

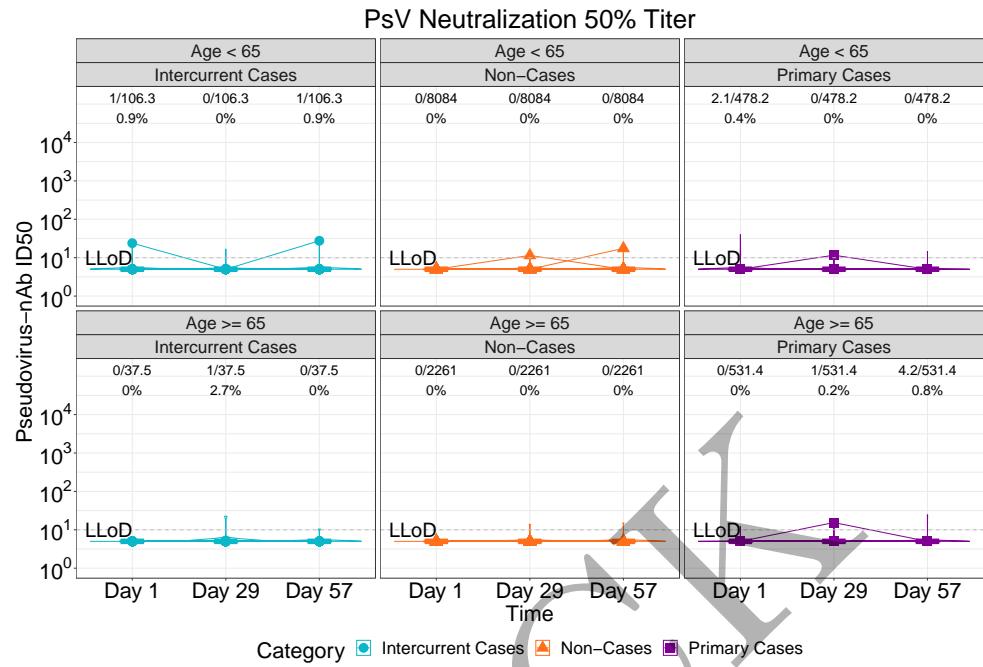


Figure 2.66: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

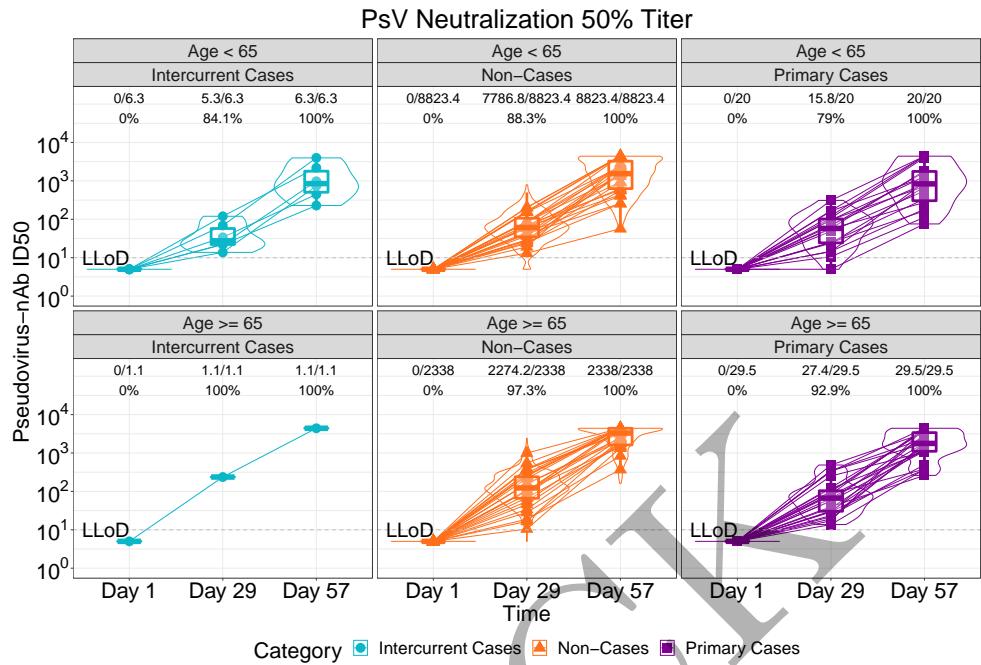


Figure 2.67: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

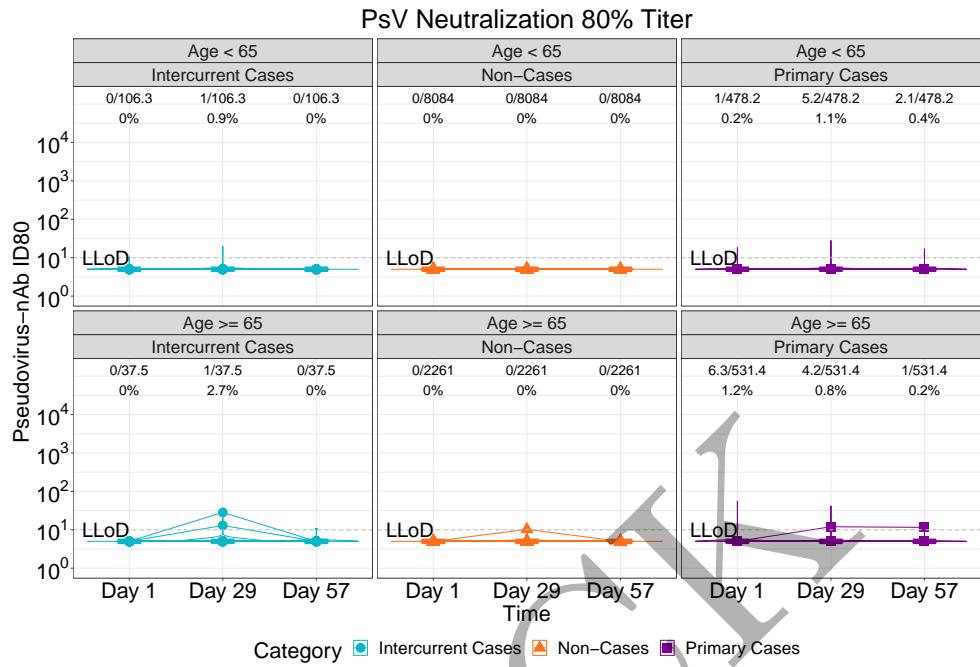


Figure 2.68: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

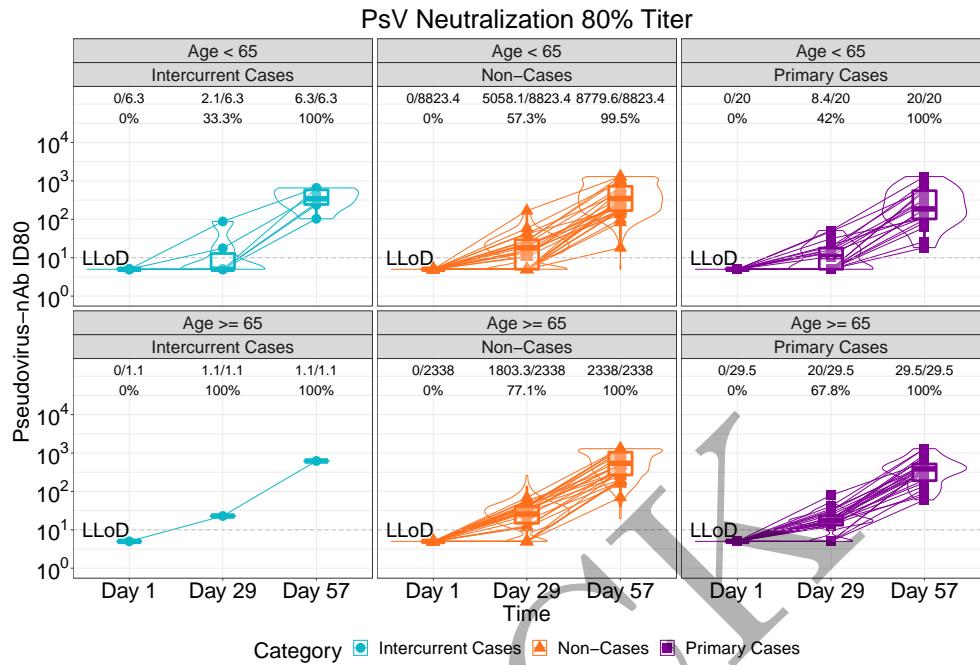


Figure 2.69: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

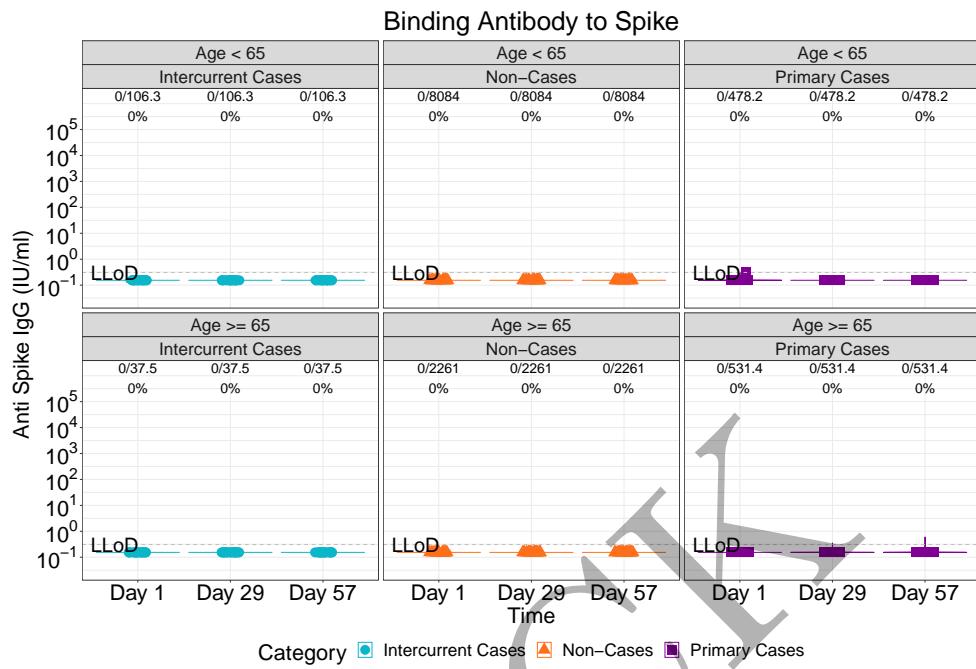


Figure 2.70: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

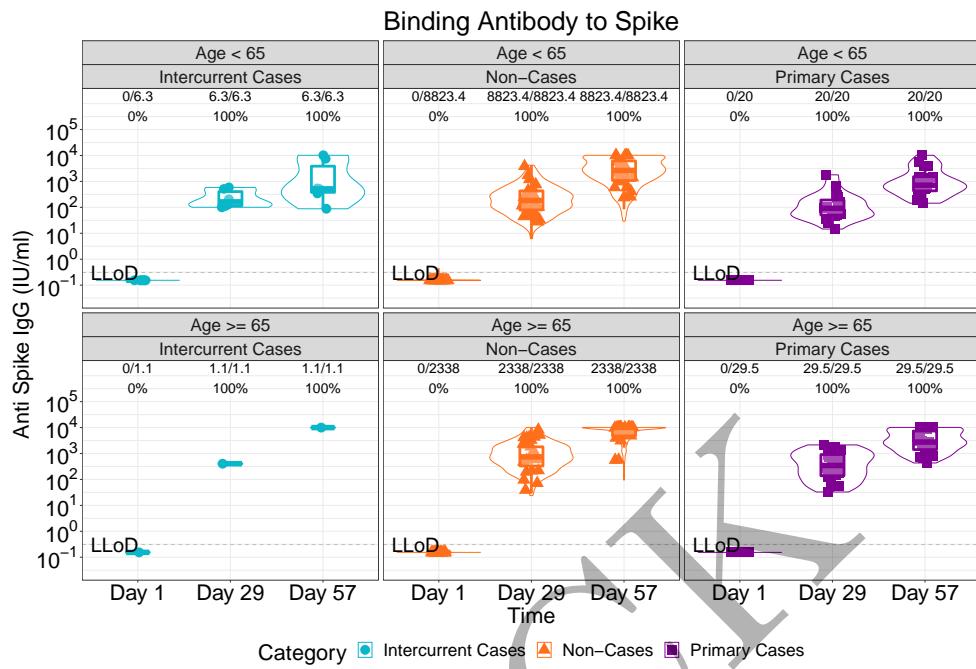


Figure 2.71: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

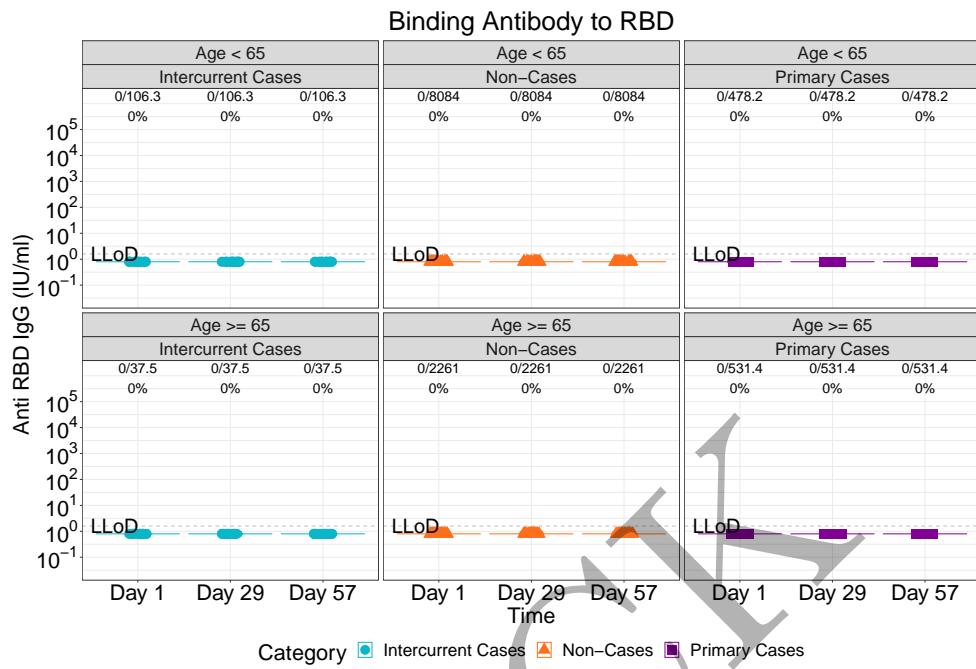


Figure 2.72: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

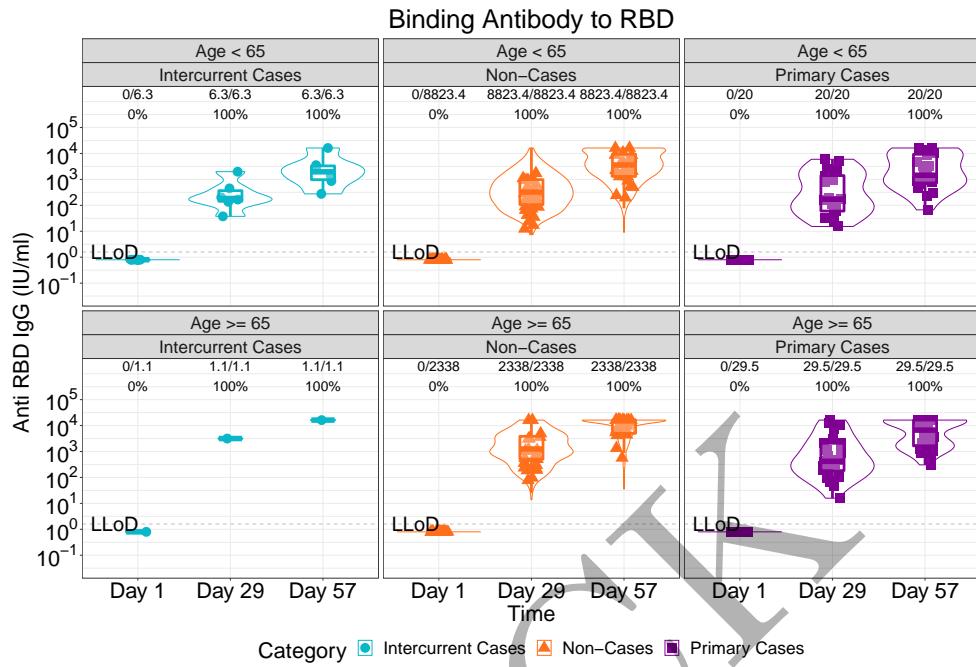


Figure 2.73: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

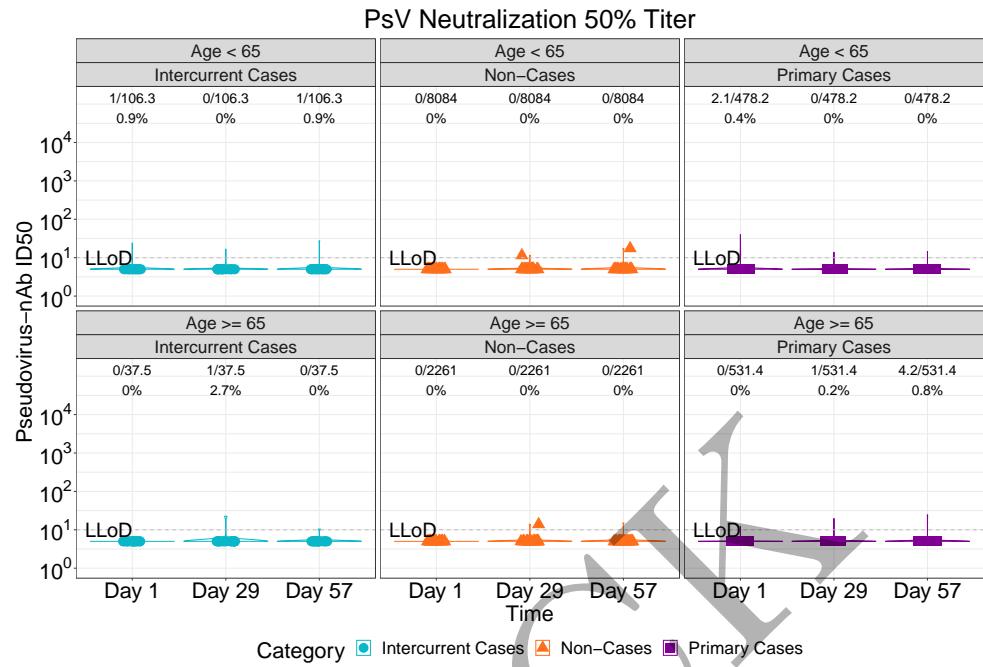


Figure 2.74: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

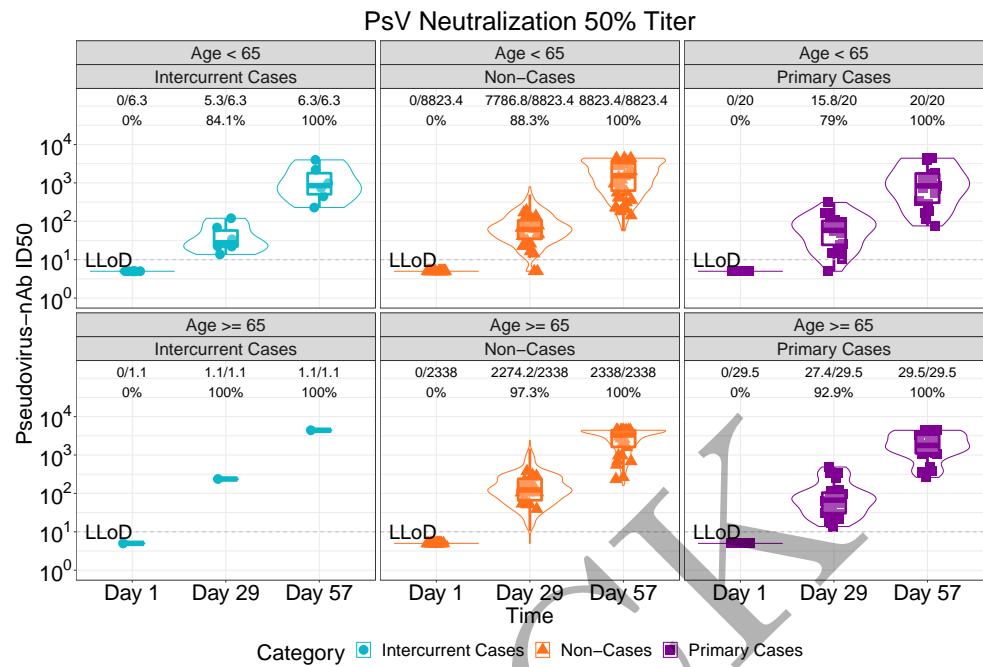


Figure 2.75: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

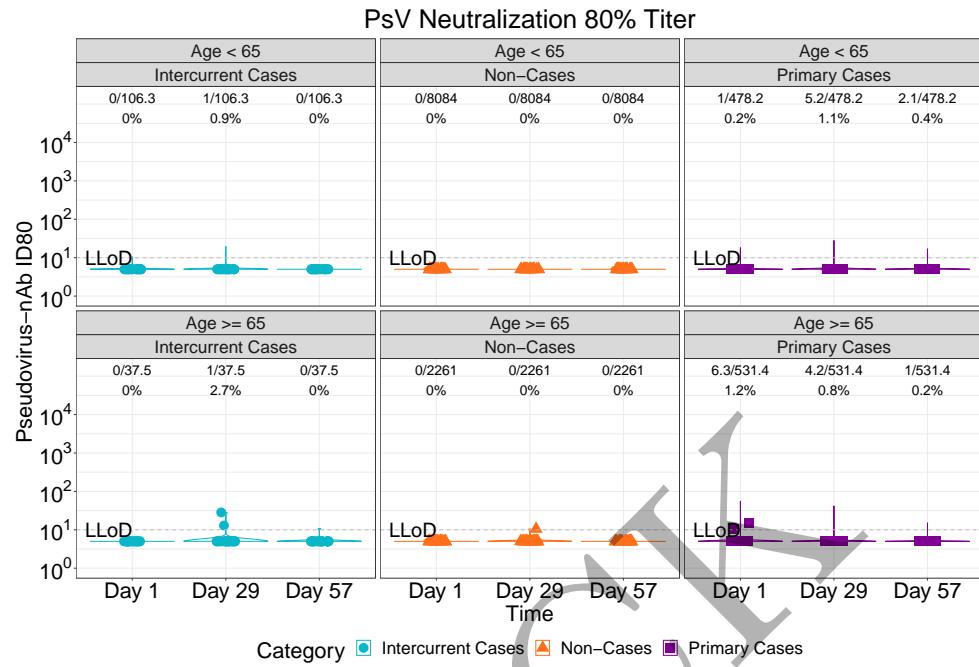


Figure 2.76: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

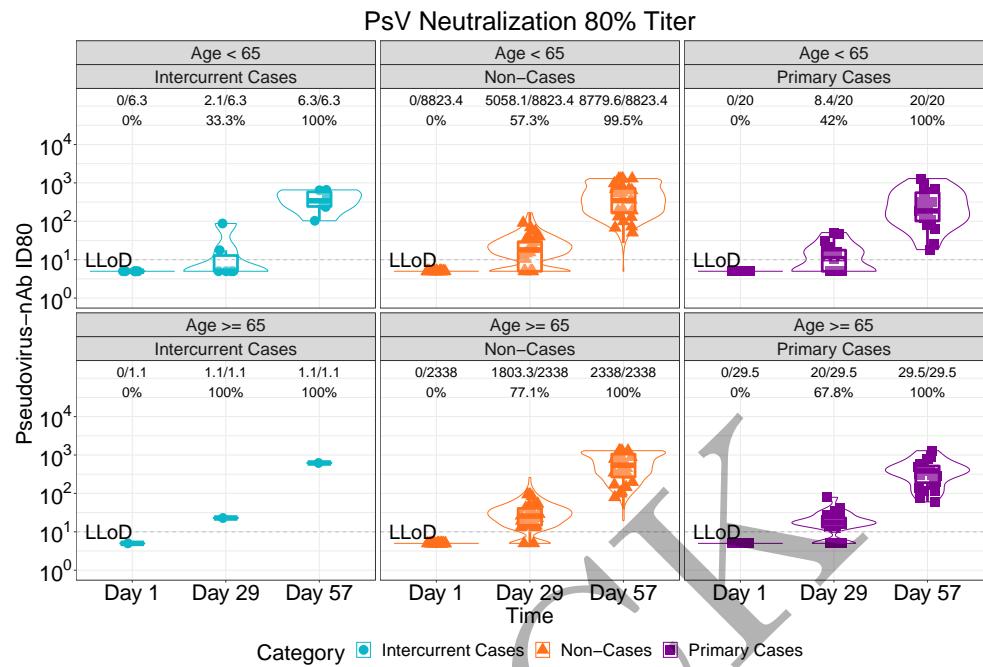


Figure 2.77: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

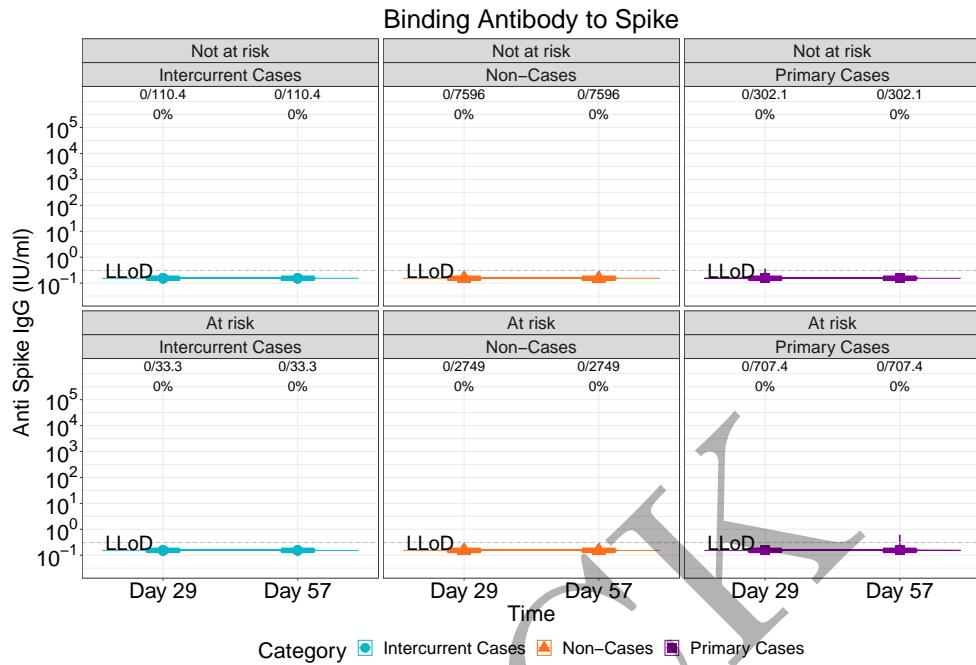


Figure 2.78: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

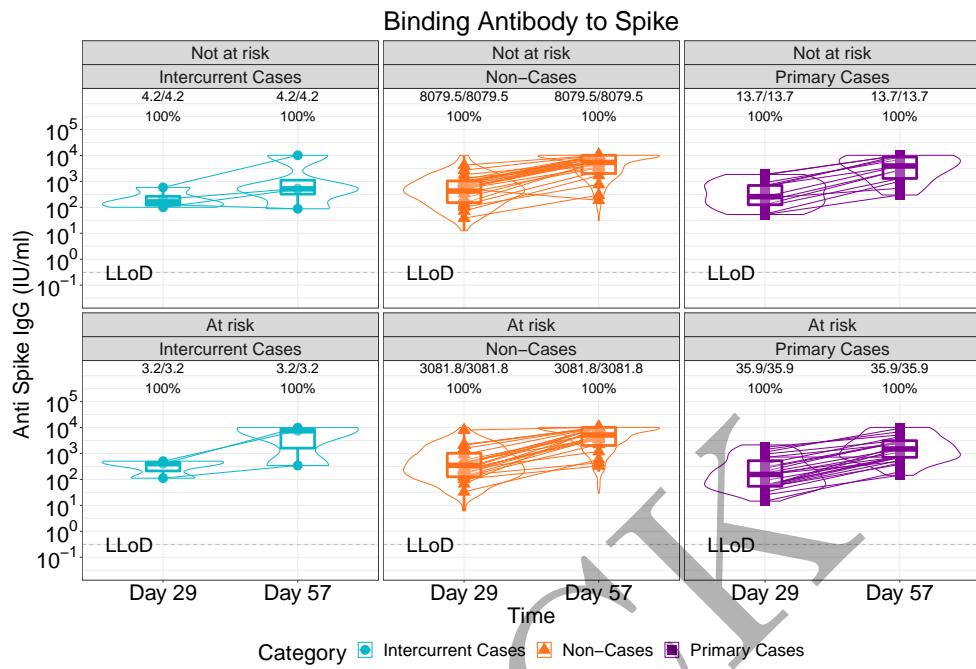


Figure 2.79: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

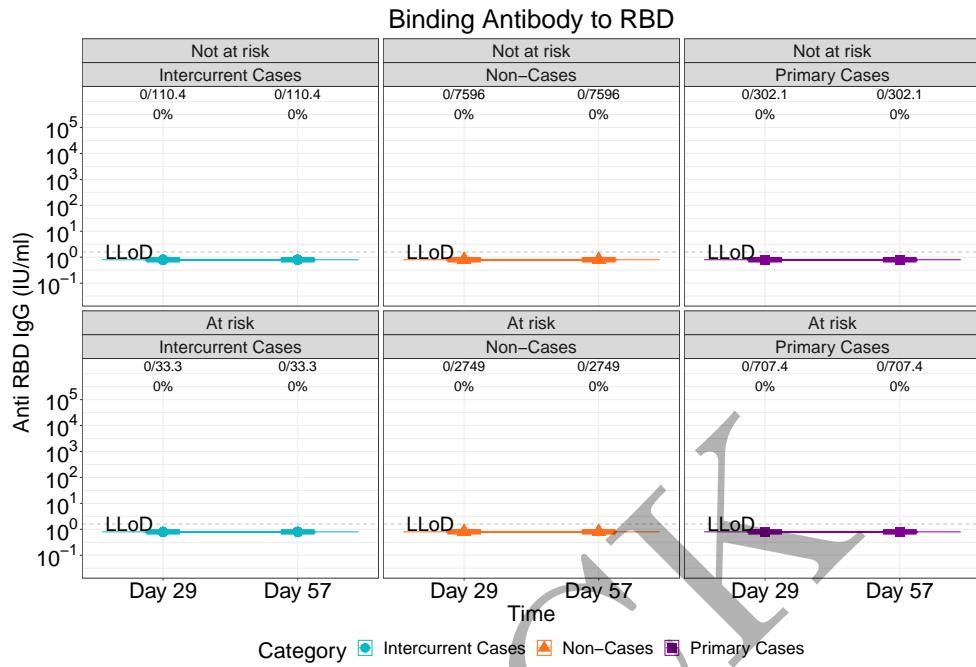


Figure 2.80: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

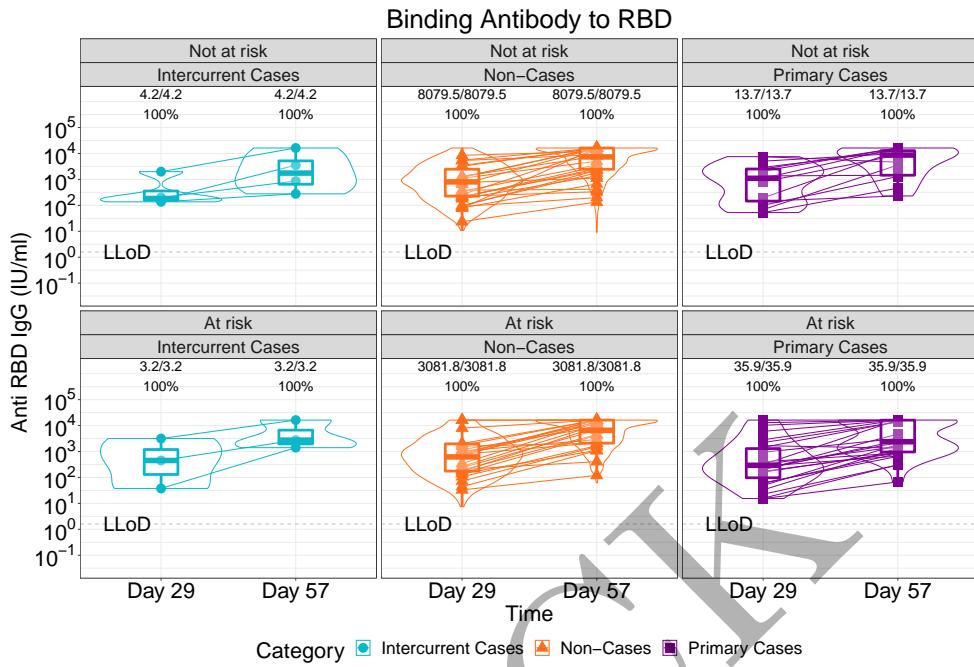


Figure 2.81: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

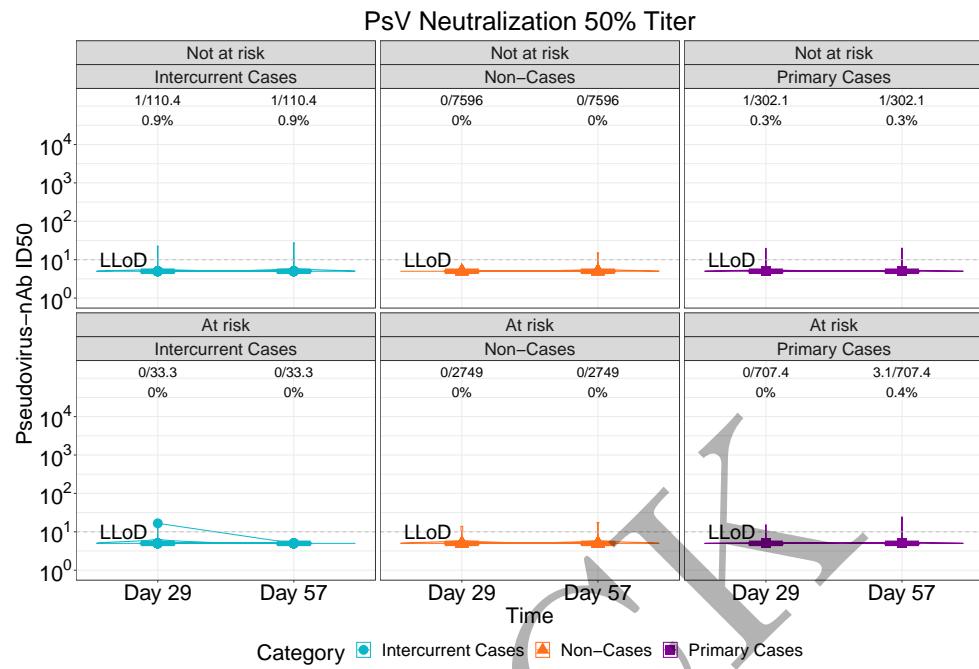


Figure 2.82: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

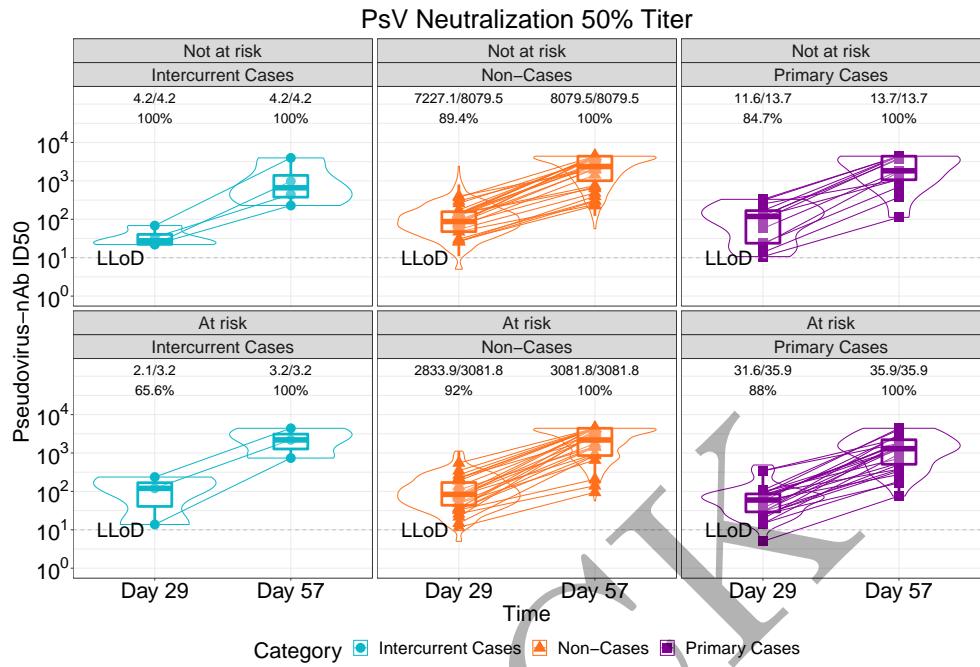


Figure 2.83: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

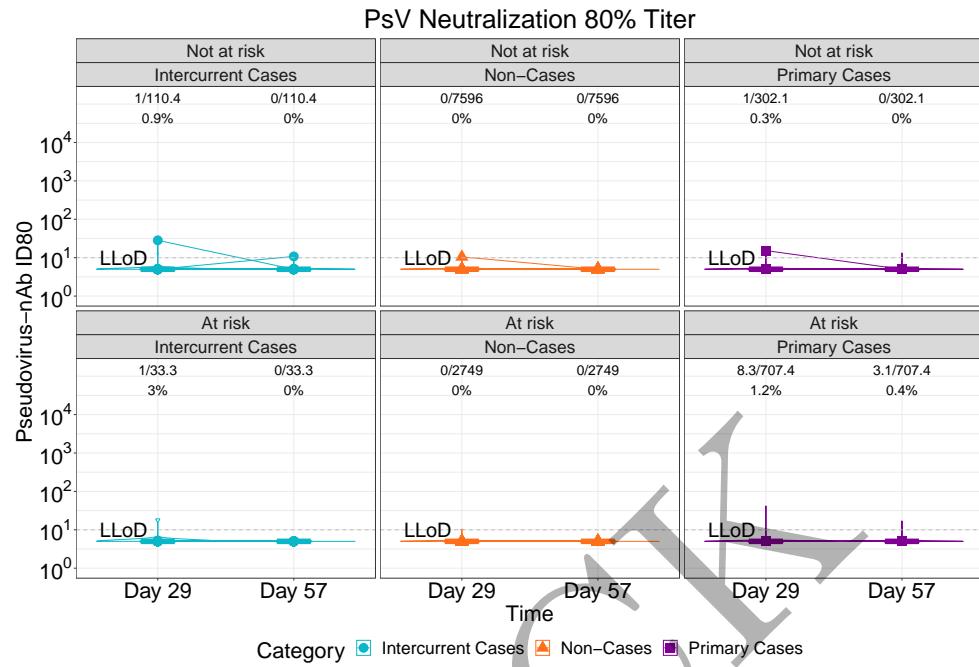


Figure 2.84: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

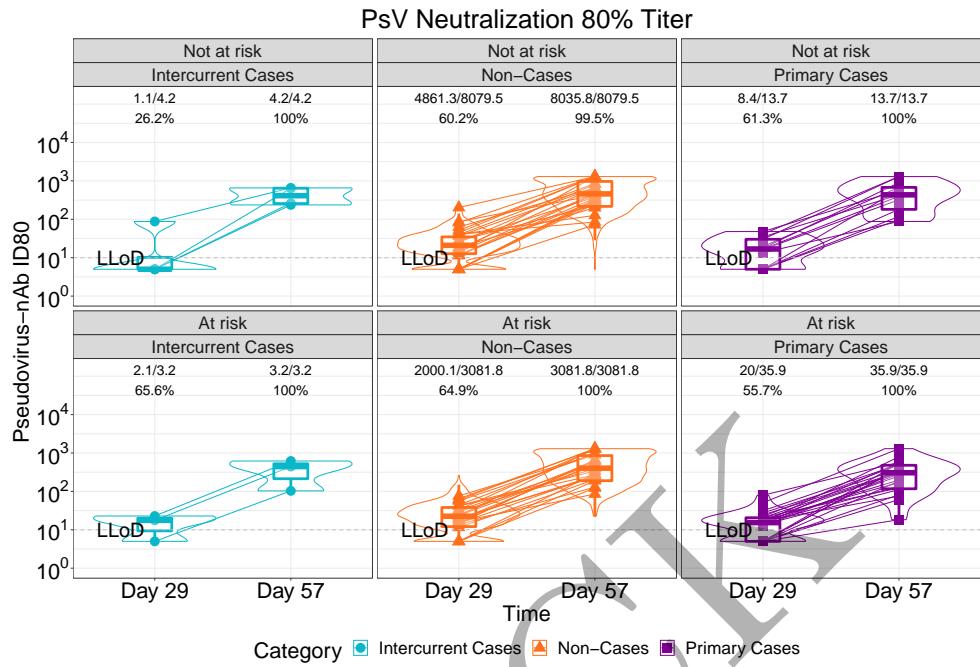


Figure 2.85: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

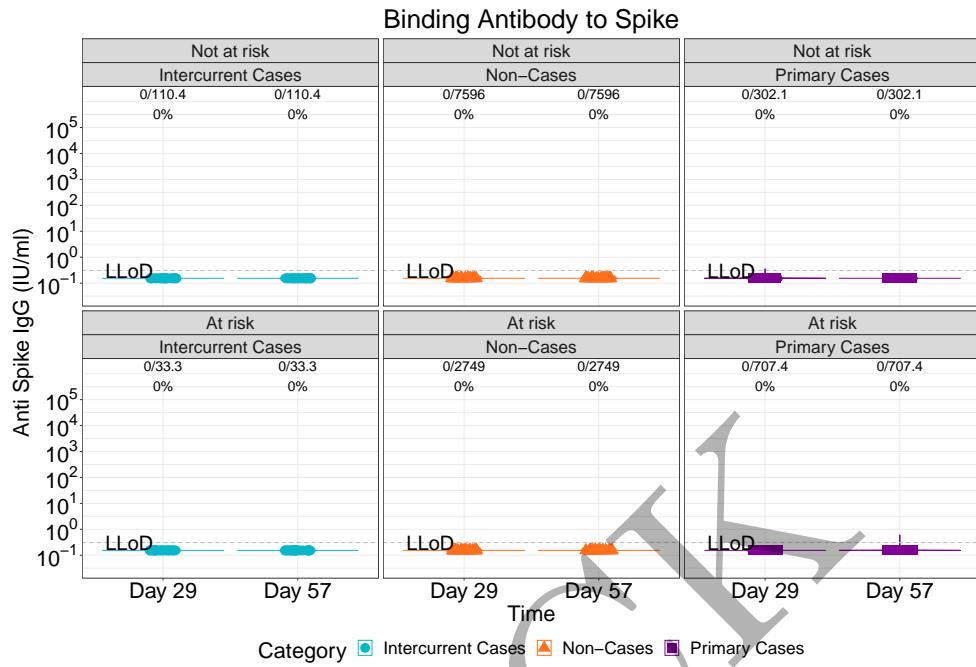


Figure 2.86: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

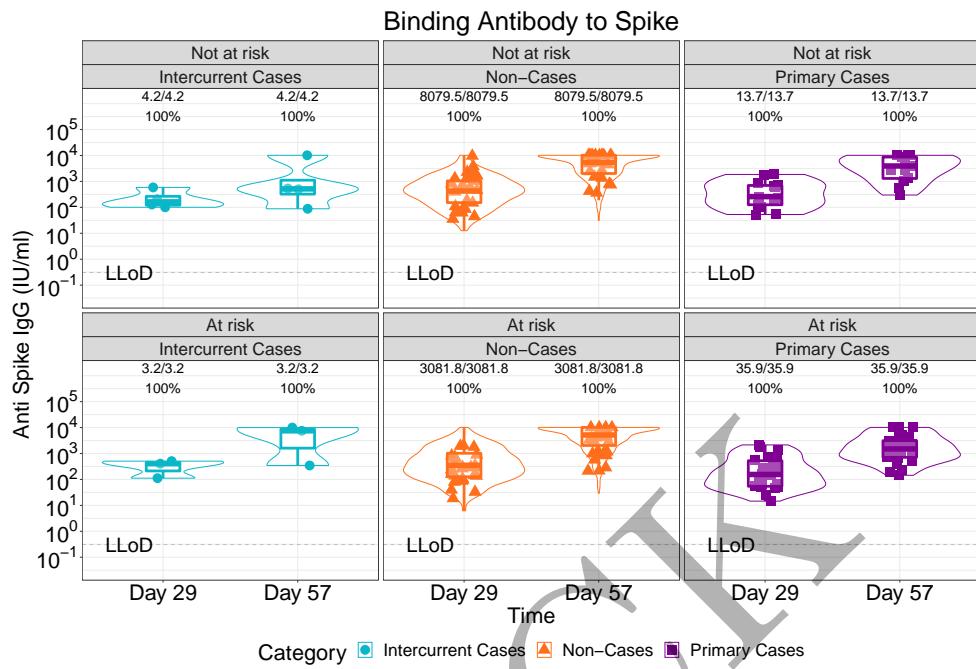


Figure 2.87: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

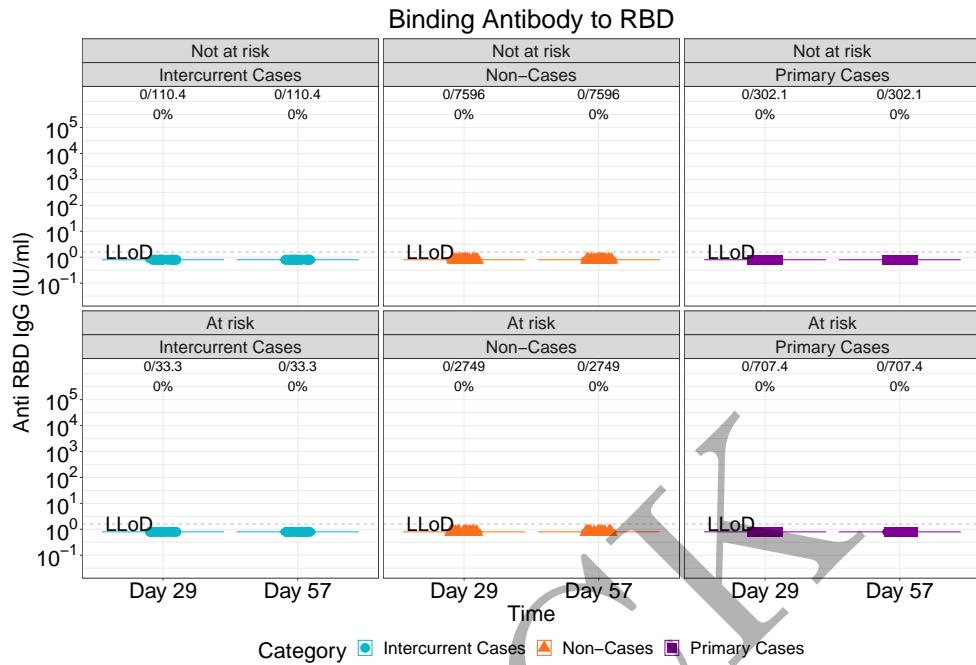


Figure 2.88: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

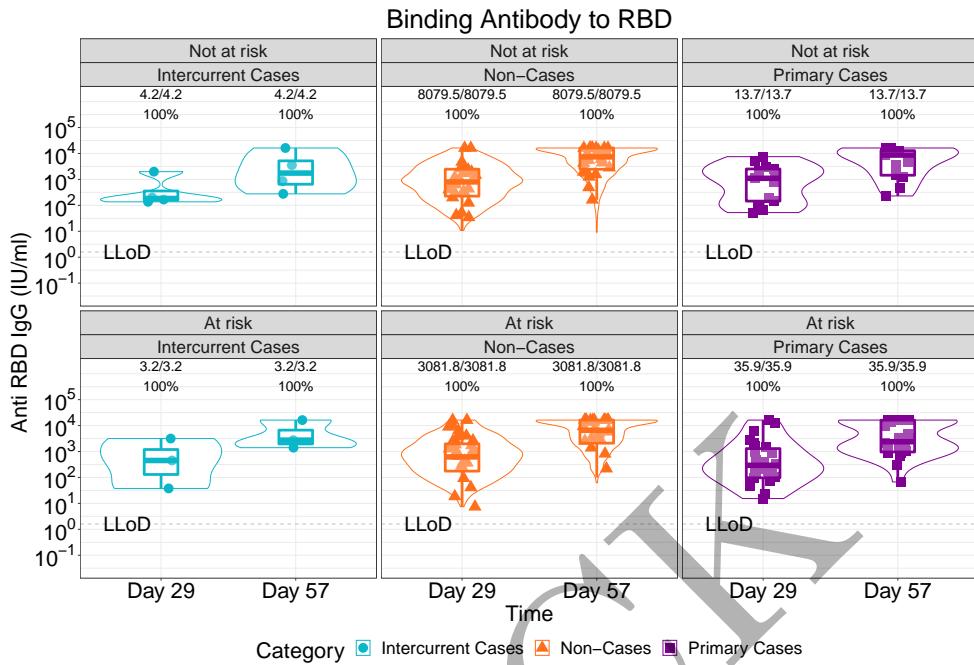


Figure 2.89: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

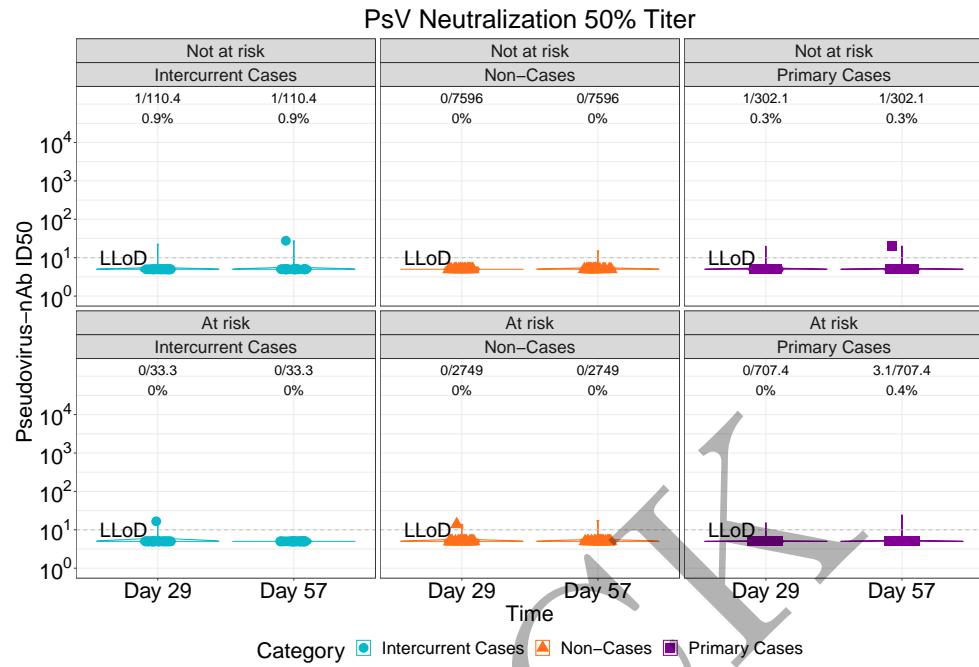


Figure 2.90: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

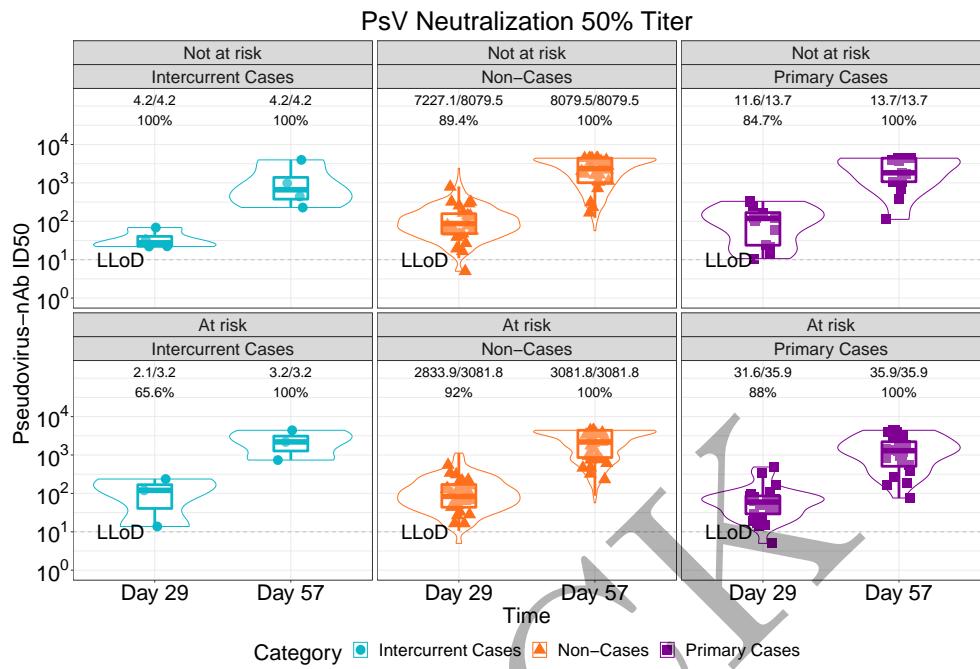


Figure 2.91: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

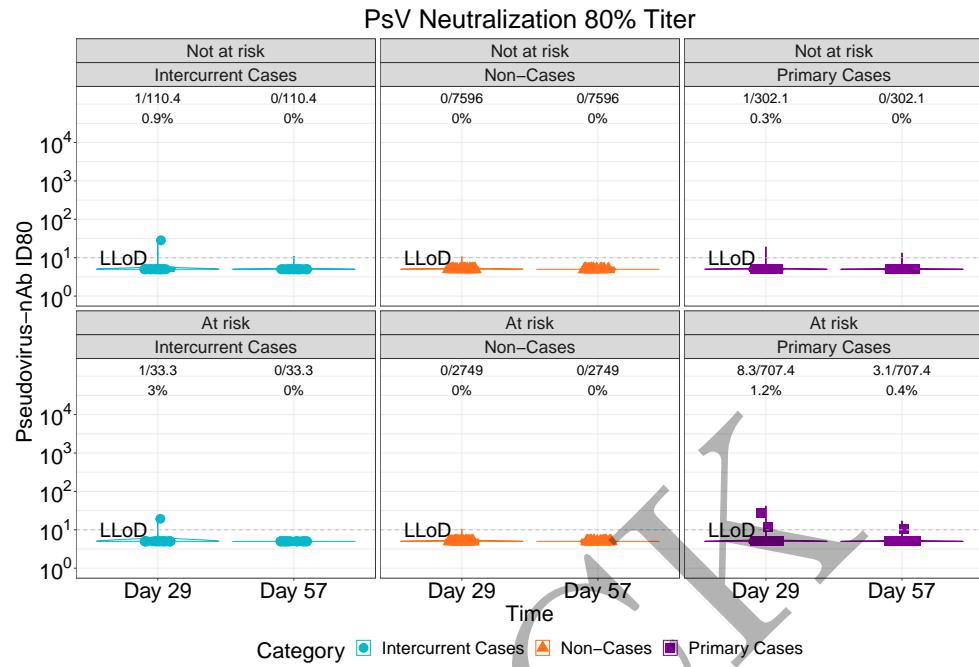


Figure 2.92: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

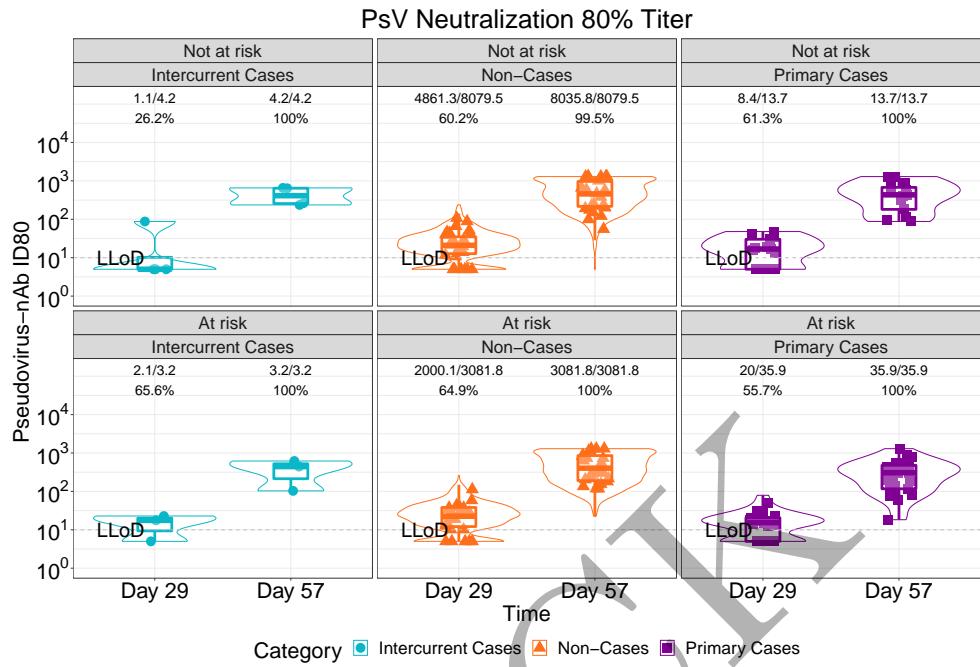


Figure 2.93: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

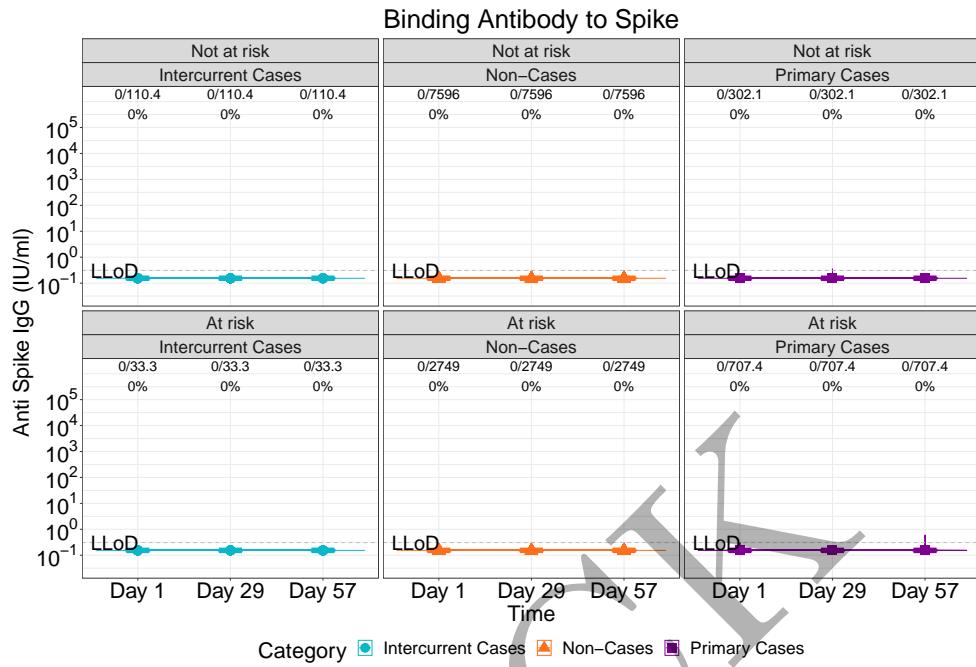


Figure 2.94: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

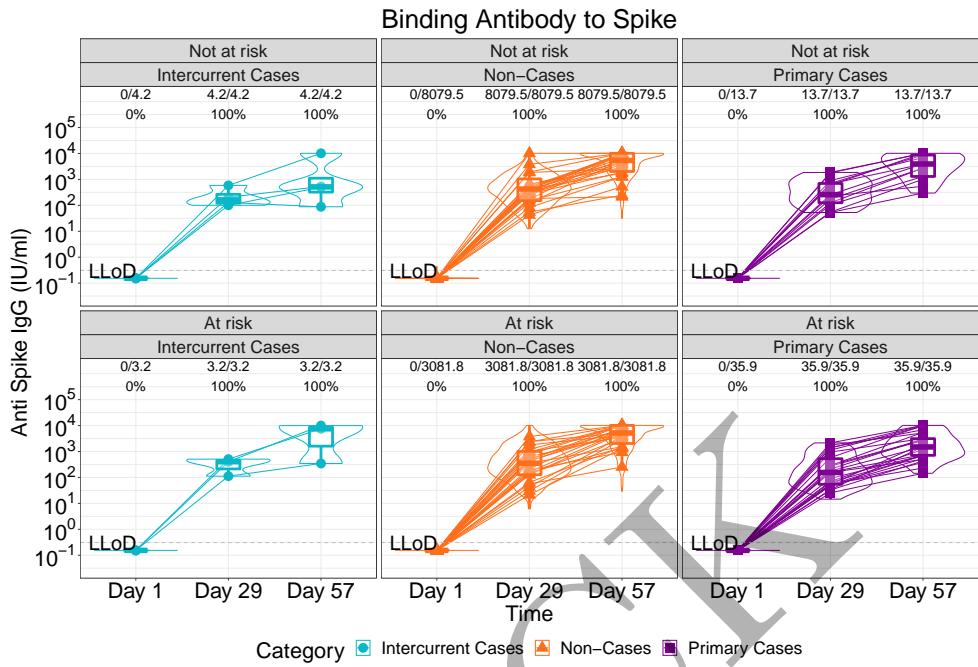


Figure 2.95: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

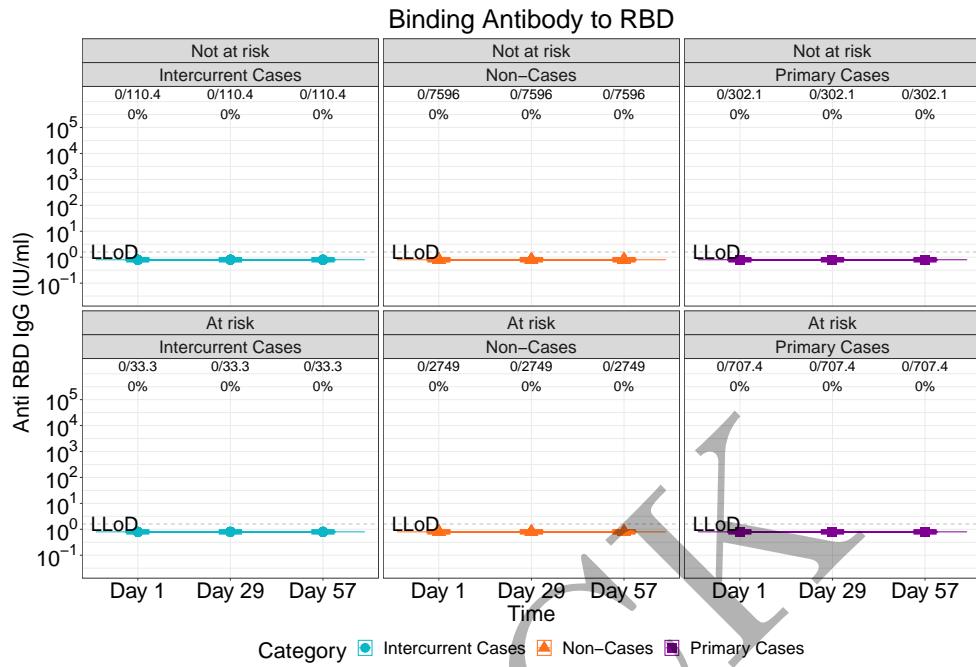


Figure 2.96: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

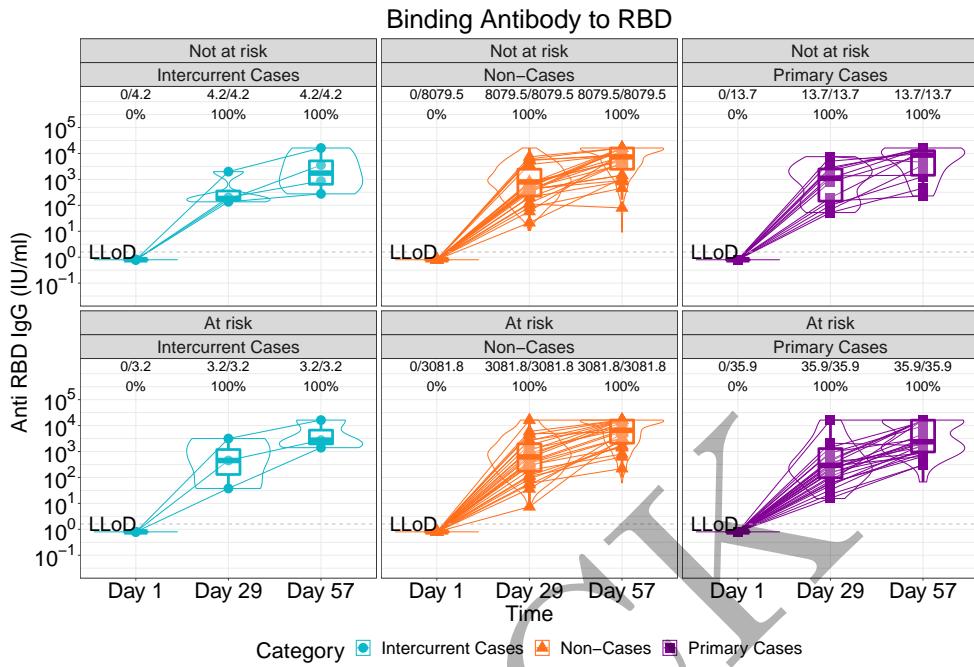


Figure 2.97: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

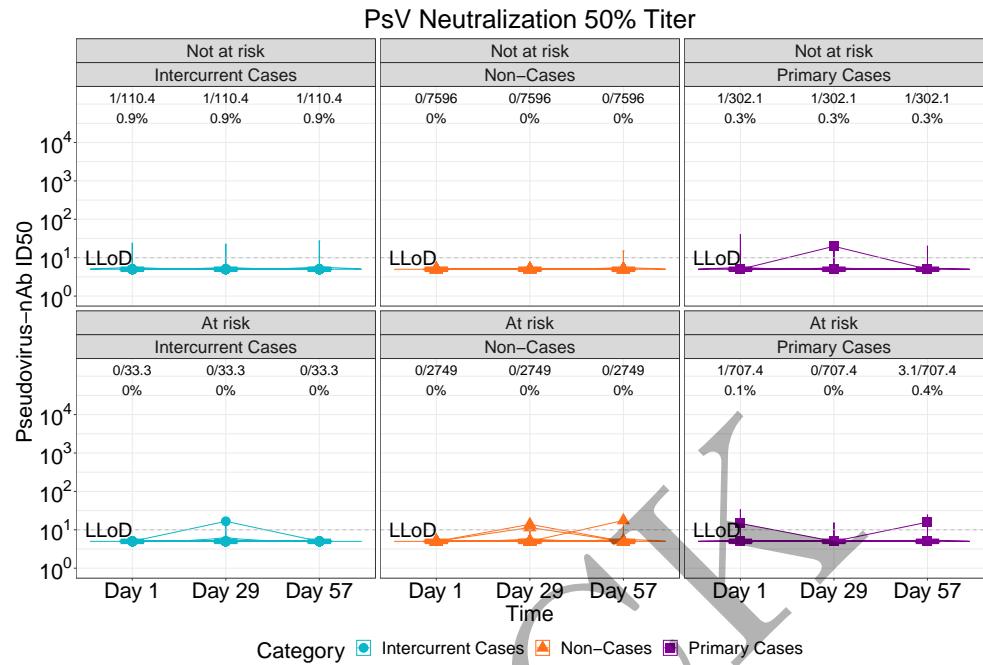


Figure 2.98: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

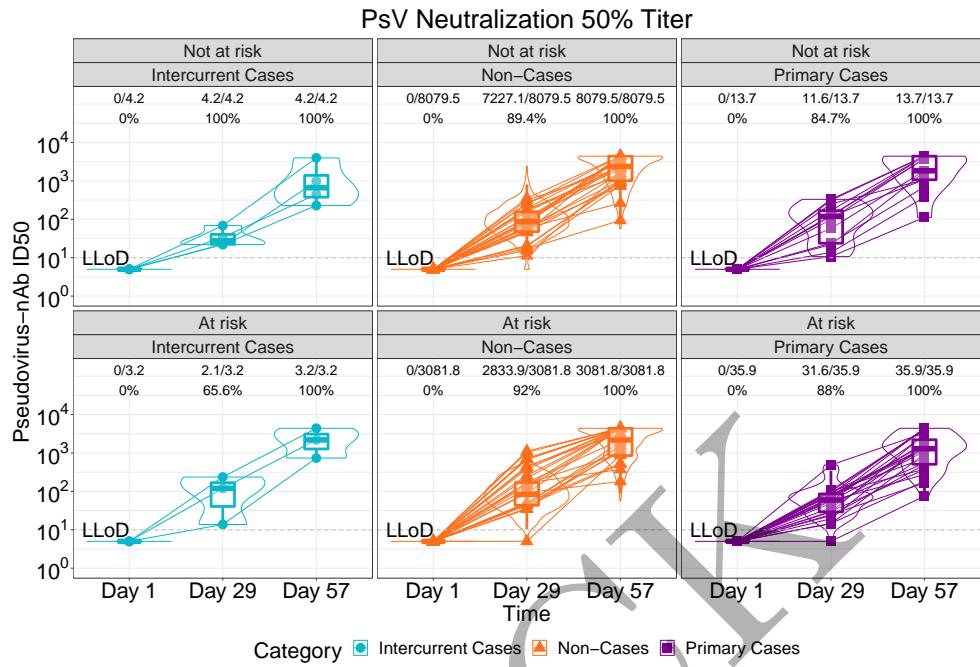


Figure 2.99: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

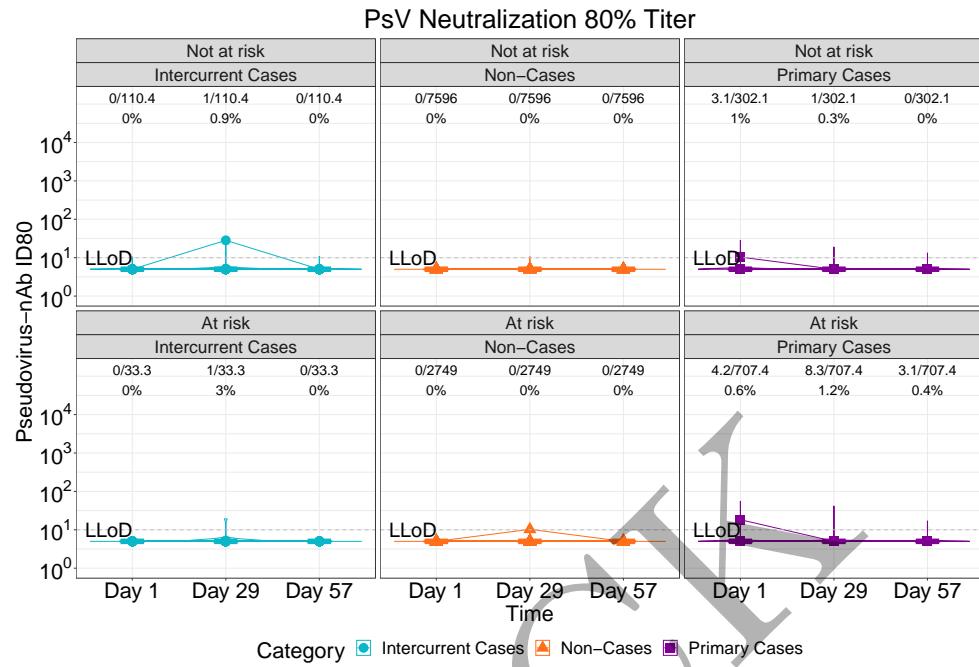


Figure 2.100: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

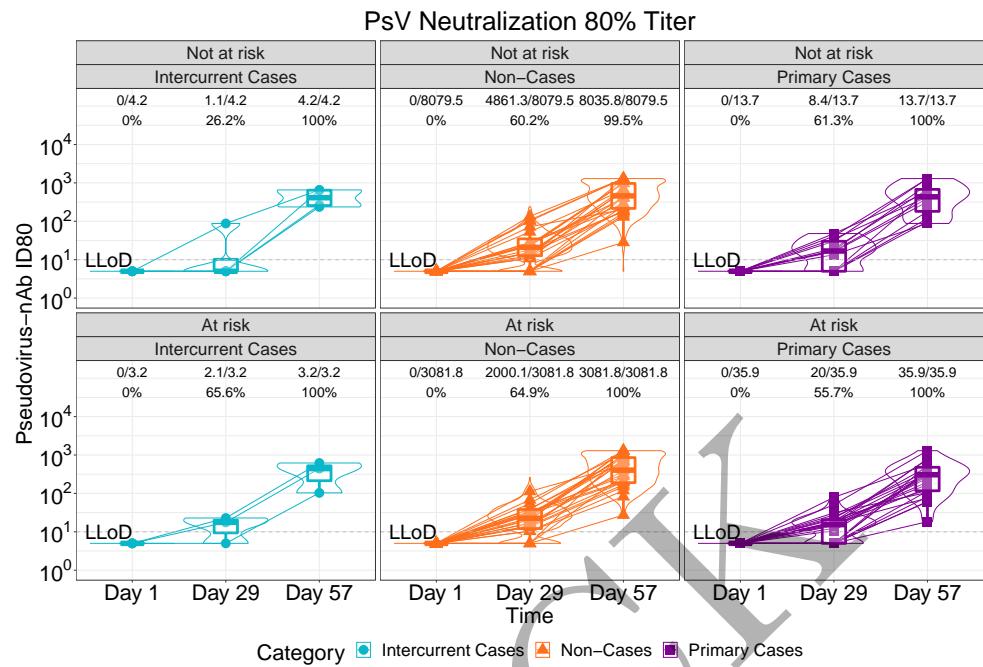


Figure 2.101: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

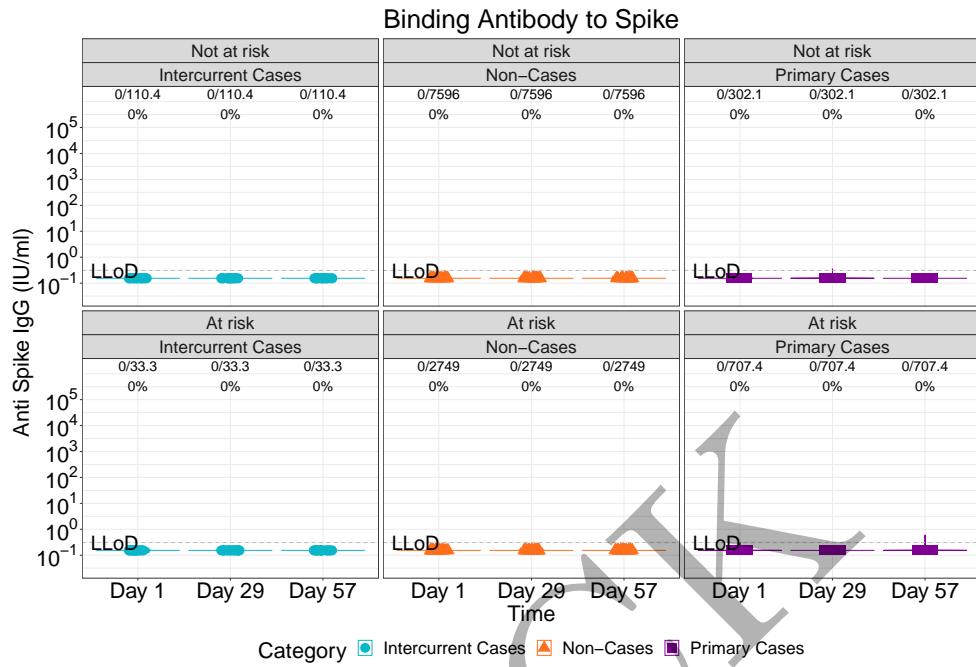


Figure 2.102: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

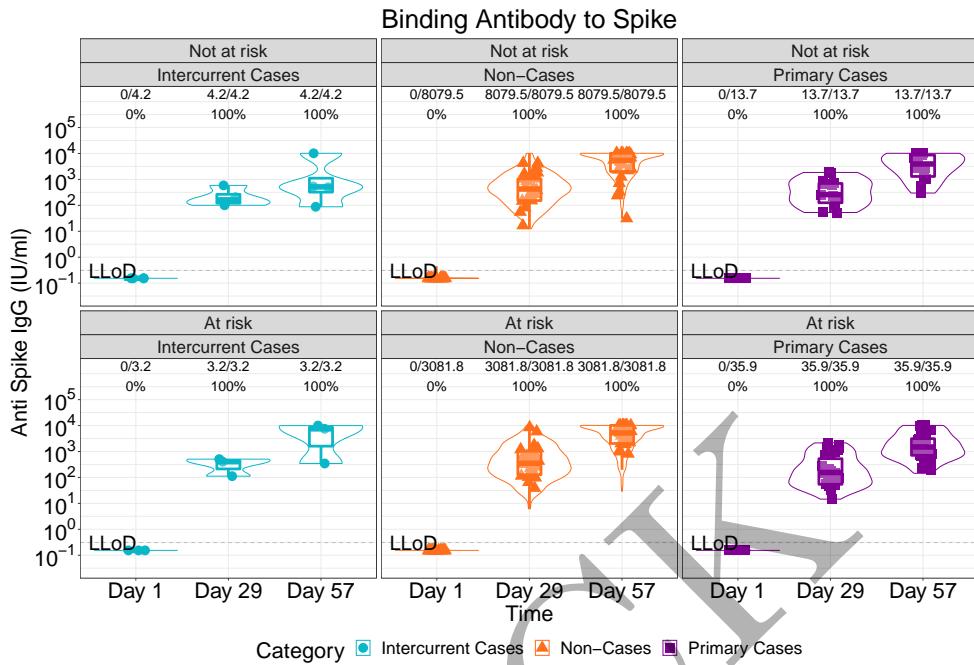


Figure 2.103: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

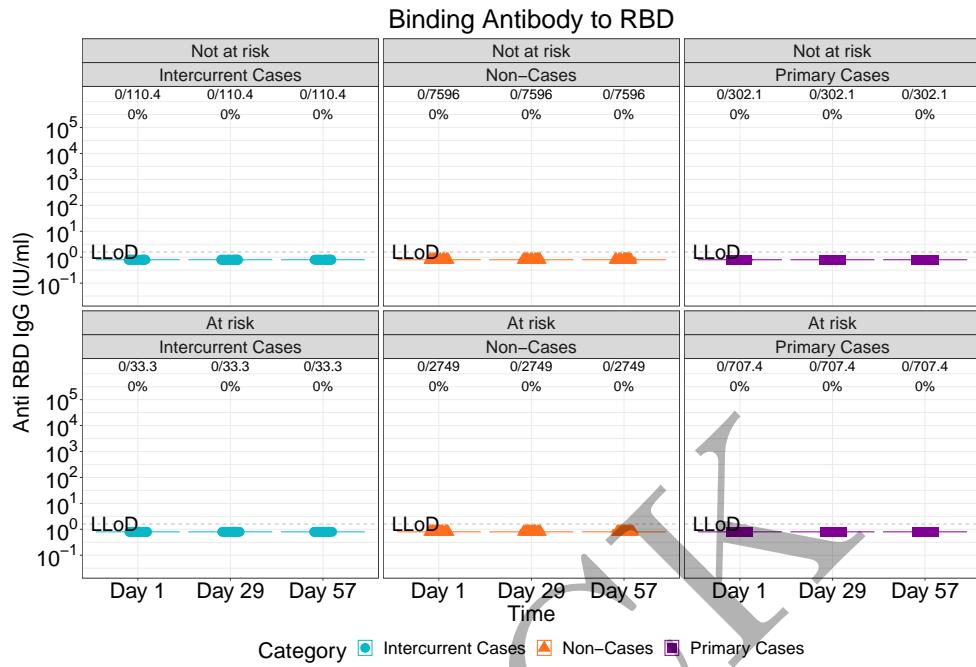


Figure 2.104: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

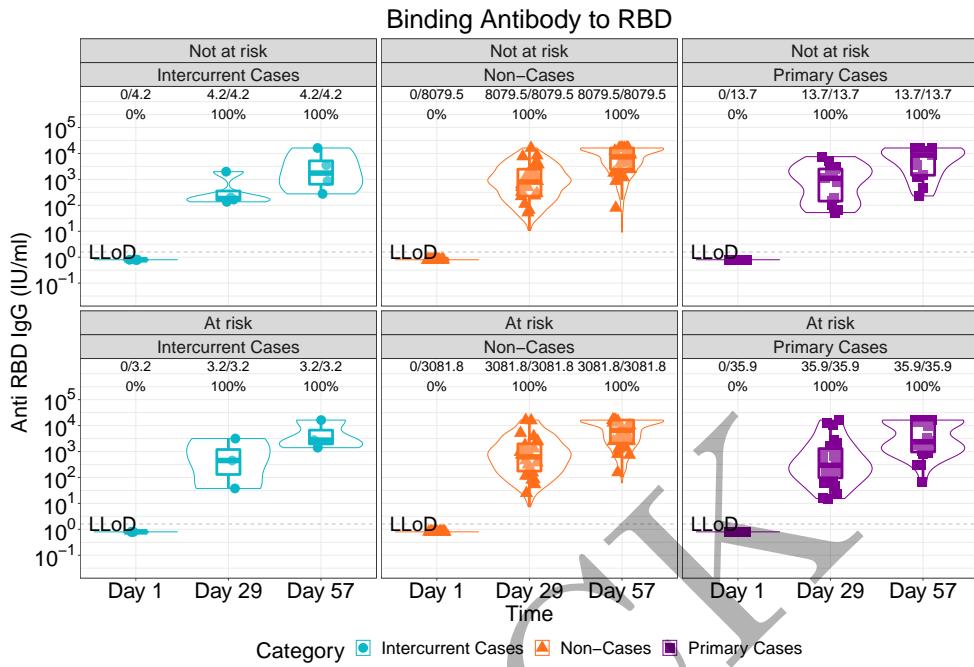


Figure 2.105: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

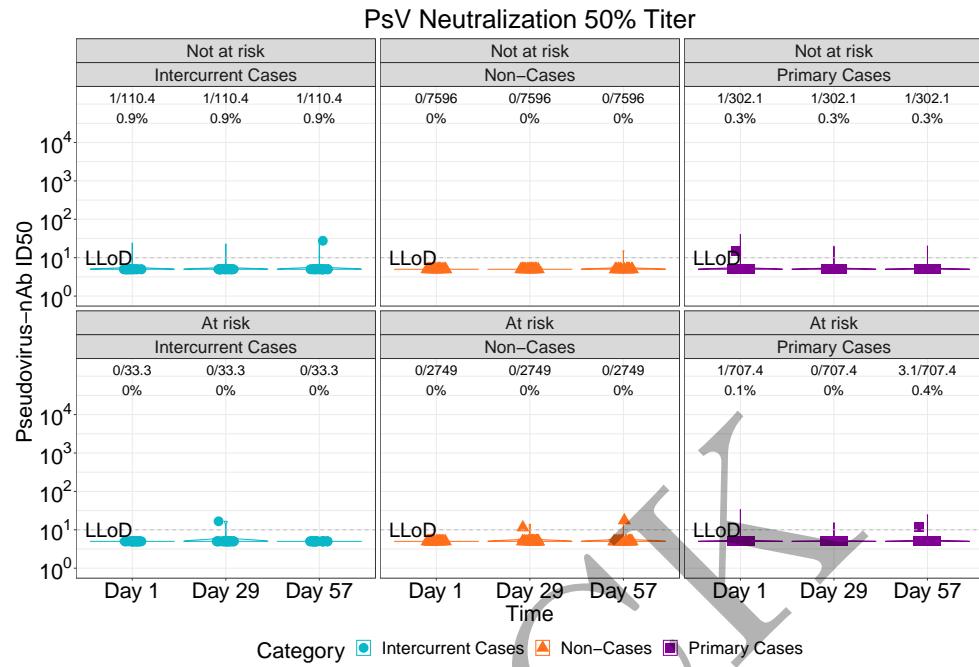


Figure 2.106: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

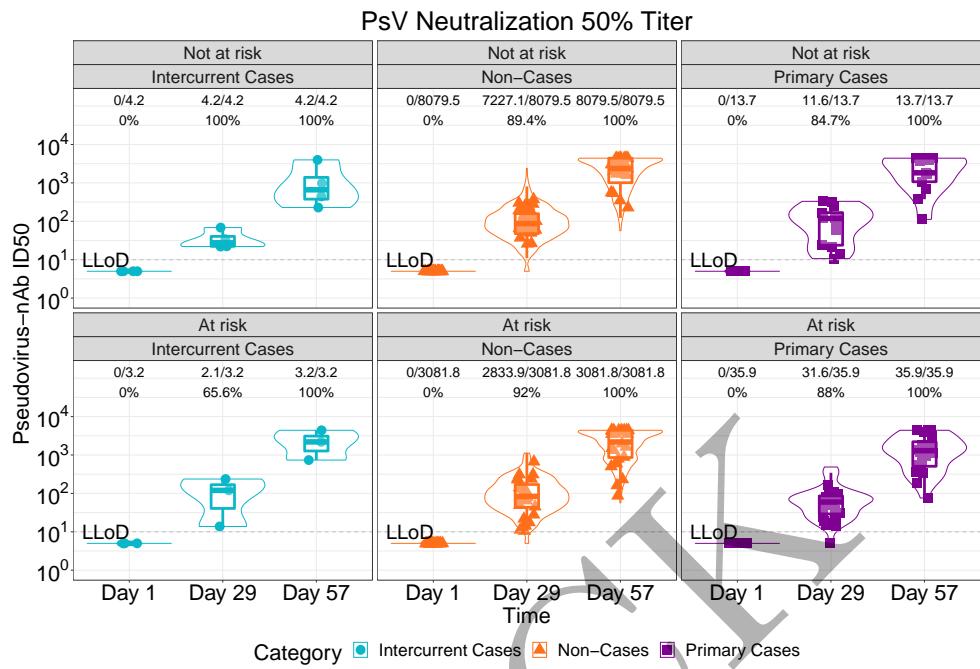


Figure 2.107: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

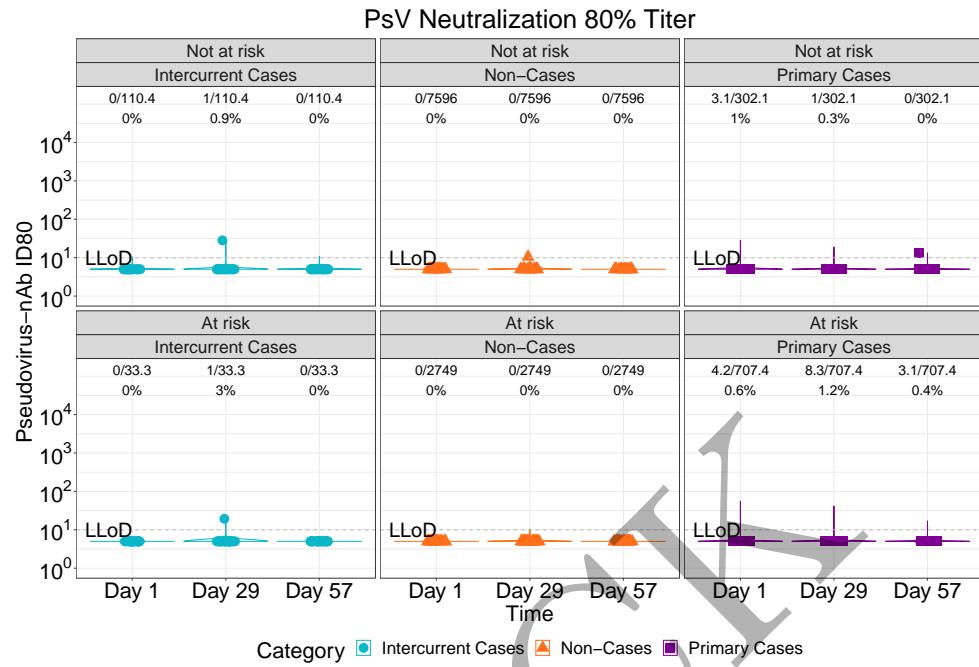


Figure 2.108: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

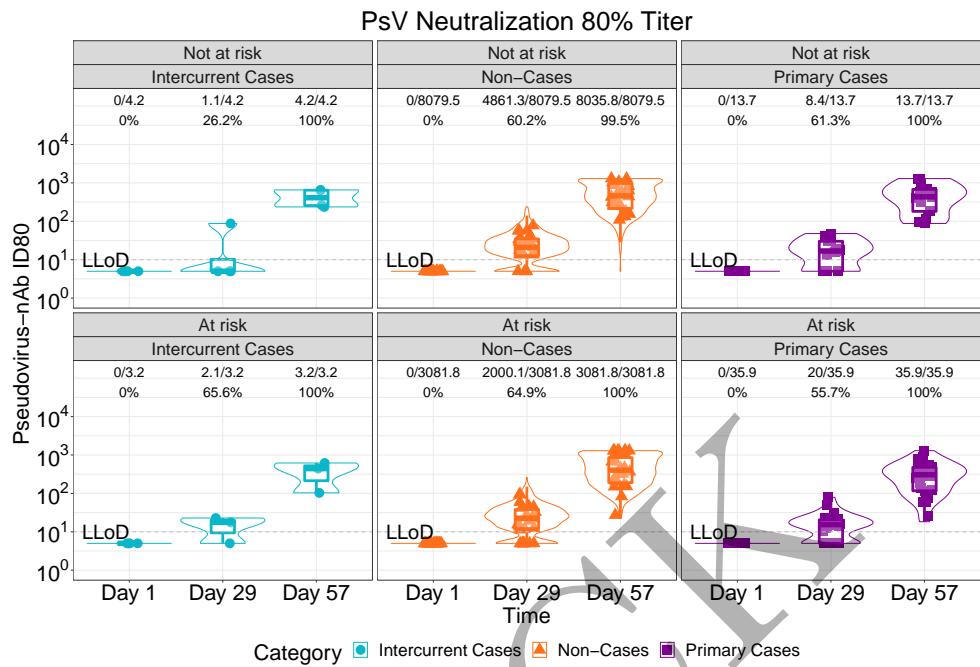


Figure 2.109: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

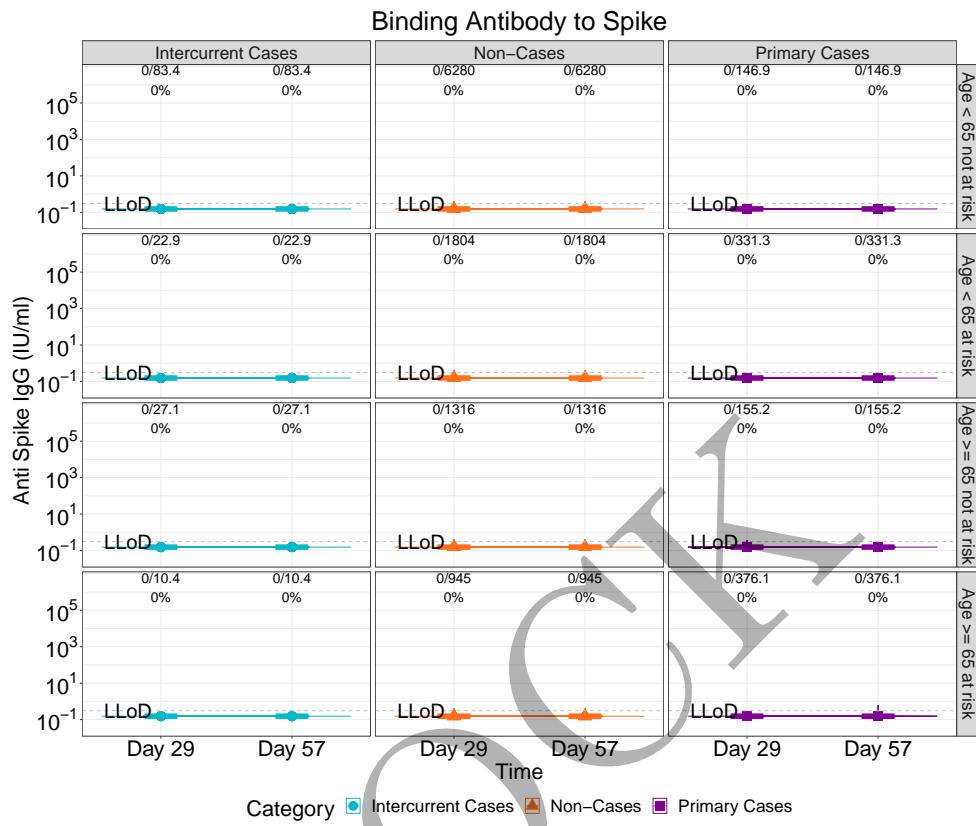


Figure 2.110: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

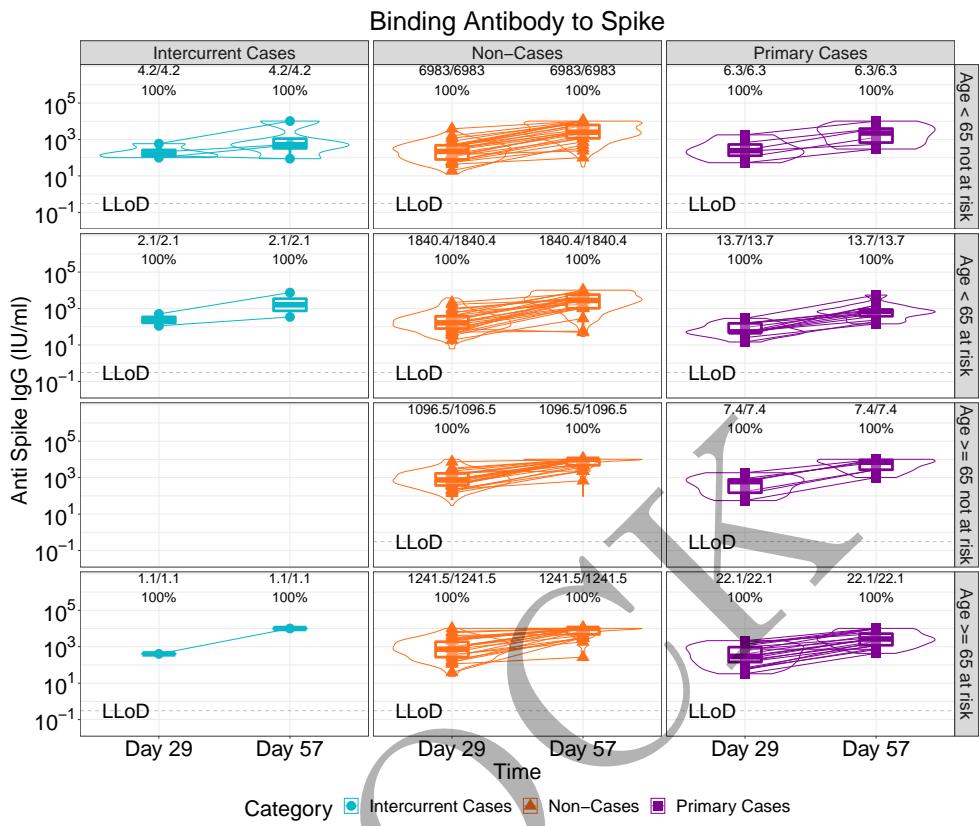


Figure 2.111: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

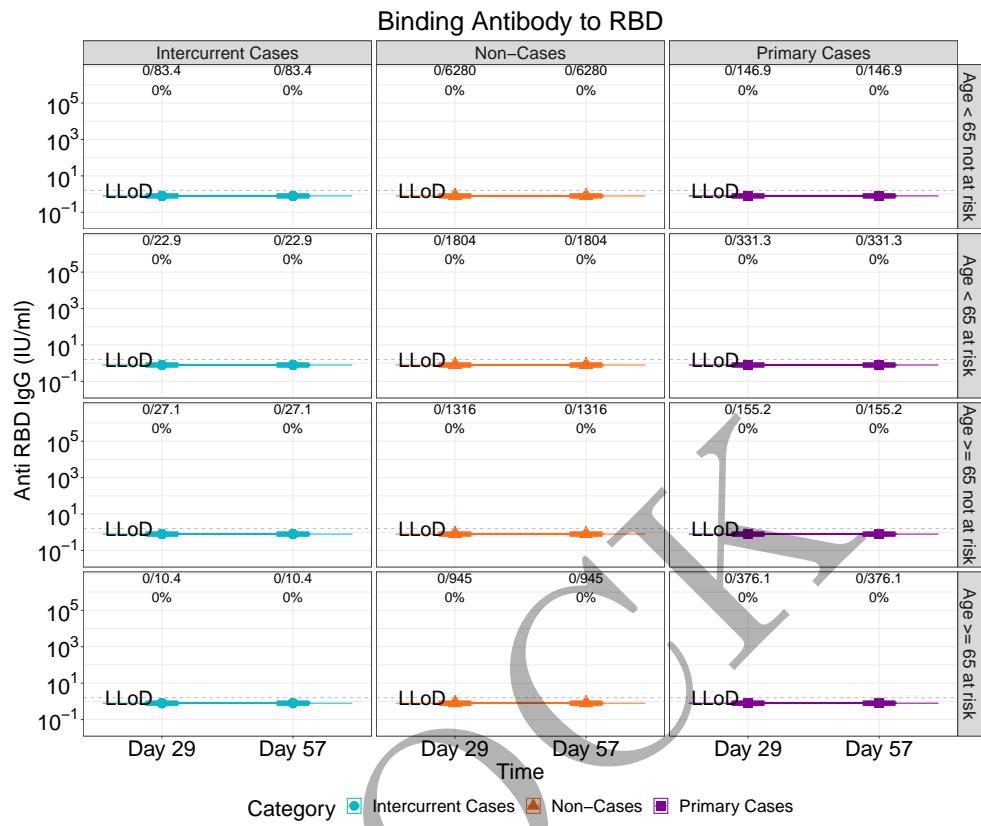


Figure 2.112: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

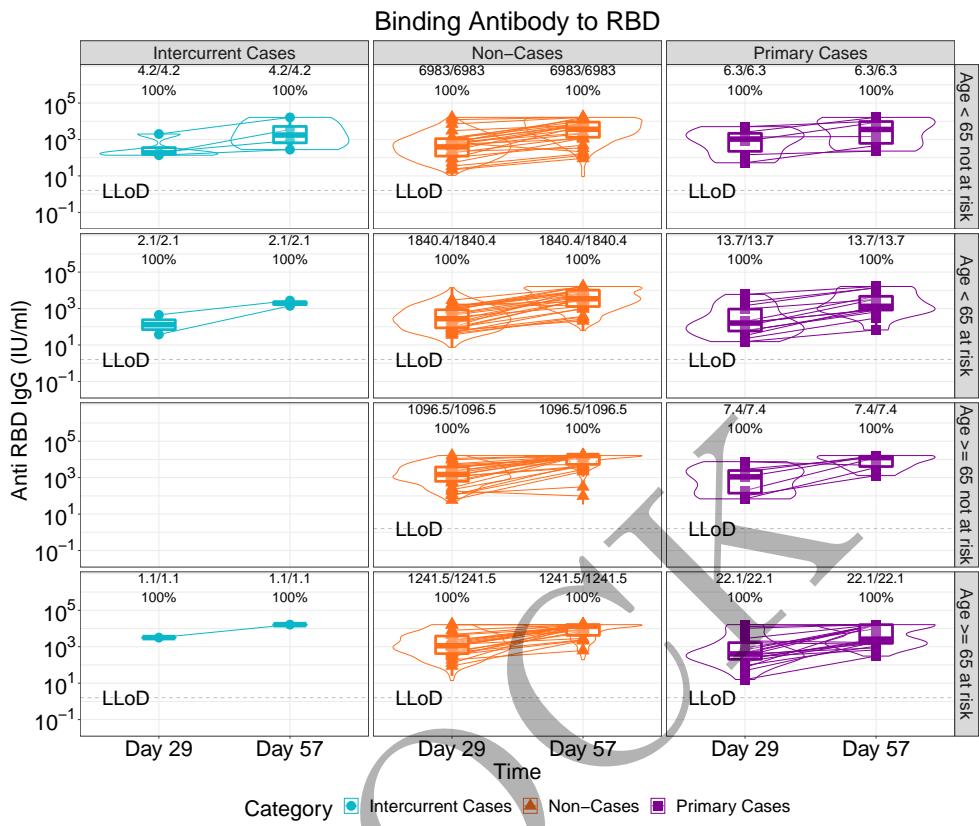


Figure 2.113: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

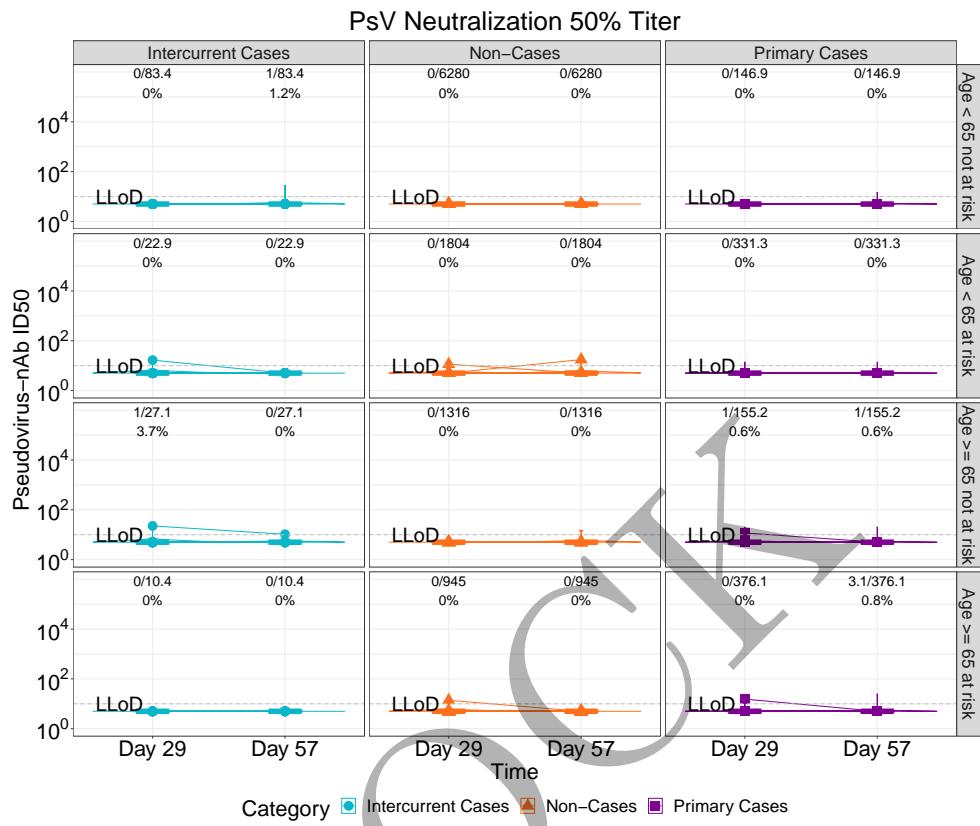


Figure 2.114: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1)

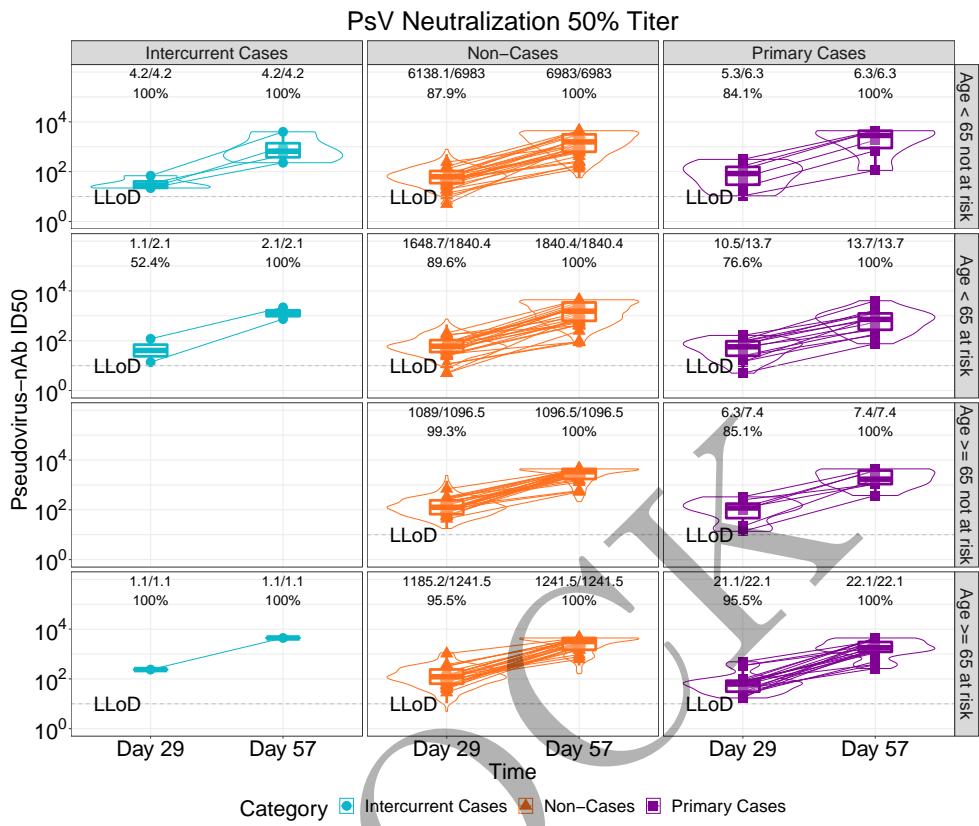


Figure 2.115: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1)

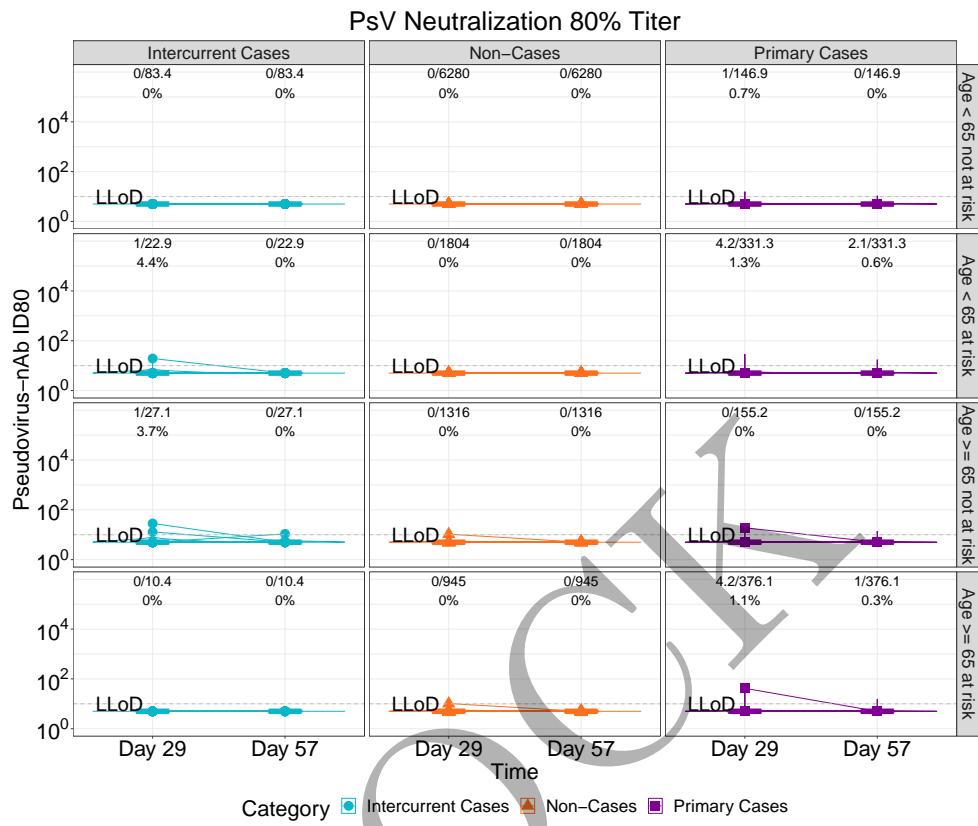


Figure 2.116: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

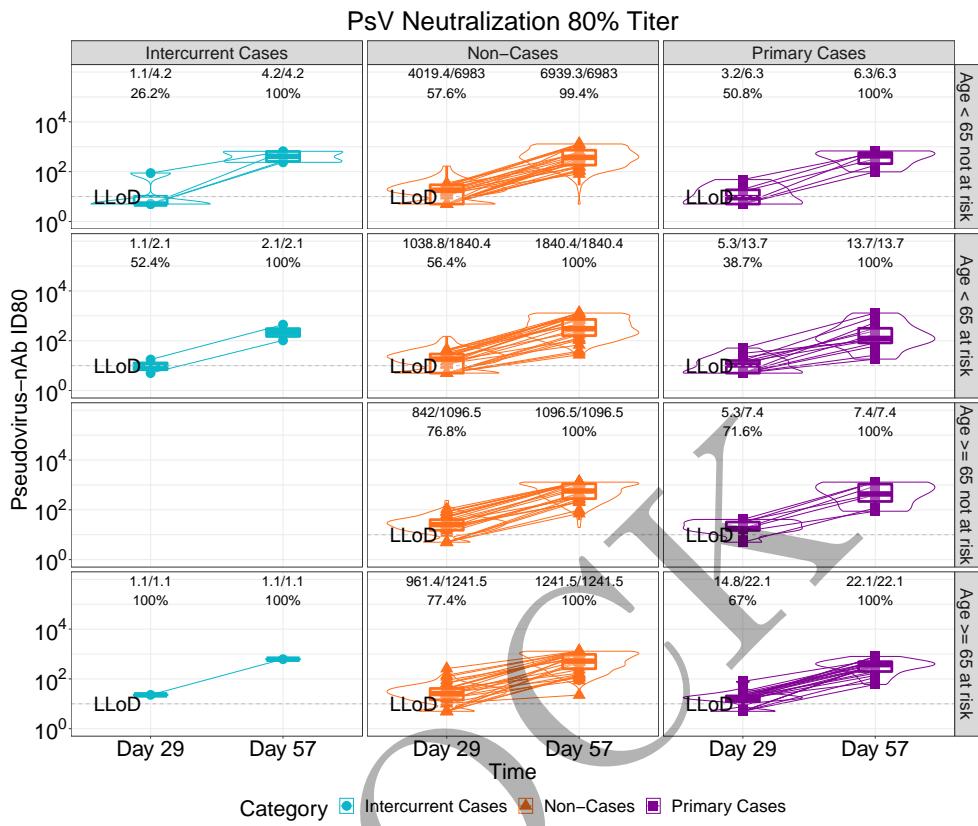


Figure 2.117: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

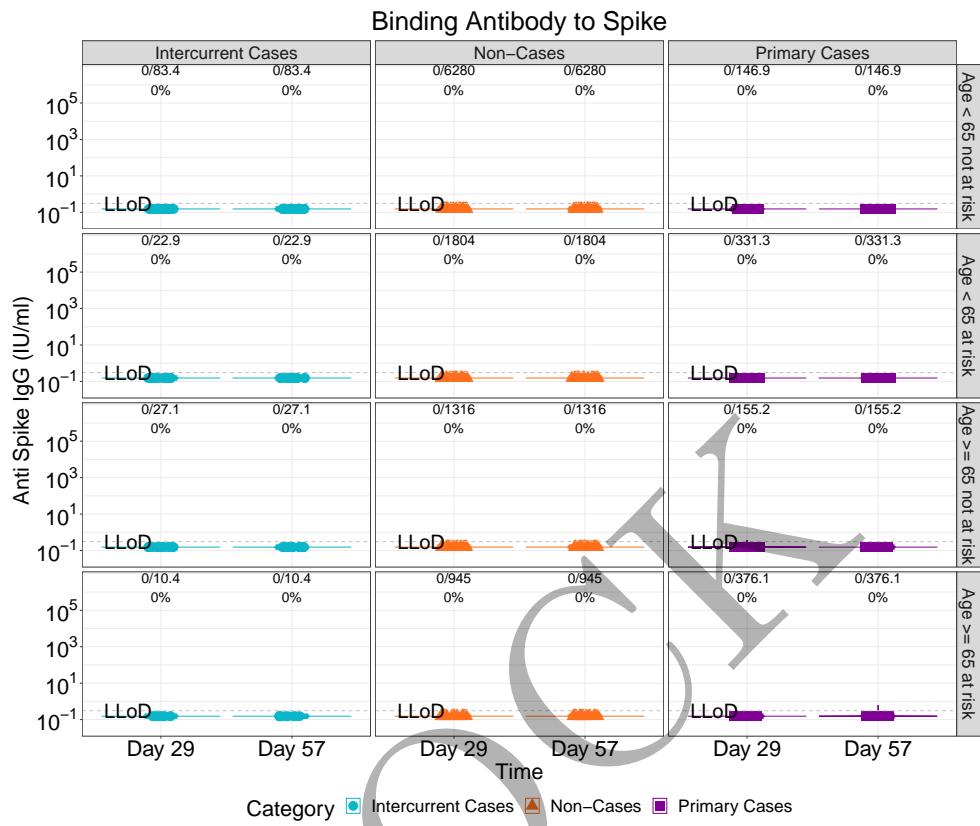


Figure 2.118: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

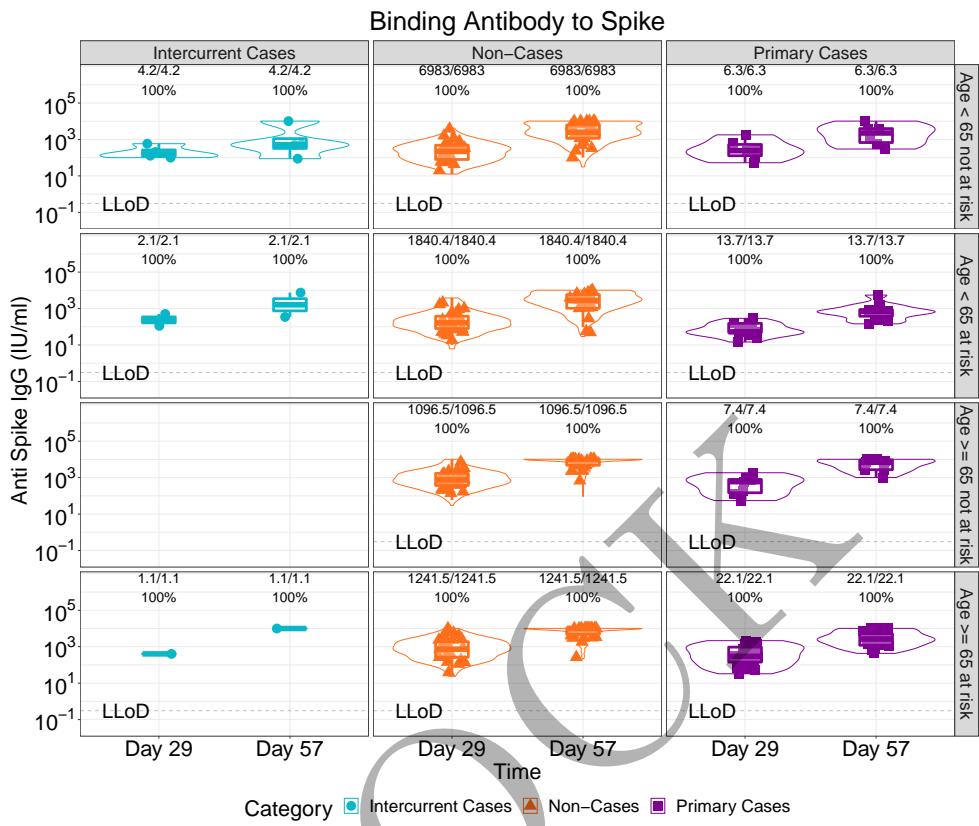


Figure 2.119: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

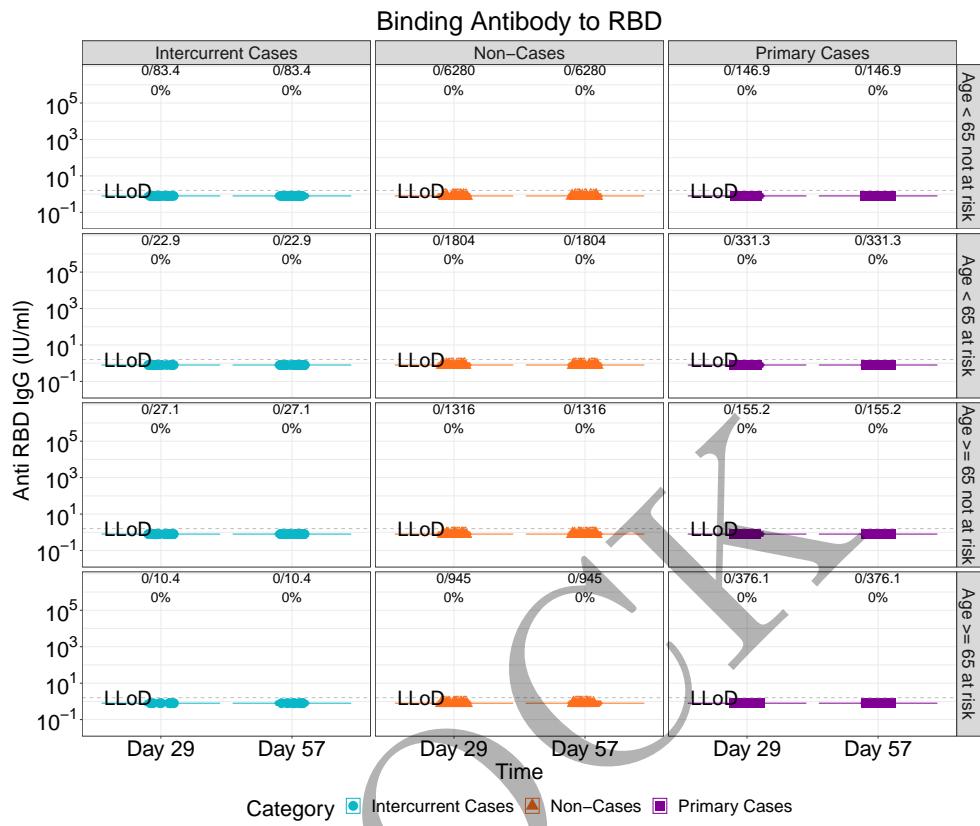


Figure 2.120: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

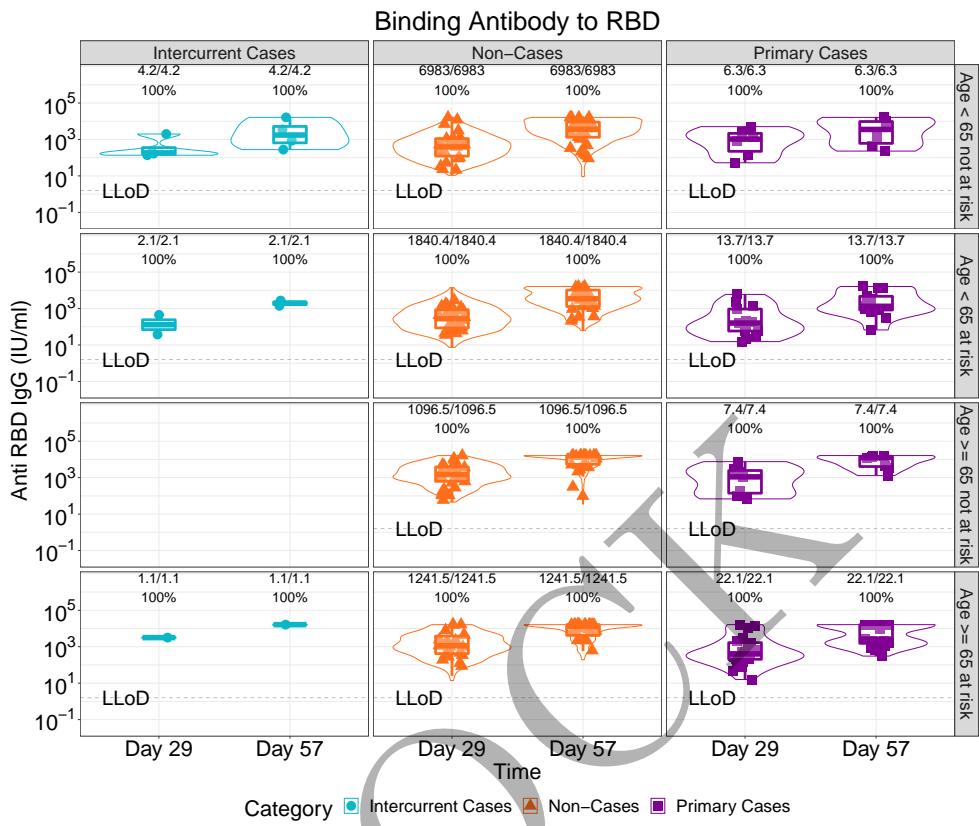


Figure 2.121: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

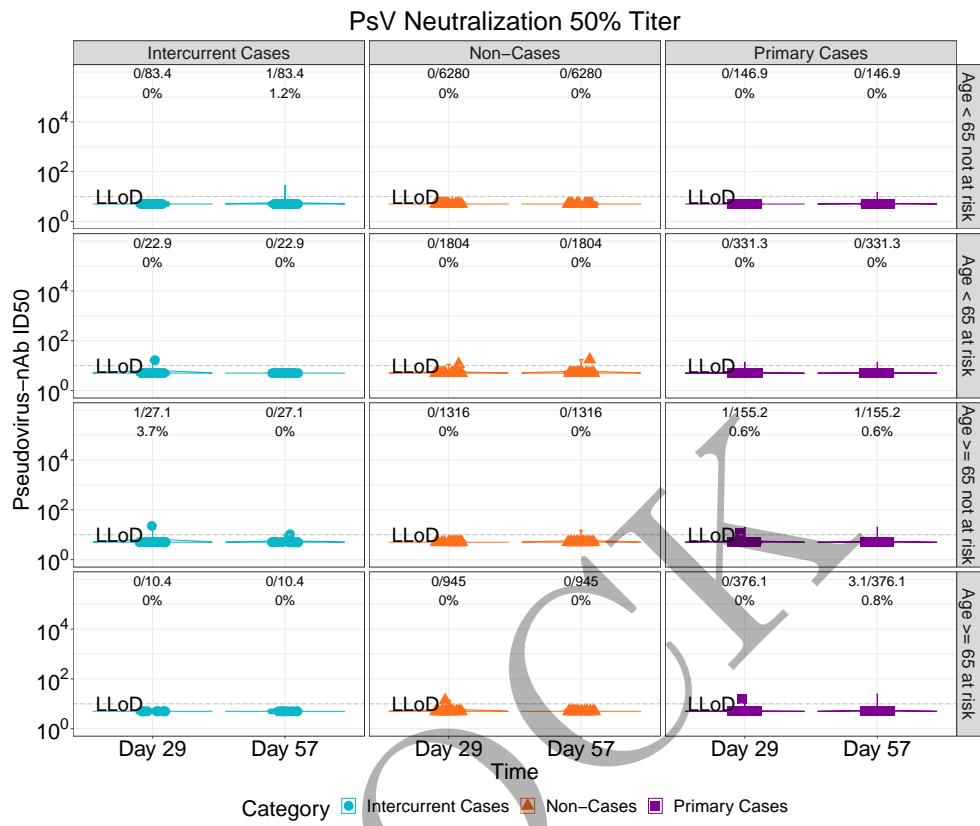


Figure 2.122: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1)

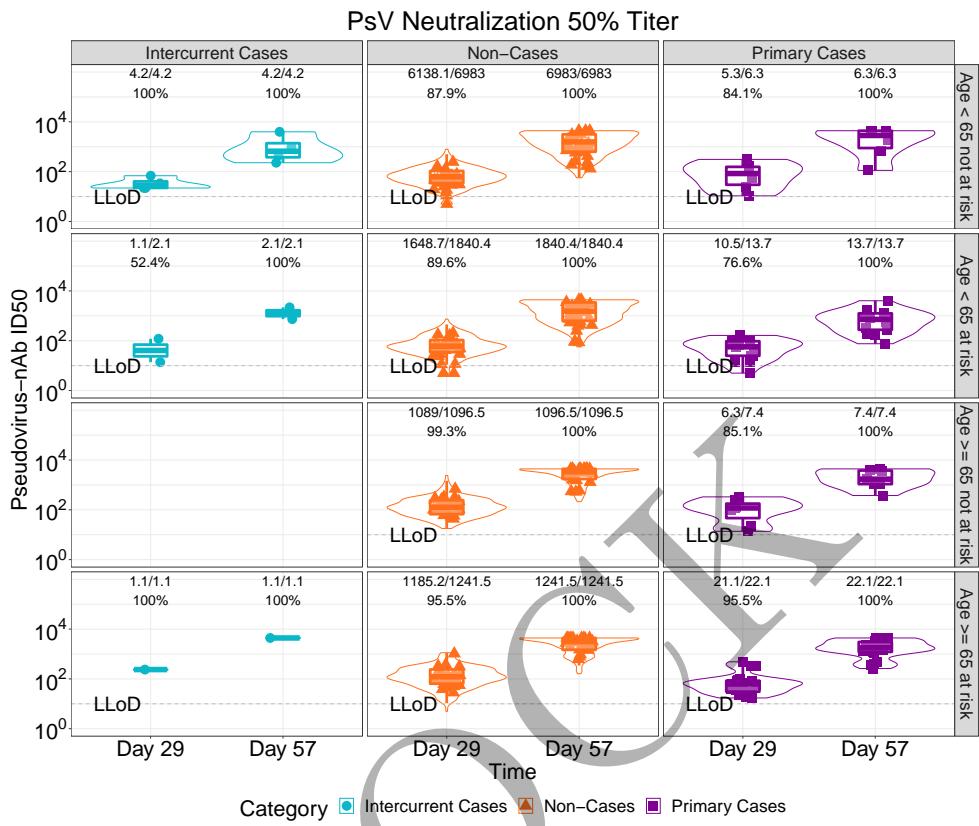


Figure 2.123: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1)

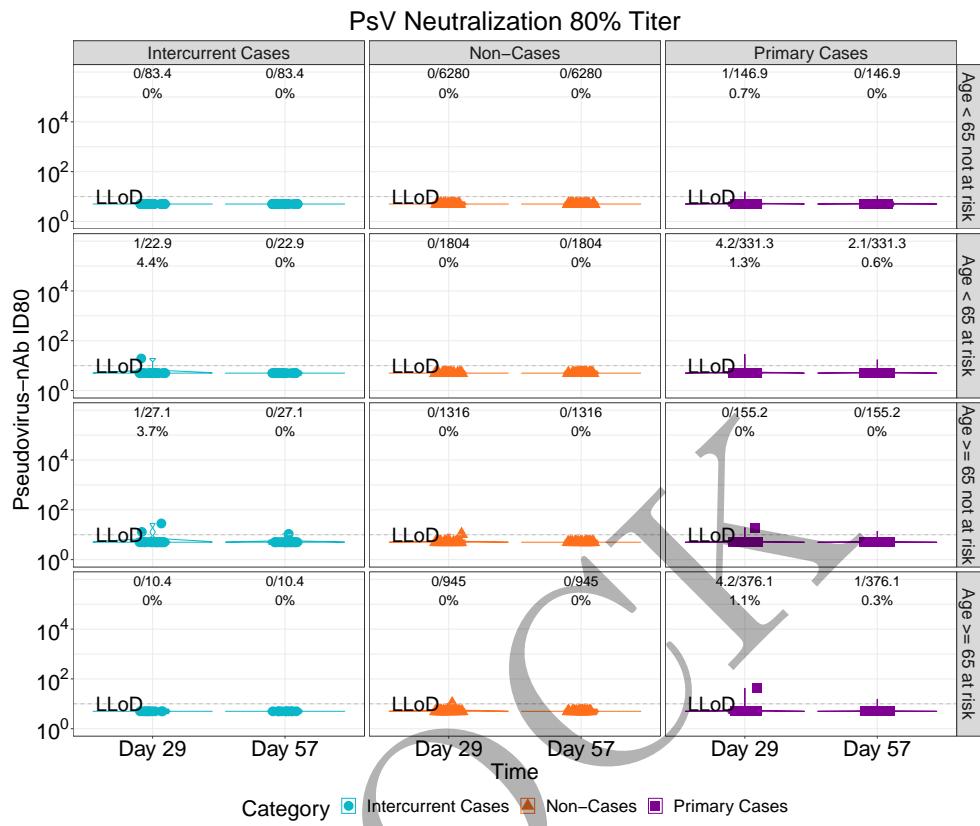


Figure 2.124: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

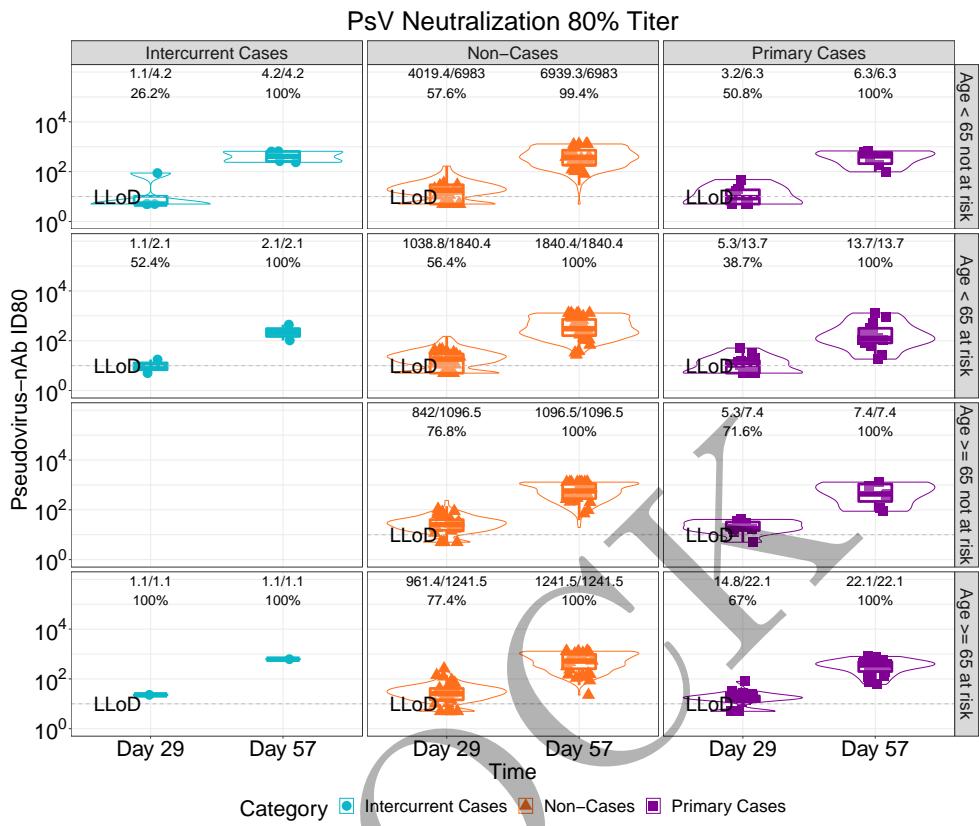


Figure 2.125: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

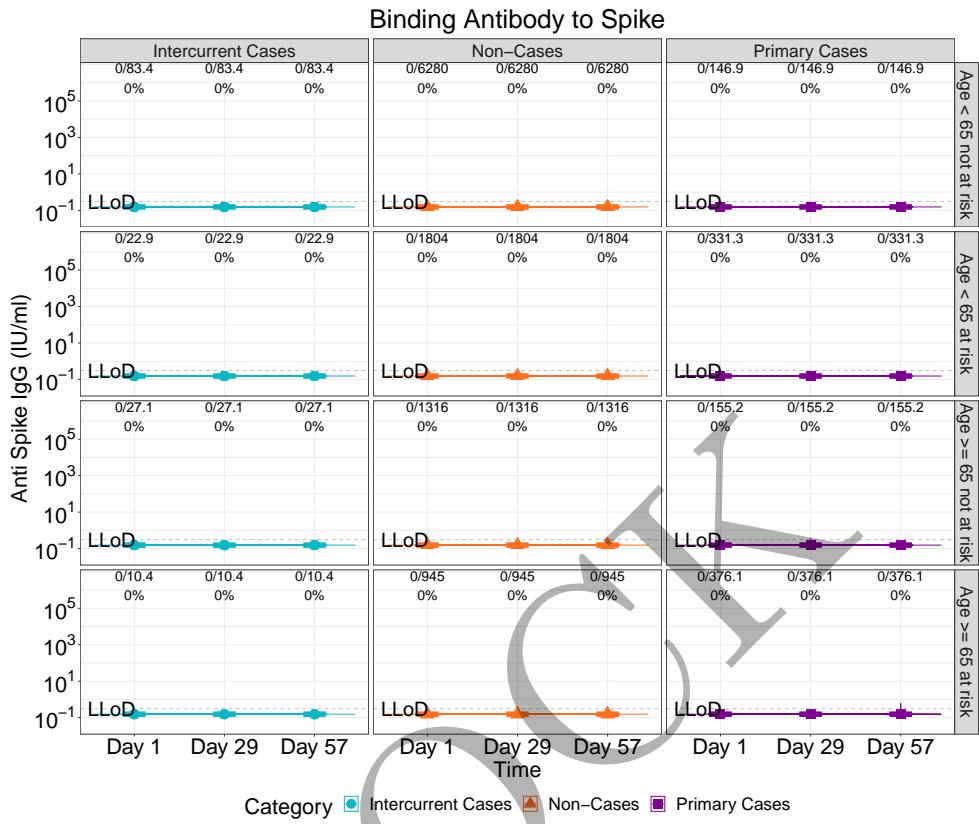


Figure 2.126: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

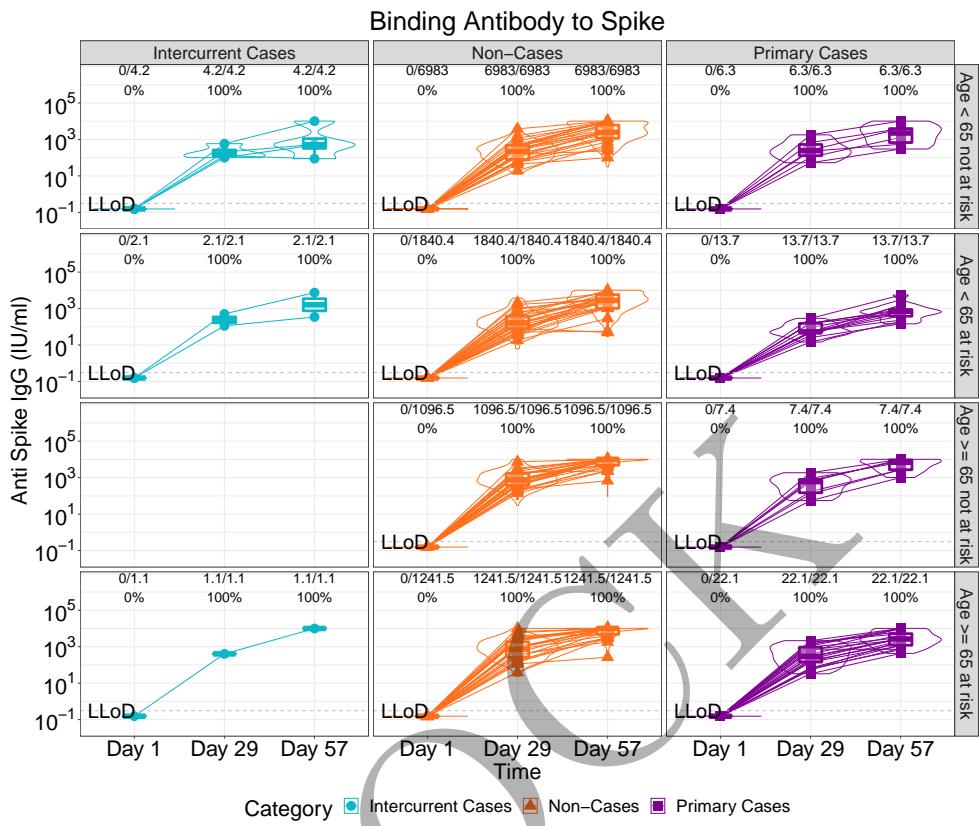


Figure 2.127: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

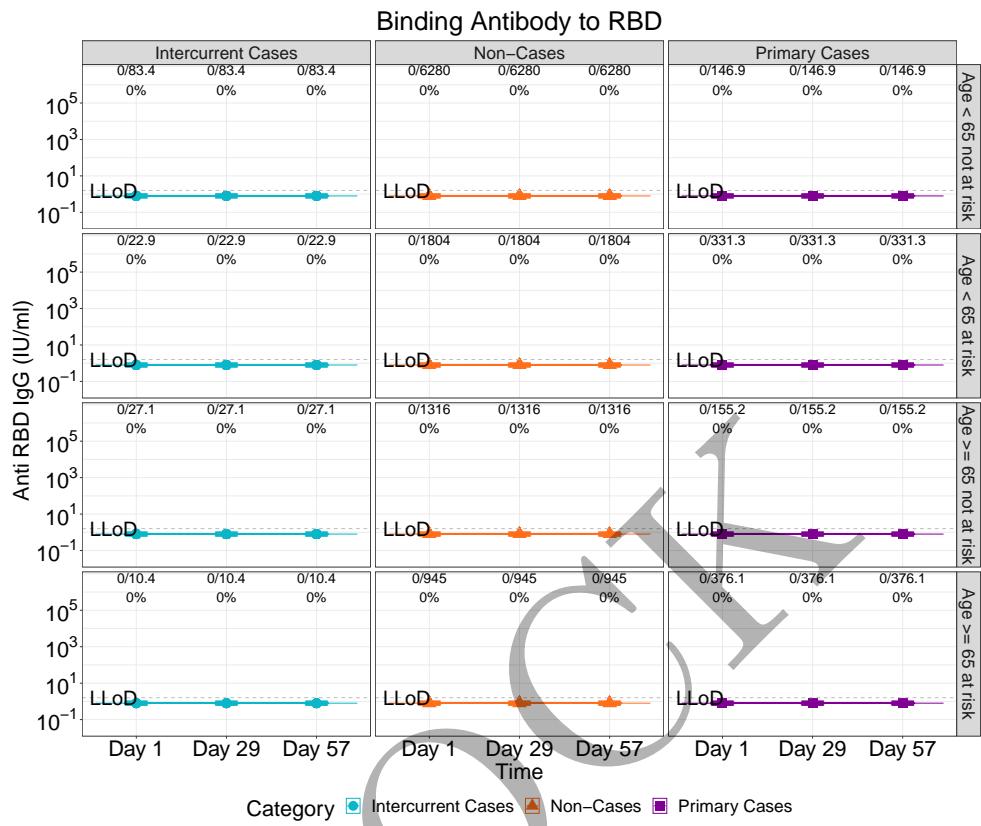


Figure 2.128: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

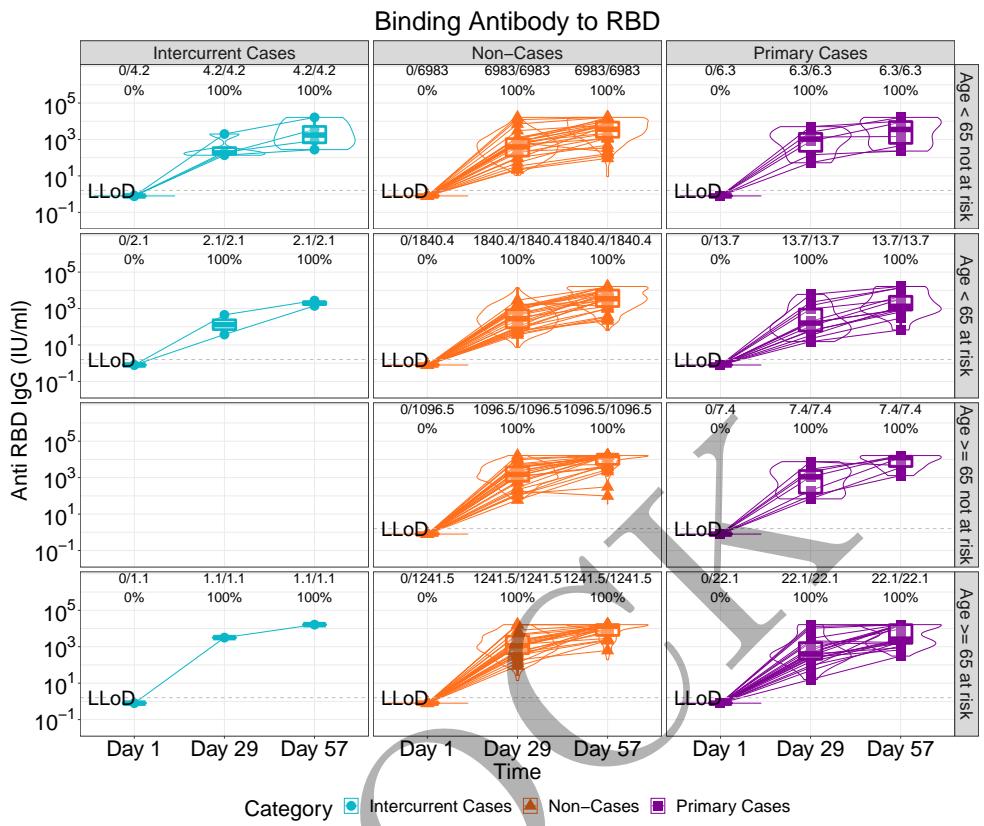


Figure 2.129: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

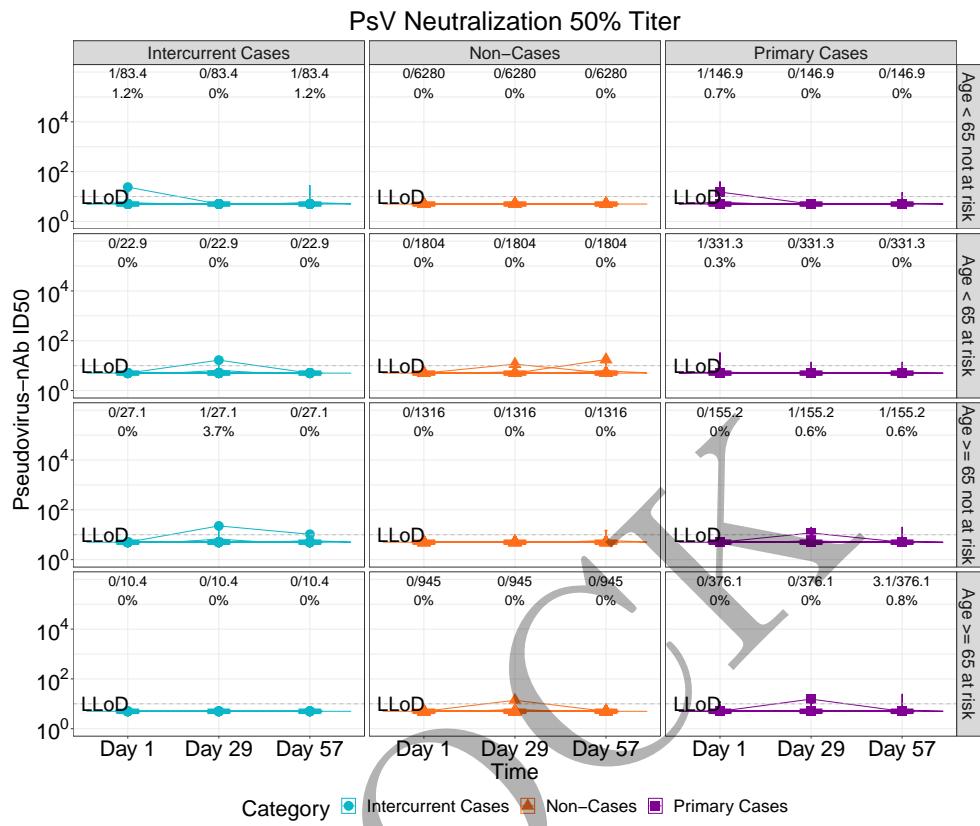


Figure 2.130: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

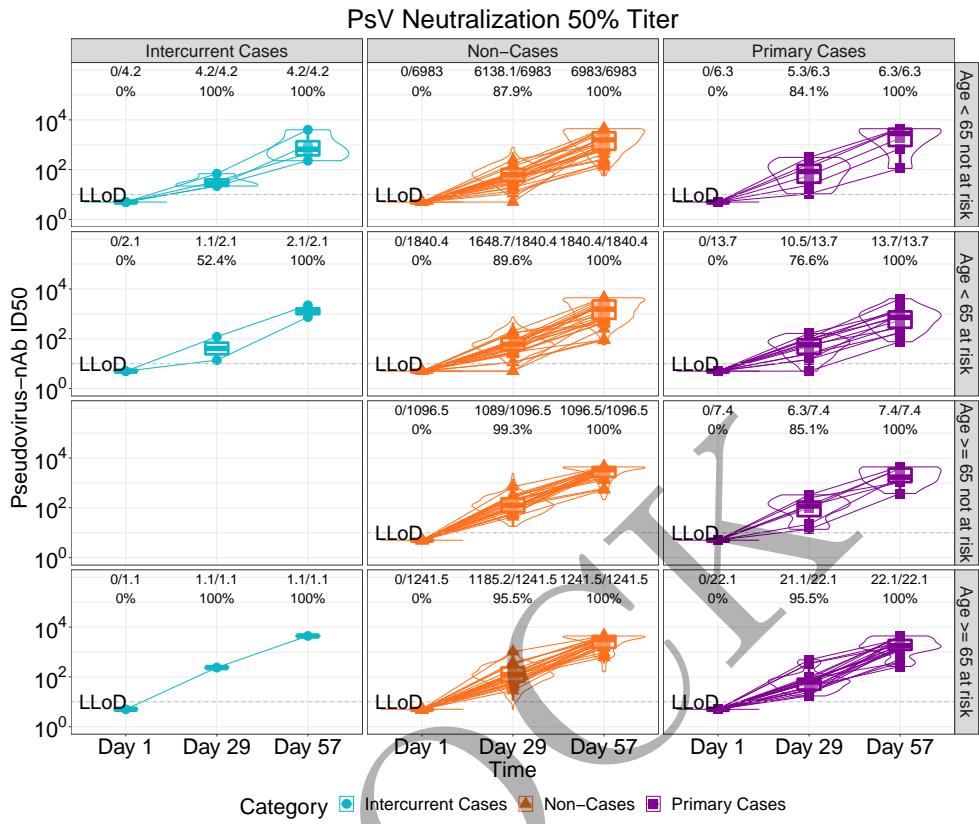


Figure 2.131: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2)

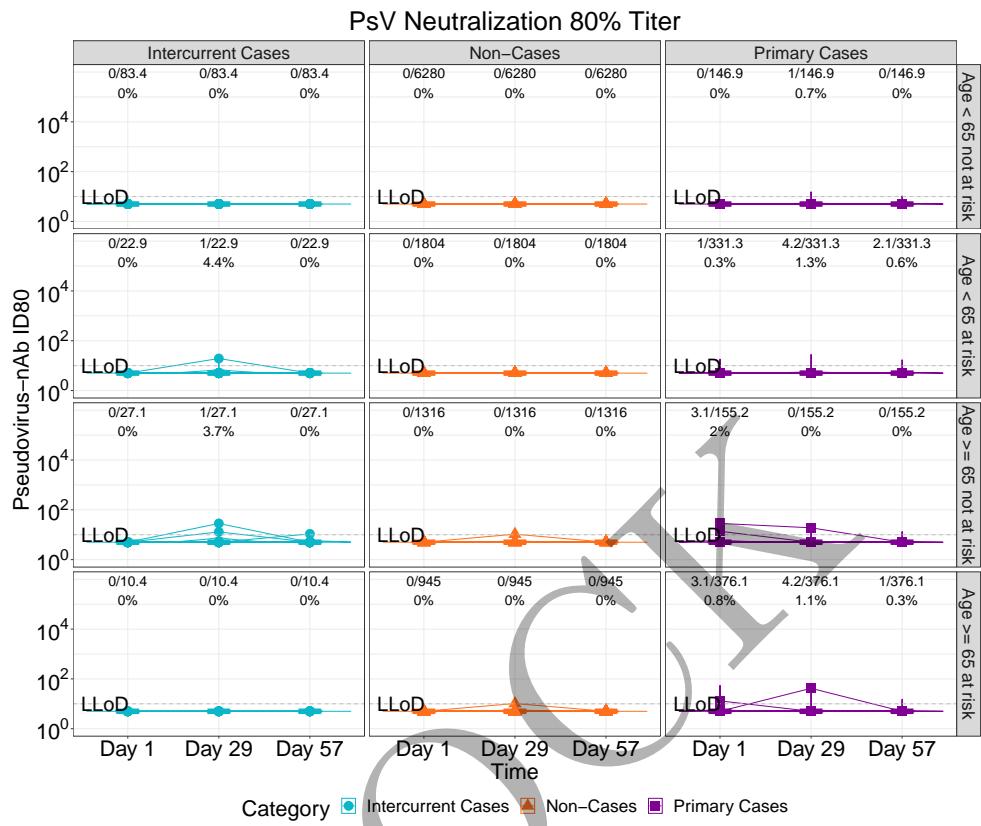


Figure 2.132: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

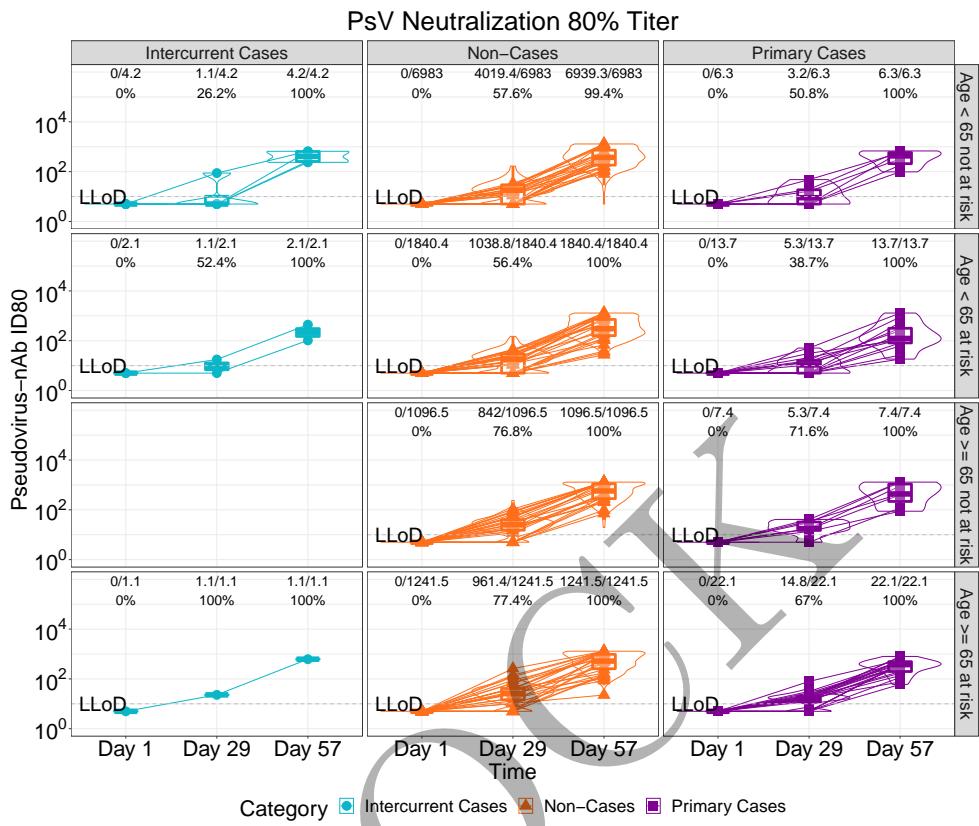


Figure 2.133: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

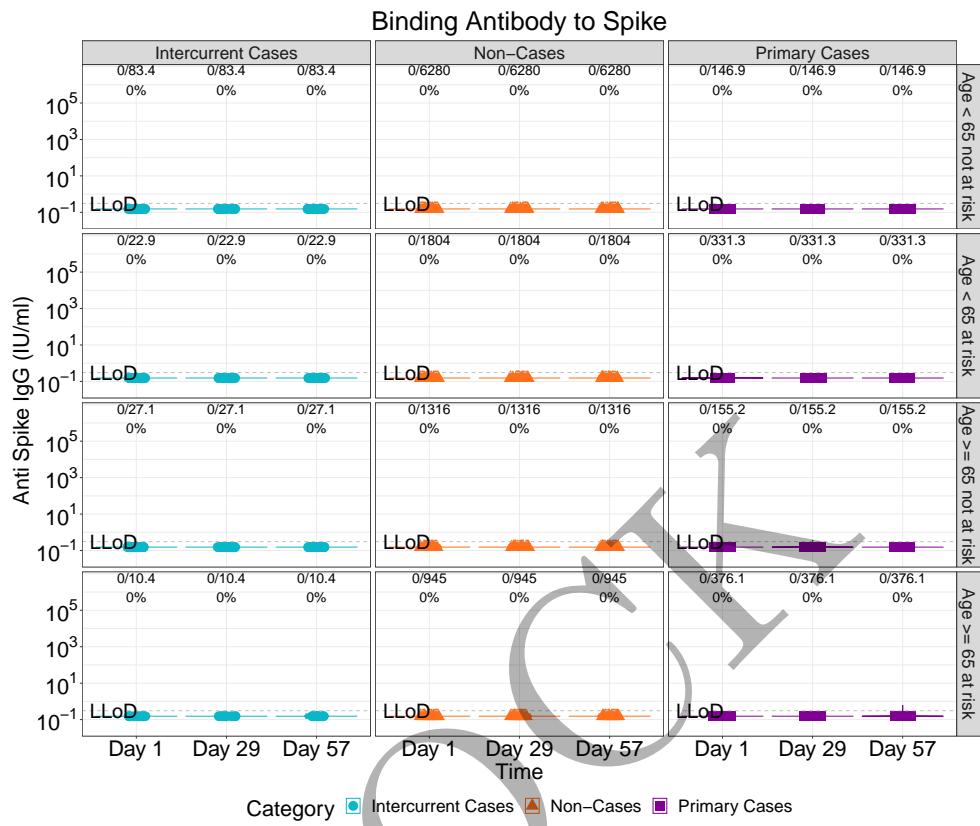


Figure 2.134: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

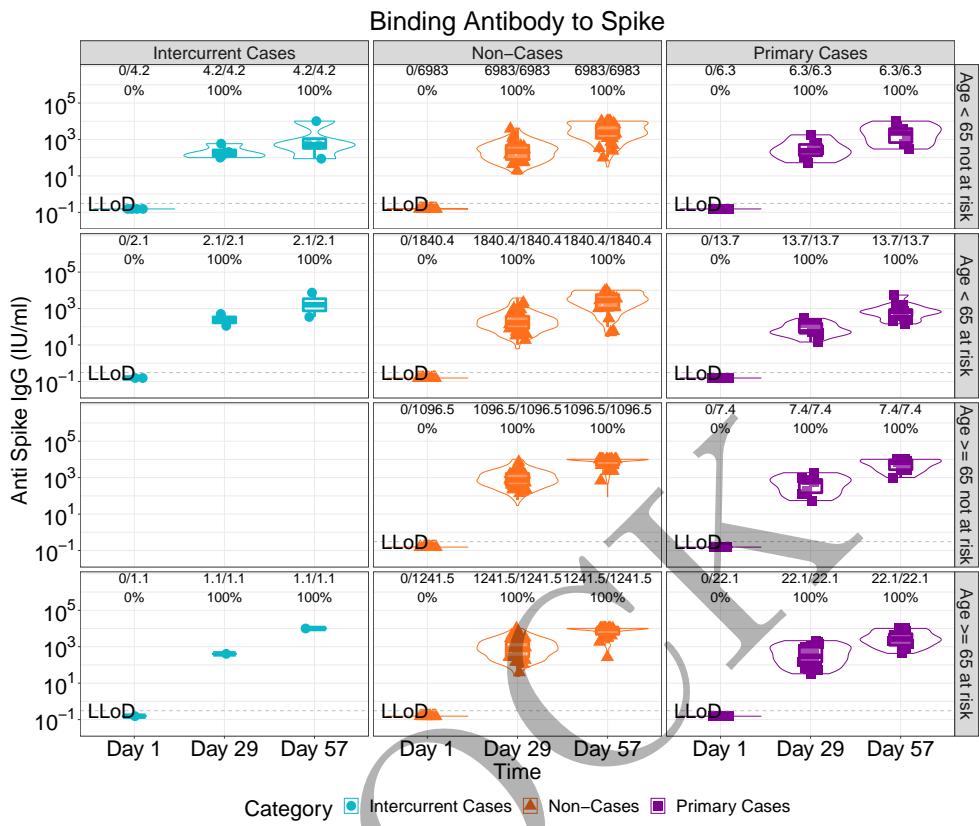


Figure 2.135: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

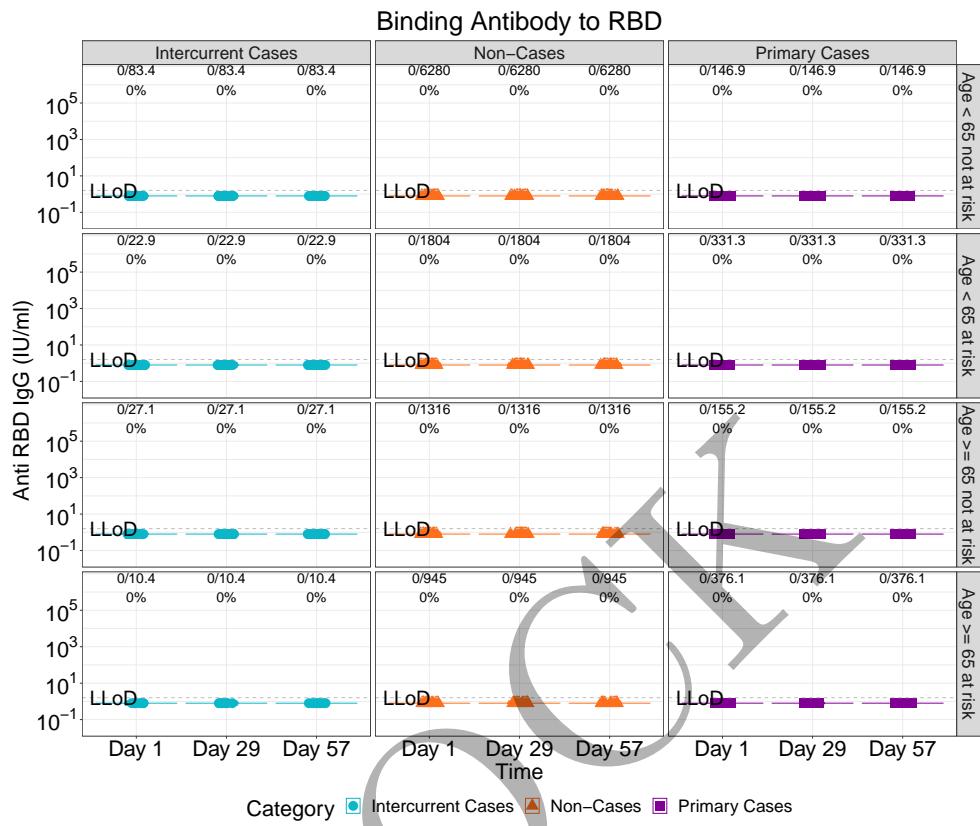


Figure 2.136: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

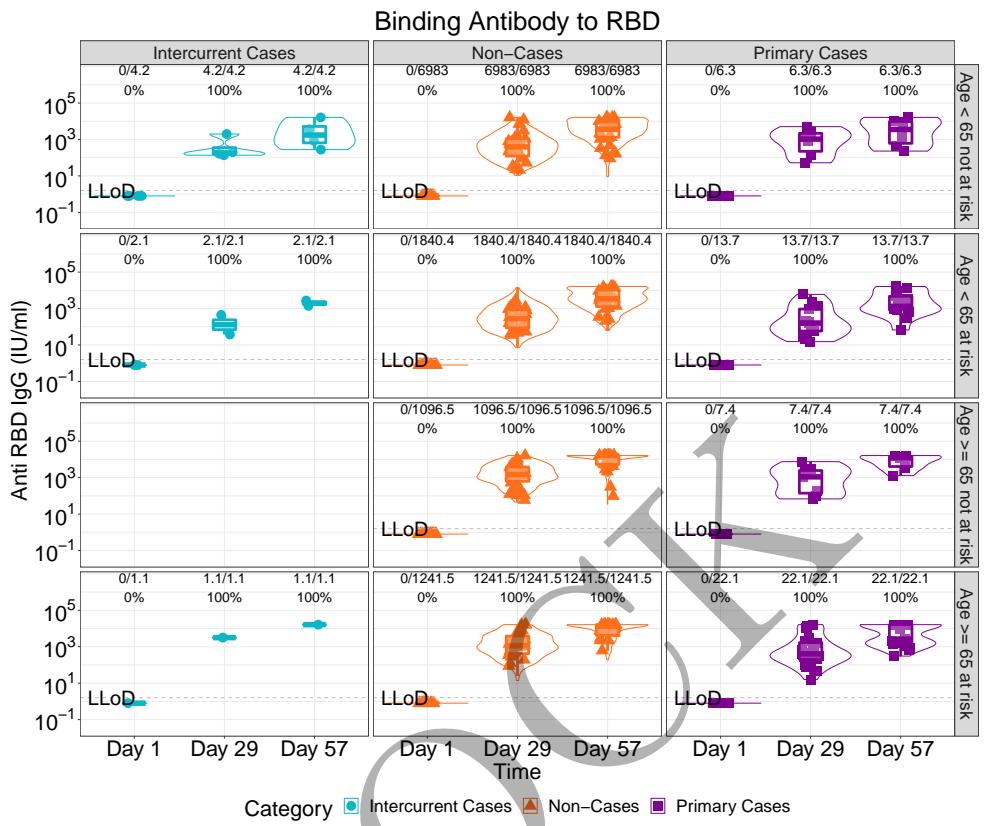


Figure 2.137: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

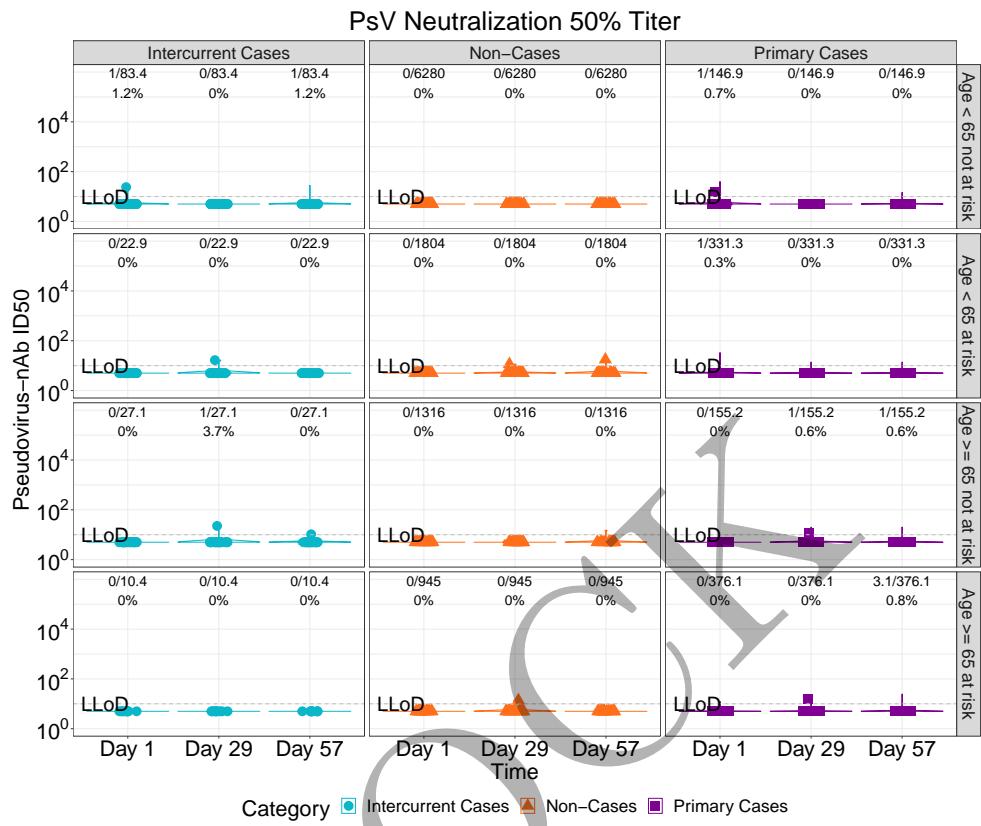


Figure 2.138: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

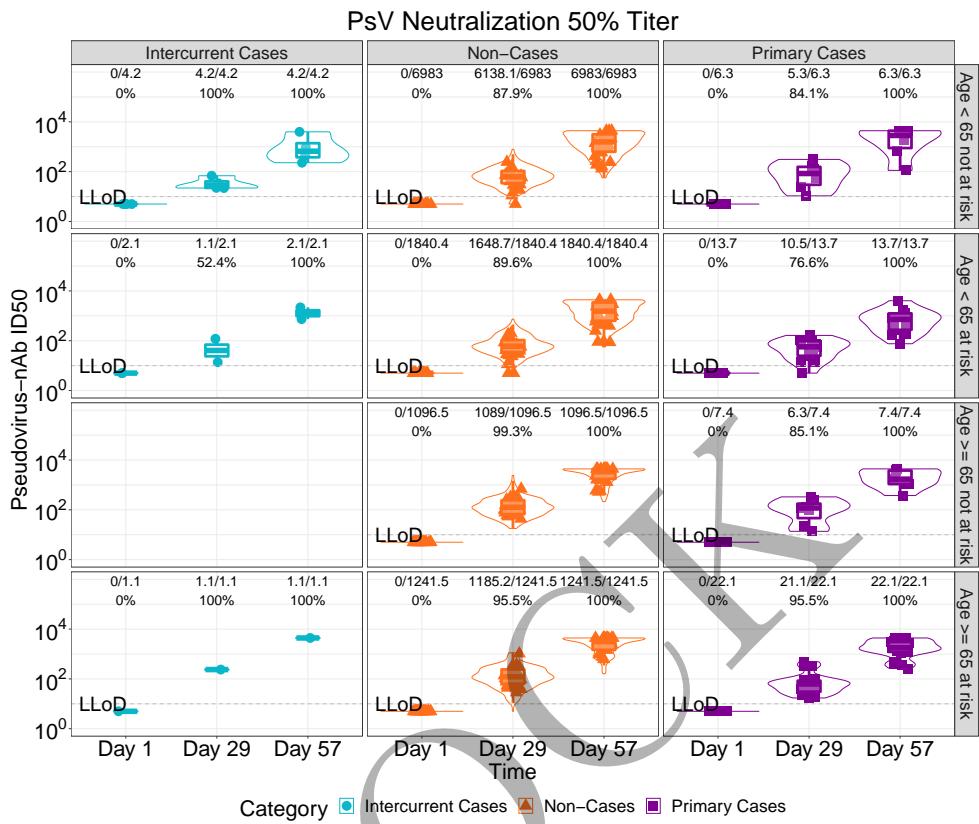


Figure 2.139: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2)

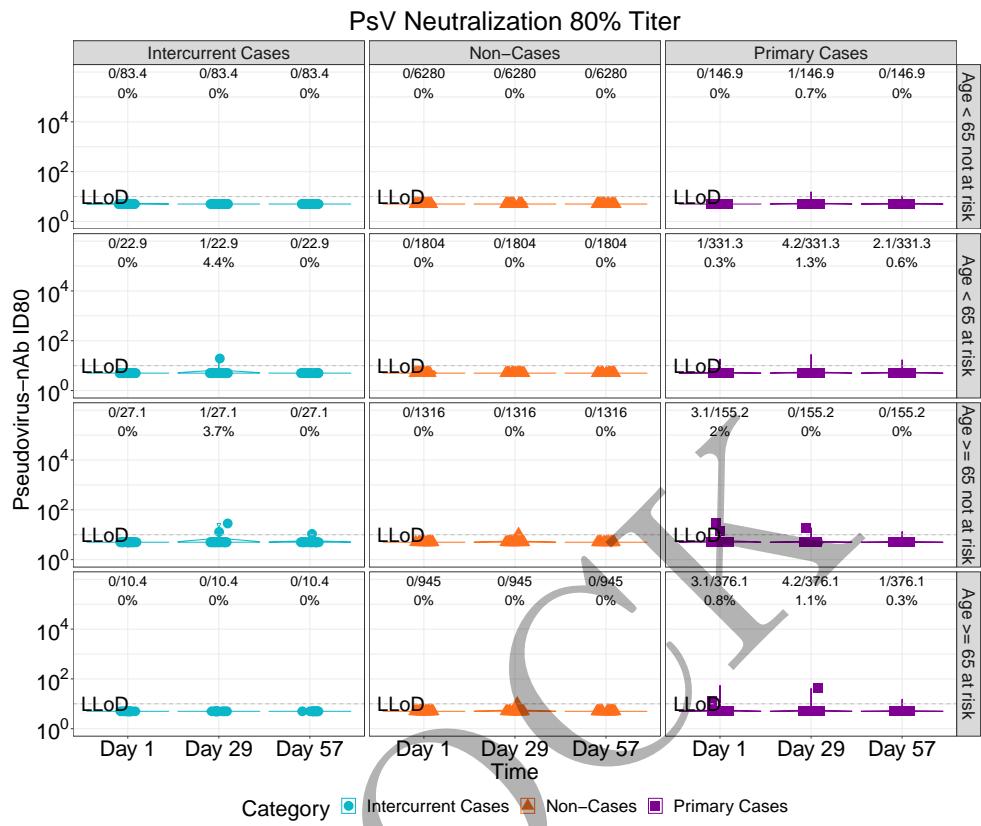


Figure 2.140: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

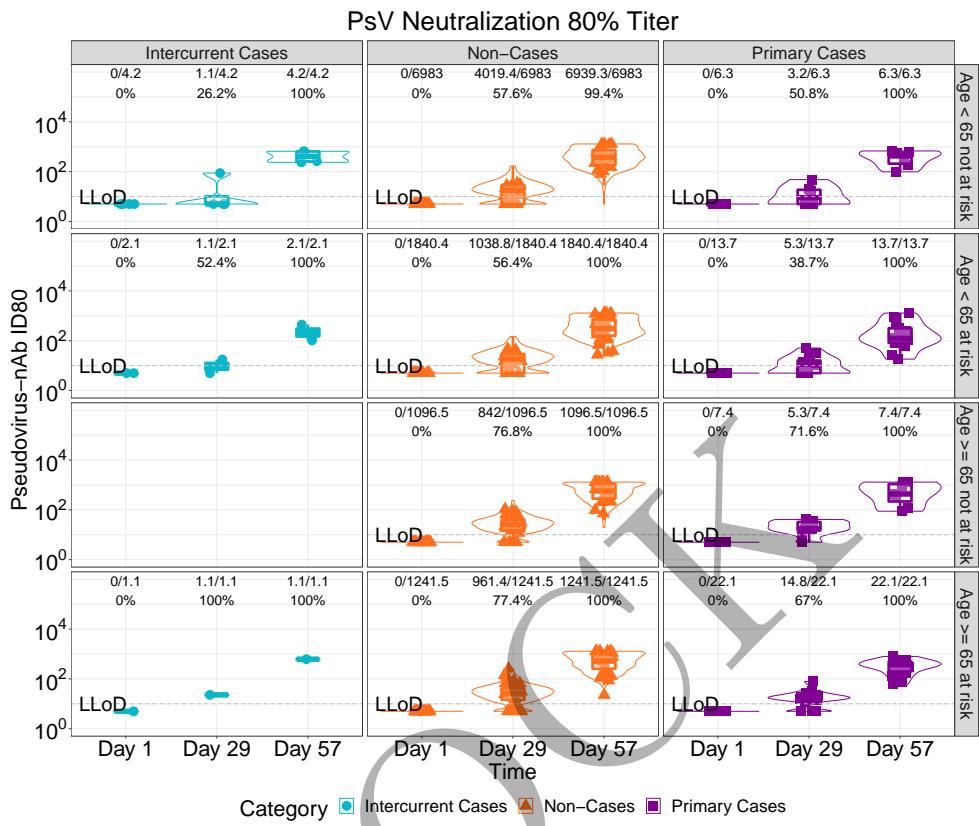


Figure 2.141: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

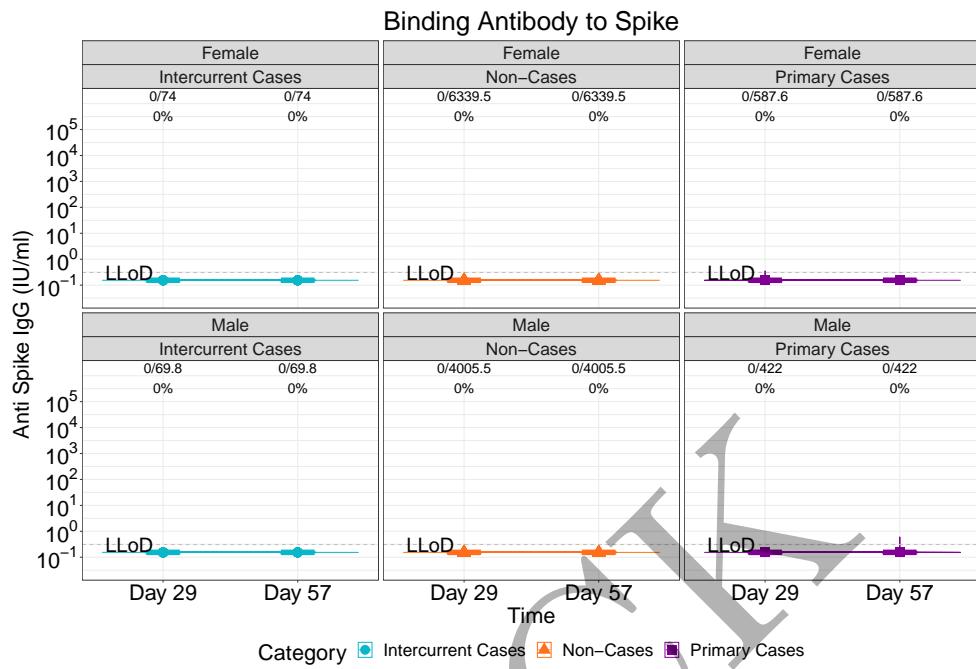


Figure 2.142: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

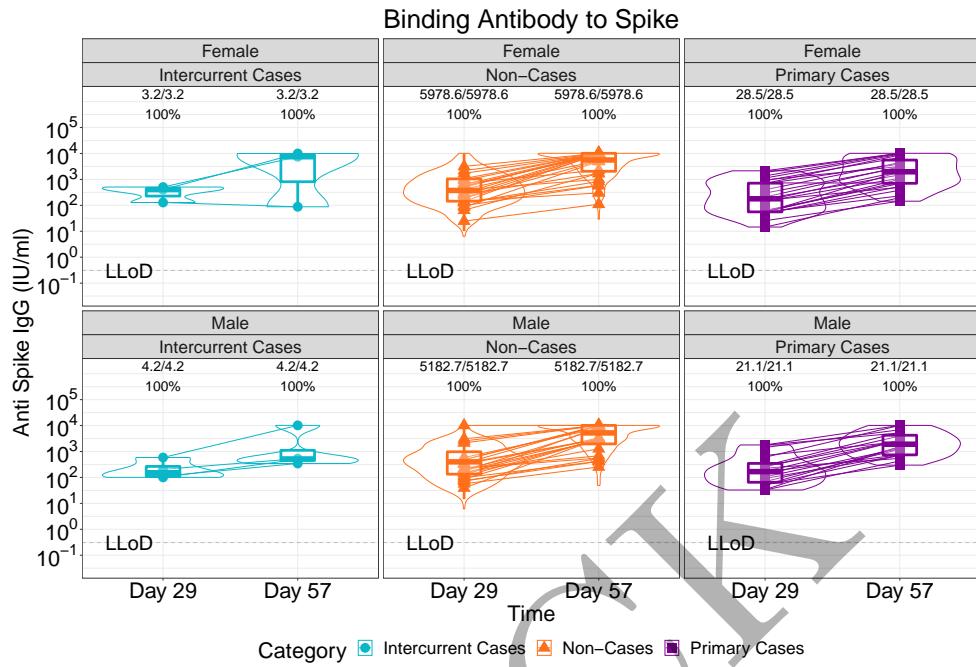


Figure 2.143: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

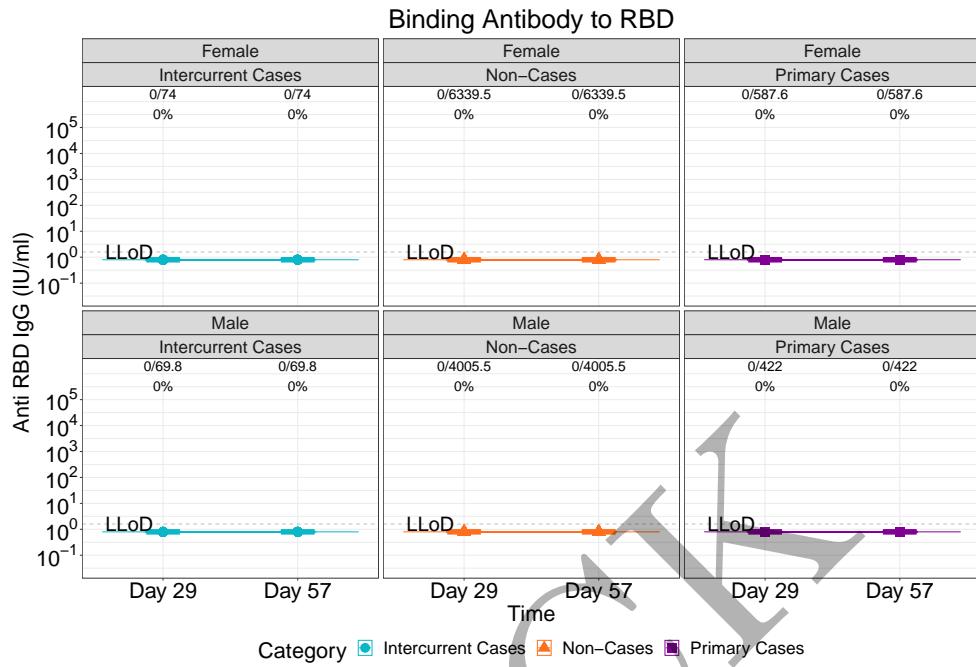


Figure 2.144: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

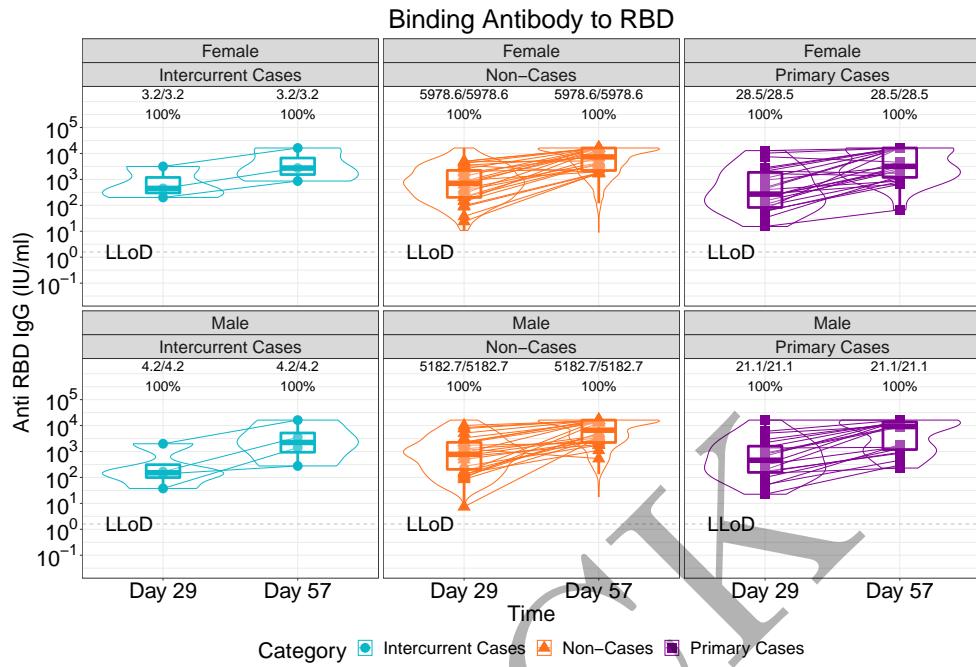


Figure 2.145: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

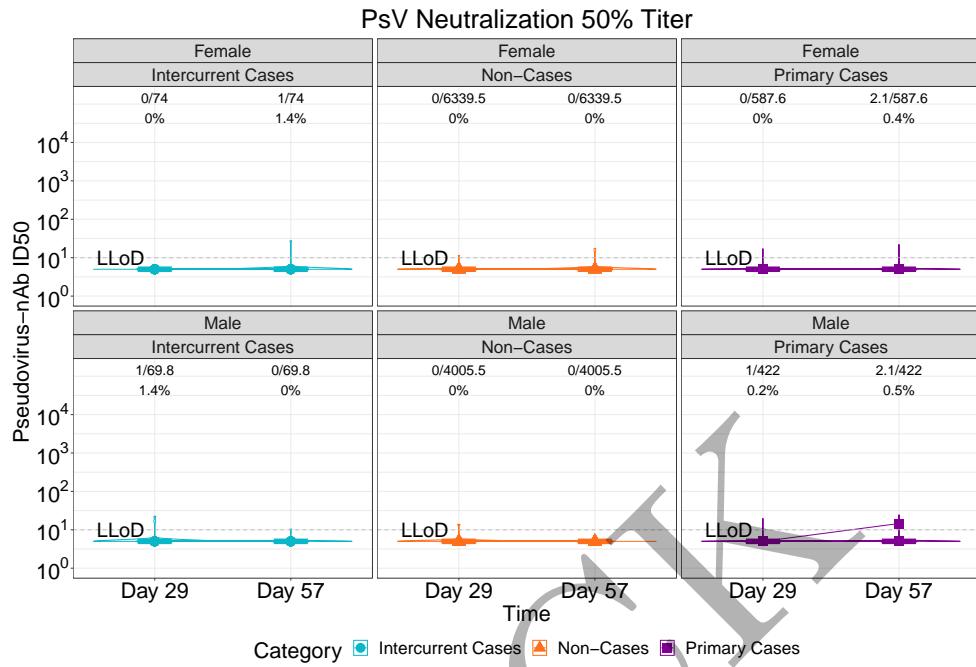


Figure 2.146: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

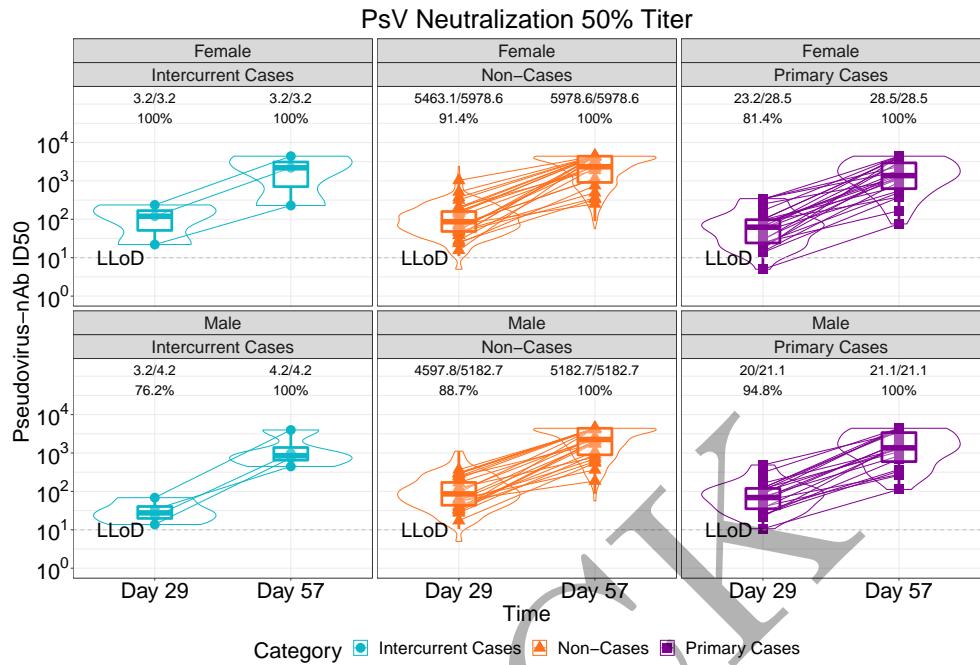


Figure 2.147: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

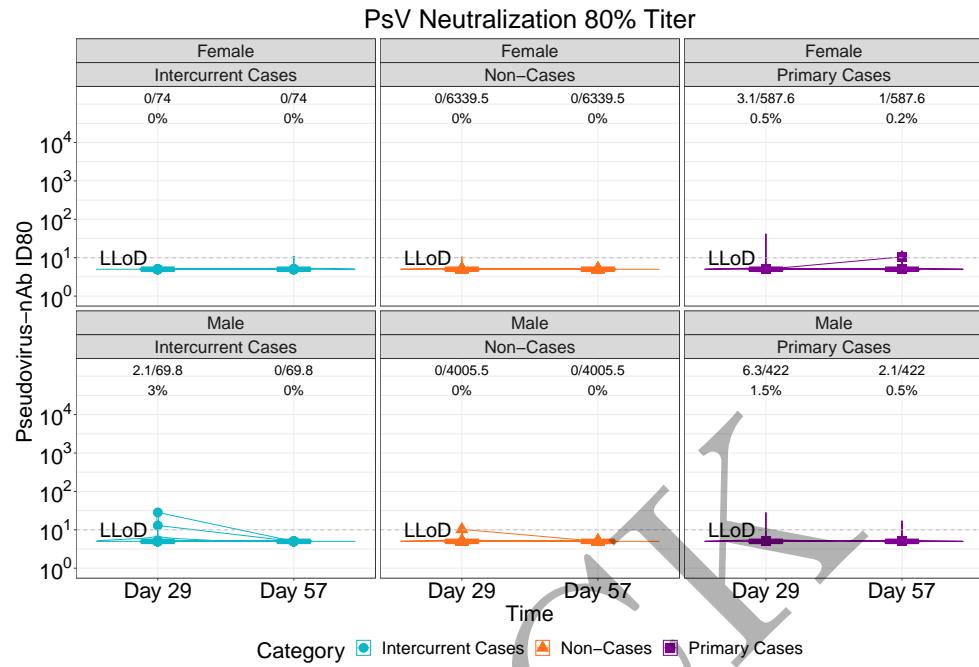


Figure 2.148: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

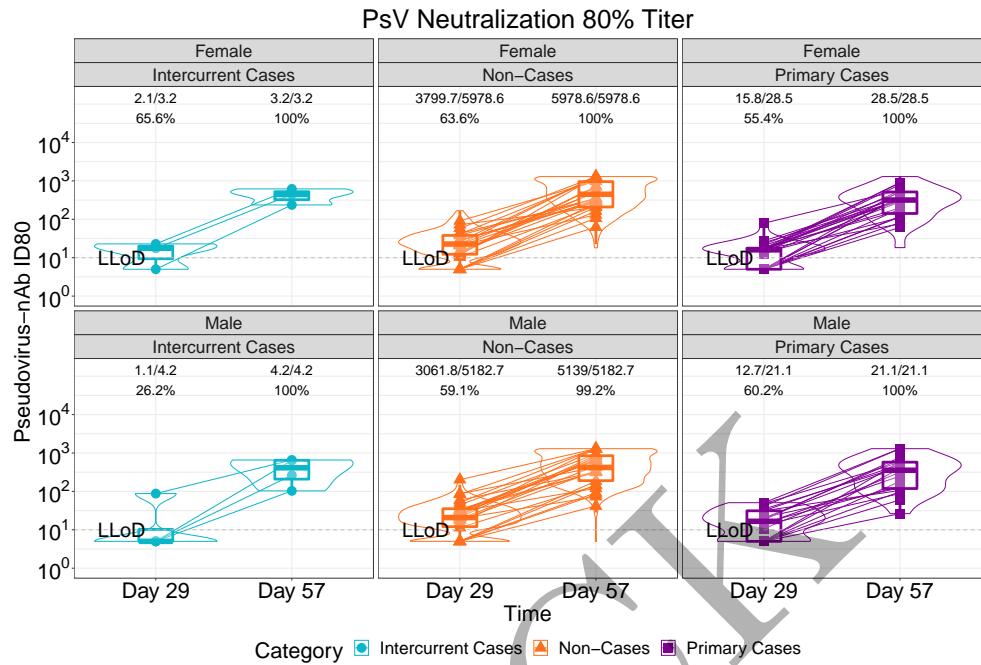


Figure 2.149: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

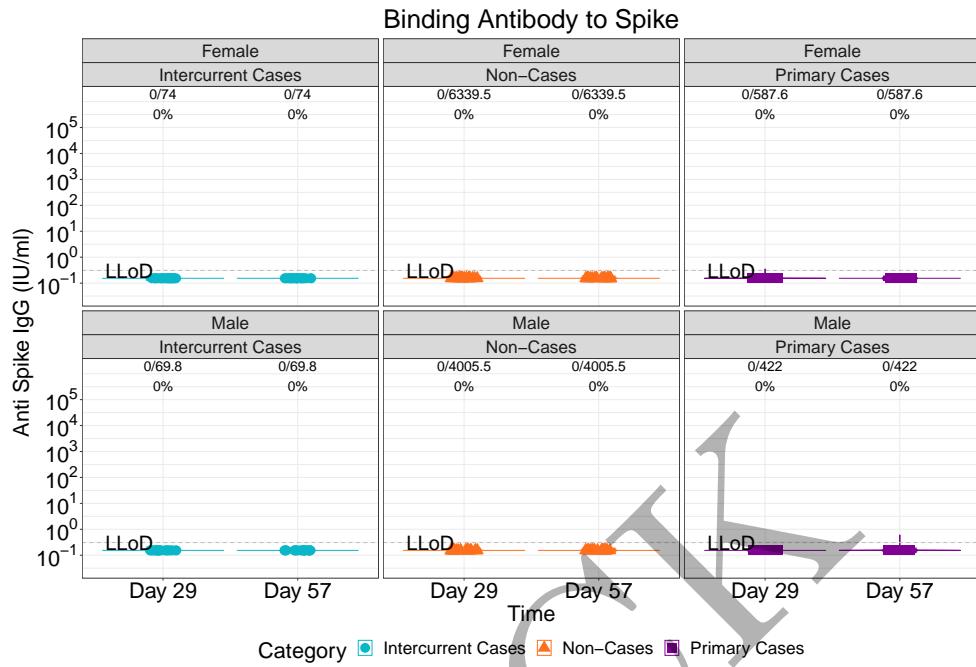


Figure 2.150: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

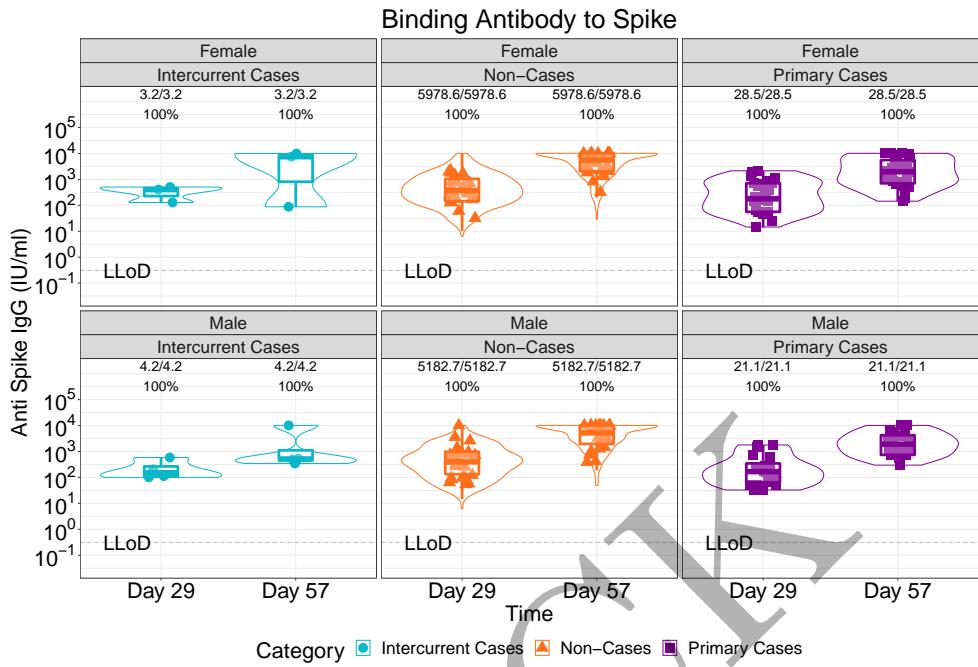


Figure 2.151: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

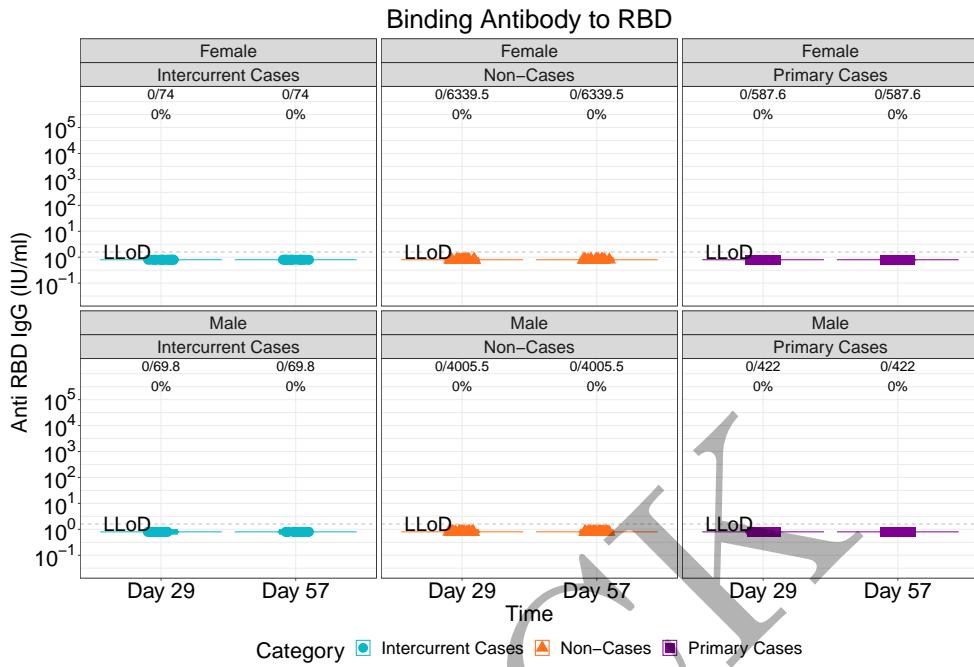


Figure 2.152: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

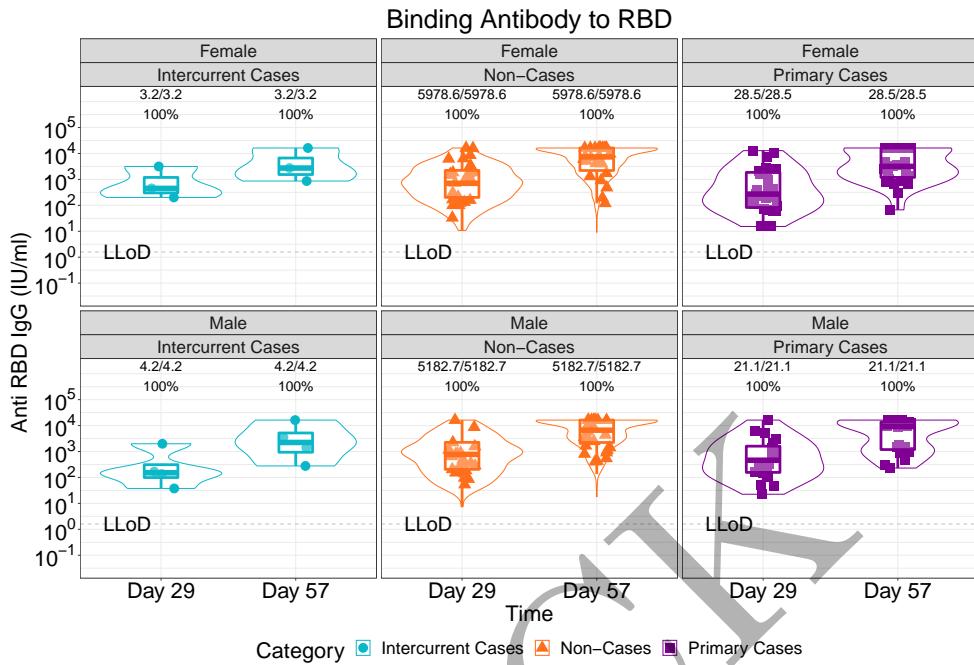


Figure 2.153: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

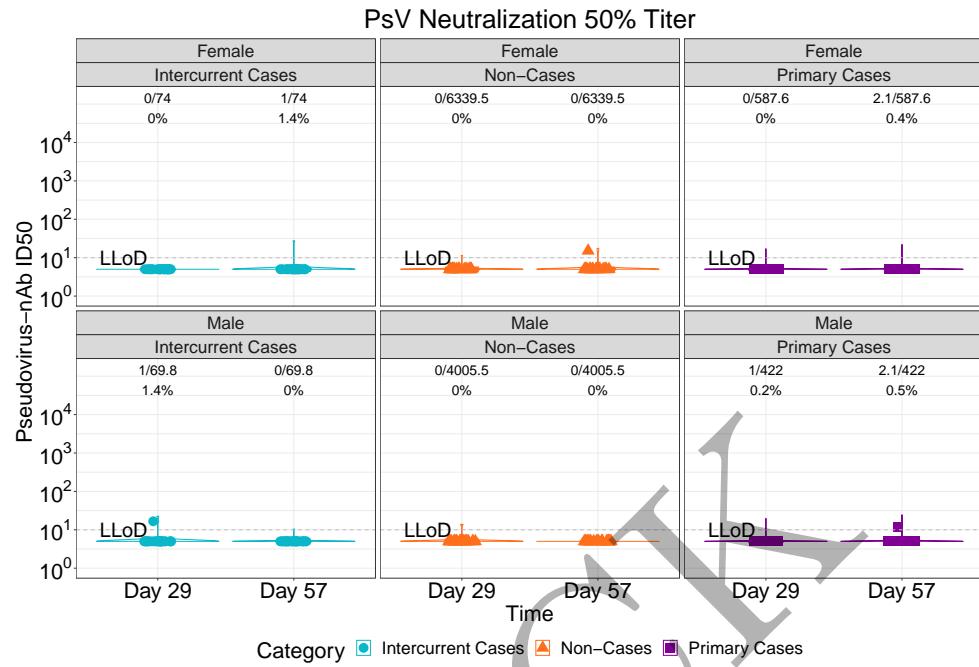


Figure 2.154: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

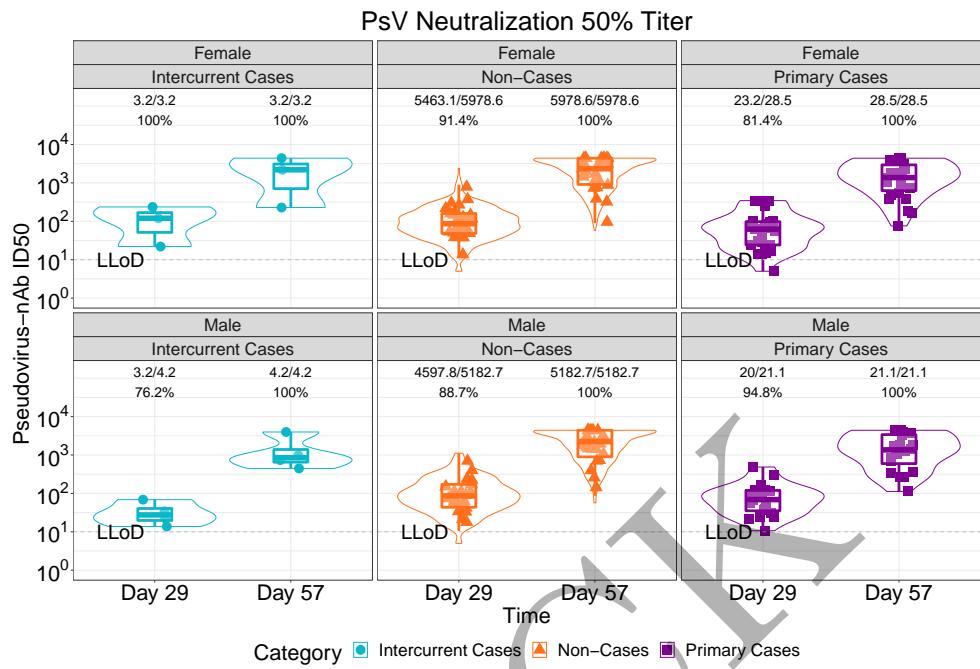


Figure 2.155: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

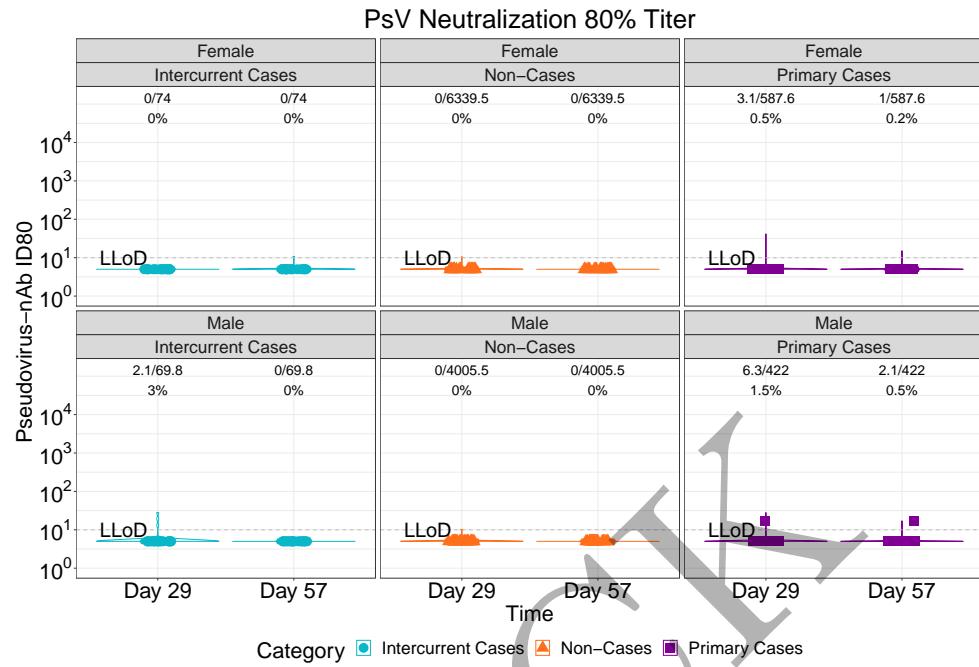


Figure 2.156: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

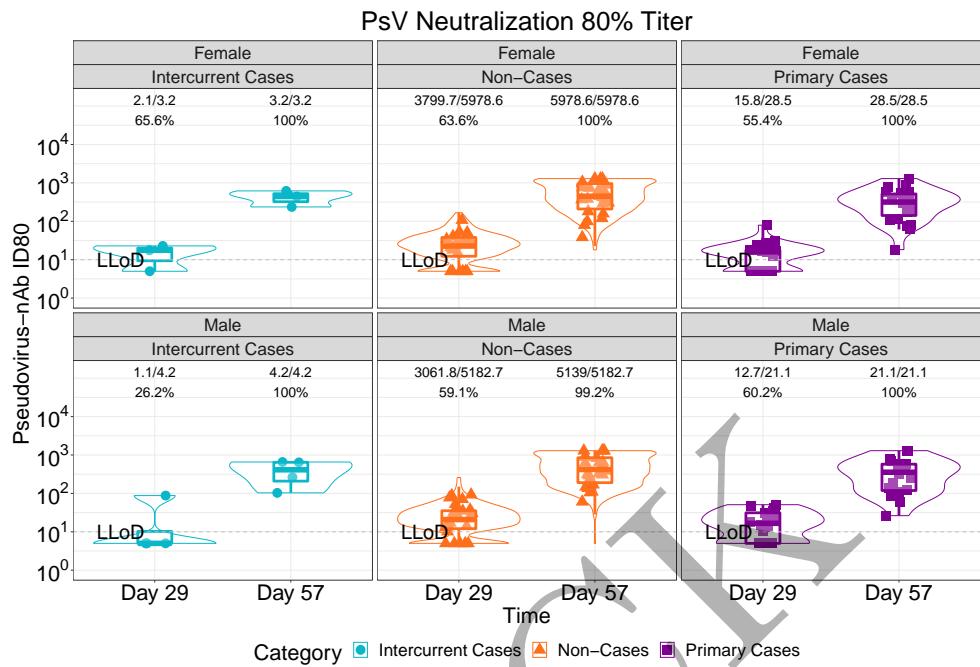


Figure 2.157: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

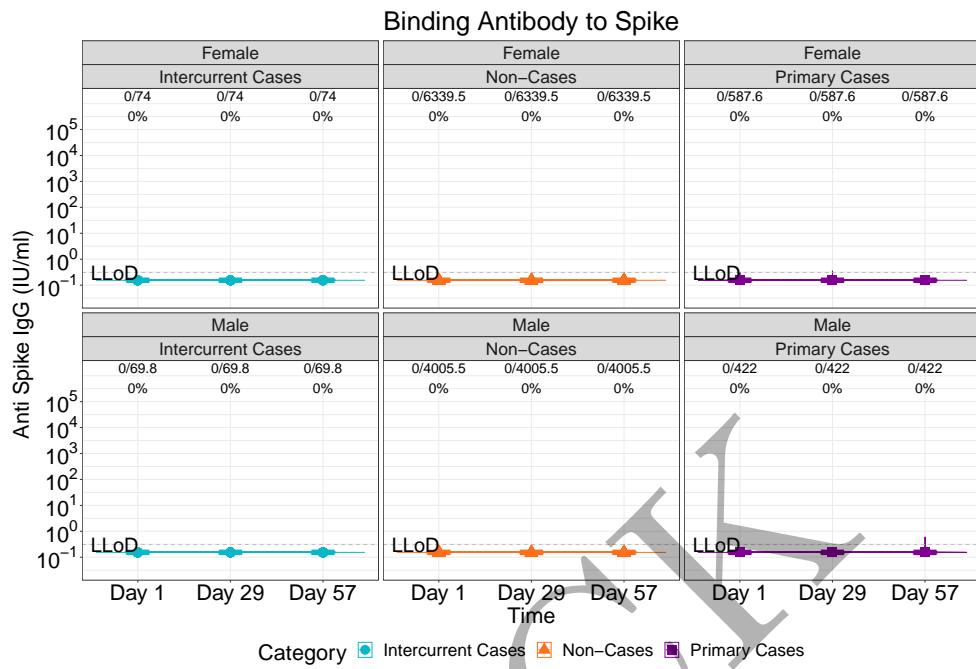


Figure 2.158: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

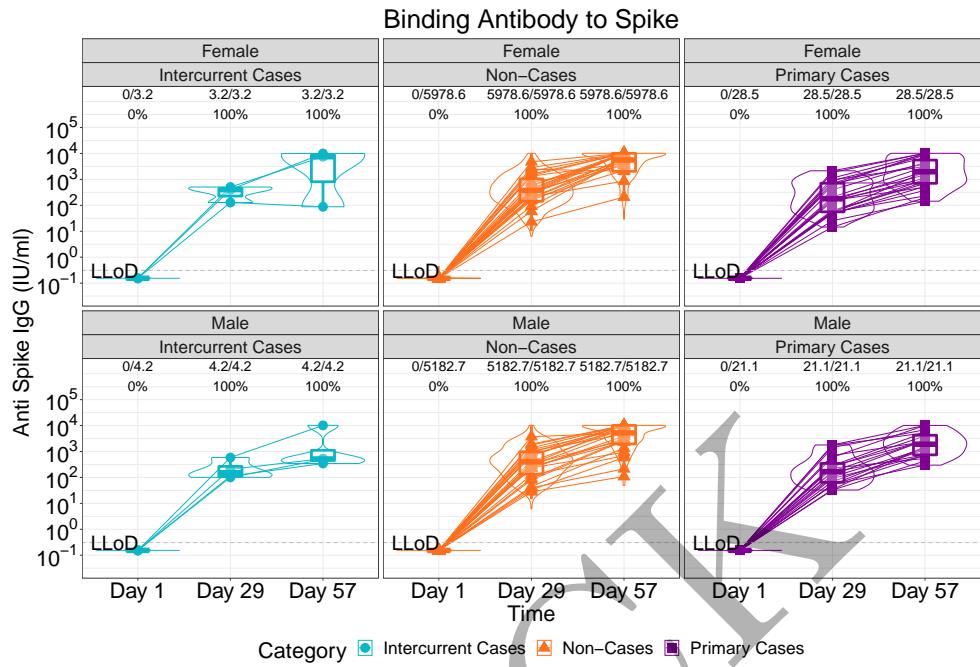


Figure 2.159: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

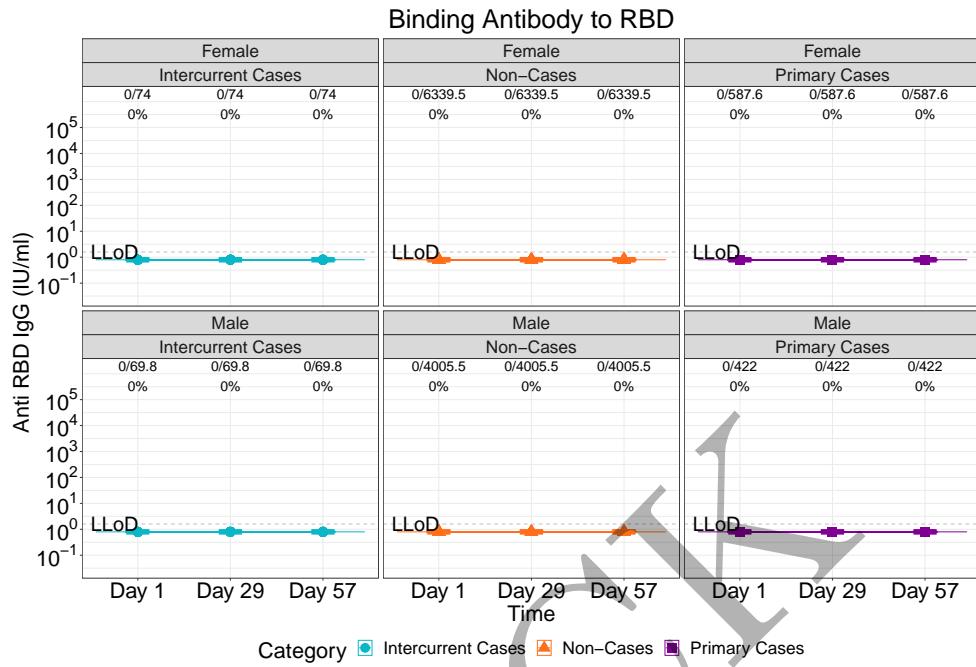


Figure 2.160: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

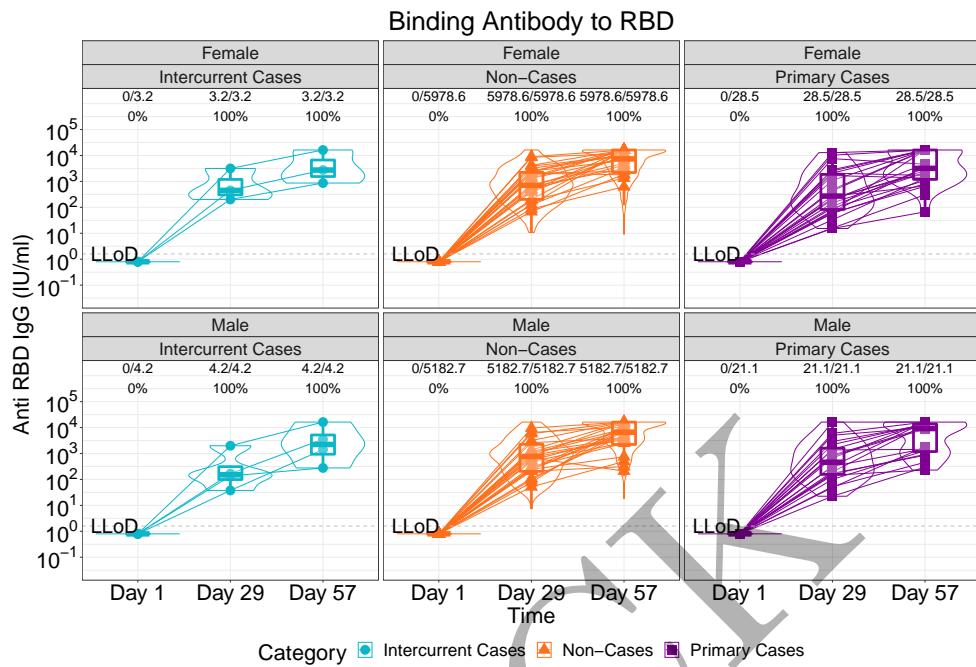


Figure 2.161: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

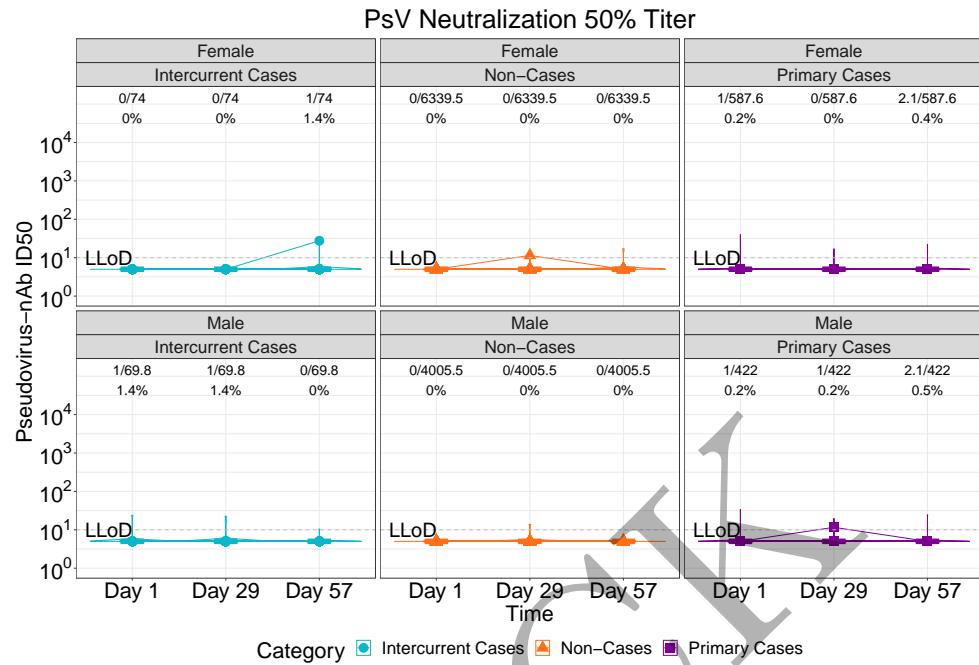


Figure 2.162: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

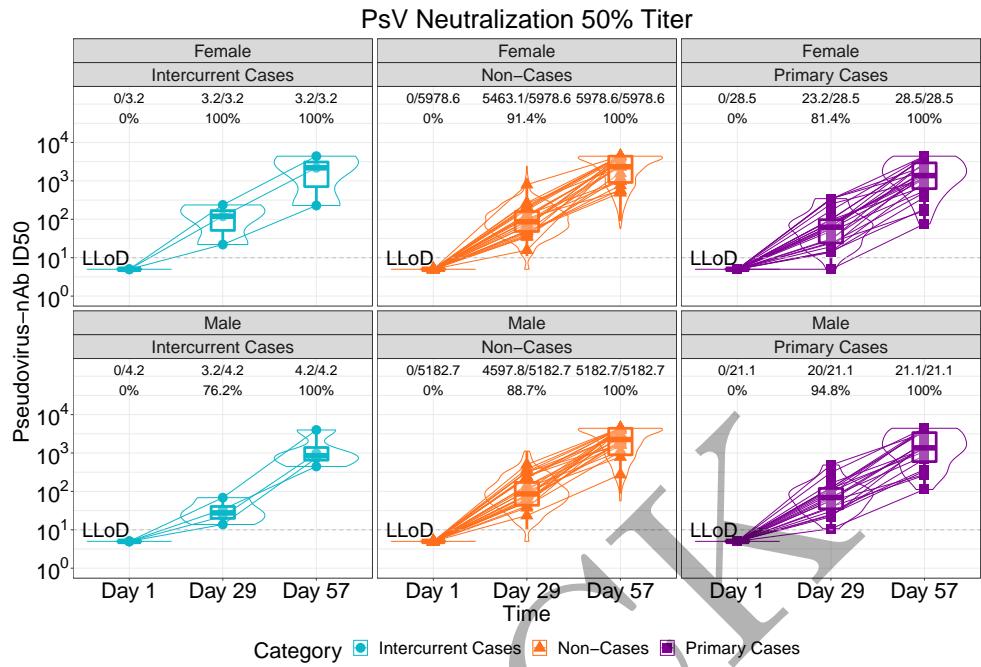


Figure 2.163: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

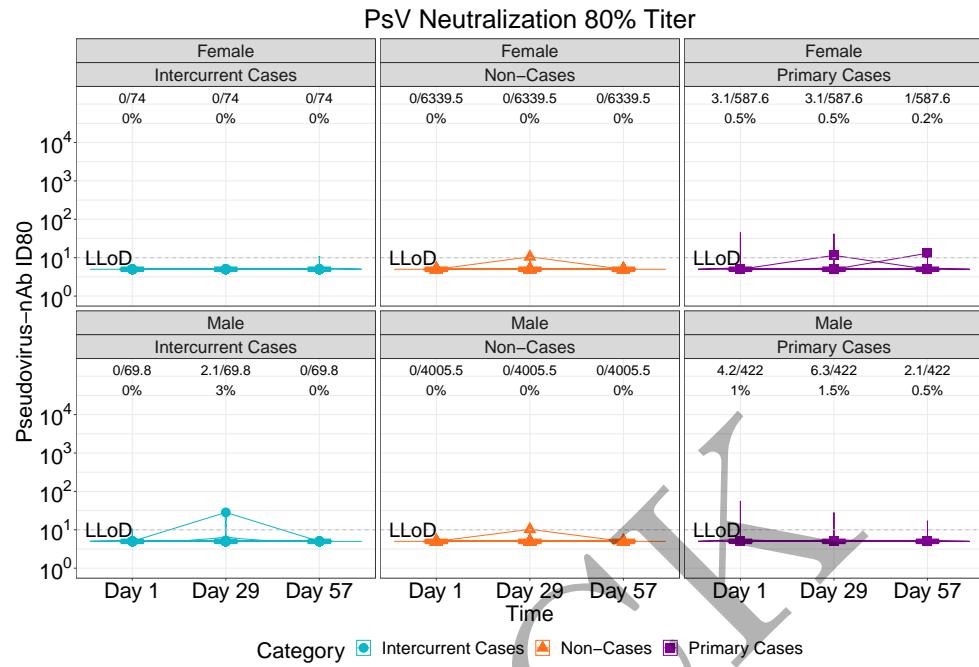


Figure 2.164: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

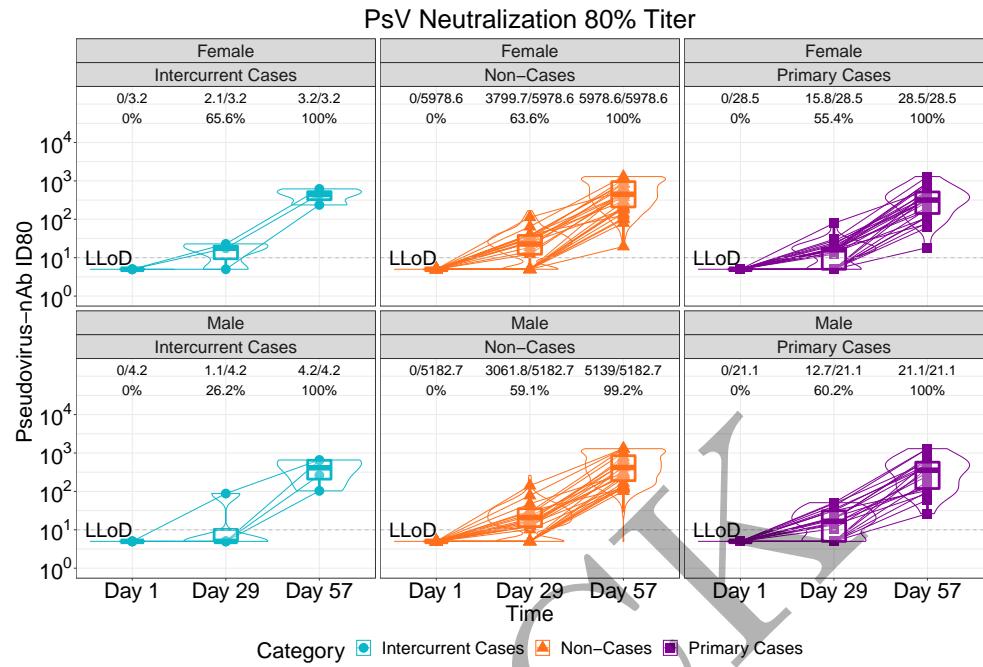


Figure 2.165: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

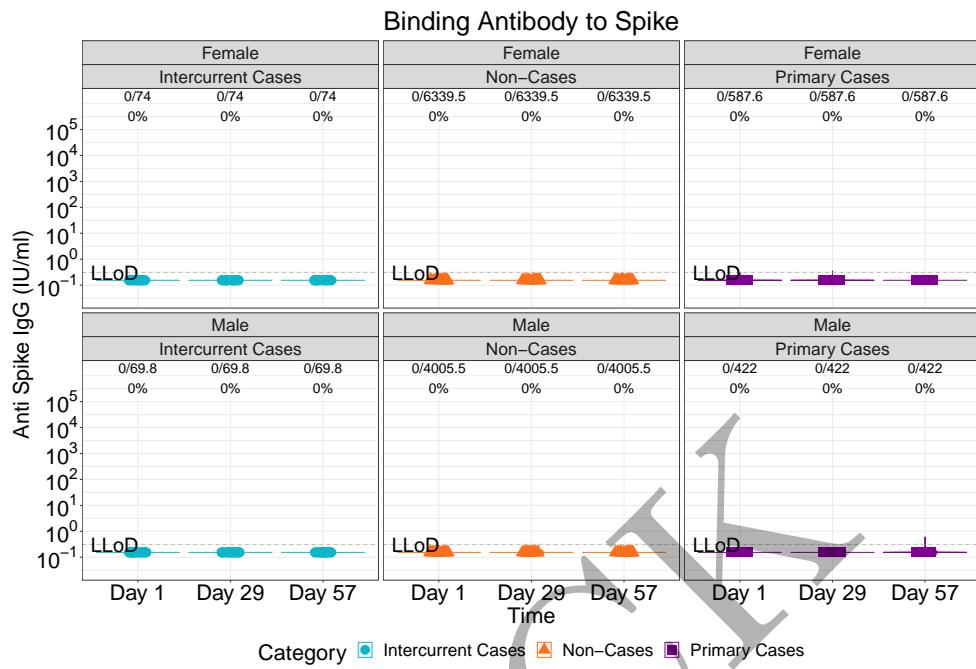


Figure 2.166: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

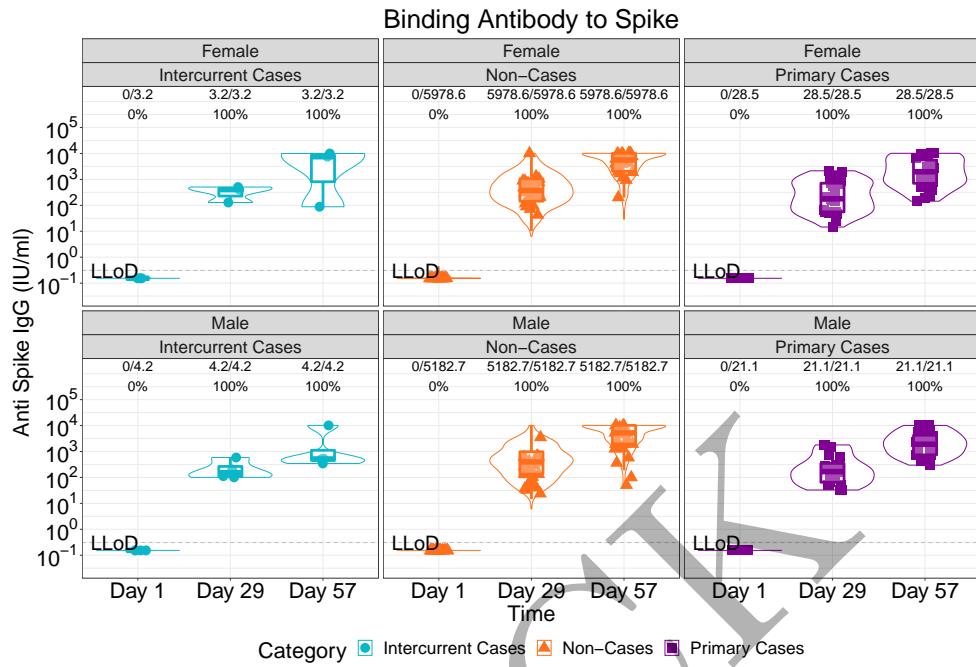


Figure 2.167: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

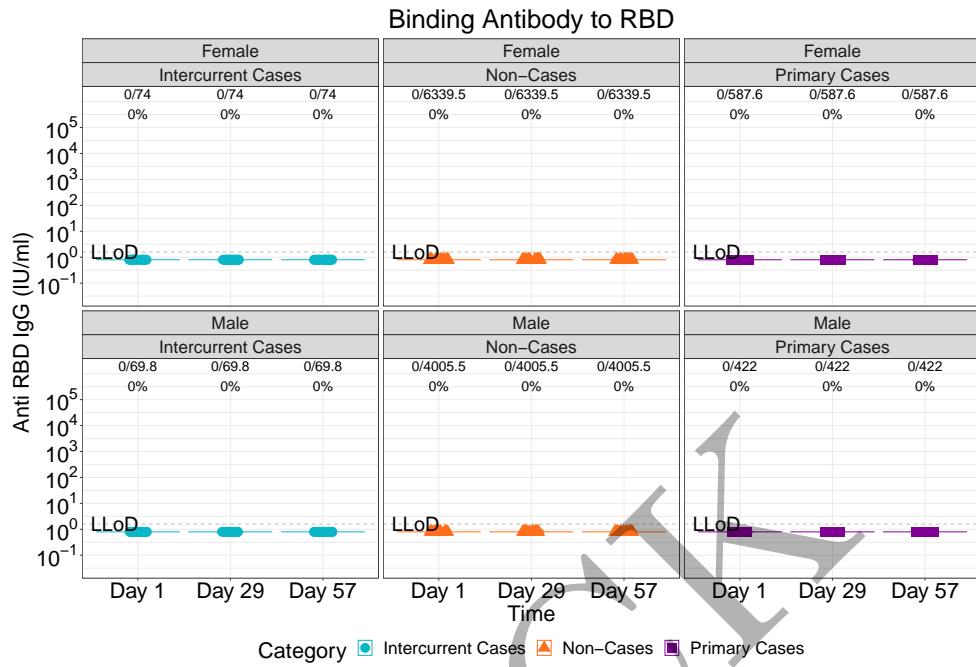


Figure 2.168: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

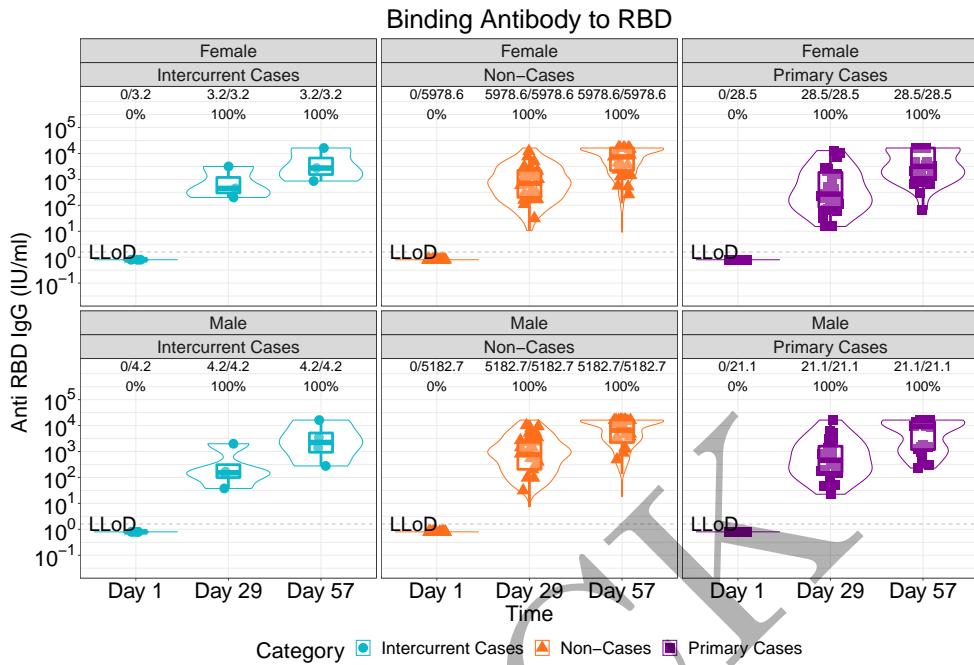


Figure 2.169: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

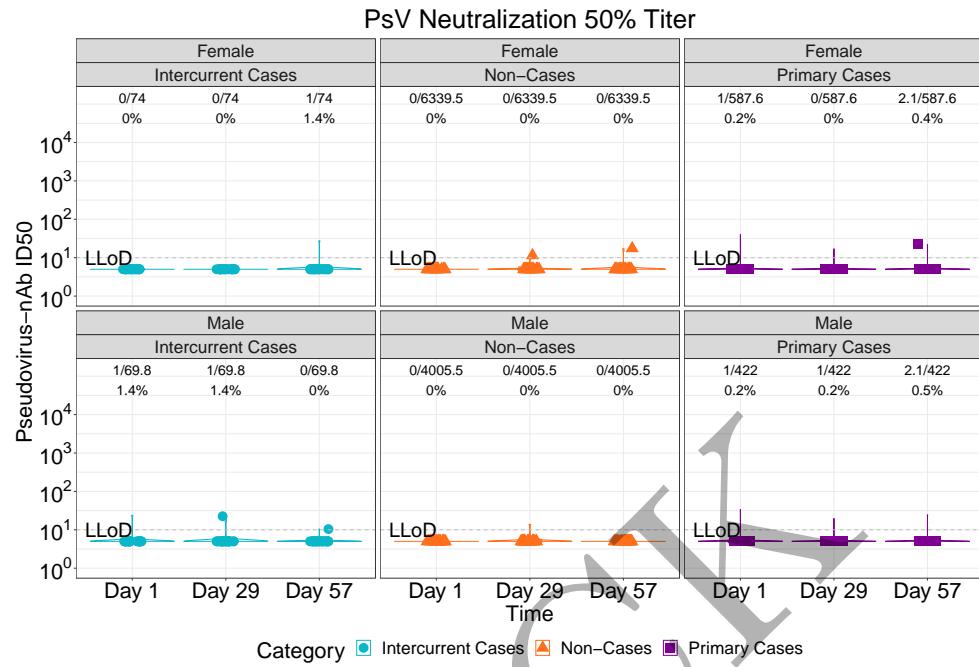


Figure 2.170: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

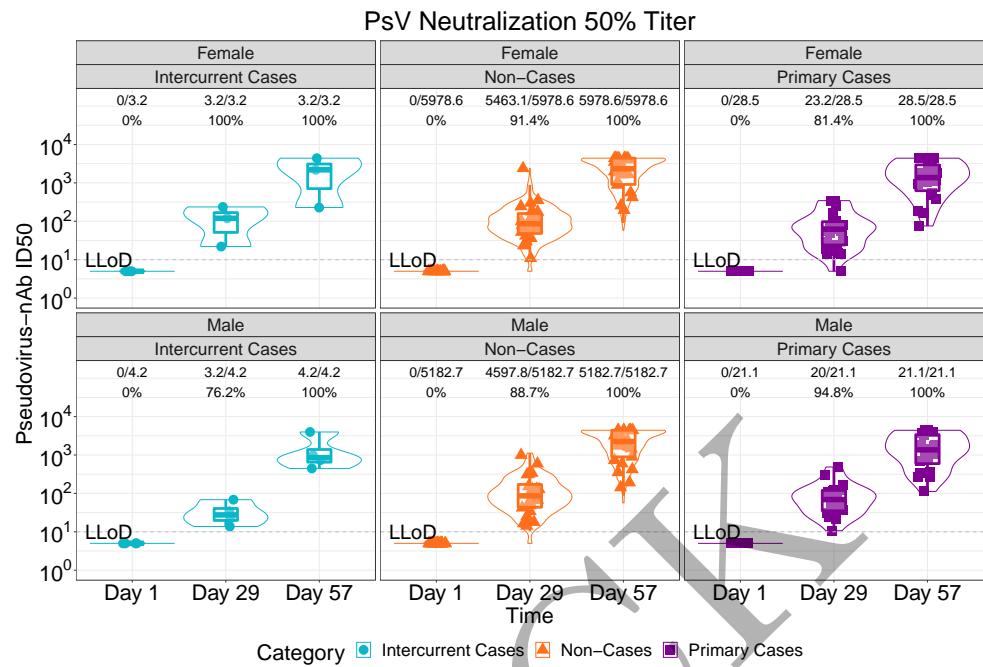


Figure 2.171: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

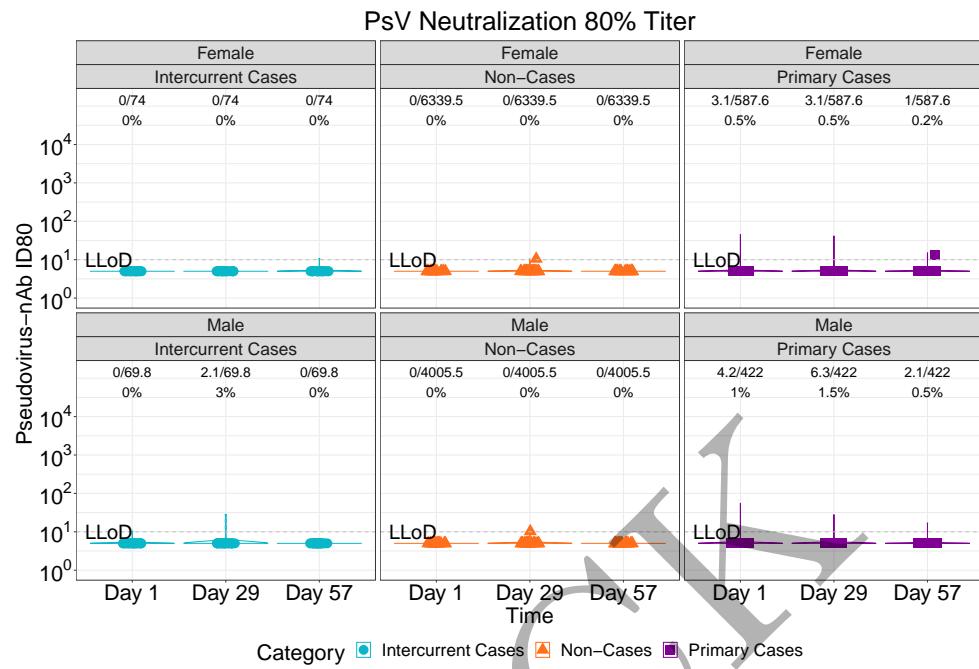


Figure 2.172: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

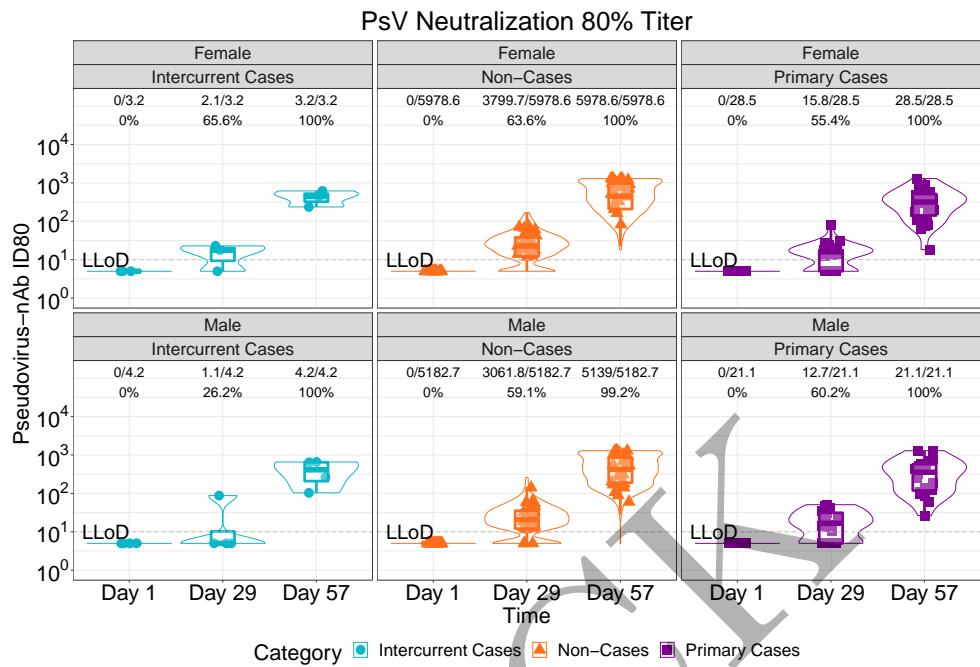


Figure 2.173: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

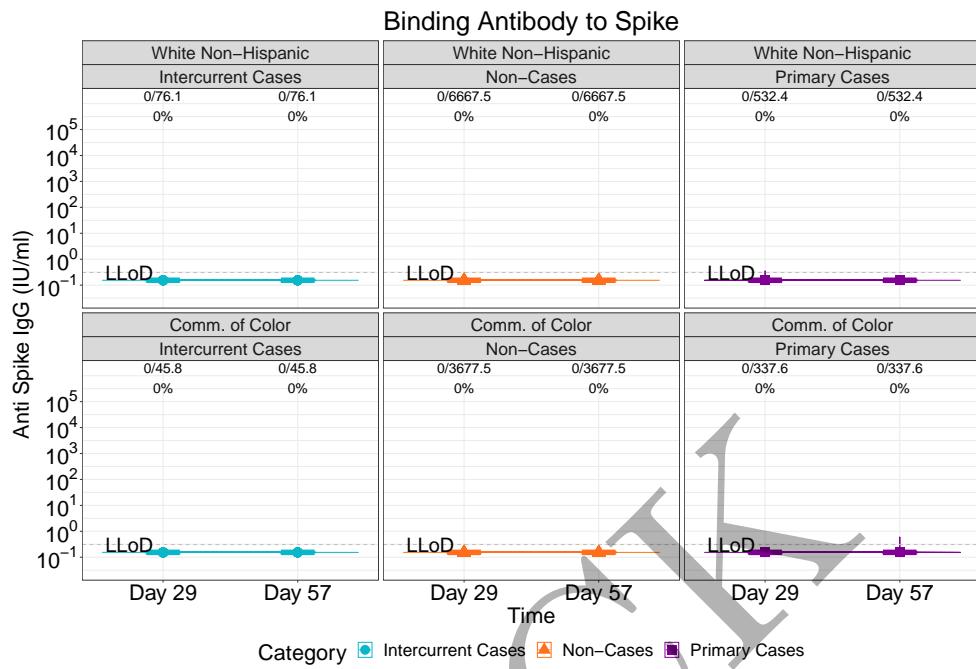


Figure 2.174: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

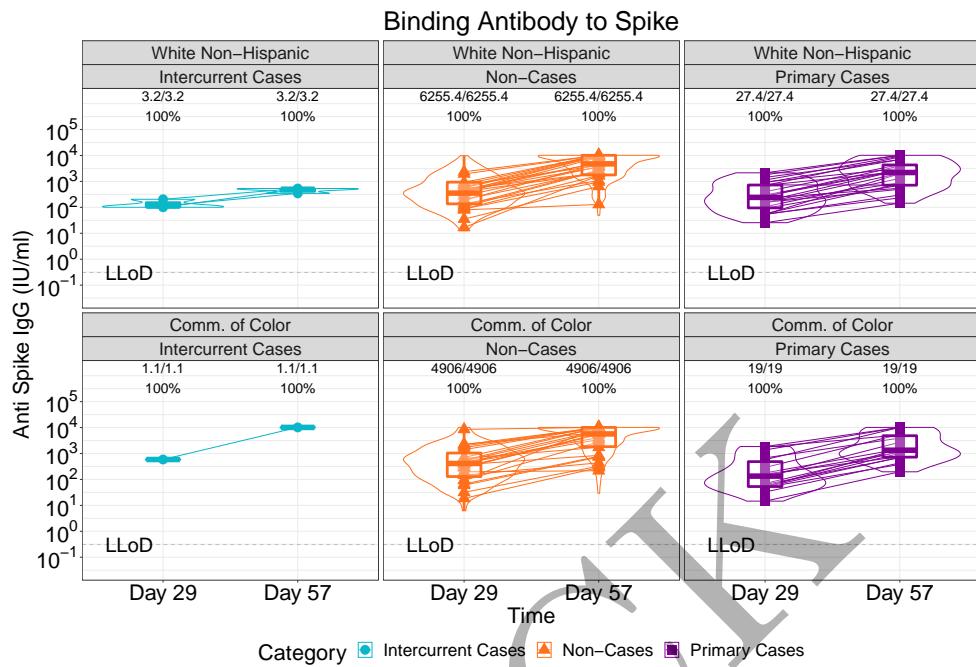


Figure 2.175: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

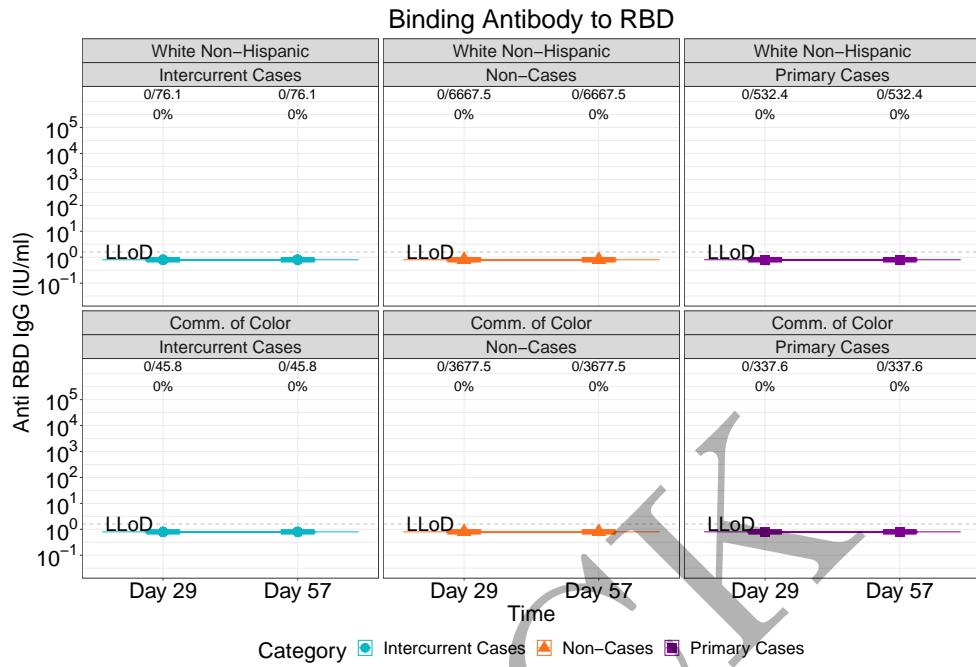


Figure 2.176: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

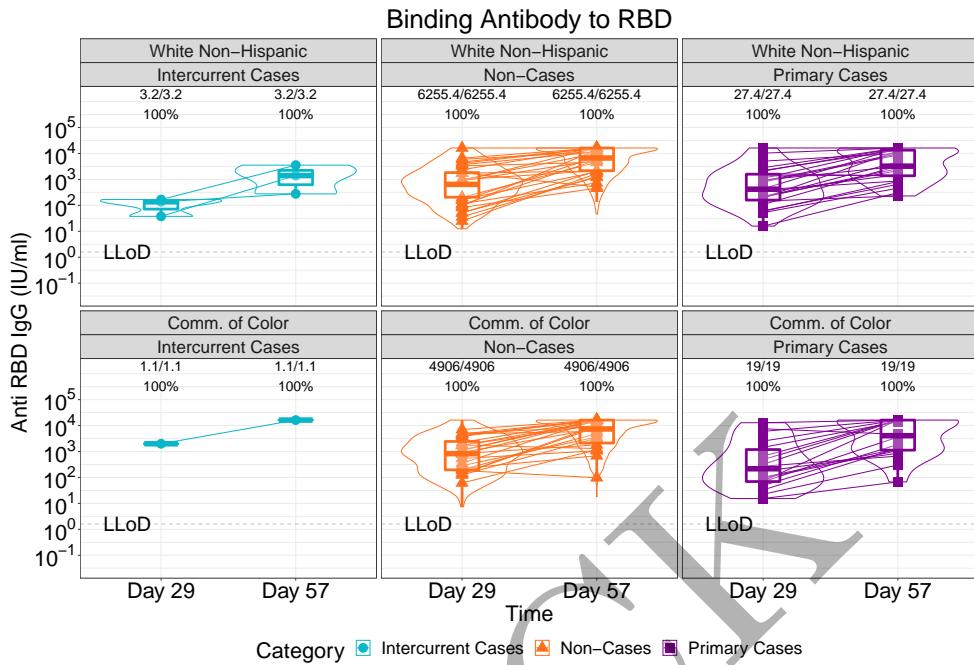


Figure 2.177: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

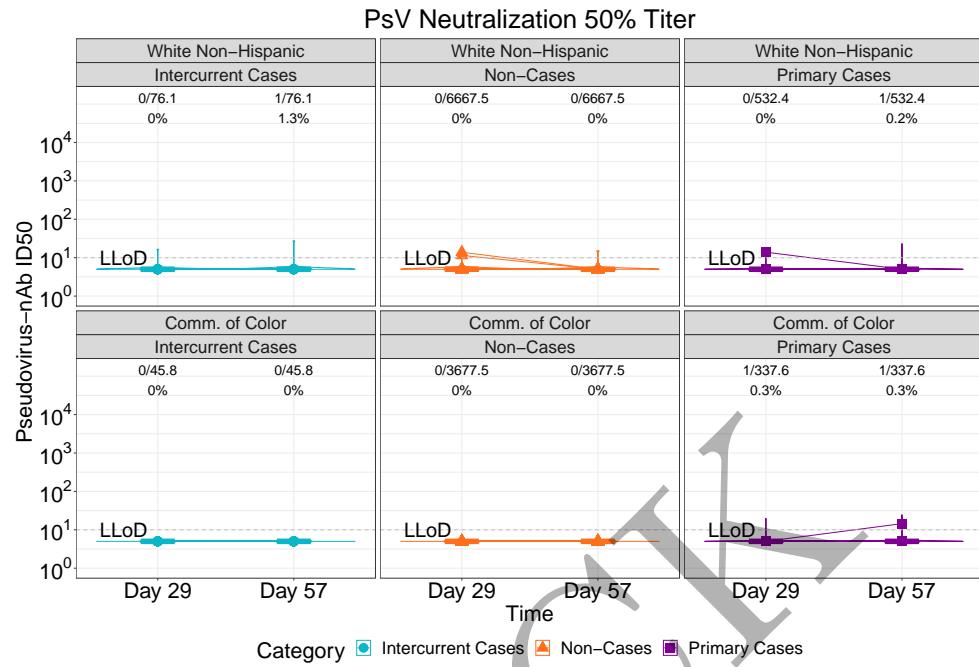


Figure 2.178: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

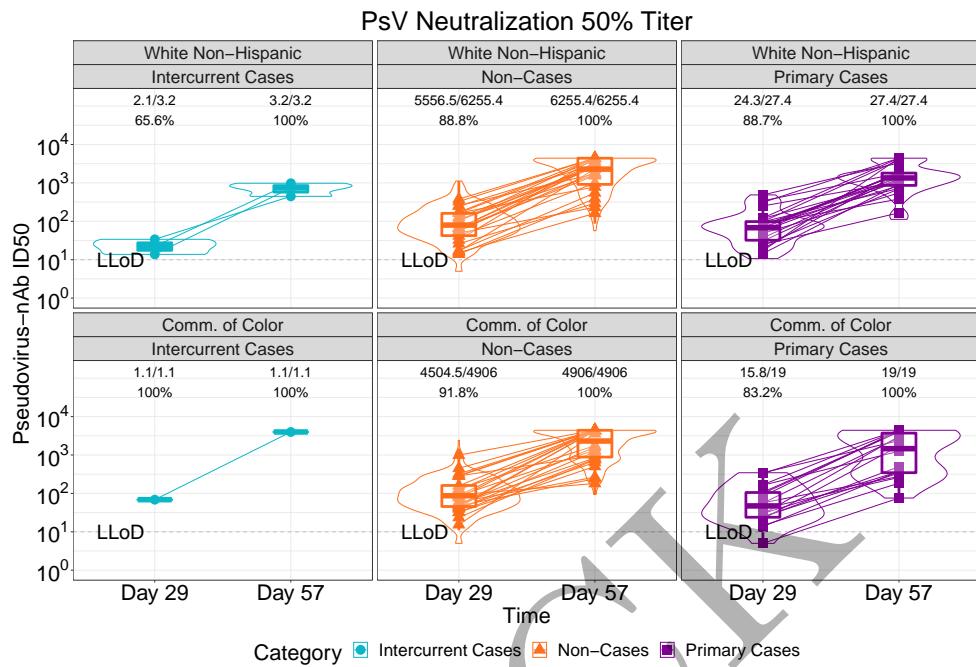


Figure 2.179: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

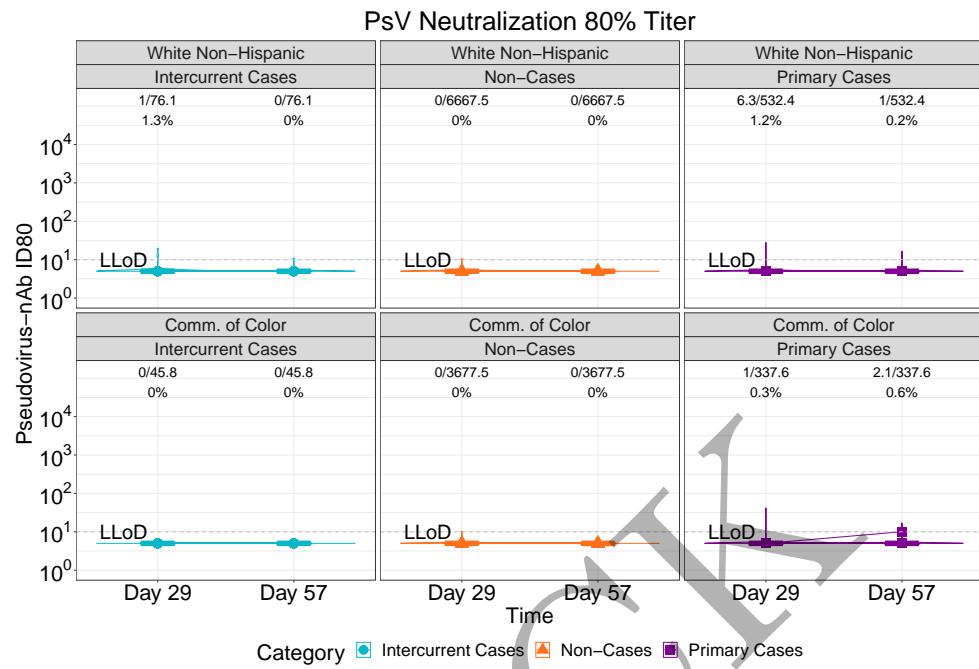


Figure 2.180: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

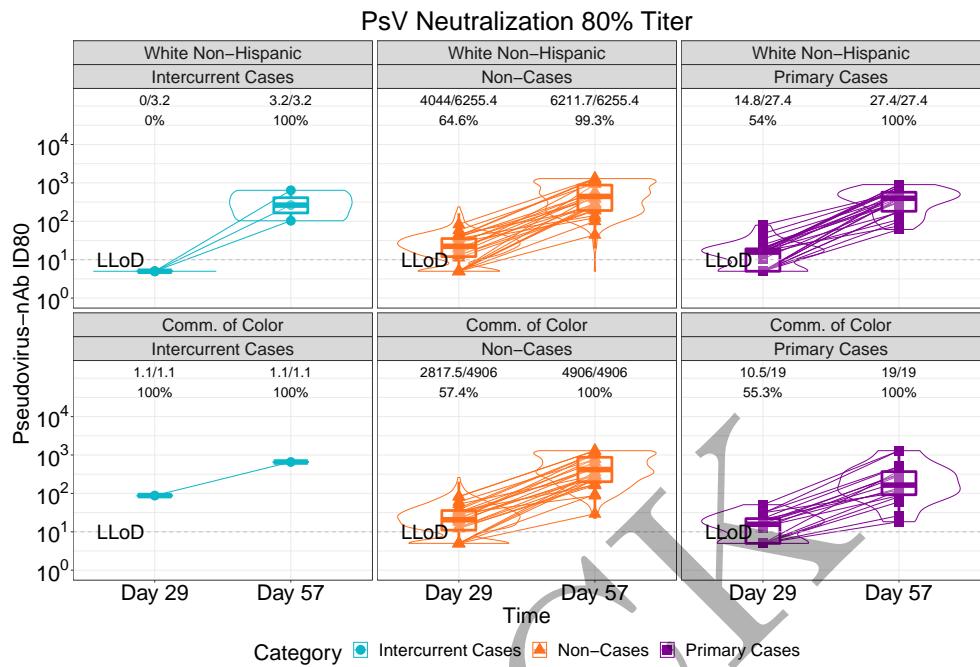


Figure 2.181: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

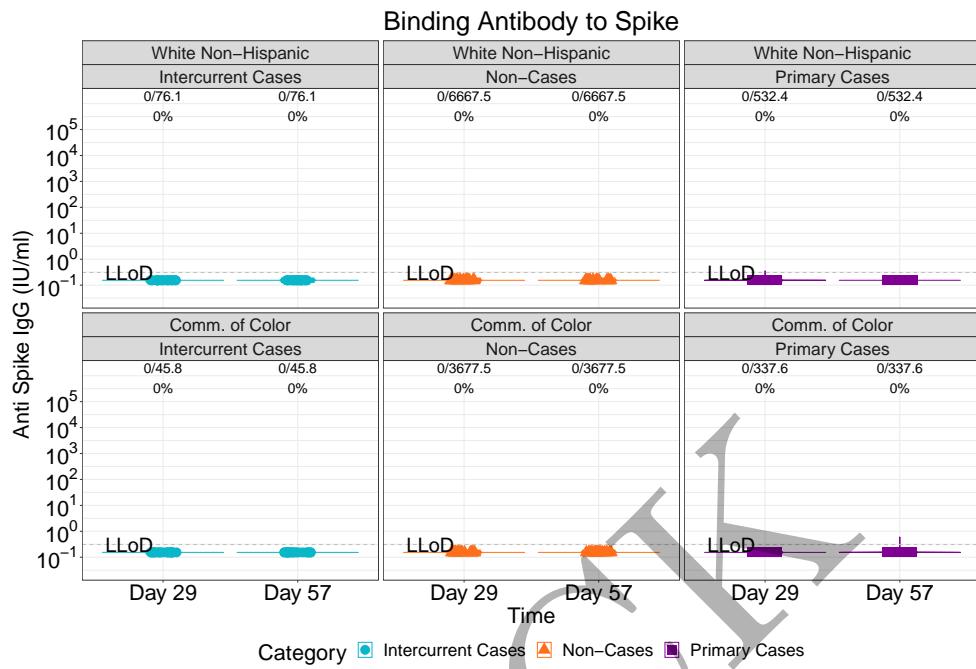


Figure 2.182: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

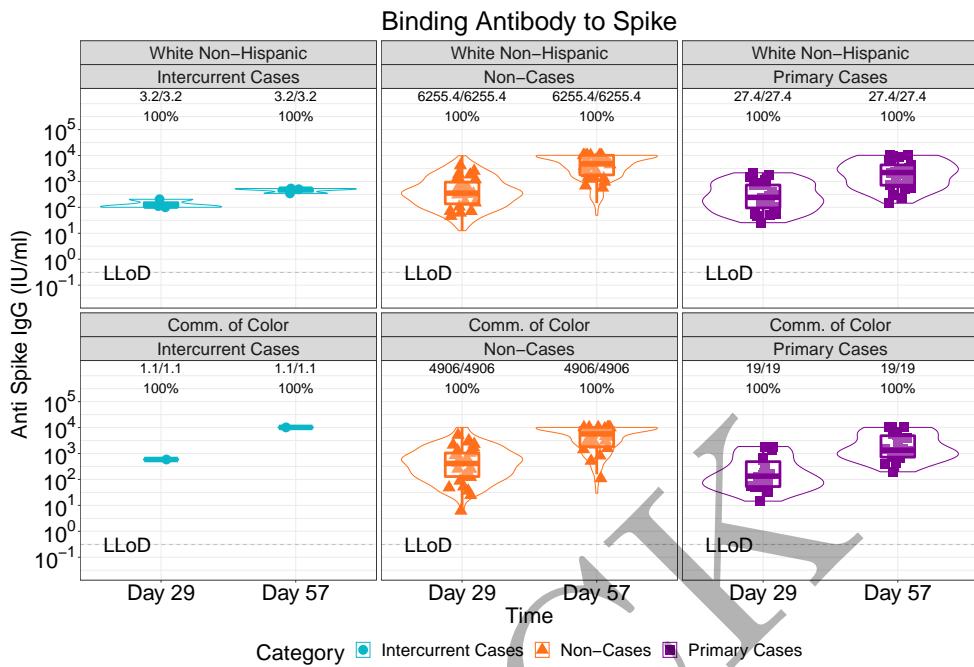


Figure 2.183: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

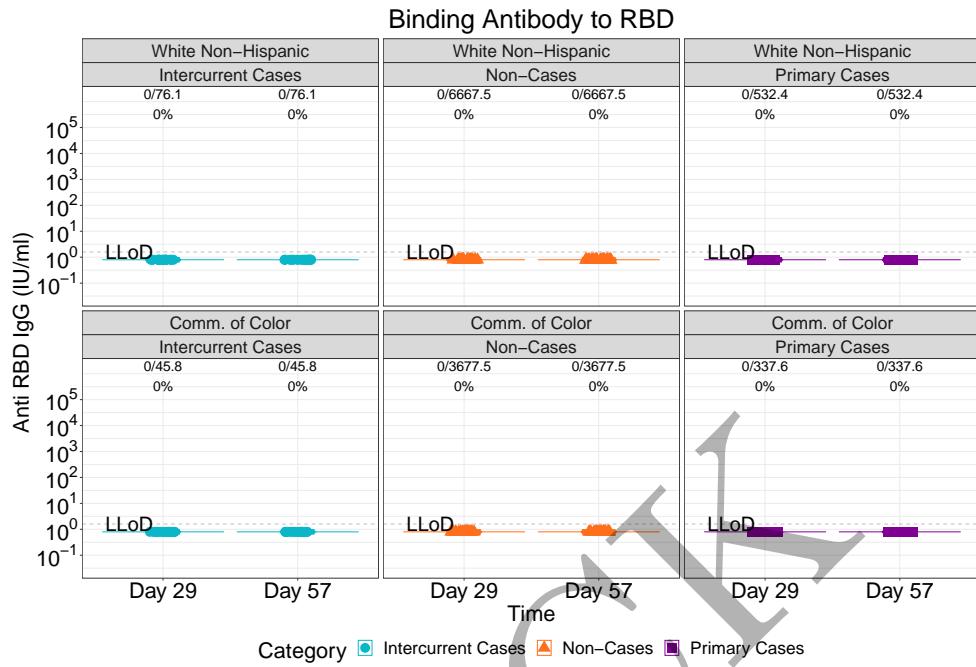


Figure 2.184: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

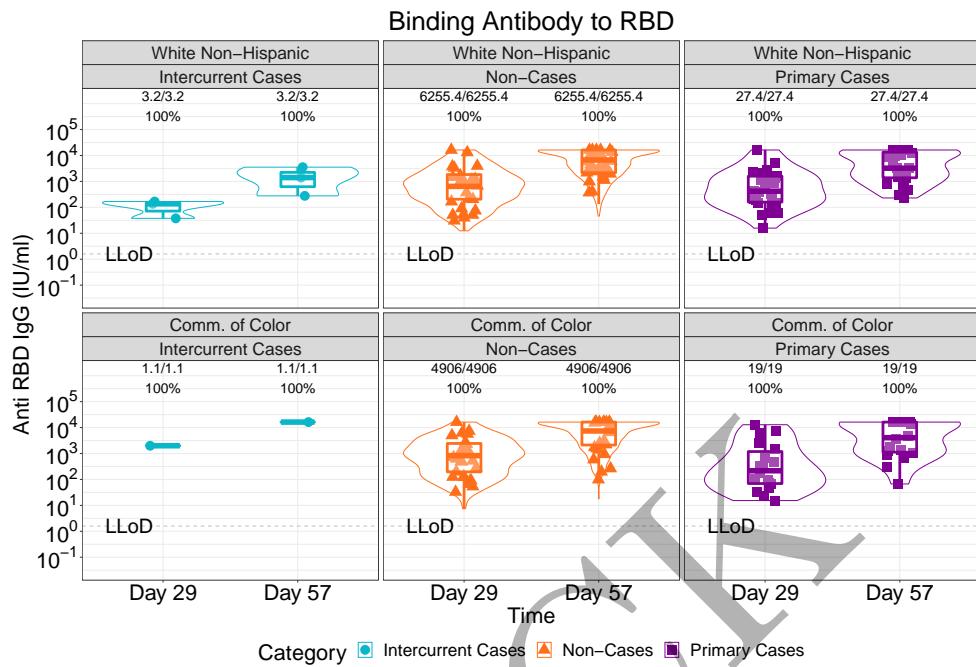


Figure 2.185: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

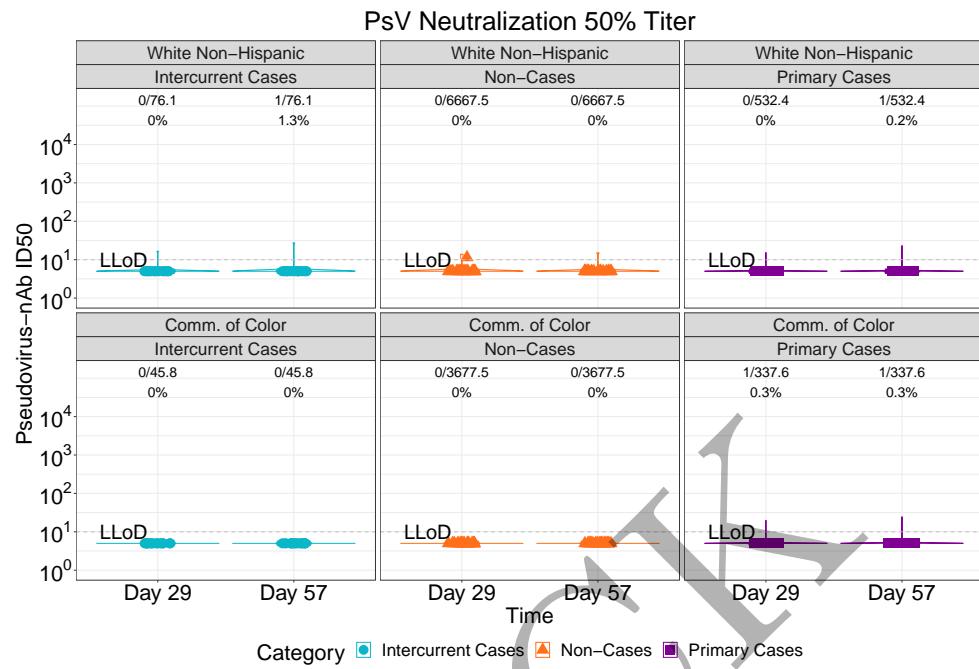


Figure 2.186: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

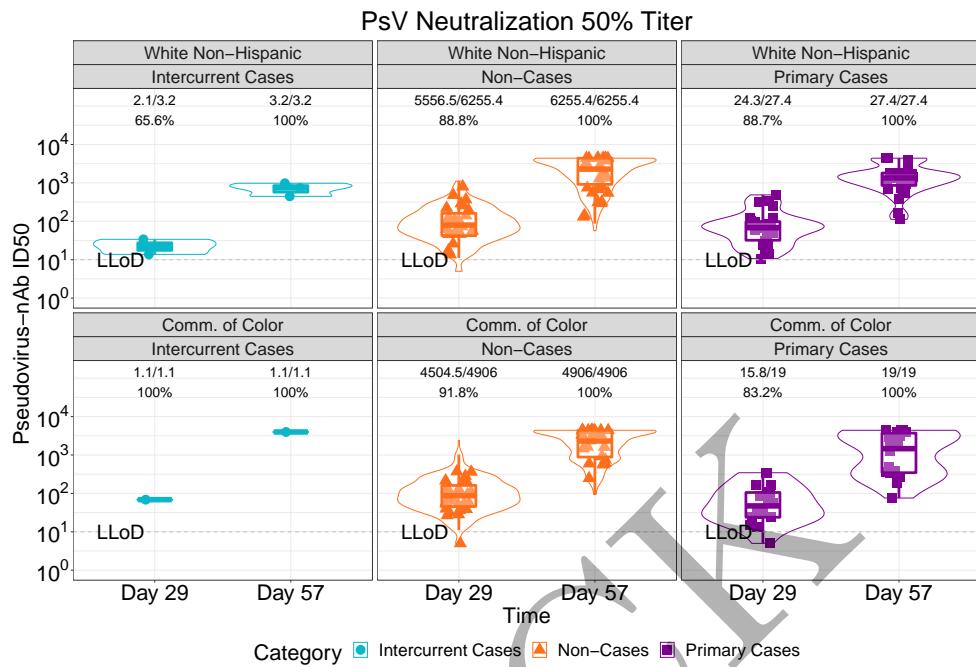


Figure 2.187: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

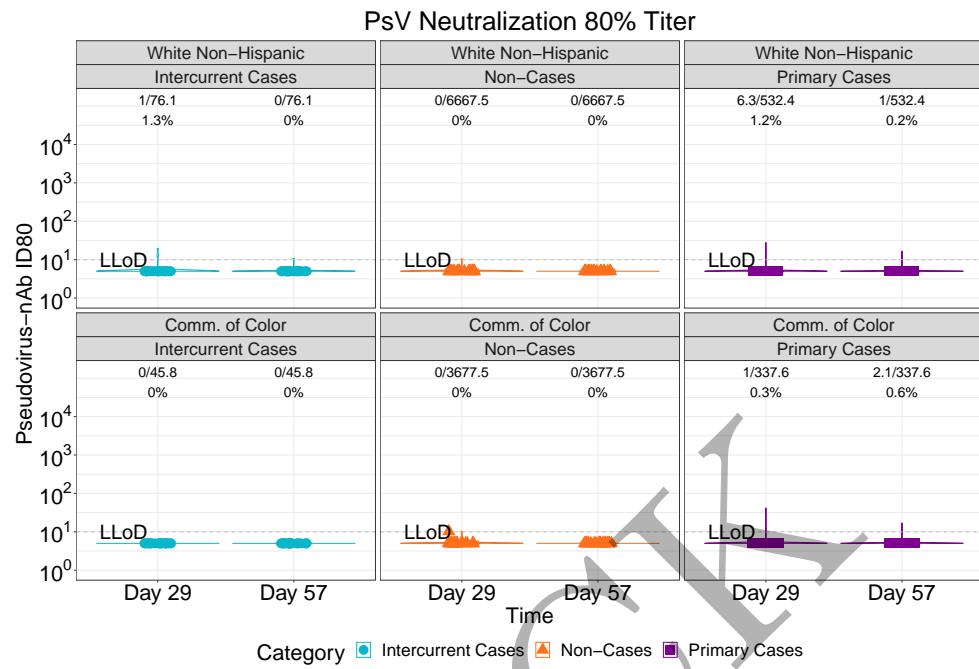


Figure 2.188: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

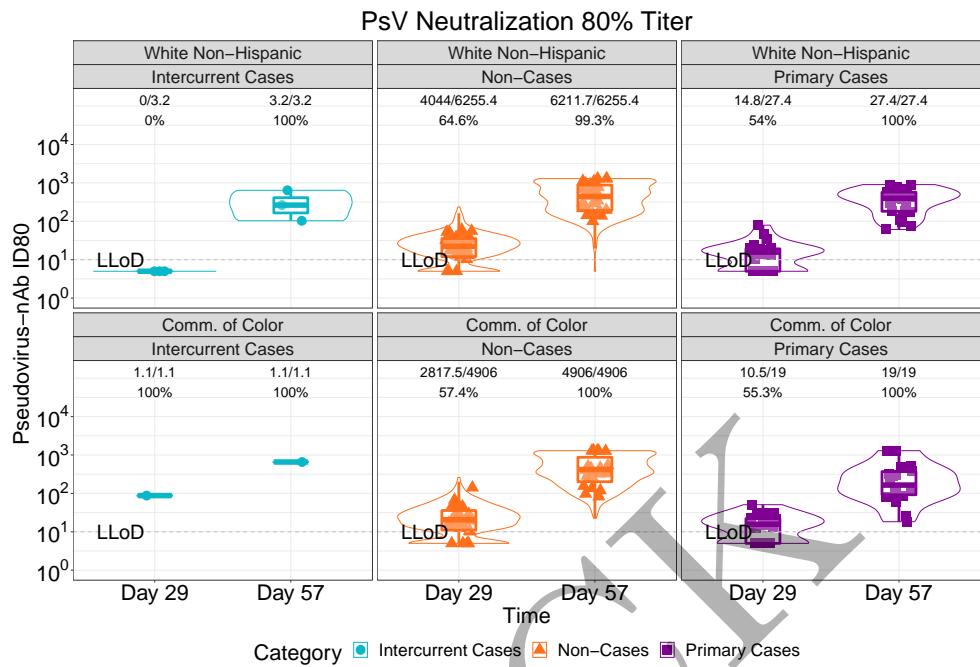


Figure 2.189: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

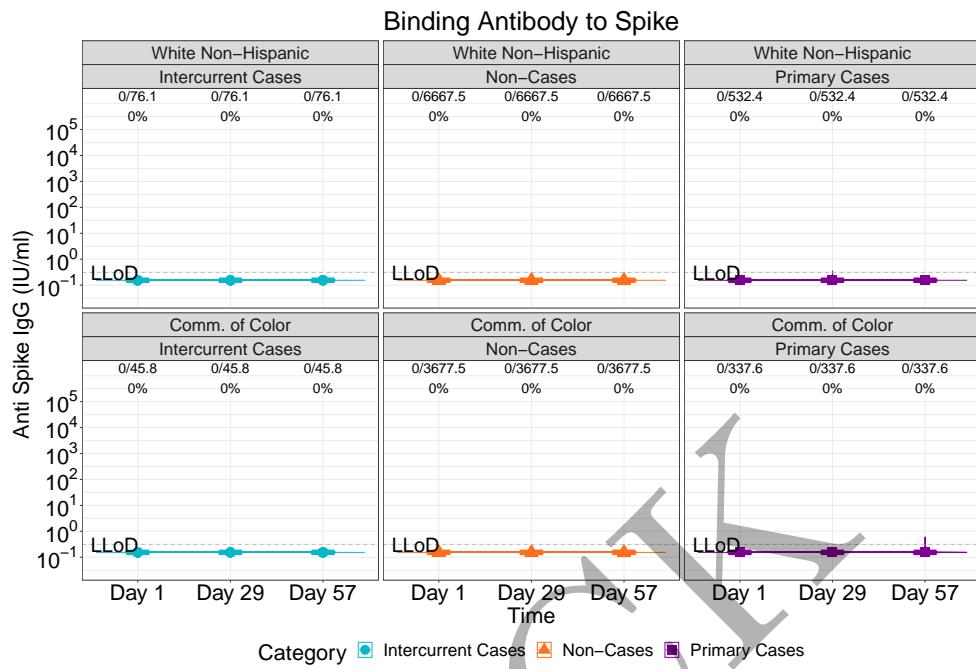


Figure 2.190: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

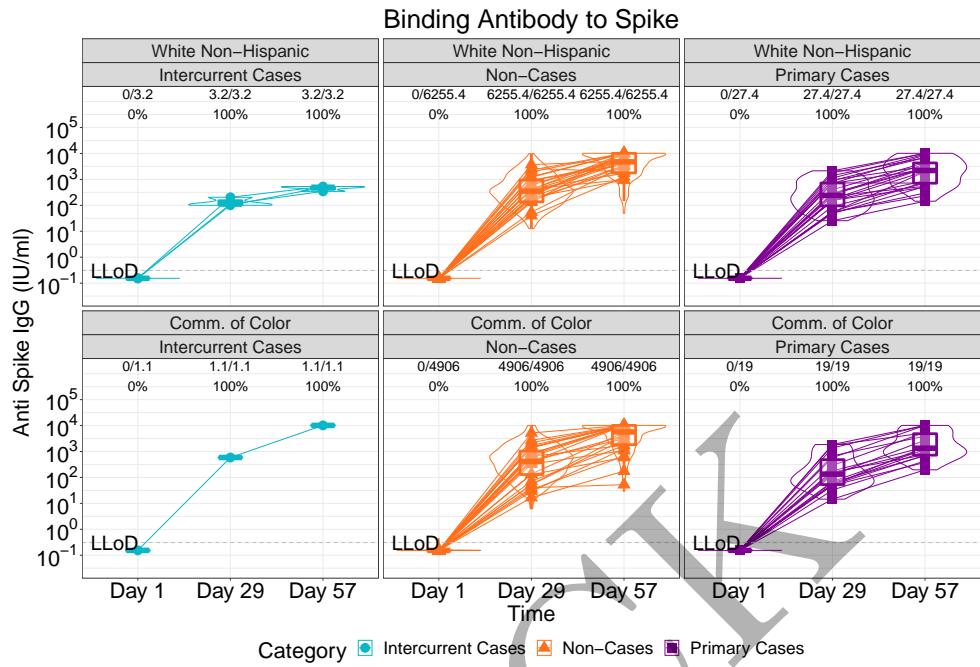


Figure 2.191: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

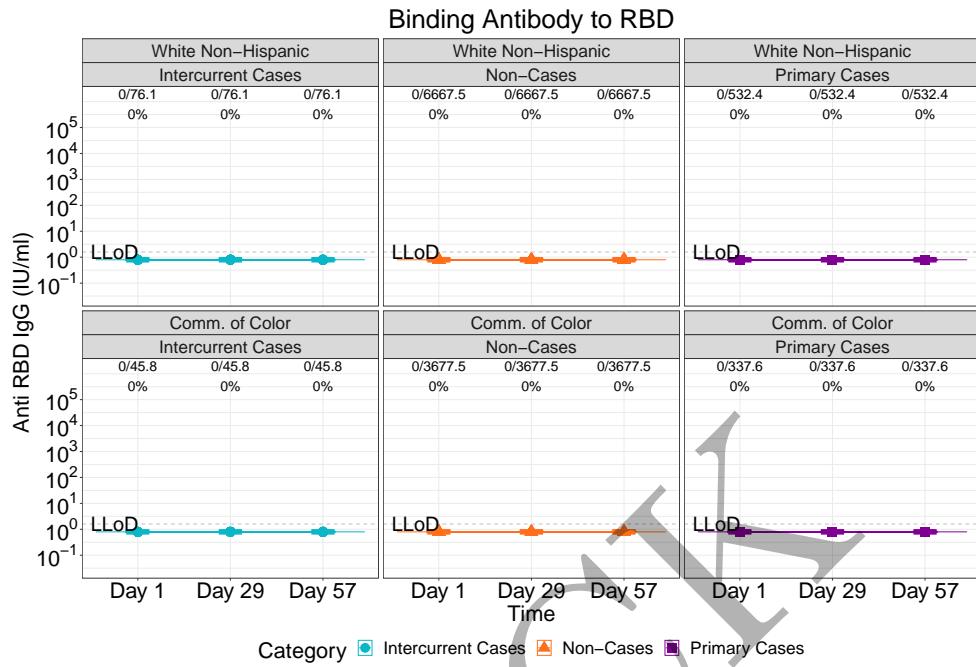


Figure 2.192: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

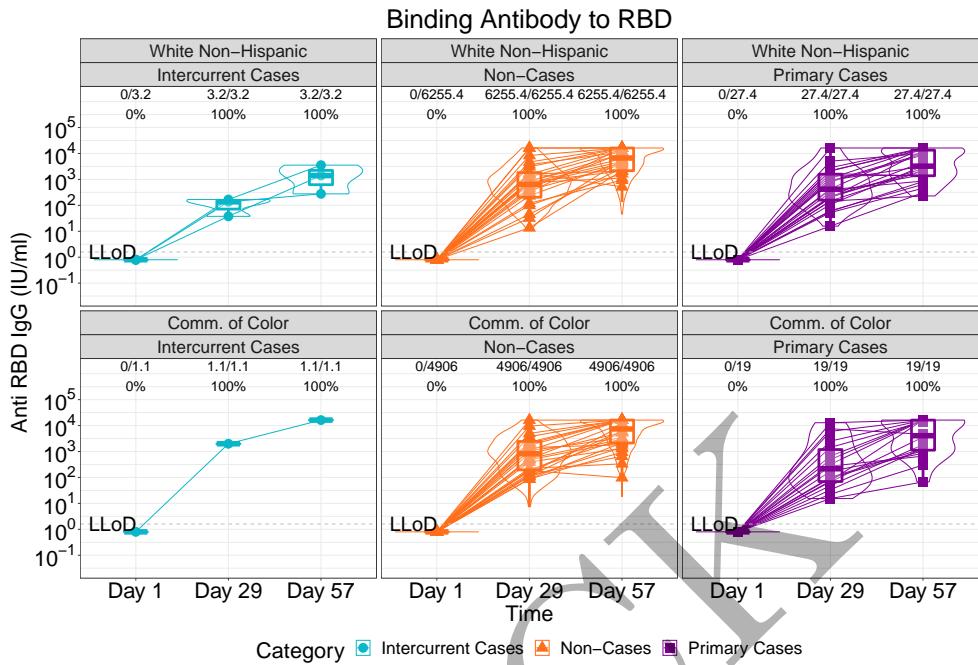


Figure 2.193: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

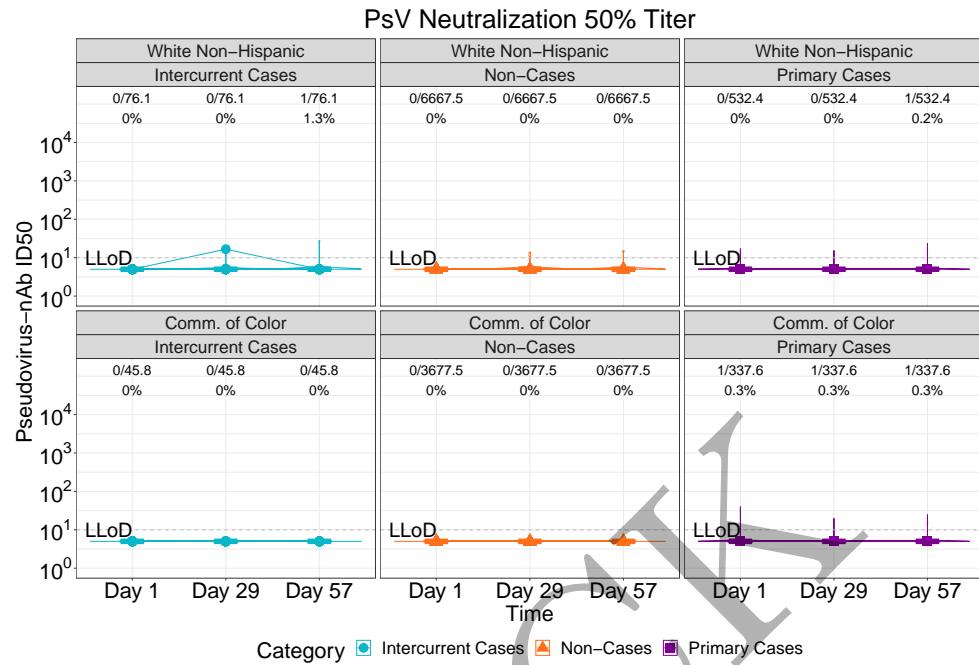


Figure 2.194: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

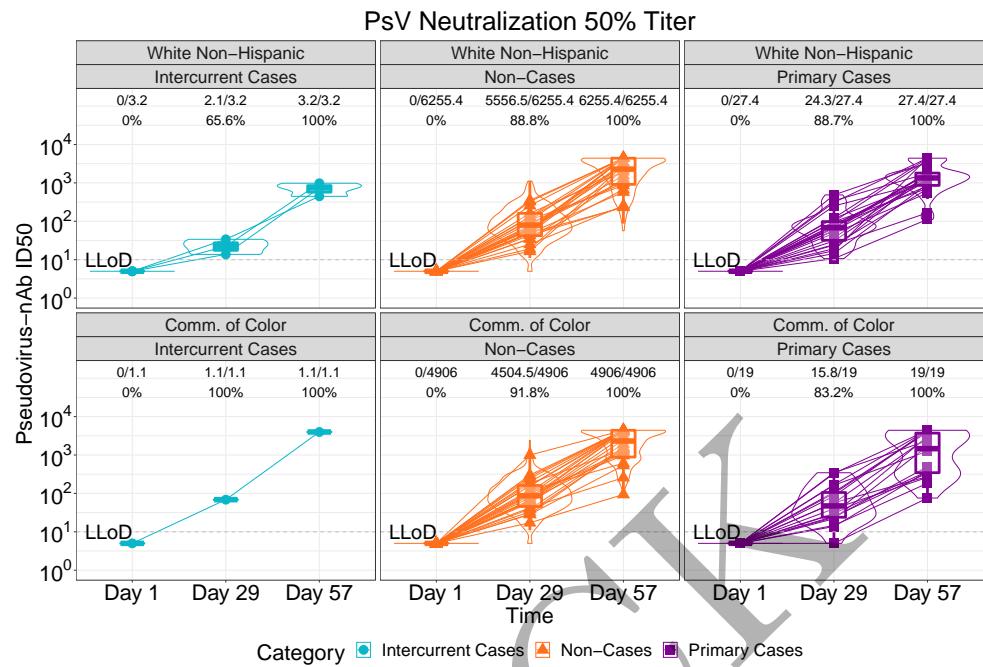


Figure 2.195: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

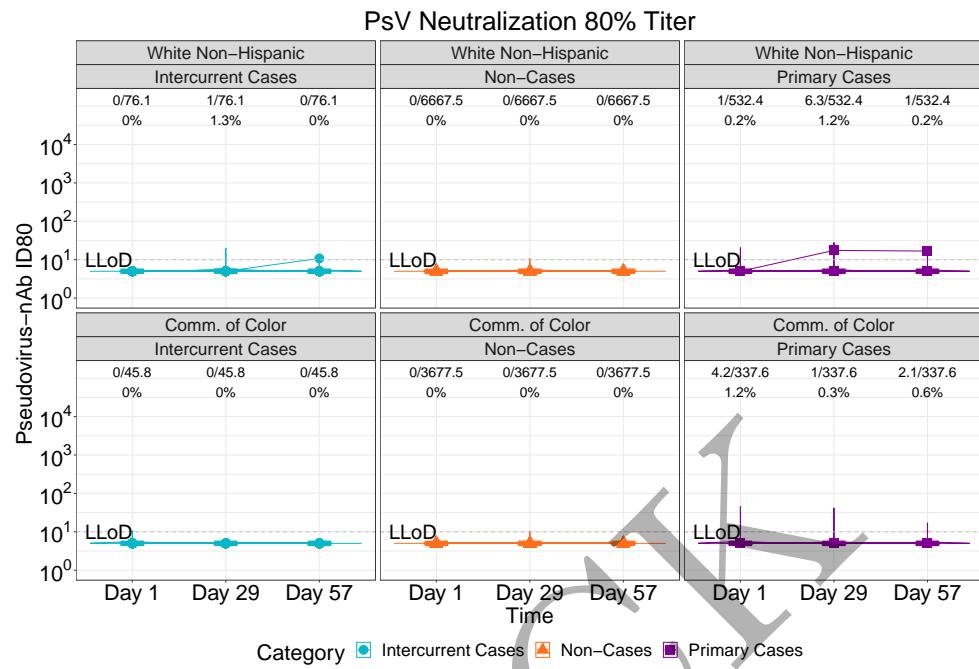


Figure 2.196: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

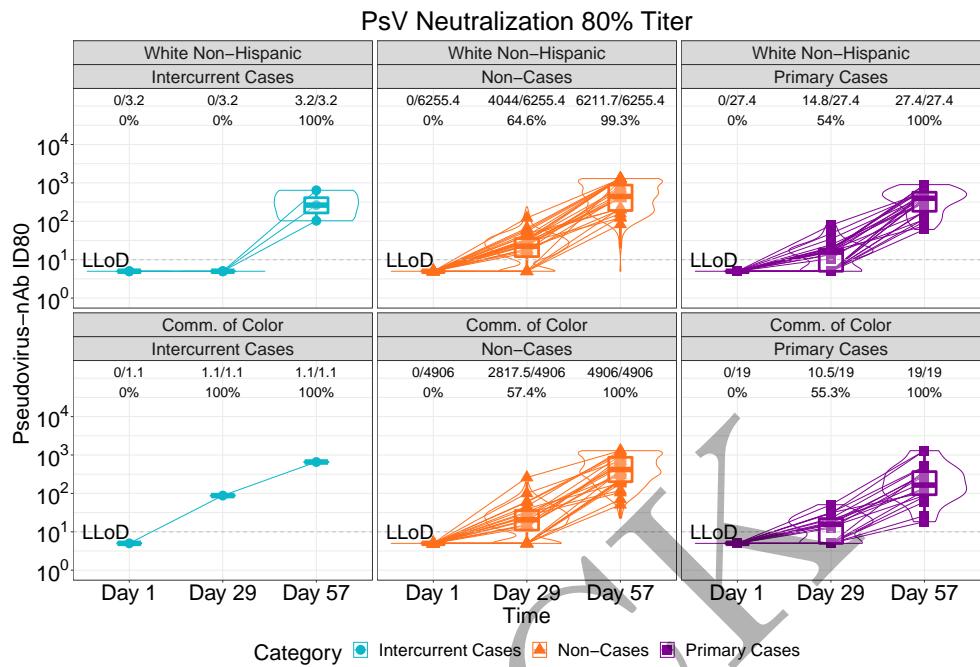


Figure 2.197: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

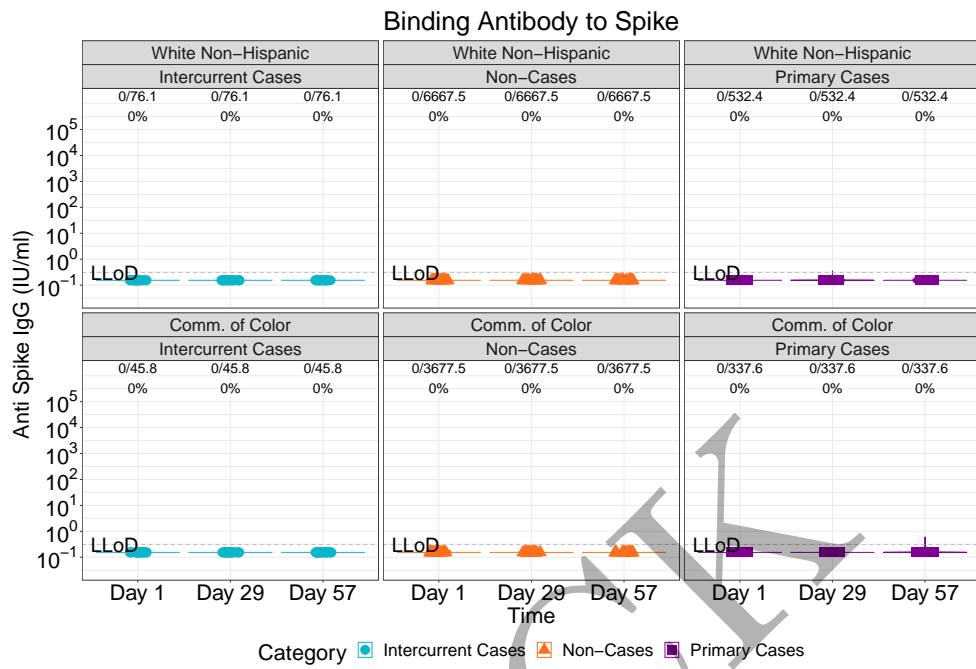


Figure 2.198: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

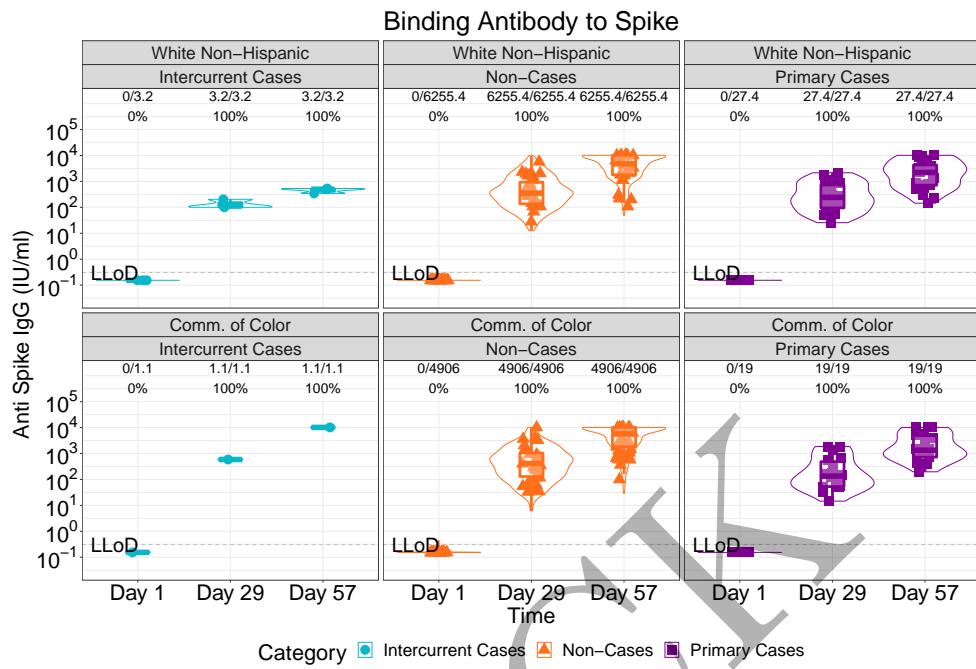


Figure 2.199: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

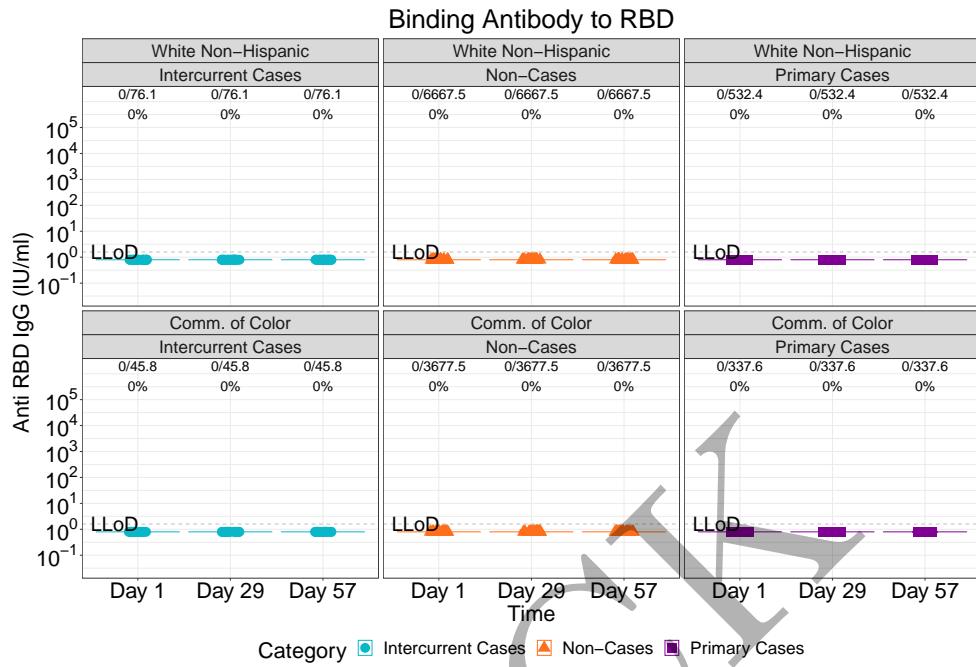


Figure 2.200: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

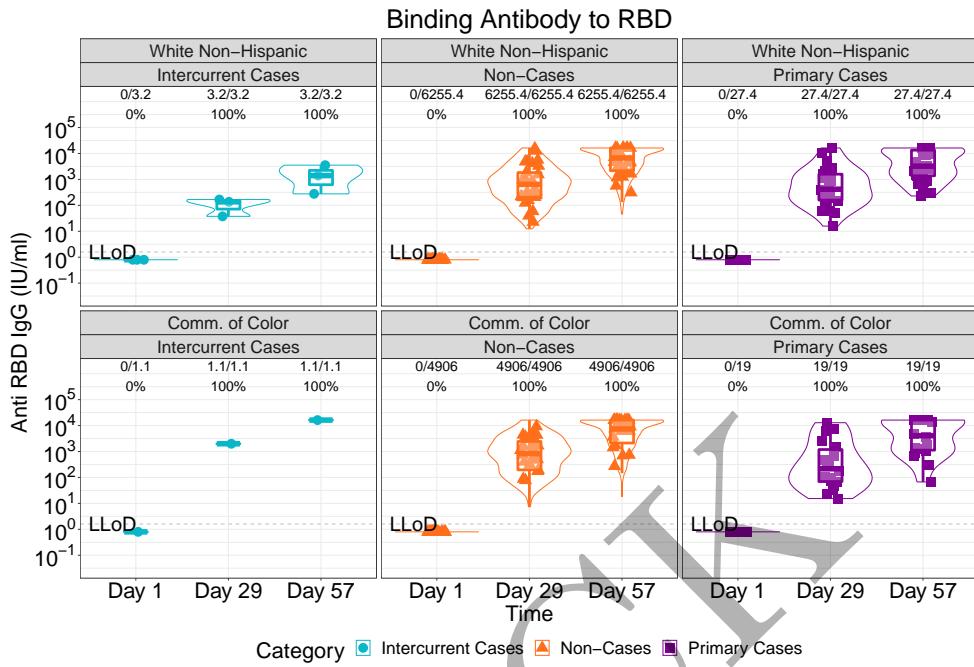


Figure 2.201: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

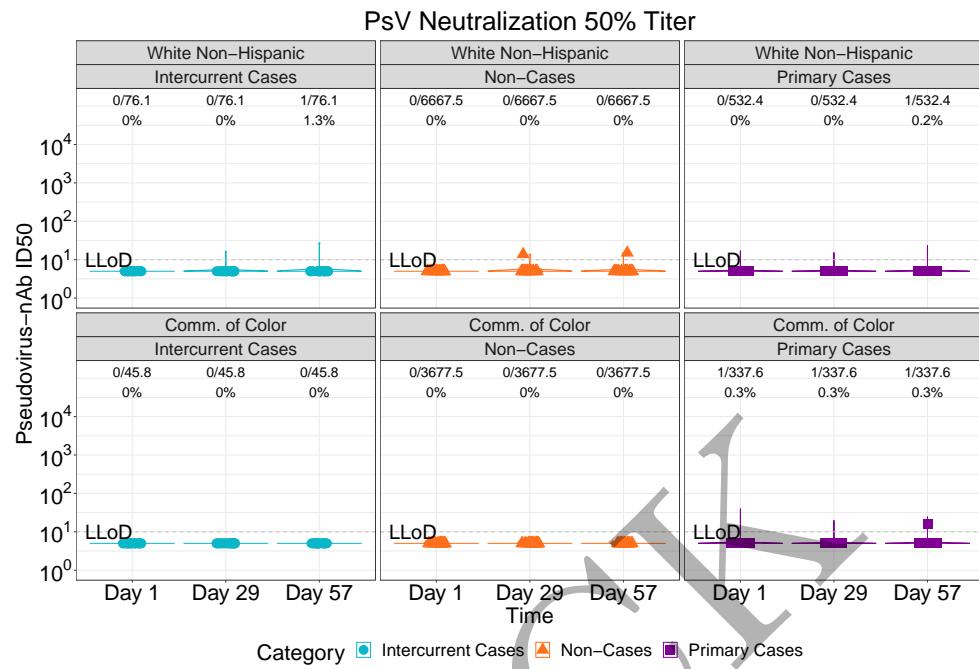


Figure 2.202: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

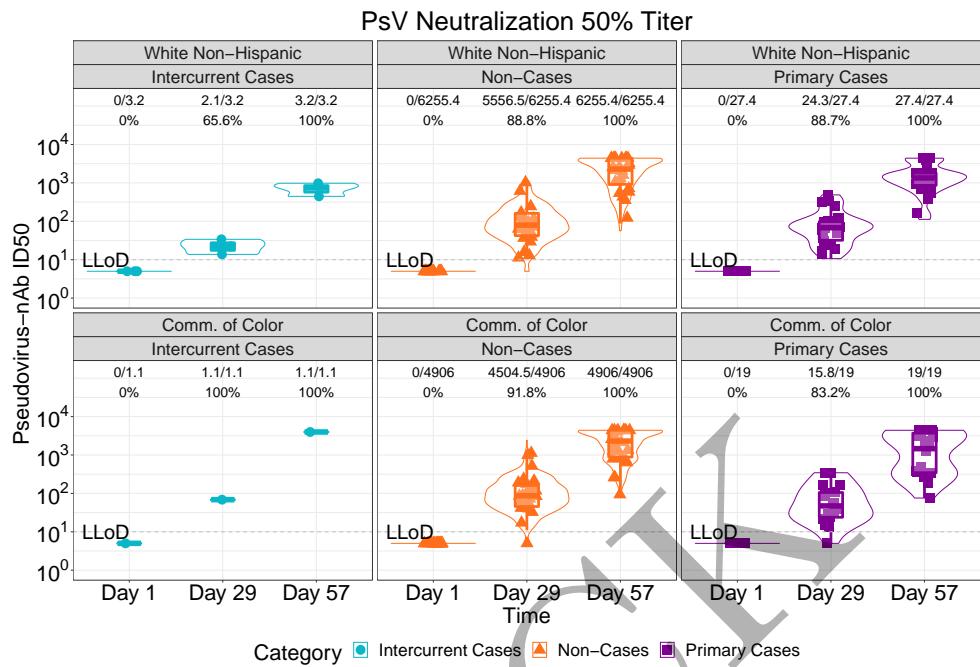


Figure 2.203: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

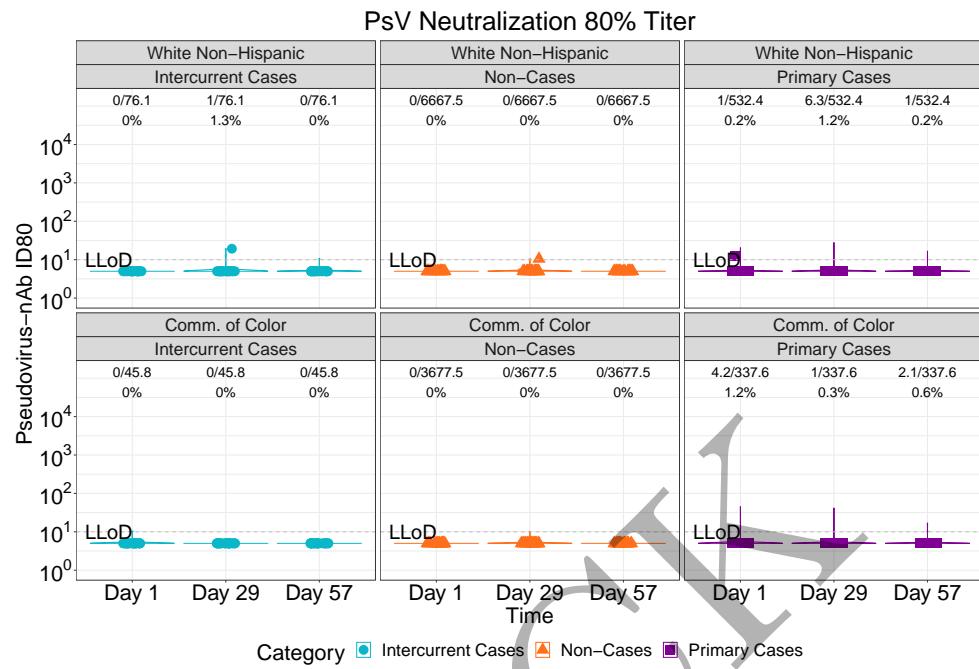


Figure 2.204: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

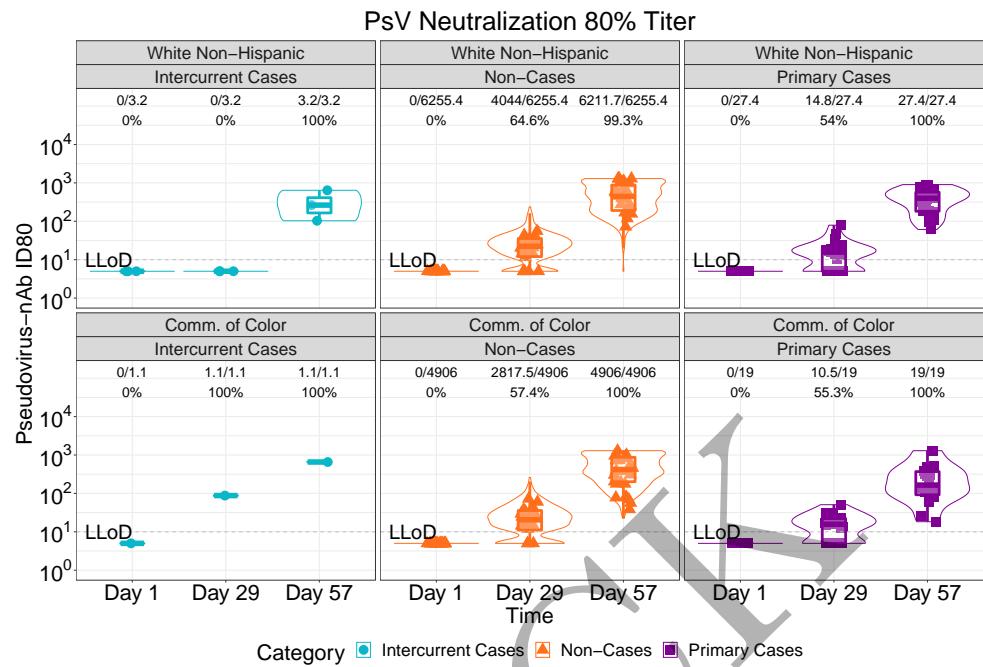


Figure 2.205: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

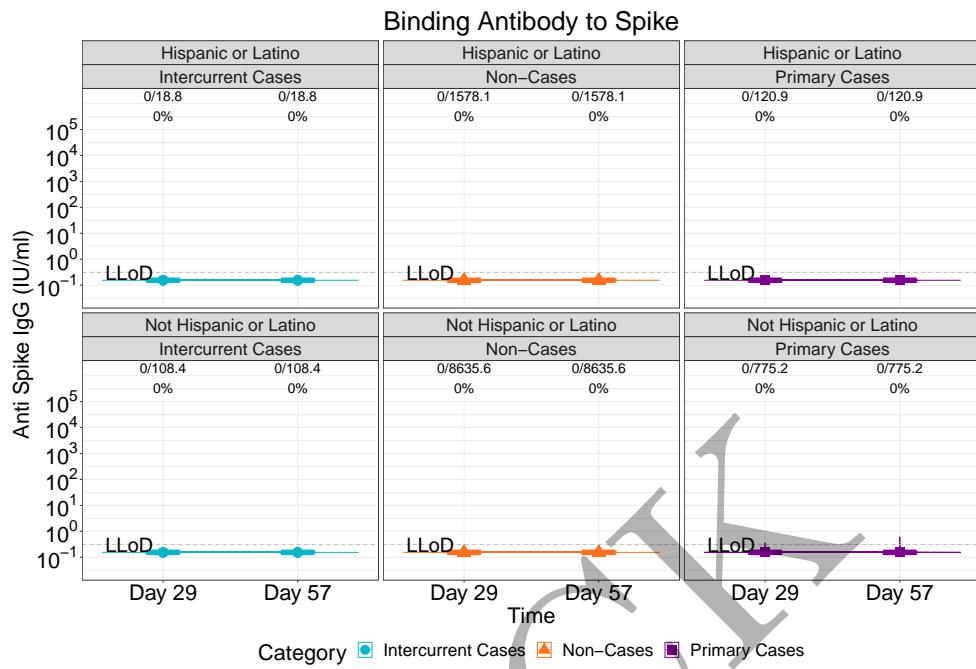


Figure 2.206: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

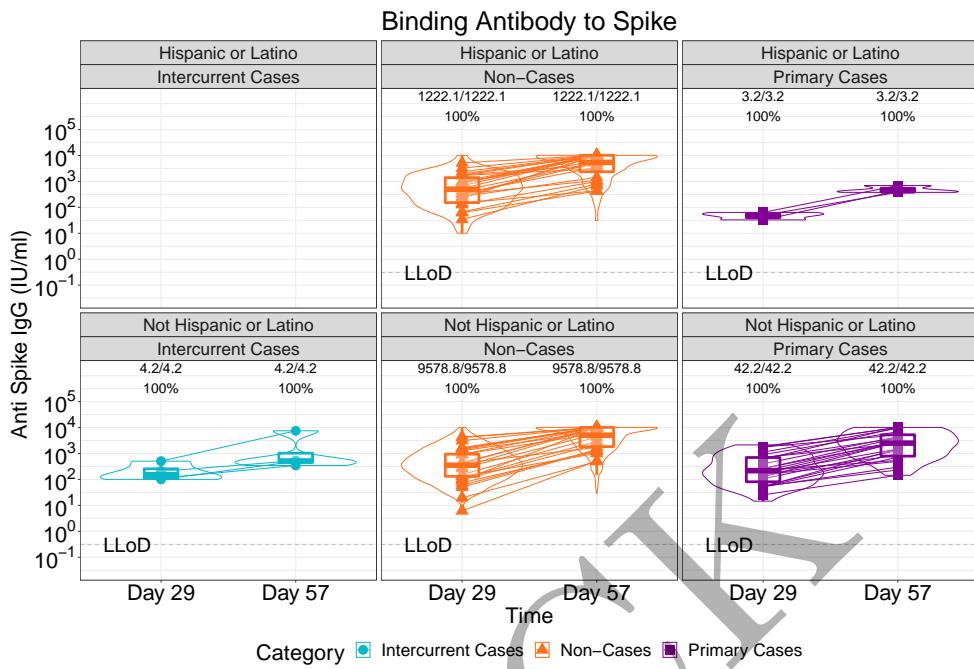


Figure 2.207: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

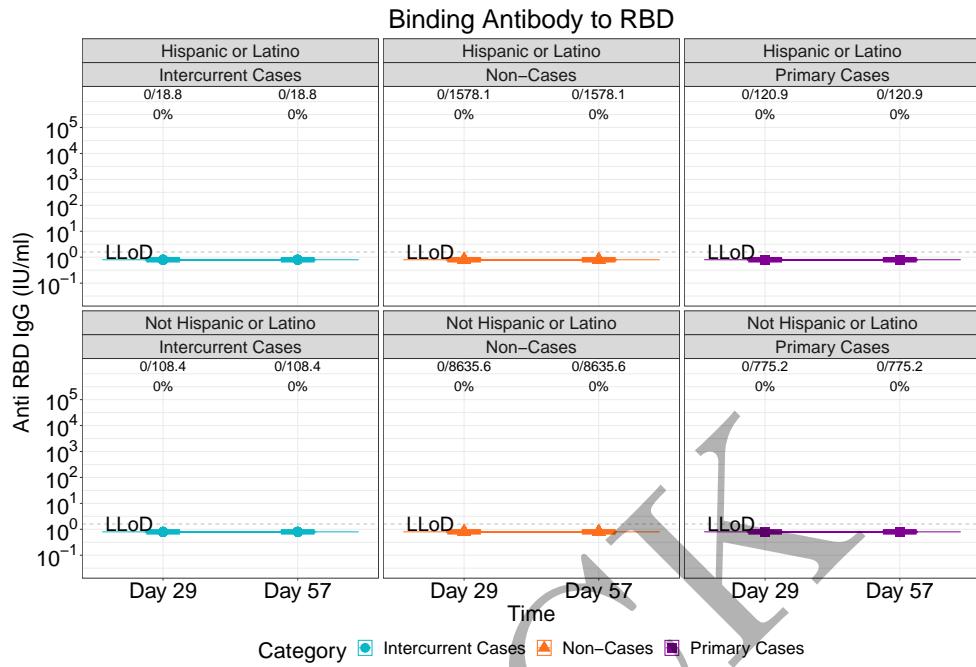


Figure 2.208: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

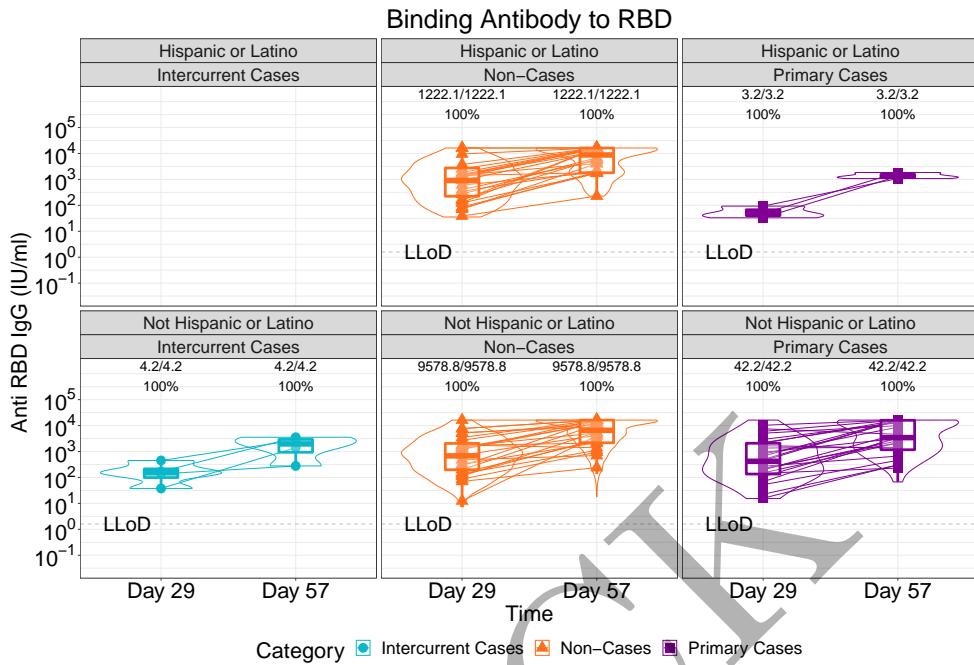


Figure 2.209: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

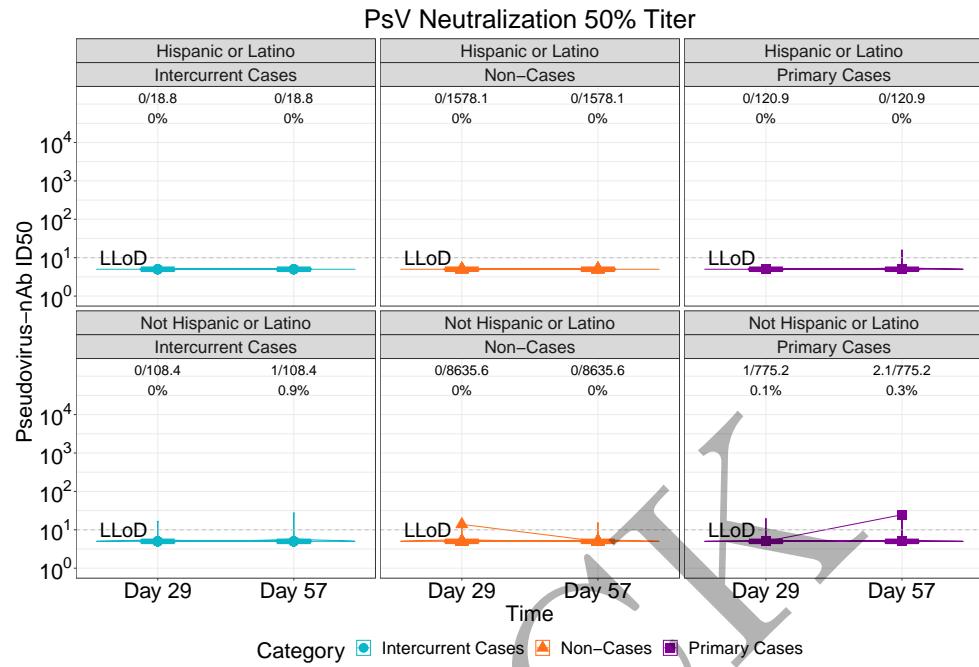


Figure 2.210: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

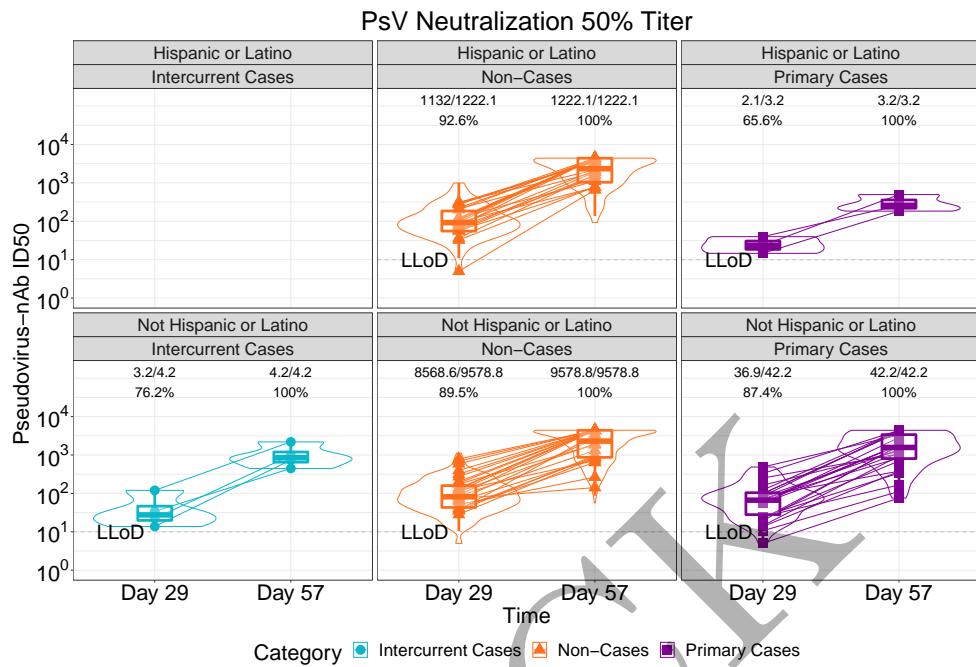


Figure 2.211: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

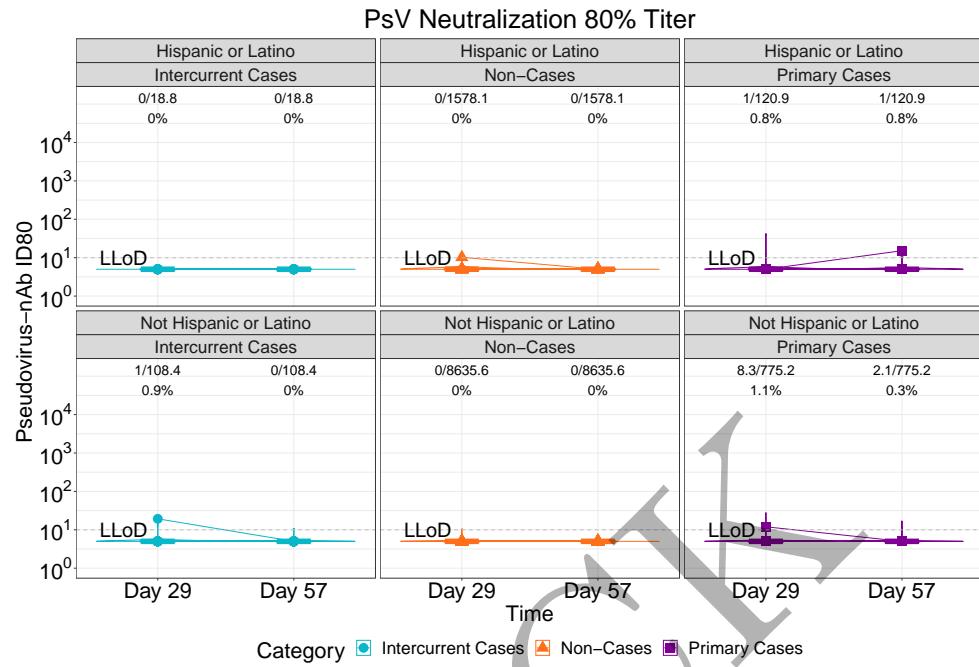


Figure 2.212: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

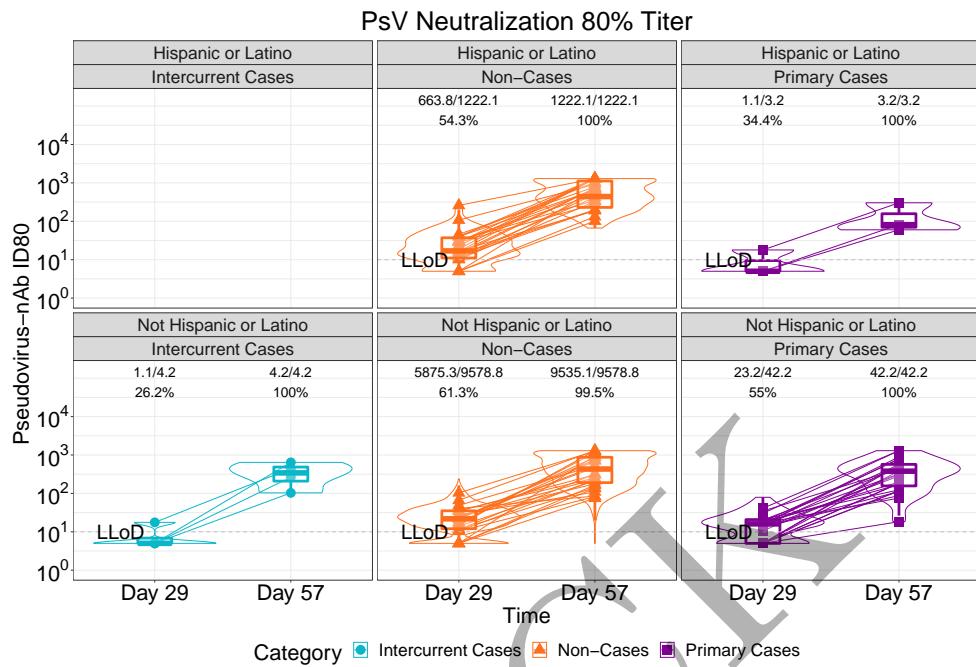


Figure 2.213: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

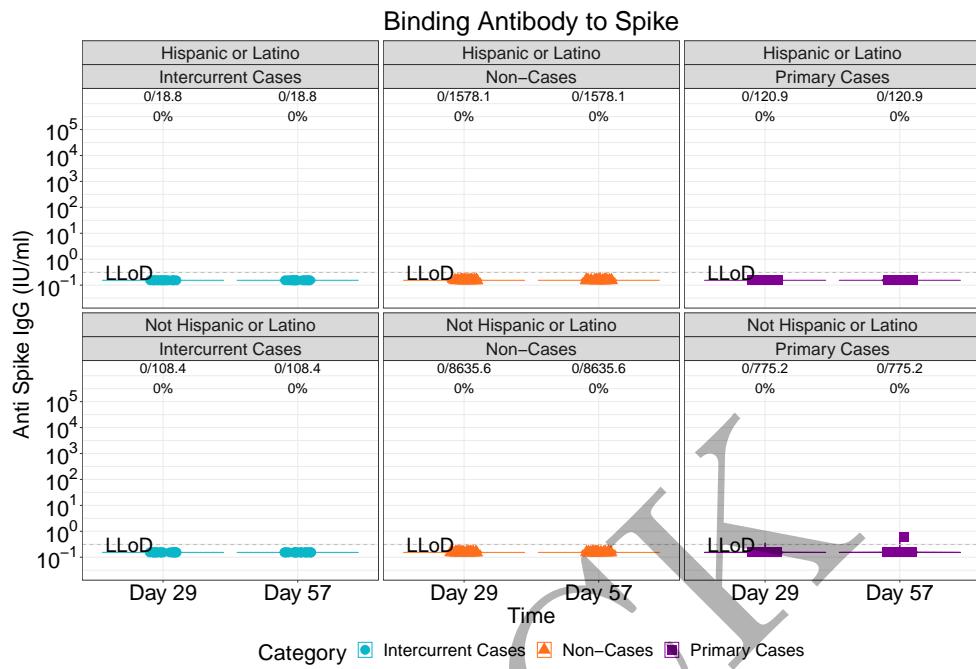


Figure 2.214: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

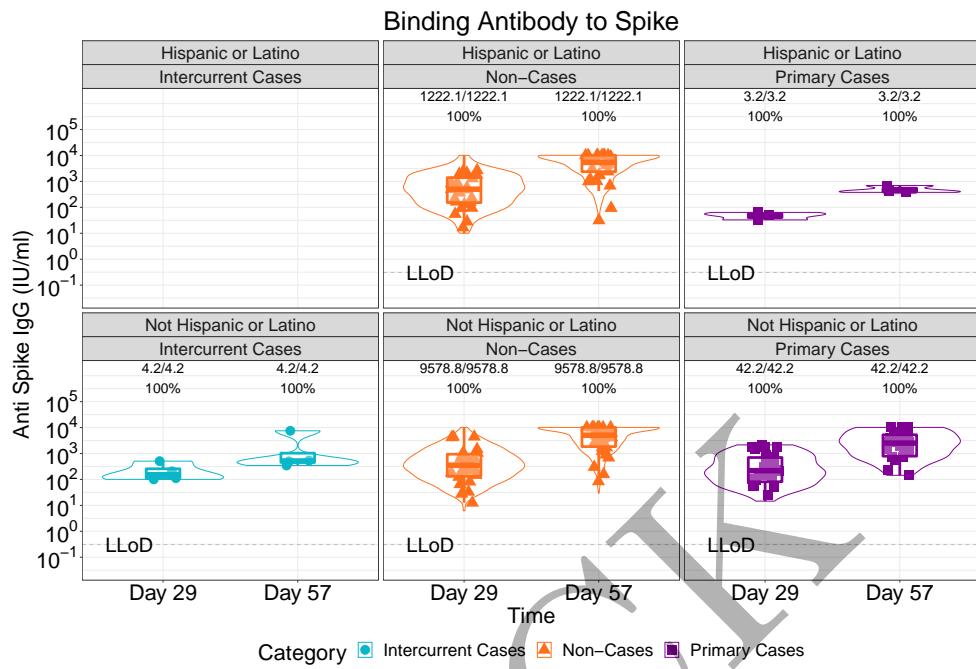


Figure 2.215: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

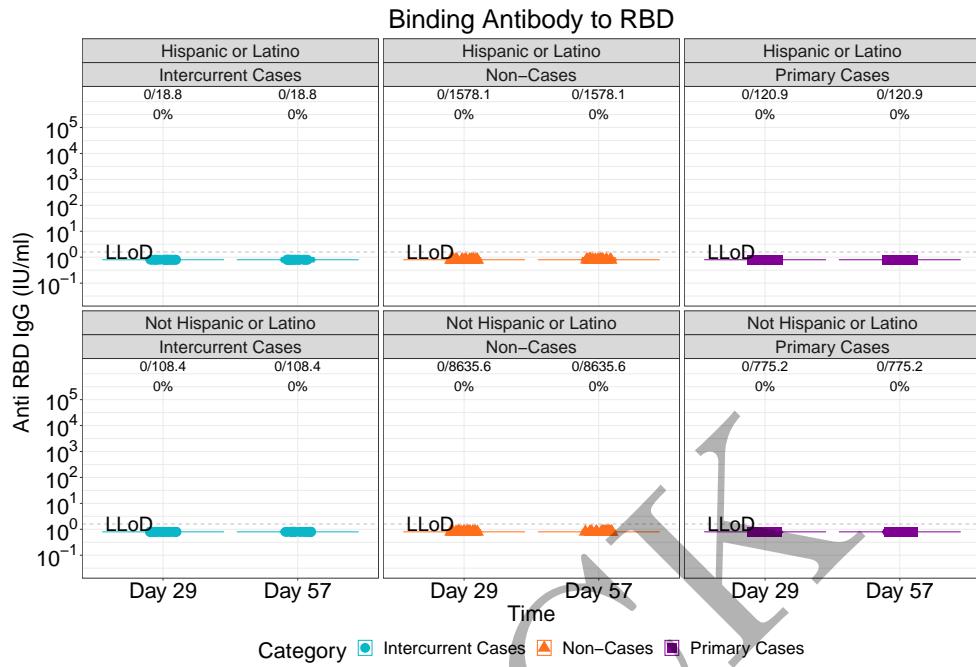


Figure 2.216: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

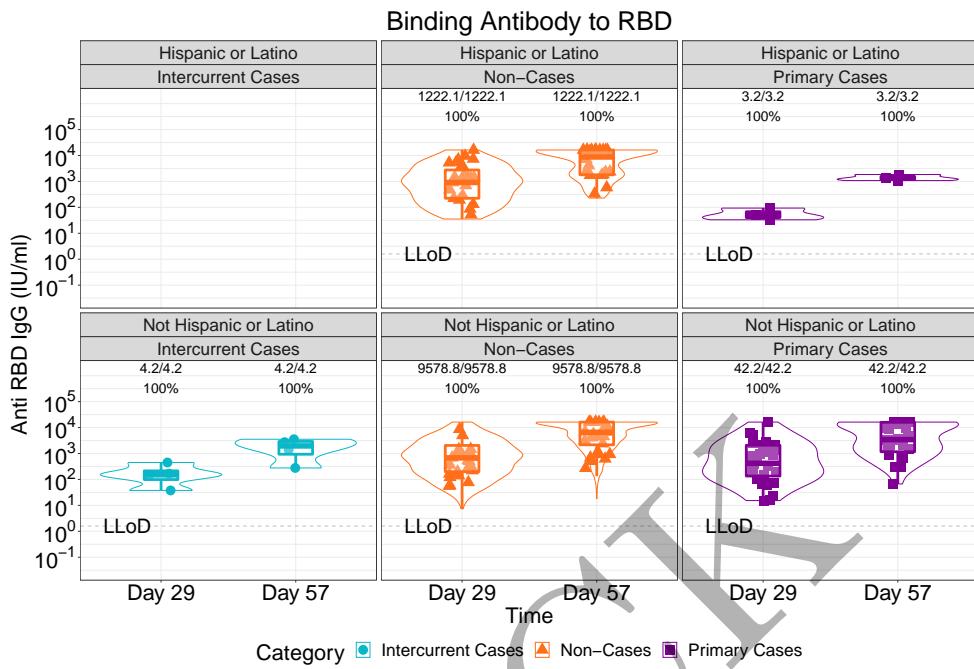


Figure 2.217: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

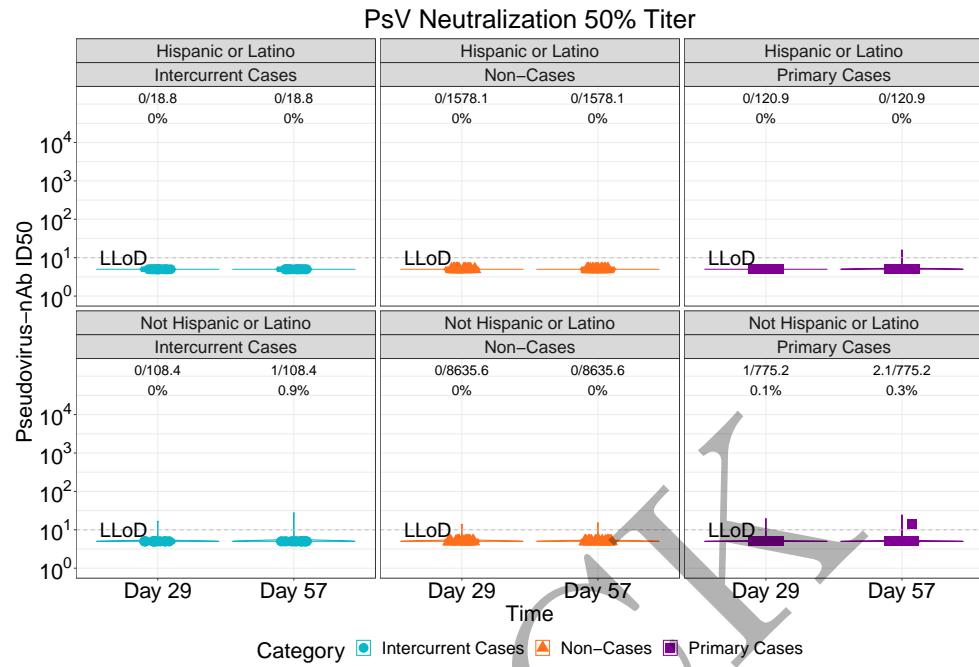


Figure 2.218: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

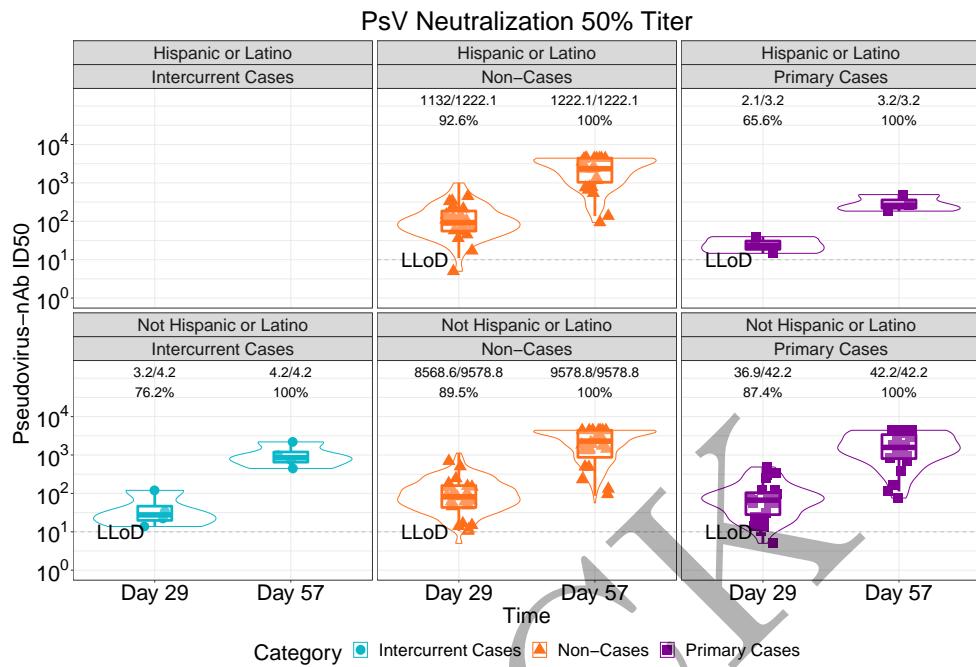


Figure 2.219: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

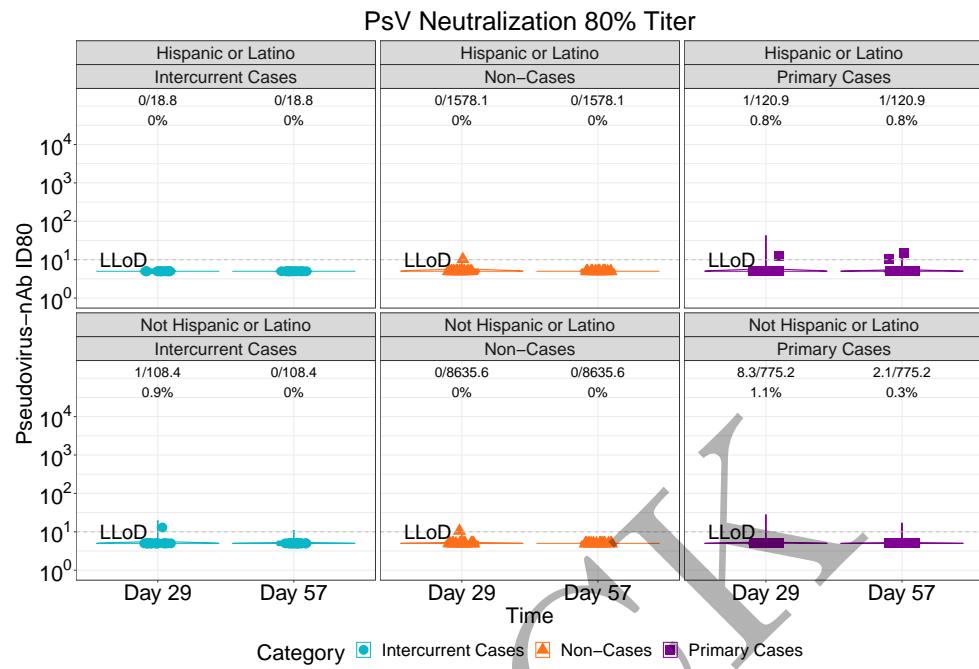


Figure 2.220: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

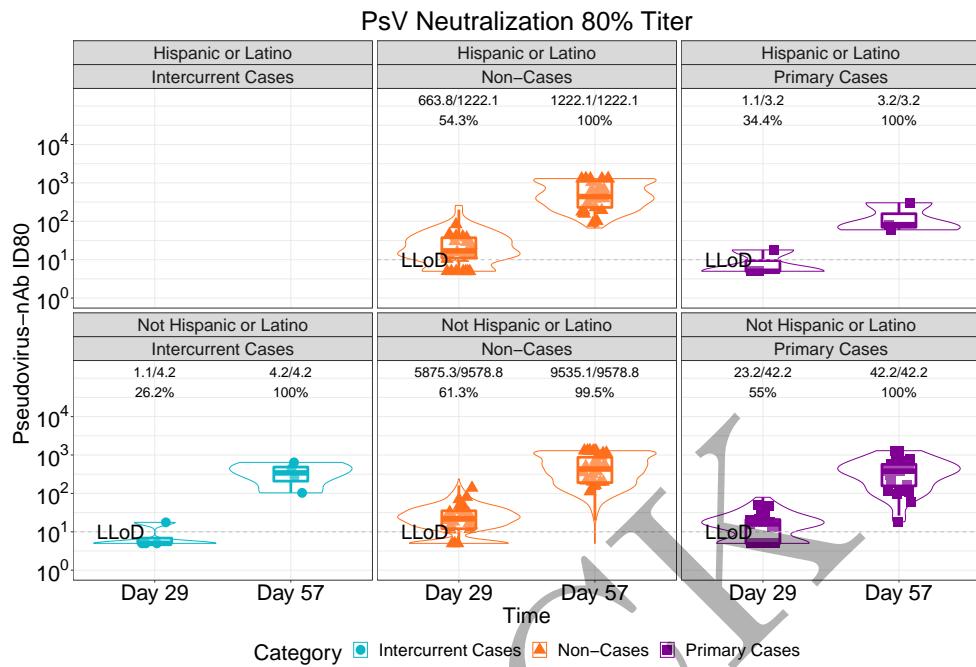


Figure 2.221: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

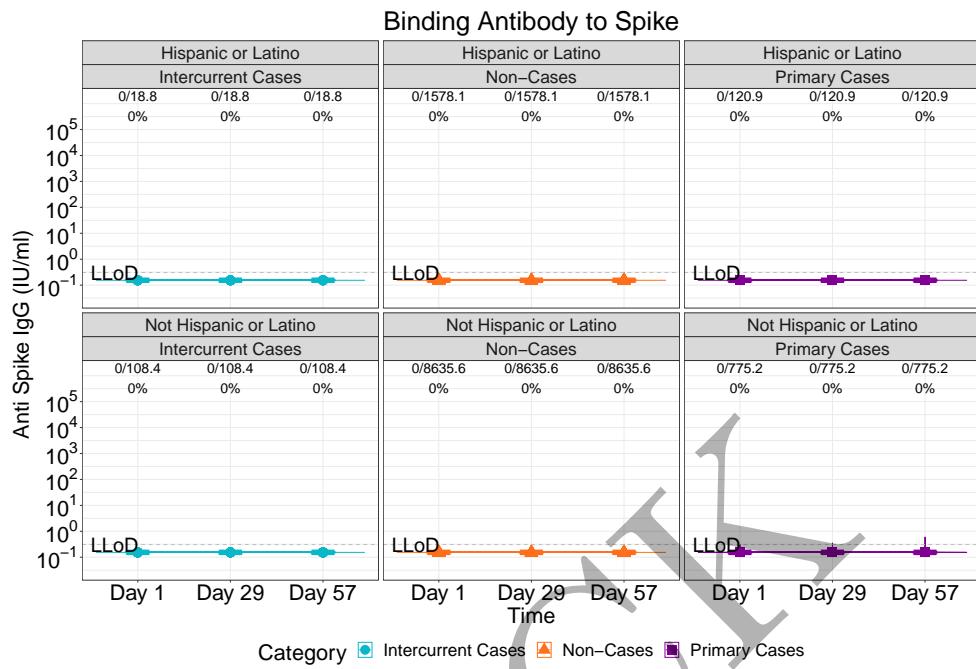


Figure 2.222: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

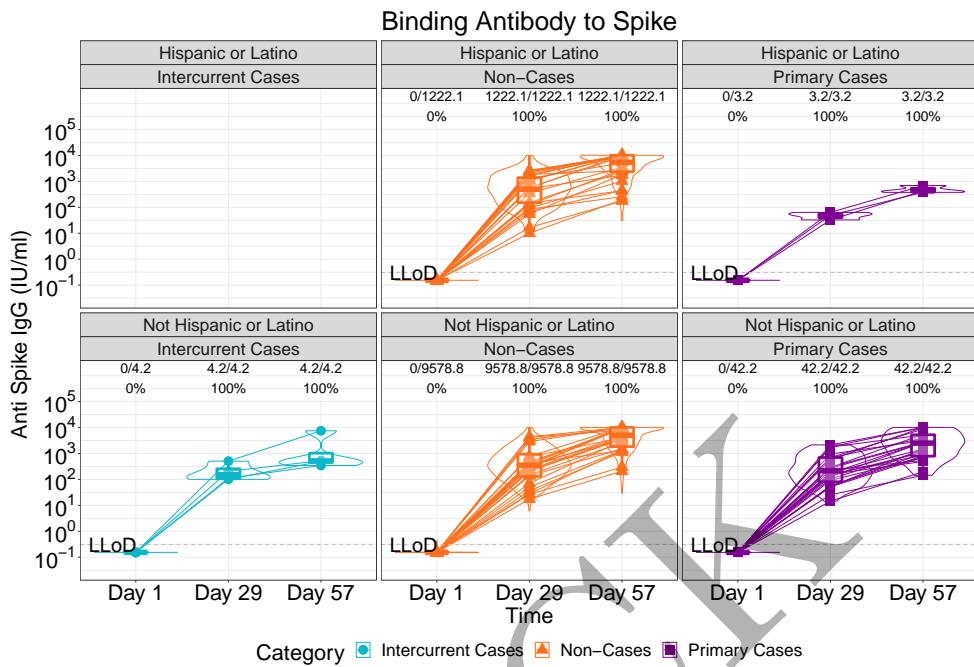


Figure 2.223: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

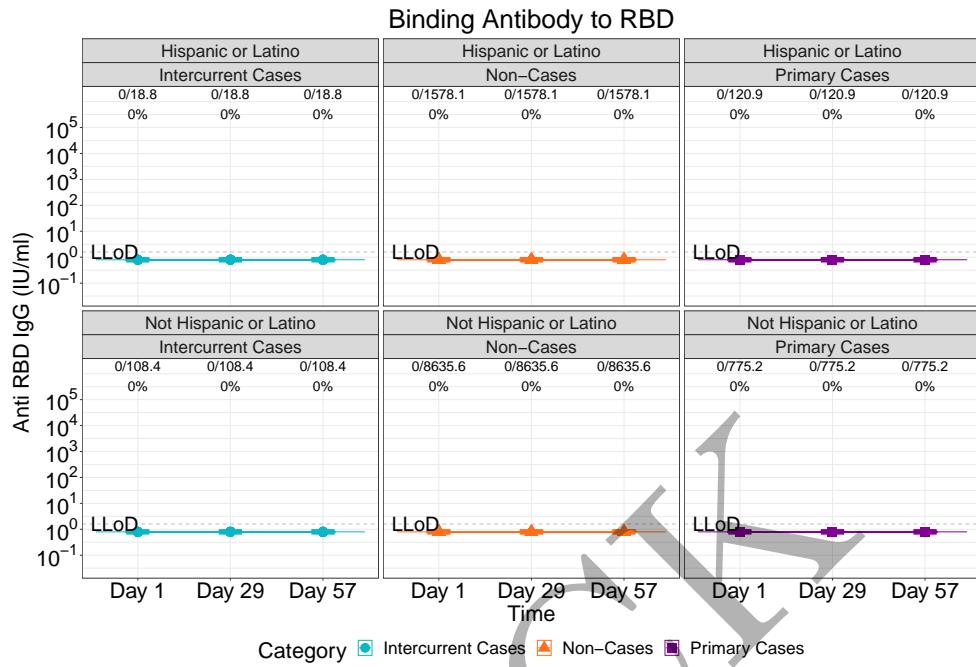


Figure 2.224: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

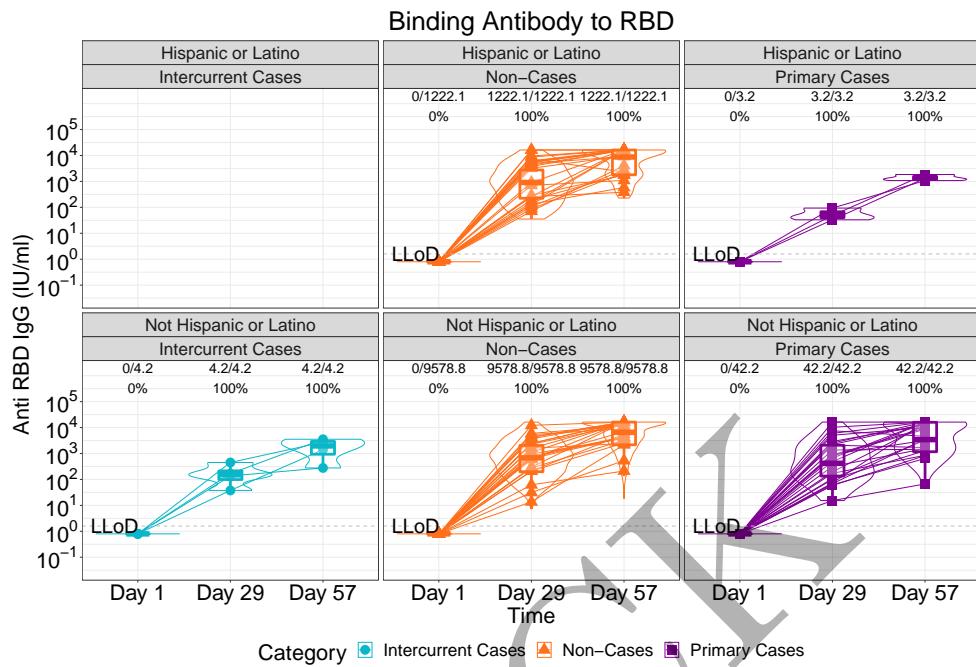


Figure 2.225: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

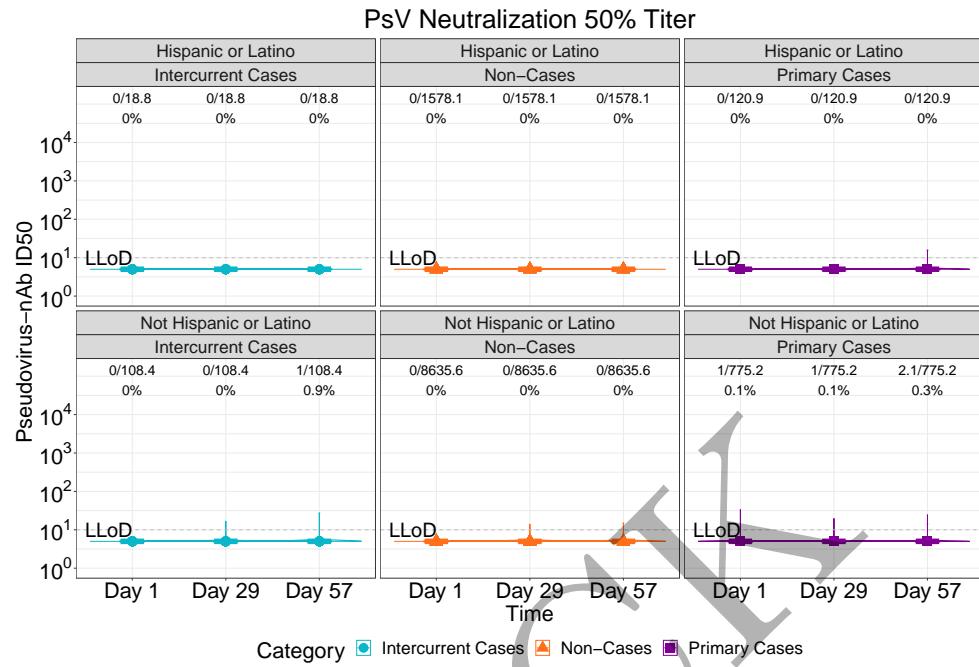


Figure 2.226: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

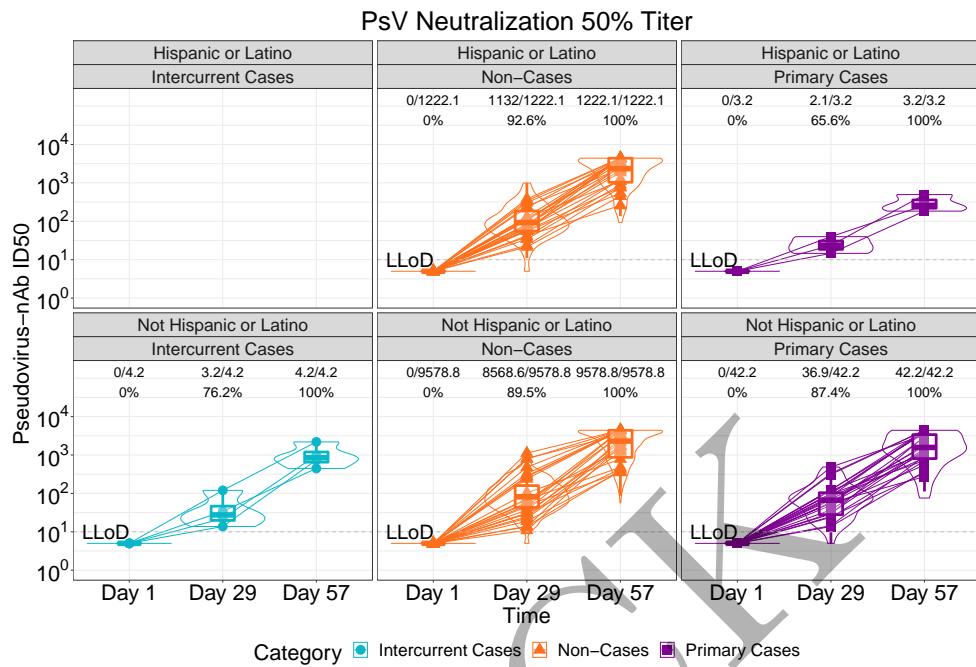


Figure 2.227: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

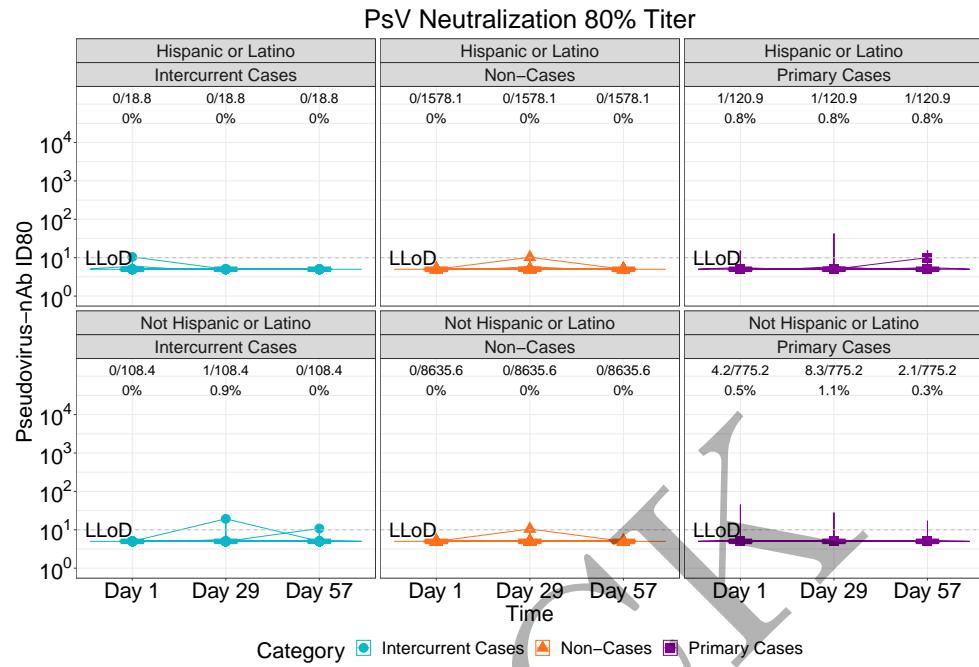


Figure 2.228: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

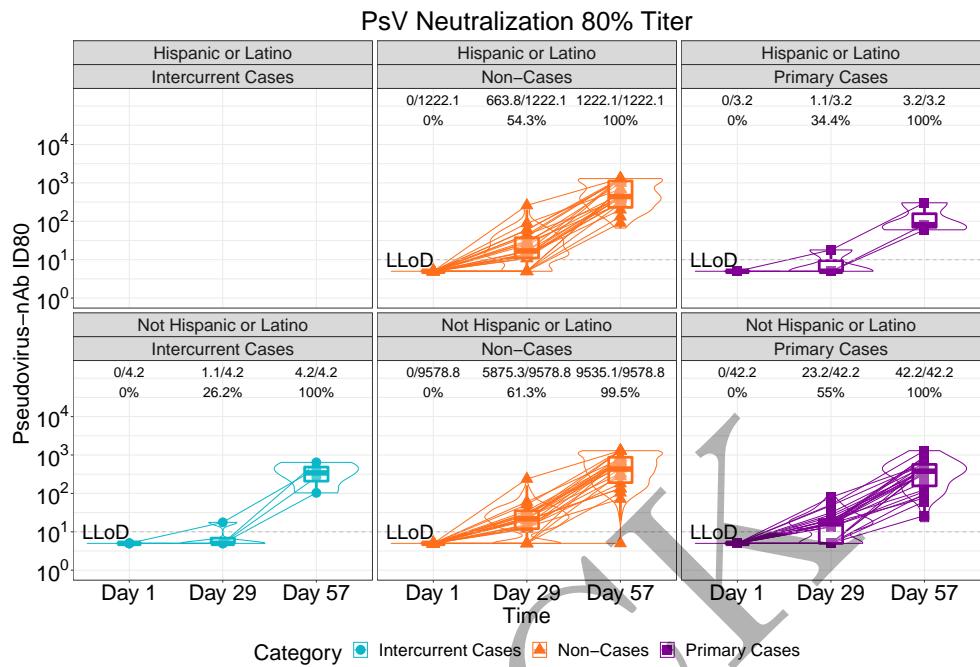


Figure 2.229: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

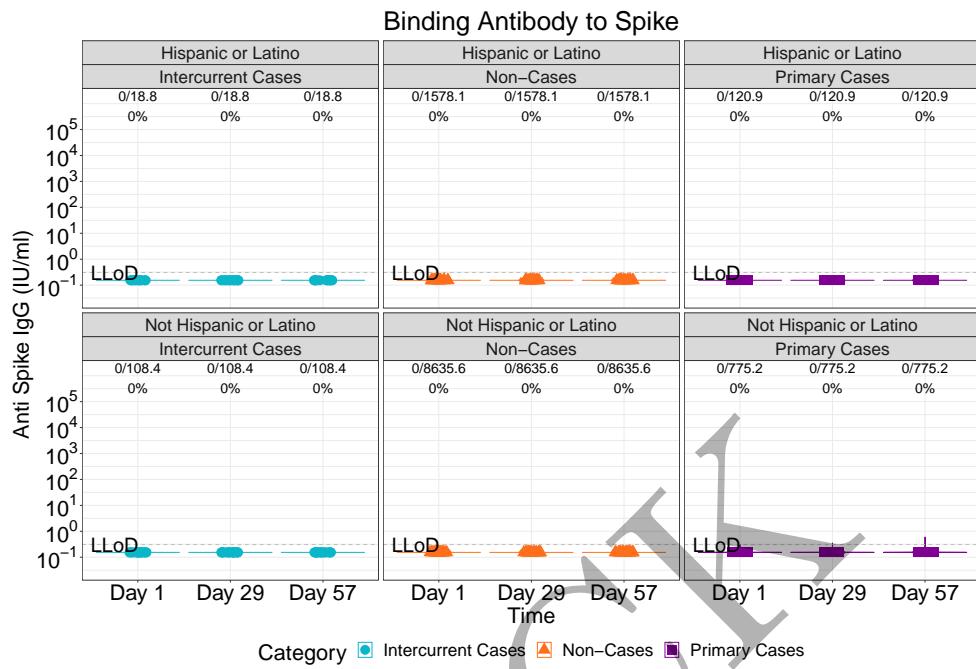


Figure 2.230: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

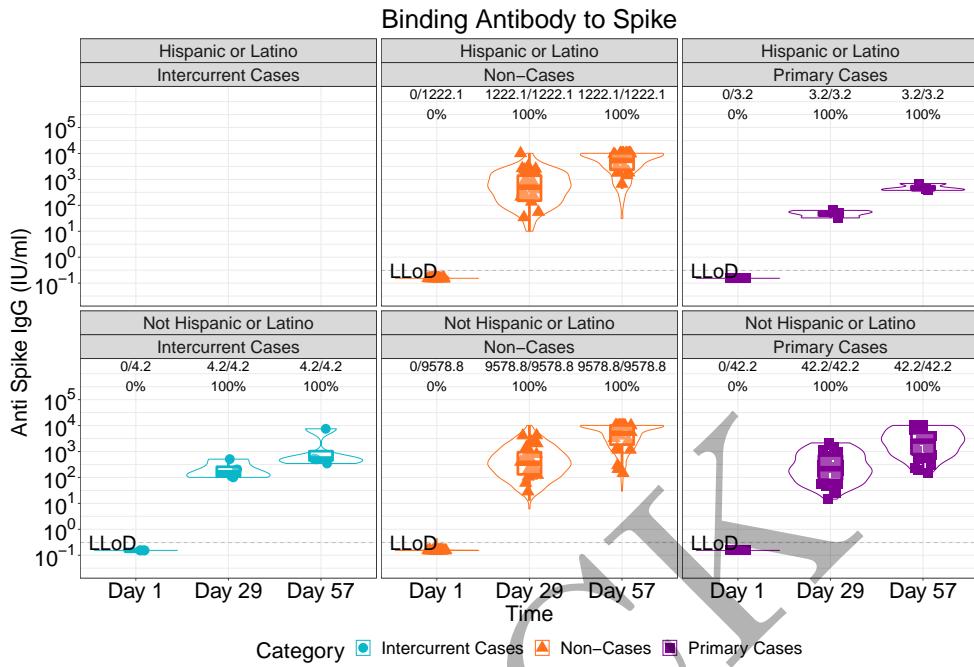


Figure 2.231: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

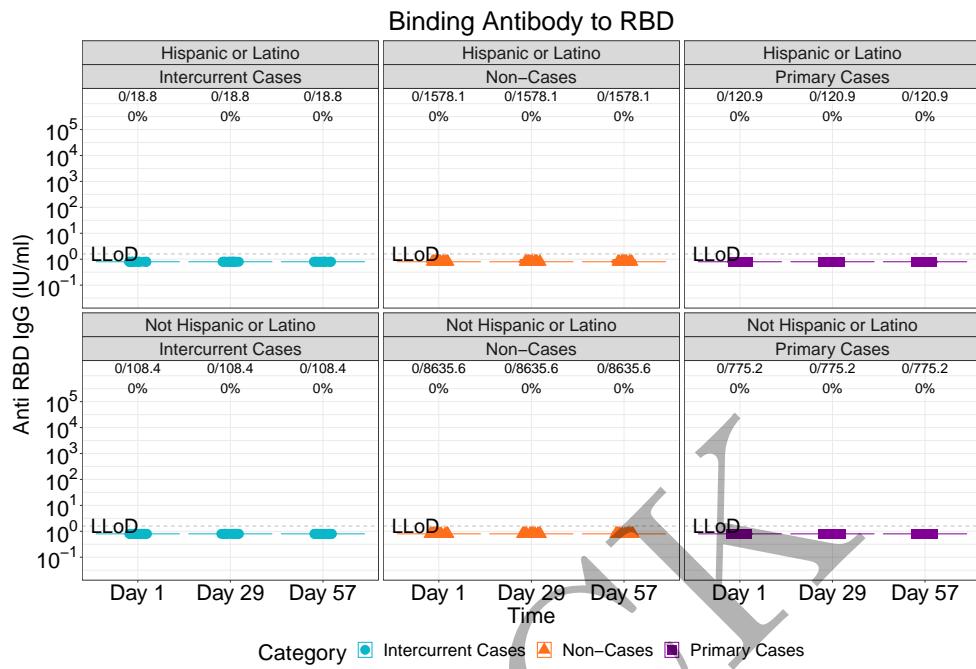


Figure 2.232: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

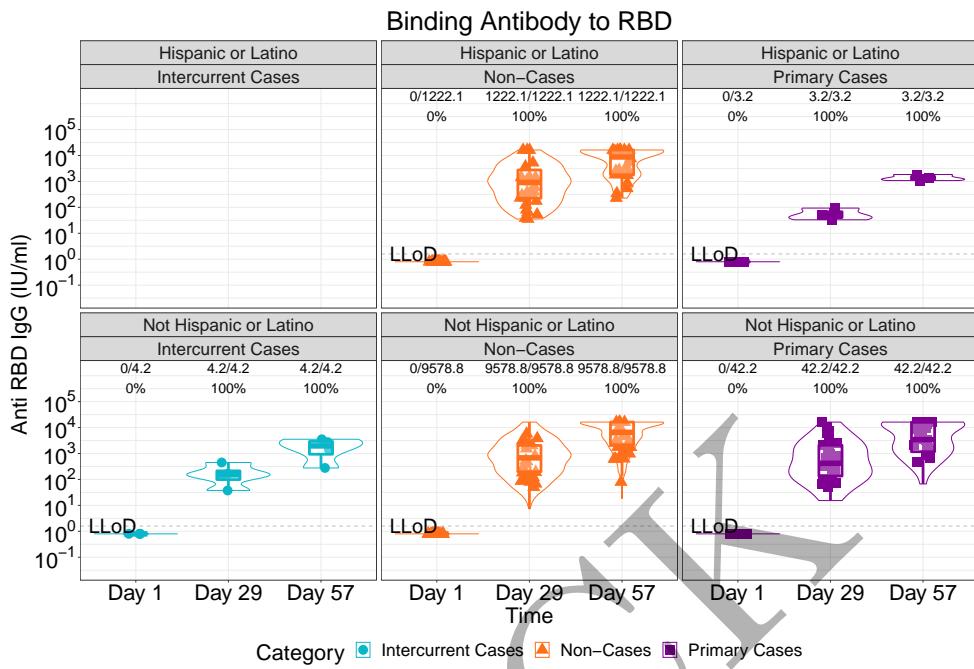


Figure 2.233: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

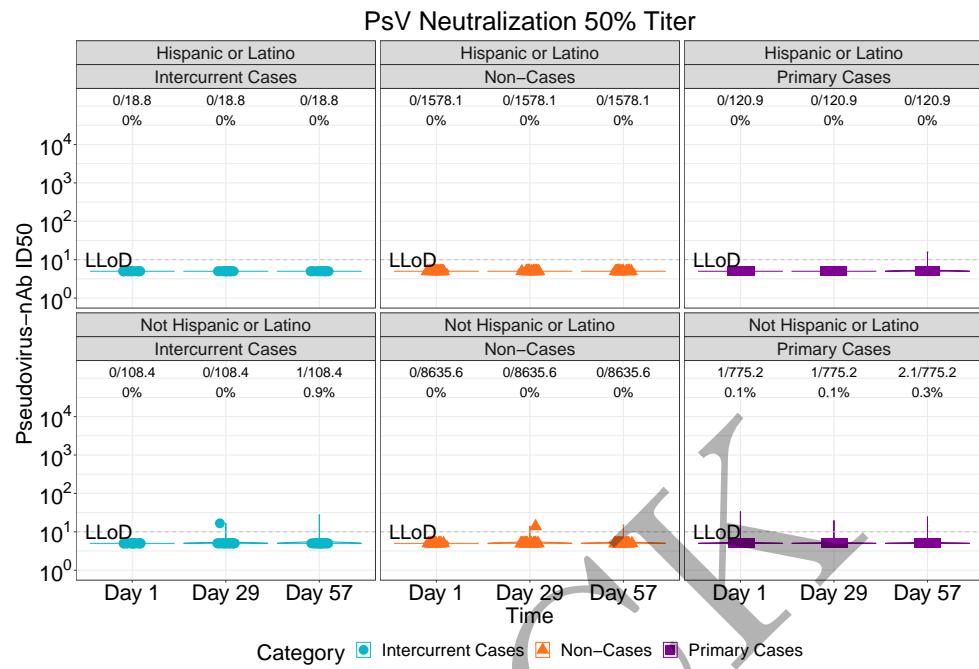


Figure 2.234: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

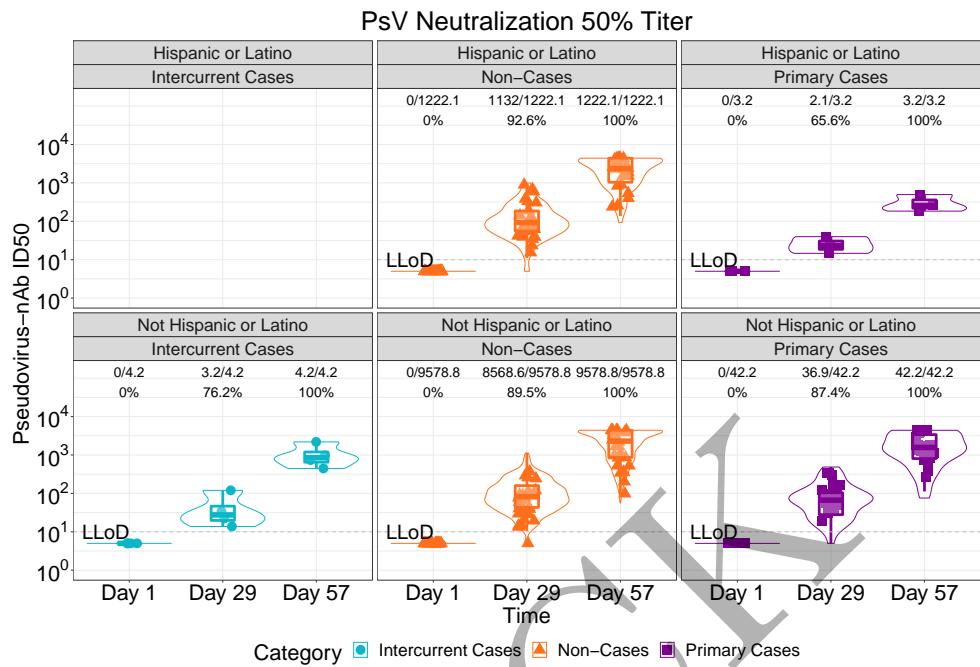


Figure 2.235: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

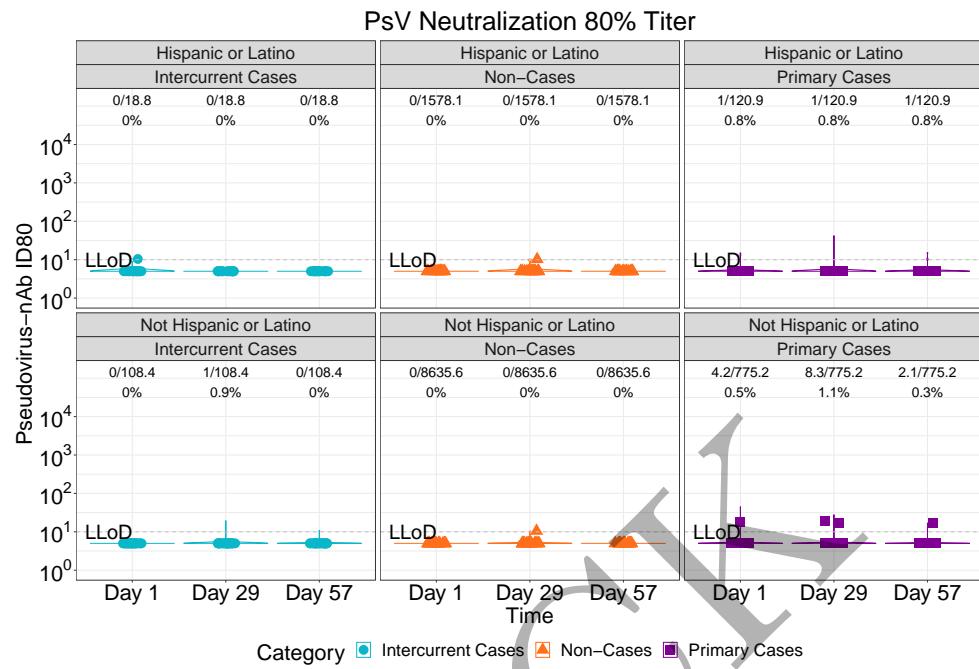


Figure 2.236: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

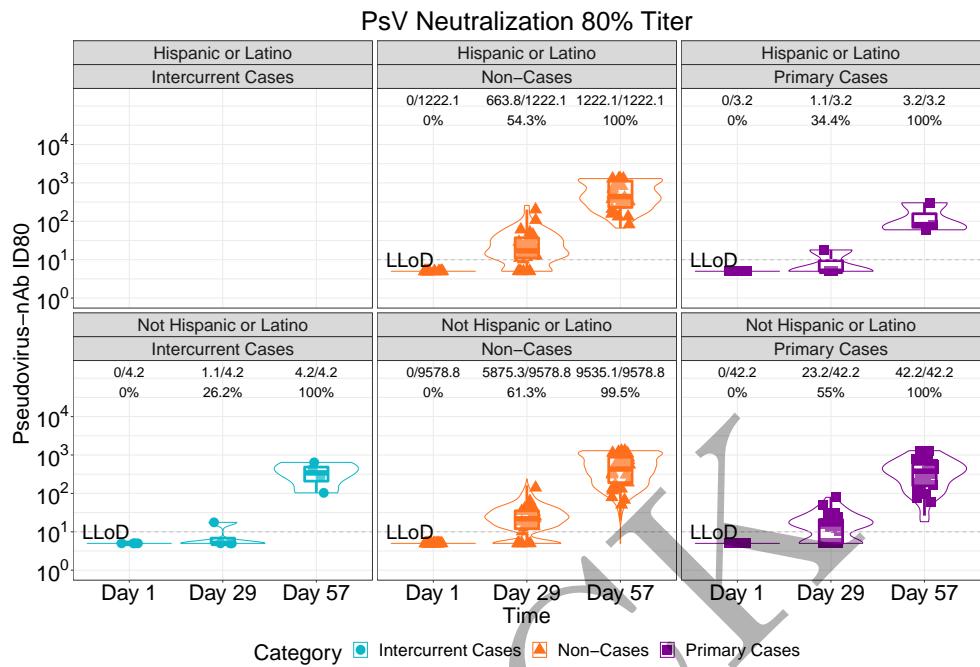


Figure 2.237: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

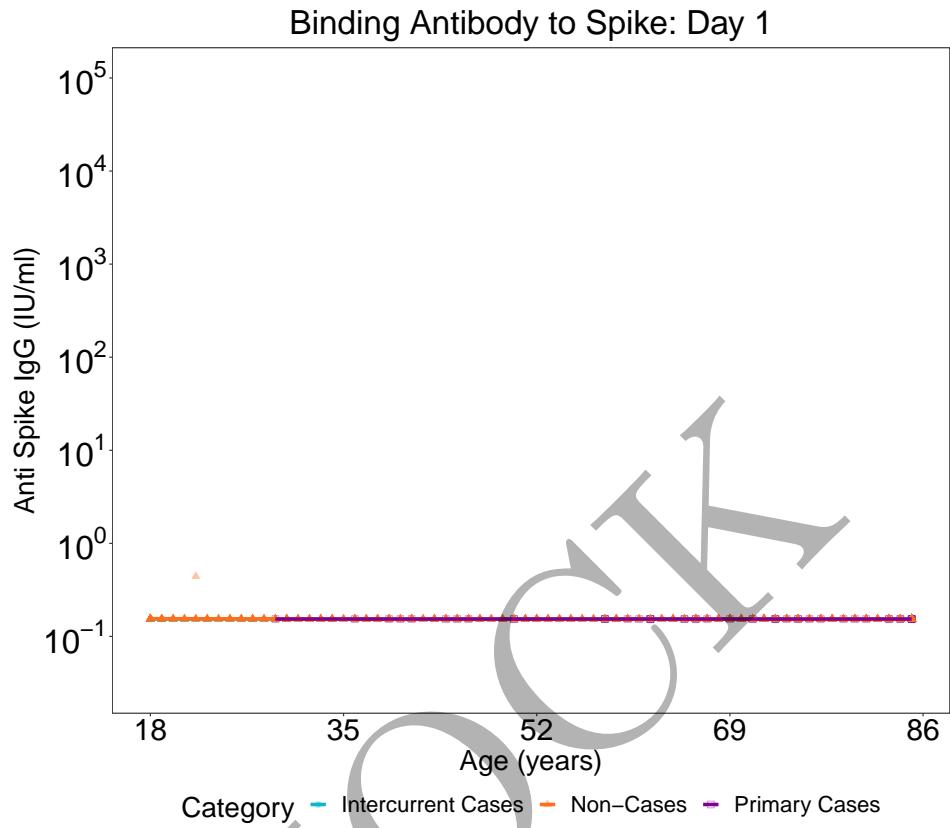


Figure 2.238: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1

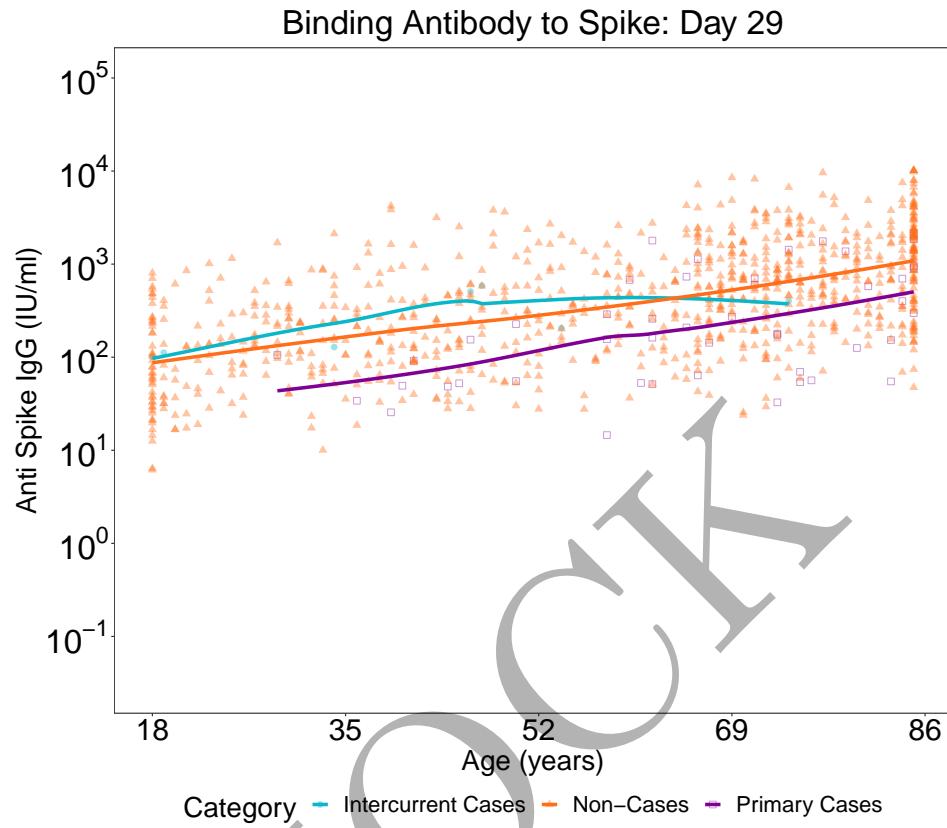


Figure 2.239: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29

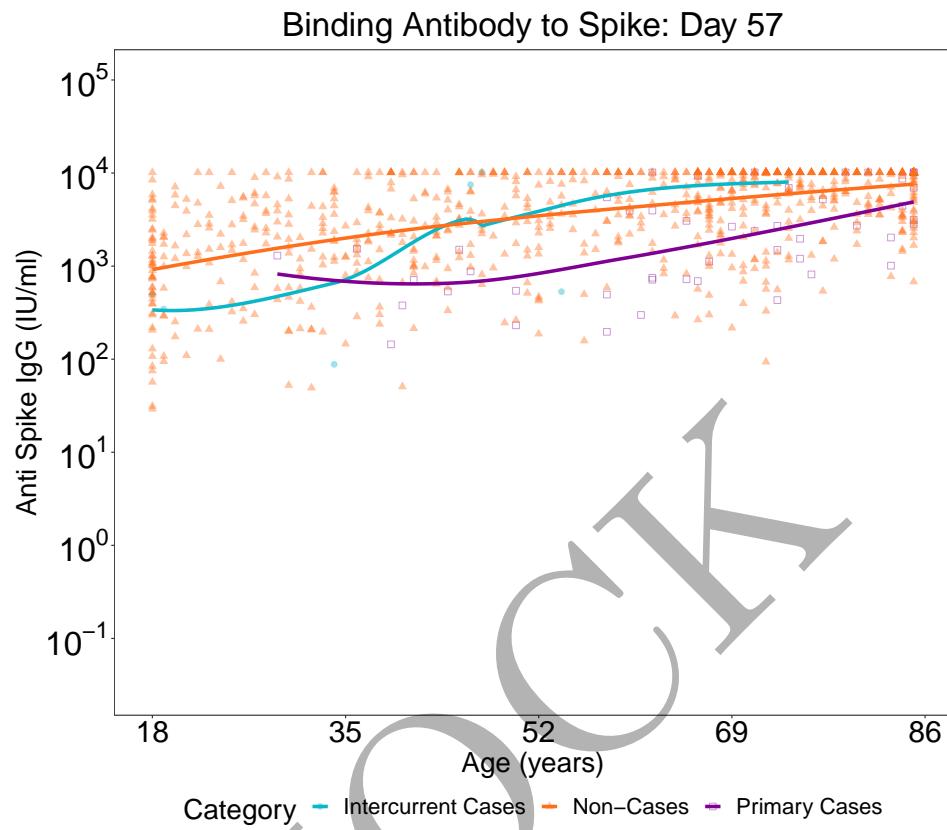


Figure 2.240: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57

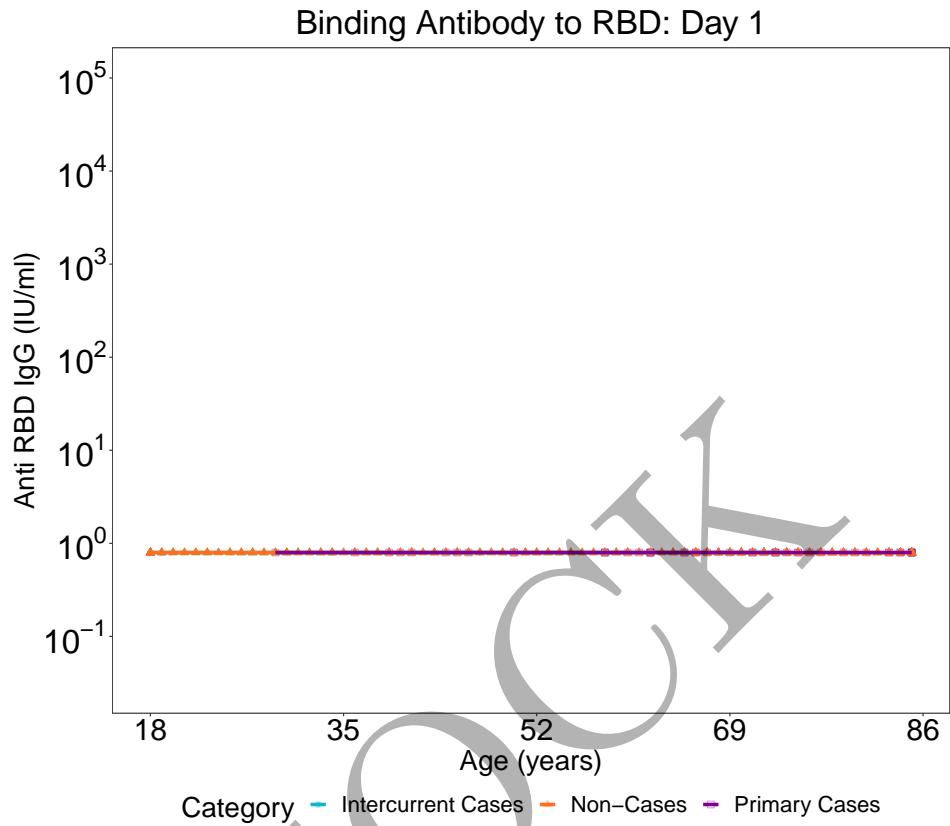


Figure 2.241: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1

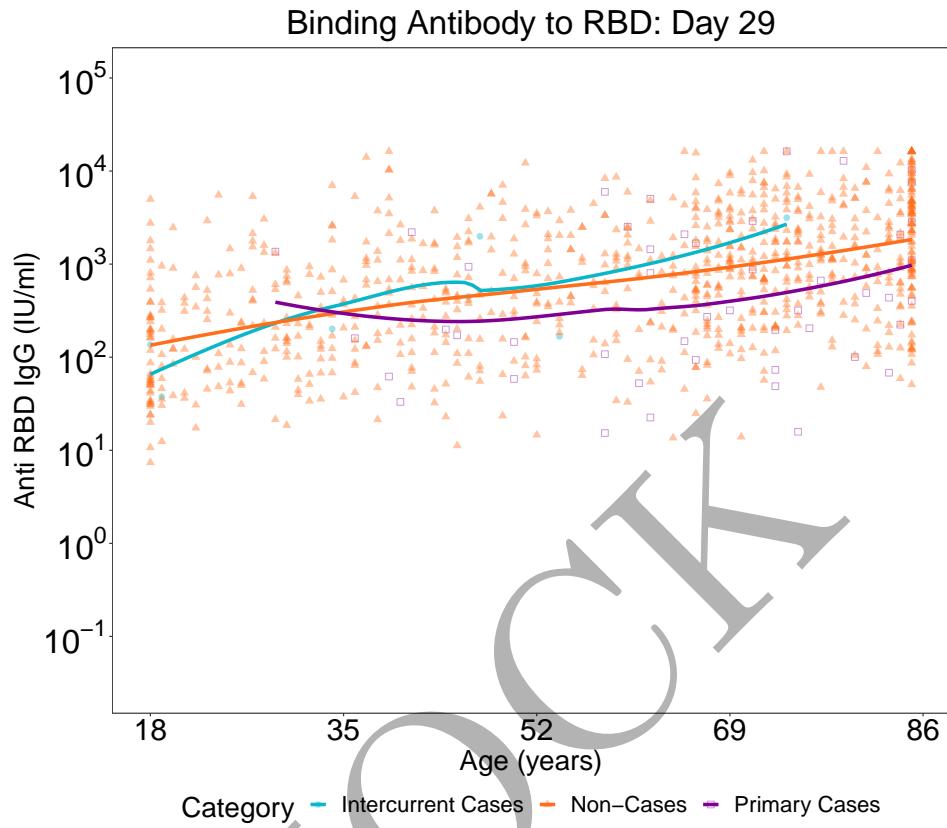


Figure 2.242: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29

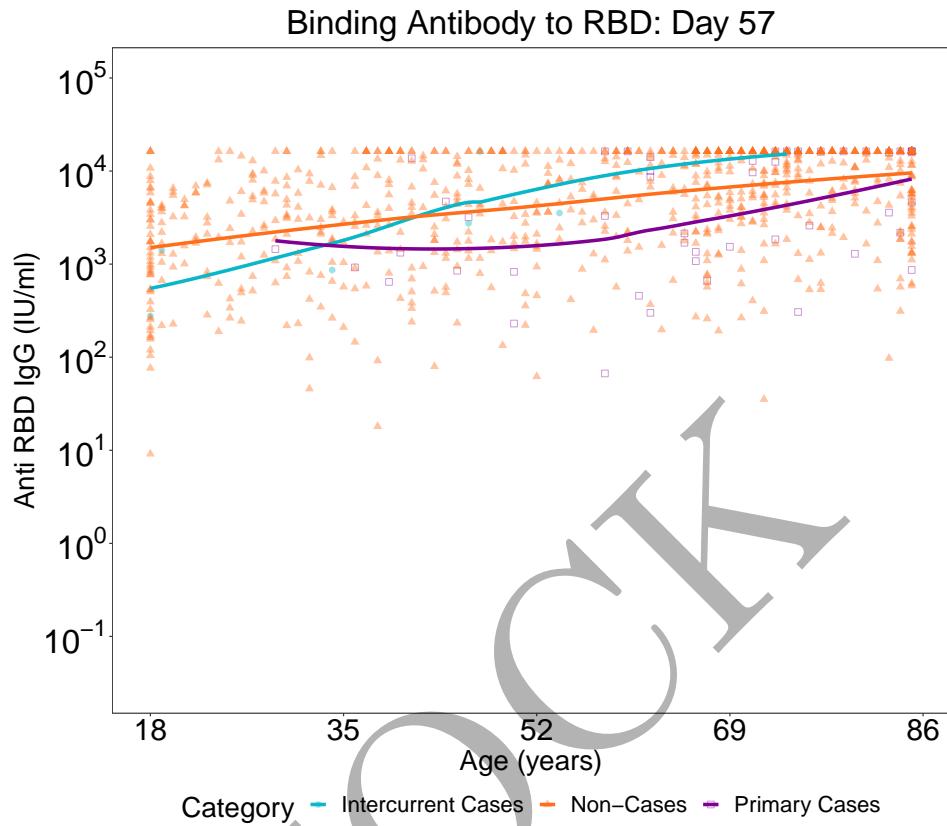


Figure 2.243: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57

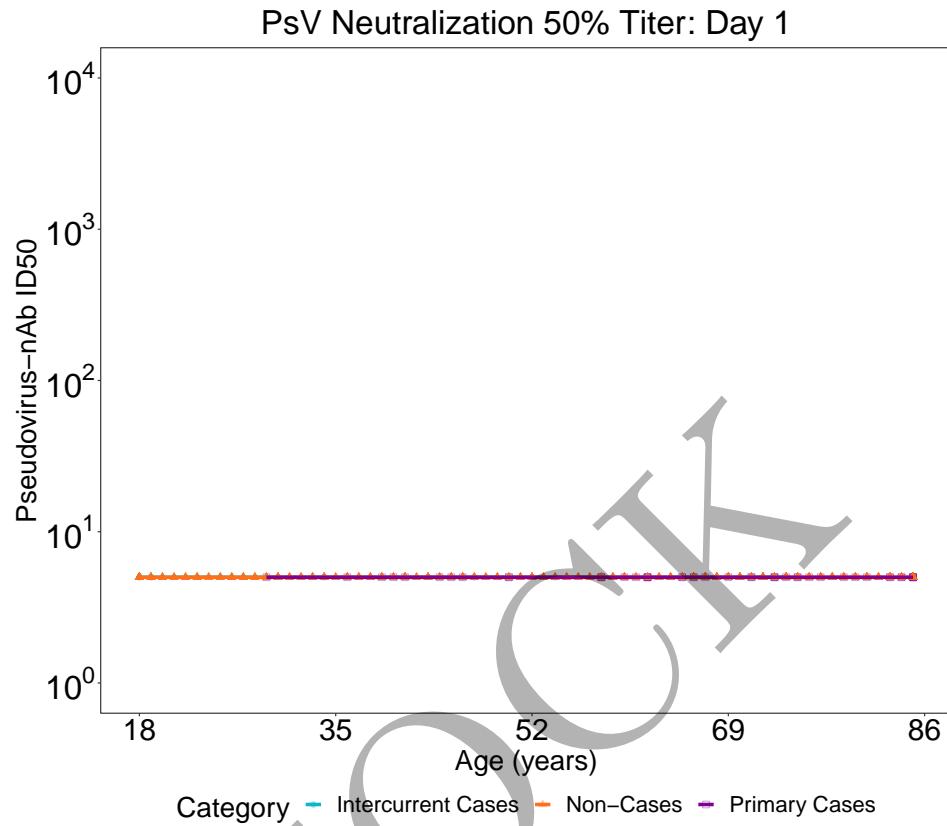


Figure 2.244: scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1

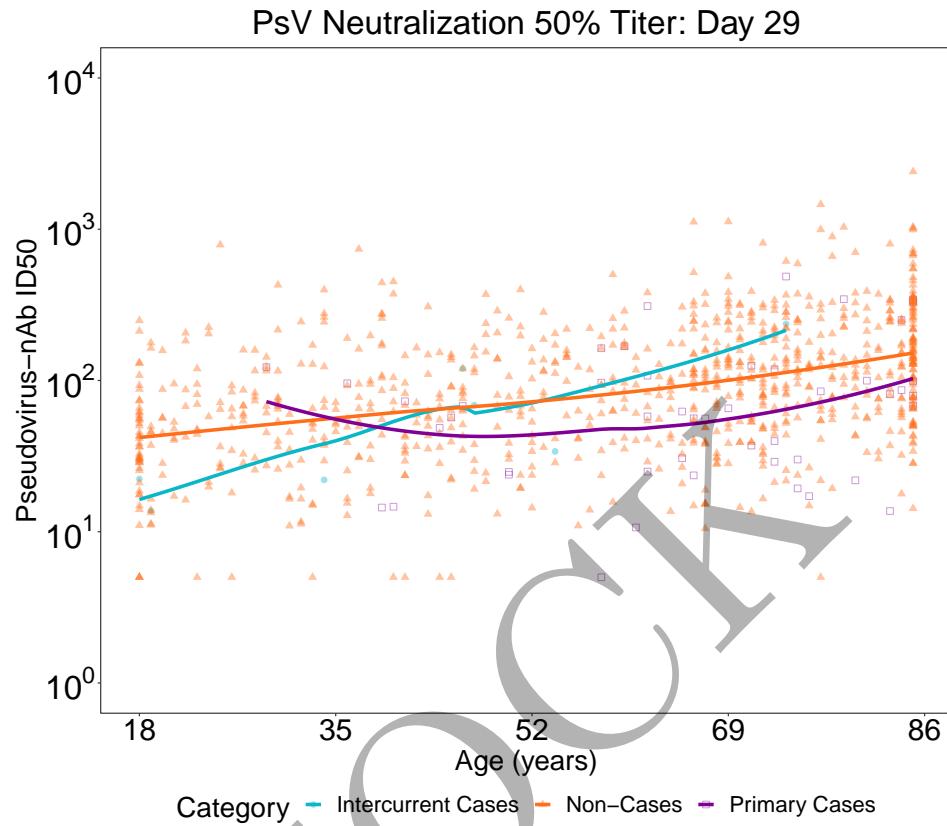


Figure 2.245: scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29

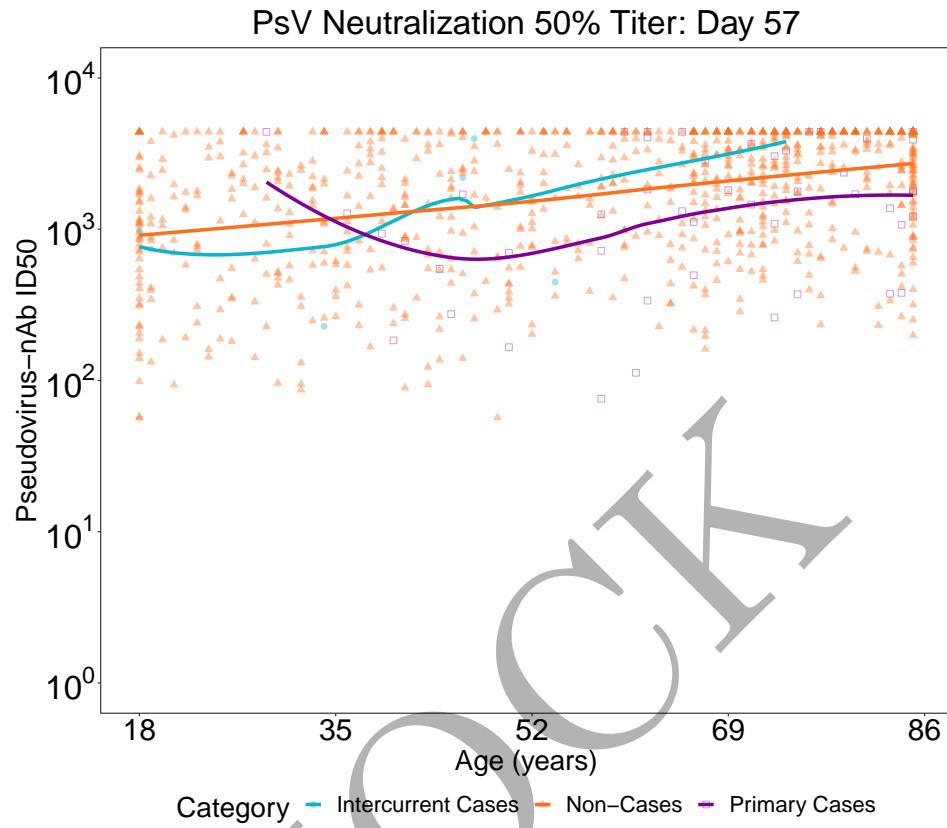


Figure 2.246: scatterplots of Pseudovirus Neutralization ID<sub>50</sub>: baseline negative vaccine arm at day 57

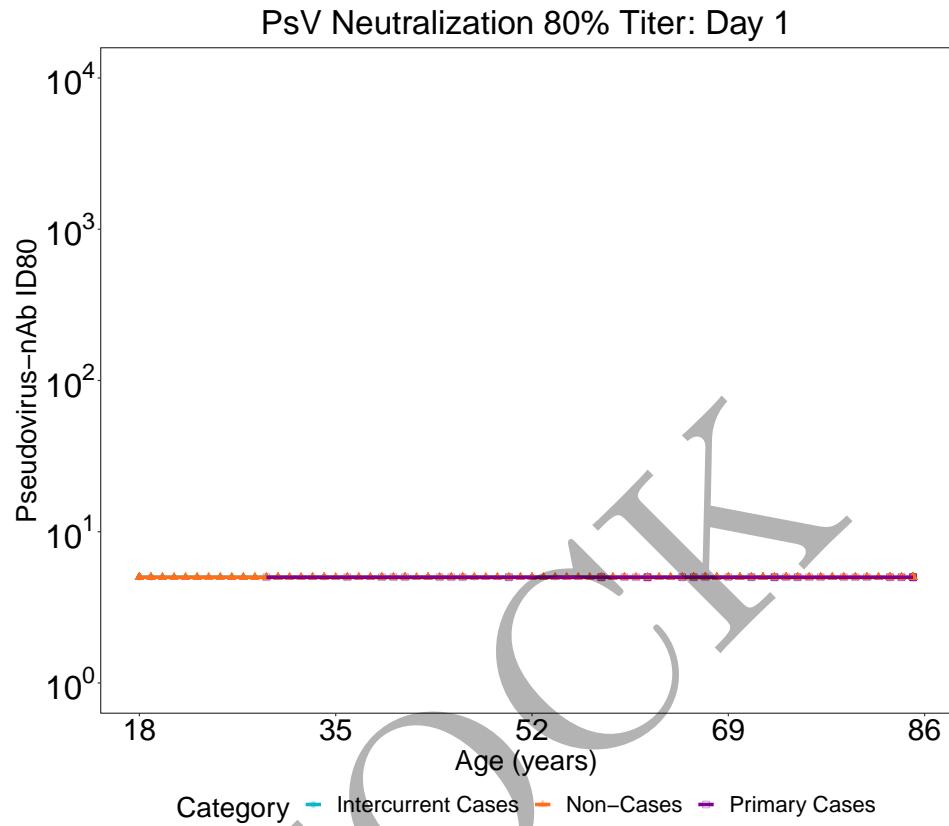


Figure 2.247: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1

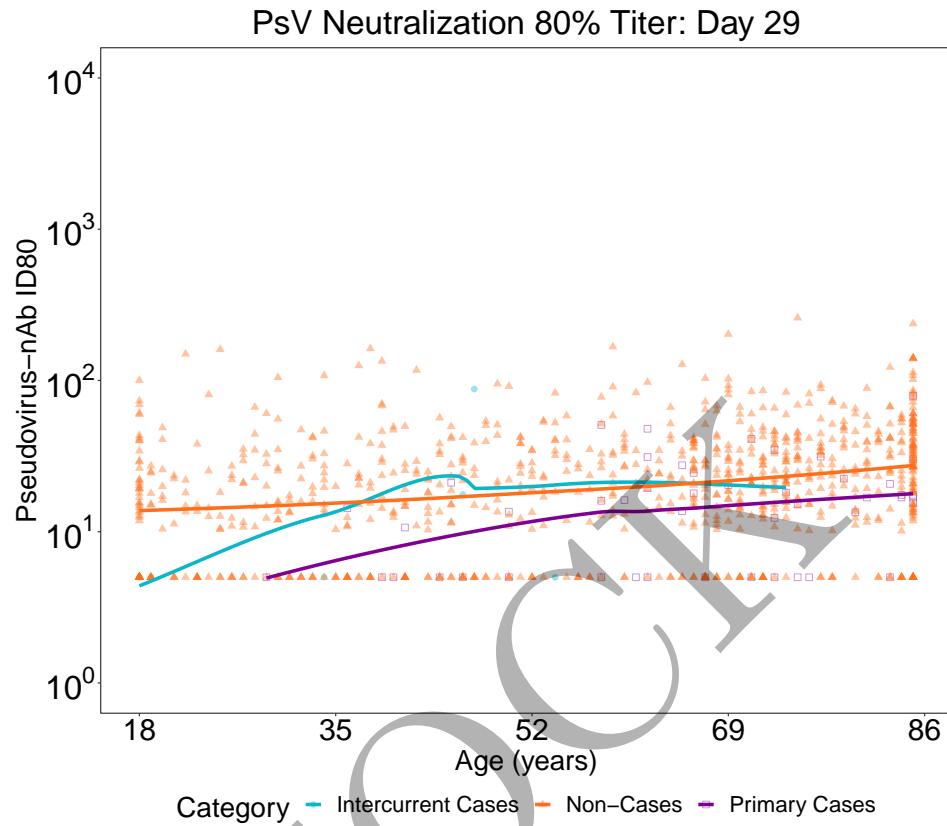


Figure 2.248: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29

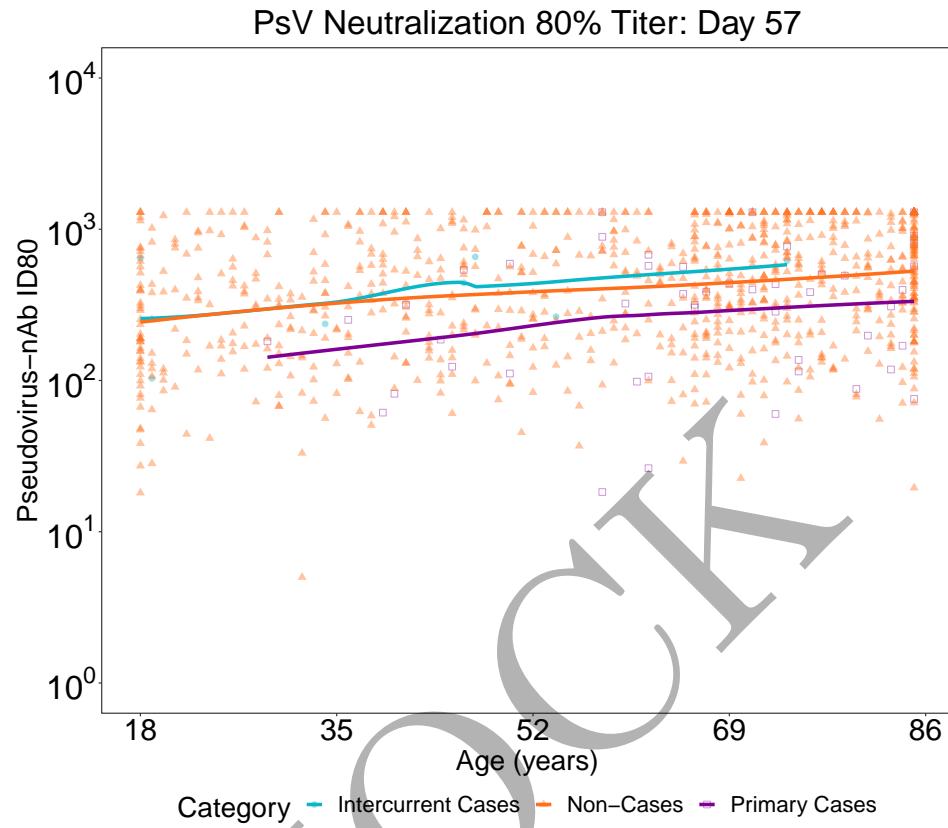


Figure 2.249: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57

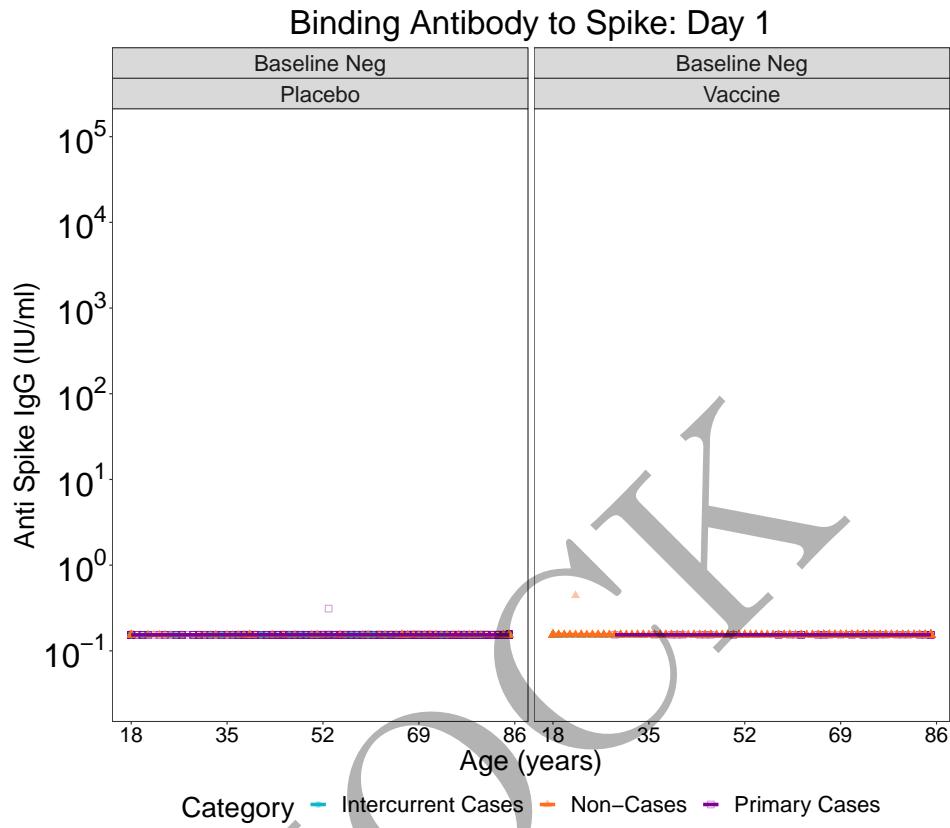


Figure 2.250: scatterplots of Binding Antibody to Spike: by arm at day 1

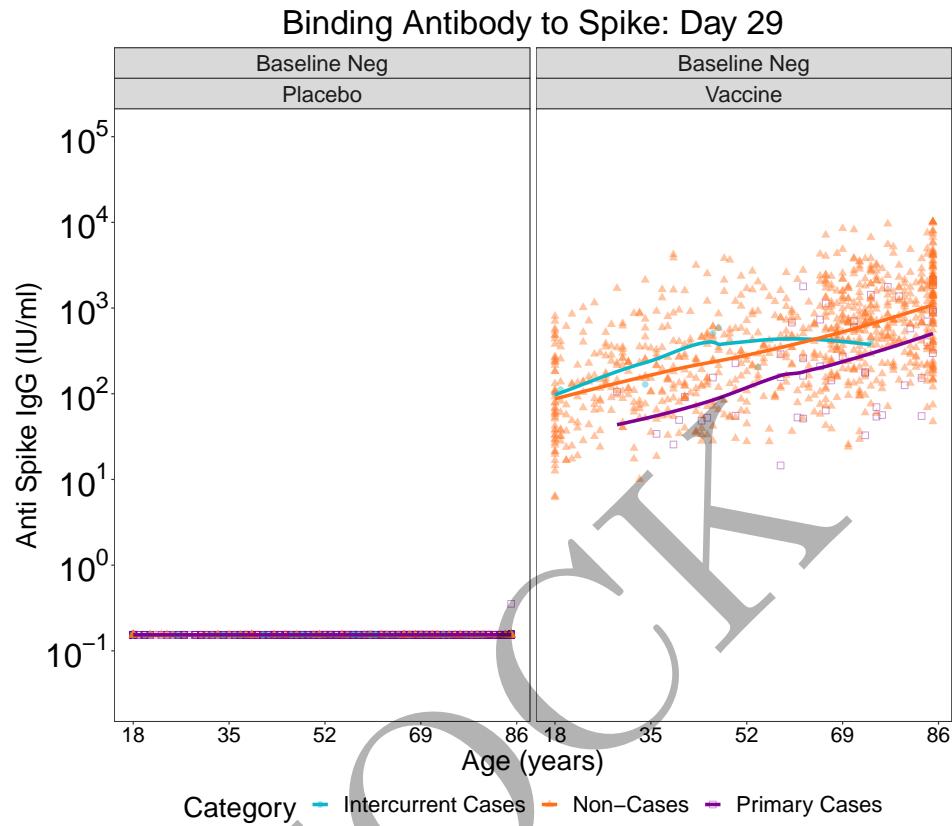


Figure 2.251: scatterplots of Binding Antibody to Spike: by arm at day 29

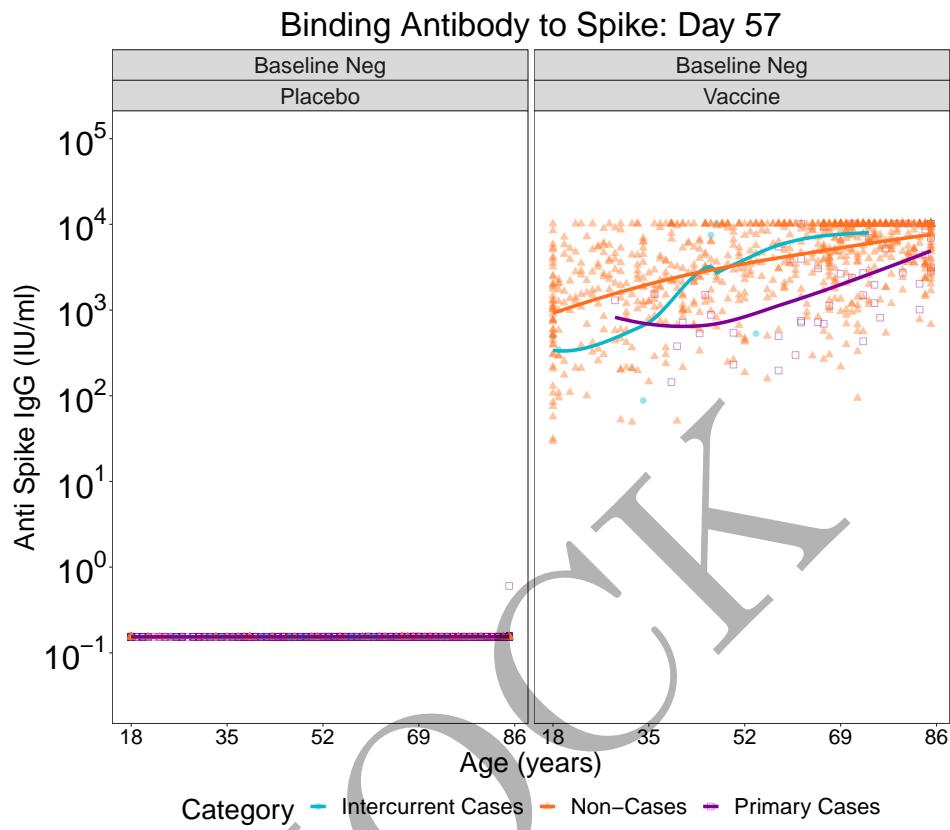


Figure 2.252: scatterplots of Binding Antibody to Spike: by arm at day 57

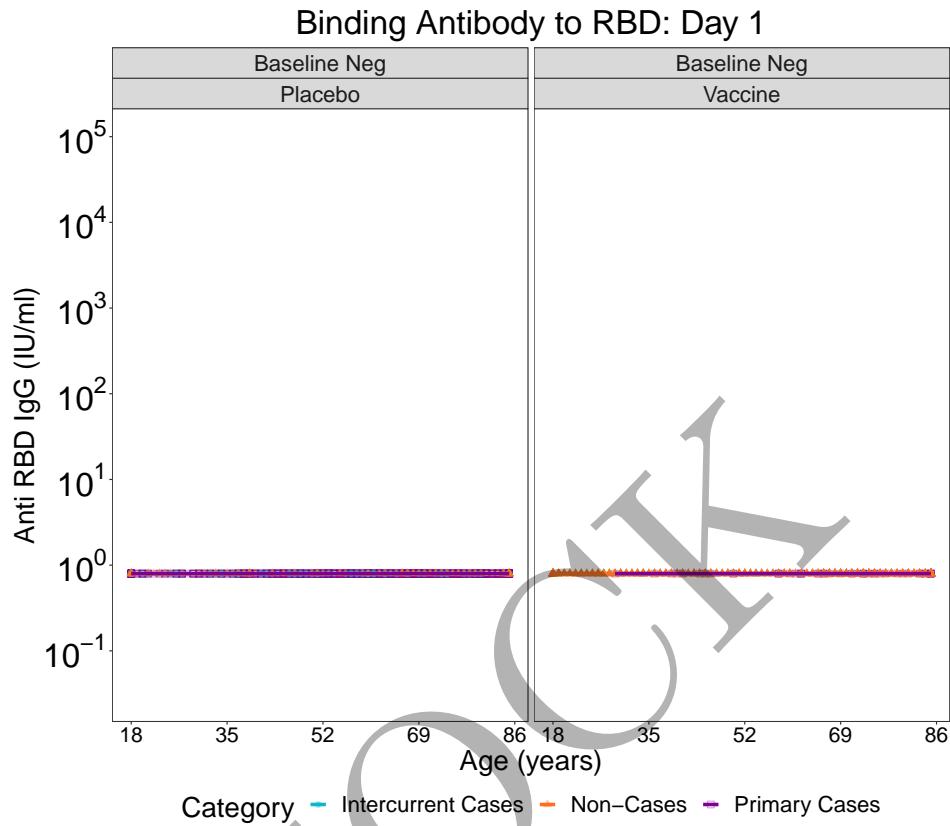


Figure 2.253: scatterplots of Binding Antibody to RBD: by arm at day 1

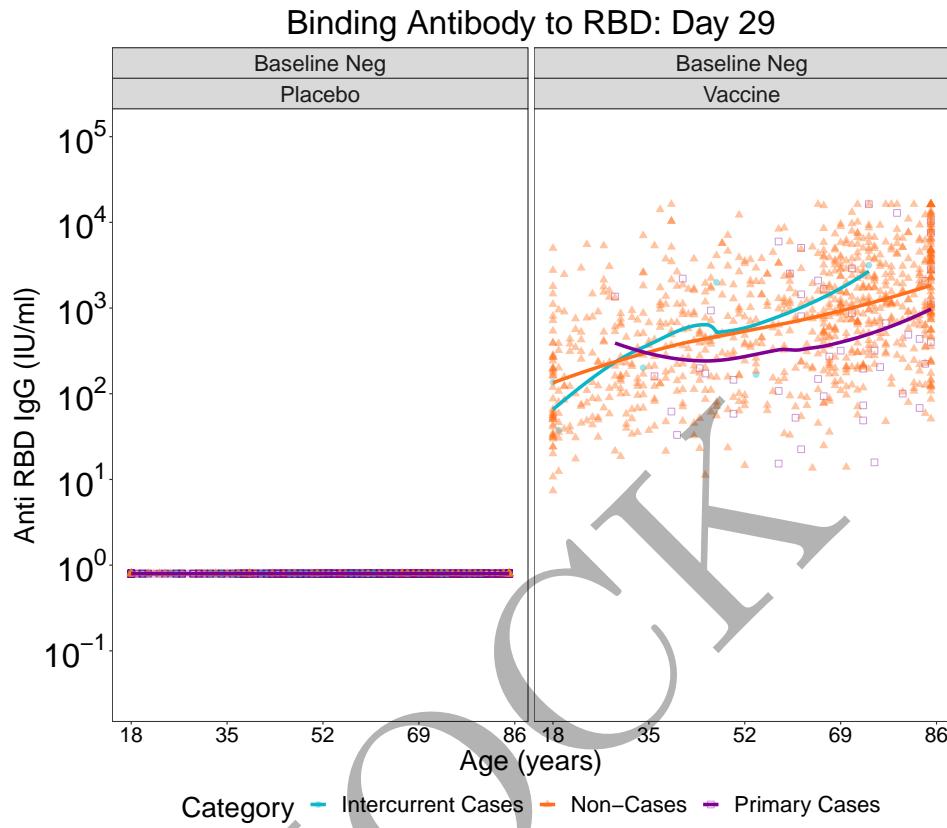


Figure 2.254: scatterplots of Binding Antibody to RBD: by arm at day 29

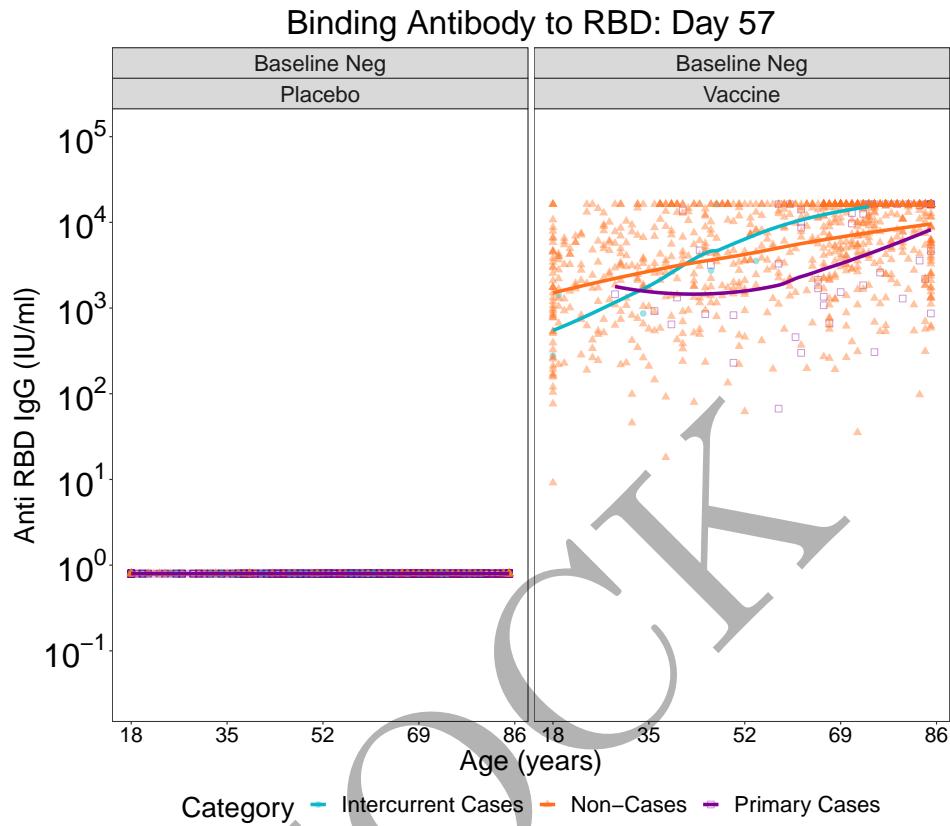


Figure 2.255: scatterplots of Binding Antibody to RBD: by arm at day 57

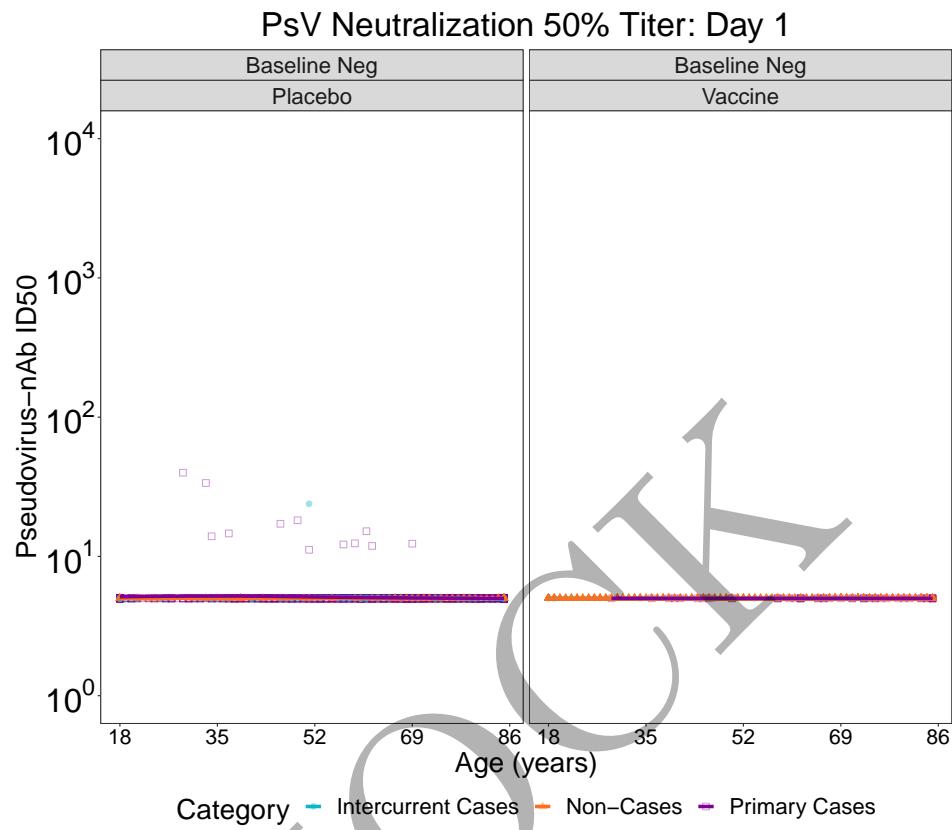


Figure 2.256: scatterplots of Pseudovirus Neutralization ID50: by arm at day 1

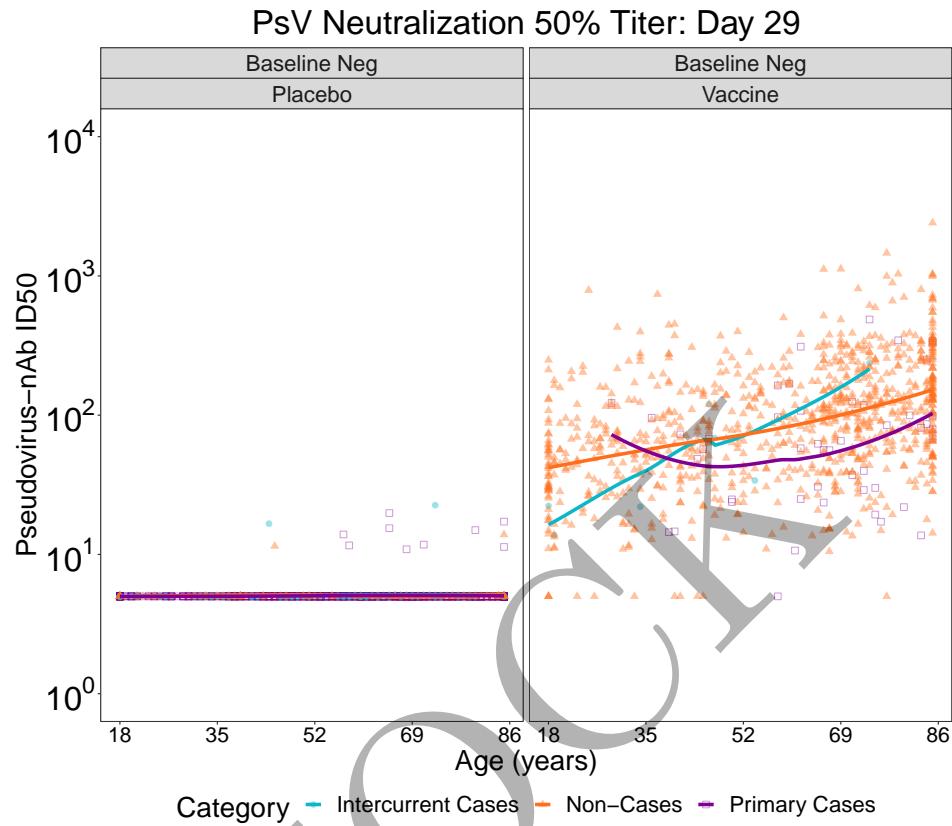


Figure 2.257: scatterplots of Pseudovirus Neutralization ID50: by arm at day 29

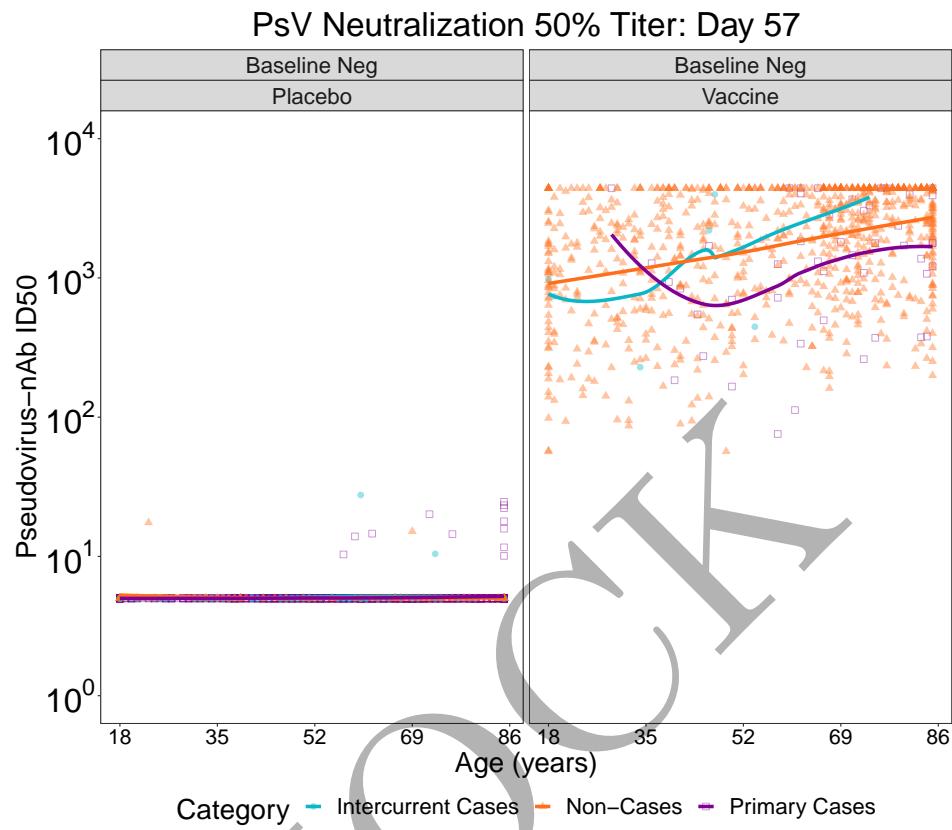


Figure 2.258: scatterplots of Pseudovirus Neutralization ID50: by arm at day 57

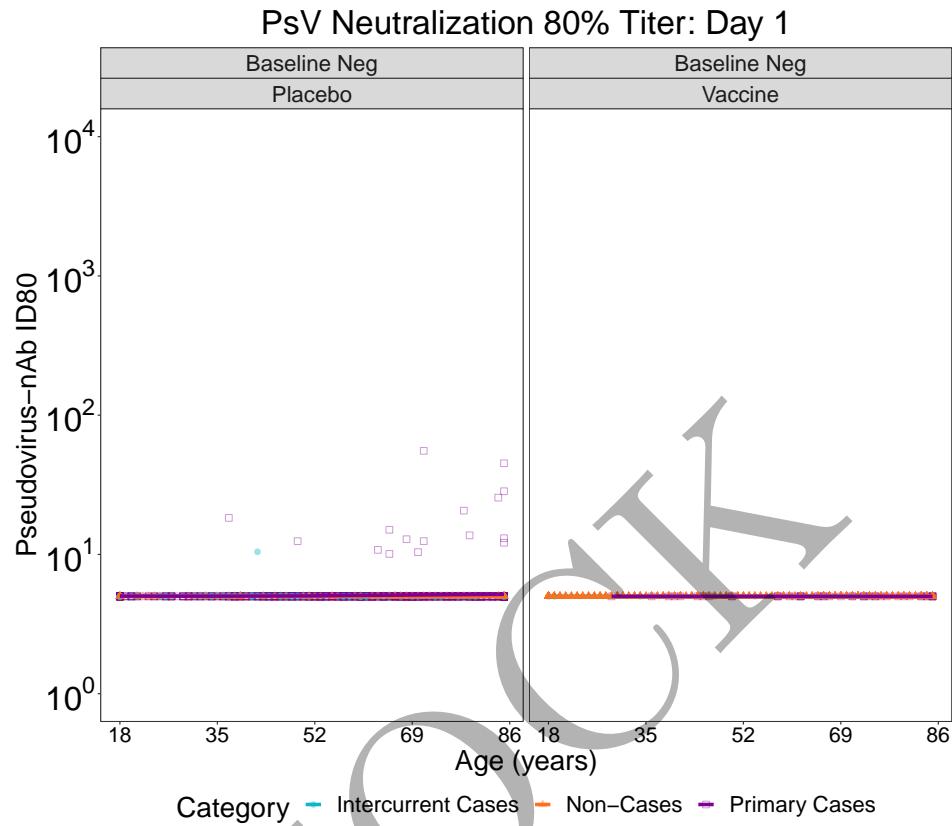


Figure 2.259: scatterplots of Pseudovirus Neutralization ID80: by arm at day 1

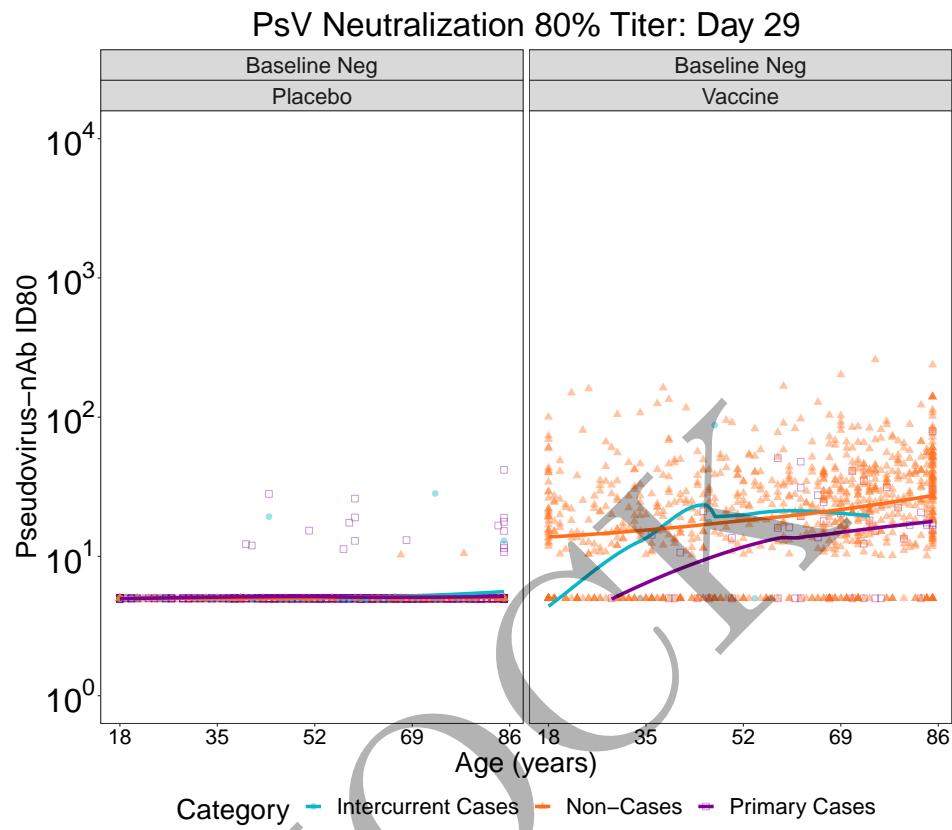


Figure 2.260: scatterplots of Pseudovirus Neutralization ID80: by arm at day 29

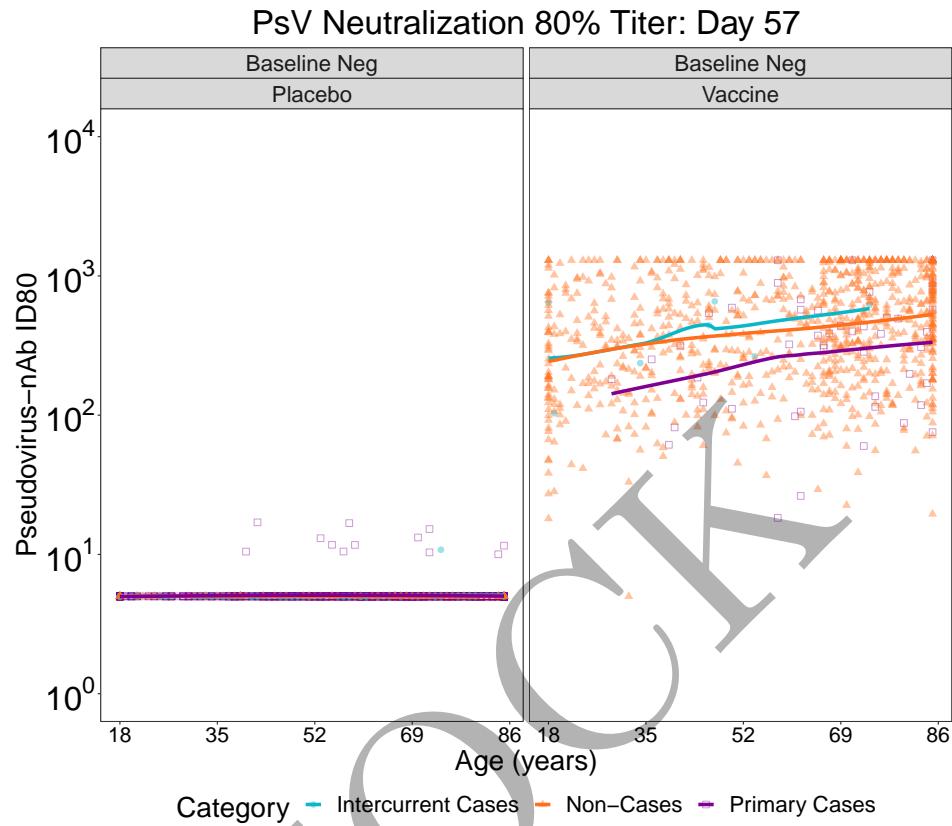


Figure 2.261: scatterplots of Pseudovirus Neutralization ID80: by arm at day 57

# Chapter 3

## Day 57 Univariate CoR: Cox Models of Risk

The main regression model is the Cox proportional hazards model. All plots are made with Cox models fit unless specified otherwise.

### 3.1 Hazard ratios

Inference for Day 57 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group:  
Hazard ratios per 10-fold increment in the marker\*

Mock Immunologic Marker	No. cases / No. at-risk**	HR per 10-fold incr. Pt. Est.	95% CI	P-value (2-sided)	q-value ***	FWER
Anti Spike IgG (IU/ml)	50/11,184	0.15	(0.09-0.25)	<0.001	<0.001	<0.001
Anti RBD IgG (IU/ml)	50/11,184	0.42	(0.25-0.70)	0.001	<0.001	<0.001
Pseudovirus-nAb ID50	50/11,184	0.29	(0.14-0.60)	0.001	<0.001	<0.001
Pseudovirus-nAb ID80	50/11,184	0.26	(0.13-0.55)	<0.001	<0.001	<0.001

\*Baseline covariates adjusted for: baseline risk score, at risk or not, community of color or not. Maximum failure event time 175 days.

\*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID; no. cases = number of this cohort with an observed COVID endpoints starting 7 days post Day 57 visit.

\*\*\*q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method.

Inference for Day 57 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group:  
Hazard ratios for Middle vs. Upper tertile vs. Lower tertile\*

Mock Immunologic Marker	Tertile	No. cases / No. at-risk**	Attack rate	Haz. Ratio Pt. Est.	95% CI	P-value (2-sided)	Overall P- value***	Overall q- value †	Overall FWER
Anti Spike IgG (IU/ml)	Lower	24/3,718	0.0065	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	15/3,722	0.0040	0.28	(0.14-0.59)	0.001			
	Upper	11/3,744	0.0029	0.07	(0.03-0.17)	<0.001			
Anti RBD IgG (IU/ml)	Lower	20/3,745	0.0053	1	N/A	N/A	0.004	<0.001	<0.001
	Middle	10/3,754	0.0027	0.33	(0.14-0.76)	0.009			
	Upper	20/3,685	0.0054	0.33	(0.16-0.69)	0.003			
Pseudovirus-nAb ID50	Lower	17/3,769	0.0045	1	N/A	N/A	0.031	<0.001	.025
	Middle	19/3,725	0.0051	0.88	(0.43-1.77)	0.713			
	Upper	14/3,690	0.0038	0.36	(0.16-0.82)	0.014			
Pseudovirus-nAb ID80	Lower	19/3,736	0.0051	1	N/A	N/A	0.009	<0.001	<0.001
	Middle	21/3,745	0.0056	0.94	(0.46-1.92)	0.875			
	Upper	10/3,703	0.0027	0.30	(0.13-0.69)	0.005			
Placebo		1013/11,312	0.0896						

\*Baseline covariates adjusted for: baseline risk score, at risk or not, community of color or not. Maximum failure event time 175 days. Cutpoints: Anti Spike IgG (IU/ml) [3.23, 3.76], Anti RBD IgG (IU/ml) [3.32, 3.95], Pseudovirus-nAb ID50 [3.01, 3.47], Pseudovirus-nAb ID80 [2.35, 2.76].

\*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 57 visit; no. cases = number of this cohort with an observed COVID endpoints.

\*\*\*Generalized Wald-test p-value of the null hypothesis that the hazard rate is constant across the Lower, Middle, and Upper tertile groups.

† q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method.

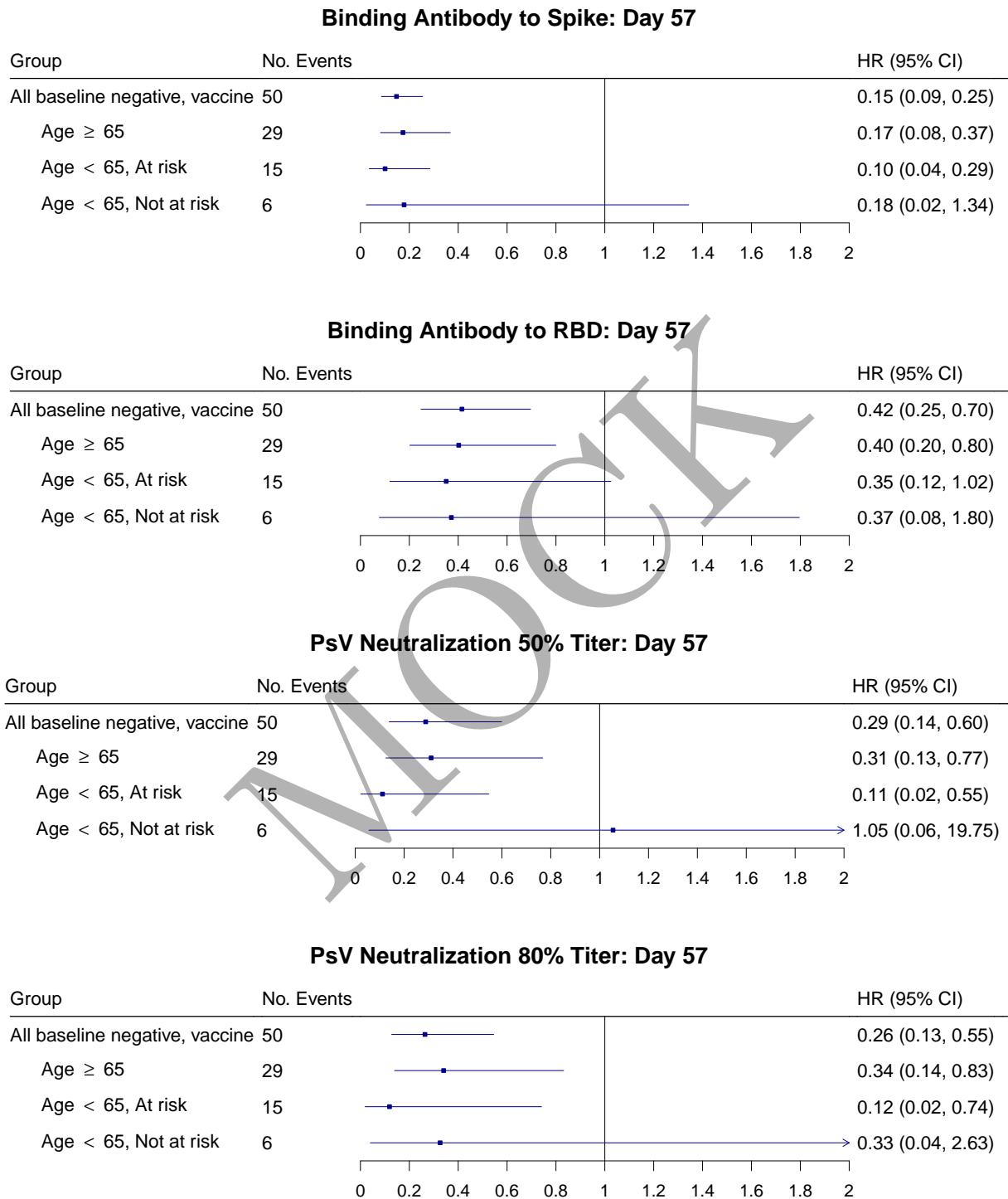


Figure 3.1: Forest plots of hazard ratios per 10-fold increase in the marker among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

### Binding Antibody to Spike: Day 57

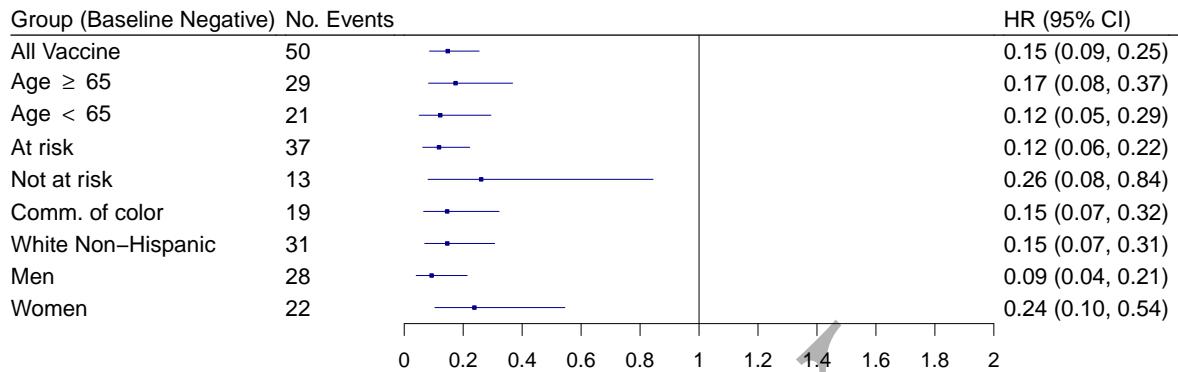


Figure 3.2: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### Binding Antibody to RBD: Day 57

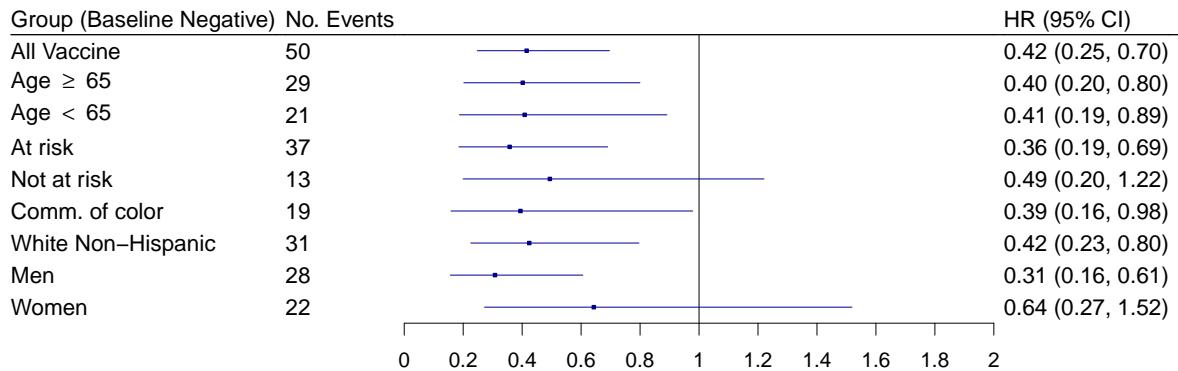


Figure 3.3: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

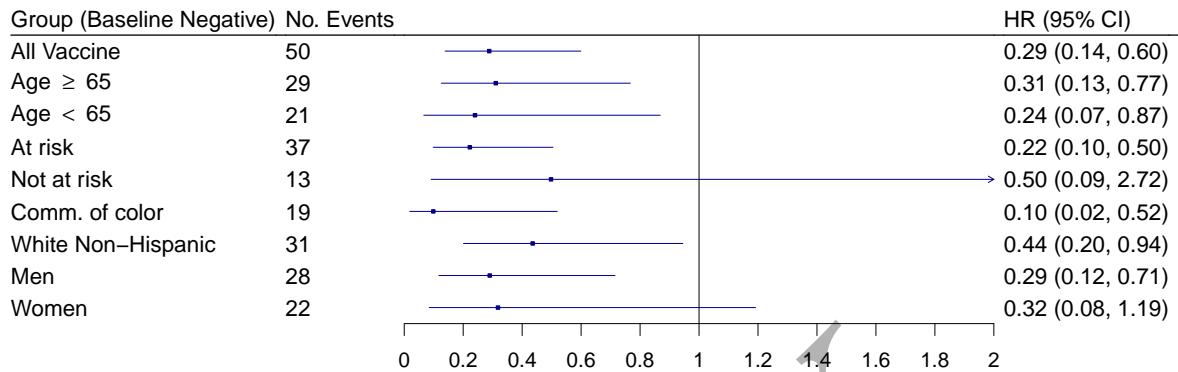
**PsV Neutralization 50% Titer: Day 57**

Figure 3.4: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID50 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

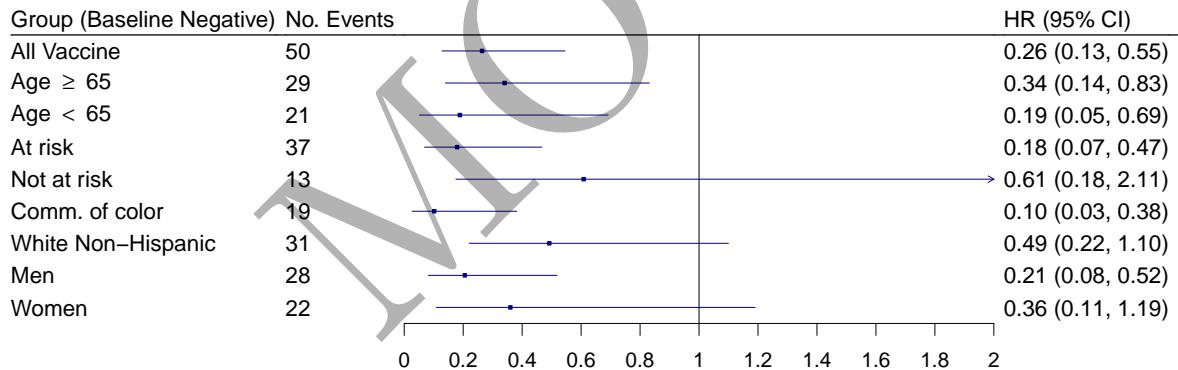
**PsV Neutralization 80% Titer: Day 57**

Figure 3.5: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### 3.2 Marginalized risk and controlled vaccine efficacy plots

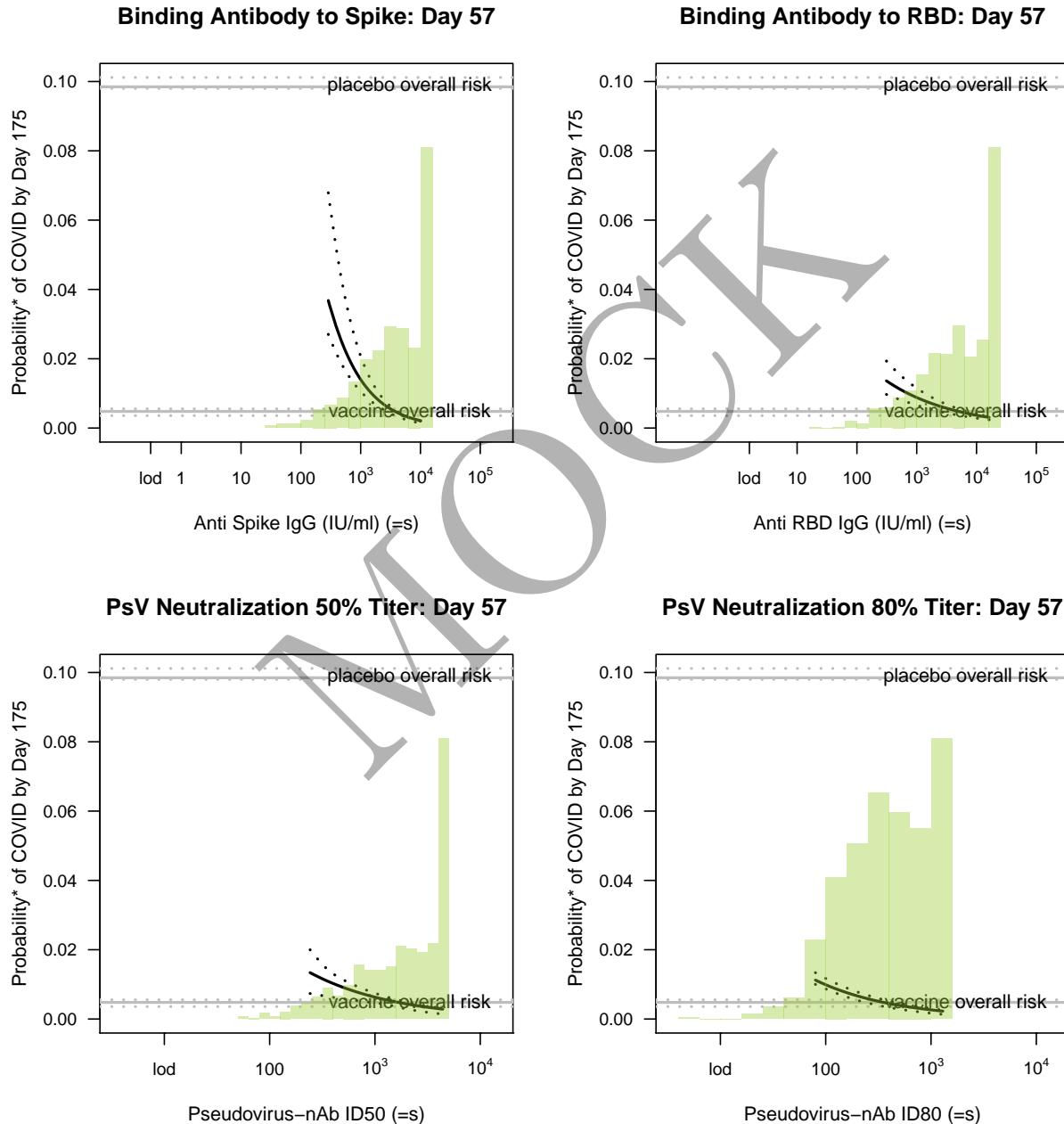


Figure 3.6: Marginalized cumulative risk by Day 175 as functions of Day 57 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 175 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

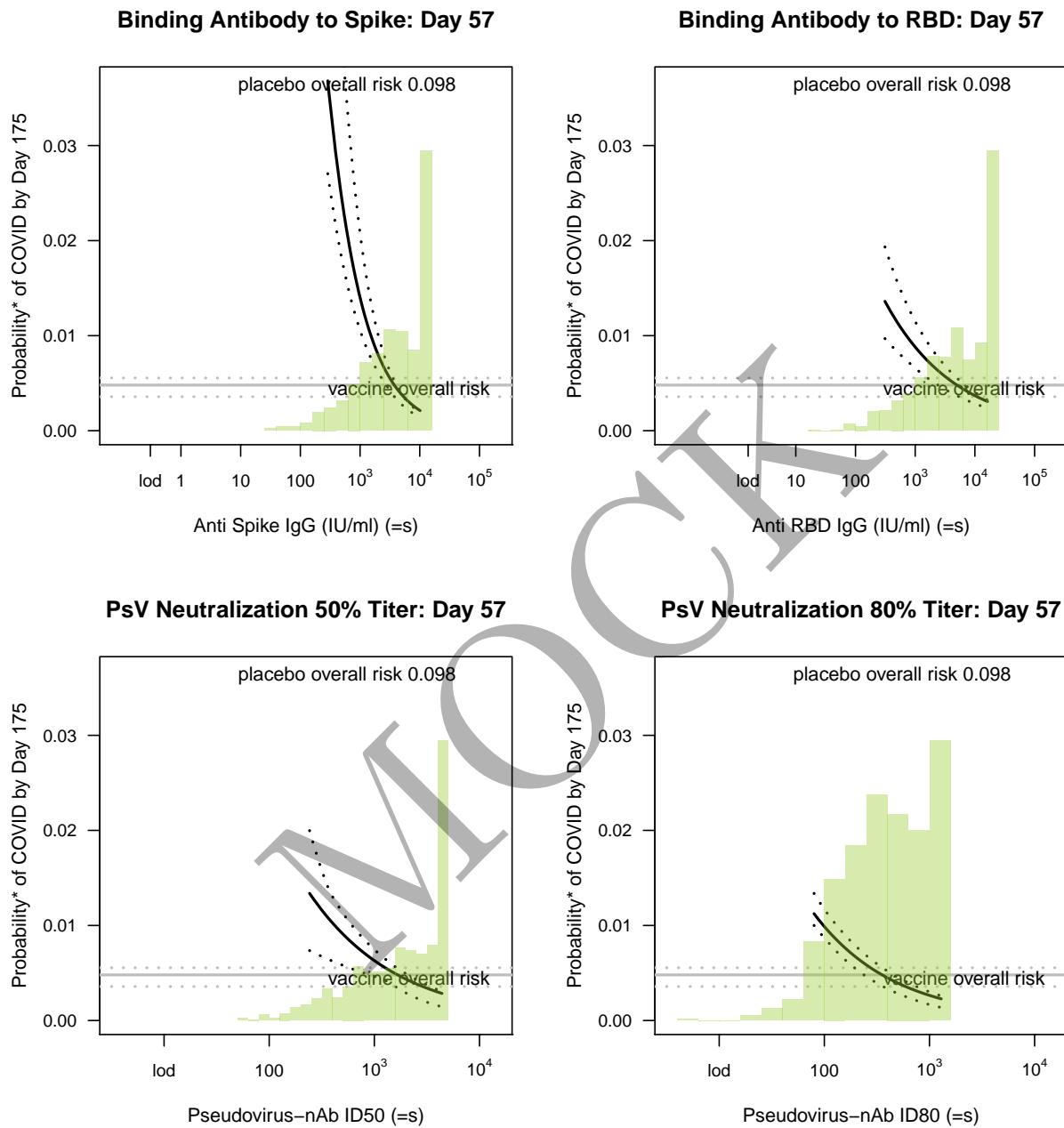


Figure 3.7: Marginalized cumulative risk by Day 175 as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 175 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

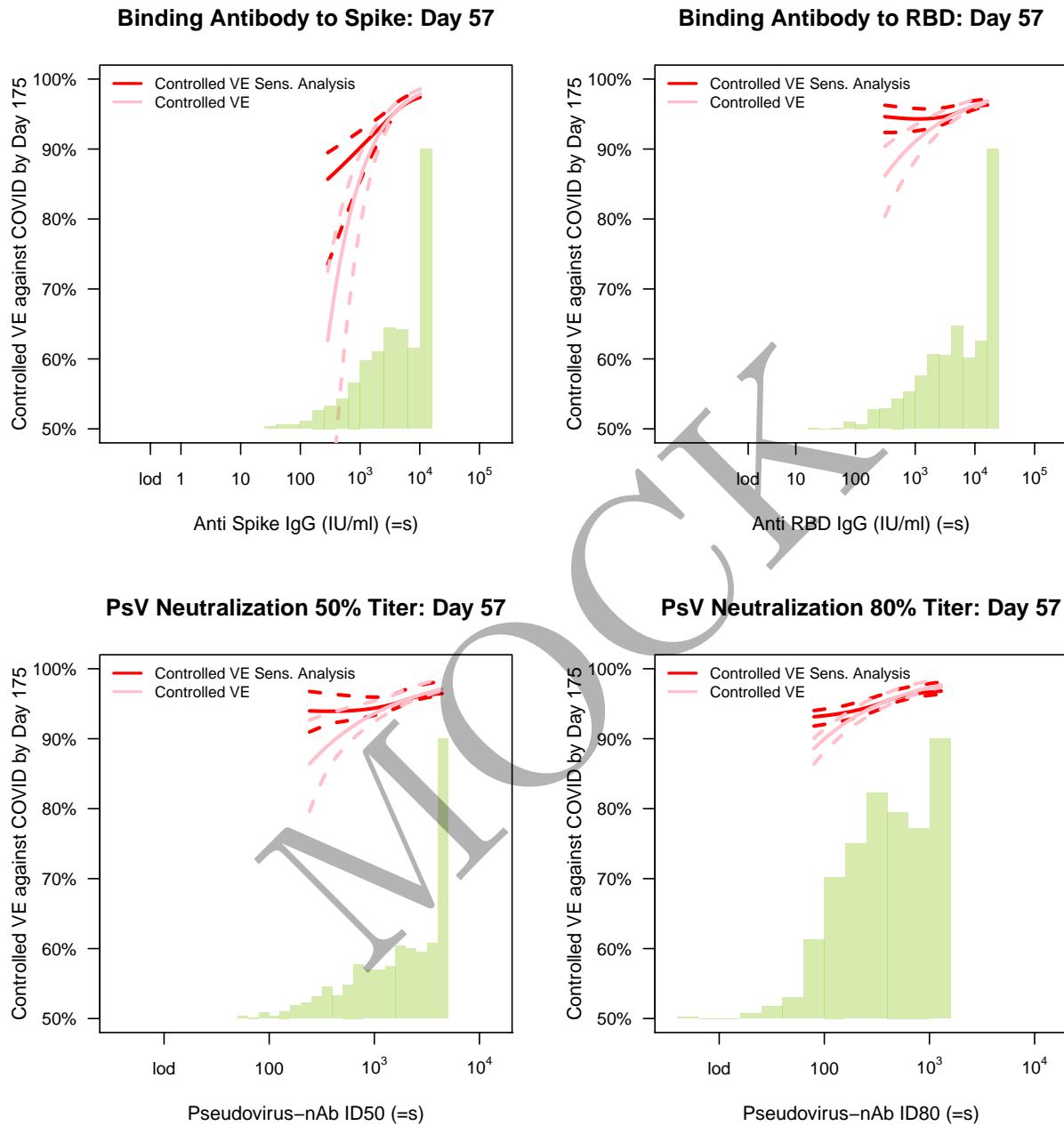


Figure 3.8: Controlled VE with sensitivity analysis as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $lod = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

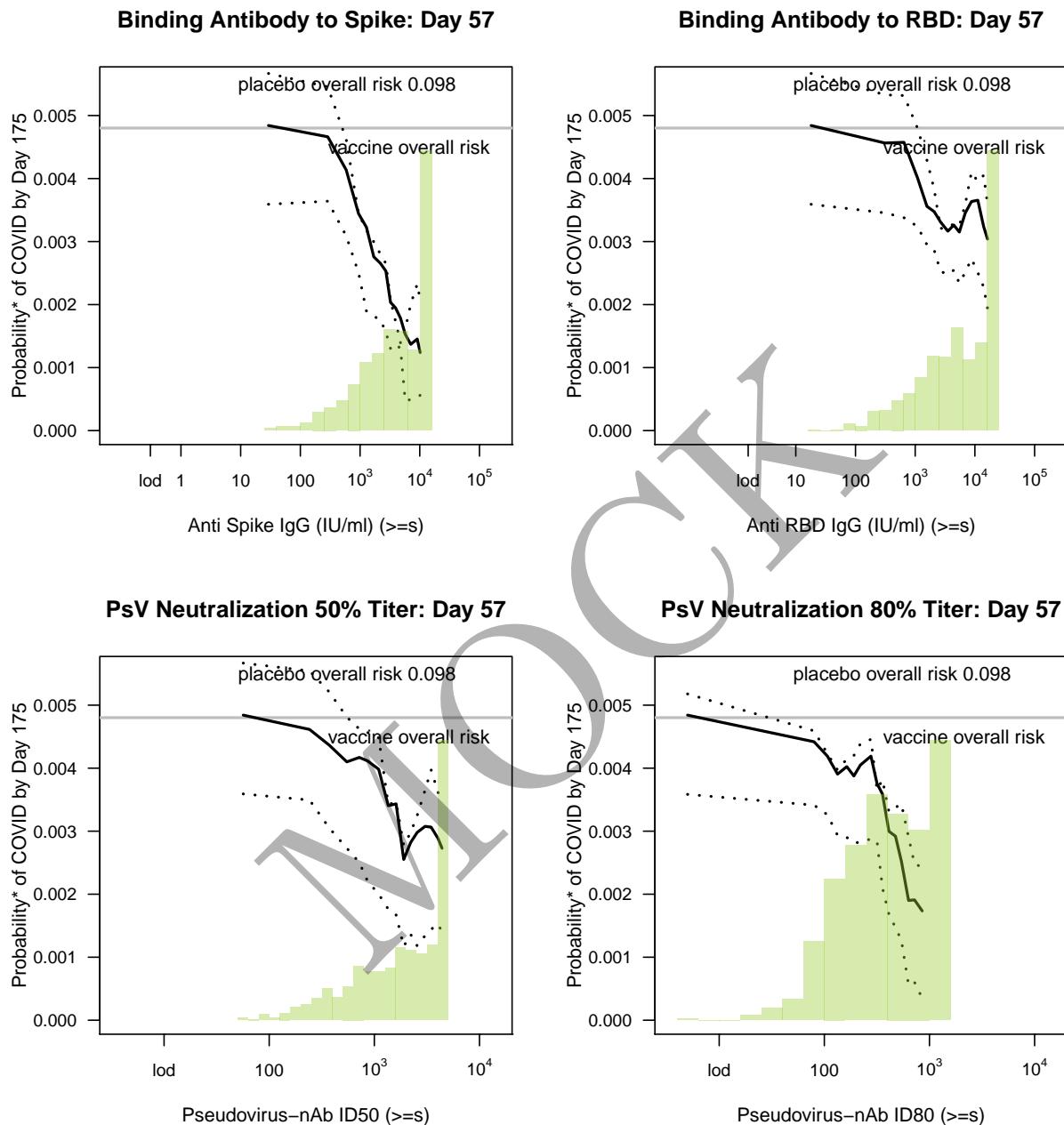


Figure 3.9: Marginalized cumulative risk by Day 175 as functions of Day 57 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 175 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid.  $l_{od} = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

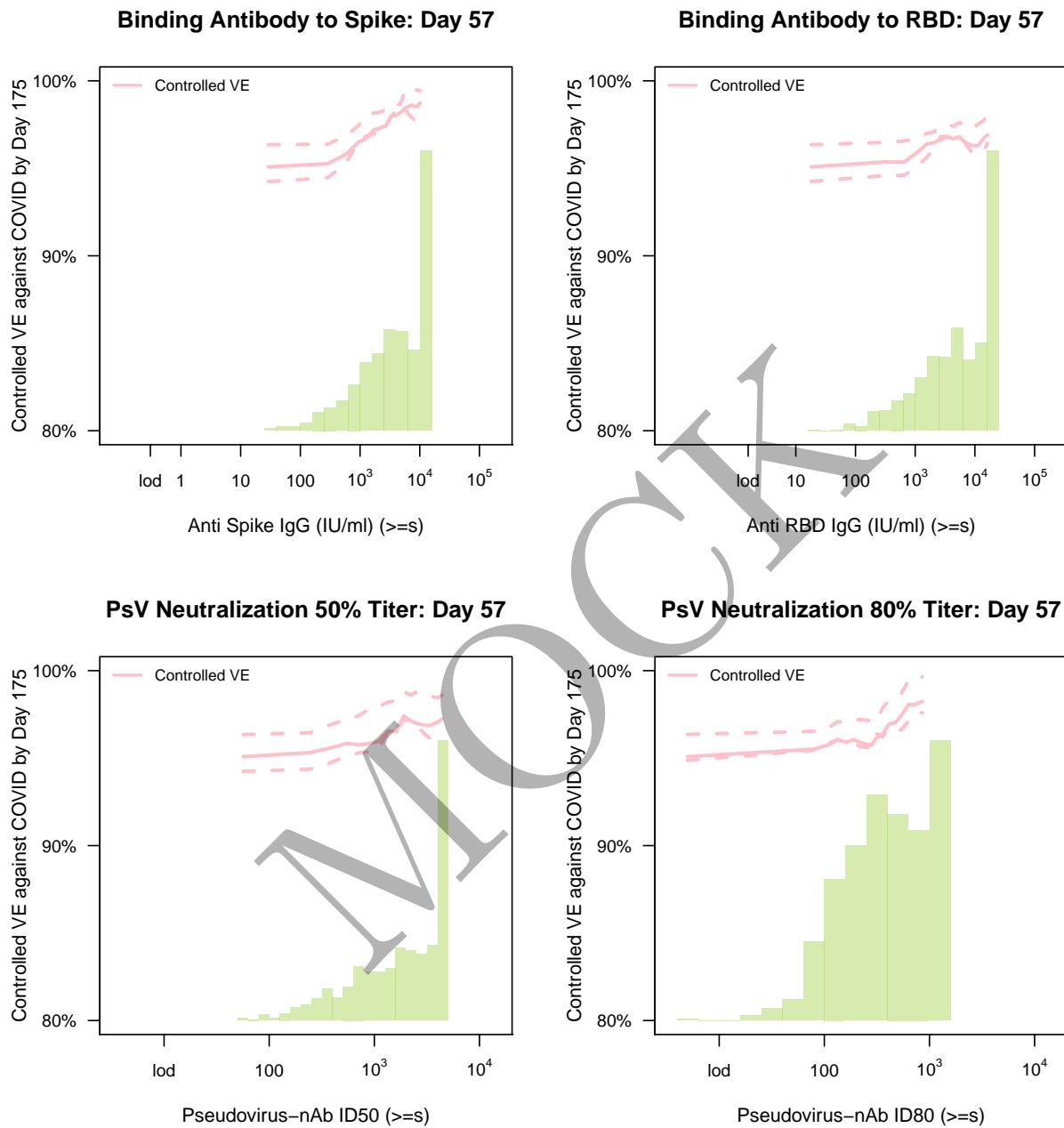


Figure 3.10: Controlled VE as functions of Day 57 markers ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $lod = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

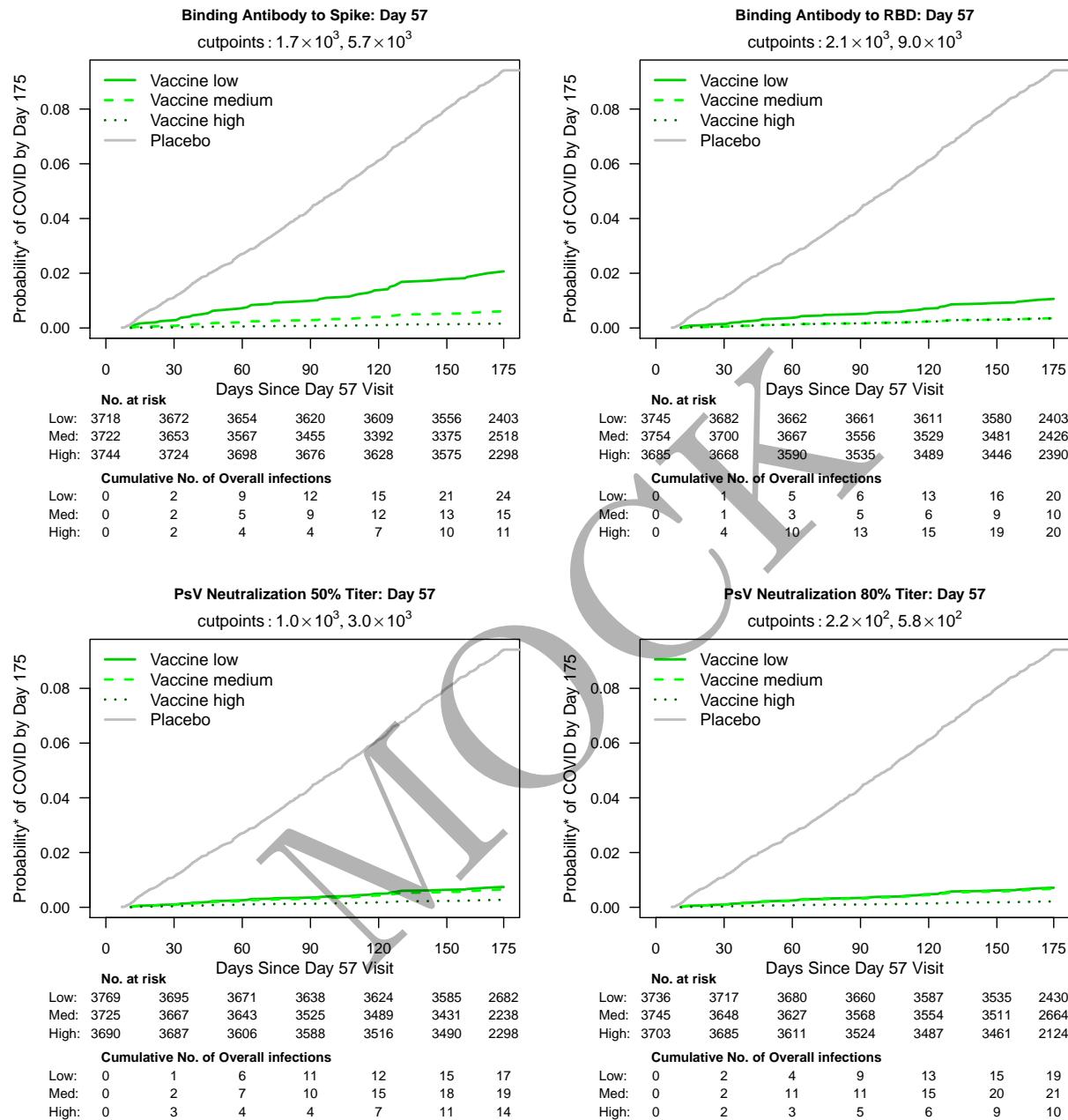


Figure 3.11: Marginalized cumulative incidence rate curves for trichotomized Day 57 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

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# Chapter 4

## Day 29 Univariate CoR: Cox Models of Risk

The main regression model is the Cox proportional hazards model. All plots are made with Cox models fit unless specified otherwise.

### 4.1 Hazard ratios

Inference for Day 29 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group:  
Hazard ratios per 10-fold increment in the marker\*

Mock Immunologic Marker	No. cases / No. at-risk**	HR per 10-fold incr. Pt. Est.	95% CI	P-value (2-sided)	q-value ***	FWER
Anti Spike IgG (IU/ml)	58/11,231	0.28	(0.16-0.49)	<0.001	<0.001	<0.001
Anti RBD IgG (IU/ml)	58/11,231	0.49	(0.29-0.83)	0.008	<0.001	<0.001
Pseudovirus-nAb ID50	58/11,231	0.26	(0.13-0.53)	<0.001	<0.001	<0.001
Pseudovirus-nAb ID80	58/11,231	0.20	(0.10-0.43)	<0.001	<0.001	<0.001

\*Baseline covariates adjusted for: baseline risk score, at risk or not, community of color or not. Maximum failure event time 203 days.

\*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID; no. cases = number of this cohort with an observed COVID endpoints starting 7 days post Day 29 visit.

\*\*\*q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method.

Inference for Day 29 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group:  
Hazard ratios for Middle vs. Upper tertile vs. Lower tertile\*

Mock Immunologic Marker	Tertile	No. cases / No. at-risk**	Attack rate	Haz. Ratio Pt. Est.	95% CI	P-value (2-sided)	Overall P- value***	Overall q- value †	Overall FWER
Anti Spike IgG (IU/ml)	Lower	21/3,745	0.0056	1	N/A	N/A	0.002	<0.001	<0.001
	Middle	19/3,742	0.0051	0.48	(0.23-1.01)	0.052			
	Upper	18/3,744	0.0048	0.23	(0.10-0.52)	<0.001			
Anti RBD IgG (IU/ml)	Lower	24/3,753	0.0064	1	N/A	N/A	0.002	<0.001	<0.001
	Middle	14/3,749	0.0037	0.35	(0.17-0.72)	0.004			
	Upper	20/3,728	0.0054	0.31	(0.14-0.65)	0.002			
Pseudovirus-nAb ID50	Lower	23/3,774	0.0061	1	N/A	N/A	0.010	<0.001	<0.001
	Middle	16/3,713	0.0043	0.52	(0.26-1.05)	0.070			
	Upper	19/3,744	0.0051	0.30	(0.14-0.66)	0.003			
Pseudovirus-nAb ID80	Lower	23/3,768	0.0061	1	N/A	N/A	0.001	<0.001	<0.001
	Middle	24/3,720	0.0065	0.81	(0.43-1.50)	0.497			
	Upper	11/3,742	0.0029	0.22	(0.10-0.50)	<0.001			
Placebo		1169/11,514	0.1015						

\*Baseline covariates adjusted for: baseline risk score, at risk or not, community of color or not. Maximum failure event time 203 days. Cutpoints: Anti Spike IgG (IU/ml) [2.1, 2.64], Anti RBD IgG (IU/ml) [2.31, 2.96], Pseudovirus-nAb ID50 [1.65, 1.98], Pseudovirus-nAb ID80 [1.11, 1.41].

\*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 29 visit; no. cases = number of this cohort with an observed COVID endpoints.

\*\*\*Generalized Wald-test p-value of the null hypothesis that the hazard rate is constant across the Lower, Middle, and Upper tertile groups.

† q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method.

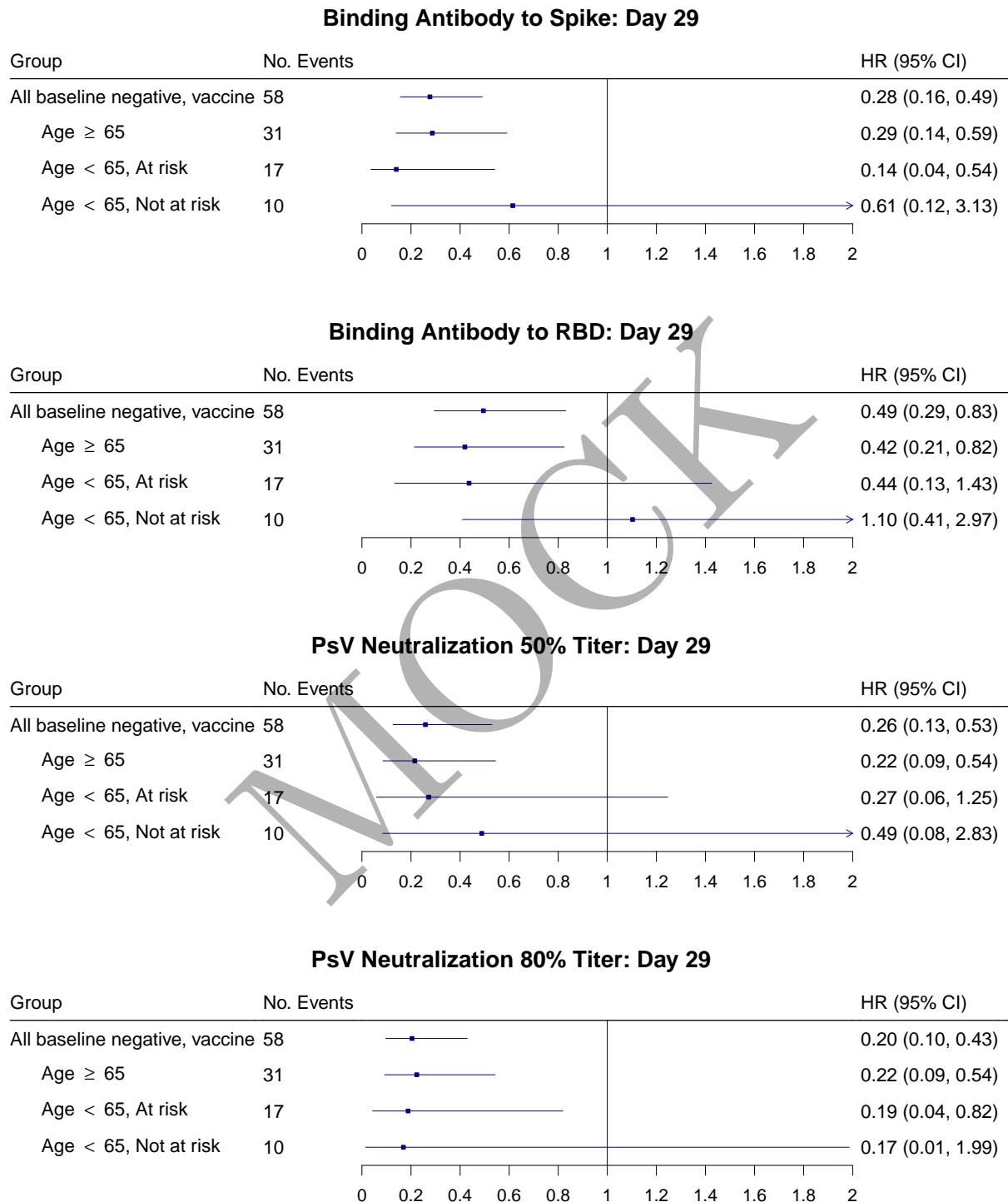


Figure 4.1: Forest plots of hazard ratios per 10-fold increase in the marker among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

### Binding Antibody to Spike: Day 29

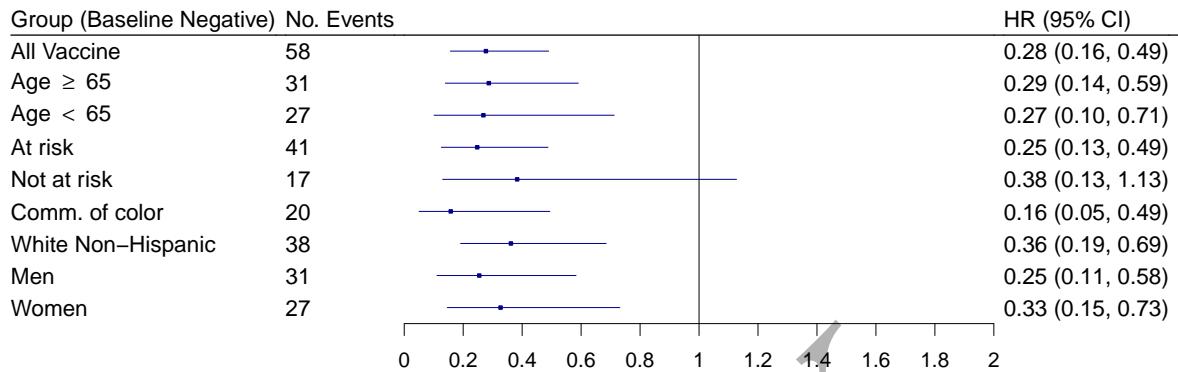


Figure 4.2: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### Binding Antibody to RBD: Day 29

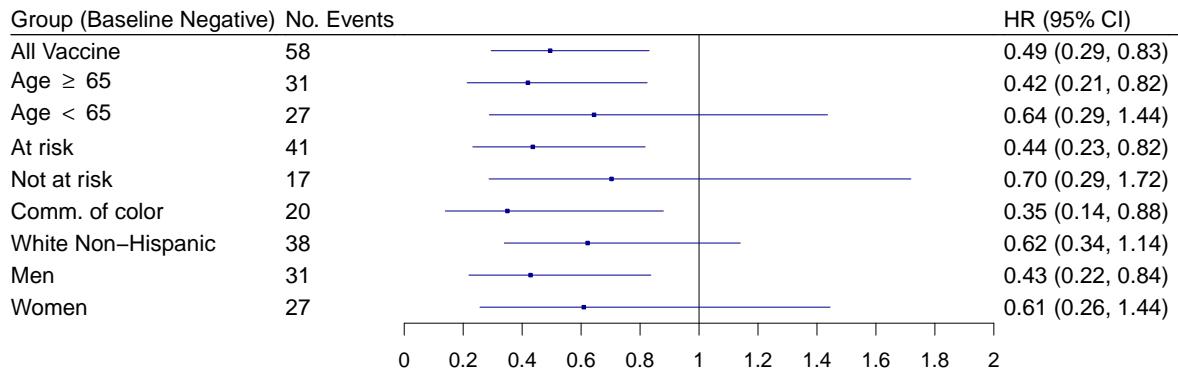


Figure 4.3: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### PsV Neutralization 50% Titer: Day 29

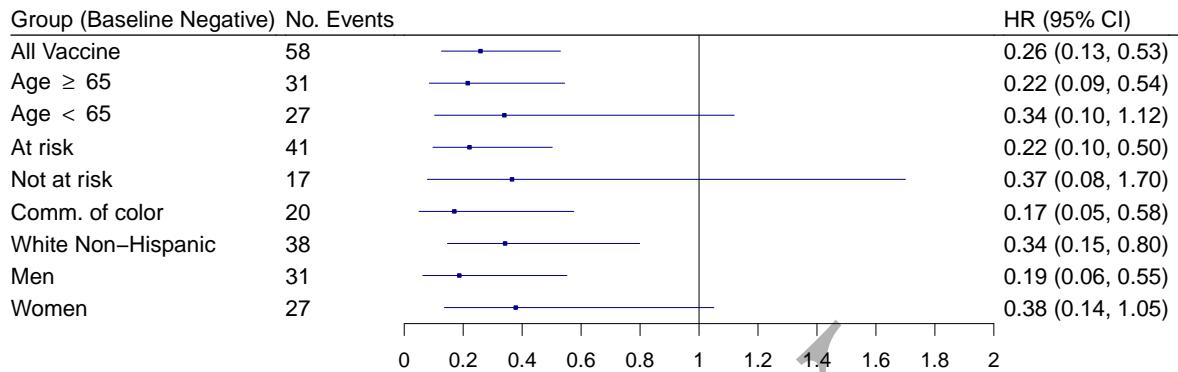


Figure 4.4: Forest plots of hazard ratios per 10-fold increase in the Day 29 pseudo neut ID50 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### PsV Neutralization 80% Titer: Day 29

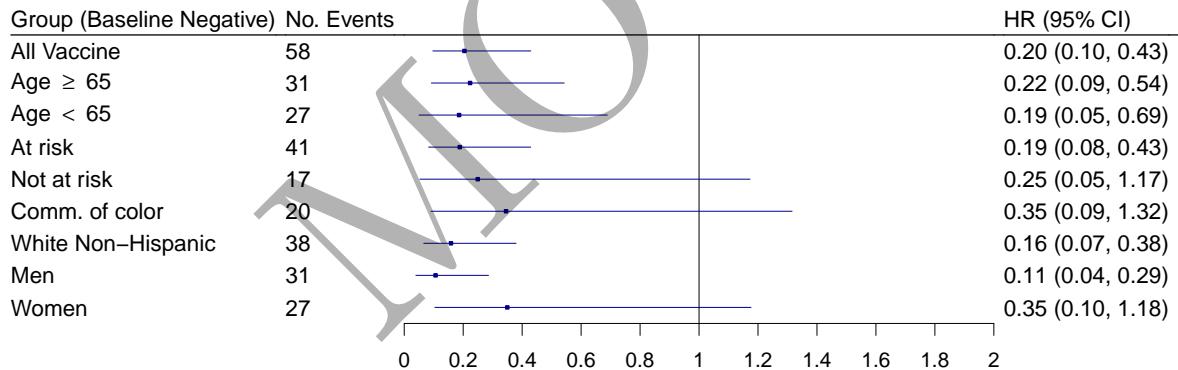


Figure 4.5: Forest plots of hazard ratios per 10-fold increase in the Day 29 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

## 4.2 Marginalized risk and controlled vaccine efficacy plots

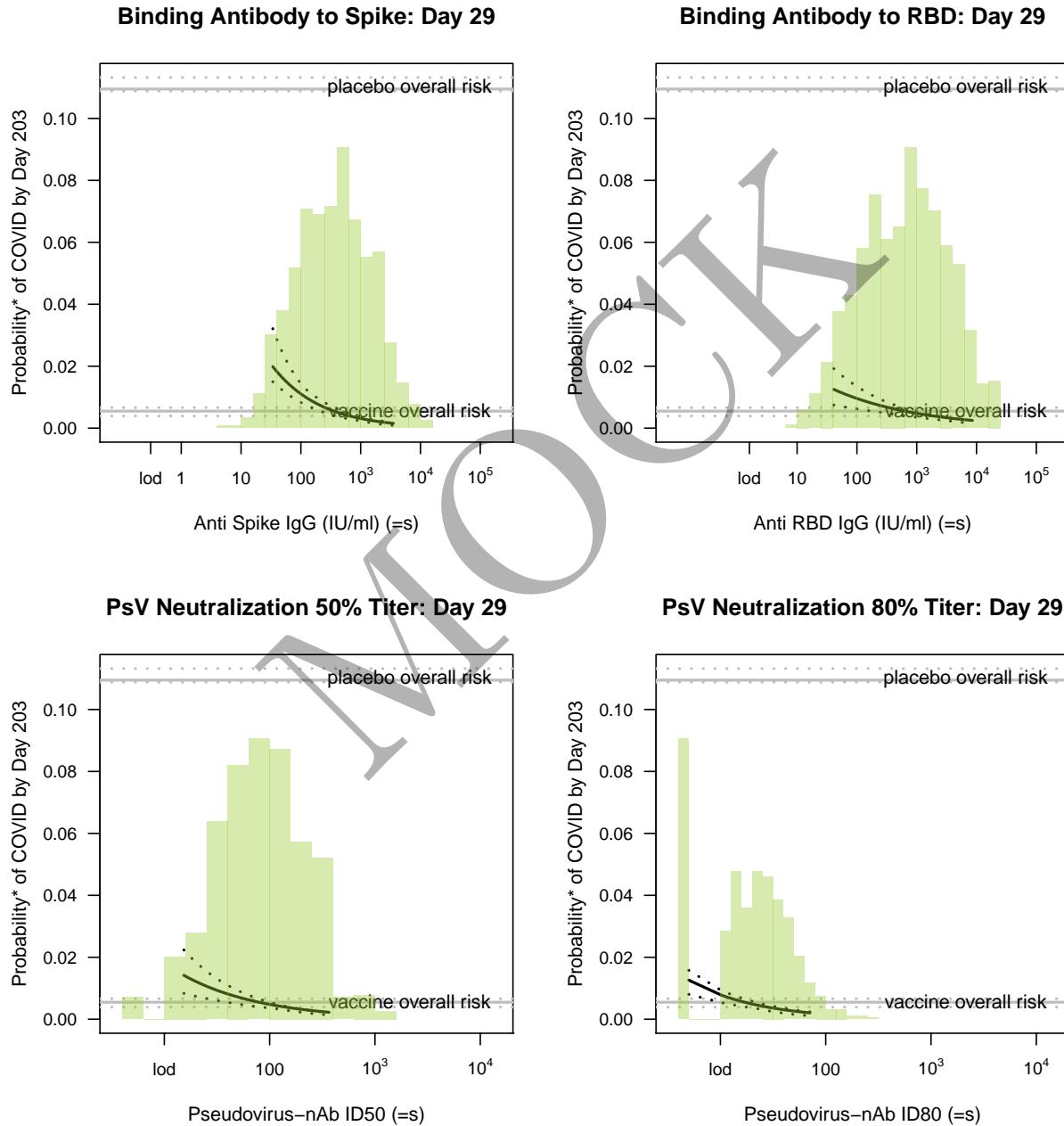


Figure 4.6: Marginalized cumulative risk by Day 203 as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 203 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

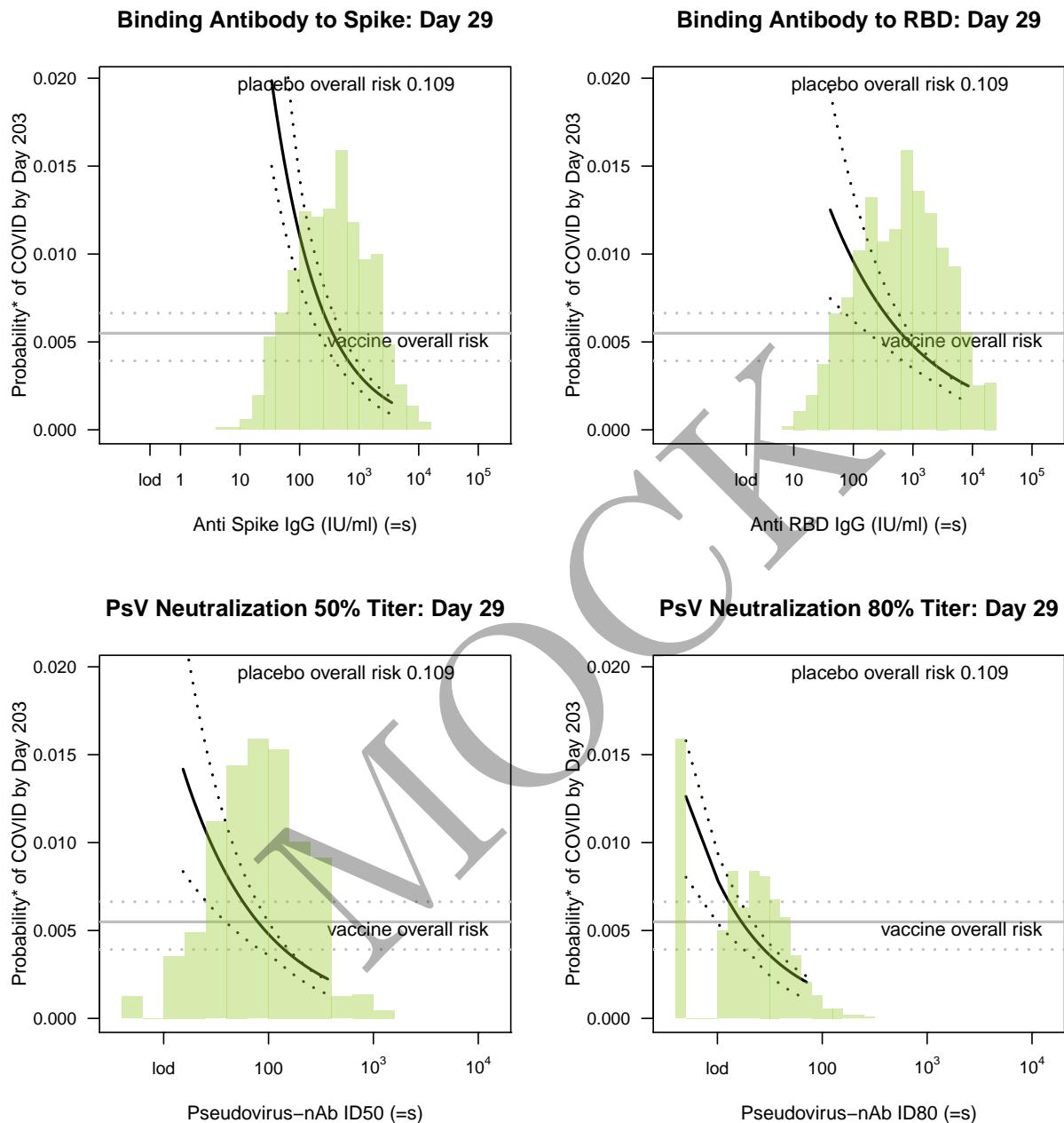


Figure 4.7: Marginalized cumulative risk by Day 203 as functions of Day 29 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 203 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

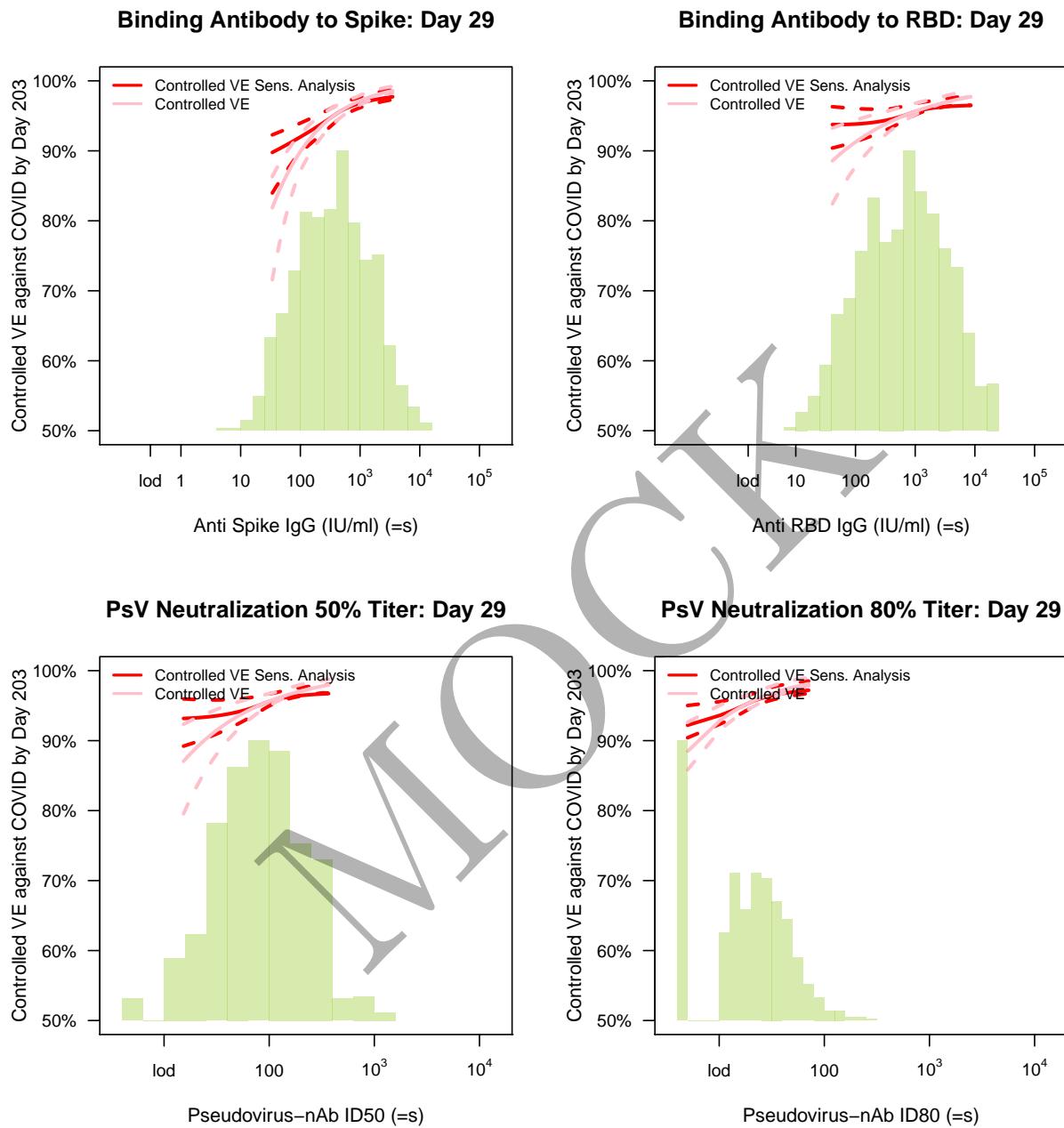


Figure 4.8: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

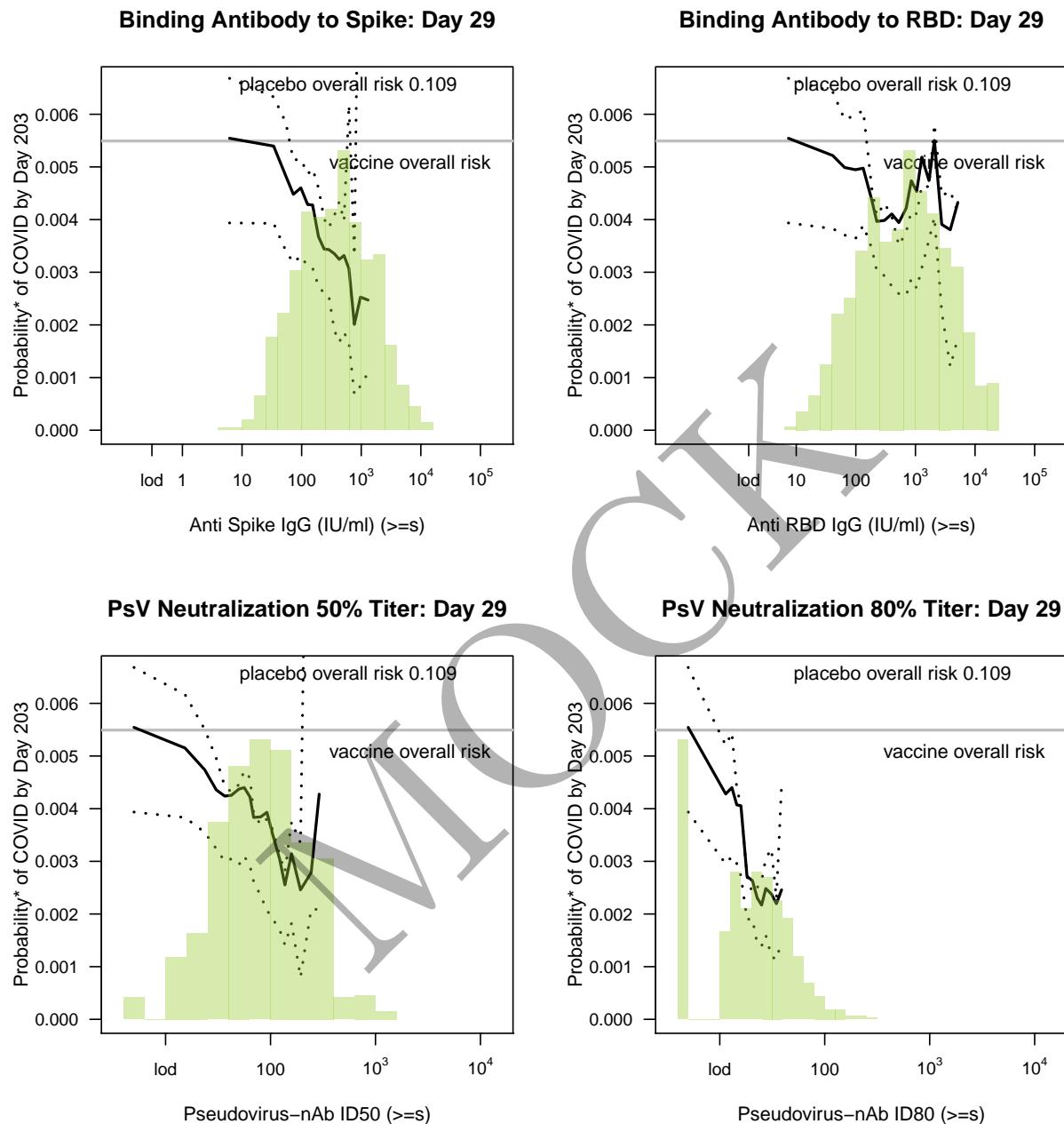


Figure 4.9: Marginalized cumulative risk by Day 203 as functions of Day 29 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 203 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid.  $l_{od} = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

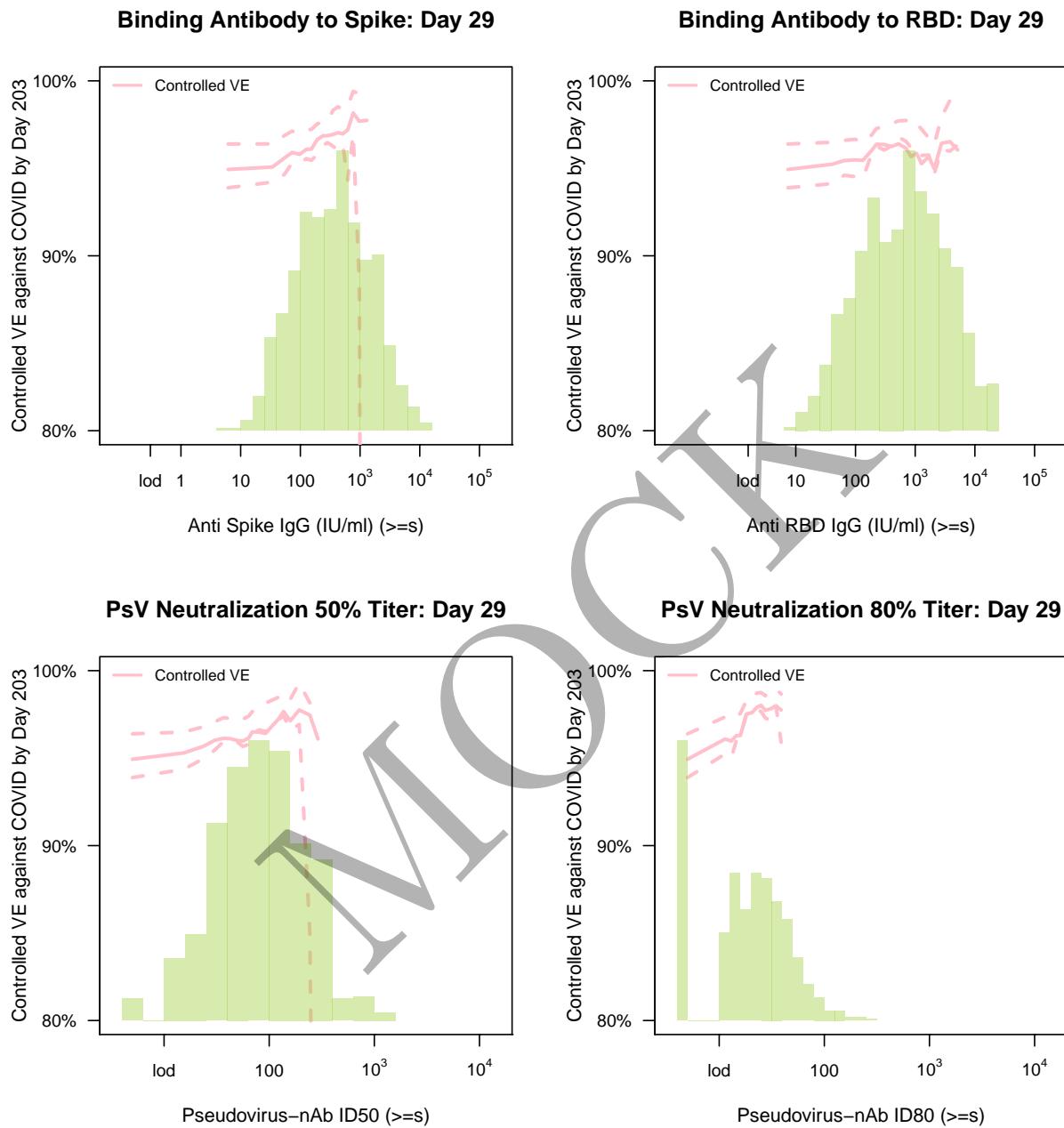


Figure 4.10: Controlled VE as functions of Day 29 markers ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $l_{od} = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

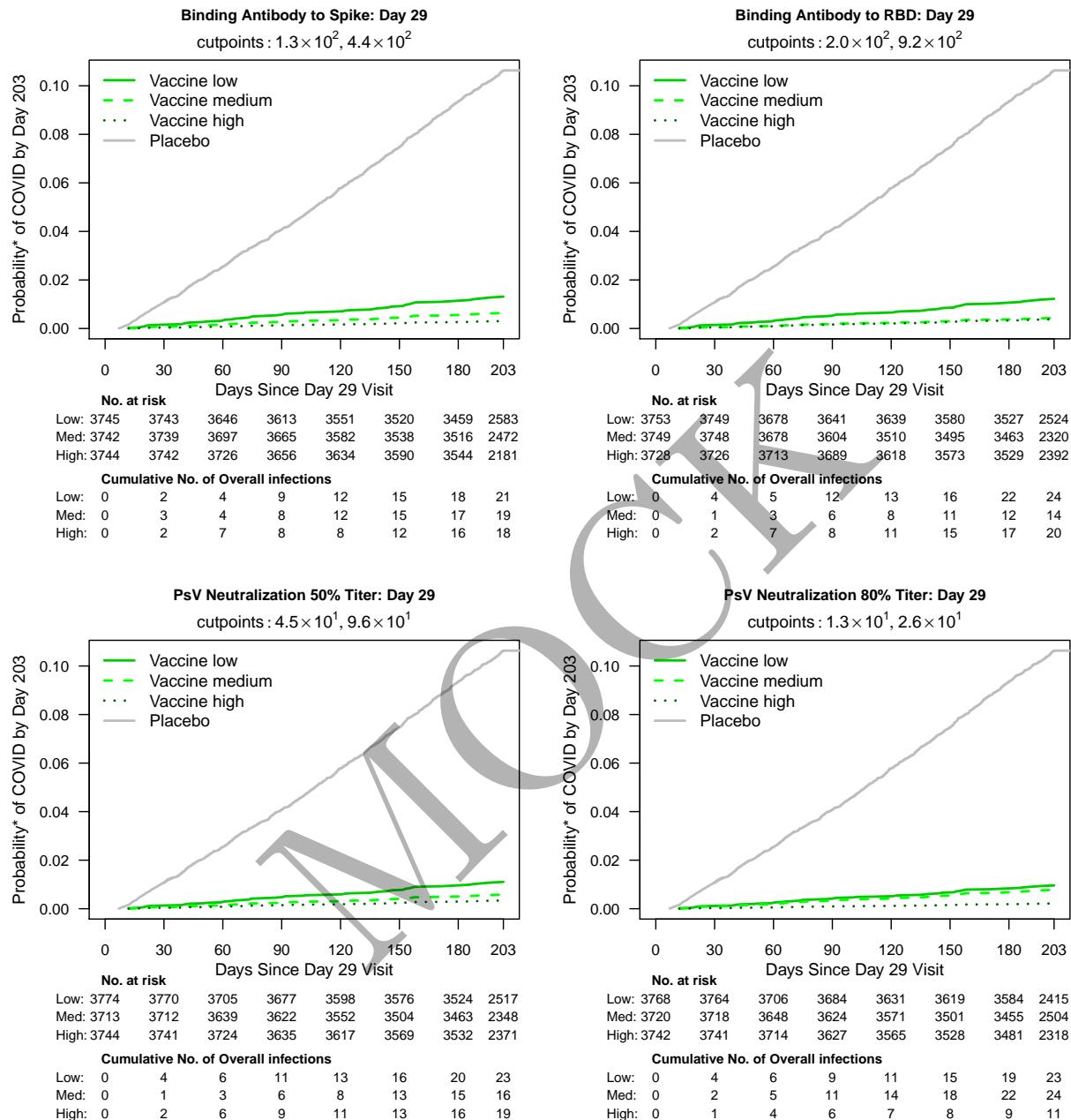


Figure 4.11: Marginalized cumulative incidence rate curves for trichotomized Day 29 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

MOCK

## Chapter 5

# Univariate CoR: Nonparametric Threshold Modeling {#cor-threshold} (>=s)

An extension of the unadjusted nonparametric threshold-searching approach developed in Donovan, Hudgens, and Gilbert (2019), the covariate-adjusted TMLE-based approach developed by van der Laan, Zhang, Gilbert (submitted) is used to estimate the so-called threshold-response function  $E_X[E[Y | S \geq s, X, A = 1] | A = 1]$  for a range of thresholds  $s$ . Here,  $X$  is a set of baseline characteristics,  $A = 1$  represents the vaccine group,  $S$  is the biomarker/immune-response/correlate of interest, and  $Y$  is the indicator of COVID disease before some time point  $t_f$ . This parameter can be viewed as a causal/covariate-adjusted version of the parameter  $P(Y = 1 | S \geq s, A = 1)$ . Intuitively, the threshold-response at a given threshold is the expected probability of obtaining COVID disease if one experiences a marker/immune-response value above that threshold. The threshold-response function is estimated for each of the four Day 57 antibody markers, in each case adjusting for the baseline covariates: baseline risk score, high risk indicator, and underrepresented minority status. A parametric learner, selected via cross-validation, is used for the covariate adjustment. A number of plots and tables are reported:

1. A plot and table with risk estimates and point-wise 95% confidence intervals
2. A plot and table with risk estimates and simultaneous 95% confidence bands
3. Monotone-corrected versions of 1 and 2.

A reverse cumulative distribution function curve estimated by the IPW NPMLE of the marker values is superimposed on the threshold-response plots and a dashed red line is added to mark the threshold value after which no more events are observed.

## 5.1 Plots and Tables with estimates and pointwise confidence interval for Day 57

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### 5.1.1 Day 57 Spike protein binding antibody

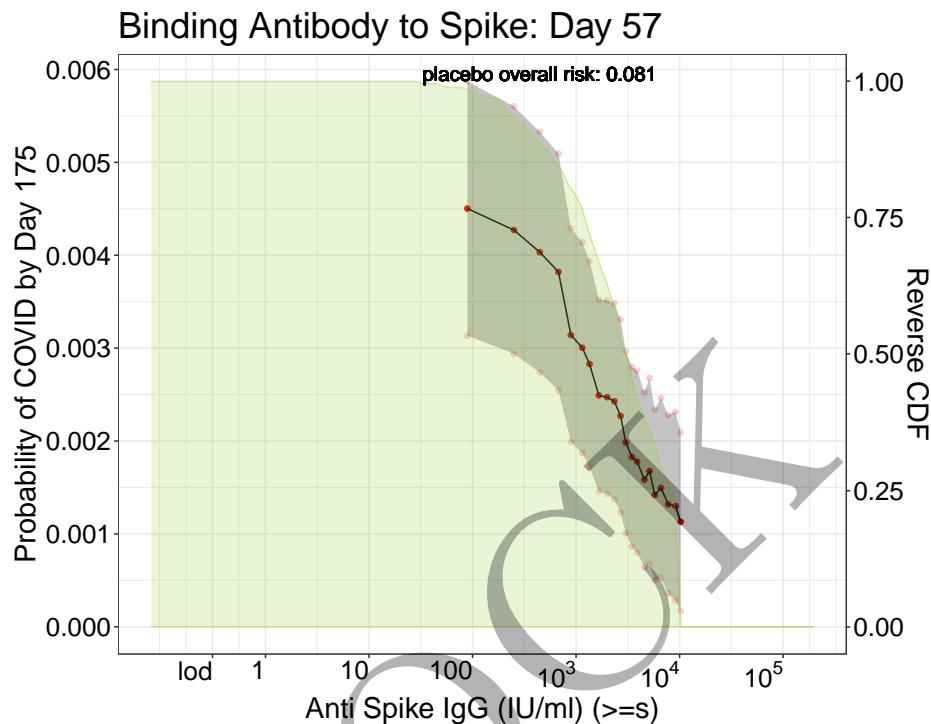


Figure 5.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.00450	0.00313	0.00587
2.653	$4.50 * 10^2$	0.00403	0.00274	0.00533
2.953	$8.97 * 10^2$	0.00314	0.00199	0.00429
3.221	$1.66 * 10^3$	0.00249	0.00146	0.00352
3.365	$2.32 * 10^3$	0.00243	0.00137	0.00348
3.483	$3.04 * 10^3$	0.00198	0.00101	0.00296
3.595	$3.94 * 10^3$	0.00178	0.00080	0.00276
3.757	$5.71 * 10^3$	0.00142	0.00050	0.00234
3.894	$7.83 * 10^3$	0.00132	0.00036	0.00228
4.007	$1.02 * 10^4$	0.00113	0.00017	0.00209

### 5.1.2 Day 57 RBD binding antibody

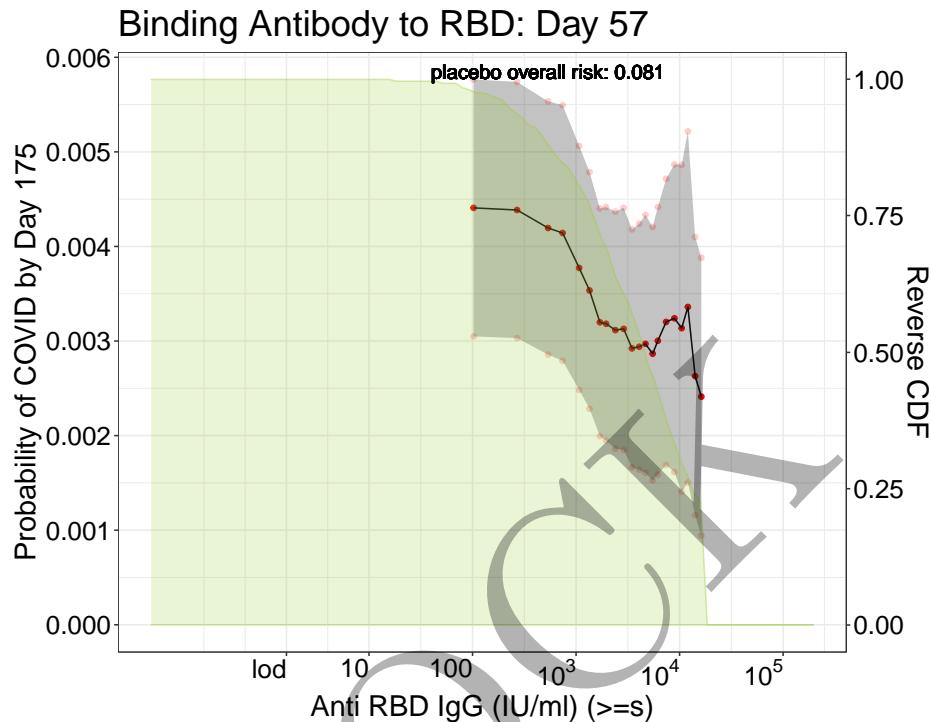


Figure 5.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.00441	0.00305	0.00577
2.727	$5.33 * 10^2$	0.00420	0.00286	0.00553
3.032	$1.08 * 10^3$	0.00377	0.00248	0.00506
3.295	$1.97 * 10^3$	0.00318	0.00195	0.00442
3.462	$2.90 * 10^3$	0.00313	0.00185	0.00441
3.615	$4.12 * 10^3$	0.00294	0.00164	0.00424
3.739	$5.48 * 10^3$	0.00287	0.00152	0.00421
3.946	$8.83 * 10^3$	0.00324	0.00161	0.00487
4.079	$1.20 * 10^4$	0.00336	0.00151	0.00522
4.211	$1.63 * 10^4$	0.00241	0.00094	0.00388

### 5.1.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

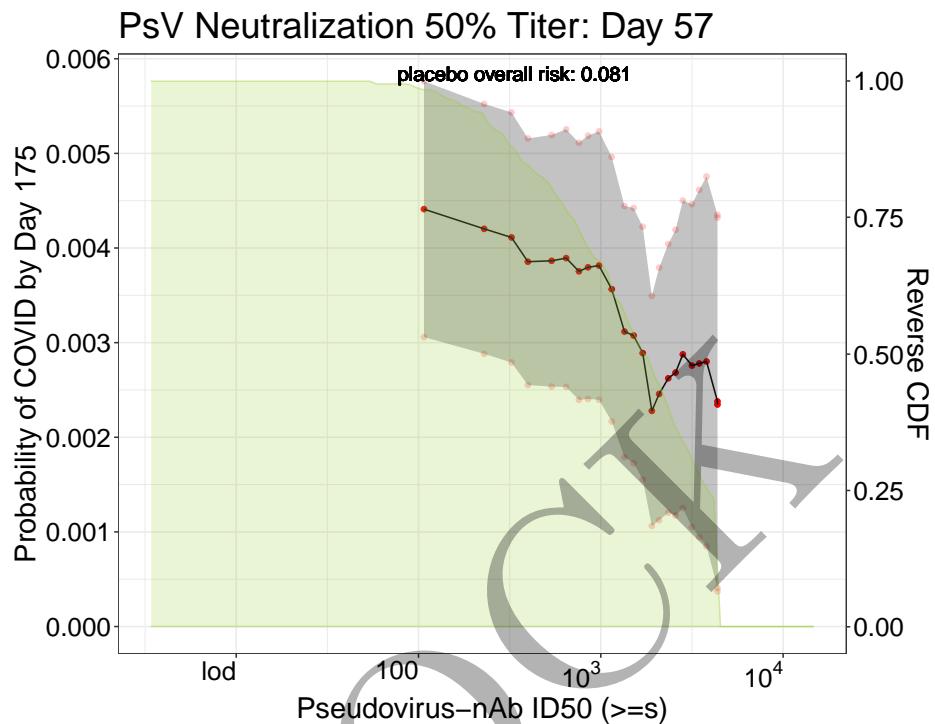


Figure 5.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.00441	0.00306	0.00576
2.509	$3.23 * 10^2$	0.00411	0.00279	0.00543
2.814	$6.52 * 10^2$	0.00389	0.00253	0.00525
2.931	$8.53 * 10^2$	0.00380	0.00240	0.00519
3.132	$1.36 * 10^3$	0.00312	0.00179	0.00444
3.234	$1.71 * 10^3$	0.00289	0.00155	0.00423
3.367	$2.33 * 10^3$	0.00262	0.00120	0.00404
3.455	$2.85 * 10^3$	0.00288	0.00125	0.00450
3.583	$3.83 * 10^3$	0.00280	0.00085	0.00476
3.644	$4.41 * 10^3$	0.00235	0.00037	0.00432

### 5.1.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

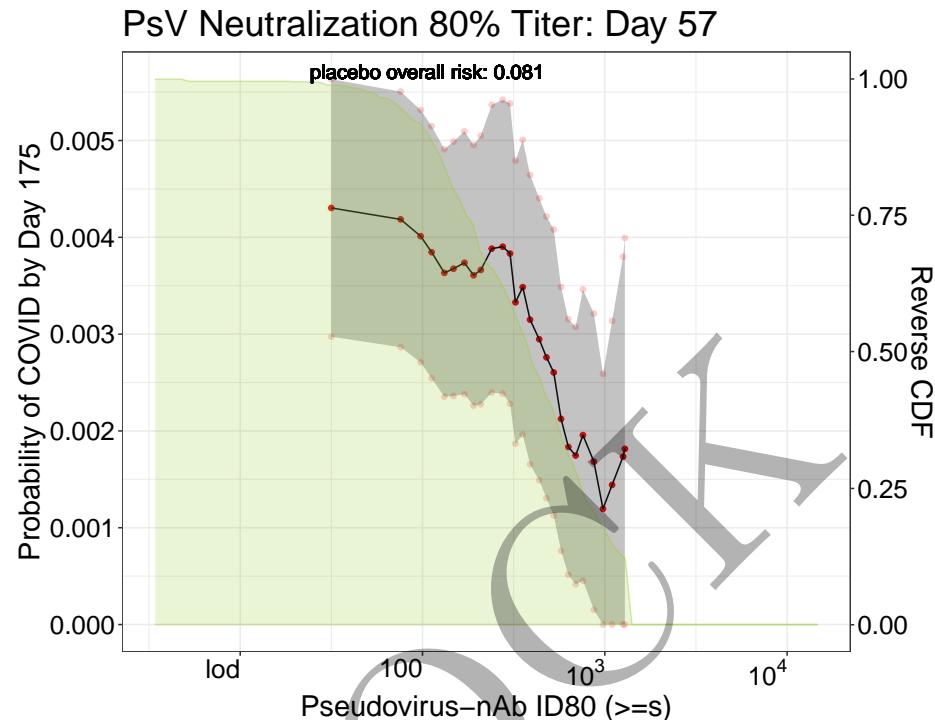


Figure 5.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.00430	0.00297	0.00563
2.048	$1.12 * 10^2$	0.00385	0.00254	0.00515
2.230	$1.70 * 10^2$	0.00374	0.00238	0.00509
2.379	$2.39 * 10^2$	0.00388	0.00240	0.00537
2.515	$3.27 * 10^2$	0.00333	0.00187	0.00479
2.588	$3.87 * 10^2$	0.00315	0.00166	0.00464
2.719	$5.24 * 10^2$	0.00260	0.00113	0.00408
2.836	$6.85 * 10^2$	0.00175	0.00042	0.00308
2.994	$9.86 * 10^2$	0.00120	0.00000	0.00259
3.112	$1.29 * 10^3$	0.00181	0.00000	0.00399

## 5.2 Plots and Tables with estimates and pointwise confidence intervals for Day 29

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### 5.2.1 Day 29 Spike protein antibody

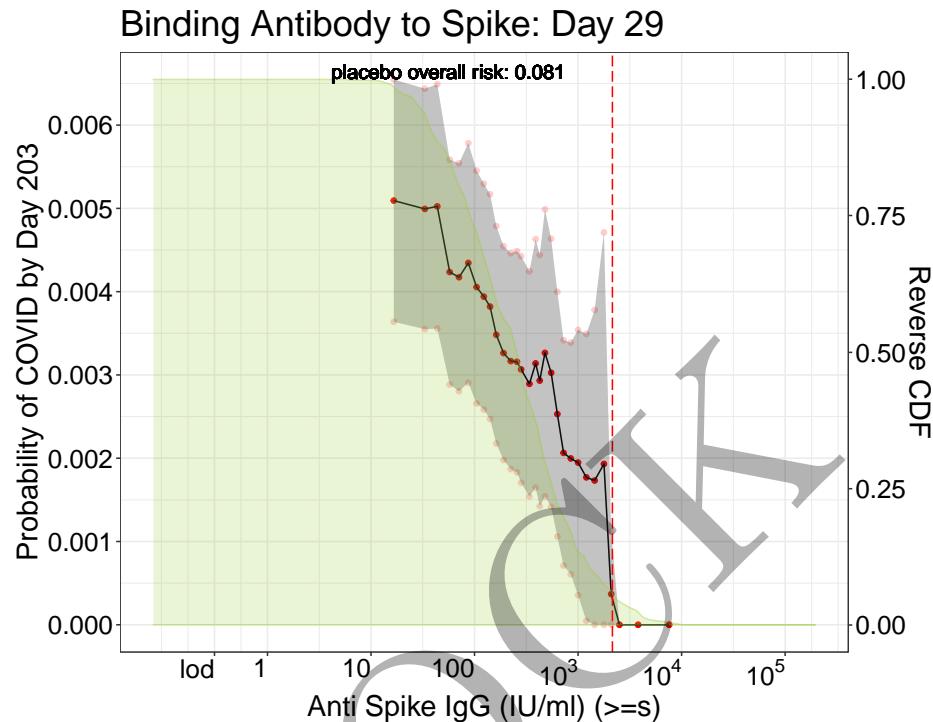


Figure 5.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 \times 10^1$	0.00509	0.00364	0.00655
1.756	$5.70 \times 10^1$	0.00424	0.00289	0.00559
2.024	$1.06 \times 10^2$	0.00405	0.00266	0.00545
2.281	$1.91 \times 10^2$	0.00326	0.00198	0.00455
2.454	$2.84 \times 10^2$	0.00307	0.00171	0.00443
2.632	$4.29 \times 10^2$	0.00293	0.00142	0.00444
2.797	$6.27 \times 10^2$	0.00253	0.00106	0.00400
3.078	$1.20 \times 10^3$	0.00177	0.00005	0.00349
3.321	$2.09 \times 10^3$	0.00037	0.00000	0.00112
3.882	$7.62 \times 10^3$	0.00000	0.00000	NA

### 5.2.2 Day 29 RBD binding antibody

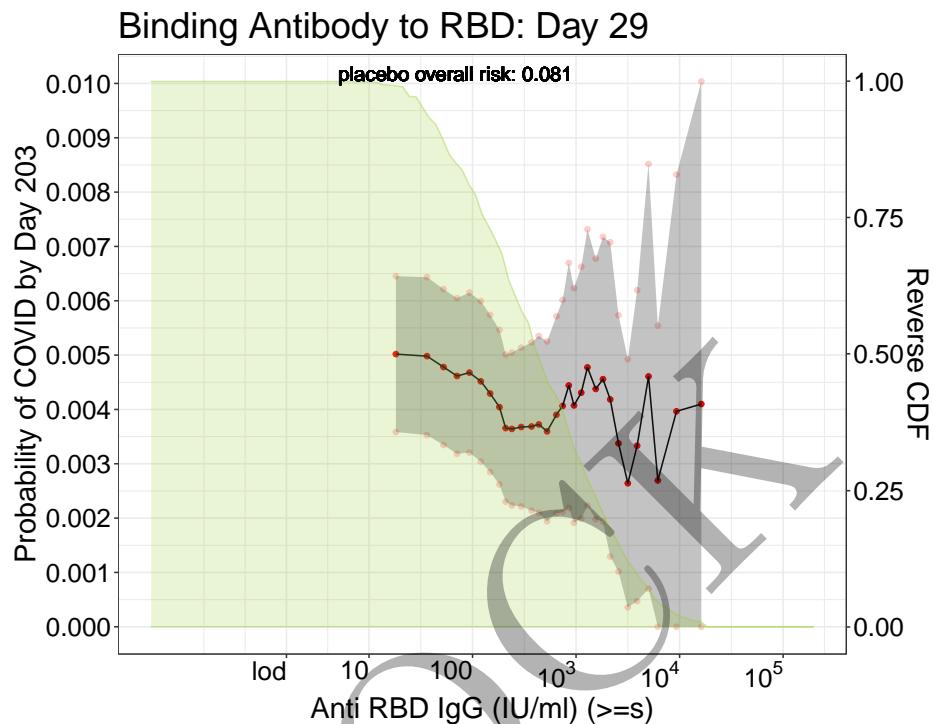


Figure 5.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.00502	0.00358	0.00645
1.854	$7.14 * 10^1$	0.00462	0.00318	0.00605
2.173	$1.49 * 10^2$	0.00429	0.00285	0.00574
2.475	$2.99 * 10^2$	0.00368	0.00222	0.00514
2.720	$5.25 * 10^2$	0.00360	0.00194	0.00525
2.931	$8.53 * 10^2$	0.00444	0.00219	0.00670
3.109	$1.29 * 10^3$	0.00477	0.00223	0.00732
3.410	$2.57 * 10^3$	0.00338	0.00102	0.00573
3.695	$4.95 * 10^3$	0.00461	0.00070	0.00852
4.211	$1.63 * 10^4$	0.00410	0.00000	0.01501

### 5.2.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

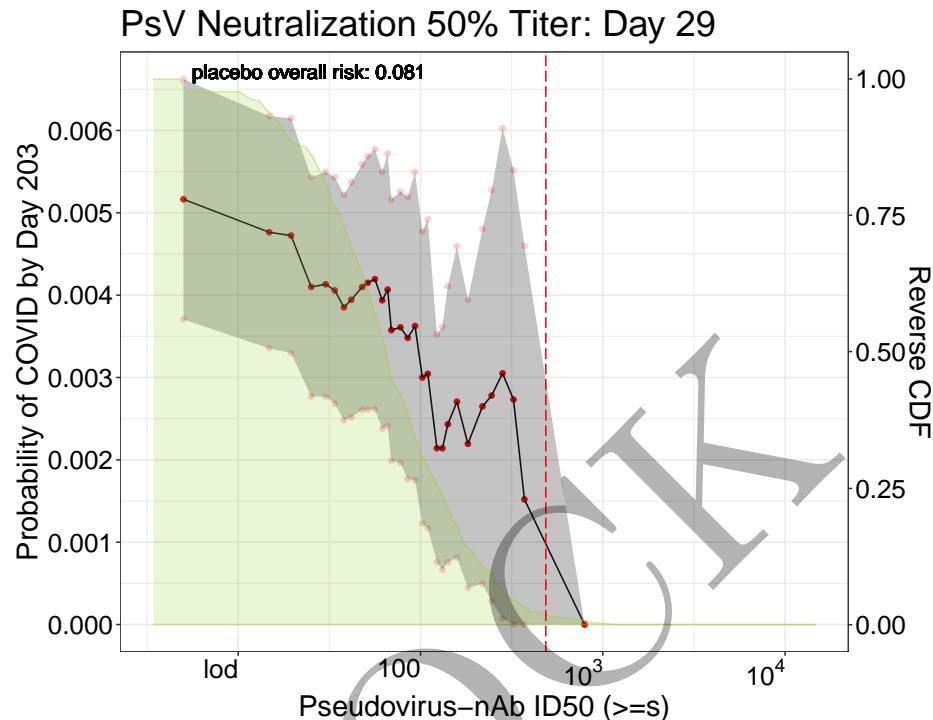


Figure 5.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00371	0.00662
1.405	$2.54 * 10^1$	0.00410	0.00277	0.00543
1.583	$3.83 * 10^1$	0.00385	0.00248	0.00522
1.749	$5.61 * 10^1$	0.00419	0.00261	0.00577
1.839	$6.90 * 10^1$	0.00358	0.00199	0.00516
1.966	$9.25 * 10^1$	0.00362	0.00175	0.00550
2.089	$1.23 * 10^2$	0.00214	0.00076	0.00353
2.261	$1.82 * 10^2$	0.00219	0.00044	0.00394
2.448	$2.81 * 10^2$	0.00305	0.00007	0.00603
2.904	$8.02 * 10^2$	0.00000	0.00000	NA

### 5.2.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

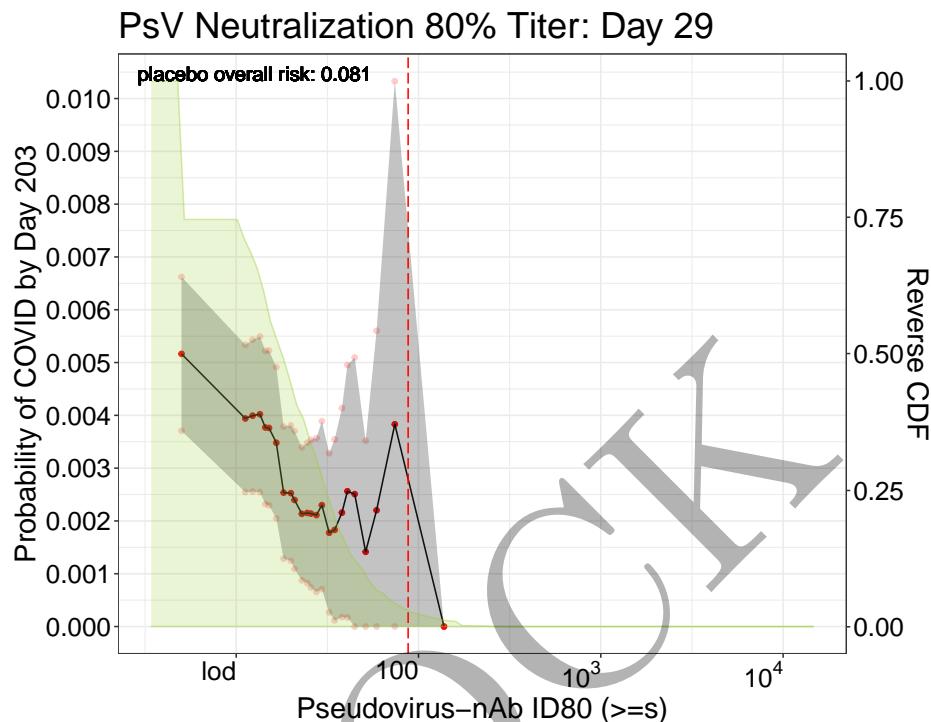


Figure 5.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00371	0.00662
1.131	$1.35 * 10^1$	0.00402	0.00255	0.00549
1.183	$1.52 * 10^1$	0.00376	0.00230	0.00523
1.296	$1.98 * 10^1$	0.00253	0.00124	0.00381
1.358	$2.28 * 10^1$	0.00213	0.00088	0.00339
1.442	$2.77 * 10^1$	0.00211	0.00065	0.00357
1.508	$3.22 * 10^1$	0.00178	0.00027	0.00328
1.612	$4.09 * 10^1$	0.00256	0.00017	0.00495
1.709	$5.12 * 10^1$	0.00142	0.00000	0.00352
2.144	$1.39 * 10^2$	0.00000	0.00000	NA

### 5.3 Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected)

MOCK

### 5.3.1 Day 57 Spike protein binding antibody

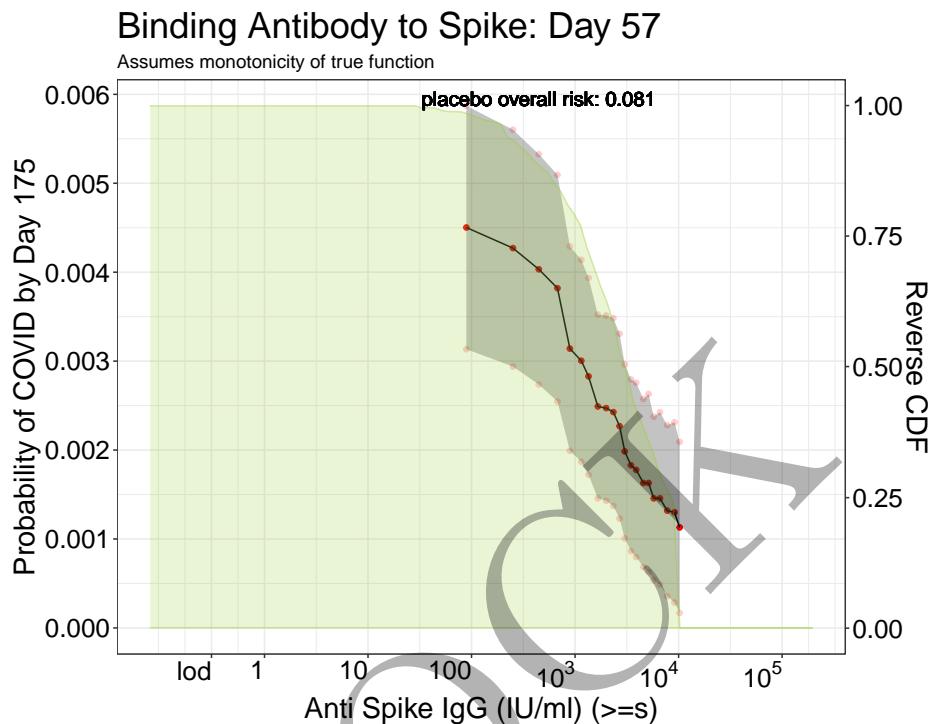


Figure 5.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	9.02 * 10 <sup>1</sup>	0.00450	0.00313	0.00587
2.653	4.50 * 10 <sup>2</sup>	0.00403	0.00274	0.00533
2.953	8.97 * 10 <sup>2</sup>	0.00314	0.00199	0.00429
3.221	1.66 * 10 <sup>3</sup>	0.00249	0.00146	0.00352
3.365	2.32 * 10 <sup>3</sup>	0.00243	0.00137	0.00348
3.483	3.04 * 10 <sup>3</sup>	0.00198	0.00101	0.00296
3.595	3.94 * 10 <sup>3</sup>	0.00178	0.00080	0.00276
3.757	5.71 * 10 <sup>3</sup>	0.00146	0.00054	0.00238
3.894	7.83 * 10 <sup>3</sup>	0.00132	0.00036	0.00228
4.007	1.02 * 10 <sup>4</sup>	0.00113	0.00017	0.00209

### 5.3.2 Day 57 RBD binding antibody

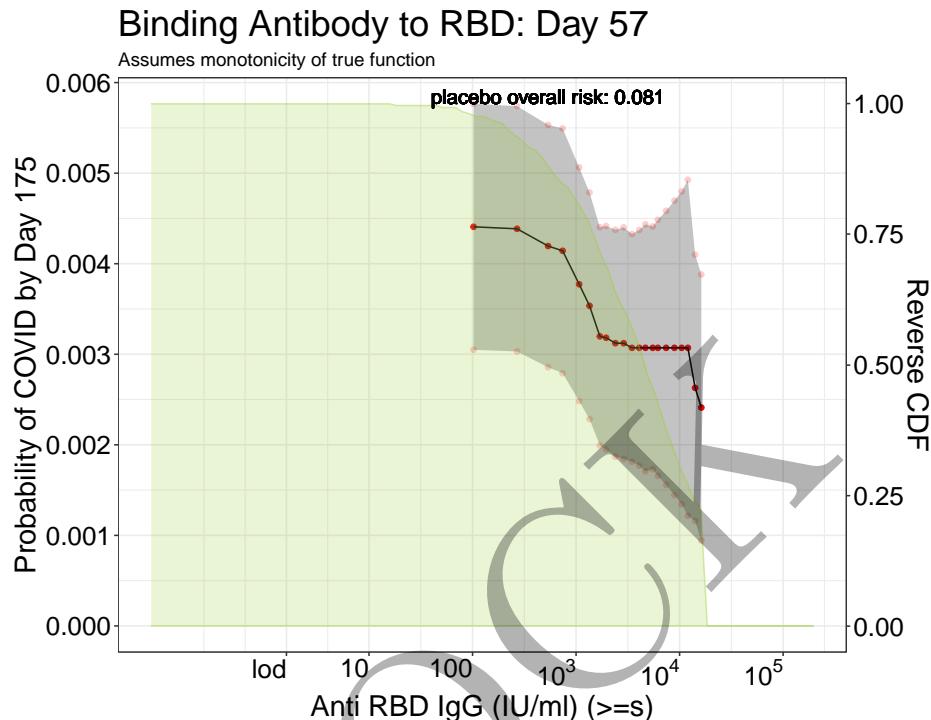


Figure 5.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 \times 10^2$	0.00441	0.00305	0.00577
2.727	$5.33 \times 10^2$	0.00420	0.00286	0.00553
3.032	$1.08 \times 10^3$	0.00377	0.00248	0.00506
3.295	$1.97 \times 10^3$	0.00318	0.00195	0.00442
3.462	$2.90 \times 10^3$	0.00312	0.00184	0.00440
3.615	$4.12 \times 10^3$	0.00307	0.00177	0.00437
3.739	$5.48 \times 10^3$	0.00307	0.00173	0.00441
3.946	$8.83 \times 10^3$	0.00307	0.00144	0.00470
4.079	$1.20 \times 10^4$	0.00307	0.00122	0.00493
4.211	$1.63 \times 10^4$	0.00241	0.00094	0.00388

### 5.3.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

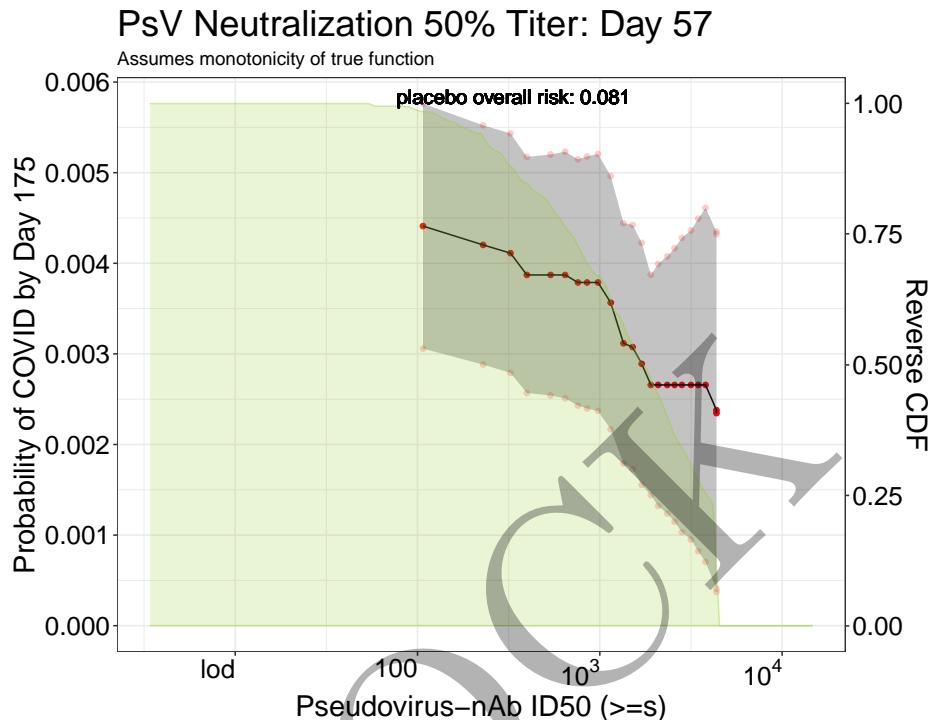


Figure 5.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.00441	0.00306	0.00576
2.509	$3.23 * 10^2$	0.00411	0.00279	0.00543
2.814	$6.52 * 10^2$	0.00387	0.00251	0.00523
2.931	$8.53 * 10^2$	0.00379	0.00240	0.00518
3.132	$1.36 * 10^3$	0.00312	0.00179	0.00444
3.234	$1.71 * 10^3$	0.00289	0.00155	0.00423
3.367	$2.33 * 10^3$	0.00266	0.00124	0.00408
3.455	$2.85 * 10^3$	0.00266	0.00103	0.00428
3.583	$3.83 * 10^3$	0.00266	0.00070	0.00461
3.644	$4.41 * 10^3$	0.00235	0.00037	0.00432

### 5.3.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

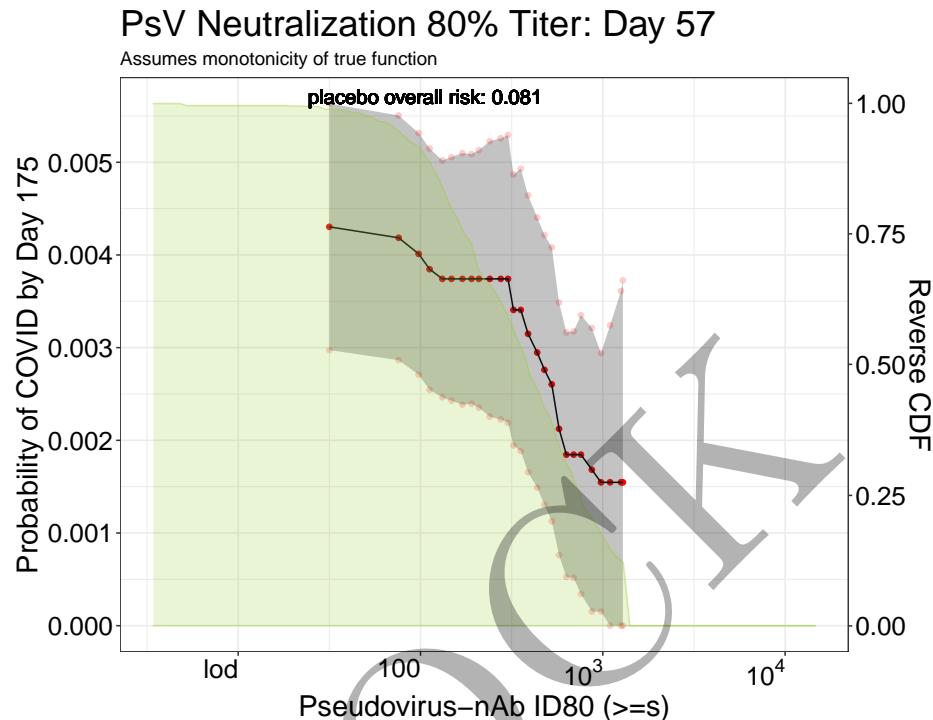


Figure 5.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 \times 10^1$	0.00430	0.00297	0.00563
2.048	$1.12 \times 10^2$	0.00385	0.00254	0.00515
2.230	$1.70 \times 10^2$	0.00374	0.00239	0.00510
2.379	$2.39 \times 10^2$	0.00374	0.00226	0.00523
2.515	$3.27 \times 10^2$	0.00341	0.00195	0.00487
2.588	$3.87 \times 10^2$	0.00315	0.00166	0.00464
2.719	$5.24 \times 10^2$	0.00260	0.00113	0.00408
2.836	$6.85 \times 10^2$	0.00185	0.00052	0.00318
2.994	$9.86 \times 10^2$	0.00155	0.00015	0.00294
3.112	$1.29 \times 10^3$	0.00155	0.00000	0.00373

## 5.4 Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected)

MOCK

### 5.4.1 Day 29 Spike protein antibody

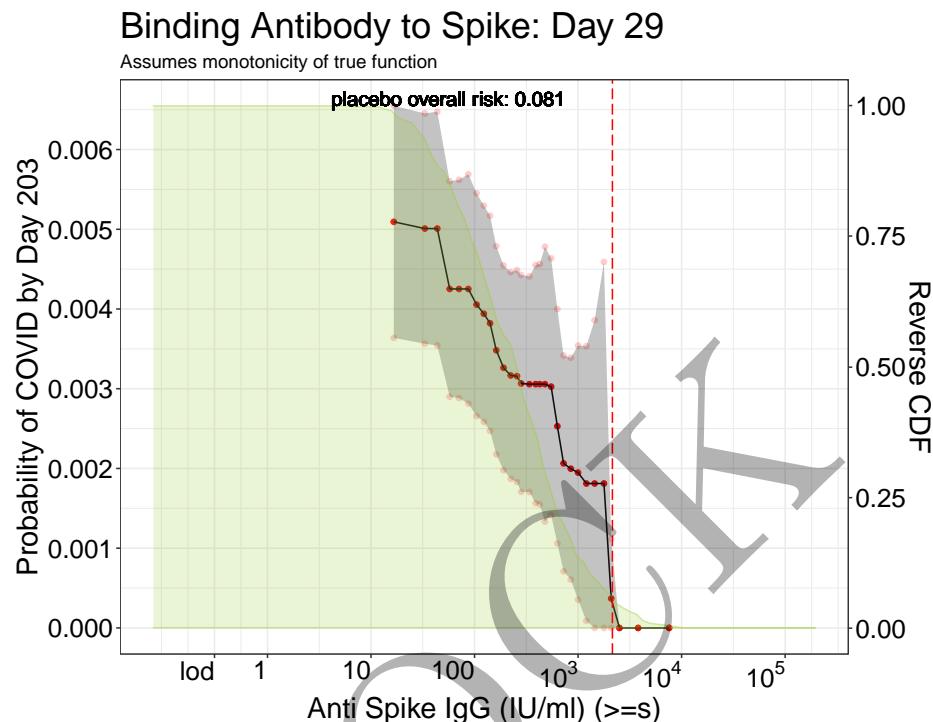


Figure 5.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	1.68 * 10 <sup>1</sup>	0.00509	0.00364	0.00655
1.756	5.70 * 10 <sup>1</sup>	0.00425	0.00290	0.00560
2.024	1.06 * 10 <sup>2</sup>	0.00405	0.00266	0.00545
2.281	1.91 * 10 <sup>2</sup>	0.00326	0.00198	0.00455
2.454	2.84 * 10 <sup>2</sup>	0.00307	0.00171	0.00443
2.632	4.29 * 10 <sup>2</sup>	0.00306	0.00155	0.00457
2.797	6.27 * 10 <sup>2</sup>	0.00253	0.00106	0.00400
3.078	1.20 * 10 <sup>3</sup>	0.00181	0.00009	0.00353
3.321	2.09 * 10 <sup>3</sup>	0.00037	0.00000	0.00112
3.882	7.62 * 10 <sup>3</sup>	0.00000	0.00000	NA

### 5.4.2 Day 29 RBD binding antibody

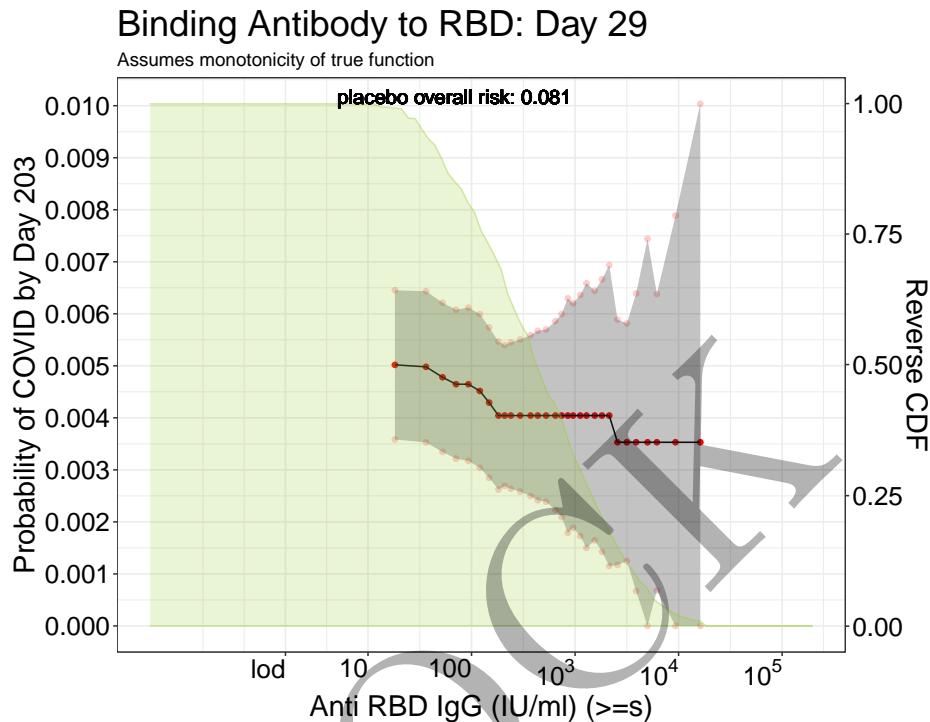


Figure 5.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.00502	0.00358	0.00645
1.854	$7.14 * 10^1$	0.00465	0.00321	0.00608
2.173	$1.49 * 10^2$	0.00429	0.00285	0.00574
2.475	$2.99 * 10^2$	0.00404	0.00258	0.00551
2.720	$5.25 * 10^2$	0.00404	0.00239	0.00570
2.931	$8.53 * 10^2$	0.00404	0.00179	0.00630
3.109	$1.29 * 10^3$	0.00404	0.00150	0.00659
3.410	$2.57 * 10^3$	0.00353	0.00117	0.00589
3.695	$4.95 * 10^3$	0.00353	0.00000	0.00744
4.211	$1.63 * 10^4$	0.00353	0.00000	0.01444

### 5.4.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

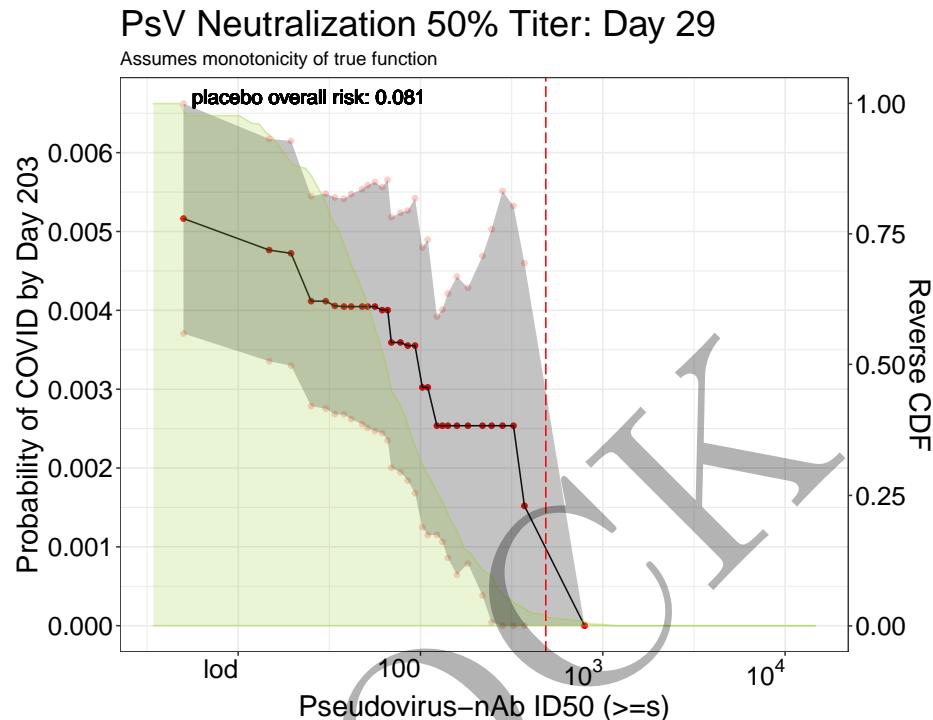


Figure 5.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00371	0.00662
1.405	$2.54 * 10^1$	0.00412	0.00279	0.00545
1.583	$3.83 * 10^1$	0.00405	0.00268	0.00542
1.749	$5.61 * 10^1$	0.00405	0.00247	0.00563
1.839	$6.90 * 10^1$	0.00359	0.00200	0.00518
1.966	$9.25 * 10^1$	0.00355	0.00168	0.00542
2.089	$1.23 * 10^2$	0.00254	0.00115	0.00392
2.261	$1.82 * 10^2$	0.00254	0.00079	0.00429
2.448	$2.81 * 10^2$	0.00254	0.00000	0.00551
2.904	$8.02 * 10^2$	0.00000	0.00000	NA

#### 5.4.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

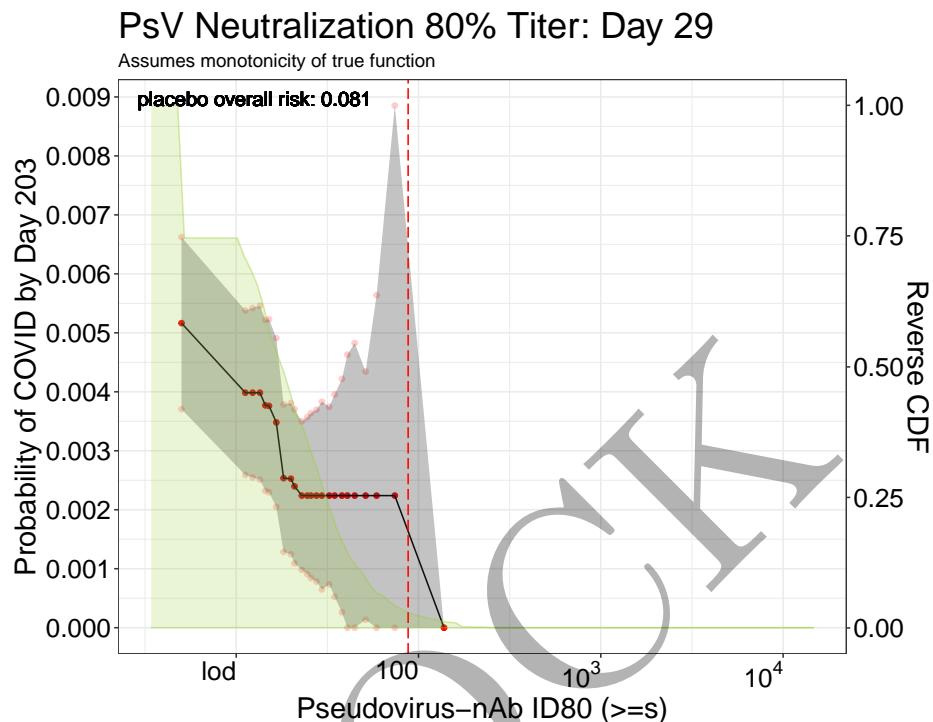


Figure 5.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00371	0.00662
1.131	$1.35 * 10^1$	0.00398	0.00251	0.00546
1.183	$1.52 * 10^1$	0.00376	0.00230	0.00523
1.296	$1.98 * 10^1$	0.00253	0.00124	0.00381
1.358	$2.28 * 10^1$	0.00224	0.00098	0.00350
1.442	$2.77 * 10^1$	0.00224	0.00078	0.00370
1.508	$3.22 * 10^1$	0.00224	0.00073	0.00375
1.612	$4.09 * 10^1$	0.00224	0.00000	0.00463
1.709	$5.12 * 10^1$	0.00224	0.00013	0.00434
2.144	$1.39 * 10^2$	0.00000	0.00000	NA

## 5.5 Plots and Tables with estimates and simultaneous confidence bands for Day 57

MOCK

### 5.5.1 Day 57 Spike protein binding antibody

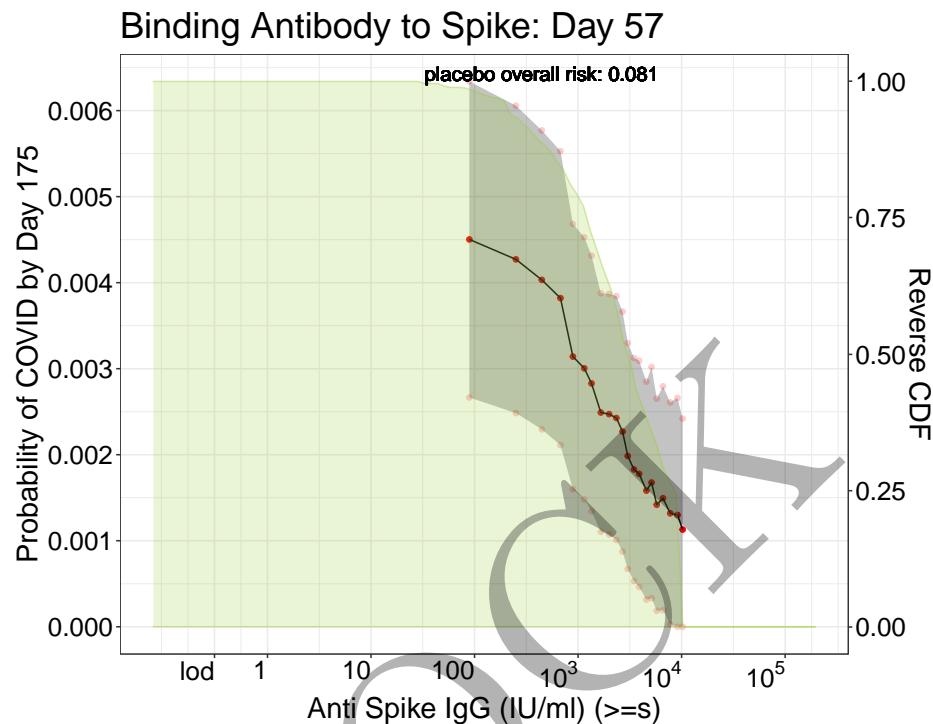


Figure 5.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.00450	0.00267	0.00634
2.653	$4.50 * 10^2$	0.00403	0.00229	0.00577
2.953	$8.97 * 10^2$	0.00314	0.00160	0.00468
3.221	$1.66 * 10^3$	0.00249	0.00110	0.00388
3.365	$2.32 * 10^3$	0.00243	0.00101	0.00384
3.483	$3.04 * 10^3$	0.00198	0.00067	0.00330
3.595	$3.94 * 10^3$	0.00178	0.00046	0.00309
3.757	$5.71 * 10^3$	0.00142	0.00019	0.00265
3.894	$7.83 * 10^3$	0.00132	0.00003	0.00261
4.007	$1.02 * 10^4$	0.00113	0.00000	0.00242

### 5.5.2 Day 57 RBD binding antibody

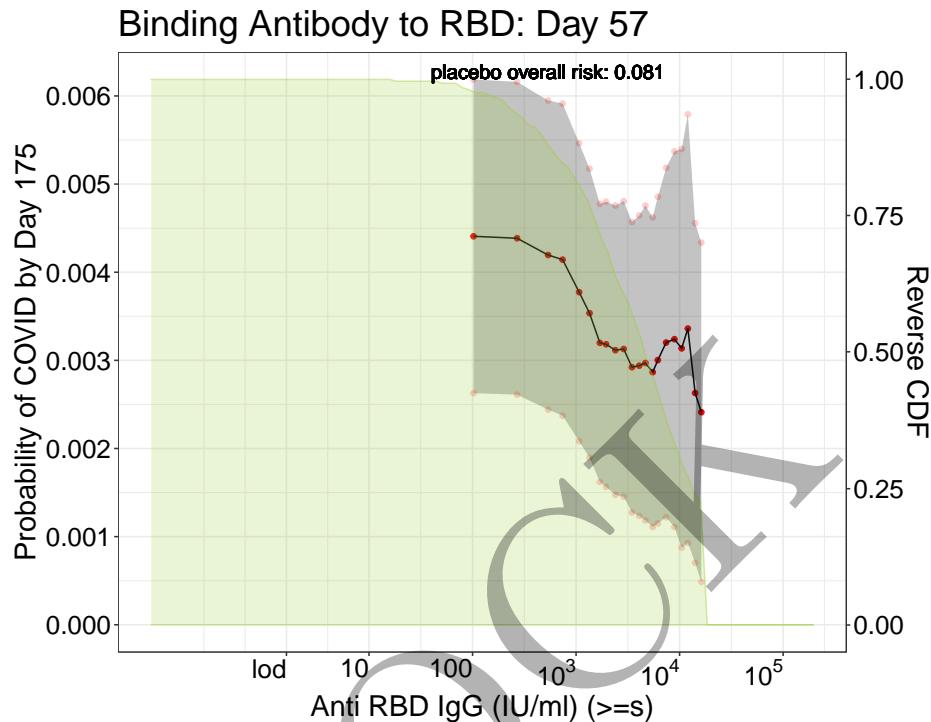


Figure 5.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.00441	0.00263	0.00619
2.727	$5.33 * 10^2$	0.00420	0.00244	0.00595
3.032	$1.08 * 10^3$	0.00377	0.00208	0.00546
3.295	$1.97 * 10^3$	0.00318	0.00157	0.00480
3.462	$2.90 * 10^3$	0.00313	0.00145	0.00480
3.615	$4.12 * 10^3$	0.00294	0.00123	0.00464
3.739	$5.48 * 10^3$	0.00287	0.00111	0.00462
3.946	$8.83 * 10^3$	0.00324	0.00111	0.00537
4.079	$1.20 * 10^4$	0.00336	0.00093	0.00579
4.211	$1.63 * 10^4$	0.00241	0.00049	0.00434

### 5.5.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

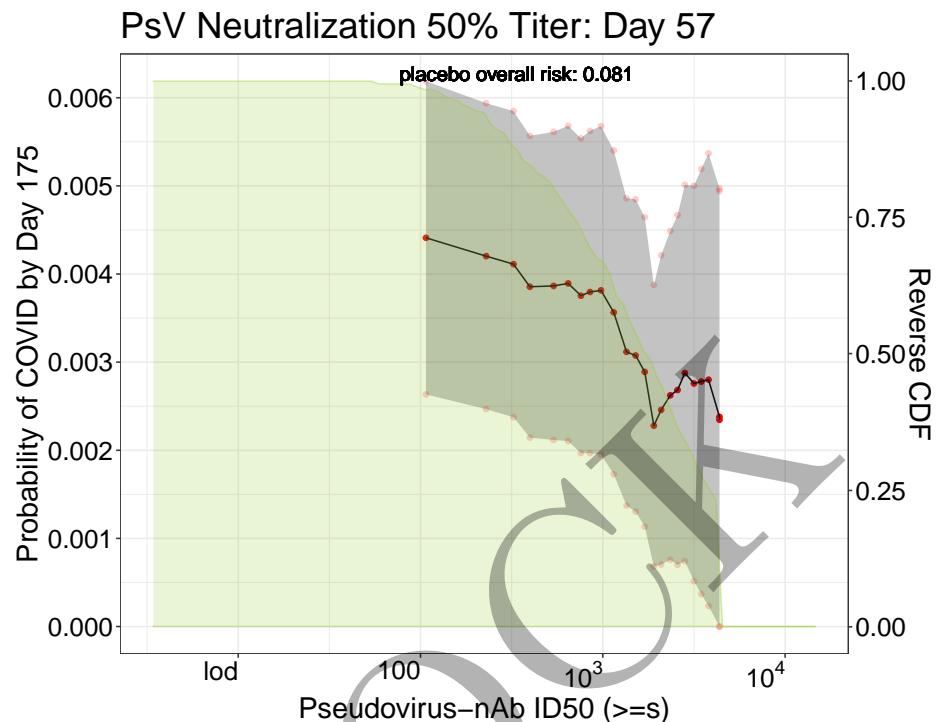


Figure 5.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.00441	0.00263	0.00619
2.509	$3.23 * 10^2$	0.00411	0.00238	0.00585
2.814	$6.52 * 10^2$	0.00389	0.00210	0.00568
2.931	$8.53 * 10^2$	0.00380	0.00197	0.00562
3.132	$1.36 * 10^3$	0.00312	0.00137	0.00486
3.234	$1.71 * 10^3$	0.00289	0.00113	0.00464
3.367	$2.33 * 10^3$	0.00262	0.00076	0.00449
3.455	$2.85 * 10^3$	0.00288	0.00074	0.00501
3.583	$3.83 * 10^3$	0.00280	0.00023	0.00537
3.644	$4.41 * 10^3$	0.00235	0.00000	0.00494

### 5.5.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

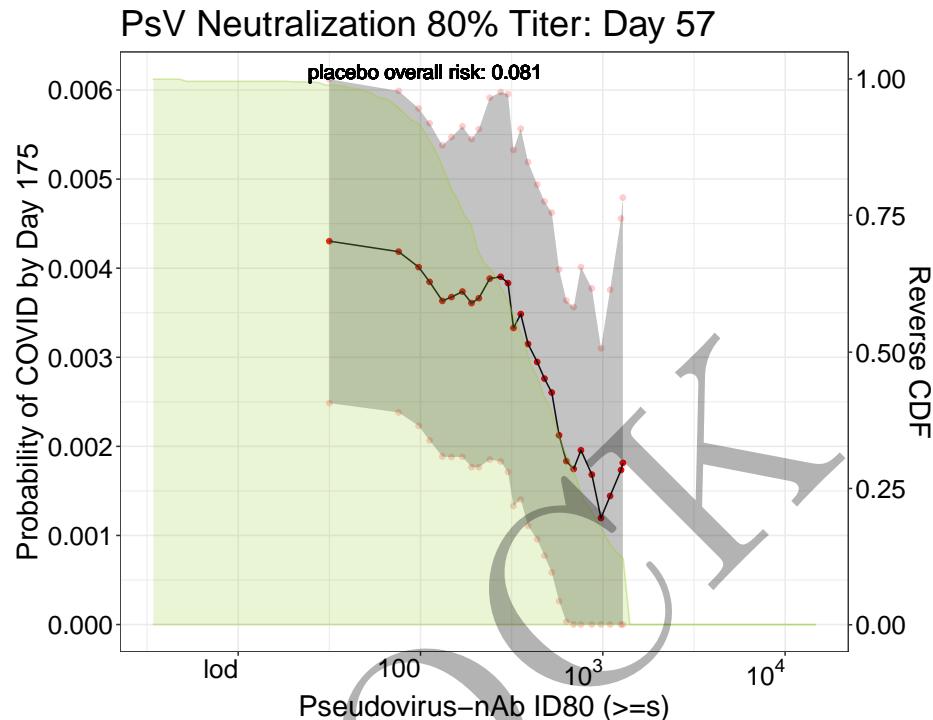


Figure 5.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.00430	0.00249	0.00612
2.048	$1.12 * 10^2$	0.00385	0.00207	0.00563
2.230	$1.70 * 10^2$	0.00374	0.00188	0.00559
2.379	$2.39 * 10^2$	0.00388	0.00185	0.00591
2.515	$3.27 * 10^2$	0.00333	0.00133	0.00533
2.588	$3.87 * 10^2$	0.00315	0.00111	0.00519
2.719	$5.24 * 10^2$	0.00260	0.00058	0.00462
2.836	$6.85 * 10^2$	0.00175	0.00000	0.00356
2.994	$9.86 * 10^2$	0.00120	0.00000	0.00310
3.112	$1.29 * 10^3$	0.00181	0.00000	0.00479

## 5.6 Plots and Tables with estimates and simultaneous confidence bands for Day 29

MOCK

### 5.6.1 Day 29 Spike protein antibody

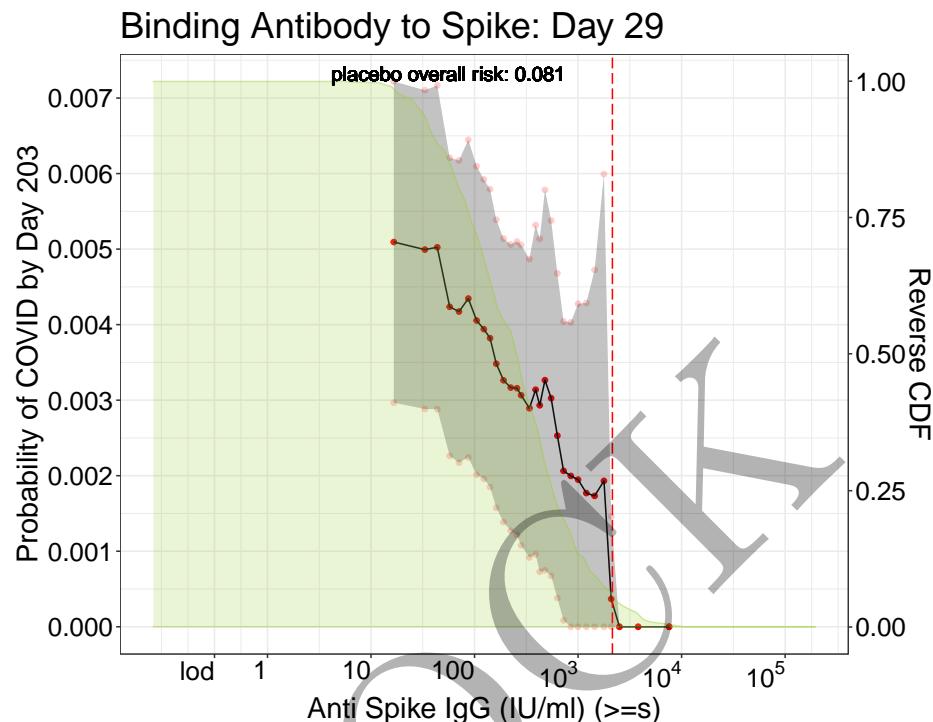


Figure 5.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.00509	0.00297	0.00722
1.756	$5.70 * 10^1$	0.00424	0.00226	0.00621
2.024	$1.06 * 10^2$	0.00405	0.00201	0.00610
2.281	$1.91 * 10^2$	0.00326	0.00139	0.00514
2.454	$2.84 * 10^2$	0.00307	0.00108	0.00505
2.632	$4.29 * 10^2$	0.00293	0.00073	0.00514
2.797	$6.27 * 10^2$	0.00253	0.00038	0.00468
3.078	$1.20 * 10^3$	0.00177	0.00000	0.00429
3.321	$2.09 * 10^3$	0.00037	0.00000	0.00146
3.882	$7.62 * 10^3$	0.00000	0.00000	NA

### 5.6.2 Day 29 RBD binding antibody

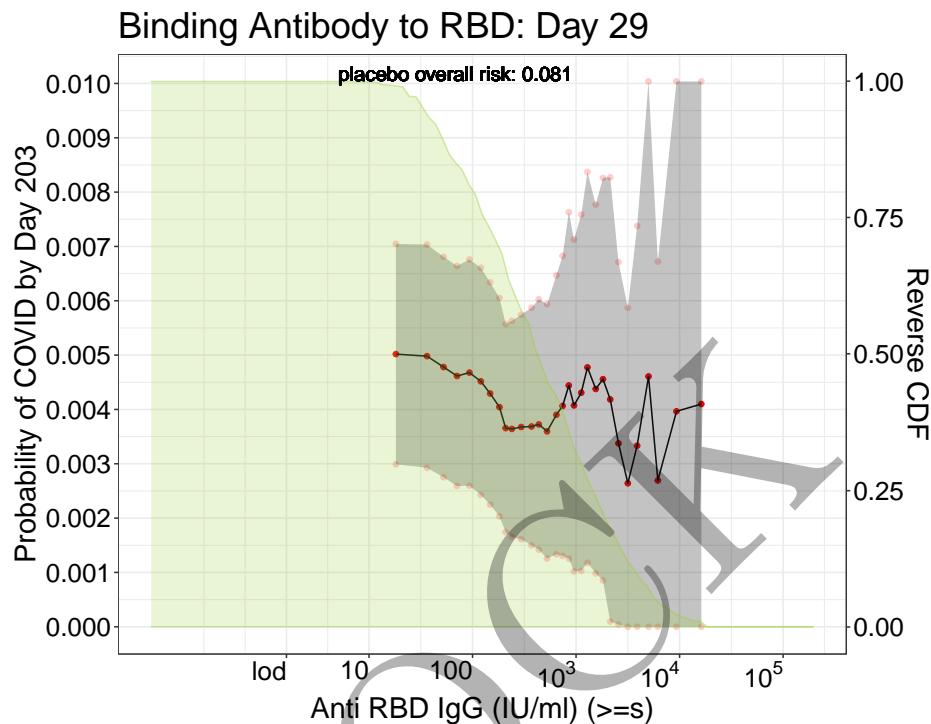


Figure 5.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.00502	0.00299	0.00705
1.854	$7.14 * 10^1$	0.00462	0.00259	0.00664
2.173	$1.49 * 10^2$	0.00429	0.00225	0.00634
2.475	$2.99 * 10^2$	0.00368	0.00161	0.00574
2.720	$5.25 * 10^2$	0.00360	0.00126	0.00594
2.931	$8.53 * 10^2$	0.00444	0.00125	0.00763
3.109	$1.29 * 10^3$	0.00477	0.00118	0.00837
3.410	$2.57 * 10^3$	0.00338	0.00004	0.00671
3.695	$4.95 * 10^3$	0.00461	0.00000	0.01014
4.211	$1.63 * 10^4$	0.00410	0.00000	0.01952

### 5.6.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

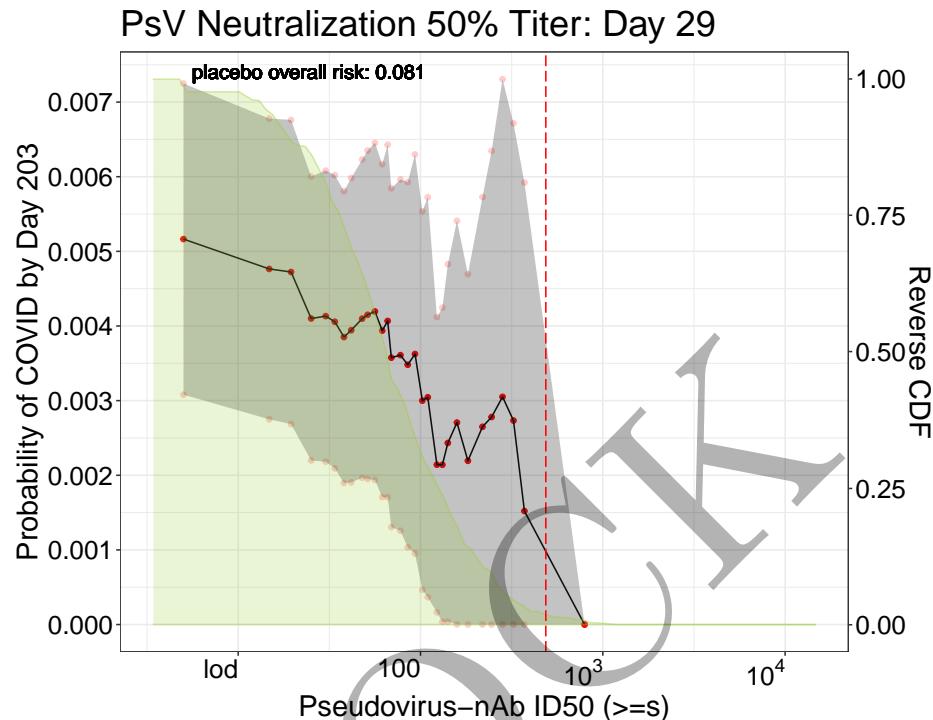


Figure 5.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00308	0.00725
1.405	$2.54 * 10^1$	0.00410	0.00220	0.00600
1.583	$3.83 * 10^1$	0.00385	0.00190	0.00581
1.749	$5.61 * 10^1$	0.00419	0.00194	0.00645
1.839	$6.90 * 10^1$	0.00358	0.00131	0.00585
1.966	$9.25 * 10^1$	0.00362	0.00095	0.00630
2.089	$1.23 * 10^2$	0.00214	0.00016	0.00412
2.261	$1.82 * 10^2$	0.00219	0.00000	0.00469
2.448	$2.81 * 10^2$	0.00305	0.00000	0.00731
2.904	$8.02 * 10^2$	0.00000	0.00000	NA

### 5.6.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

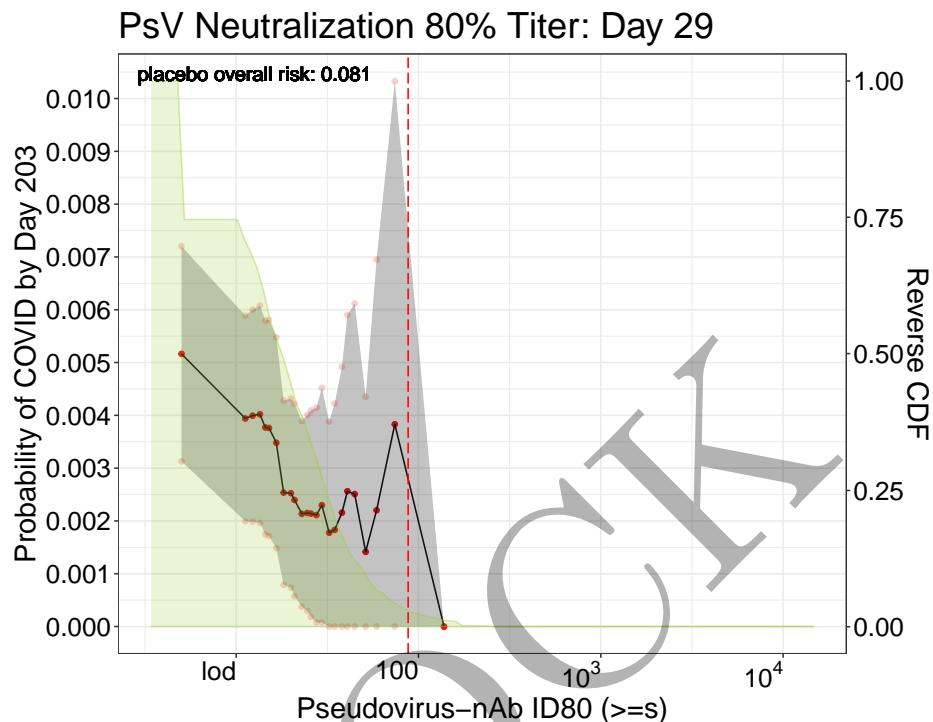


Figure 5.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00313	0.00720
1.131	$1.35 * 10^1$	0.00402	0.00196	0.00608
1.183	$1.52 * 10^1$	0.00376	0.00171	0.00581
1.296	$1.98 * 10^1$	0.00253	0.00074	0.00432
1.358	$2.28 * 10^1$	0.00213	0.00038	0.00389
1.442	$2.77 * 10^1$	0.00211	0.00008	0.00414
1.508	$3.22 * 10^1$	0.00178	0.00000	0.00388
1.612	$4.09 * 10^1$	0.00256	0.00000	0.00590
1.709	$5.12 * 10^1$	0.00142	0.00000	0.00435
2.144	$1.39 * 10^2$	0.00000	0.00000	NA

## 5.7 Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected)

MOCK

### 5.7.1 Day 57 Spike protein binding antibody

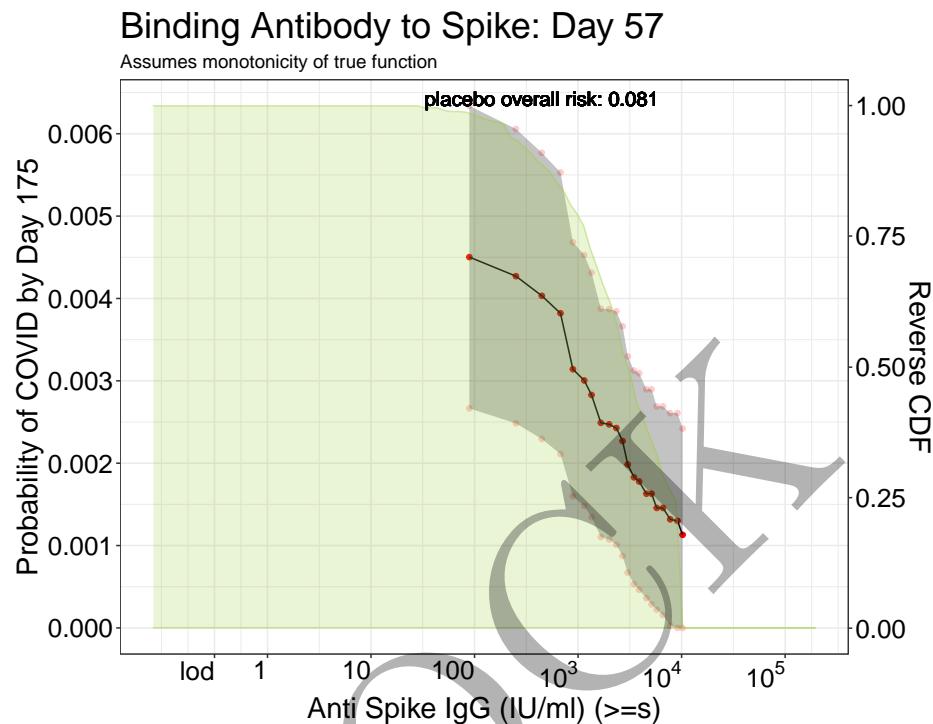


Figure 5.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.00450	0.00267	0.00634
2.653	$4.50 * 10^2$	0.00403	0.00229	0.00577
2.953	$8.97 * 10^2$	0.00314	0.00160	0.00468
3.221	$1.66 * 10^3$	0.00249	0.00110	0.00388
3.365	$2.32 * 10^3$	0.00243	0.00101	0.00384
3.483	$3.04 * 10^3$	0.00198	0.00067	0.00330
3.595	$3.94 * 10^3$	0.00178	0.00046	0.00309
3.757	$5.71 * 10^3$	0.00146	0.00022	0.00269
3.894	$7.83 * 10^3$	0.00132	0.00003	0.00261
4.007	$1.02 * 10^4$	0.00113	0.00000	0.00242

### 5.7.2 Day 57 RBD binding antibody

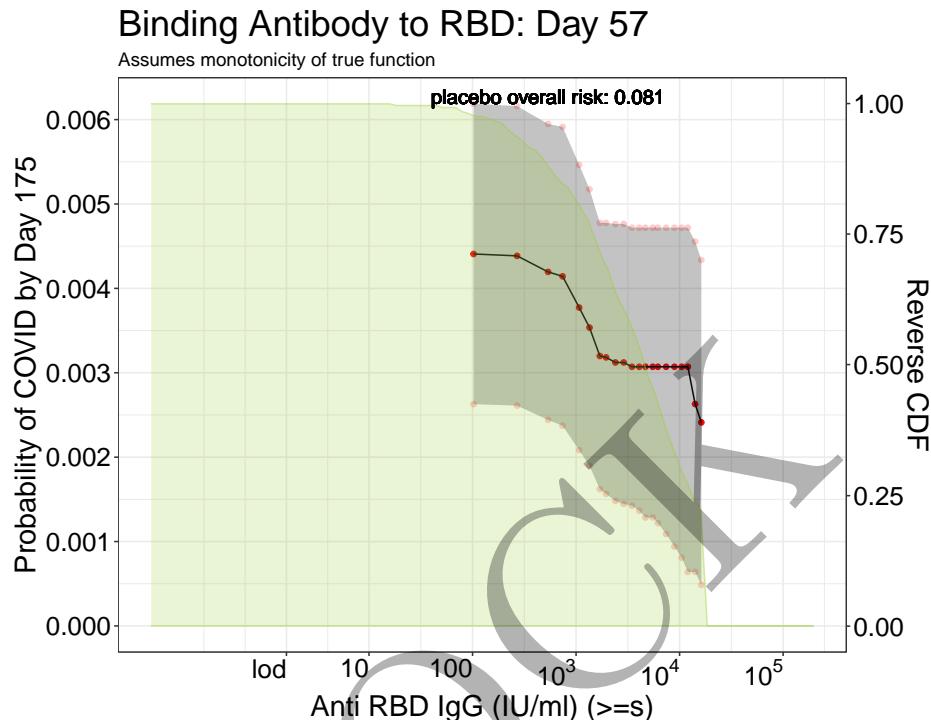


Figure 5.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.00441	0.00263	0.00619
2.727	$5.33 * 10^2$	0.00420	0.00244	0.00595
3.032	$1.08 * 10^3$	0.00377	0.00208	0.00546
3.295	$1.97 * 10^3$	0.00318	0.00157	0.00480
3.462	$2.90 * 10^3$	0.00312	0.00145	0.00480
3.615	$4.12 * 10^3$	0.00307	0.00137	0.00478
3.739	$5.48 * 10^3$	0.00307	0.00131	0.00483
3.946	$8.83 * 10^3$	0.00307	0.00094	0.00520
4.079	$1.20 * 10^4$	0.00307	0.00064	0.00550
4.211	$1.63 * 10^4$	0.00241	0.00049	0.00434

### 5.7.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

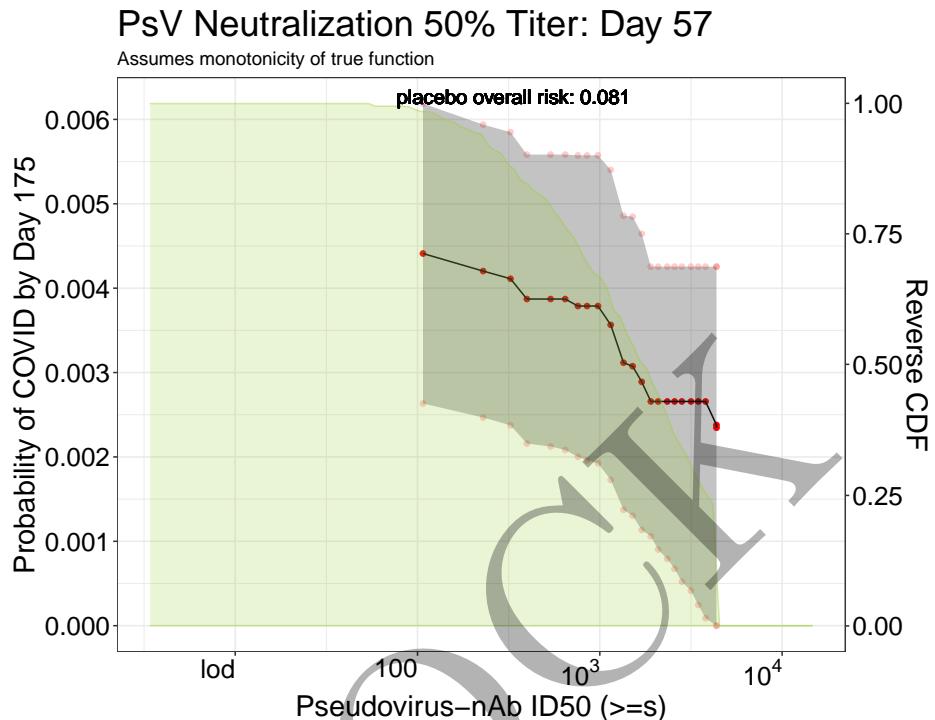


Figure 5.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.00441	0.00263	0.00619
2.509	$3.23 * 10^2$	0.00411	0.00238	0.00585
2.814	$6.52 * 10^2$	0.00387	0.00208	0.00566
2.931	$8.53 * 10^2$	0.00379	0.00196	0.00562
3.132	$1.36 * 10^3$	0.00312	0.00137	0.00486
3.234	$1.71 * 10^3$	0.00289	0.00113	0.00464
3.367	$2.33 * 10^3$	0.00266	0.00079	0.00452
3.455	$2.85 * 10^3$	0.00266	0.00052	0.00479
3.583	$3.83 * 10^3$	0.00266	0.00009	0.00523
3.644	$4.41 * 10^3$	0.00235	0.00000	0.00494

### 5.7.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

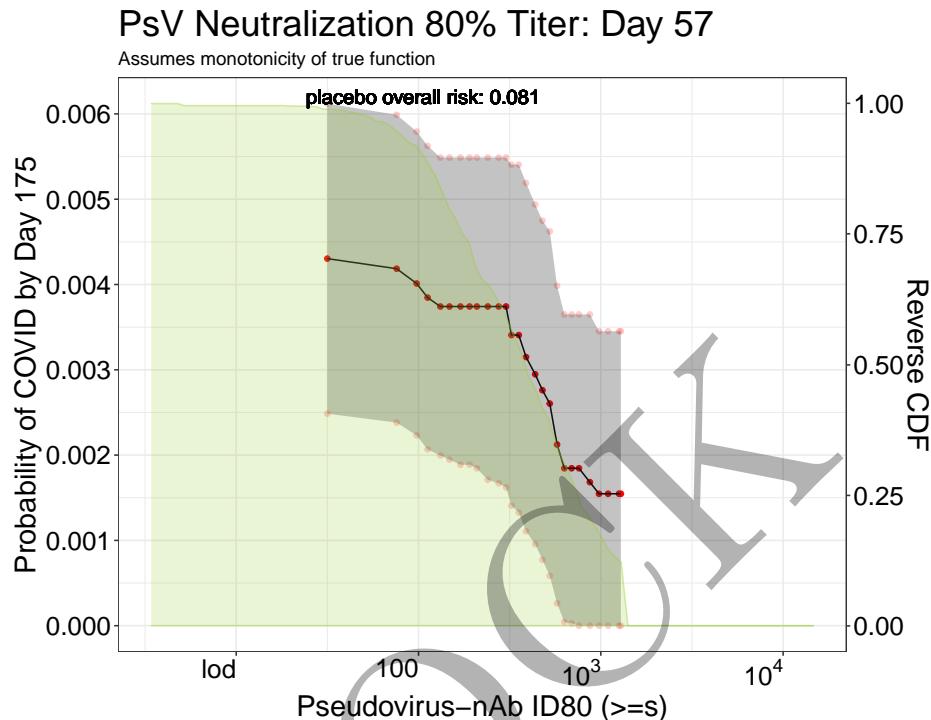


Figure 5.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 \times 10^1$	0.00430	0.00249	0.00612
2.048	$1.12 \times 10^2$	0.00385	0.00207	0.00563
2.230	$1.70 \times 10^2$	0.00374	0.00189	0.00560
2.379	$2.39 \times 10^2$	0.00374	0.00171	0.00577
2.515	$3.27 \times 10^2$	0.00341	0.00141	0.00540
2.588	$3.87 \times 10^2$	0.00315	0.00111	0.00519
2.719	$5.24 \times 10^2$	0.00260	0.00058	0.00462
2.836	$6.85 \times 10^2$	0.00185	0.00003	0.00366
2.994	$9.86 \times 10^2$	0.00155	0.00000	0.00345
3.112	$1.29 \times 10^3$	0.00155	0.00000	0.00452

## 5.8 Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected)

MOCK

### 5.8.1 Day 29 Spike protein antibody

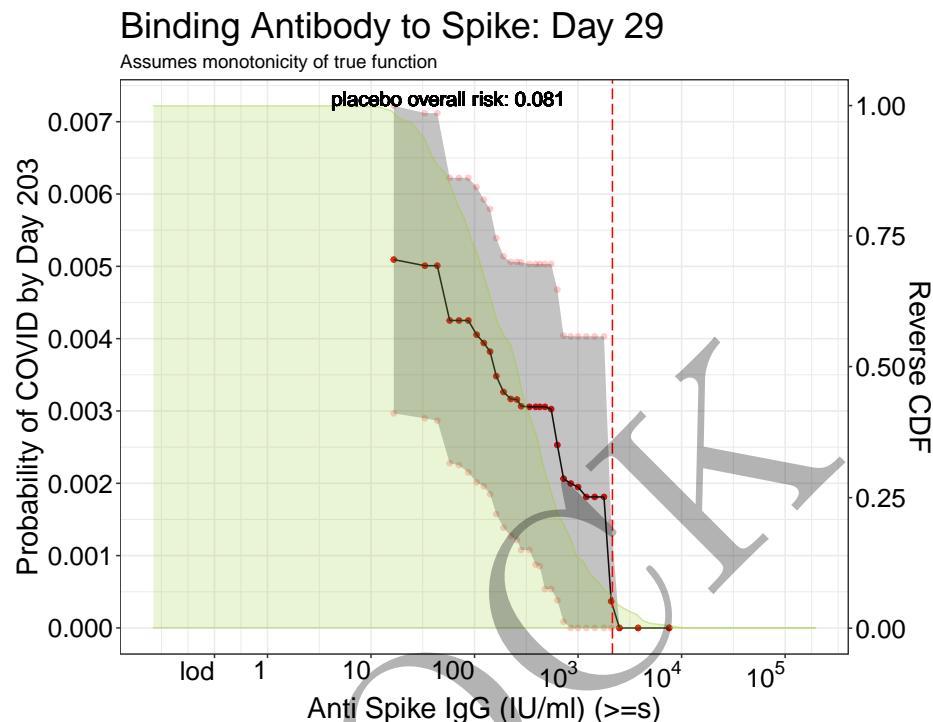


Figure 5.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.00509	0.00297	0.00722
1.756	$5.70 * 10^1$	0.00425	0.00228	0.00622
2.024	$1.06 * 10^2$	0.00405	0.00201	0.00610
2.281	$1.91 * 10^2$	0.00326	0.00139	0.00514
2.454	$2.84 * 10^2$	0.00307	0.00108	0.00505
2.632	$4.29 * 10^2$	0.00306	0.00085	0.00526
2.797	$6.27 * 10^2$	0.00253	0.00038	0.00468
3.078	$1.20 * 10^3$	0.00181	0.00000	0.00433
3.321	$2.09 * 10^3$	0.00037	0.00000	0.00146
3.882	$7.62 * 10^3$	0.00000	0.00000	NA

### 5.8.2 Day 29 RBD binding antibody

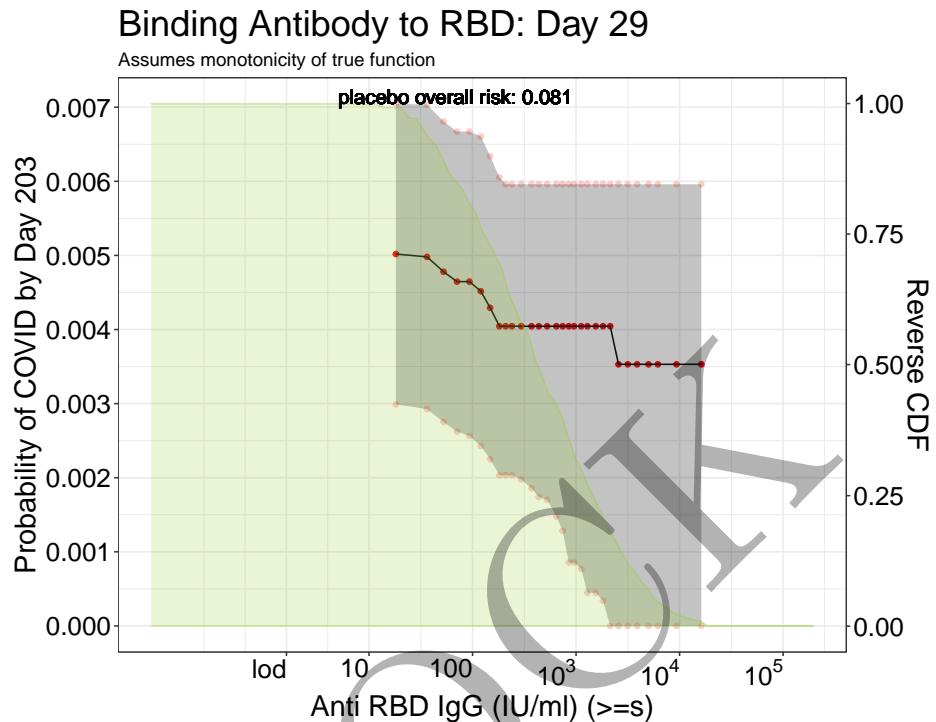


Figure 5.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.00502	0.00299	0.00705
1.854	$7.14 * 10^1$	0.00465	0.00262	0.00667
2.173	$1.49 * 10^2$	0.00429	0.00225	0.00634
2.475	$2.99 * 10^2$	0.00404	0.00198	0.00611
2.720	$5.25 * 10^2$	0.00404	0.00170	0.00639
2.931	$8.53 * 10^2$	0.00404	0.00086	0.00723
3.109	$1.29 * 10^3$	0.00404	0.00045	0.00764
3.410	$2.57 * 10^3$	0.00353	0.00020	0.00687
3.695	$4.95 * 10^3$	0.00353	0.00000	0.00906
4.211	$1.63 * 10^4$	0.00353	0.00000	0.01895

### 5.8.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

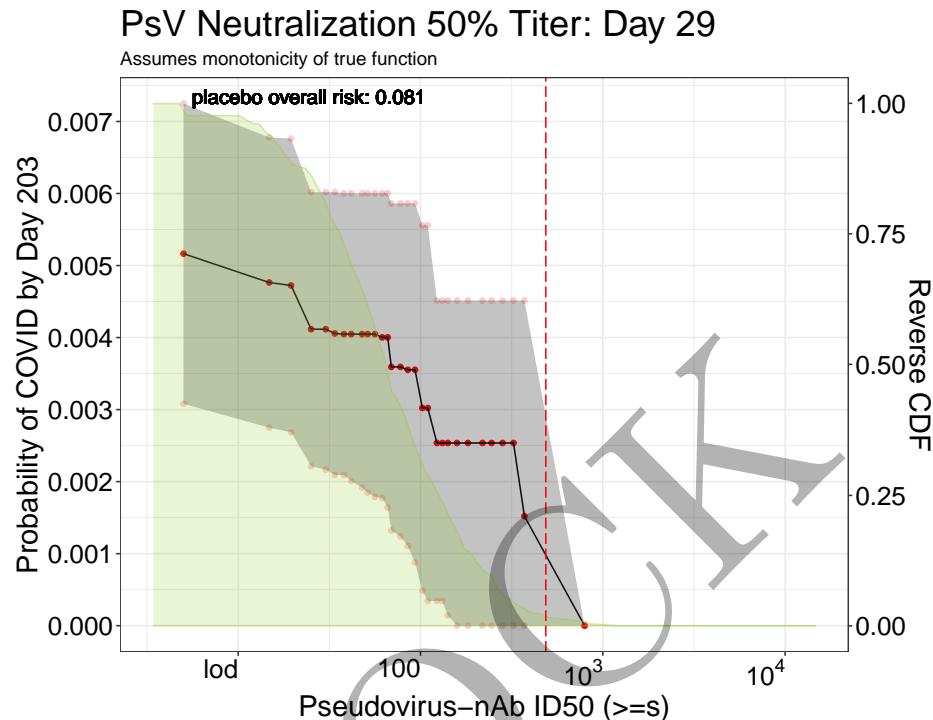


Figure 5.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00308	0.00725
1.405	$2.54 * 10^1$	0.00412	0.00221	0.00602
1.583	$3.83 * 10^1$	0.00405	0.00209	0.00600
1.749	$5.61 * 10^1$	0.00405	0.00179	0.00631
1.839	$6.90 * 10^1$	0.00359	0.00132	0.00586
1.966	$9.25 * 10^1$	0.00355	0.00088	0.00623
2.089	$1.23 * 10^2$	0.00254	0.00056	0.00451
2.261	$1.82 * 10^2$	0.00254	0.00004	0.00504
2.448	$2.81 * 10^2$	0.00254	0.00000	0.00679
2.904	$8.02 * 10^2$	0.00000	0.00000	NA

### 5.8.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

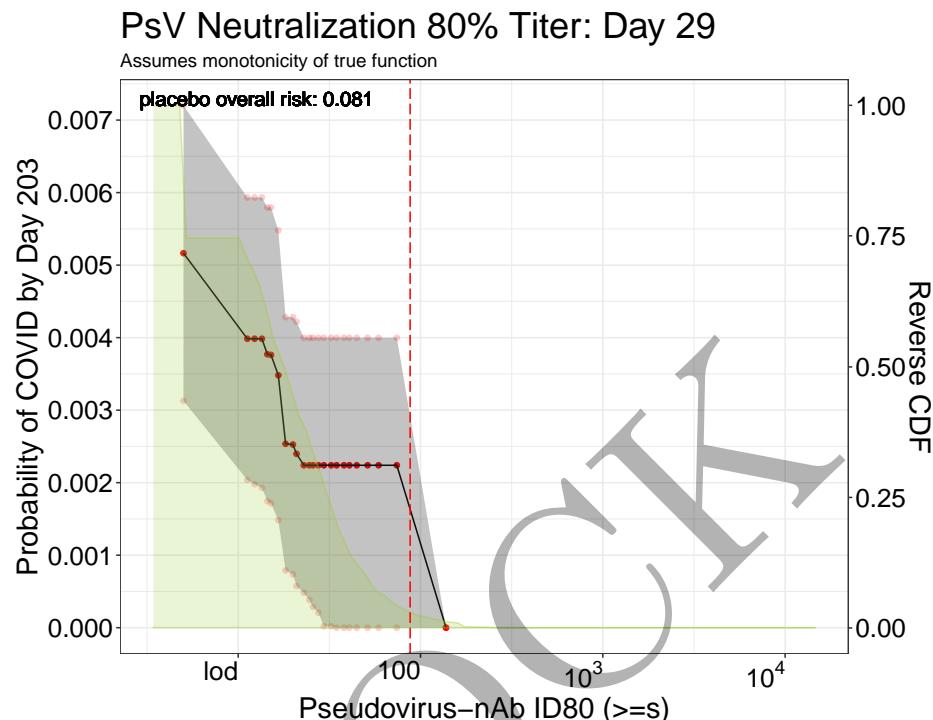


Figure 5.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00516	0.00313	0.00720
1.131	$1.35 * 10^1$	0.00398	0.00193	0.00604
1.183	$1.52 * 10^1$	0.00376	0.00171	0.00581
1.296	$1.98 * 10^1$	0.00253	0.00074	0.00432
1.358	$2.28 * 10^1$	0.00224	0.00048	0.00400
1.442	$2.77 * 10^1$	0.00224	0.00021	0.00427
1.508	$3.22 * 10^1$	0.00224	0.00014	0.00434
1.612	$4.09 * 10^1$	0.00224	0.00000	0.00558
1.709	$5.12 * 10^1$	0.00224	0.00000	0.00518
2.144	$1.39 * 10^2$	0.00000	0.00000	NA

MOCK

# Chapter 6

## Univariate CoR: Nonparametric Threshold Modeling {#cor-threshold} ( $\leq s$ )

The same methodology as the previous section is apply to estimate the “below” threshold-response function  $E_{WE}[Y = 1|A = 1, X, S \leq s]$ .

### 6.1 Plots and Tables with estimates and pointwise confidence interval for Day 57

### 6.1.1 Day 57 Spike protein binding antibody

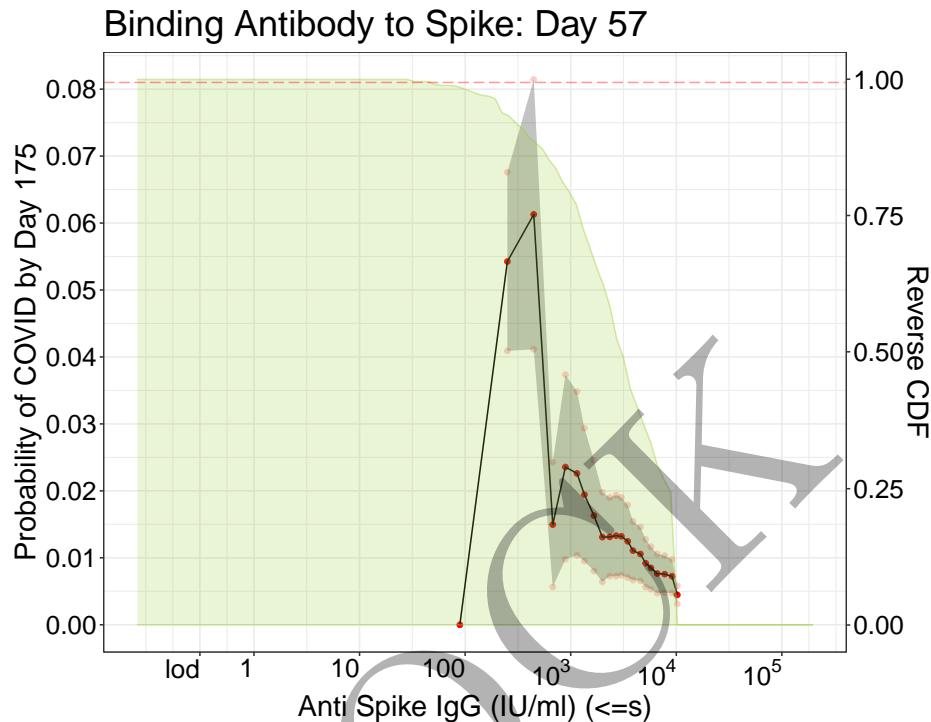


Figure 6.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.00000	0.00000	NA
2.653	$4.50 * 10^2$	0.06129	0.04114	0.08145
2.953	$8.97 * 10^2$	0.02356	0.00978	0.03734
3.221	$1.66 * 10^3$	0.01631	0.00803	0.02458
3.365	$2.32 * 10^3$	0.01313	0.00726	0.01900
3.483	$3.04 * 10^3$	0.01321	0.00740	0.01902
3.595	$3.94 * 10^3$	0.01107	0.00668	0.01546
3.757	$5.71 * 10^3$	0.00848	0.00530	0.01166
3.894	$7.83 * 10^3$	0.00756	0.00479	0.01033
4.007	$1.02 * 10^4$	0.00447	0.00312	0.00583

### 6.1.2 Day 57 RBD binding antibody

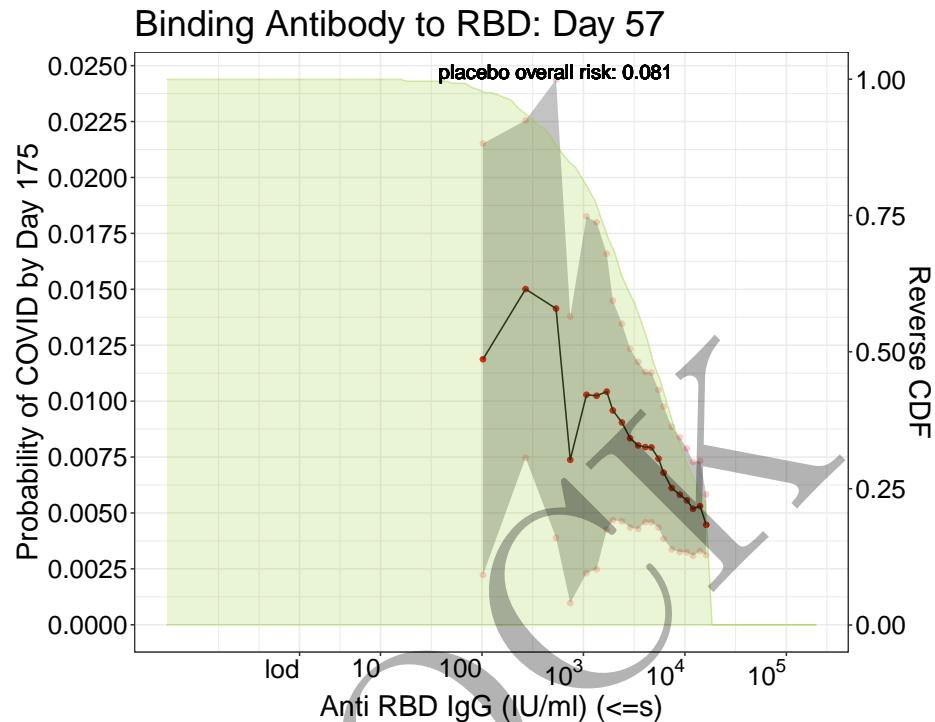


Figure 6.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.01187	0.00223	0.02152
2.727	$5.33 * 10^2$	0.01414	0.00389	0.02438
3.032	$1.08 * 10^3$	0.01028	0.00231	0.01826
3.295	$1.97 * 10^3$	0.00958	0.00467	0.01449
3.462	$2.90 * 10^3$	0.00834	0.00435	0.01233
3.615	$4.12 * 10^3$	0.00794	0.00459	0.01130
3.739	$5.48 * 10^3$	0.00743	0.00435	0.01050
3.946	$8.83 * 10^3$	0.00582	0.00325	0.00838
4.079	$1.20 * 10^4$	0.00519	0.00309	0.00728
4.211	$1.63 * 10^4$	0.00447	0.00312	0.00583

### 6.1.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

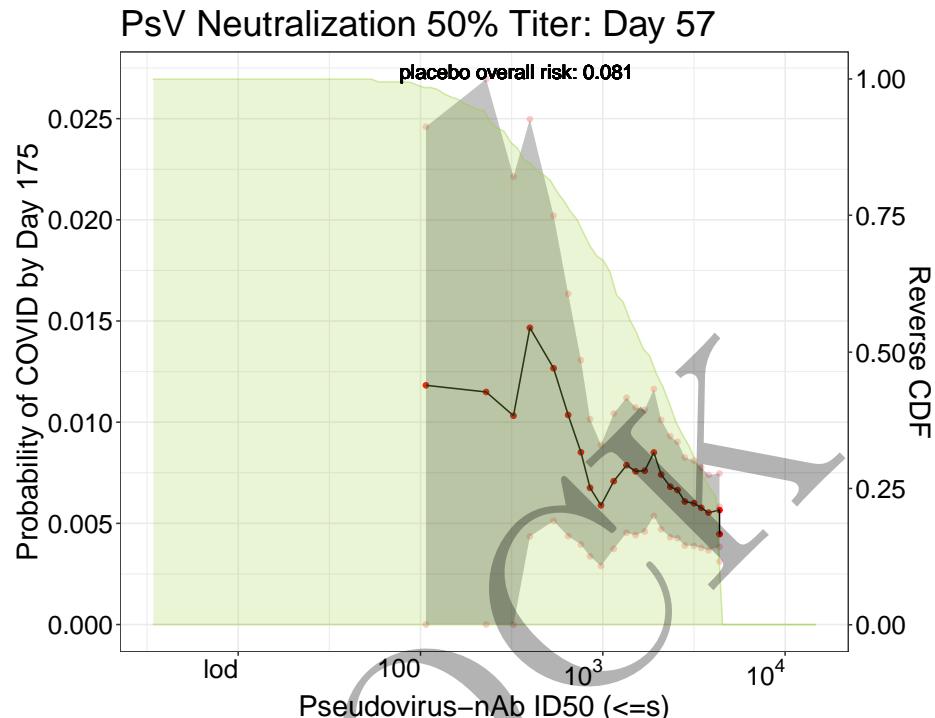


Figure 6.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.01182	0.00000	0.02460
2.509	$3.23 * 10^2$	0.01032	0.00000	0.02214
2.814	$6.52 * 10^2$	0.01036	0.00437	0.01635
2.931	$8.53 * 10^2$	0.00676	0.00337	0.01015
3.132	$1.36 * 10^3$	0.00787	0.00453	0.01121
3.234	$1.71 * 10^3$	0.00760	0.00459	0.01061
3.367	$2.33 * 10^3$	0.00681	0.00432	0.00931
3.455	$2.85 * 10^3$	0.00608	0.00391	0.00825
3.583	$3.83 * 10^3$	0.00553	0.00367	0.00739
3.644	$4.41 * 10^3$	0.00447	0.00312	0.00583

### 6.1.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

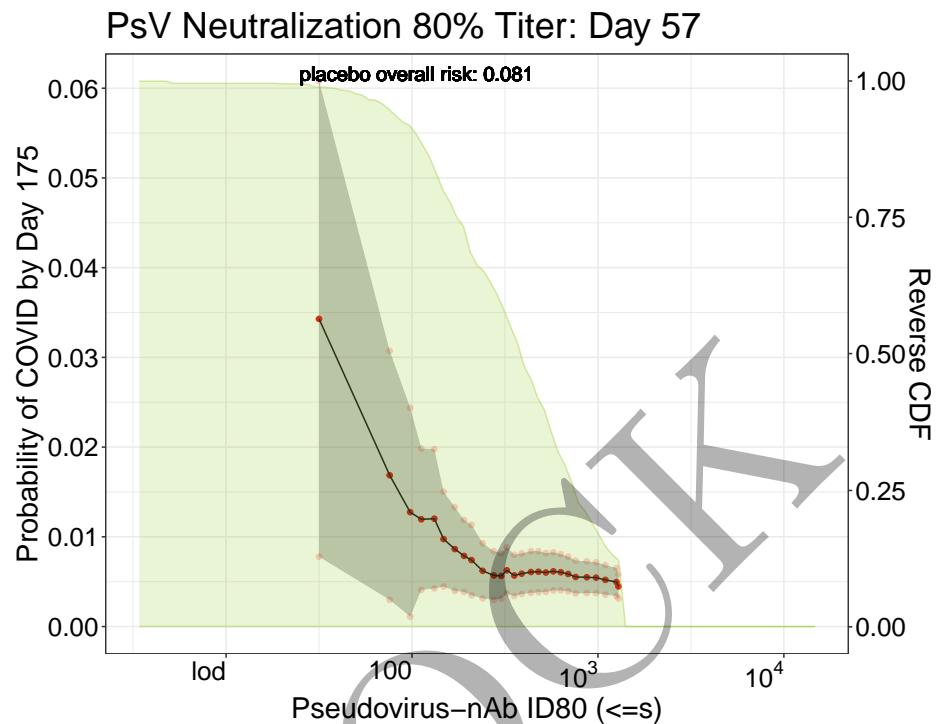


Figure 6.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.03428	0.00778	0.06078
2.048	$1.12 * 10^2$	0.01195	0.00407	0.01983
2.230	$1.70 * 10^2$	0.00863	0.00396	0.01330
2.379	$2.39 * 10^2$	0.00621	0.00314	0.00928
2.515	$3.27 * 10^2$	0.00627	0.00369	0.00884
2.588	$3.87 * 10^2$	0.00589	0.00363	0.00816
2.719	$5.24 * 10^2$	0.00602	0.00386	0.00819
2.836	$6.85 * 10^2$	0.00586	0.00393	0.00779
2.994	$9.86 * 10^2$	0.00545	0.00373	0.00716
3.112	$1.29 * 10^3$	0.00447	0.00312	0.00583

## 6.2 Plots and Tables with estimates and pointwise confidence intervals for Day 29

MOCK

### 6.2.1 Day 29 Spike protein antibody

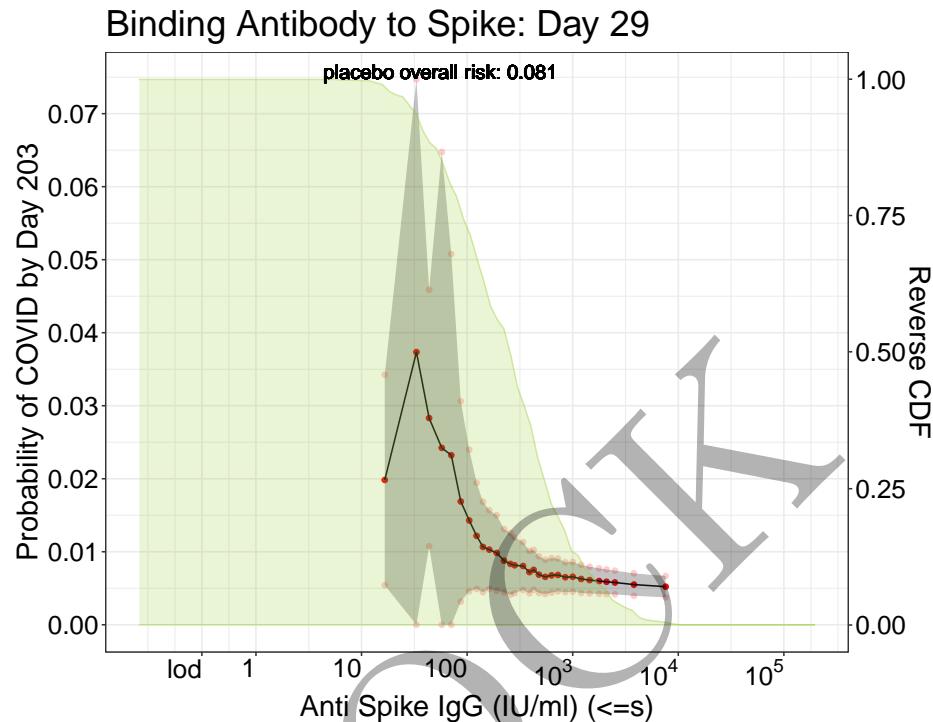


Figure 6.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.01983	0.00541	0.03425
1.756	$5.70 * 10^1$	0.02423	0.00000	0.06476
2.024	$1.06 * 10^2$	0.01429	0.00459	0.02398
2.281	$1.91 * 10^2$	0.00983	0.00466	0.01500
2.454	$2.84 * 10^2$	0.00815	0.00433	0.01197
2.632	$4.29 * 10^2$	0.00752	0.00480	0.01025
2.797	$6.27 * 10^2$	0.00677	0.00441	0.00912
3.078	$1.20 * 10^3$	0.00627	0.00435	0.00820
3.321	$2.09 * 10^3$	0.00589	0.00421	0.00757
3.882	$7.62 * 10^3$	0.00522	0.00376	0.00668

### 6.2.2 Day 29 RBD binding antibody

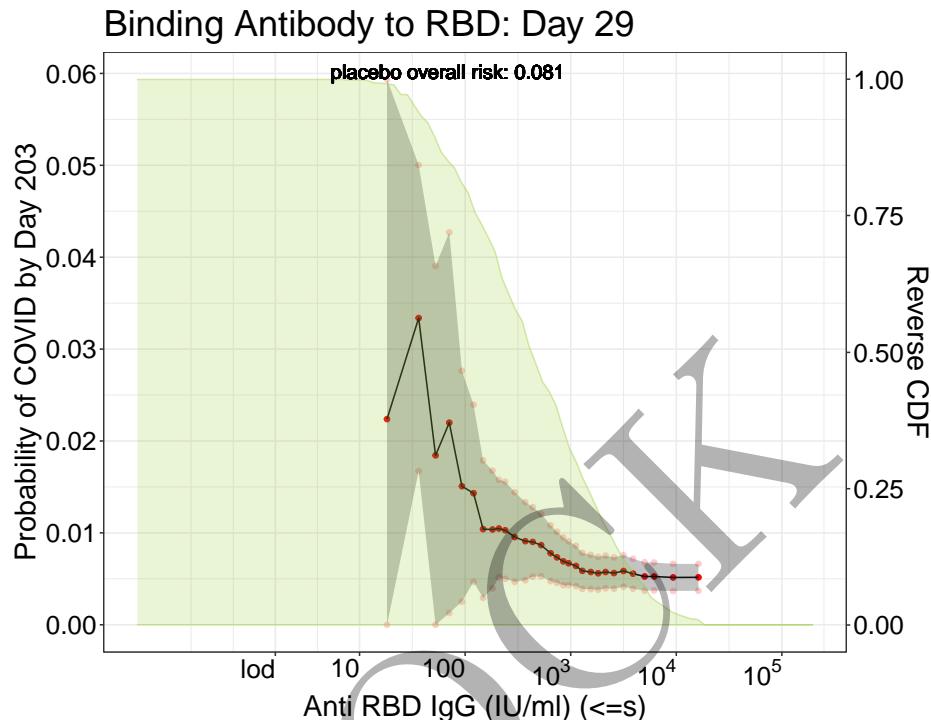


Figure 6.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.02238	0.00000	0.05935
1.854	$7.14 * 10^1$	0.02199	0.00128	0.04271
2.173	$1.49 * 10^2$	0.01041	0.00292	0.01789
2.475	$2.99 * 10^2$	0.00955	0.00467	0.01442
2.720	$5.25 * 10^2$	0.00867	0.00526	0.01207
2.931	$8.53 * 10^2$	0.00691	0.00430	0.00951
3.109	$1.29 * 10^3$	0.00587	0.00391	0.00783
3.410	$2.57 * 10^3$	0.00563	0.00392	0.00733
3.695	$4.95 * 10^3$	0.00525	0.00371	0.00680
4.211	$1.63 * 10^4$	0.00516	0.00371	0.00662

### 6.2.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

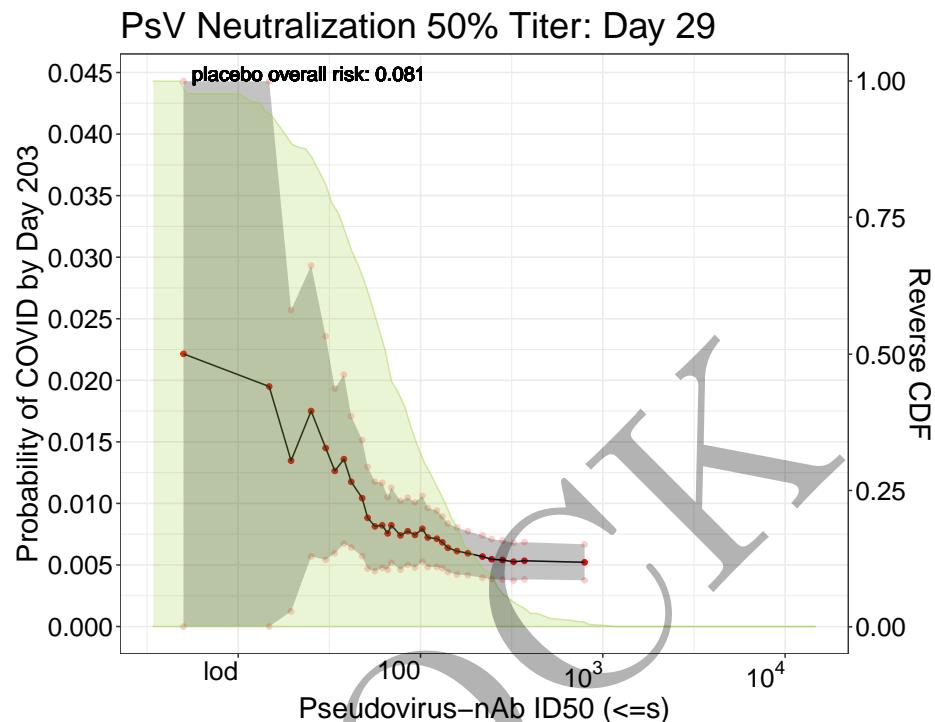


Figure 6.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	5.00 * 10 <sup>0</sup>	0.02215	0.00000	0.05842
1.405	2.54 * 10 <sup>1</sup>	0.01750	0.00569	0.02932
1.583	3.83 * 10 <sup>1</sup>	0.01360	0.00673	0.02046
1.749	5.61 * 10 <sup>1</sup>	0.00814	0.00451	0.01177
1.839	6.90 * 10 <sup>1</sup>	0.00822	0.00518	0.01127
1.966	9.25 * 10 <sup>1</sup>	0.00744	0.00479	0.01008
2.089	1.23 * 10 <sup>2</sup>	0.00713	0.00484	0.00942
2.261	1.82 * 10 <sup>2</sup>	0.00595	0.00417	0.00774
2.448	2.81 * 10 <sup>2</sup>	0.00540	0.00382	0.00698
2.904	8.02 * 10 <sup>2</sup>	0.00522	0.00376	0.00668

### 6.2.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

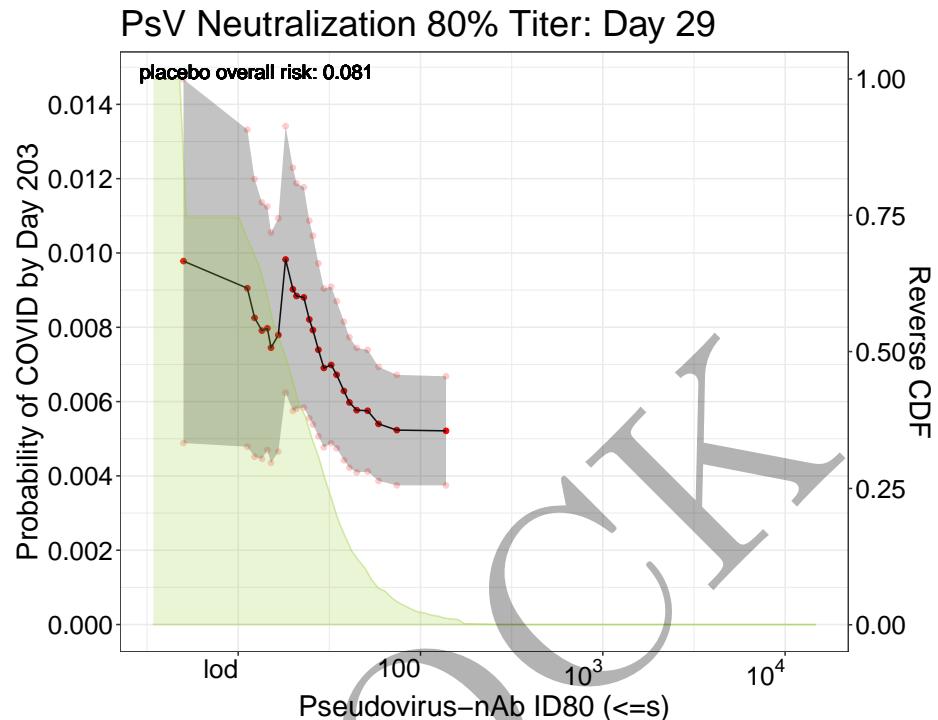


Figure 6.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00978	0.00489	0.01468
1.131	$1.35 * 10^1$	0.00791	0.00446	0.01136
1.183	$1.52 * 10^1$	0.00745	0.00435	0.01055
1.296	$1.98 * 10^1$	0.00902	0.00575	0.01229
1.358	$2.28 * 10^1$	0.00880	0.00584	0.01177
1.442	$2.77 * 10^1$	0.00739	0.00507	0.00972
1.508	$3.22 * 10^1$	0.00699	0.00488	0.00909
1.612	$4.09 * 10^1$	0.00598	0.00422	0.00774
1.709	$5.12 * 10^1$	0.00575	0.00412	0.00739
2.144	$1.39 * 10^2$	0.00521	0.00374	0.00668

### 6.3 Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected)

MOCK

### 6.3.1 Day 57 Spike protein binding antibody

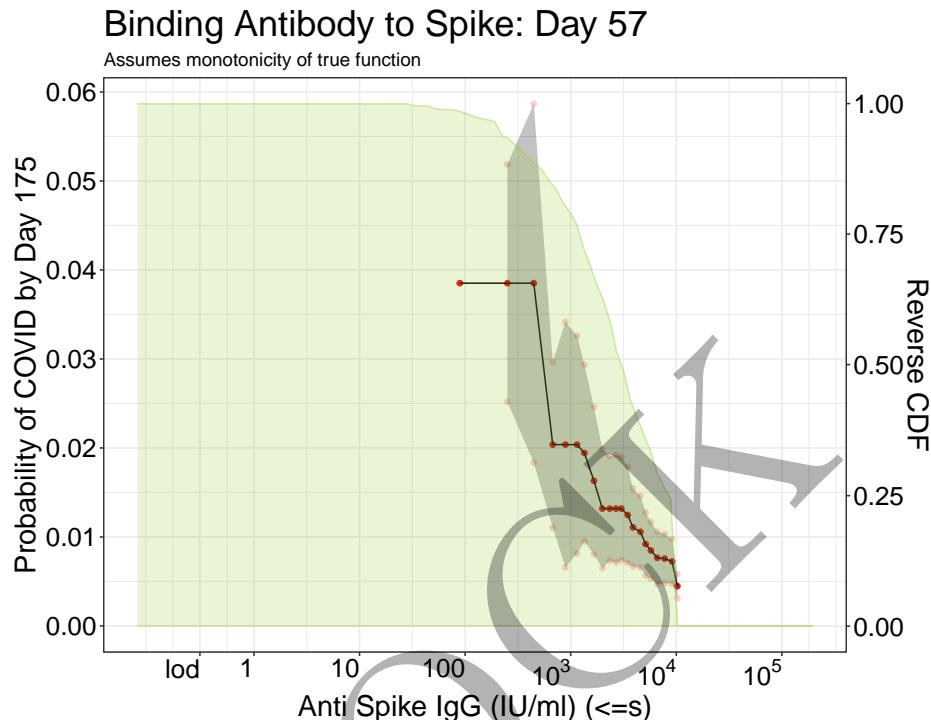


Figure 6.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.03852	0.03852	NA
2.653	$4.50 * 10^2$	0.03852	0.01836	0.05867
2.953	$8.97 * 10^2$	0.02037	0.00659	0.03416
3.221	$1.66 * 10^3$	0.01631	0.00803	0.02458
3.365	$2.32 * 10^3$	0.01318	0.00731	0.01905
3.483	$3.04 * 10^3$	0.01318	0.00737	0.01900
3.595	$3.94 * 10^3$	0.01107	0.00668	0.01546
3.757	$5.71 * 10^3$	0.00848	0.00530	0.01166
3.894	$7.83 * 10^3$	0.00756	0.00479	0.01033
4.007	$1.02 * 10^4$	0.00447	0.00312	0.00583

### 6.3.2 Day 57 RBD binding antibody

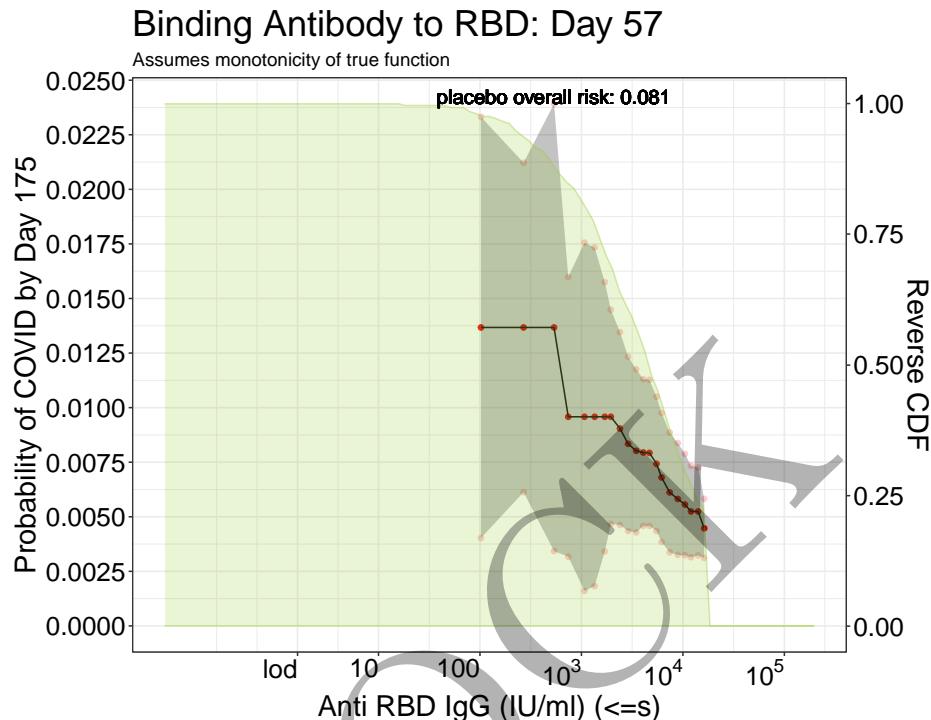


Figure 6.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.01367	0.00403	0.02332
2.727	$5.33 * 10^2$	0.01367	0.00343	0.02392
3.032	$1.08 * 10^3$	0.00958	0.00161	0.01756
3.295	$1.97 * 10^3$	0.00958	0.00467	0.01449
3.462	$2.90 * 10^3$	0.00834	0.00435	0.01233
3.615	$4.12 * 10^3$	0.00794	0.00459	0.01130
3.739	$5.48 * 10^3$	0.00743	0.00435	0.01050
3.946	$8.83 * 10^3$	0.00582	0.00325	0.00838
4.079	$1.20 * 10^4$	0.00524	0.00315	0.00734
4.211	$1.63 * 10^4$	0.00447	0.00312	0.00583

### 6.3.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

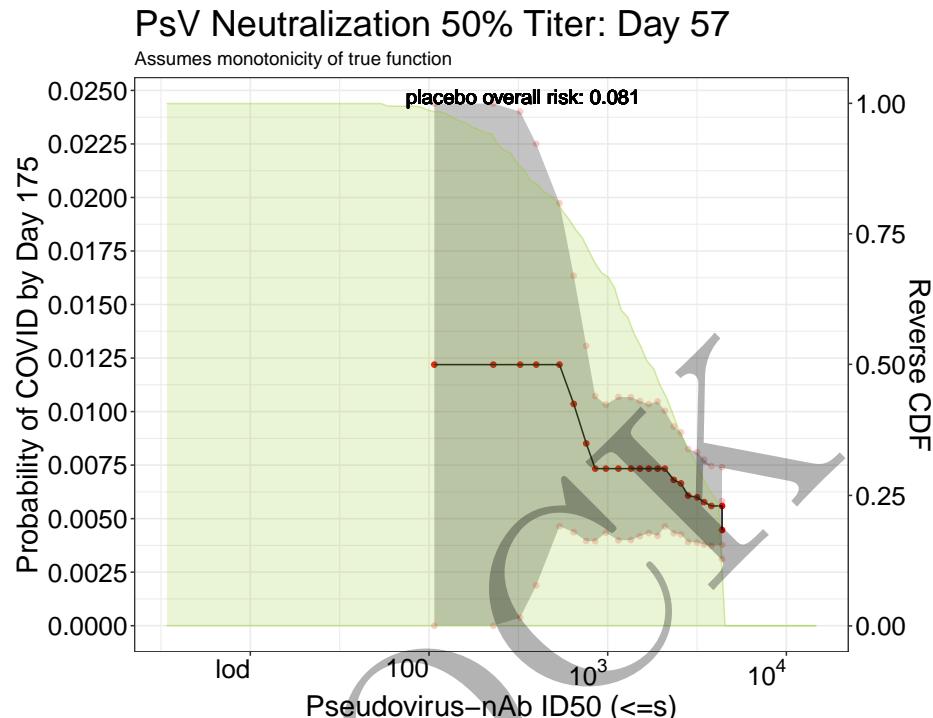


Figure 6.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.01219	0.00000	0.02497
2.509	$3.23 * 10^2$	0.01219	0.00038	0.02401
2.814	$6.52 * 10^2$	0.01036	0.00437	0.01635
2.931	$8.53 * 10^2$	0.00734	0.00395	0.01072
3.132	$1.36 * 10^3$	0.00734	0.00400	0.01067
3.234	$1.71 * 10^3$	0.00734	0.00433	0.01035
3.367	$2.33 * 10^3$	0.00681	0.00432	0.00931
3.455	$2.85 * 10^3$	0.00608	0.00391	0.00825
3.583	$3.83 * 10^3$	0.00559	0.00373	0.00745
3.644	$4.41 * 10^3$	0.00447	0.00312	0.00583

### 6.3.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

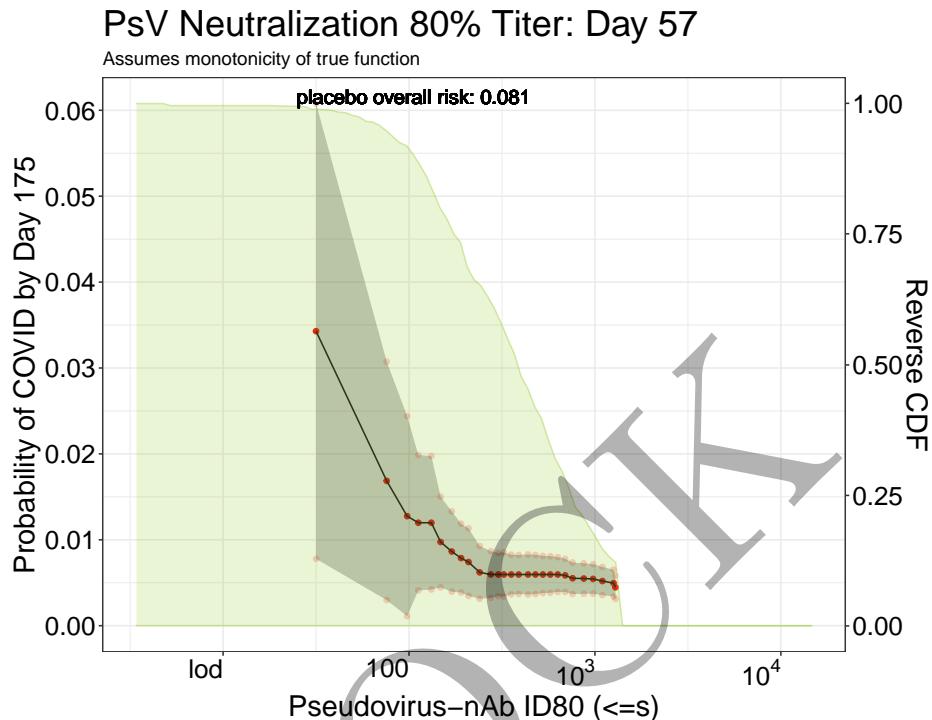


Figure 6.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.03428	0.00778	0.06078
2.048	$1.12 * 10^2$	0.01199	0.00411	0.01987
2.230	$1.70 * 10^2$	0.00863	0.00396	0.01330
2.379	$2.39 * 10^2$	0.00621	0.00314	0.00928
2.515	$3.27 * 10^2$	0.00596	0.00339	0.00853
2.588	$3.87 * 10^2$	0.00596	0.00369	0.00823
2.719	$5.24 * 10^2$	0.00596	0.00380	0.00812
2.836	$6.85 * 10^2$	0.00586	0.00393	0.00779
2.994	$9.86 * 10^2$	0.00545	0.00373	0.00716
3.112	$1.29 * 10^3$	0.00447	0.00312	0.00583

## 6.4 Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected)

MOCK

### 6.4.1 Day 29 Spike protein antibody

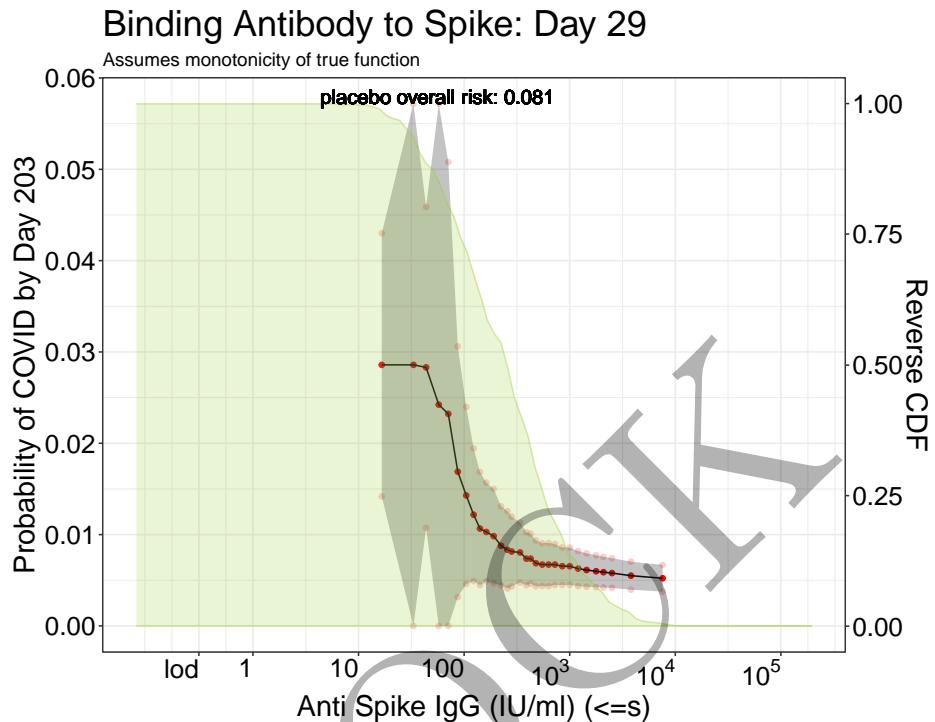


Figure 6.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.02859	0.01417	0.04300
1.756	$5.70 * 10^1$	0.02423	0.00000	0.06476
2.024	$1.06 * 10^2$	0.01429	0.00459	0.02398
2.281	$1.91 * 10^2$	0.00983	0.00466	0.01500
2.454	$2.84 * 10^2$	0.00815	0.00433	0.01197
2.632	$4.29 * 10^2$	0.00737	0.00464	0.01009
2.797	$6.27 * 10^2$	0.00672	0.00436	0.00907
3.078	$1.20 * 10^3$	0.00627	0.00435	0.00820
3.321	$2.09 * 10^3$	0.00589	0.00421	0.00757
3.882	$7.62 * 10^3$	0.00522	0.00376	0.00668

### 6.4.2 Day 29 RBD binding antibody

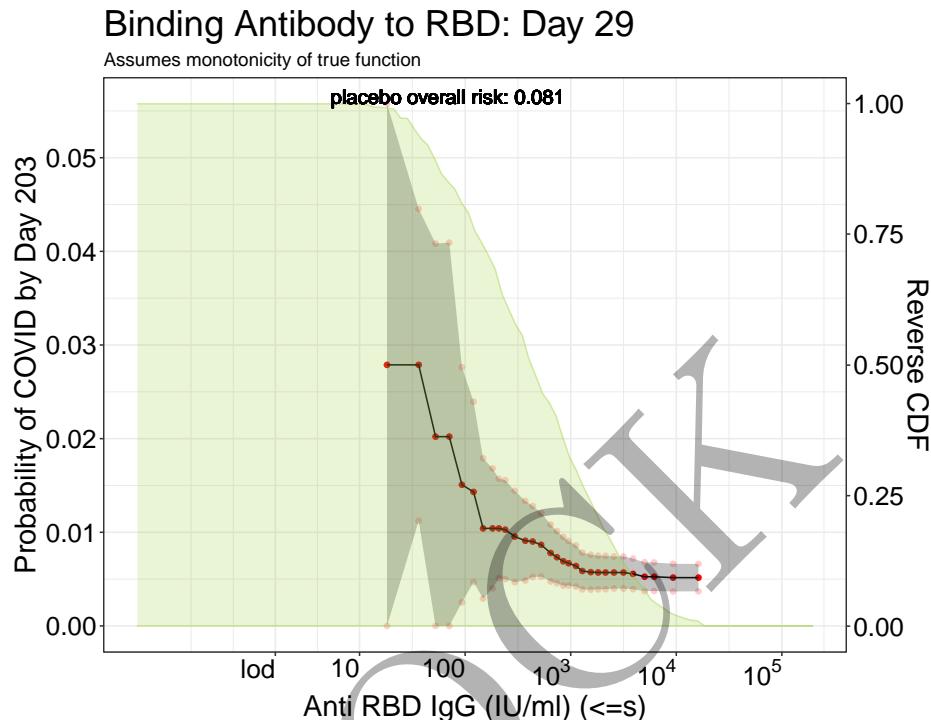


Figure 6.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.02788	0.00000	0.06485
1.854	$7.14 * 10^1$	0.02021	0.00000	0.04093
2.173	$1.49 * 10^2$	0.01041	0.00293	0.01790
2.475	$2.99 * 10^2$	0.00955	0.00467	0.01442
2.720	$5.25 * 10^2$	0.00867	0.00526	0.01207
2.931	$8.53 * 10^2$	0.00691	0.00430	0.00951
3.109	$1.29 * 10^3$	0.00587	0.00391	0.00783
3.410	$2.57 * 10^3$	0.00570	0.00400	0.00741
3.695	$4.95 * 10^3$	0.00525	0.00371	0.00680
4.211	$1.63 * 10^4$	0.00516	0.00370	0.00662

### 6.4.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

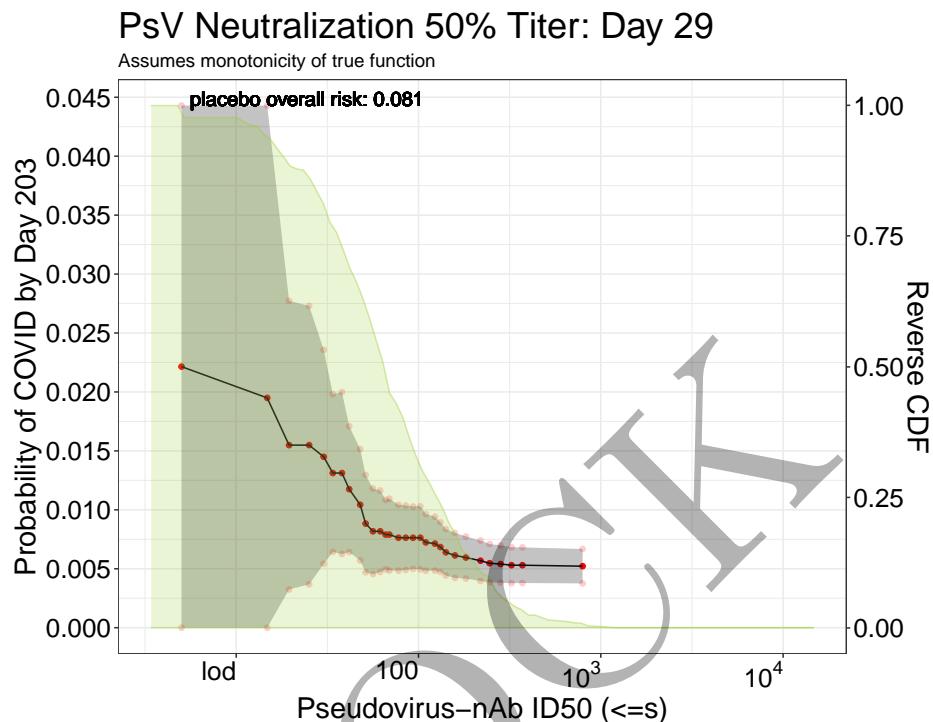


Figure 6.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.02215	0.00000	0.05842
1.405	$2.54 * 10^1$	0.01549	0.00368	0.02730
1.583	$3.83 * 10^1$	0.01312	0.00625	0.01998
1.749	$5.61 * 10^1$	0.00818	0.00455	0.01181
1.839	$6.90 * 10^1$	0.00790	0.00485	0.01094
1.966	$9.25 * 10^1$	0.00763	0.00499	0.01028
2.089	$1.23 * 10^2$	0.00713	0.00484	0.00942
2.261	$1.82 * 10^2$	0.00595	0.00417	0.00774
2.448	$2.81 * 10^2$	0.00540	0.00382	0.00698
2.904	$8.02 * 10^2$	0.00522	0.00376	0.00668

#### 6.4.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

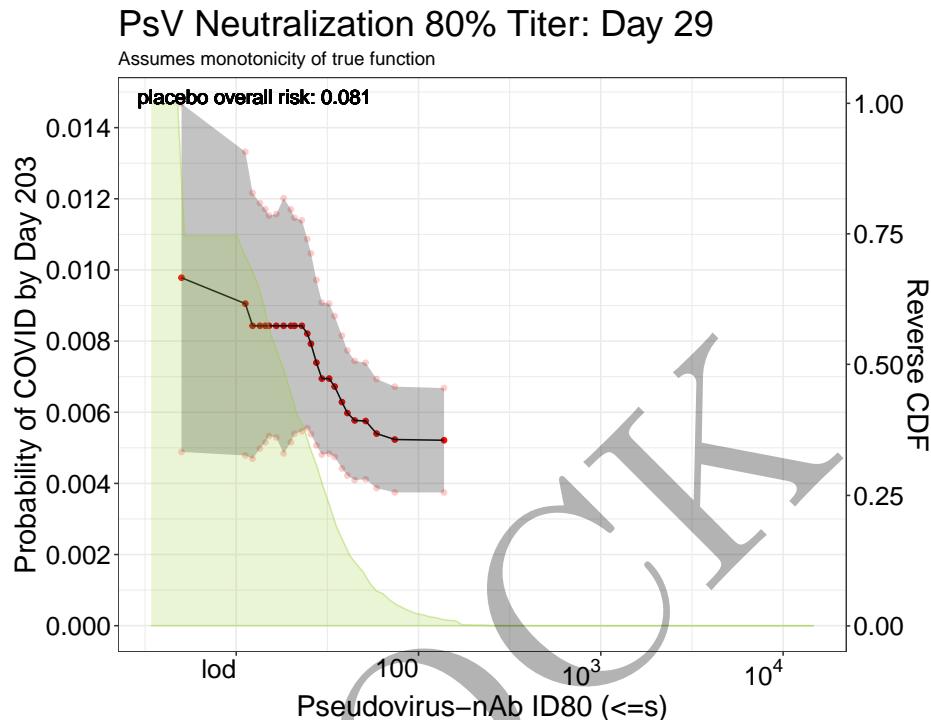


Figure 6.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00978	0.00489	0.01468
1.131	$1.35 * 10^1$	0.00843	0.00498	0.01188
1.183	$1.52 * 10^1$	0.00843	0.00533	0.01153
1.296	$1.98 * 10^1$	0.00843	0.00516	0.01170
1.358	$2.28 * 10^1$	0.00843	0.00547	0.01140
1.442	$2.77 * 10^1$	0.00739	0.00507	0.00972
1.508	$3.22 * 10^1$	0.00695	0.00484	0.00905
1.612	$4.09 * 10^1$	0.00598	0.00422	0.00774
1.709	$5.12 * 10^1$	0.00575	0.00412	0.00739
2.144	$1.39 * 10^2$	0.00521	0.00374	0.00668

## 6.5 Plots and Tables with estimates and simultaneous confidence bands for Day 57

MOCK

### 6.5.1 Day 57 Spike protein binding antibody

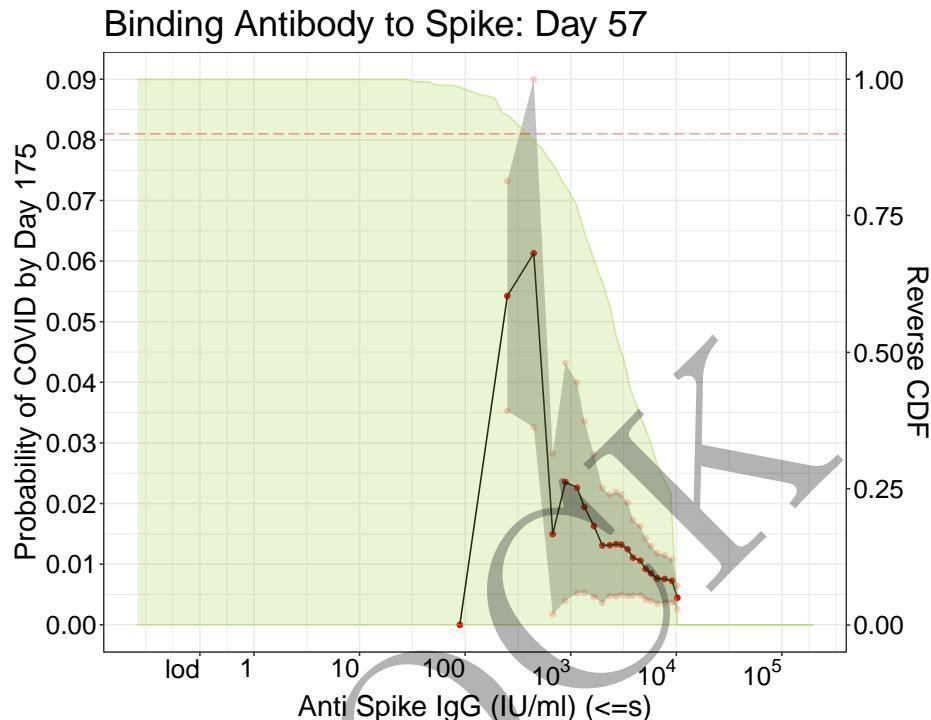


Figure 6.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.00000	0.00000	NA
2.653	$4.50 * 10^2$	0.06129	0.03261	0.08997
2.953	$8.97 * 10^2$	0.02356	0.00395	0.04317
3.221	$1.66 * 10^3$	0.01631	0.00454	0.02808
3.365	$2.32 * 10^3$	0.01313	0.00478	0.02148
3.483	$3.04 * 10^3$	0.01321	0.00494	0.02148
3.595	$3.94 * 10^3$	0.01107	0.00482	0.01732
3.757	$5.71 * 10^3$	0.00848	0.00396	0.01301
3.894	$7.83 * 10^3$	0.00756	0.00362	0.01150
4.007	$1.02 * 10^4$	0.00447	0.00254	0.00640

### 6.5.2 Day 57 RBD binding antibody

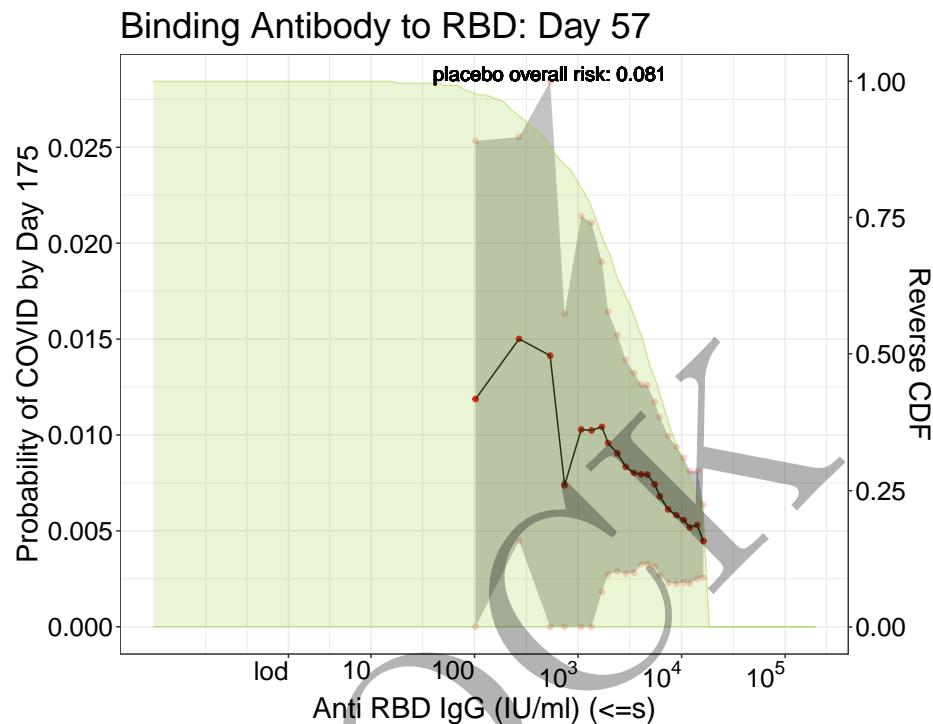


Figure 6.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.01187	0.00000	0.02533
2.727	$5.33 * 10^2$	0.01414	0.00000	0.02843
3.032	$1.08 * 10^3$	0.01028	0.00000	0.02141
3.295	$1.97 * 10^3$	0.00958	0.00274	0.01643
3.462	$2.90 * 10^3$	0.00834	0.00277	0.01391
3.615	$4.12 * 10^3$	0.00794	0.00326	0.01263
3.739	$5.48 * 10^3$	0.00743	0.00314	0.01172
3.946	$8.83 * 10^3$	0.00582	0.00224	0.00939
4.079	$1.20 * 10^4$	0.00519	0.00226	0.00811
4.211	$1.63 * 10^4$	0.00447	0.00258	0.00636

### 6.5.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

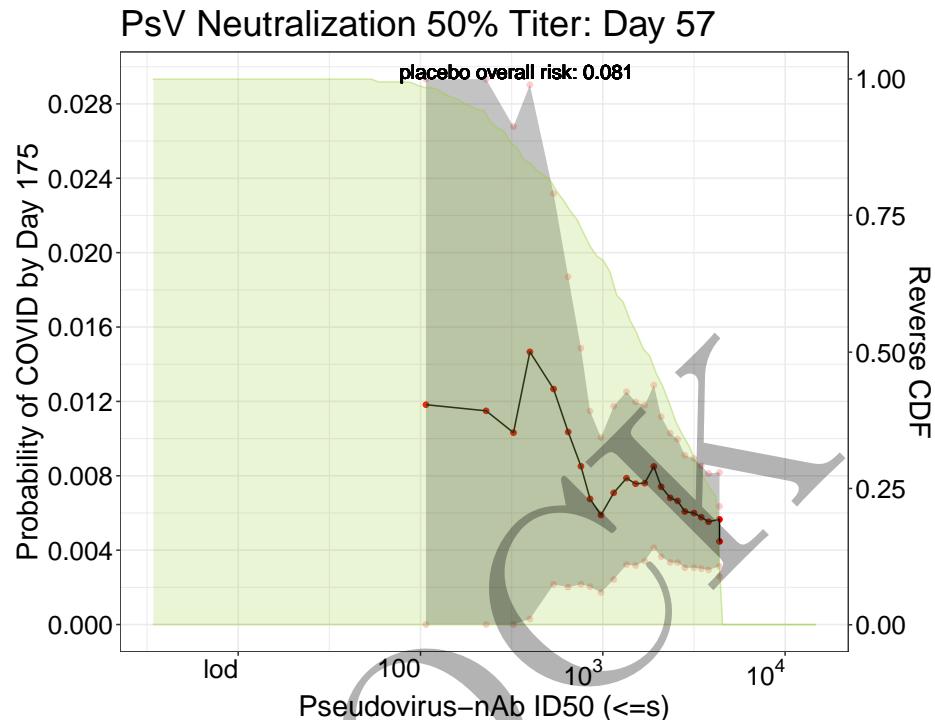


Figure 6.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.01182	0.00000	0.02962
2.509	$3.23 * 10^2$	0.01032	0.00000	0.02678
2.814	$6.52 * 10^2$	0.01036	0.00201	0.01870
2.931	$8.53 * 10^2$	0.00676	0.00204	0.01148
3.132	$1.36 * 10^3$	0.00787	0.00322	0.01252
3.234	$1.71 * 10^3$	0.00760	0.00341	0.01180
3.367	$2.33 * 10^3$	0.00681	0.00334	0.01029
3.455	$2.85 * 10^3$	0.00608	0.00305	0.00911
3.583	$3.83 * 10^3$	0.00553	0.00294	0.00812
3.644	$4.41 * 10^3$	0.00447	0.00258	0.00636

#### 6.5.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

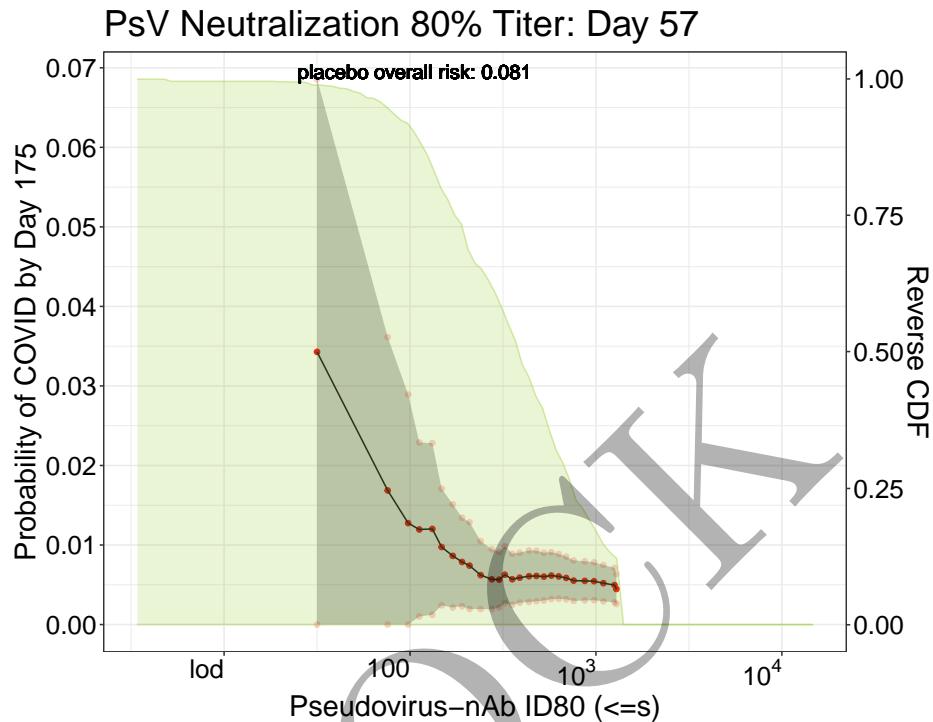


Figure 6.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.03428	0.00000	0.07108
2.048	$1.12 * 10^2$	0.01195	0.00101	0.02290
2.230	$1.70 * 10^2$	0.00863	0.00215	0.01512
2.379	$2.39 * 10^2$	0.00621	0.00194	0.01048
2.515	$3.27 * 10^2$	0.00627	0.00269	0.00984
2.588	$3.87 * 10^2$	0.00589	0.00274	0.00904
2.719	$5.24 * 10^2$	0.00602	0.00302	0.00903
2.836	$6.85 * 10^2$	0.00586	0.00317	0.00854
2.994	$9.86 * 10^2$	0.00545	0.00306	0.00783
3.112	$1.29 * 10^3$	0.00447	0.00259	0.00635

## 6.6 Plots and Tables with estimates and simultaneous confidence bands for Day 29

MOCK

### 6.6.1 Day 29 Spike protein antibody

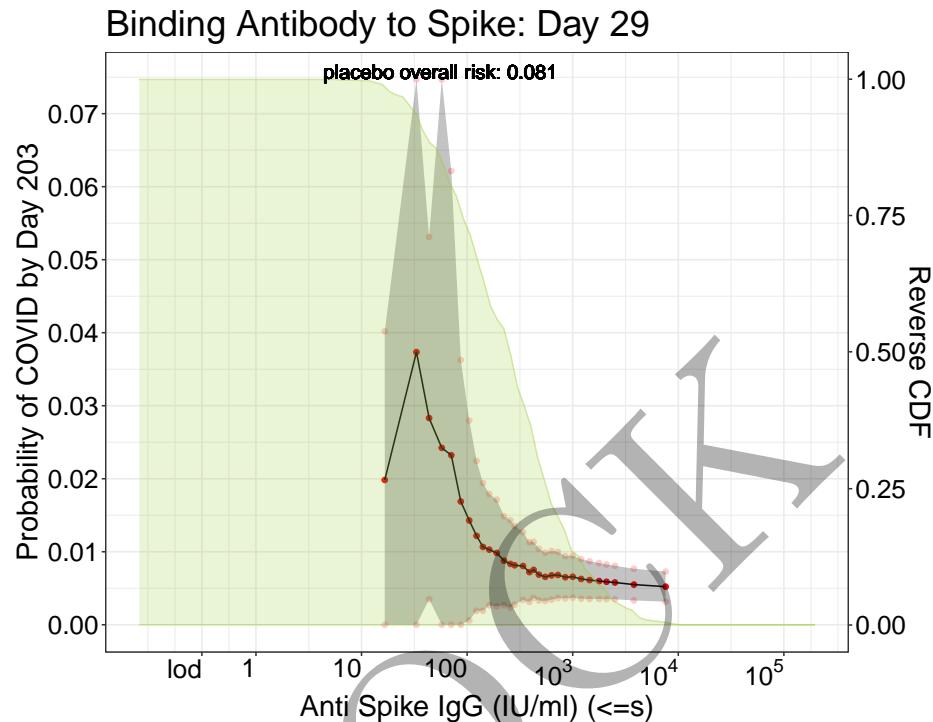


Figure 6.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.01983	0.00000	0.04018
1.756	$5.70 * 10^1$	0.02423	0.00000	0.08145
2.024	$1.06 * 10^2$	0.01429	0.00060	0.02797
2.281	$1.91 * 10^2$	0.00983	0.00254	0.01713
2.454	$2.84 * 10^2$	0.00815	0.00276	0.01354
2.632	$4.29 * 10^2$	0.00752	0.00368	0.01137
2.797	$6.27 * 10^2$	0.00677	0.00344	0.01009
3.078	$1.20 * 10^3$	0.00627	0.00356	0.00899
3.321	$2.09 * 10^3$	0.00589	0.00351	0.00826
3.882	$7.62 * 10^3$	0.00522	0.00316	0.00728

### 6.6.2 Day 29 RBD binding antibody

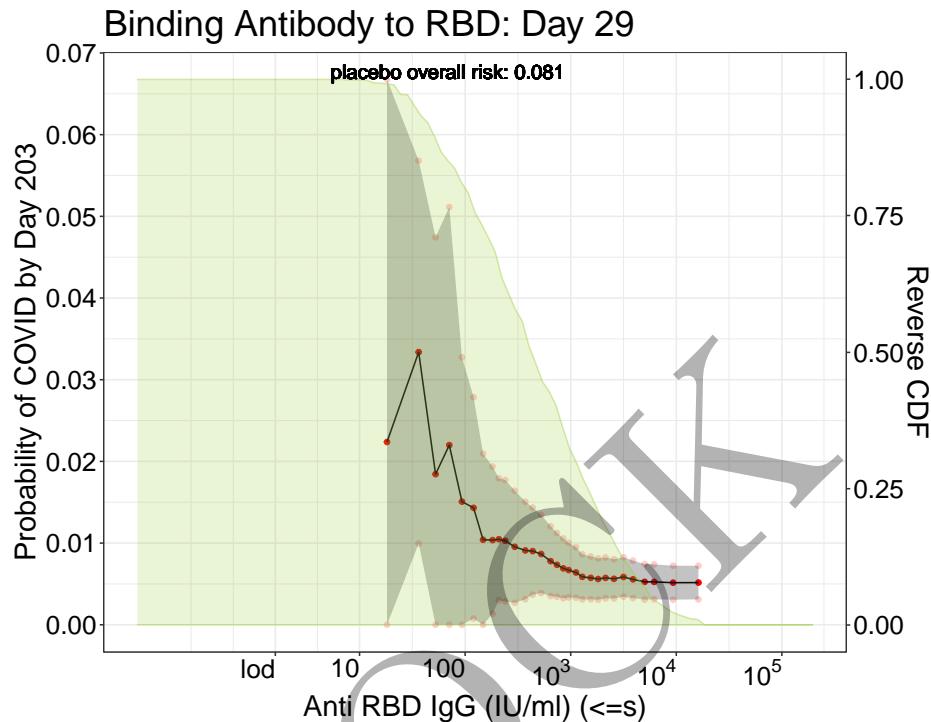


Figure 6.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.02238	0.00000	0.07438
1.854	$7.14 * 10^1$	0.02199	0.00000	0.05113
2.173	$1.49 * 10^2$	0.01041	0.00000	0.02094
2.475	$2.99 * 10^2$	0.00955	0.00268	0.01641
2.720	$5.25 * 10^2$	0.00867	0.00388	0.01345
2.931	$8.53 * 10^2$	0.00691	0.00324	0.01057
3.109	$1.29 * 10^3$	0.00587	0.00311	0.00863
3.410	$2.57 * 10^3$	0.00563	0.00323	0.00803
3.695	$4.95 * 10^3$	0.00525	0.00309	0.00742
4.211	$1.63 * 10^4$	0.00516	0.00311	0.00722

### 6.6.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

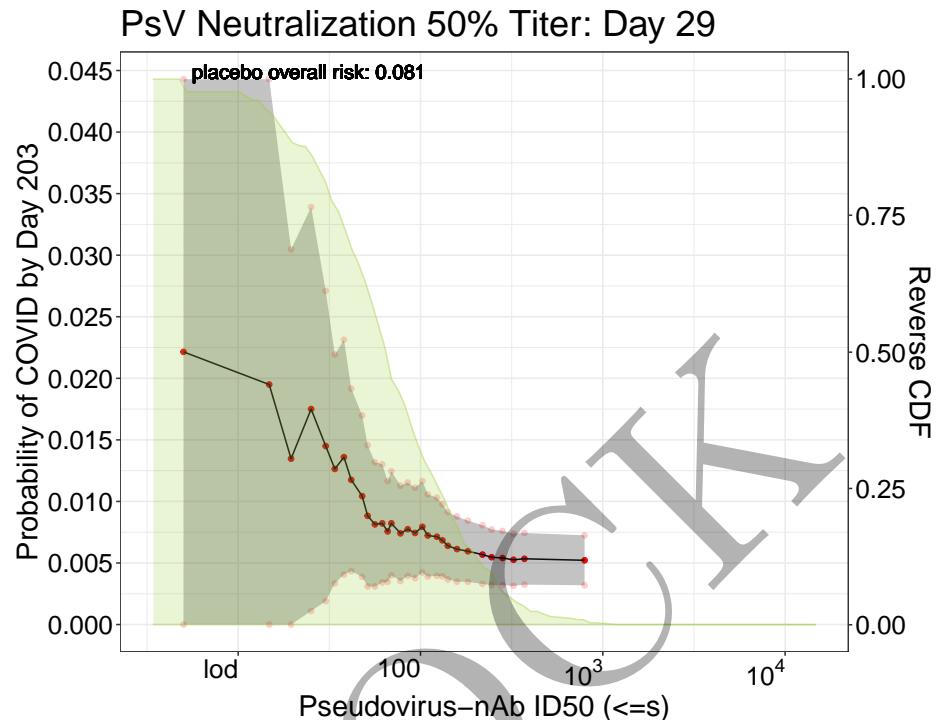


Figure 6.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.02215	0.00000	0.07252
1.405	$2.54 * 10^1$	0.01750	0.00110	0.03391
1.583	$3.83 * 10^1$	0.01360	0.00406	0.02313
1.749	$5.61 * 10^1$	0.00814	0.00309	0.01318
1.839	$6.90 * 10^1$	0.00822	0.00399	0.01246
1.966	$9.25 * 10^1$	0.00744	0.00376	0.01111
2.089	$1.23 * 10^2$	0.00713	0.00396	0.01031
2.261	$1.82 * 10^2$	0.00595	0.00347	0.00844
2.448	$2.81 * 10^2$	0.00540	0.00320	0.00760
2.904	$8.02 * 10^2$	0.00522	0.00319	0.00725

#### 6.6.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

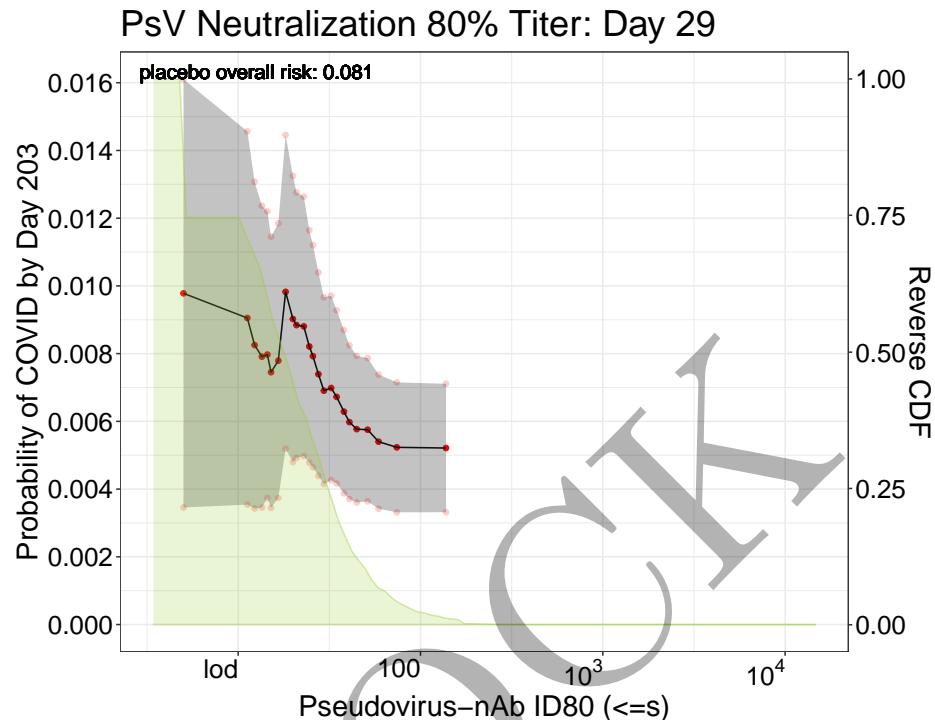


Figure 6.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00978	0.00346	0.01610
1.131	$1.35 * 10^1$	0.00791	0.00345	0.01237
1.183	$1.52 * 10^1$	0.00745	0.00345	0.01146
1.296	$1.98 * 10^1$	0.00902	0.00480	0.01325
1.358	$2.28 * 10^1$	0.00880	0.00497	0.01263
1.442	$2.77 * 10^1$	0.00739	0.00439	0.01040
1.508	$3.22 * 10^1$	0.00699	0.00426	0.00971
1.612	$4.09 * 10^1$	0.00598	0.00371	0.00825
1.709	$5.12 * 10^1$	0.00575	0.00364	0.00787
2.144	$1.39 * 10^2$	0.00521	0.00332	0.00711

## 6.7 Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected)

MOCK

### 6.7.1 Day 57 Spike protein binding antibody

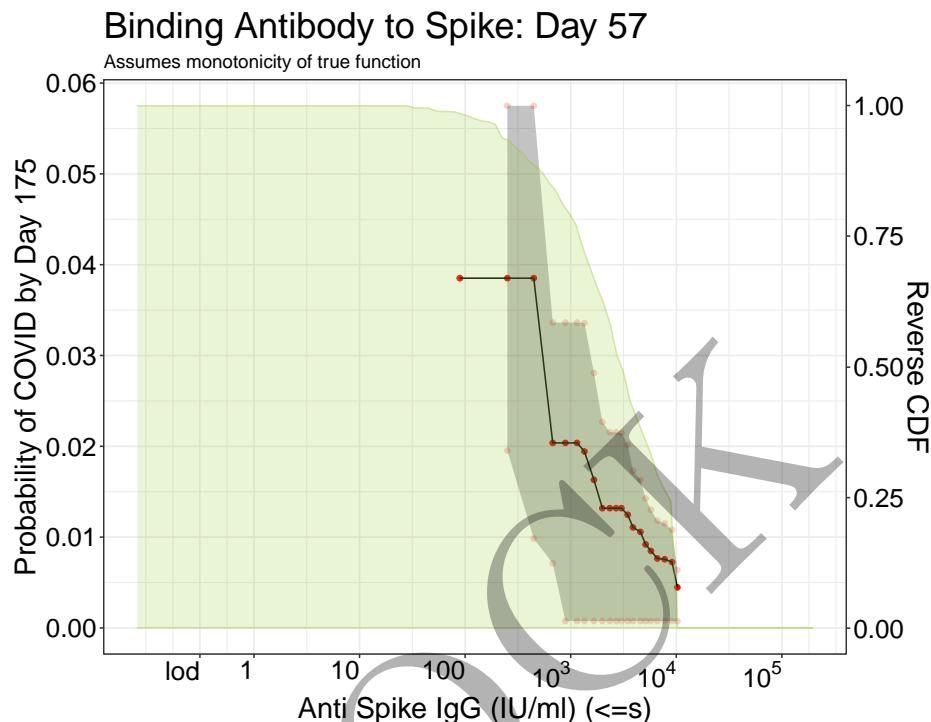


Figure 6.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.955	$9.02 * 10^1$	0.03852	0.03852	NA
2.653	$4.50 * 10^2$	0.03852	0.00983	0.06720
2.953	$8.97 * 10^2$	0.02037	0.00076	0.03998
3.221	$1.66 * 10^3$	0.01631	0.00454	0.02808
3.365	$2.32 * 10^3$	0.01318	0.00483	0.02154
3.483	$3.04 * 10^3$	0.01318	0.00492	0.02145
3.595	$3.94 * 10^3$	0.01107	0.00482	0.01732
3.757	$5.71 * 10^3$	0.00848	0.00396	0.01301
3.894	$7.83 * 10^3$	0.00756	0.00362	0.01150
4.007	$1.02 * 10^4$	0.00447	0.00254	0.00640

### 6.7.2 Day 57 RBD binding antibody

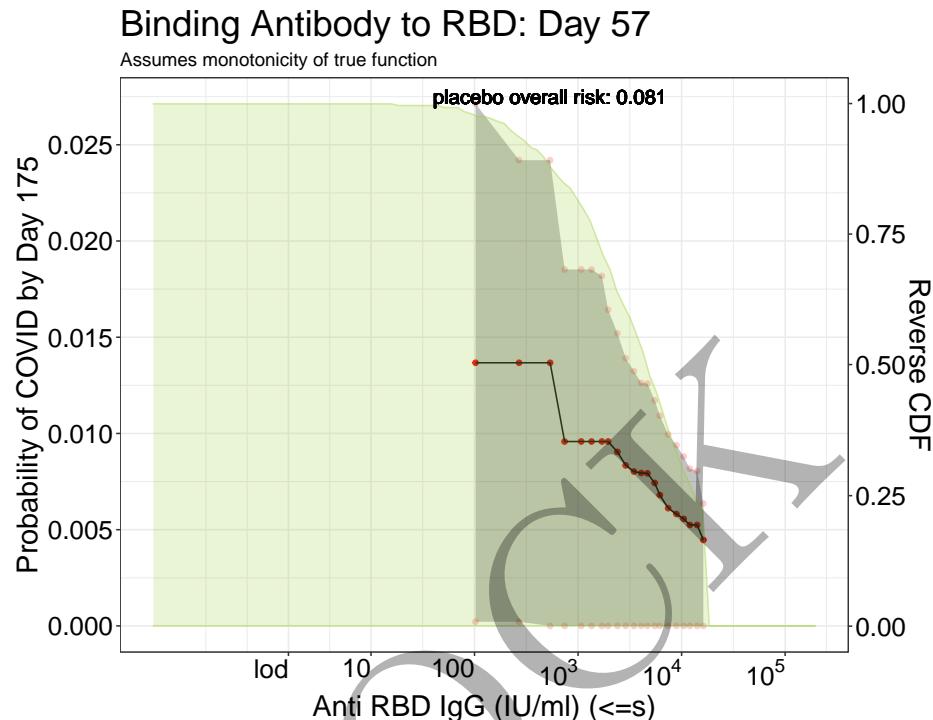


Figure 6.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.010	$1.02 * 10^2$	0.01367	0.00022	0.02713
2.727	$5.33 * 10^2$	0.01367	0.00000	0.02797
3.032	$1.08 * 10^3$	0.00958	0.00000	0.02071
3.295	$1.97 * 10^3$	0.00958	0.00273	0.01643
3.462	$2.90 * 10^3$	0.00834	0.00277	0.01391
3.615	$4.12 * 10^3$	0.00794	0.00326	0.01263
3.739	$5.48 * 10^3$	0.00743	0.00314	0.01172
3.946	$8.83 * 10^3$	0.00582	0.00224	0.00939
4.079	$1.20 * 10^4$	0.00524	0.00232	0.00817
4.211	$1.63 * 10^4$	0.00447	0.00258	0.00636

### 6.7.3 Day 57 Pseudo virus-neutralizing antibody (50% titer)

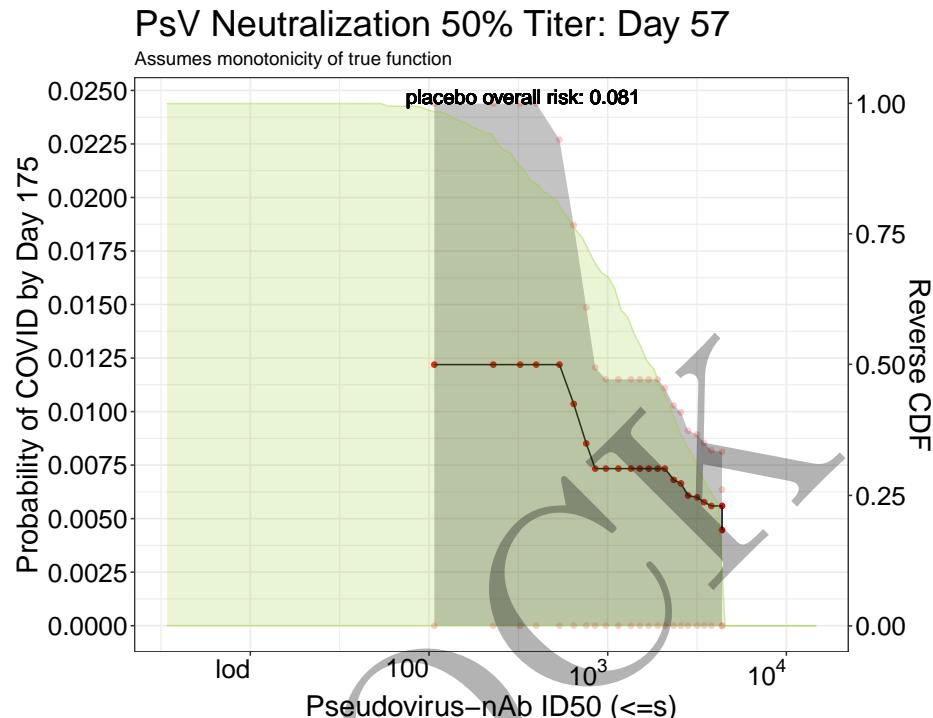


Figure 6.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.030	$1.07 * 10^2$	0.01219	0.00000	0.02999
2.509	$3.23 * 10^2$	0.01219	0.00000	0.02865
2.814	$6.52 * 10^2$	0.01036	0.00201	0.01870
2.931	$8.53 * 10^2$	0.00734	0.00262	0.01206
3.132	$1.36 * 10^3$	0.00734	0.00269	0.01199
3.234	$1.71 * 10^3$	0.00734	0.00314	0.01153
3.367	$2.33 * 10^3$	0.00681	0.00334	0.01029
3.455	$2.85 * 10^3$	0.00608	0.00305	0.00911
3.583	$3.83 * 10^3$	0.00559	0.00300	0.00819
3.644	$4.41 * 10^3$	0.00447	0.00258	0.00636

### 6.7.4 Day 57 Pseudo virus-neutralizing antibody (80% titer)

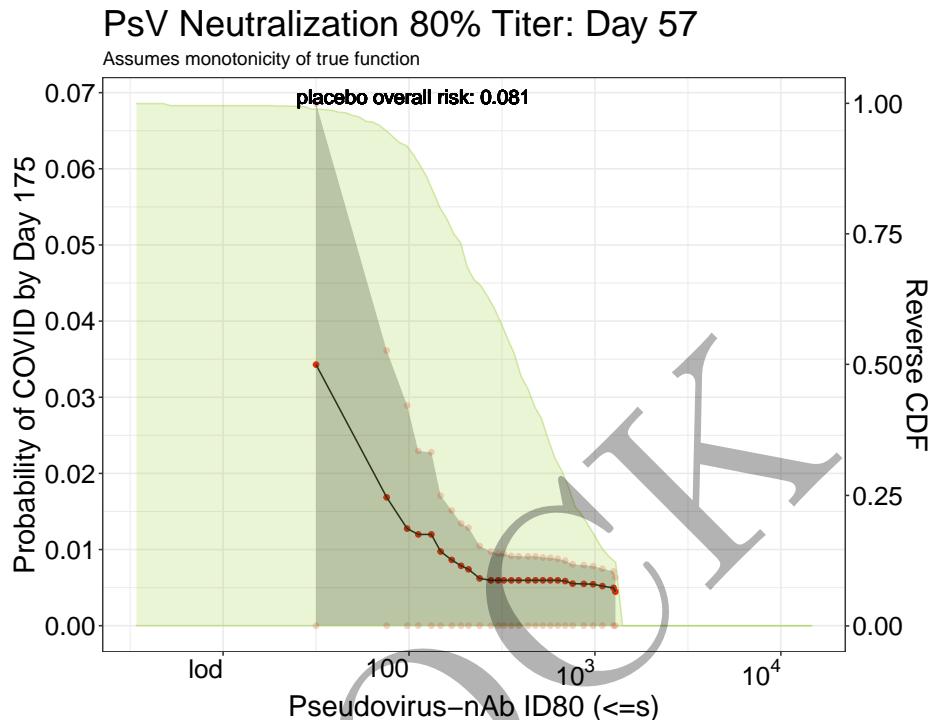


Figure 6.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.501	$3.17 * 10^1$	0.03428	0.00000	0.07108
2.048	$1.12 * 10^2$	0.01199	0.00104	0.02293
2.230	$1.70 * 10^2$	0.00863	0.00215	0.01512
2.379	$2.39 * 10^2$	0.00621	0.00194	0.01048
2.515	$3.27 * 10^2$	0.00596	0.00239	0.00953
2.588	$3.87 * 10^2$	0.00596	0.00281	0.00911
2.719	$5.24 * 10^2$	0.00596	0.00296	0.00896
2.836	$6.85 * 10^2$	0.00586	0.00317	0.00854
2.994	$9.86 * 10^2$	0.00545	0.00306	0.00783
3.112	$1.29 * 10^3$	0.00447	0.00259	0.00635

## 6.8 Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected)

MOCK

### 6.8.1 Day 29 Spike protein antibody

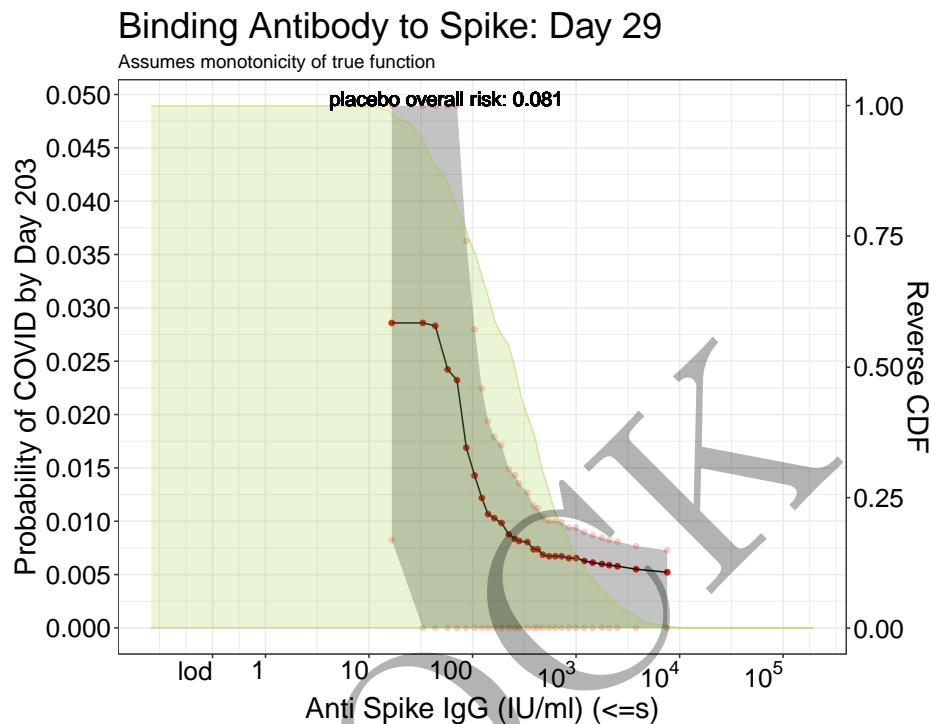


Figure 6.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.225	$1.68 * 10^1$	0.02859	0.00824	0.04894
1.756	$5.70 * 10^1$	0.02423	0.00000	0.08145
2.024	$1.06 * 10^2$	0.01429	0.00060	0.02797
2.281	$1.91 * 10^2$	0.00983	0.00254	0.01713
2.454	$2.84 * 10^2$	0.00815	0.00276	0.01354
2.632	$4.29 * 10^2$	0.00737	0.00352	0.01121
2.797	$6.27 * 10^2$	0.00672	0.00339	0.01004
3.078	$1.20 * 10^3$	0.00627	0.00356	0.00899
3.321	$2.09 * 10^3$	0.00589	0.00351	0.00826
3.882	$7.62 * 10^3$	0.00522	0.00316	0.00728

### 6.8.2 Day 29 RBD binding antibody

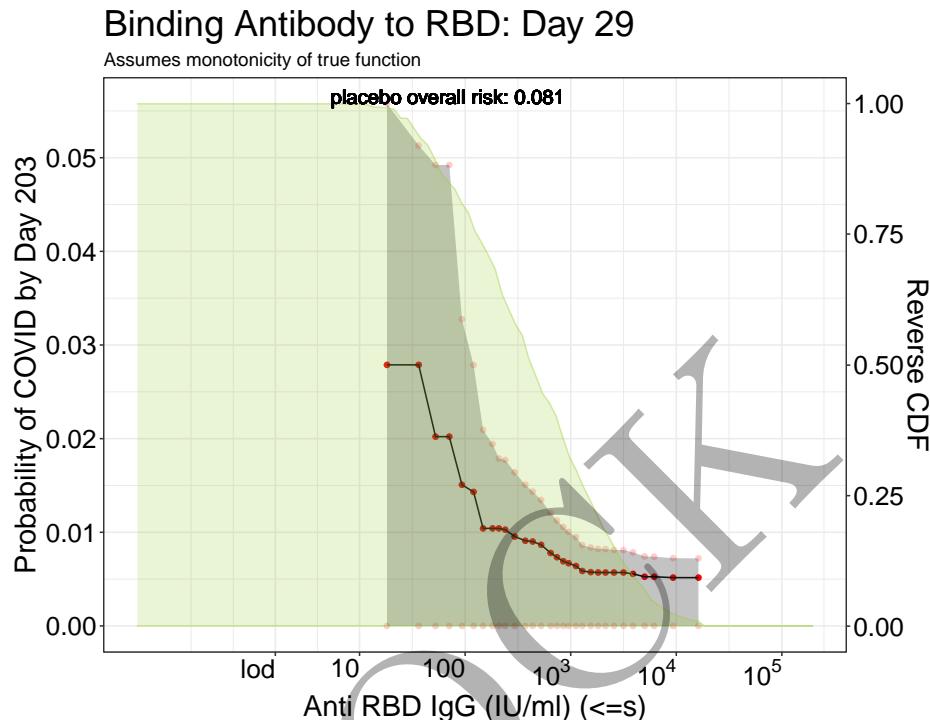


Figure 6.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.262	$1.83 * 10^1$	0.02788	0.00000	0.07988
1.854	$7.14 * 10^1$	0.02021	0.00000	0.04935
2.173	$1.49 * 10^2$	0.01041	0.00000	0.02094
2.475	$2.99 * 10^2$	0.00955	0.00268	0.01641
2.720	$5.25 * 10^2$	0.00867	0.00388	0.01345
2.931	$8.53 * 10^2$	0.00691	0.00324	0.01057
3.109	$1.29 * 10^3$	0.00587	0.00311	0.00863
3.410	$2.57 * 10^3$	0.00570	0.00330	0.00810
3.695	$4.95 * 10^3$	0.00525	0.00309	0.00742
4.211	$1.63 * 10^4$	0.00516	0.00311	0.00721

### 6.8.3 Day 29 Pseudo virus-neutralizing antibody (50% titer)

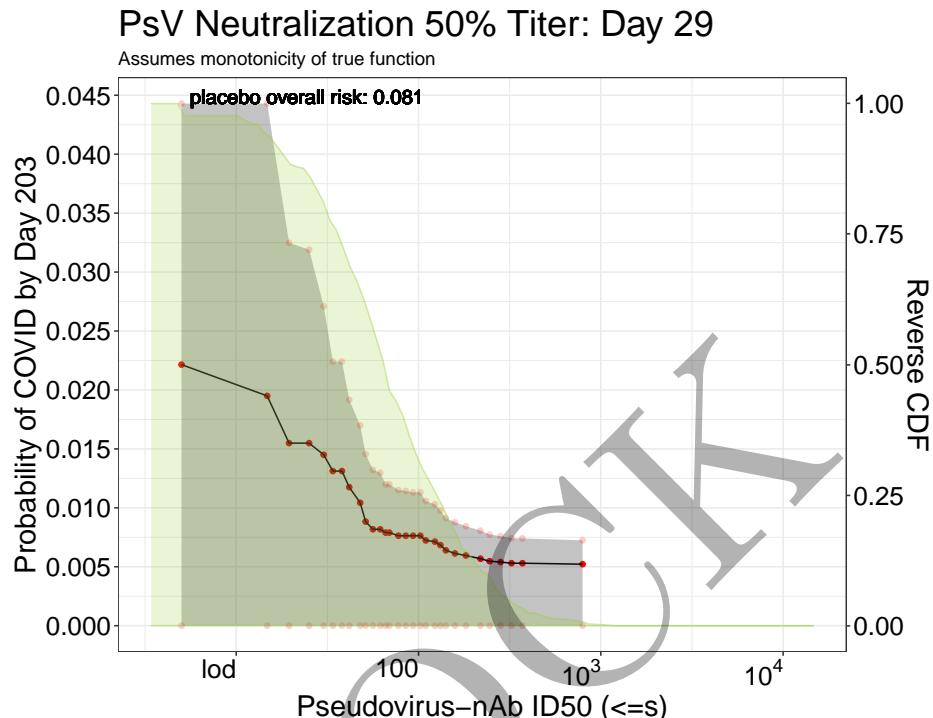


Figure 6.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.02215	0.00000	0.07252
1.405	$2.54 * 10^1$	0.01549	0.00000	0.03189
1.583	$3.83 * 10^1$	0.01312	0.00358	0.02265
1.749	$5.61 * 10^1$	0.00818	0.00313	0.01322
1.839	$6.90 * 10^1$	0.00790	0.00367	0.01213
1.966	$9.25 * 10^1$	0.00763	0.00396	0.01131
2.089	$1.23 * 10^2$	0.00713	0.00396	0.01031
2.261	$1.82 * 10^2$	0.00595	0.00347	0.00844
2.448	$2.81 * 10^2$	0.00540	0.00320	0.00760
2.904	$8.02 * 10^2$	0.00522	0.00319	0.00725

### 6.8.4 Day 29 Pseudo virus-neutralizing antibody (80% titer)

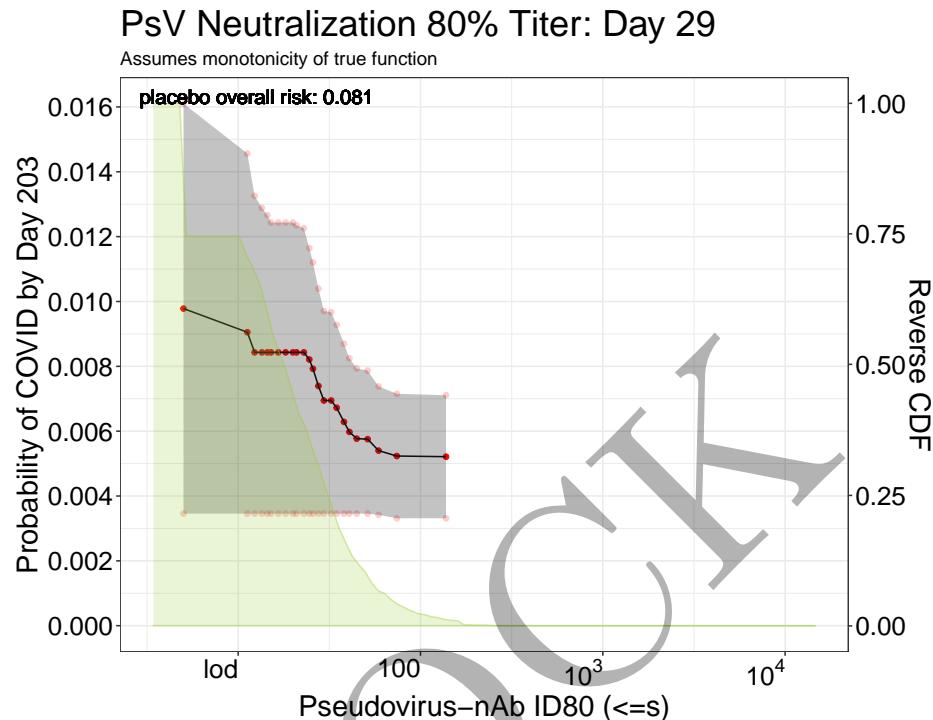


Figure 6.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00978	0.00346	0.01610
1.131	$1.35 * 10^1$	0.00843	0.00397	0.01289
1.183	$1.52 * 10^1$	0.00843	0.00443	0.01244
1.296	$1.98 * 10^1$	0.00843	0.00420	0.01266
1.358	$2.28 * 10^1$	0.00843	0.00460	0.01226
1.442	$2.77 * 10^1$	0.00739	0.00439	0.01040
1.508	$3.22 * 10^1$	0.00695	0.00422	0.00967
1.612	$4.09 * 10^1$	0.00598	0.00371	0.00825
1.709	$5.12 * 10^1$	0.00575	0.00364	0.00787
2.144	$1.39 * 10^2$	0.00521	0.00332	0.00711

# Chapter 7

## Appendix

- This report was built from the [CoVPN/correlates\\_reporting](#) repository with commit hash 61d21303da13f80e762b2718e0f9f8d6d254b505. A diff of the changes introduced by that commit may be viewed at [https://github.com/CoVPN/correlates\\_reporting/commit/61d21303da13f80e762b2718e0f9f8d6d254b505](https://github.com/CoVPN/correlates_reporting/commit/61d21303da13f80e762b2718e0f9f8d6d254b505)
- The sha256 hash sum of the raw input file, “COVID\_VEtiral\_practicedata\_primarystage1.csv”: 9093a3d1fd6eb4b5523bfa7df143e1bc6e1f3ee0f6b340eaf60d3859e07a1023
- The sha256 hash sum of the processed file, “practice\_data.csv”: b3eb4a4bc4134968cce332b14e8bbd891517cf559f9a34594