

COVID-19 Correlates of Risk Analysis Report  
mock Study

USG COVID-19 Response Biostatistics Team

May 24, 2021



# Contents

<b>1 Summary Tables</b>	<b>27</b>
1.1 Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Negative Per-Protocol Cohort . . . . .	27
1.2 Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Positive Per-Protocol Cohort . . . . .	29
1.3 Antibody levels in the baseline SARS-CoV-2 negative per-protocol cohort (vaccine recipients) . . . . .	30
1.4 Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (vaccine recipients) . . . . .	31
1.5 Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (placebo recipients) . . . . .	32
<b>2 Graphical Descriptions of Antibody Marker Data</b>	<b>33</b>
2.1 Boxplots . . . . .	34
2.2 Weighted RCDF plots . . . . .	38
2.3 Weighted RCDF plots of threshold correlate concentration for vaccine efficacy . . . . .	42
2.4 Spaghetti plots . . . . .	46
2.5 Violin and line plots . . . . .	47
<b>3 Day 57 Univariate CoR: Cox Models of Risk</b>	<b>295</b>
3.1 Hazard ratios . . . . .	295
3.2 Marginalized risk and controlled vaccine efficacy plots . . . . .	300
<b>4 Day 29 Univariate CoR: Cox Models of Risk</b>	<b>307</b>
4.1 Hazard ratios . . . . .	307
4.2 Marginalized risk and controlled vaccine efficacy plots . . . . .	312
<b>5 Univariate CoR: Nonparametric Threshold Modeling {#cor-threshold} (&gt;=s)</b>	<b>319</b>
5.1 Plots and Tables with estimates and pointwise confidence interval for Day 57 . . . . .	320
5.2 Plots and Tables with estimates and pointwise confidence intervals for Day 29 . . . . .	325
5.3 Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected) . . . . .	330
5.4 Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected) . . . . .	335

5.5	Plots and Tables with estimates and simultaneous confidence bands for Day 57 . . . . .	340
5.6	Plots and Tables with estimates and simultaneous confidence bands for Day 29 . . . . .	345
5.7	Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected) . . . . .	350
5.8	Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected) . . . . .	355
<b>6</b>	<b>Univariate CoR: Nonparametric Threshold Modeling {#cor-threshold} (&lt;=s)</b>	<b>361</b>
6.1	Plots and Tables with estimates and pointwise confidence interval for Day 57 . . . . .	361
6.2	Plots and Tables with estimates and pointwise confidence intervals for Day 29 . . . . .	366
6.3	Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected) . . . . .	371
6.4	Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected) . . . . .	376
6.5	Plots and Tables with estimates and simultaneous confidence bands for Day 57 . . . . .	381
6.6	Plots and Tables with estimates and simultaneous confidence bands for Day 29 . . . . .	386
6.7	Plots and Tables with estimates and pointwise confidence interval for Day 57 (monotone-corrected) . . . . .	391
6.8	Plots and Tables with estimates and pointwise confidence intervals for Day 29 (monotone-corrected) . . . . .	396
<b>7</b>	<b>Appendix</b>	<b>401</b>

# List of Tables

1.1	Table 1. Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Negative Per-Protocol Cohort . . . . .	27
1.2	Table 2. Demographic and Clinical Characteristics at Baseline in the Baseline SARS-CoV-2 Positive Per-Protocol Cohort . . . . .	29
1.3	Table 3. Antibody levels in the baseline SARS-CoV-2 negative per-protocol cohort (vaccine recipients) . . . . .	30
1.4	Table 4. Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (vaccine recipients) . . . . .	31
1.5	Table 5. Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (placebo recipients) . . . . .	32
3.1	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* . . . . .	295
3.2	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* . . . . .	296
4.1	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* . . . . .	307
4.2	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* . . . . .	308
5.1	Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. . . . .	321
5.2	Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	322
5.3	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. . . . .	323
5.4	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. . . . .	324
5.5	Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. . . . .	326
5.6	Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	327
5.7	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. . . . .	328

5.8	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. . . . .	329
5.9	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. . . . .	331
5.10	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	332
5.11	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. . . . .	333
5.12	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. . . . .	334
5.13	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. . . . .	336
5.14	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	337
5.15	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. . . . .	338
5.16	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. . . . .	339
5.17	Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. . . . .	341
5.18	Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	342
5.19	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. . . . .	343
5.20	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. . . . .	344
5.21	Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. . . . .	346
5.22	Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	347
5.23	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. . . . .	348
5.24	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. . . . .	349
5.25	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. . . . .	351
5.26	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	352
5.27	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. . . . .	353
5.28	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. . . . .	354
5.29	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. . . . .	356

5.30	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	357
5.31	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. . . . .	358
5.32	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. . . . .	359
6.1	Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. . . . .	362
6.2	Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	363
6.3	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. . . . .	364
6.4	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. . . . .	365
6.5	Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. . . . .	367
6.6	Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	368
6.7	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. . . . .	369
6.8	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. . . . .	370
6.9	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. . . . .	372
6.10	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	373
6.11	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. . . . .	374
6.12	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. . . . .	375
6.13	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. . . . .	377
6.14	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	378
6.15	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. . . . .	379
6.16	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. . . . .	380
6.17	Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. . . . .	382
6.18	Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	383

6.19	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. . . . .	384
6.20	Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. . . . .	385
6.21	Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. . . . .	387
6.22	Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	388
6.23	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. . . . .	389
6.24	Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. . . . .	390
6.25	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. . . . .	392
6.26	Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	393
6.27	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. . . . .	394
6.28	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. . . . .	395
6.29	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. . . . .	397
6.30	Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	398
6.31	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. . . . .	399
6.32	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. . . . .	400

# List of Figures

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. . . . .	34
2.2	Boxplots of D57 fold-rise over D1 Ab markers: vaccine arm. . . . .	35
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. . . . .	36
2.4	Boxplots of D29 fold-rise over D1 Ab markers: vaccine arm. . . . .	37
2.5	RCDF plots for D57 Ab markers by treatment arm. . . . .	38
2.6	RCDF plots for D57 fold-rise over D1 Ab markers by treatment arm. . . . .	39
2.7	RCDF plots for D29 Ab markers by treatment arm. . . . .	40
2.8	RCDF plots for D29 fold-rise over D1 Ab markers by treatment arm. . . . .	41
2.9	Marker RCDF of D57 anti-Spike binding Ab: vaccine arm . . . . .	42
2.10	Marker RCDF of D57 anti-RBD binding Ab: vaccine arm . . . . .	43
2.11	Marker RCDF of D57 PsV-nAb ID50: vaccine arm . . . . .	44
2.12	Marker RCDF of D57 PsV-nAb ID80: vaccine arm . . . . .	45
2.13	Spaghetti Plots of Marker Trajectory: vaccine arm . . . . .	46
2.14	lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 1) . . . . .	47
2.15	lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1) . . . . .	48
2.16	lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 1) . . . . .	49
2.17	lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1) . . . . .	50
2.18	lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1) . . . . .	51
2.19	lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1) . . . . .	52
2.20	lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1) . . . . .	53
2.21	lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1) . . . . .	54
2.22	violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 1) . . . . .	55
2.23	violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1) . . . . .	56
2.24	violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 1) . . . . .	57
2.25	violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1) . . . . .	58
2.26	violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1) . . . . .	59
2.27	violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1) . . . . .	60

2.28 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1) . . . . .	61
2.29 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1) . . . . .	62
2.30 lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 2) . . . . .	63
2.31 lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2) . . . . .	64
2.32 lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 2) . . . . .	65
2.33 lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2) . . . . .	66
2.34 lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2) . . . . .	67
2.35 lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2) . . . . .	68
2.36 lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2) . . . . .	69
2.37 lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2) . . . . .	70
2.38 violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 2) . . . . .	71
2.39 violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2) . . . . .	72
2.40 violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 2) . . . . .	73
2.41 violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2) . . . . .	74
2.42 violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2) . . . . .	75
2.43 violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2) . . . . .	76
2.44 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2) . . . . .	77
2.45 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2) . . . . .	78
2.46 lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1) . . . . .	79
2.47 lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1) . . . . .	80
2.48 lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1) . . . . .	81
2.49 lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1) . . . . .	82
2.50 lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1) . . . . .	83
2.51 lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1) . . . . .	84
2.52 lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1) . . . . .	85
2.53 lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1) . . . . .	86
2.54 violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1) . . . . .	87
2.55 violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1) . . . . .	88
2.56 violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1) . . . . .	89
2.57 violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1) . . . . .	90
2.58 violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1) . . . . .	91
2.59 violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1) . . . . .	92
2.60 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1) . . . . .	93
2.61 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1) . . . . .	94

2.62 lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2) . . . . .	95
2.63 lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2) . . . . .	96
2.64 lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2) . . . . .	97
2.65 lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2) . . . . .	98
2.66 lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)	99
2.67 lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)	100
2.68 lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)	101
2.69 lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)	102
2.70 violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2) . . . . .	103
2.71 violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2) . . . . .	104
2.72 violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2) . . . . .	105
2.73 violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2) . . . . .	106
2.74 violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2) . . . . .	107
2.75 violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2) . . . . .	108
2.76 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2) . . . . .	109
2.77 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2) . . . . .	110
2.78 lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1) . . . . .	111
2.79 lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1) . . . . .	112
2.80 lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1) . . . . .	113
2.81 lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1) . . . . .	114
2.82 lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1) . . . . .	115
2.83 lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1) . . . . .	116
2.84 lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1) . . . . .	117
2.85 lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1) . . . . .	118
2.86 violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1) . . . . .	119
2.87 violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1) . . . . .	120
2.88 violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1) . . . . .	121

2.89 violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1) . . . . .	122
2.90 violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1) . . . . .	123
2.91 violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1) . . . . .	124
2.92 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1) . . . . .	125
2.93 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1) . . . . .	126
2.94 lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2) . . . . .	127
2.95 lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2) . . . . .	128
2.96 lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2) . . . . .	129
2.97 lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2) . . . . .	130
2.98 lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2) . . . . .	131
2.99 lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2) . . . . .	132
2.100 lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2) . . . . .	133
2.101 lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2) . . . . .	134
2.102 violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2) . . . . .	135
2.103 violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2) . . . . .	136
2.104 violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2) . . . . .	137
2.105 violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2) . . . . .	138
2.106 violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2) . . . . .	139
2.107 violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2) . . . . .	140
2.108 violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2) . . . . .	141
2.109 violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2) . . . . .	142
2.110 lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1) . . . . .	143

2.111lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	144
2.112lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1) . . . . .	145
2.113lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	146
2.114lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1) . . . . .	147
2.115lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	148
2.116lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1) . . . . .	149
2.117lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	150
2.118violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1) . . . . .	151
2.119violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	152
2.120violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1) . . . . .	153
2.121violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	154
2.122violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1) . . . . .	155
2.123violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	156
2.124violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1) . . . . .	157
2.125violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1) . . . . .	158
2.126lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2) . . . . .	159
2.127lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	160
2.128lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2) . . . . .	161
2.129lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	162
2.130lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2) . . . . .	163
2.131lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	164
2.132lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2) . . . . .	165

2.133lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	166
2.134violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2) . . . . .	167
2.135violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	168
2.136violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2) . . . . .	169
2.137violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	170
2.138violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2) . . . . .	171
2.139violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	172
2.140violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2) . . . . .	173
2.141violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2) . . . . .	174
2.142lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	175
2.143lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	176
2.144lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	177
2.145lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	178
2.146lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	179
2.147lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	180
2.148lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	181
2.149lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	182
2.150violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	183
2.151violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	184
2.152violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	185
2.153violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	186
2.154violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	187

2.155violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	188
2.156violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1) . . . . .	189
2.157violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1) . . . . .	190
2.158lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	191
2.159lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	192
2.160lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	193
2.161lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	194
2.162lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	195
2.163lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	196
2.164lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	197
2.165lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	198
2.166violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	199
2.167violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	200
2.168violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	201
2.169violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	202
2.170violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	203
2.171violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	204
2.172violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2) . . . . .	205
2.173violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2) . . . . .	206
2.174lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	207
2.175lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	208
2.176lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	209

2.177lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	210
2.178lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	211
2.179lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	212
2.180lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	213
2.181lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	214
2.182violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	215
2.183violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	216
2.184violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	217
2.185violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	218
2.186violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	219
2.187violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	220
2.188violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1) . . . . .	221
2.189violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1) . . . . .	222
2.190lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	223
2.191lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	224
2.192lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	225
2.193lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	226
2.194lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	227
2.195lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	228
2.196lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	229
2.197lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	230
2.198violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	231

2.199violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	232
2.200violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	233
2.201violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	234
2.202violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	235
2.203violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	236
2.204violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2) . . . . .	237
2.205violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2) . . . . .	238
2.206lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	239
2.207lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	240
2.208lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	241
2.209lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	242
2.210lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	243
2.211lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	244
2.212lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	245
2.213lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	246
2.214violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	247
2.215violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	248
2.216violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	249
2.217violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	250
2.218violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	251
2.219violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	252
2.220violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1) . . . . .	253

2.221violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1) . . . . .	254
2.222lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	255
2.223lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	256
2.224lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	257
2.225lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	258
2.226lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	259
2.227lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	260
2.228lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	261
2.229lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	262
2.230violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	263
2.231violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	264
2.232violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	265
2.233violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	266
2.234violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	267
2.235violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	268
2.236violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2) . . . . .	269
2.237violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2) . . . . .	270
2.238scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1 . . . . .	271
2.239scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29 . . . . .	272
2.240scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57 . . . . .	273
2.241scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1 . . . . .	274
2.242scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29 . . . . .	275
2.243scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57 . . . . .	276
2.244scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1 . . . . .	277
2.245scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29 . . . . .	278

2.246scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 57 . . . . .	279
2.247scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1 . . . . .	280
2.248scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29 . . . . .	281
2.249scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57 . . . . .	282
2.250scatterplots of Binding Antibody to Spike: by arm at day 1 . . . . .	283
2.251scatterplots of Binding Antibody to Spike: by arm at day 29 . . . . .	284
2.252scatterplots of Binding Antibody to Spike: by arm at day 57 . . . . .	285
2.253scatterplots of Binding Antibody to RBD: by arm at day 1 . . . . .	286
2.254scatterplots of Binding Antibody to RBD: by arm at day 29 . . . . .	287
2.255scatterplots of Binding Antibody to RBD: by arm at day 57 . . . . .	288
2.256scatterplots of Pseudovirus Neutralization ID50: by arm at day 1 . . . . .	289
2.257scatterplots of Pseudovirus Neutralization ID50: by arm at day 29 . . . . .	290
2.258scatterplots of Pseudovirus Neutralization ID50: by arm at day 57 . . . . .	291
2.259scatterplots of Pseudovirus Neutralization ID80: by arm at day 1 . . . . .	292
2.260scatterplots of Pseudovirus Neutralization ID80: by arm at day 29 . . . . .	293
2.261scatterplots of Pseudovirus Neutralization ID80: by arm at day 57 . . . . .	294
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. . . . .	297
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. . . . .	298
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. . . . .	298
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. . . . .	299
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. . . . .	299
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. . . . .	300
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. . . . .	301

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. . . . .	302
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. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively. . . . .	303
3.10	Controlled VE 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. . . . .	304
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. . . . .	305
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. . . . .	309
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. . . . .	310
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. . . . .	310
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. . . . .	311
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. . . . .	311
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. . . . .	312
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. . . . .	313
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. . . . .	314

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. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively. . . . .	315
4.10 Controlled VE 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. . . . .	316
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. . . . .	317
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. . . . .	321
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. . . . .	322
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. . . . .	323
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. . . . .	324
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. . . . .	326
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. . . . .	327
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. . . . .	328
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. . . . .	329
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. . . . .	331
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. . . . .	332

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. . . . .	333
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. . . . .	334
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. . . . .	336
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. . . . .	337
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. . . . .	338
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. . . . .	339
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. . . . .	341
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. . . . .	342
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. . . . .	343
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. . . . .	344
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. . . . .	346
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. . . . .	347
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. . . . .	348

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. . . . .	349
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. . . . .	351
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. . . . .	352
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. . . . .	353
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. . . . .	354
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. . . . .	356
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. . . . .	357
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. . . . .	358
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. . . . .	359
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. . . . .	362
6.2 Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	363
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. . . . .	364
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. . . . .	365

6.5	Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. . . . .	367
6.6	Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. . . . .	368
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. . . . .	369
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. . . . .	370
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. . . . .	372
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. . . . .	373
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. . . . .	374
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. . . . .	375
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. . . . .	377
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. . . . .	378
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. . . . .	379
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. . . . .	380
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. . . . .	382
6.18	Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	383
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. . . . .	384
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. . . . .	385
6.21	Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. . . . .	387

6.22 Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. . . . .	388
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. . . . .	389
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. . . . .	390
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. . . . .	392
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. . . . .	393
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. . . . .	394
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. . . . .	395
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. . . . .	397
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. . . . .	398
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. . . . .	399
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. . . . .	400

MOCK

# 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).

MOCH

## 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**

MOCK

**Graphical Descriptions of Antibody  
Marker Data**

## 2.1 Boxplots

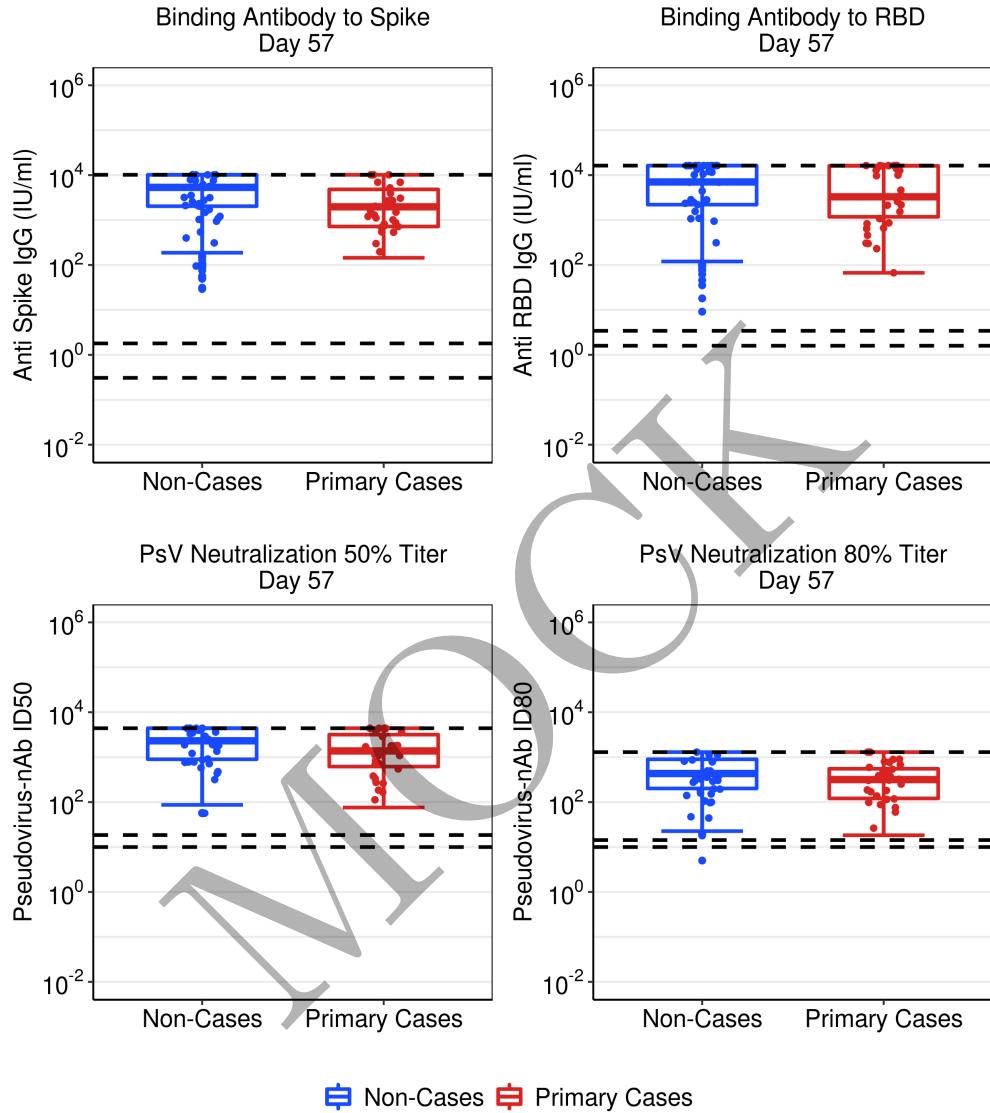


Figure 2.1: Boxplots of D57 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

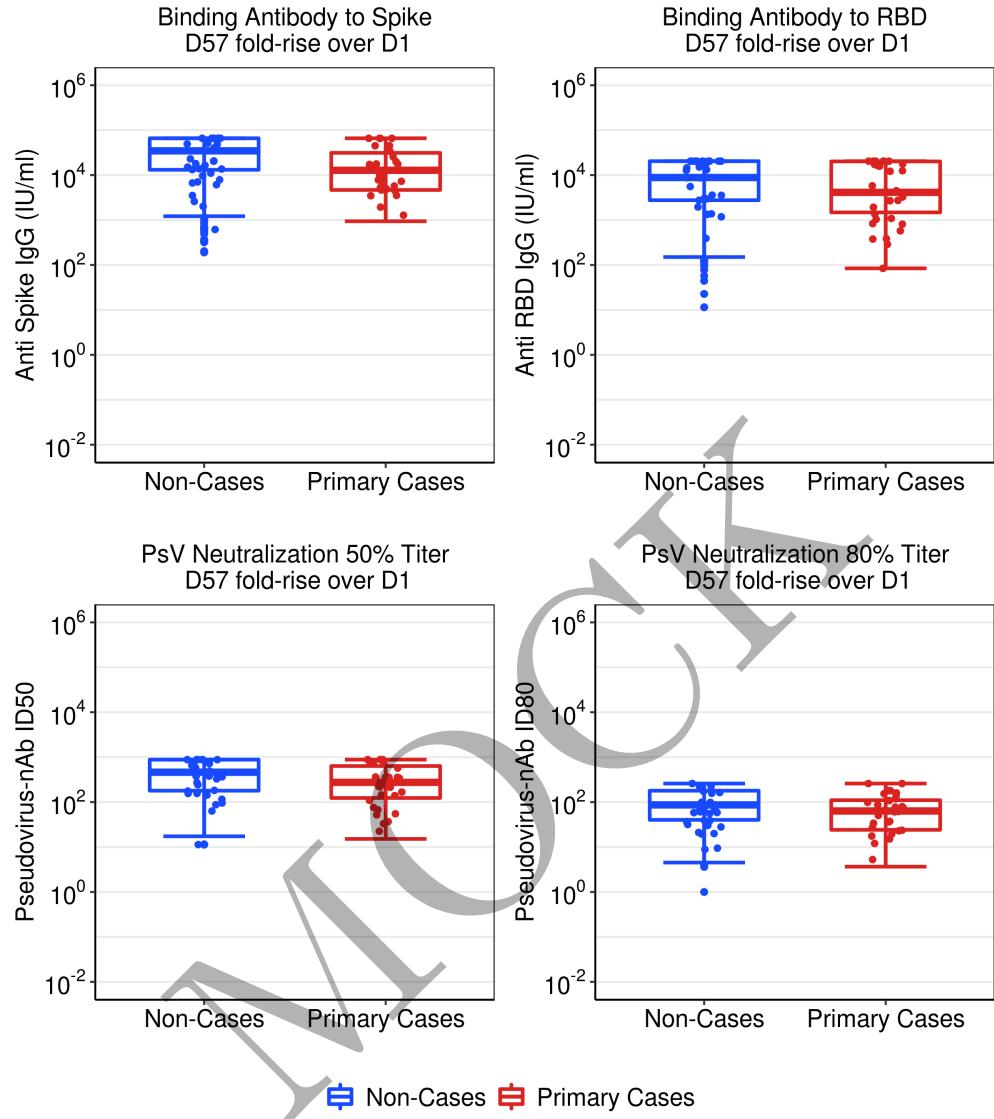


Figure 2.2: Boxplots of D57 fold-rise over D1 Ab markers: vaccine arm.

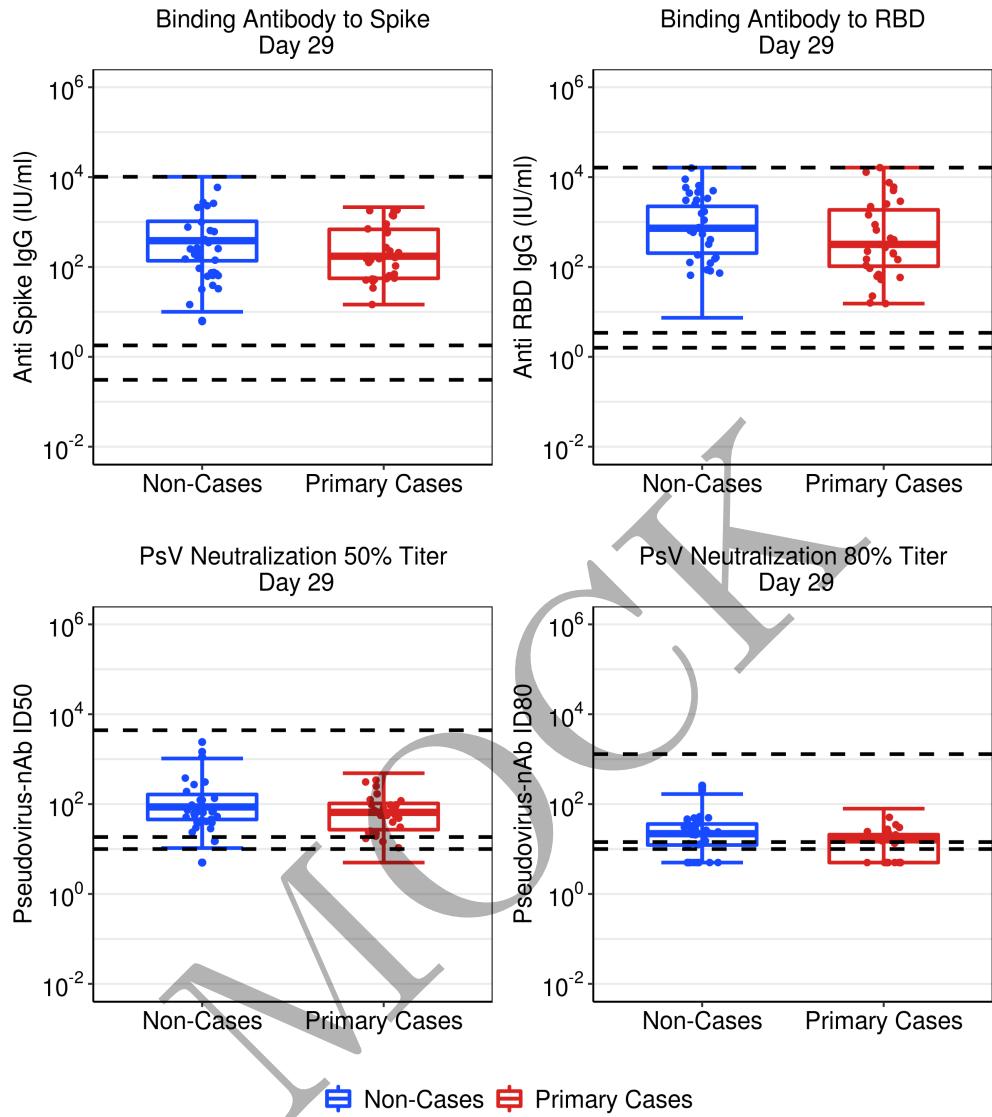


Figure 2.3: Boxplots of D29 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

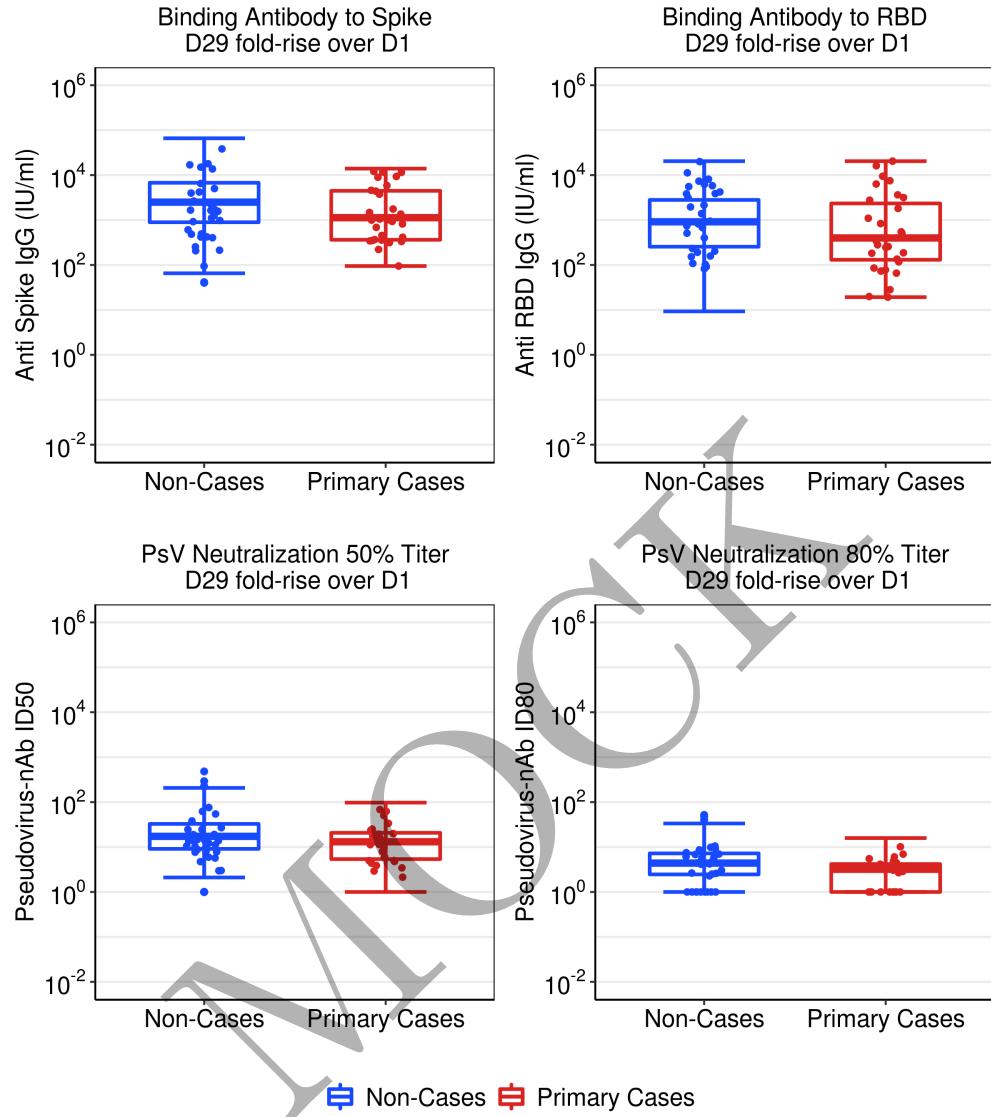


Figure 2.4: Boxplots of D29 fold-rise over D1 Ab markers: vaccine arm.

## 2.2 Weighted RCDF plots

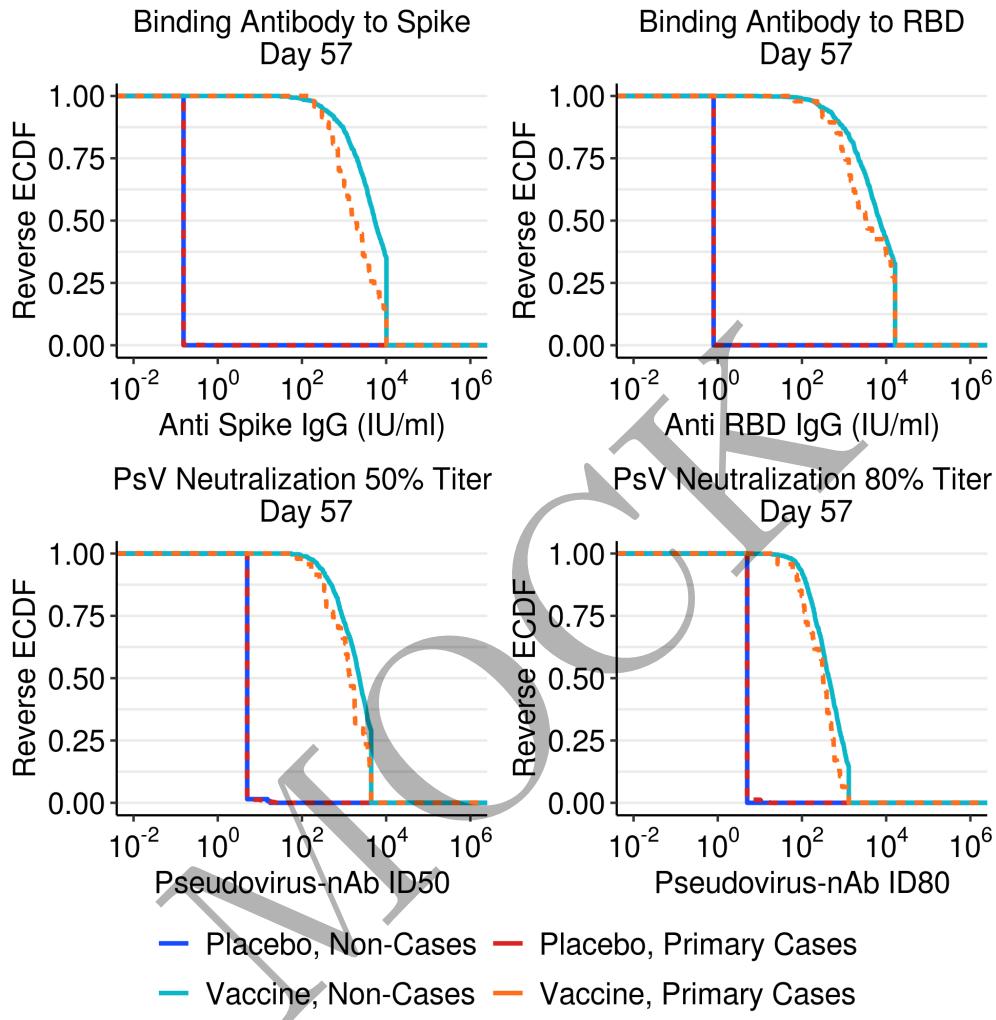


Figure 2.5: RCDF plots for D57 Ab markers by treatment arm.

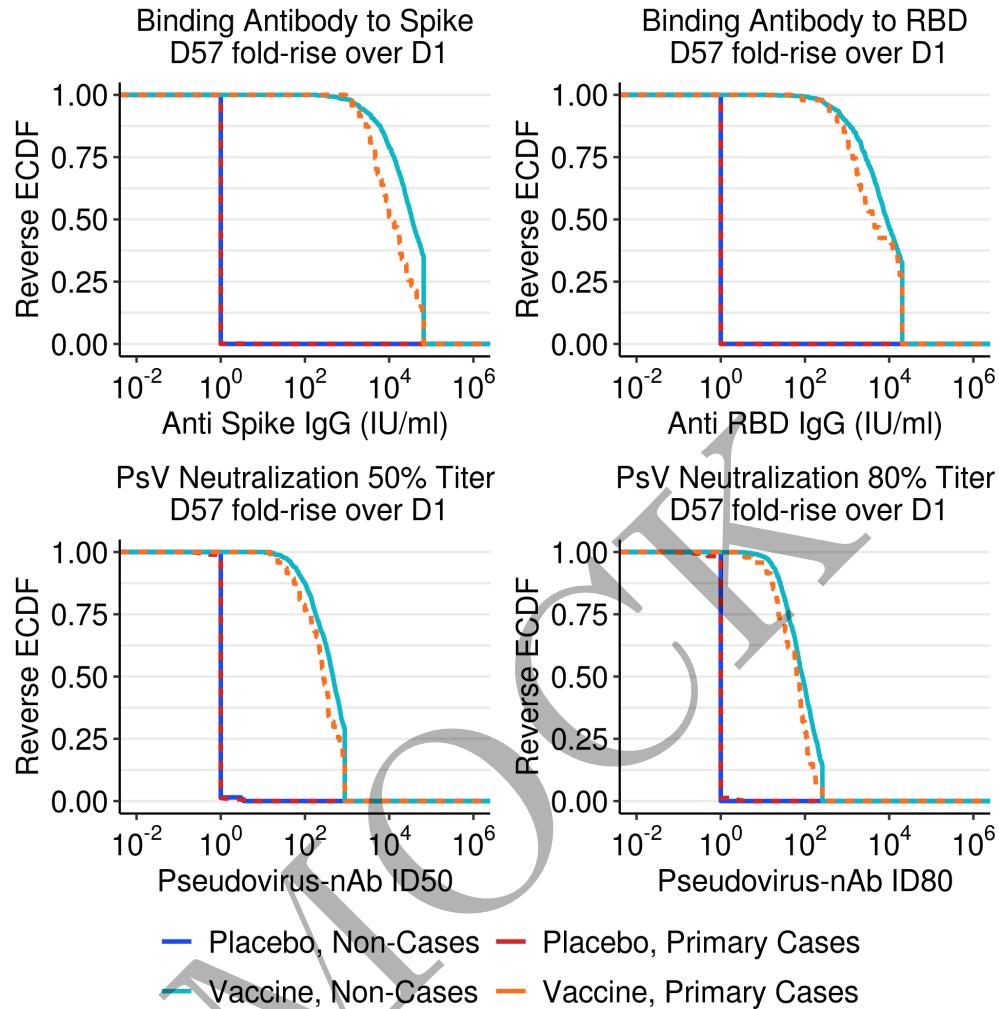


Figure 2.6: RCDF plots for D57 fold-rise over D1 Ab markers by treatment arm.

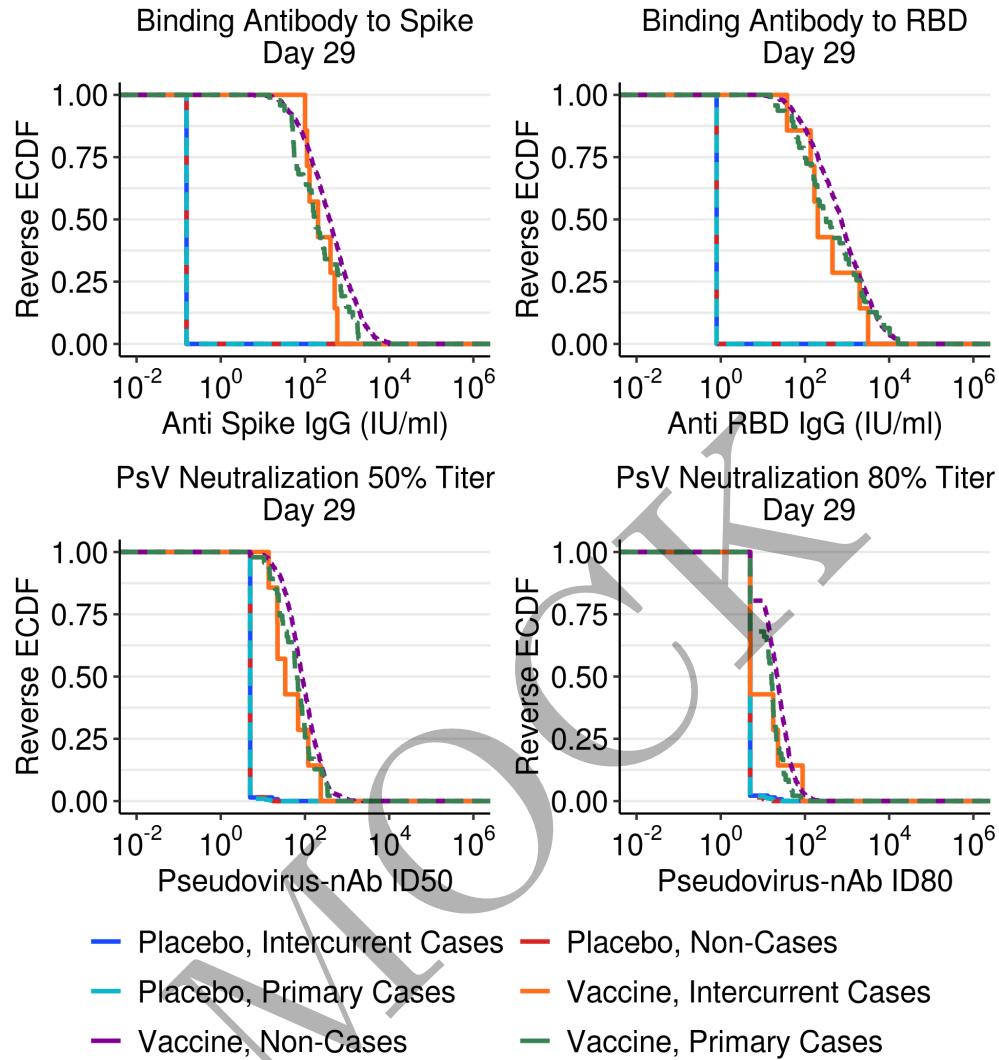


Figure 2.7: RCDF plots for D29 Ab markers by treatment arm.

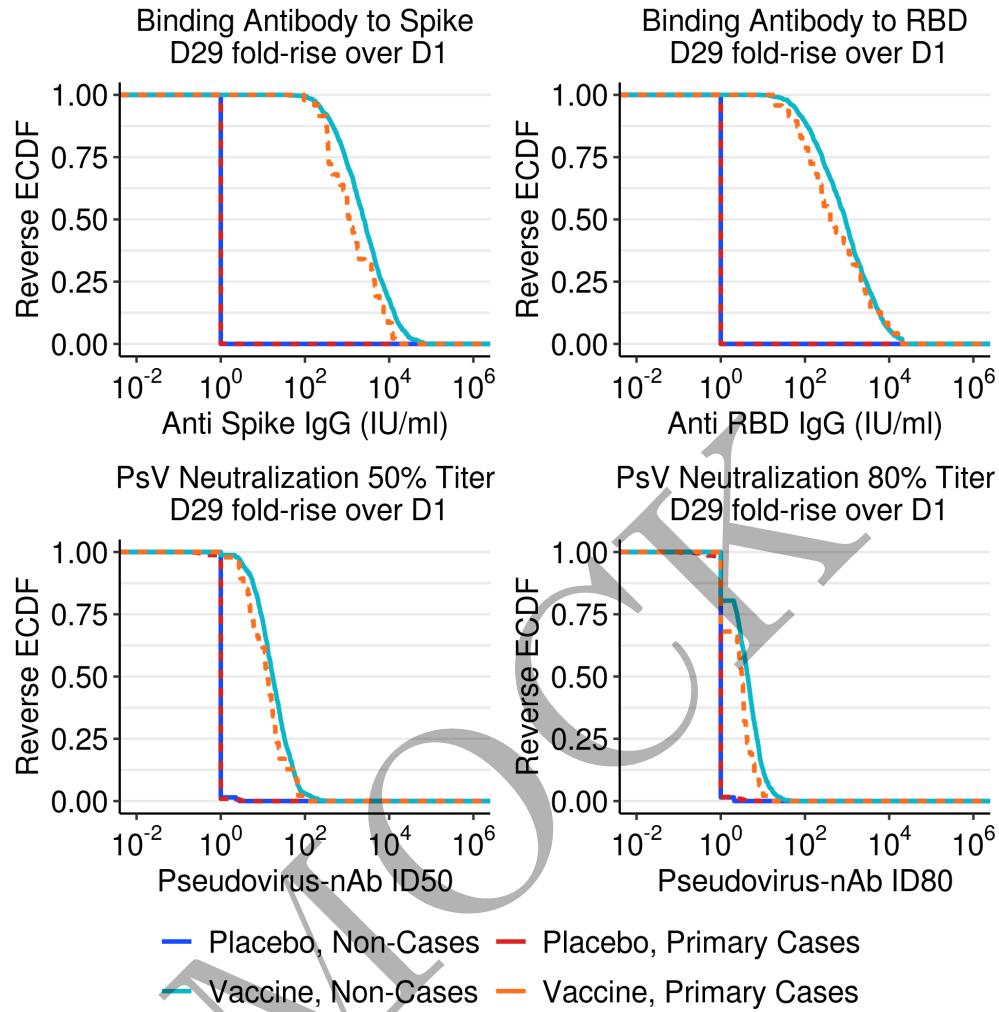


Figure 2.8: RCDF plots for D29 fold-rise over D1 Ab markers by treatment arm.

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

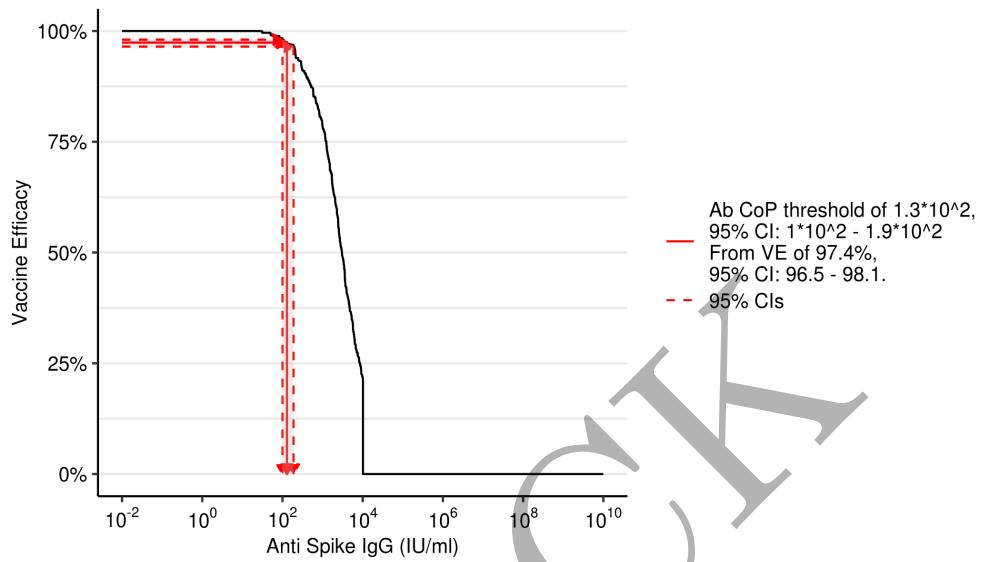


Figure 2.9: Marker RCDF of D57 anti-Spike binding Ab: vaccine arm

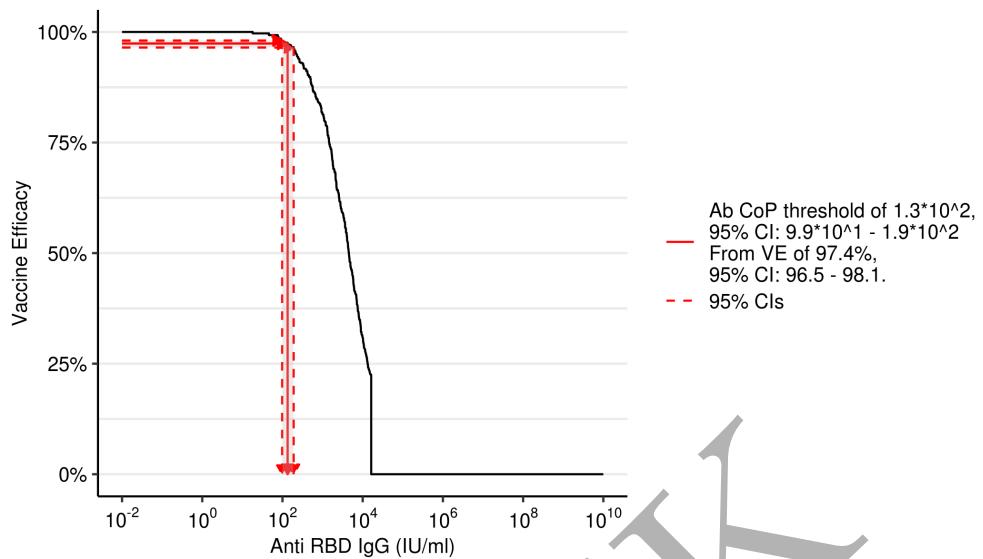


Figure 2.10: Marker RCDF of D57 anti-RBD binding Ab: vaccine arm

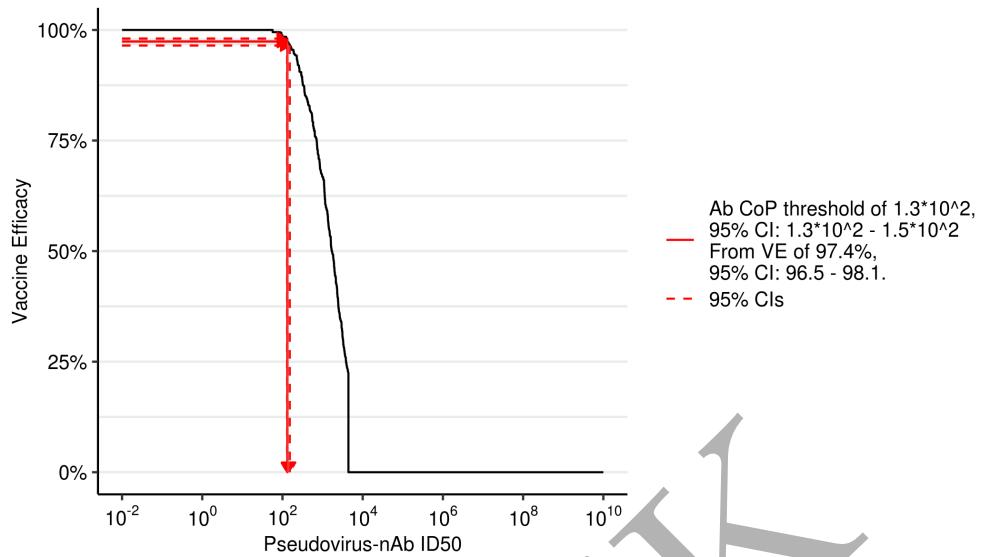


Figure 2.11: Marker RCDF of D57 PsV-nAb ID50: vaccine arm

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

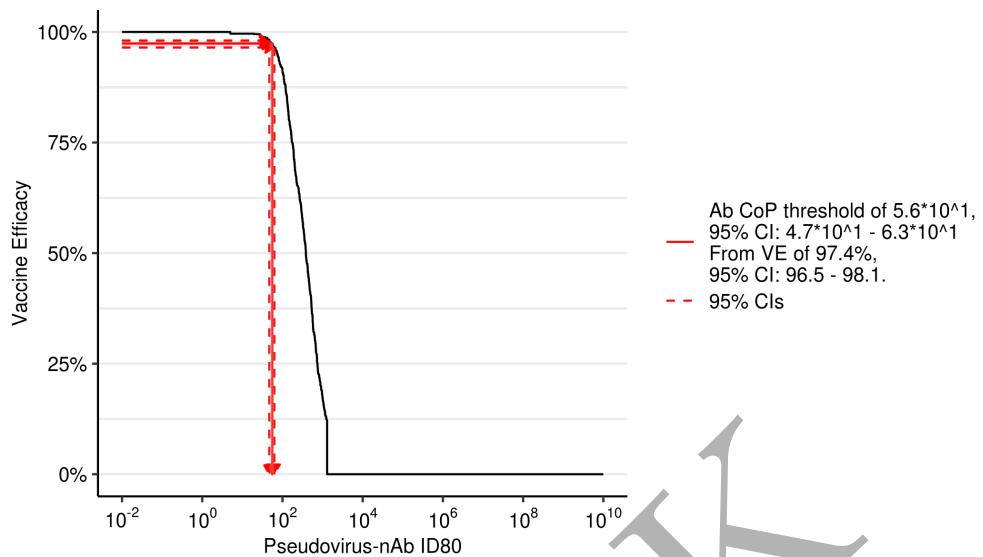


Figure 2.12: Marker RCDF of D57 PsV-nAb ID80: vaccine arm

## 2.4 Spaghetti plots

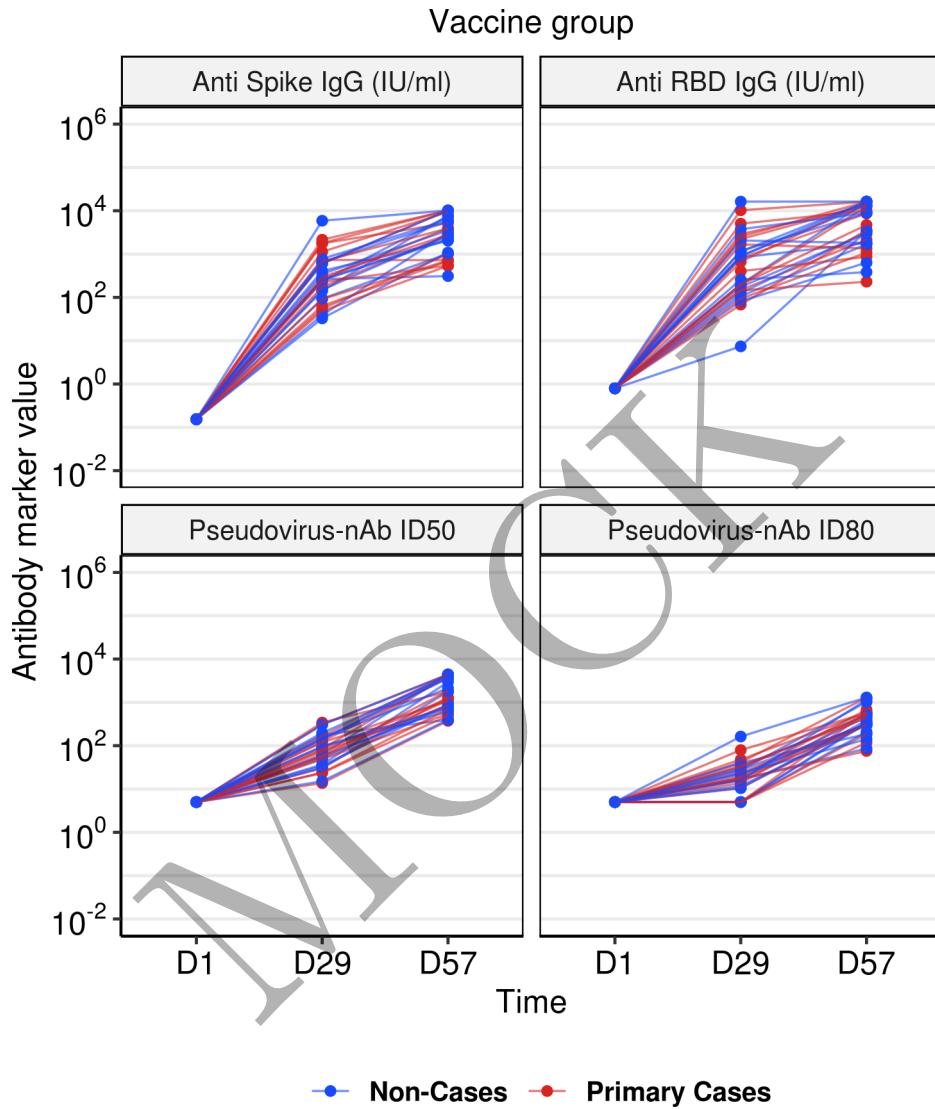


Figure 2.13: Spaghetti Plots of Marker Trajectory: vaccine arm

## 2.5 Violin and line plots

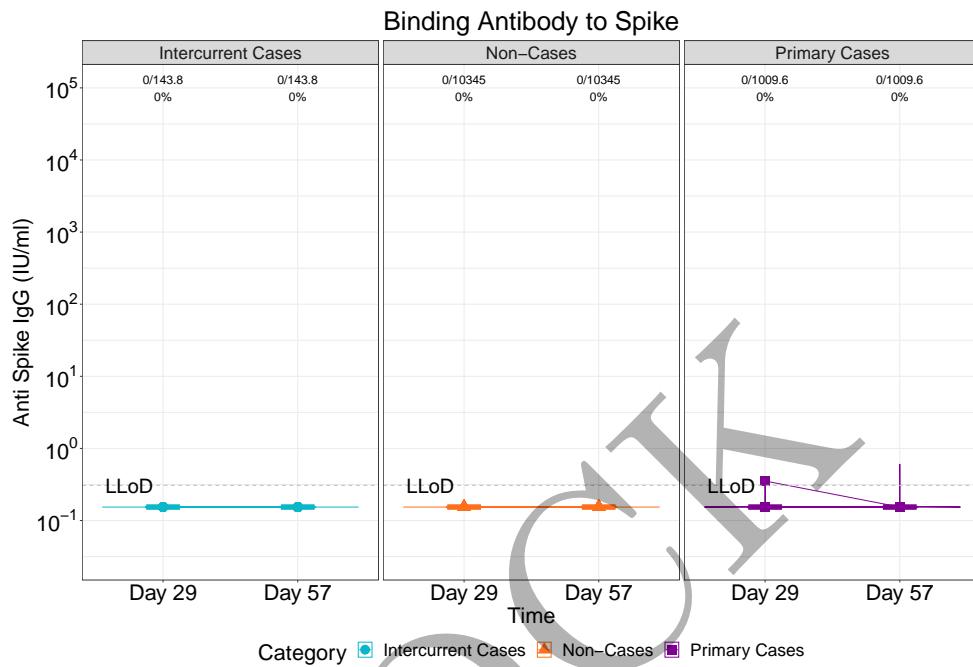


Figure 2.14: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

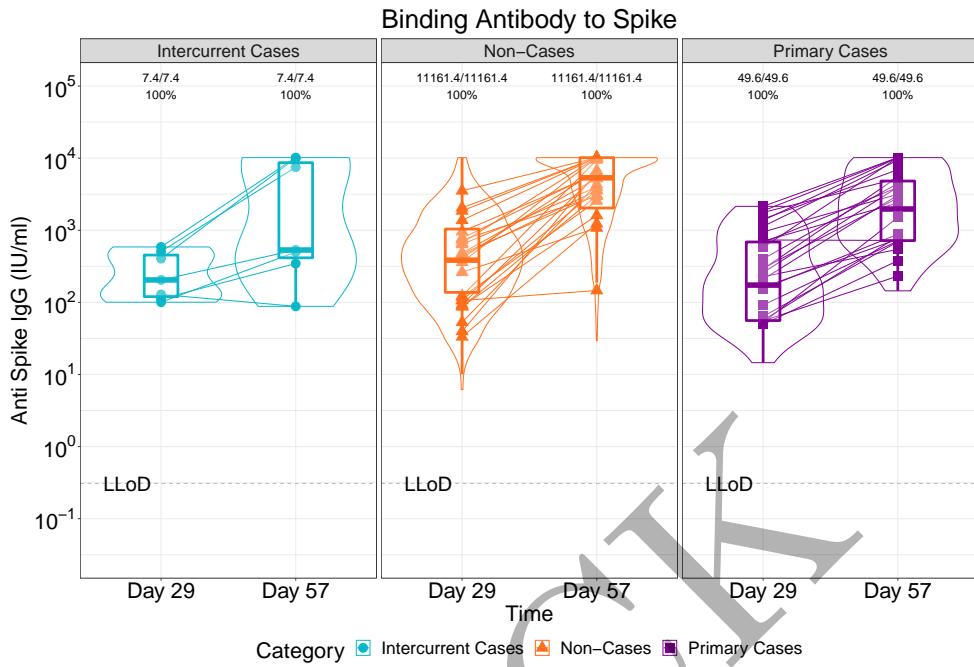


Figure 2.15: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

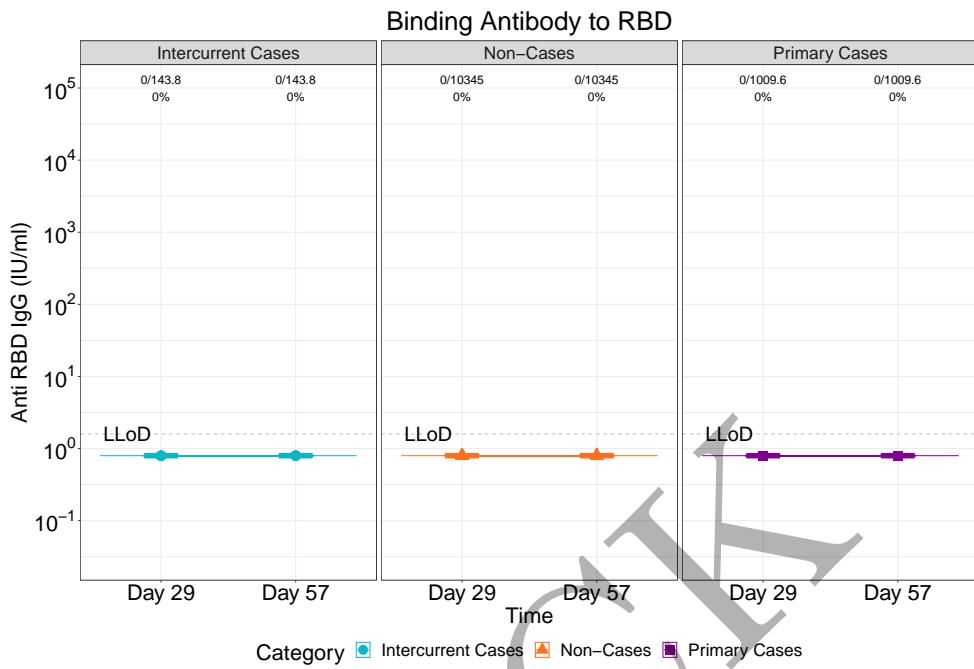


Figure 2.16: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

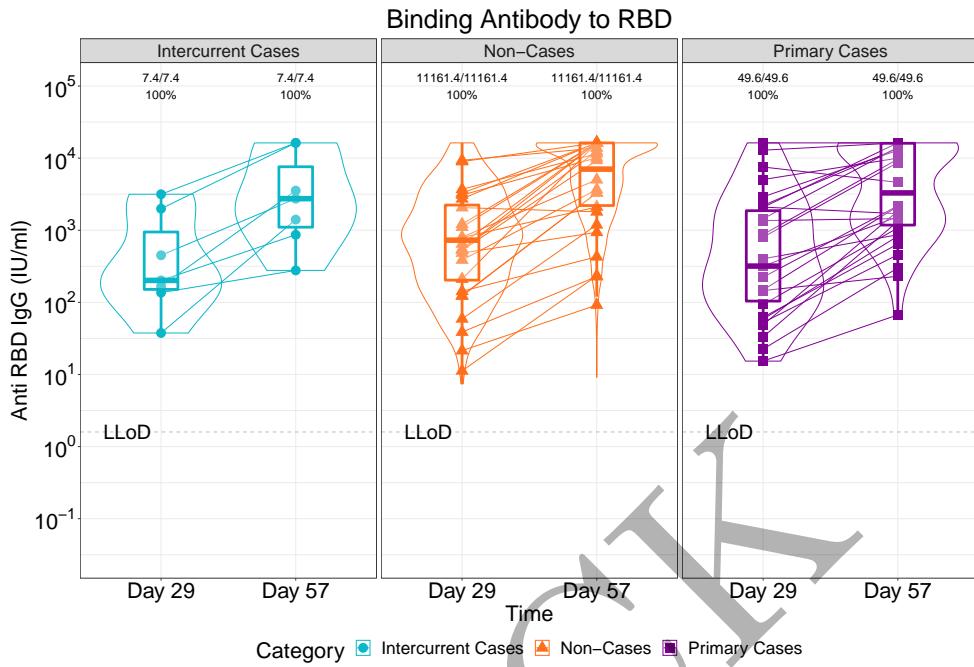


Figure 2.17: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

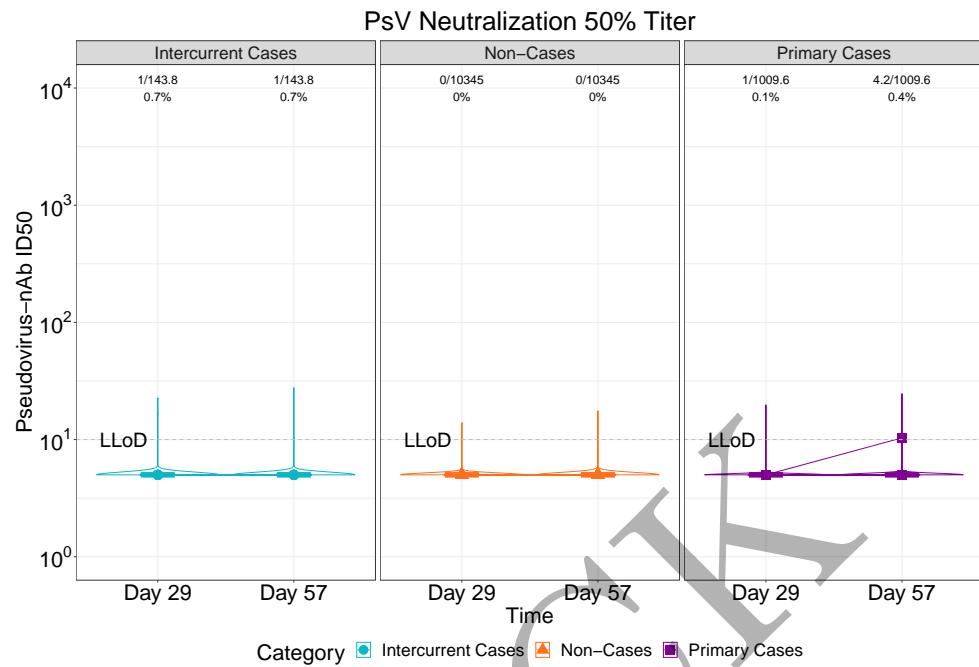


Figure 2.18: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

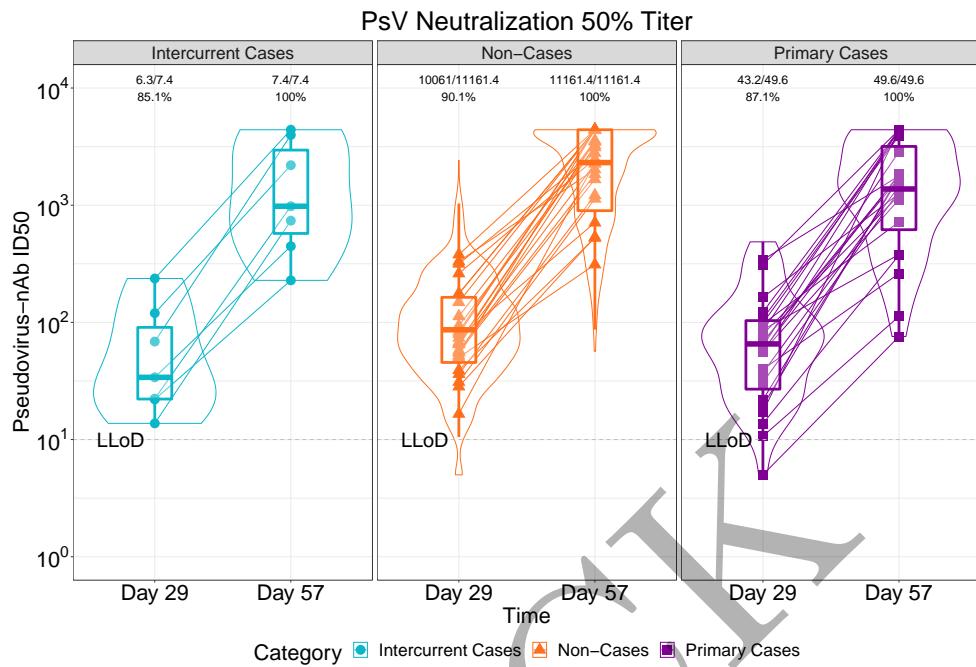


Figure 2.19: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

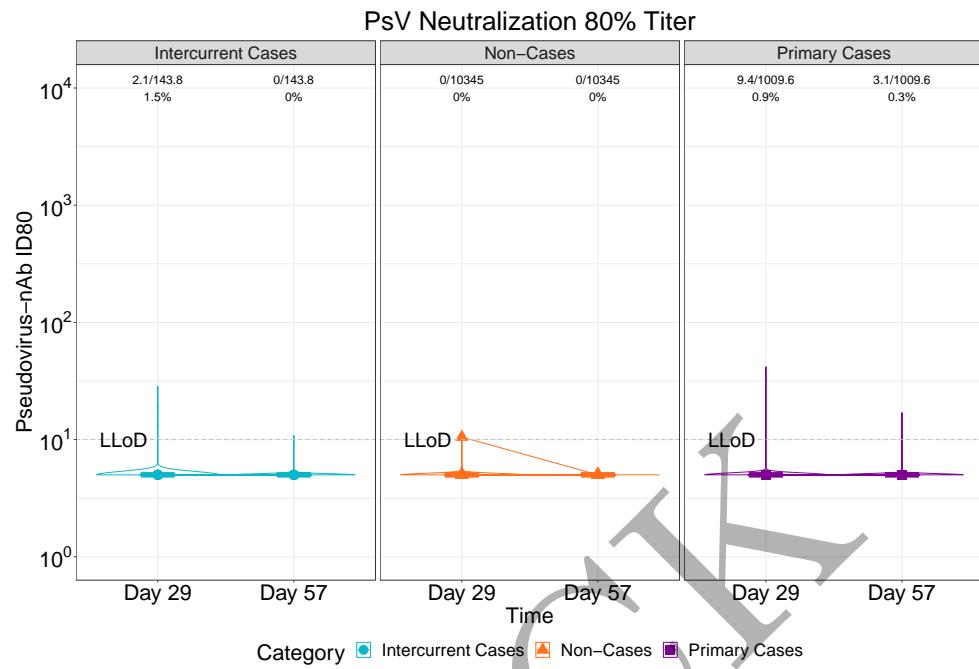


Figure 2.20: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

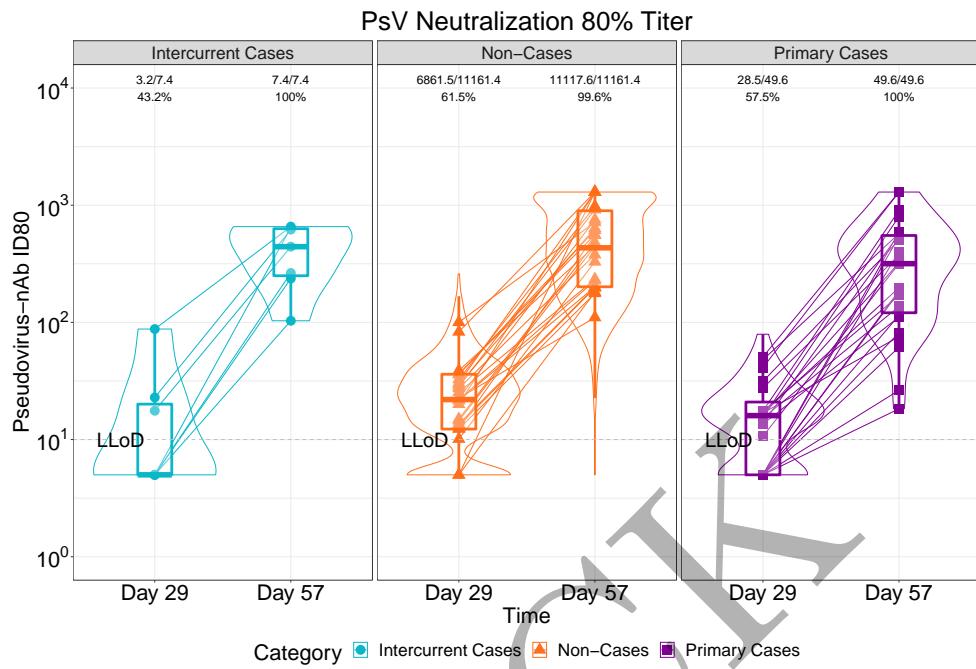


Figure 2.21: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

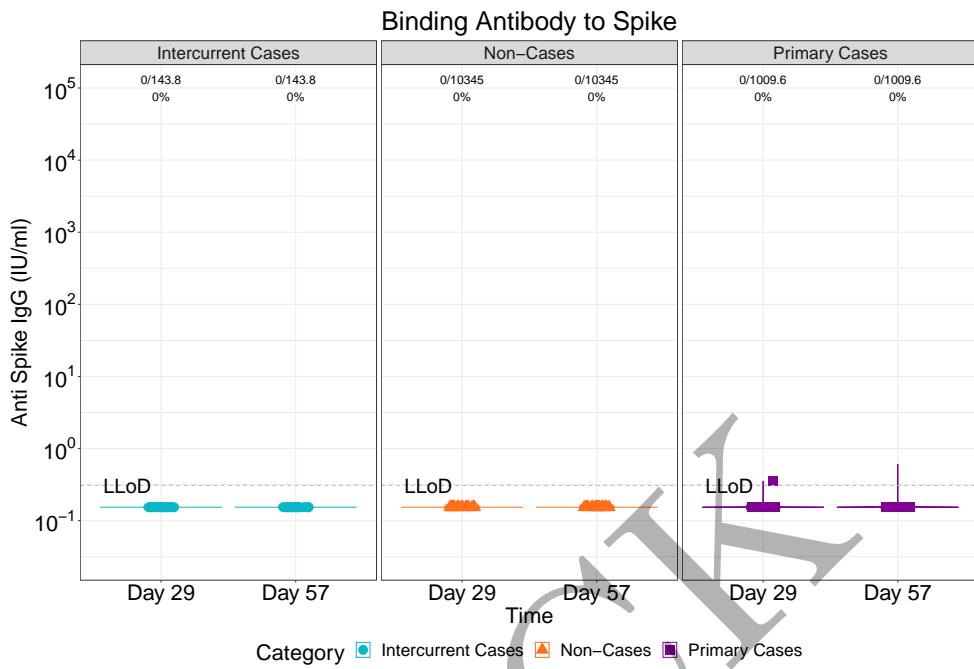


Figure 2.22: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

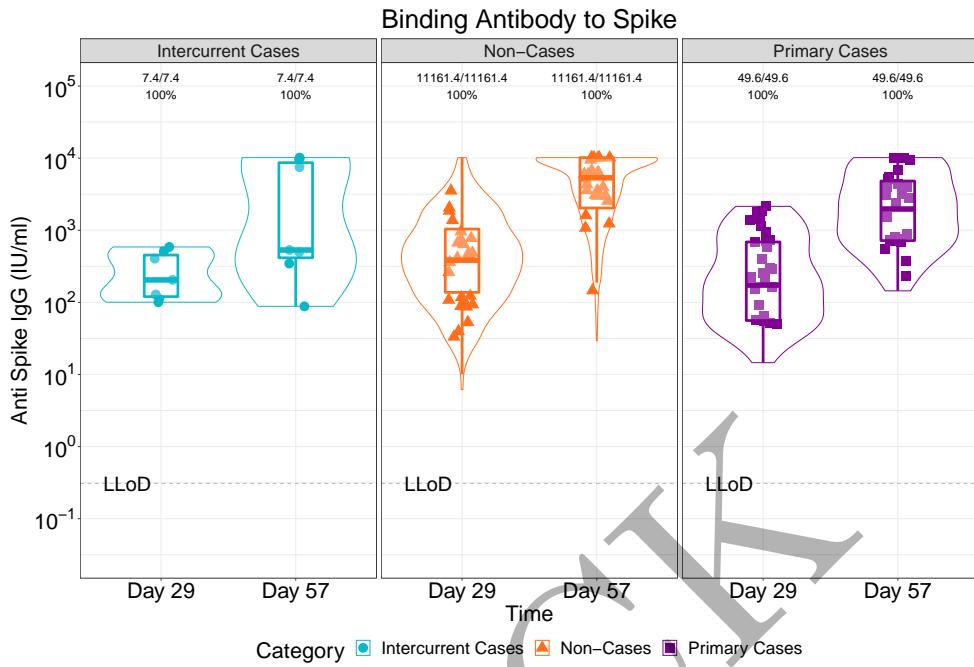


Figure 2.23: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

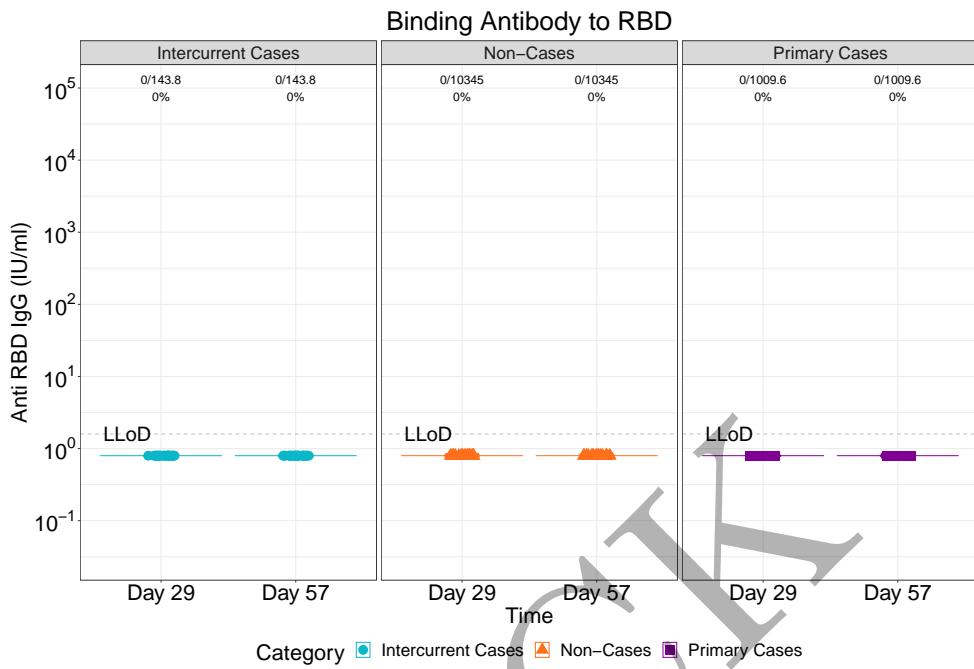


Figure 2.24: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

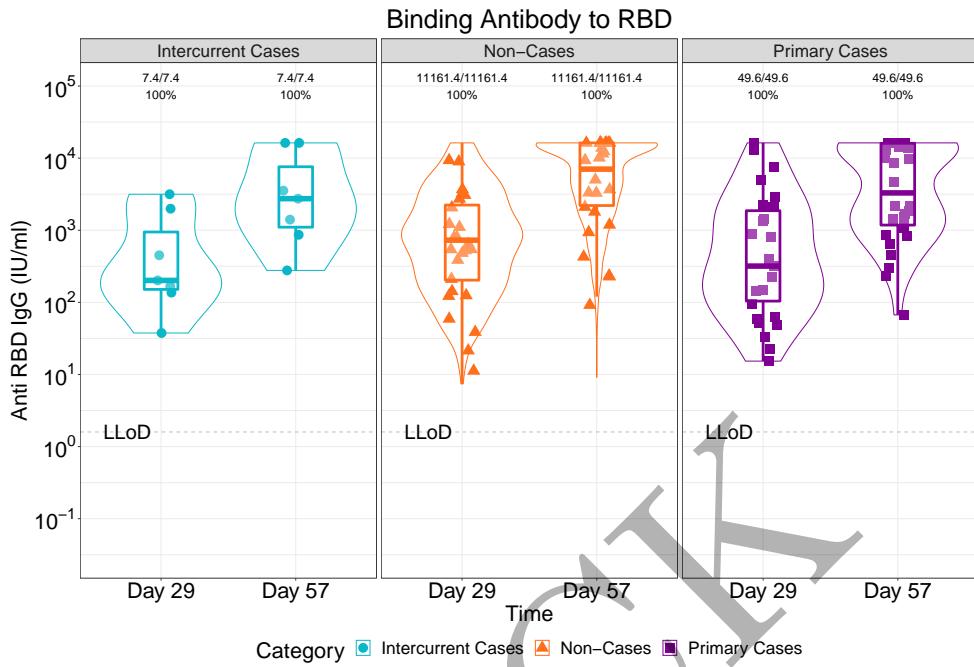


Figure 2.25: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

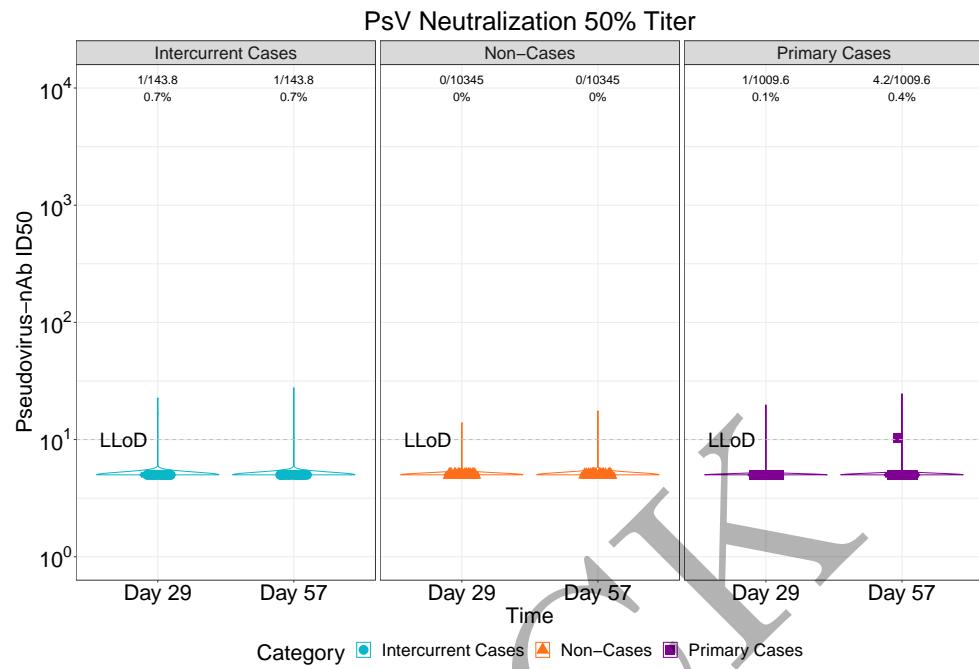


Figure 2.26: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

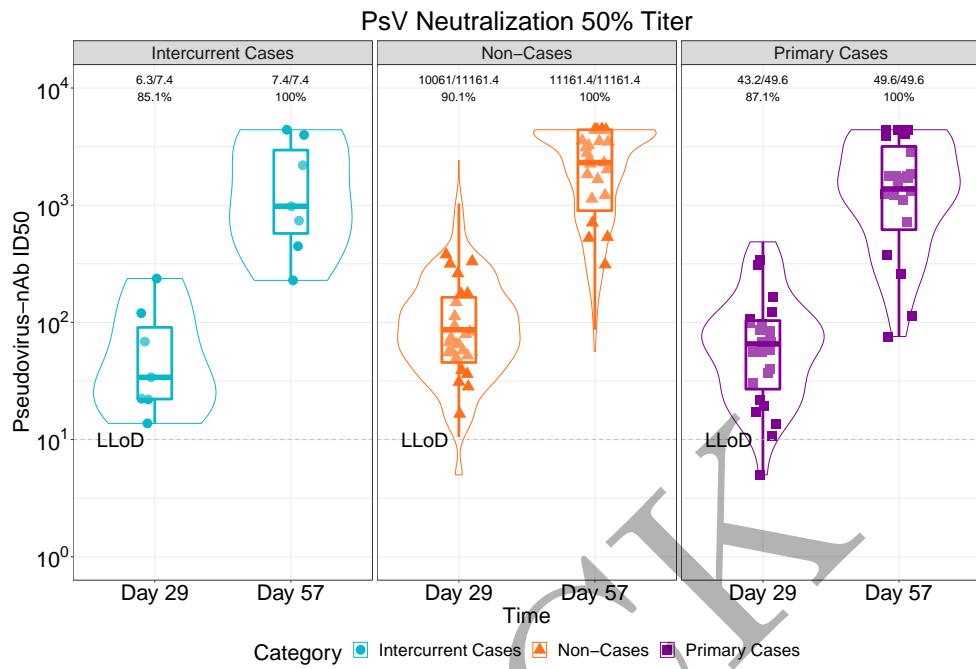


Figure 2.27: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

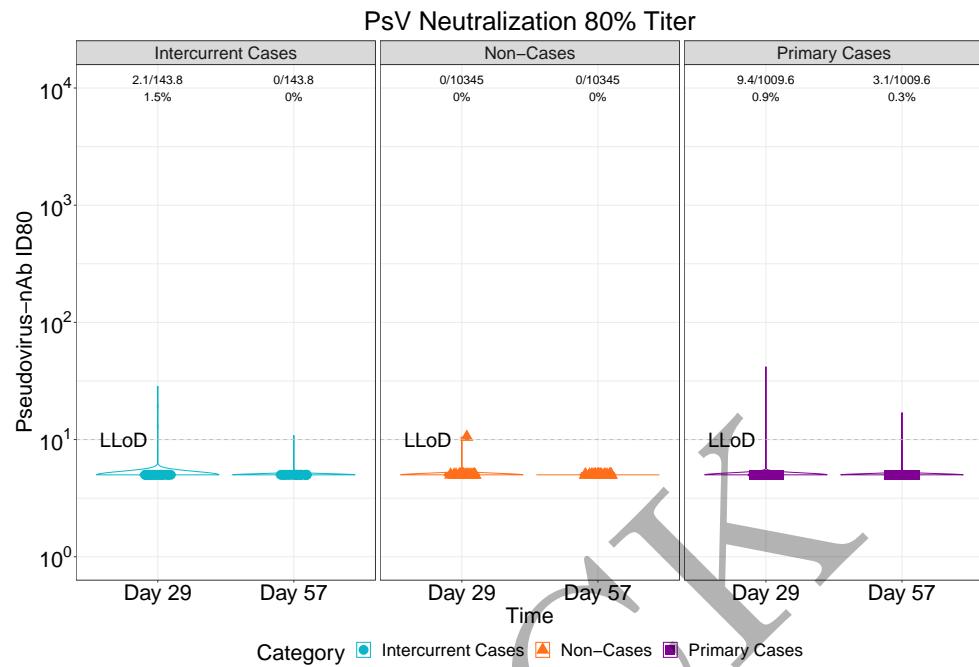


Figure 2.28: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

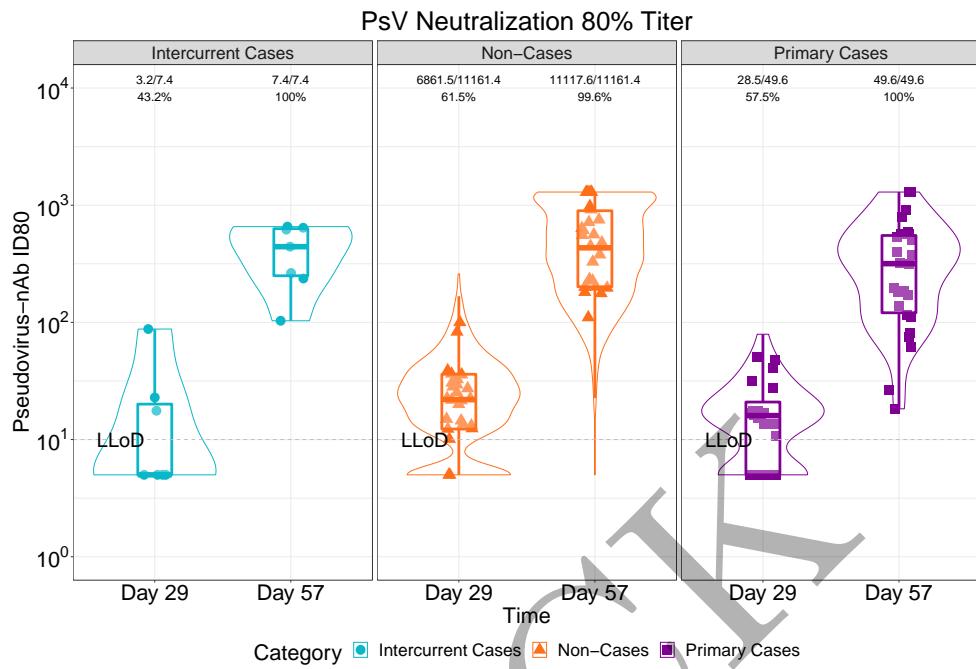


Figure 2.29: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

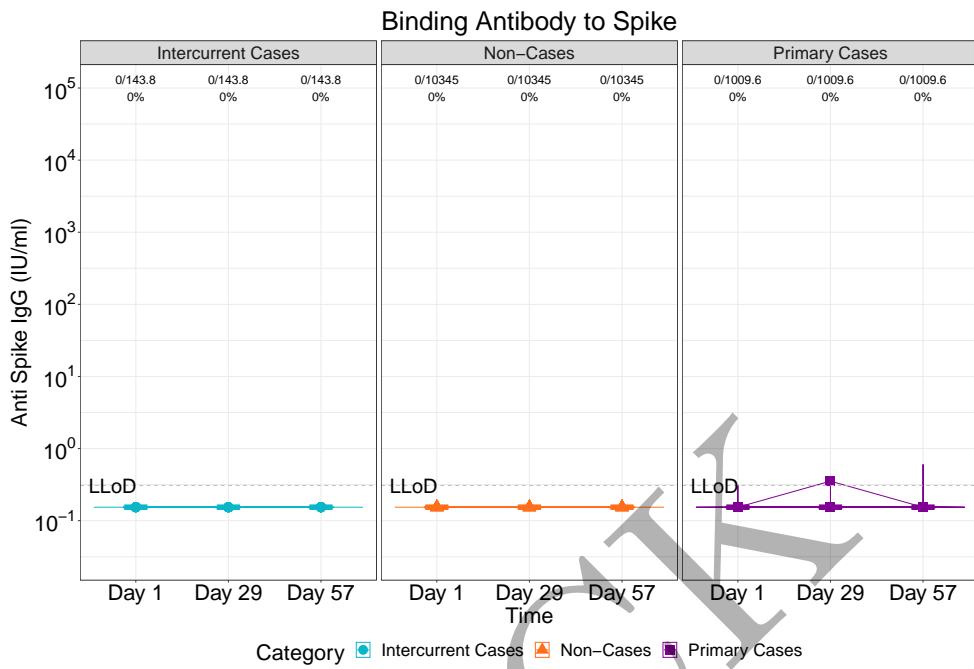


Figure 2.30: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

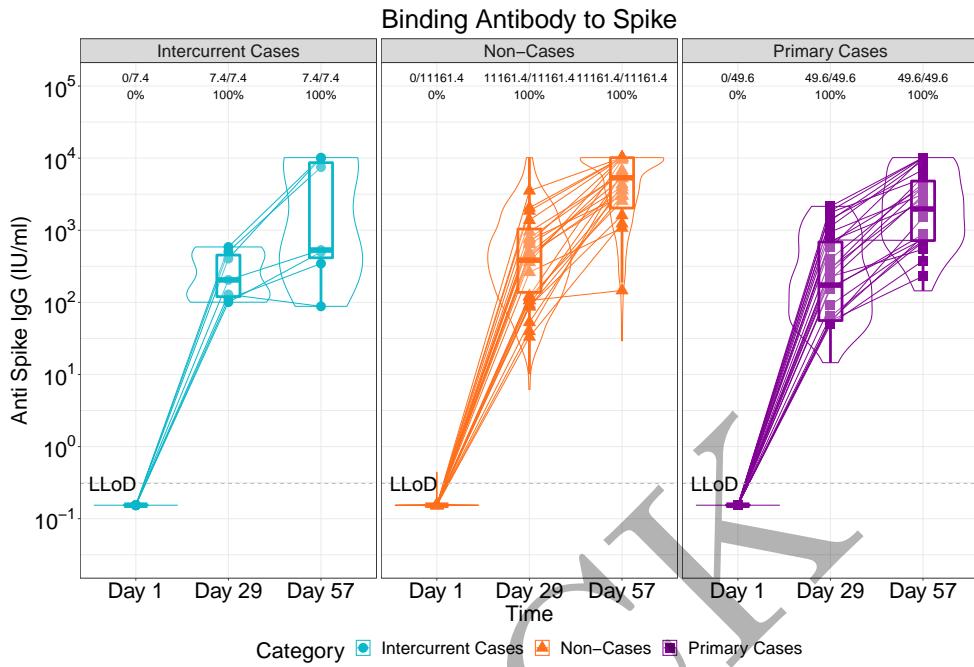


Figure 2.31: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

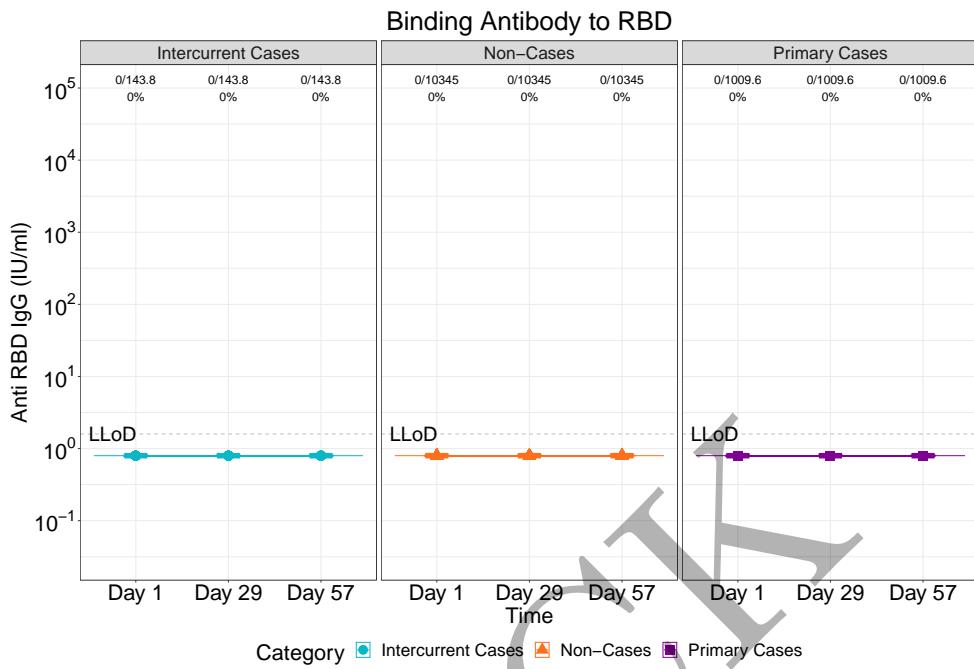


Figure 2.32: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

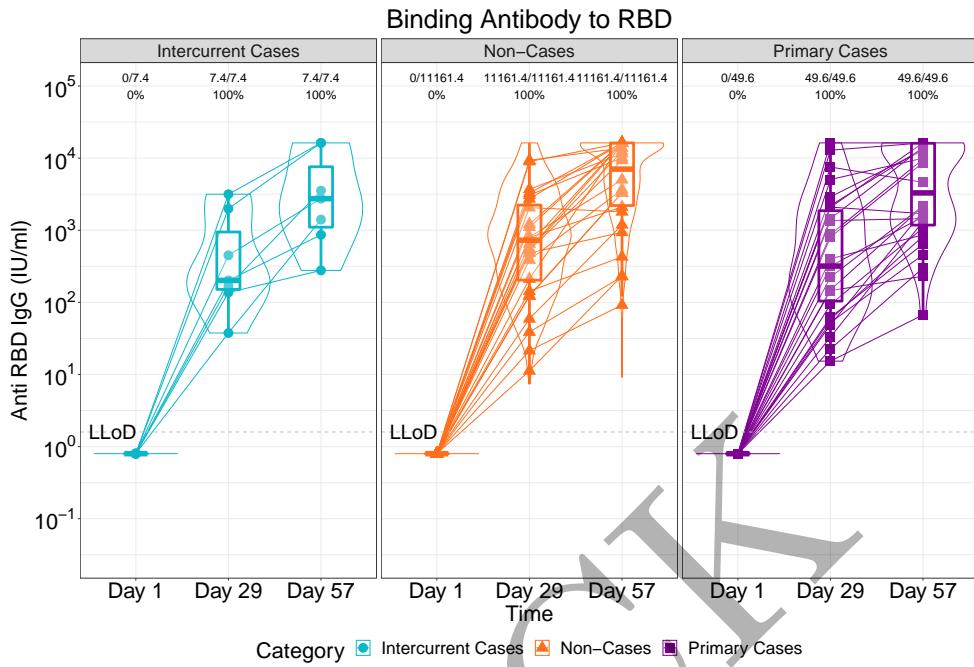


Figure 2.33: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

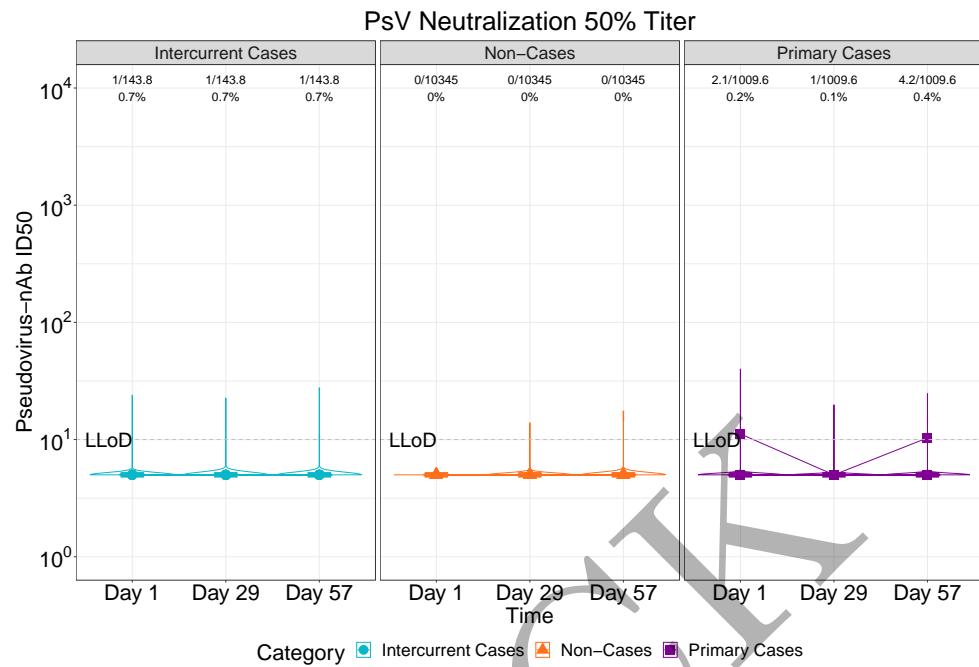


Figure 2.34: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

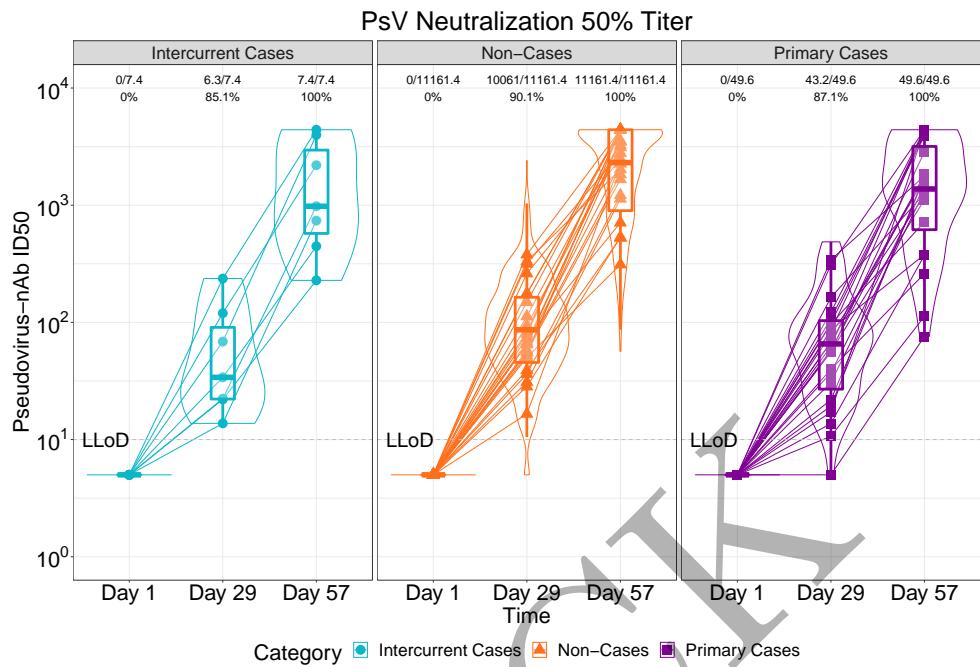


Figure 2.35: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

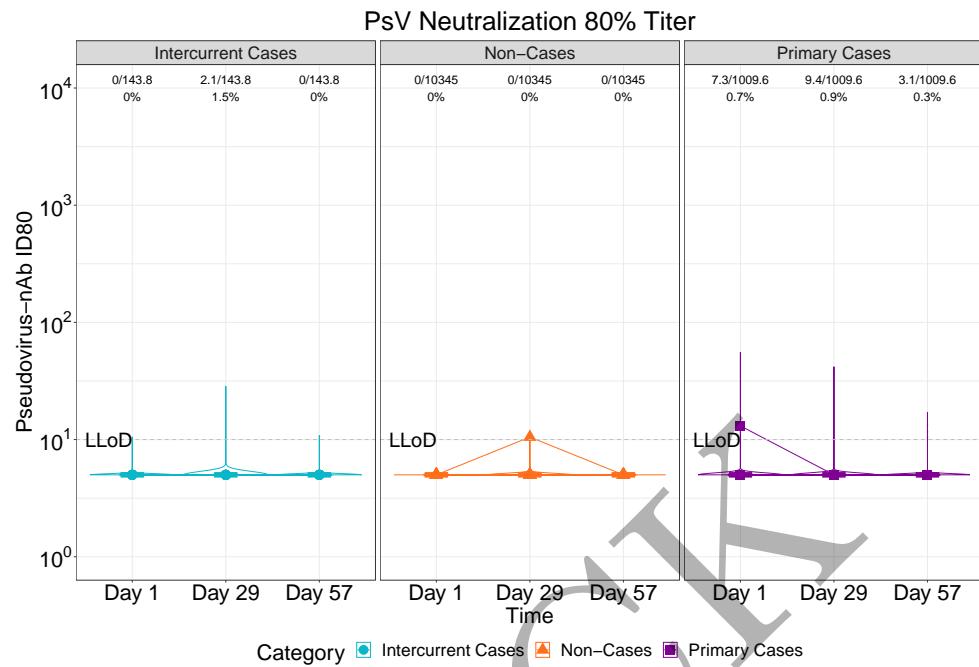


Figure 2.36: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

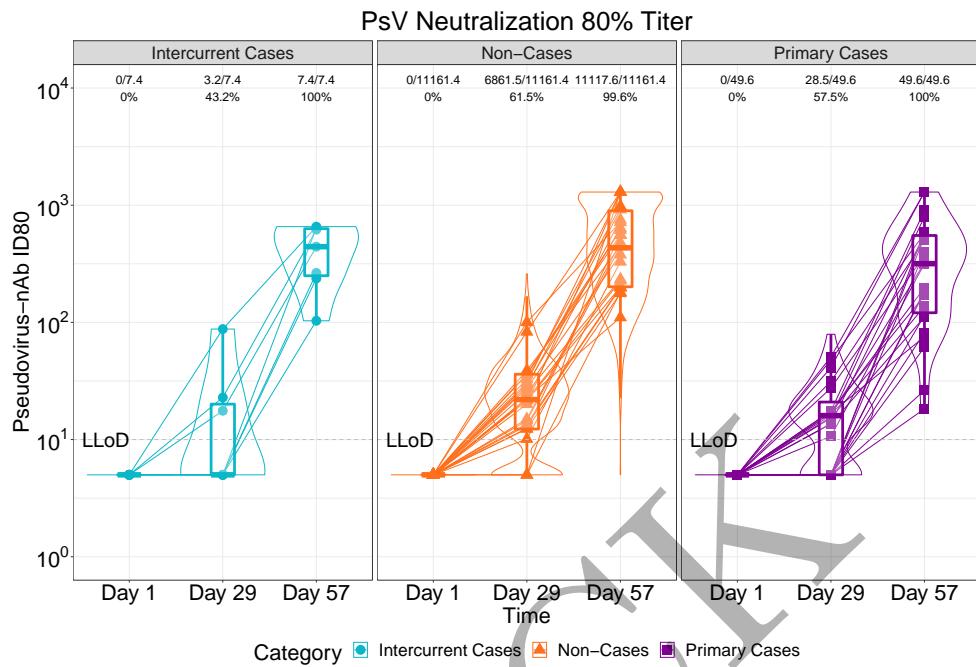


Figure 2.37: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

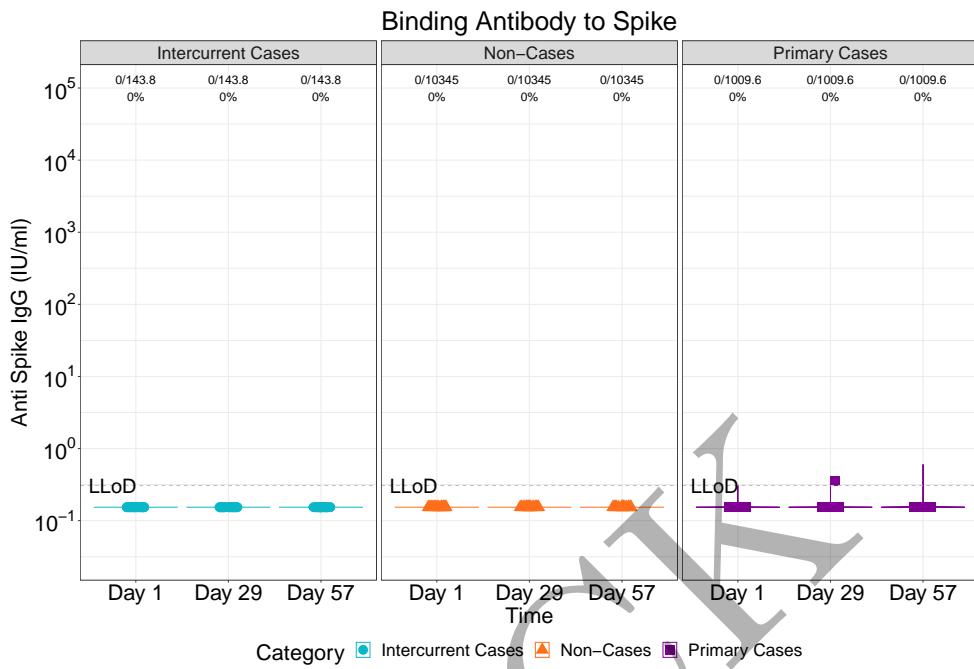


Figure 2.38: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

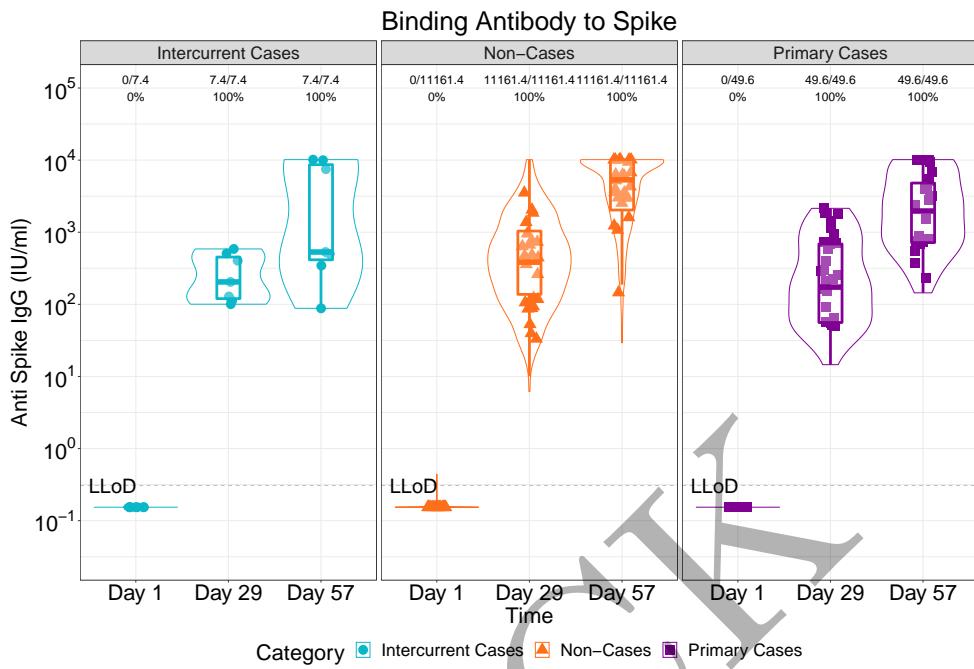


Figure 2.39: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

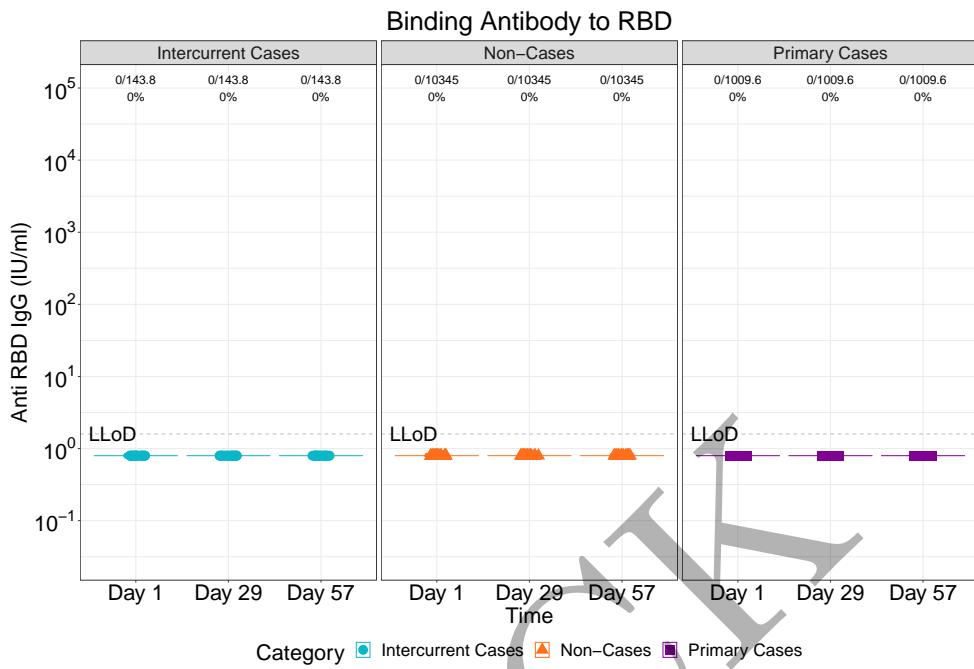


Figure 2.40: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

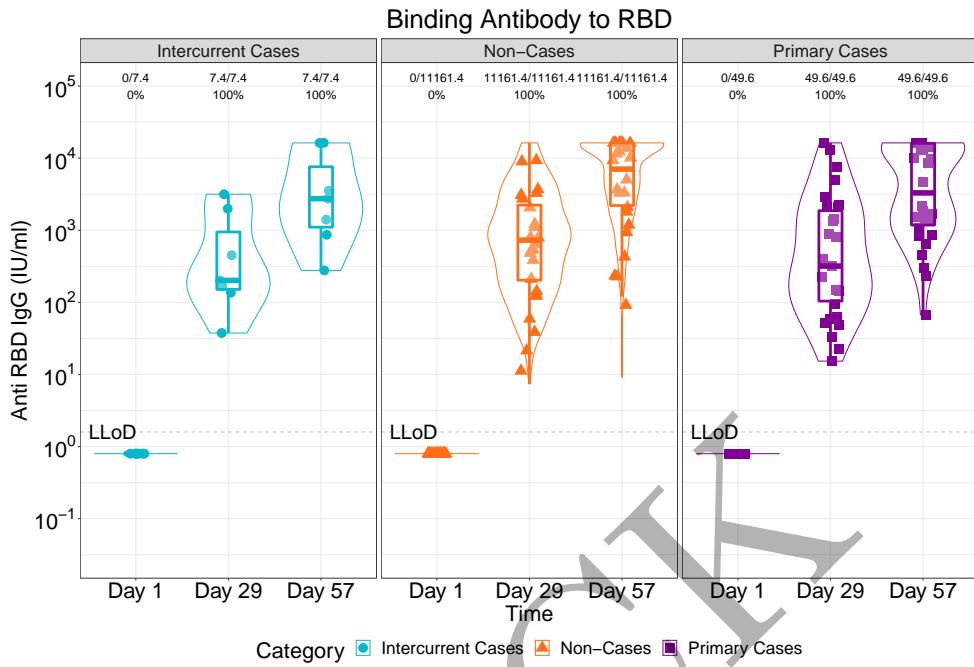


Figure 2.41: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

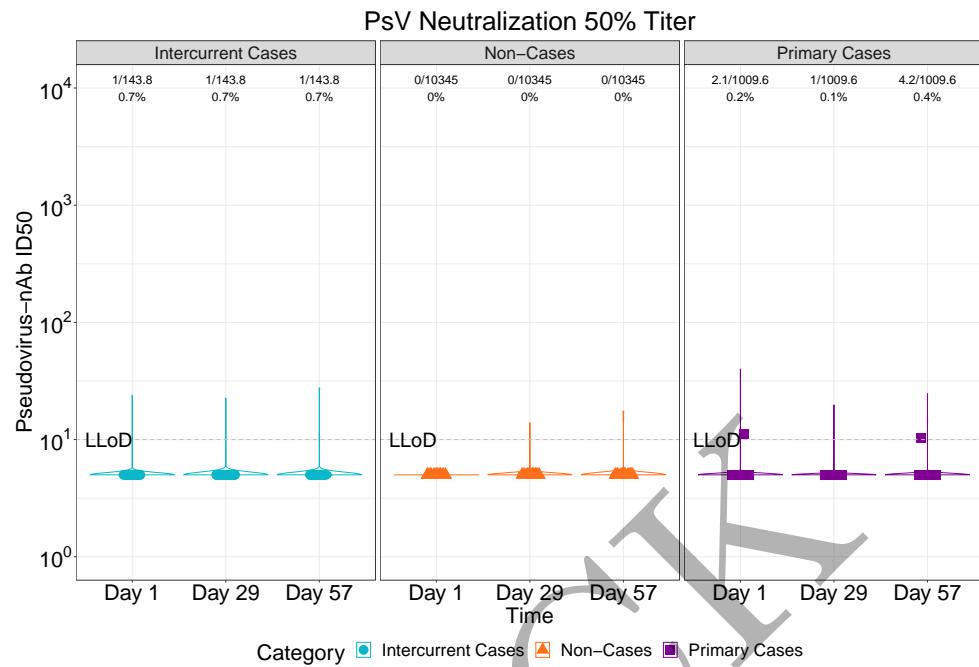


Figure 2.42: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

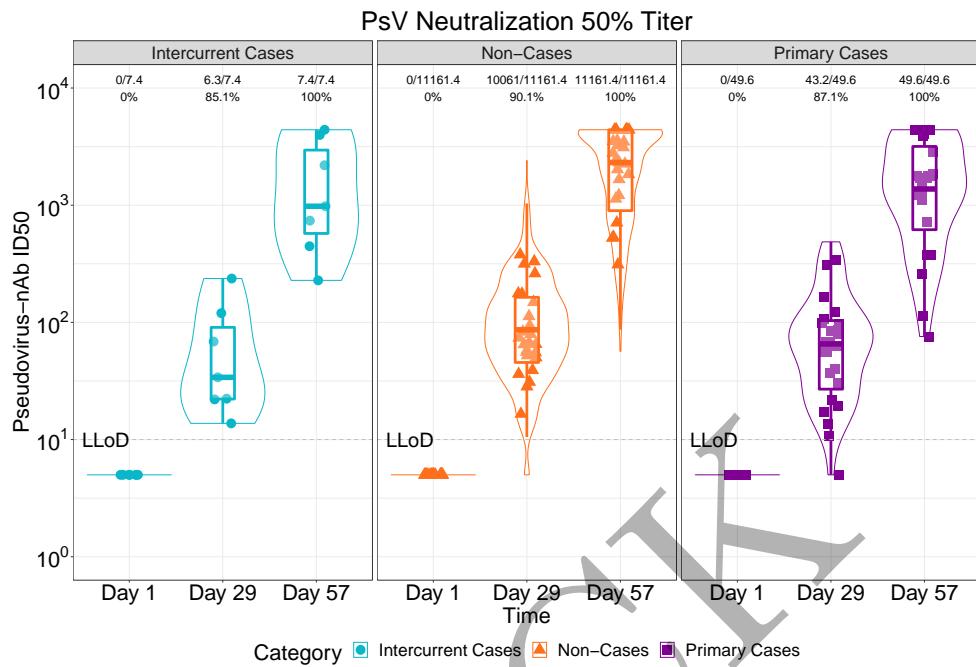


Figure 2.43: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

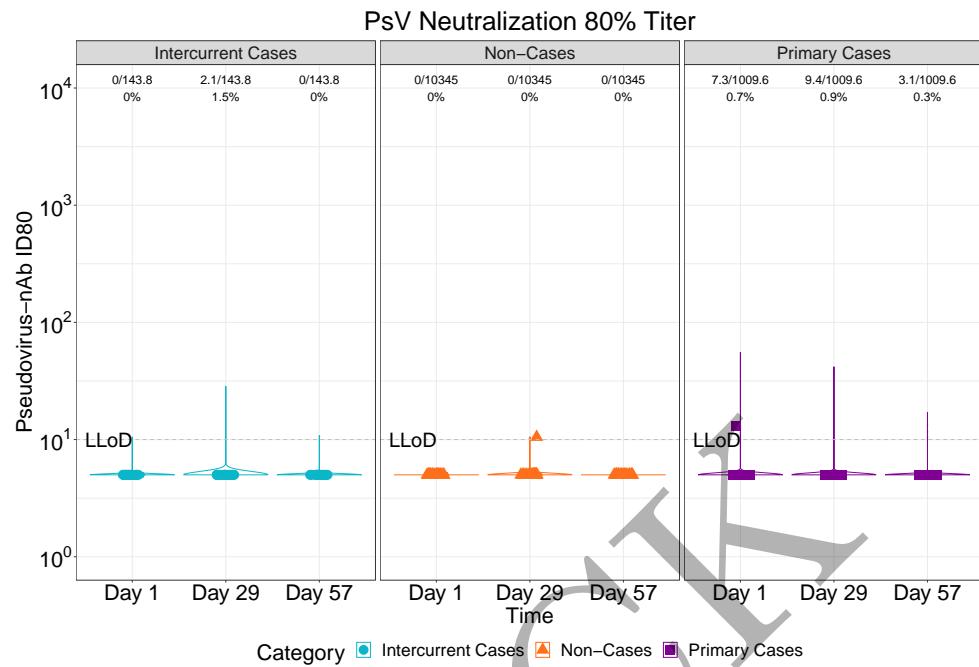


Figure 2.44: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

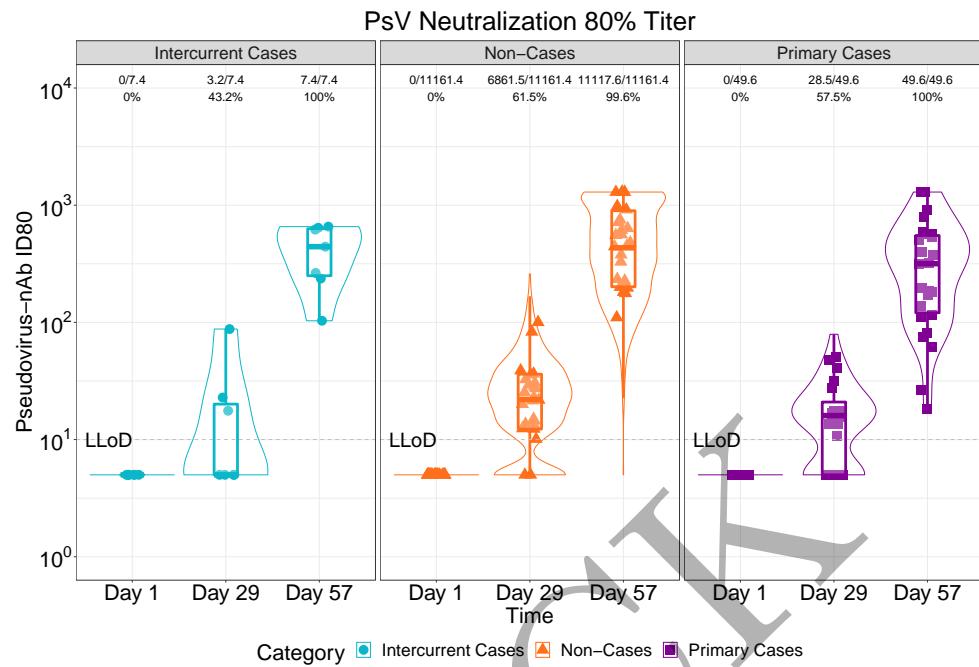


Figure 2.45: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

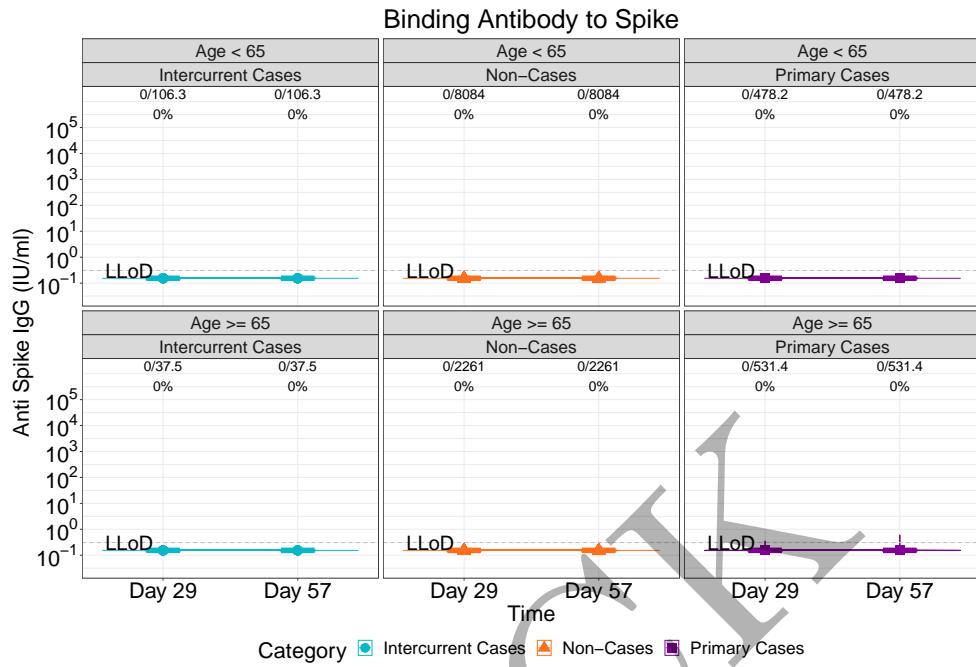


Figure 2.46: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

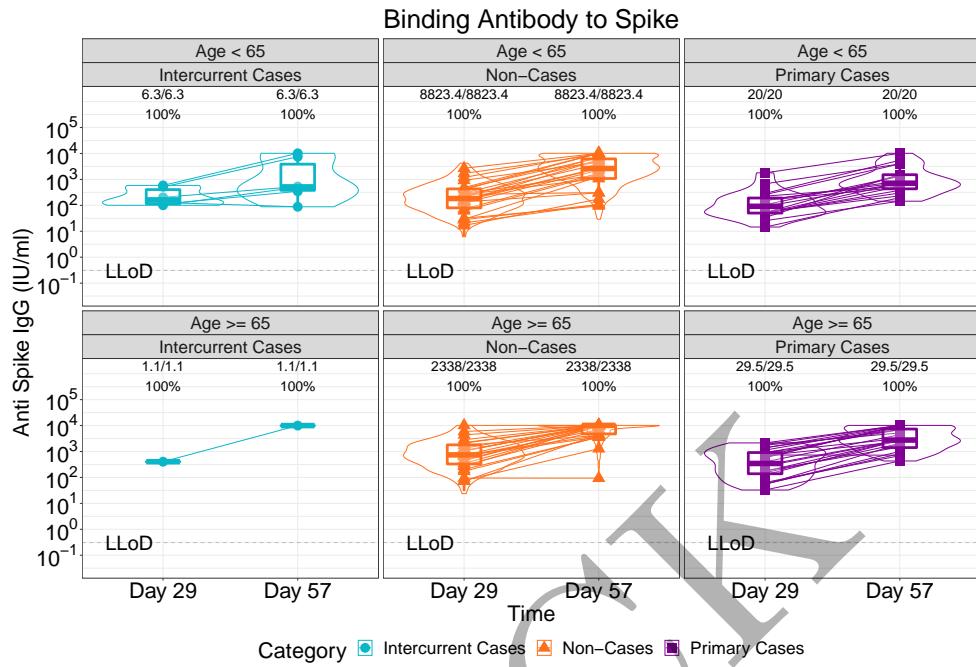


Figure 2.47: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

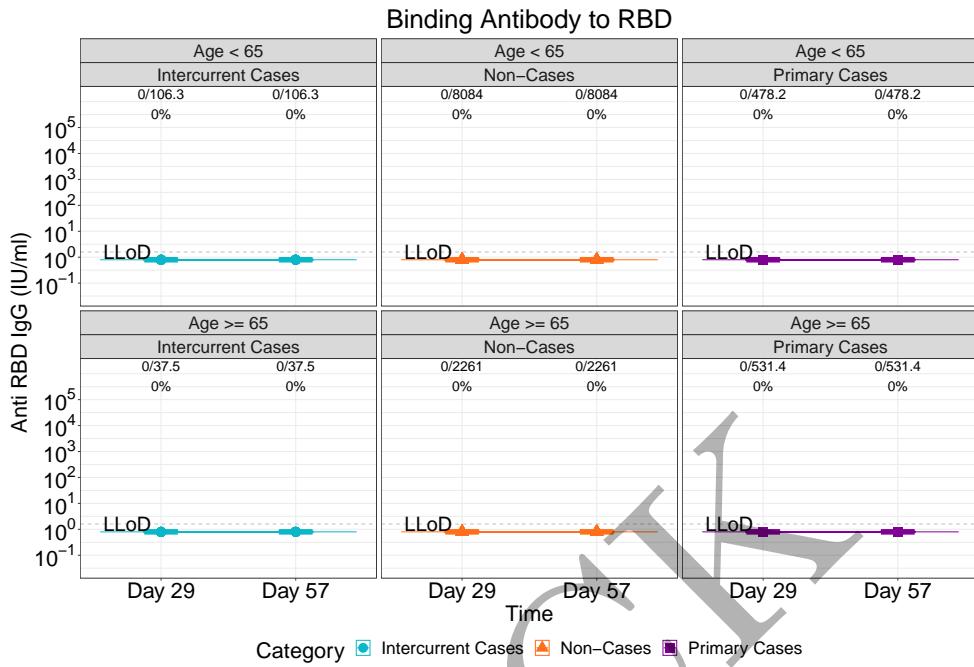


Figure 2.48: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

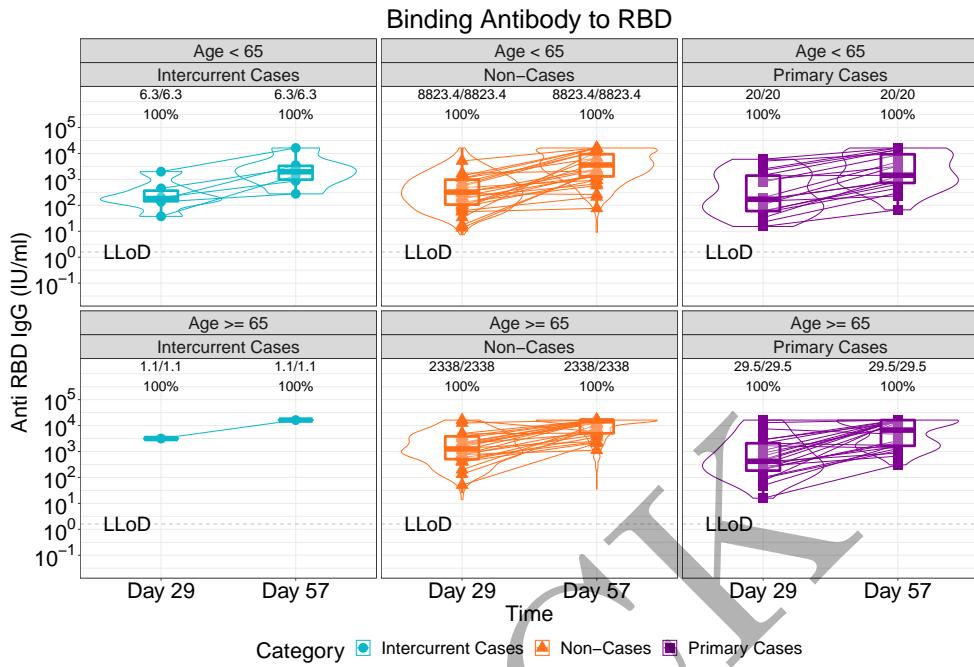


Figure 2.49: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

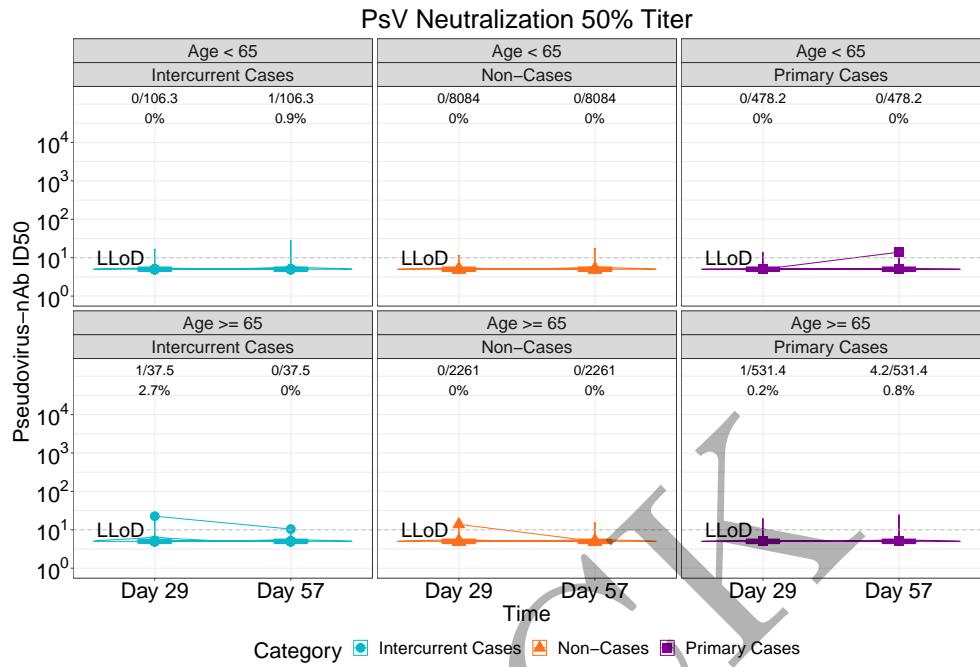


Figure 2.50: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

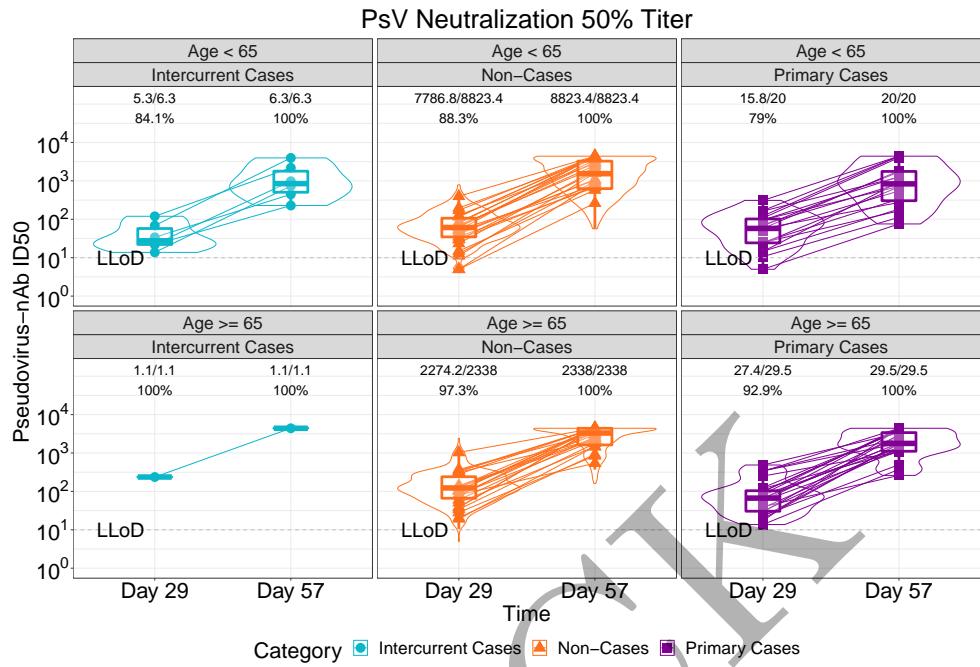


Figure 2.51: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

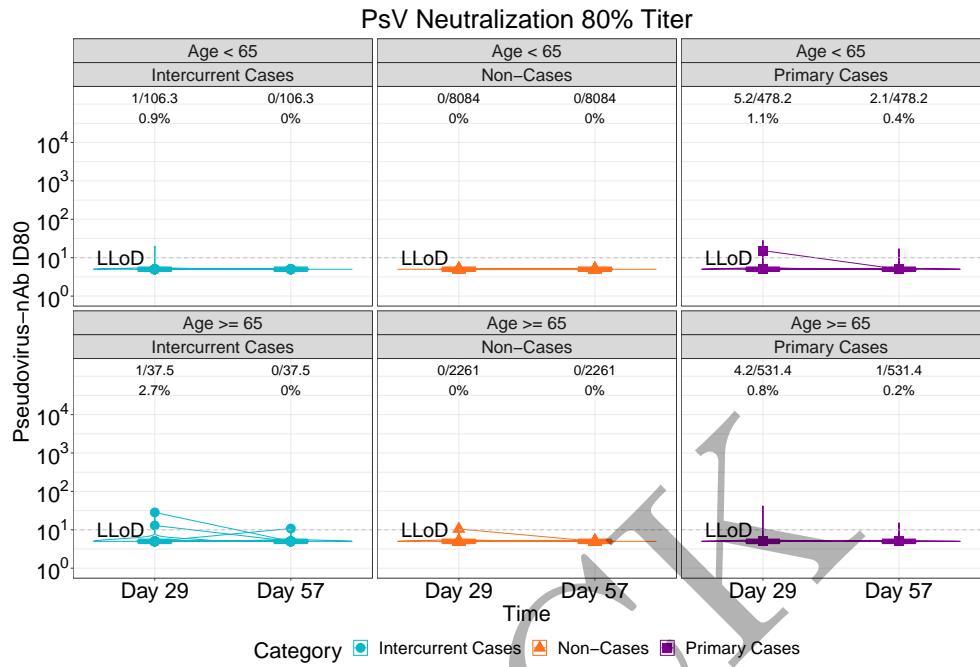


Figure 2.52: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

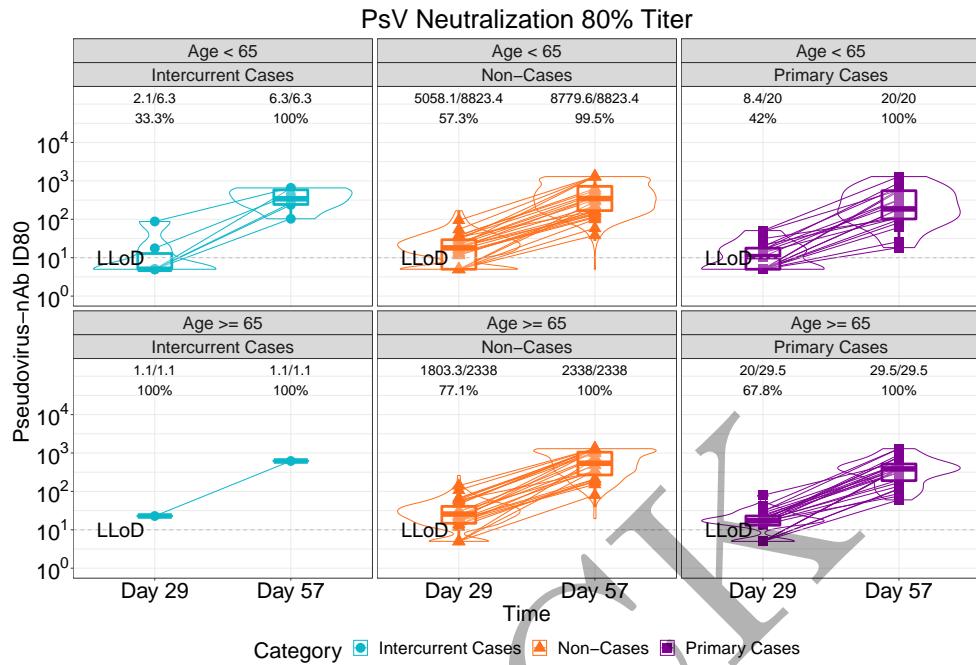


Figure 2.53: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

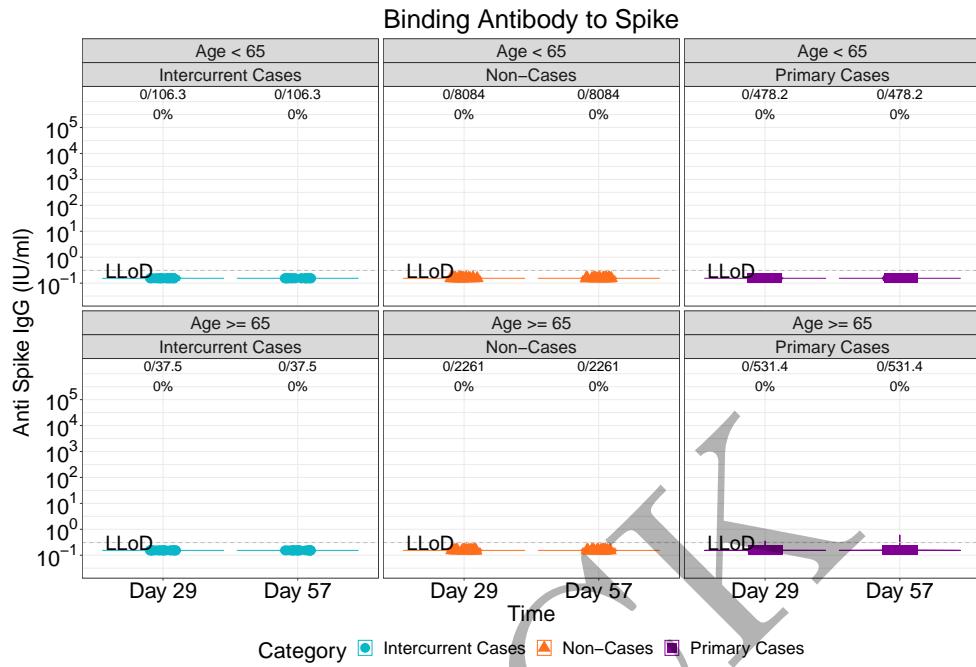


Figure 2.54: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

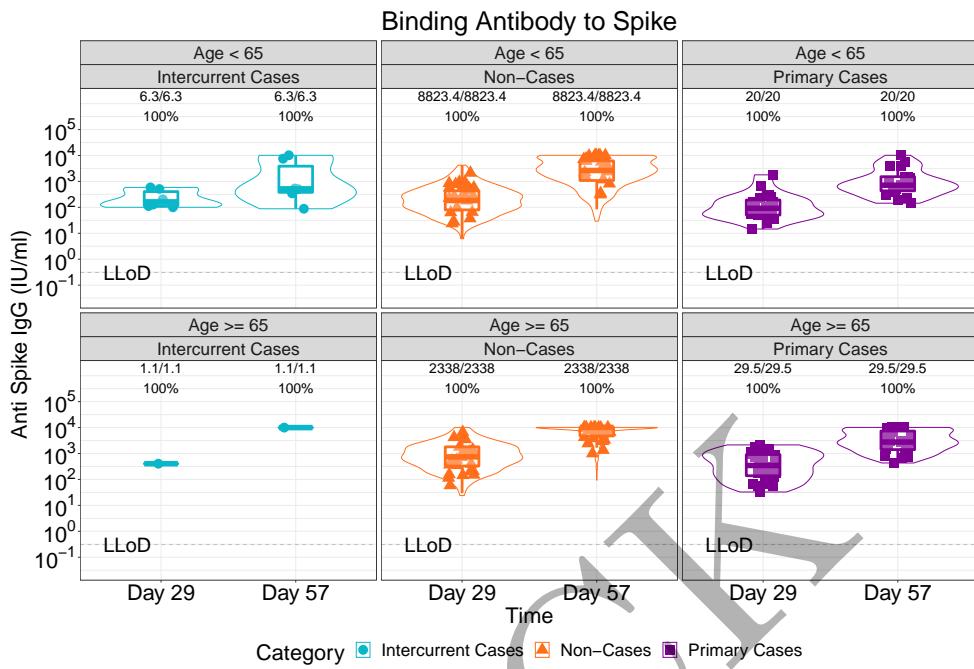


Figure 2.55: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

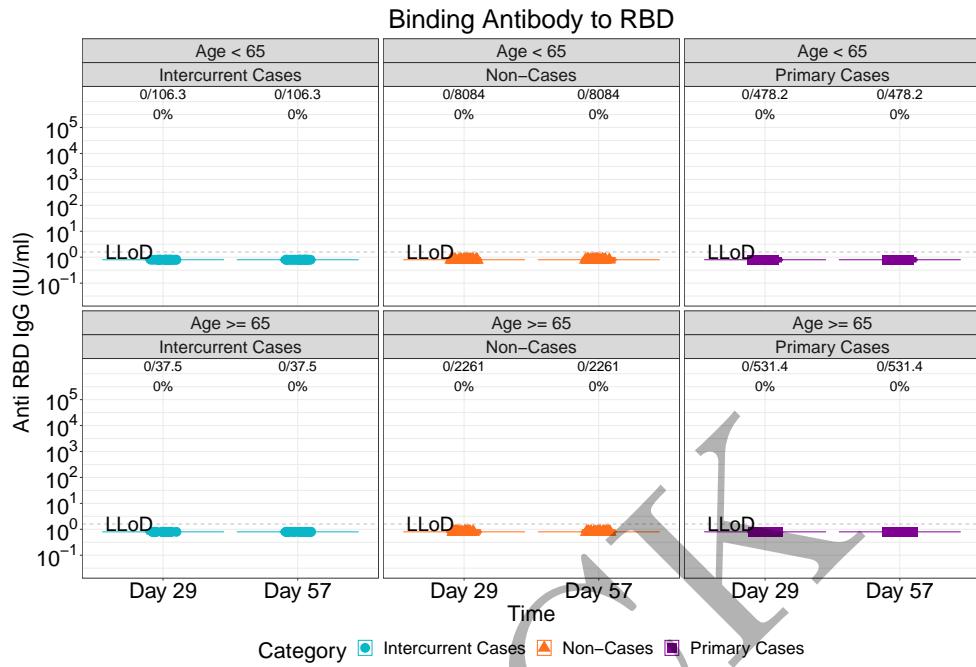


Figure 2.56: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

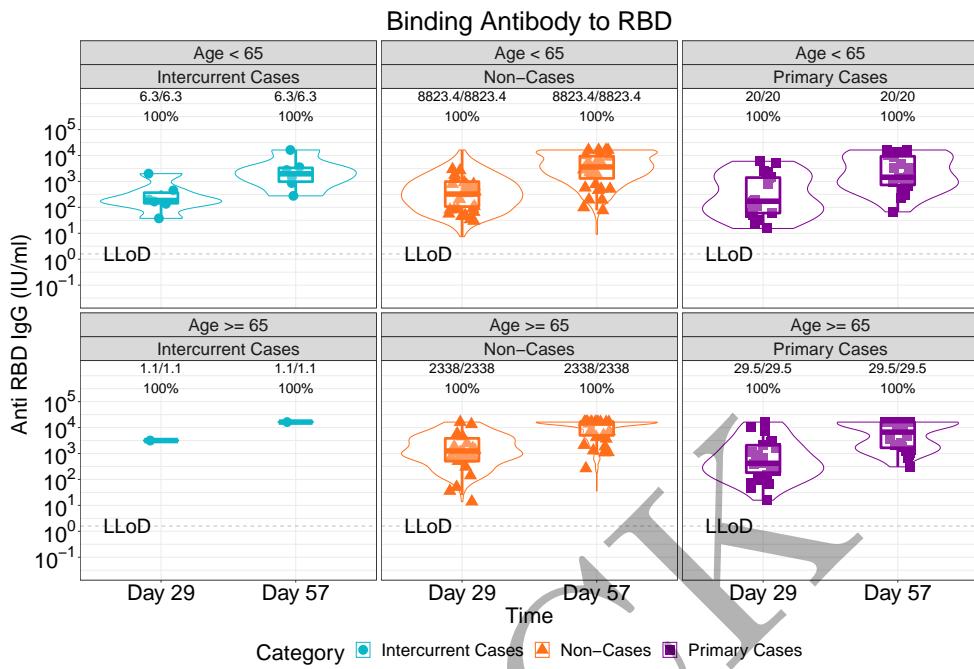


Figure 2.57: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

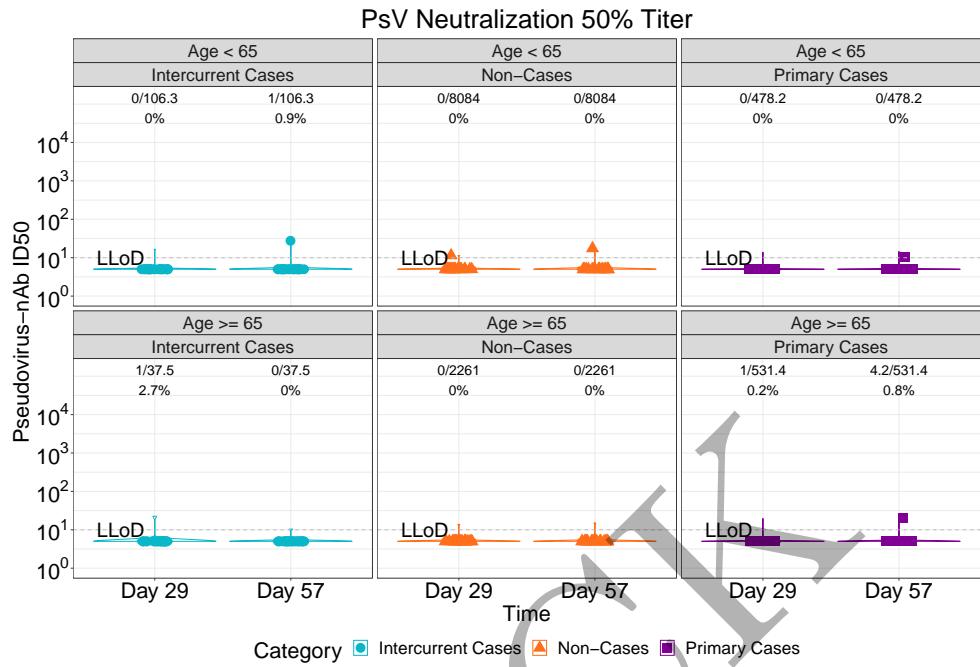


Figure 2.58: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

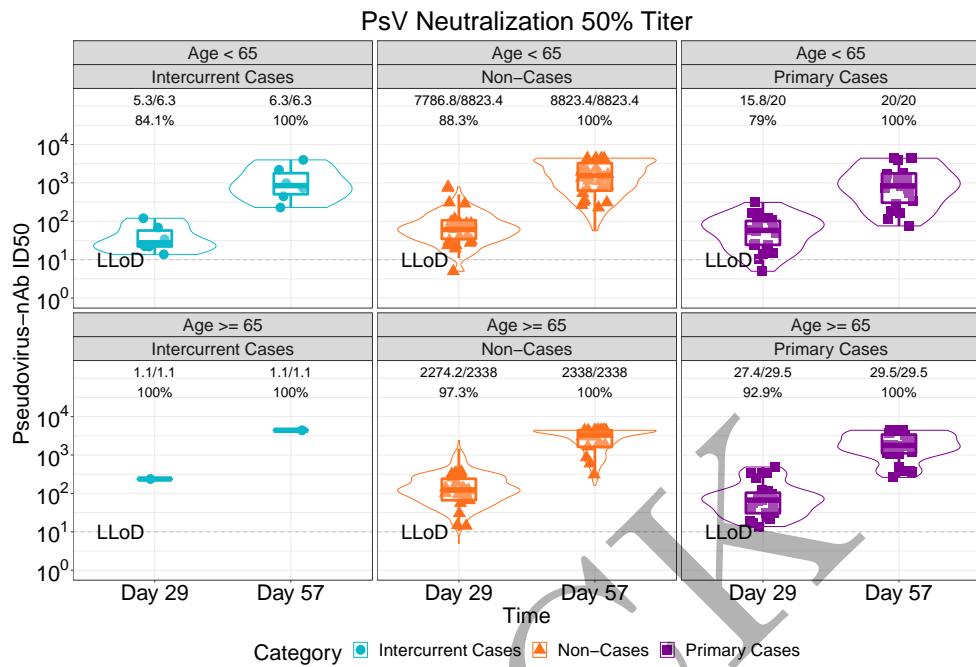


Figure 2.59: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

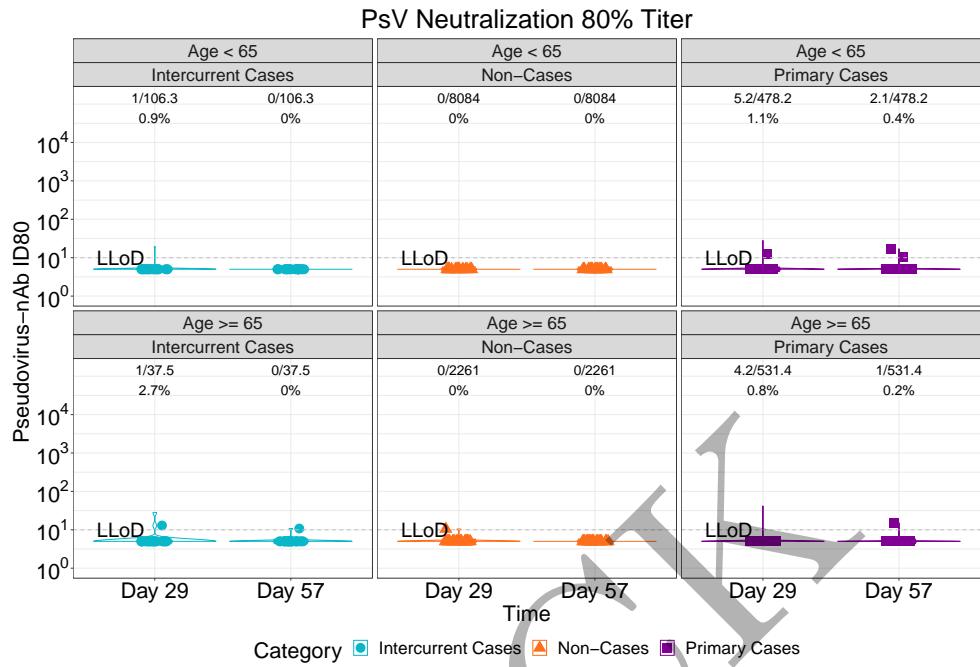


Figure 2.60: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

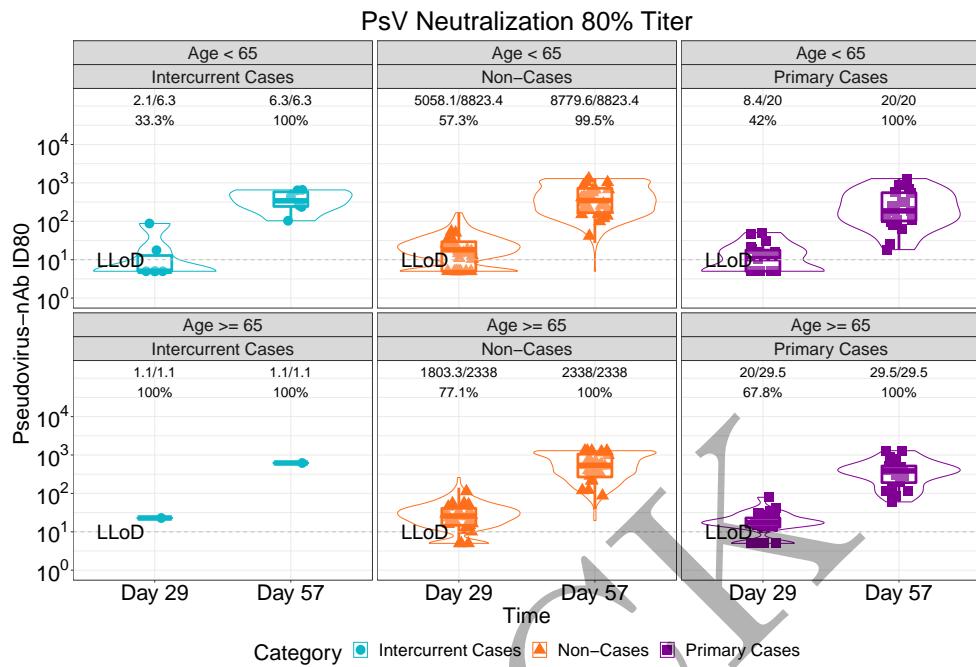


Figure 2.61: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

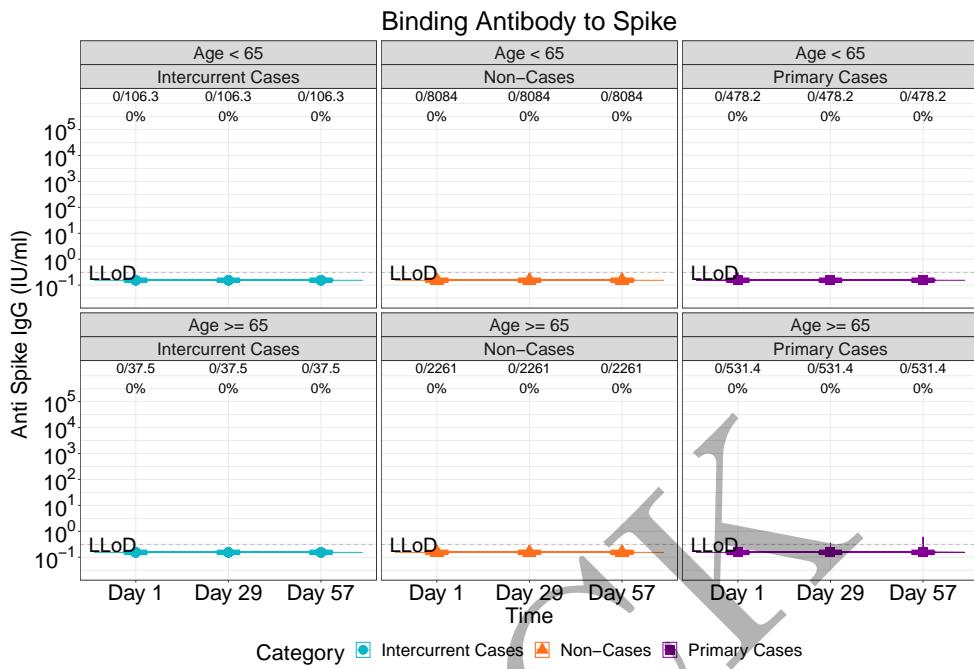


Figure 2.62: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

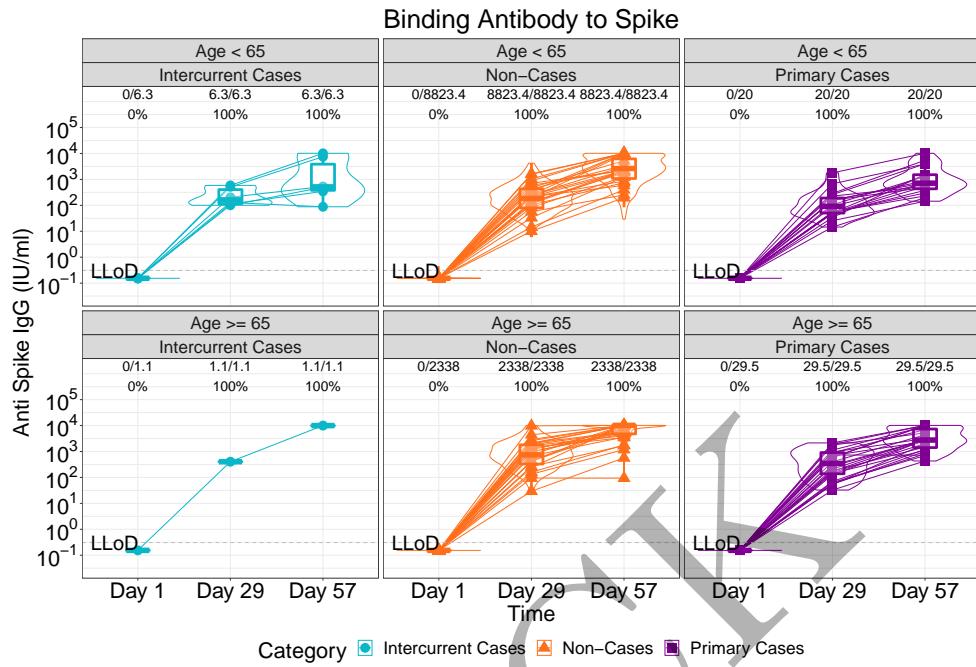


Figure 2.63: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

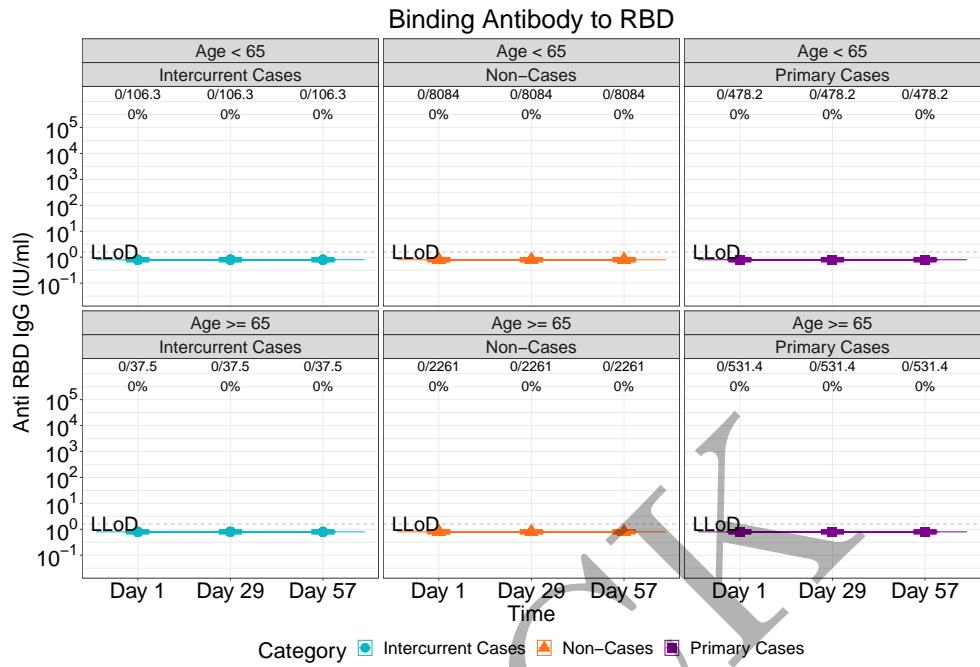


Figure 2.64: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

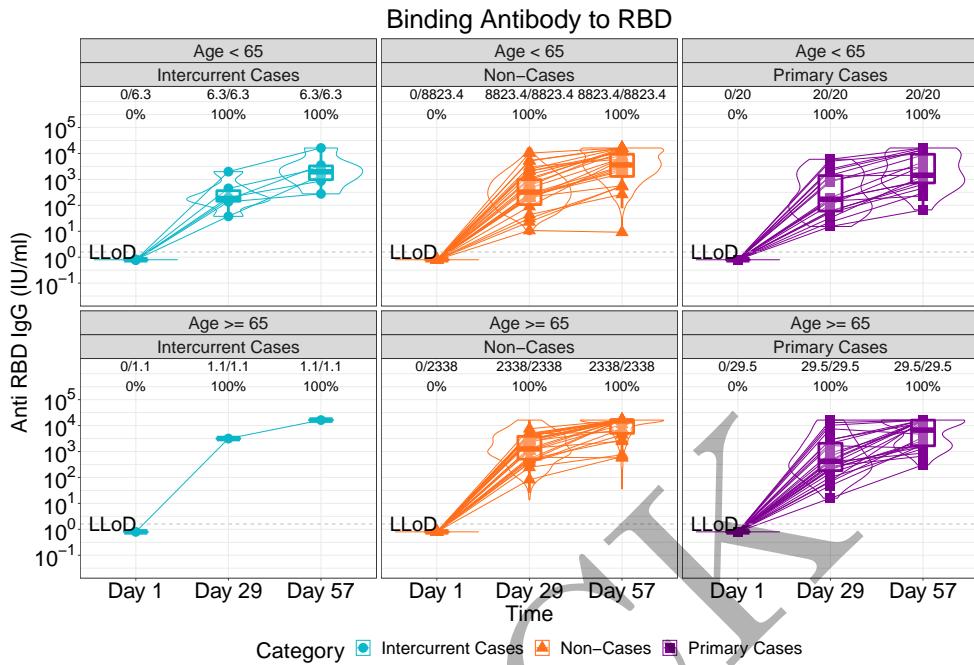


Figure 2.65: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

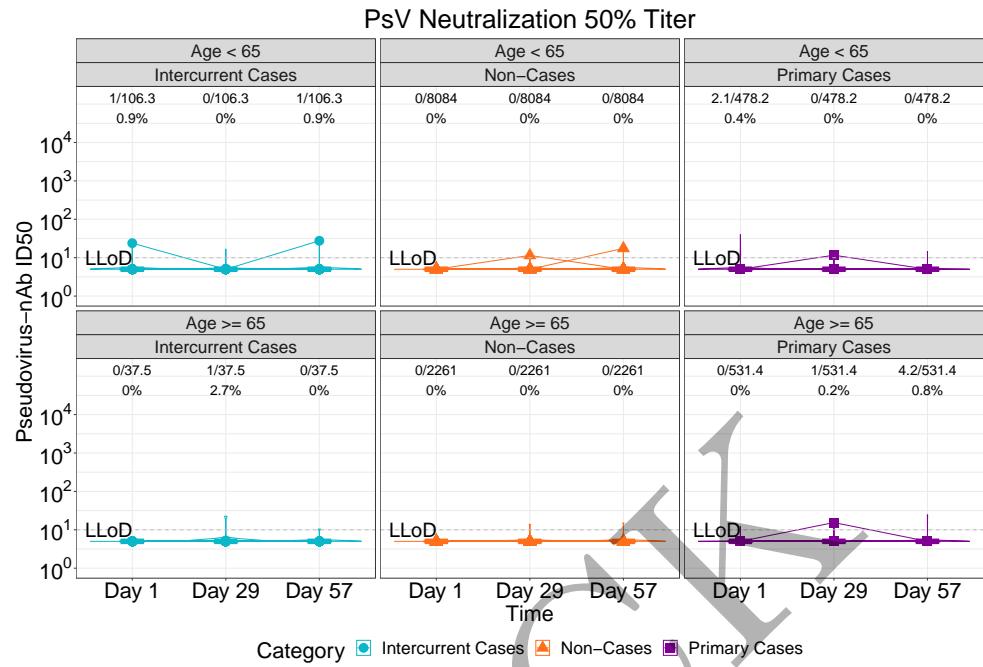


Figure 2.66: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

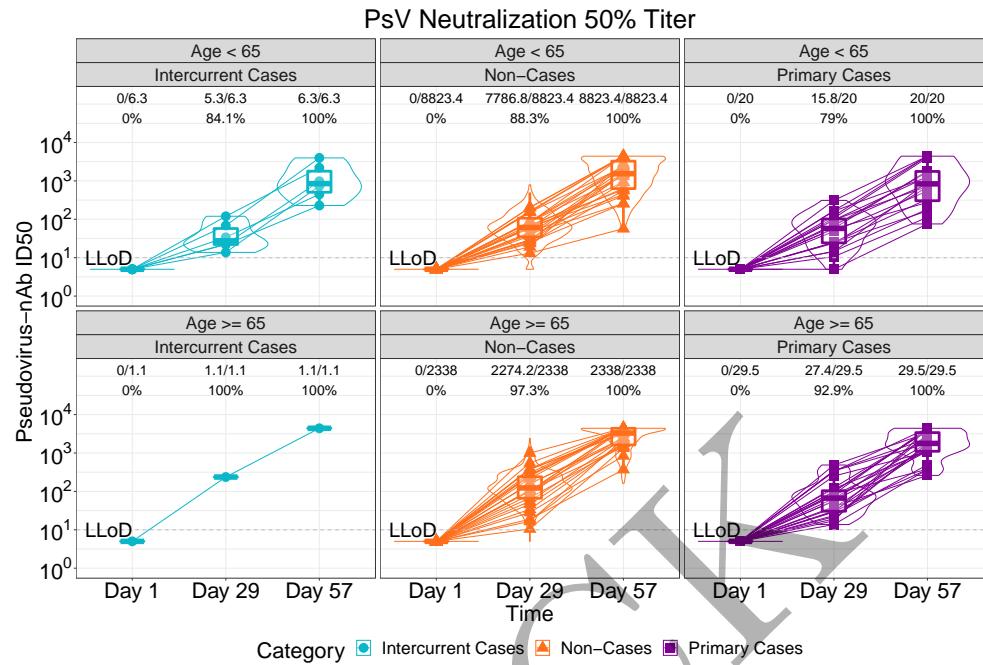


Figure 2.67: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

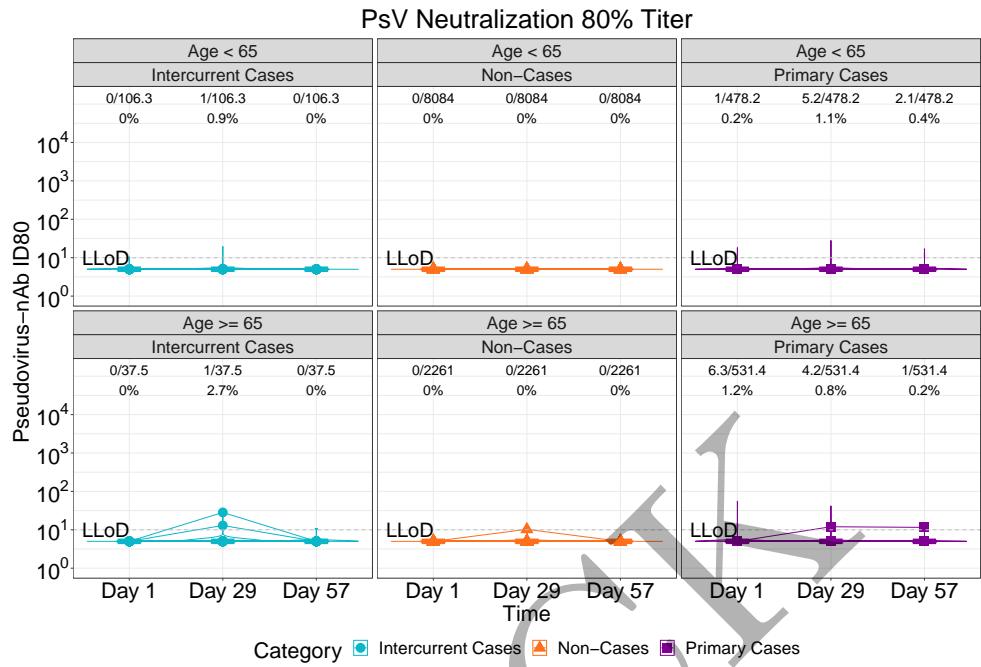


Figure 2.68: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

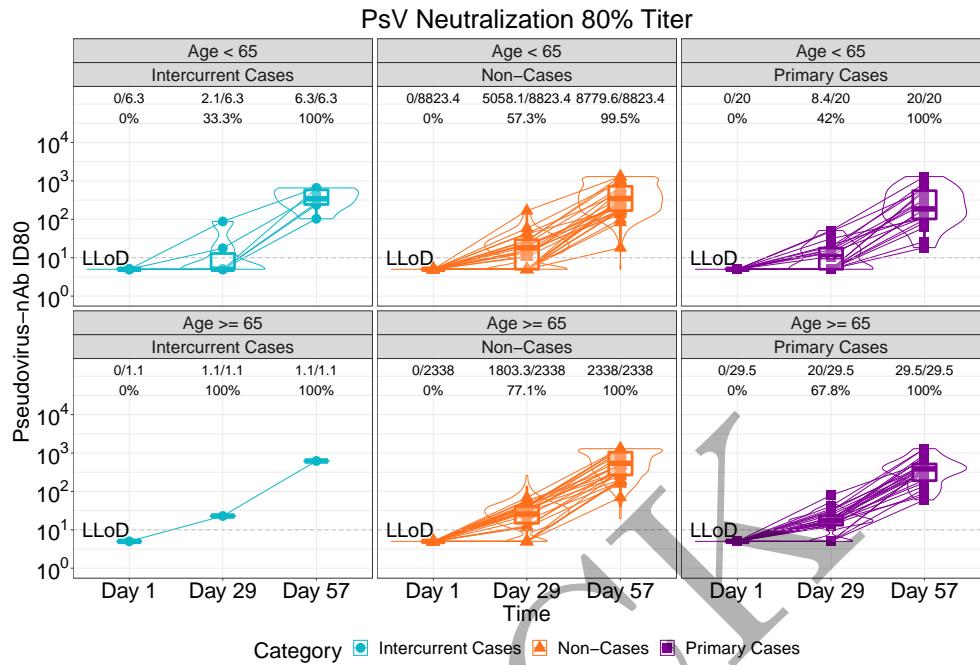


Figure 2.69: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

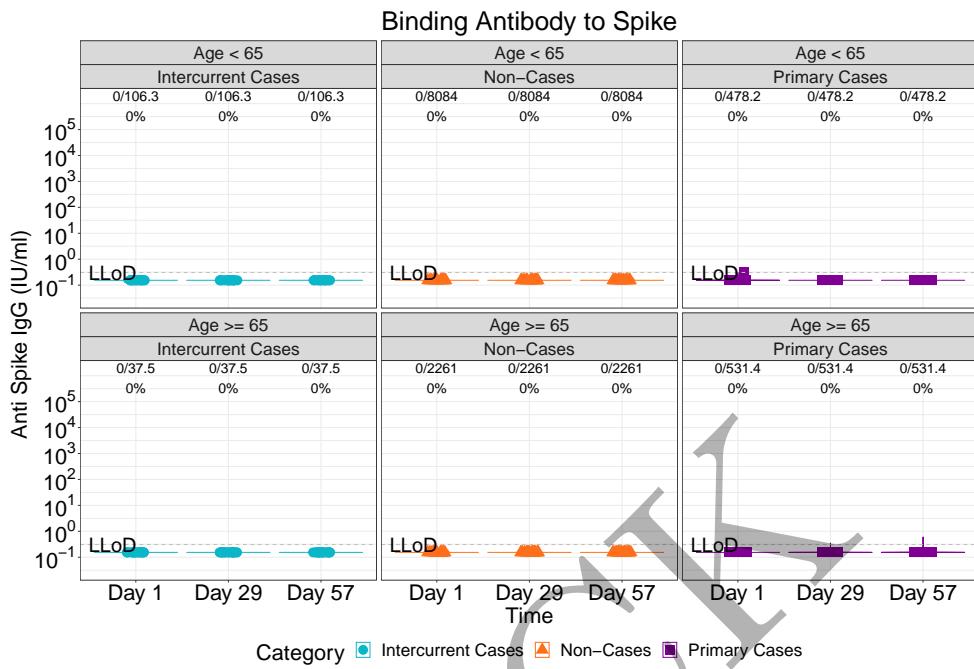


Figure 2.70: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

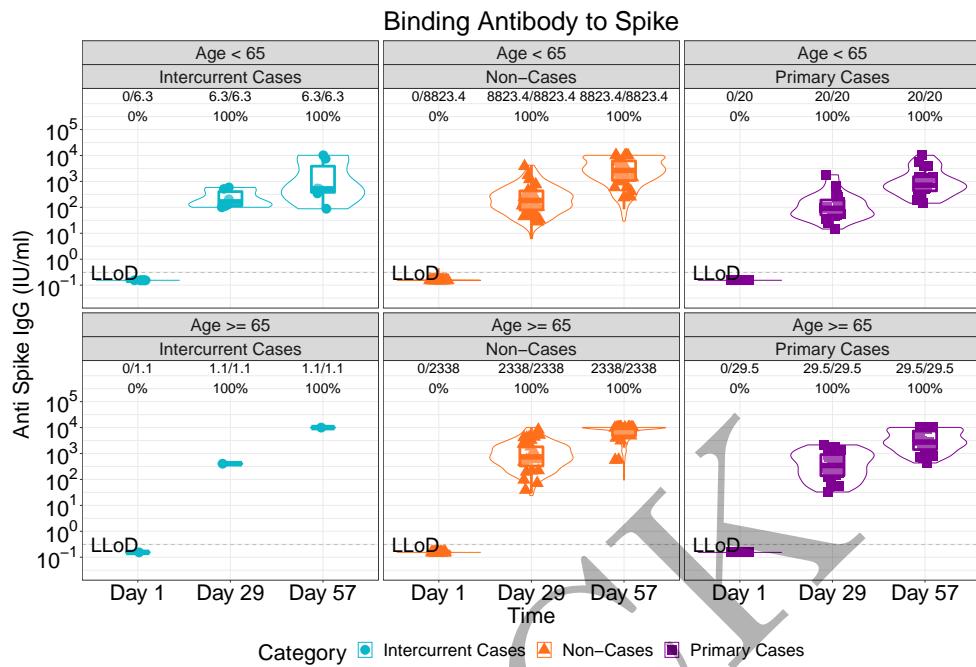


Figure 2.71: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

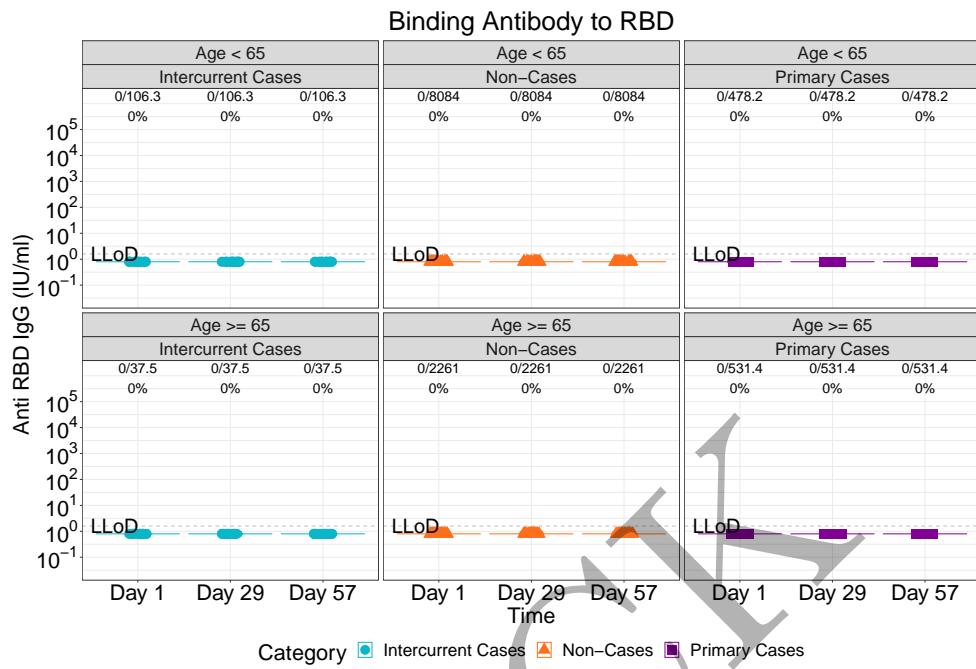


Figure 2.72: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

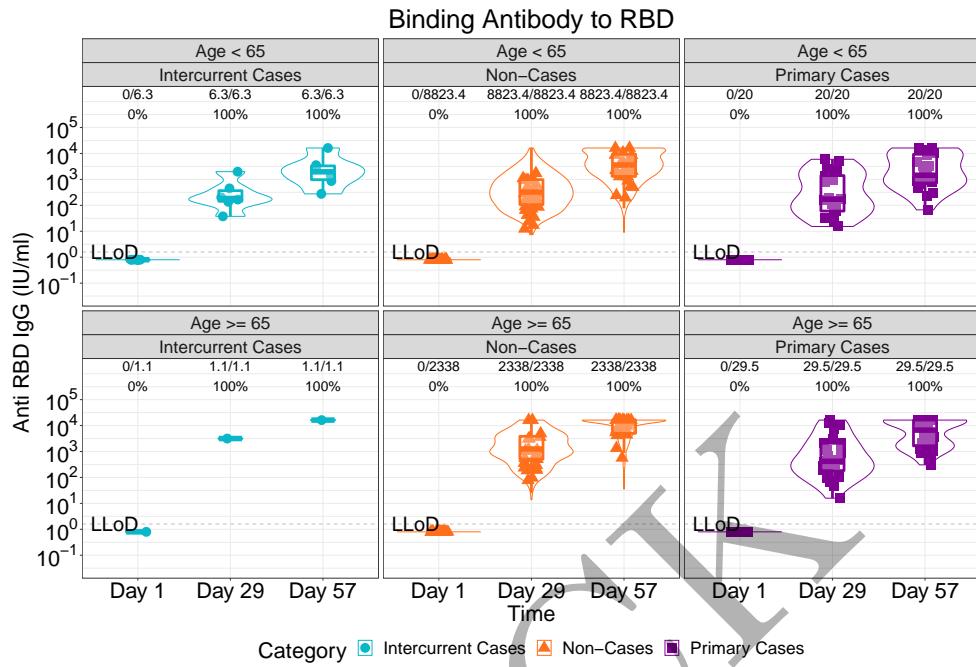


Figure 2.73: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

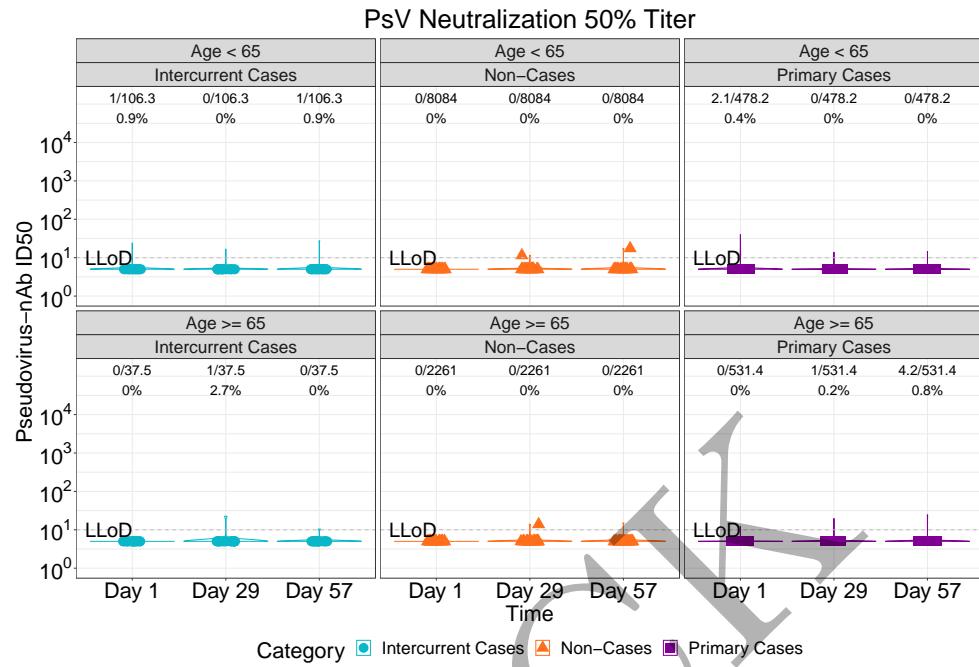


Figure 2.74: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

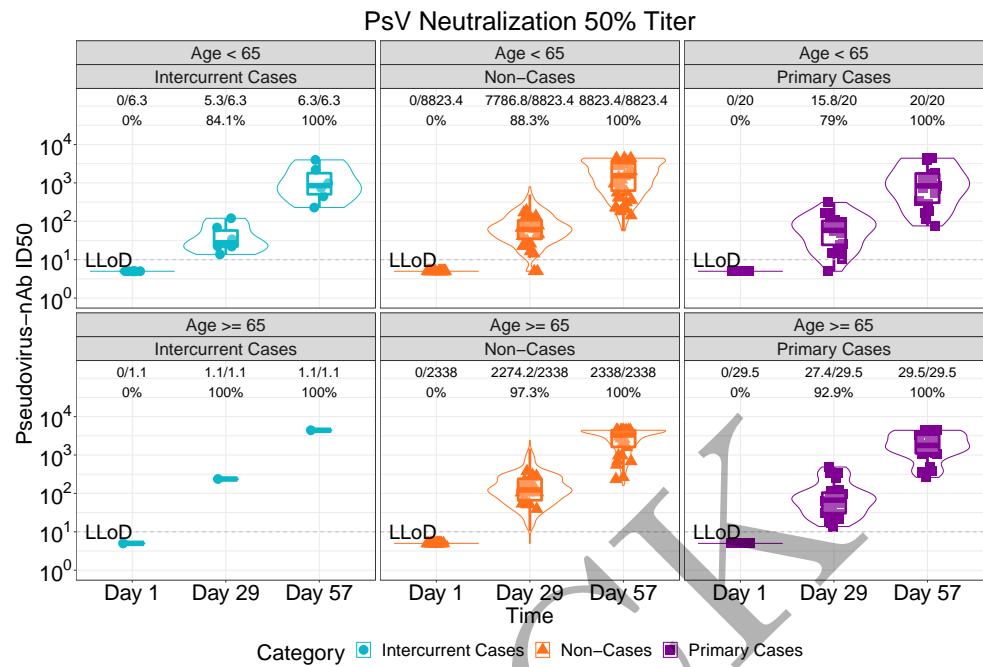


Figure 2.75: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

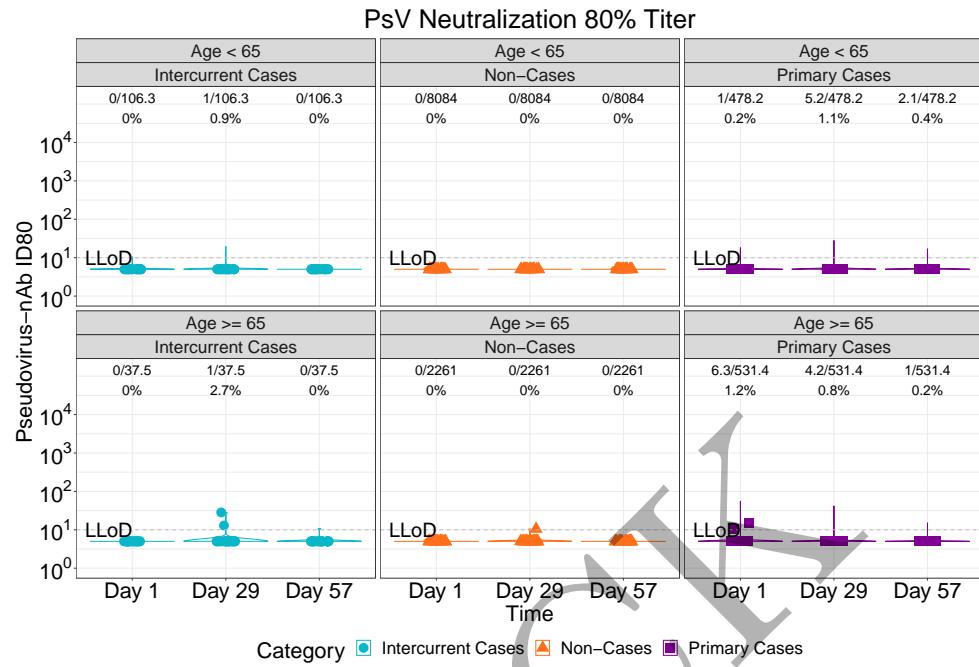


Figure 2.76: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

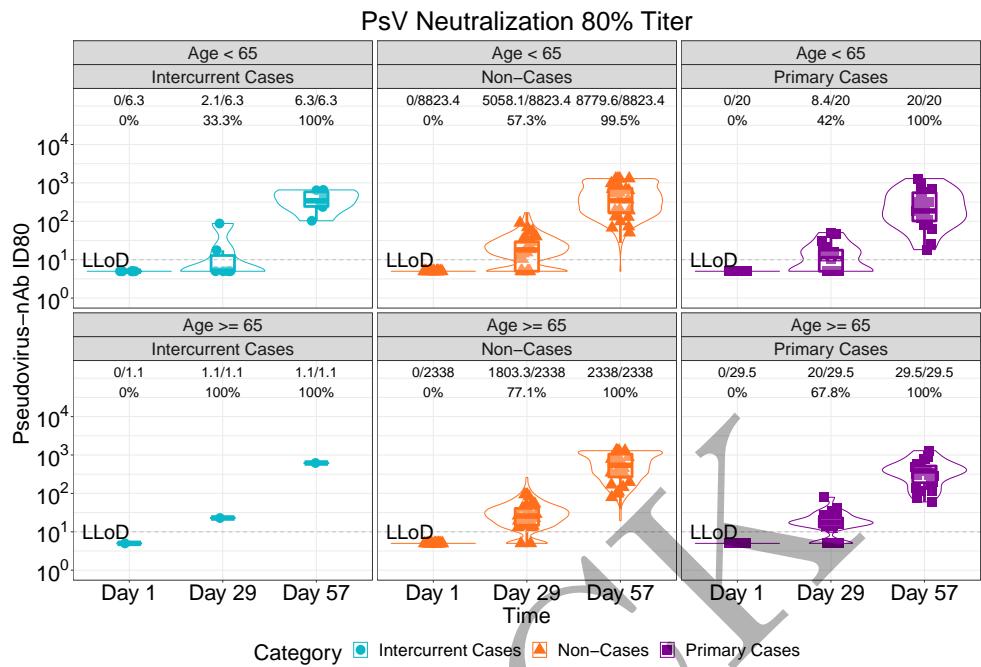


Figure 2.77: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

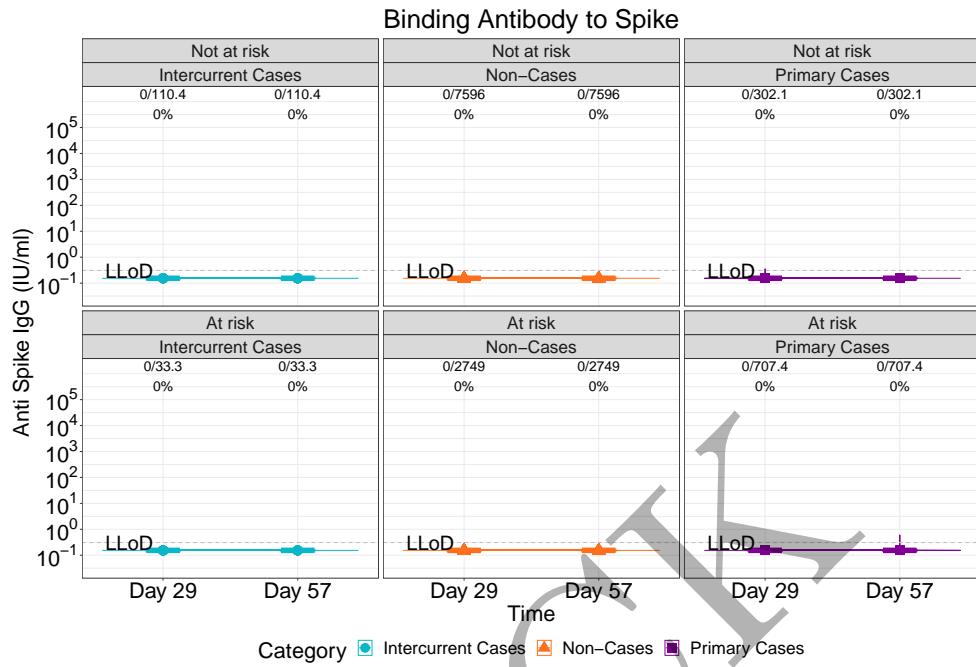


Figure 2.78: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

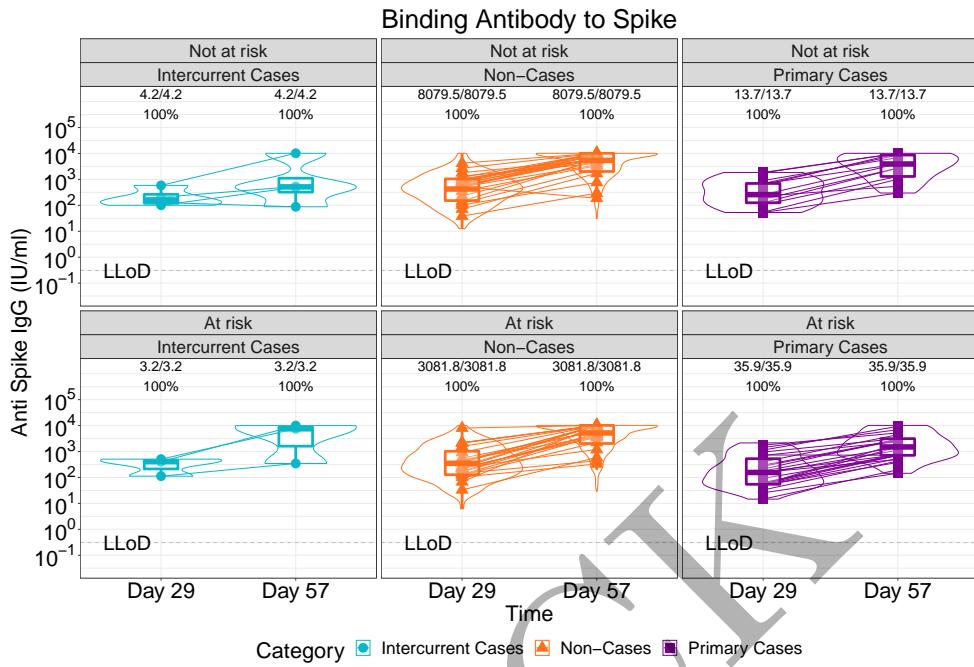


Figure 2.79: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

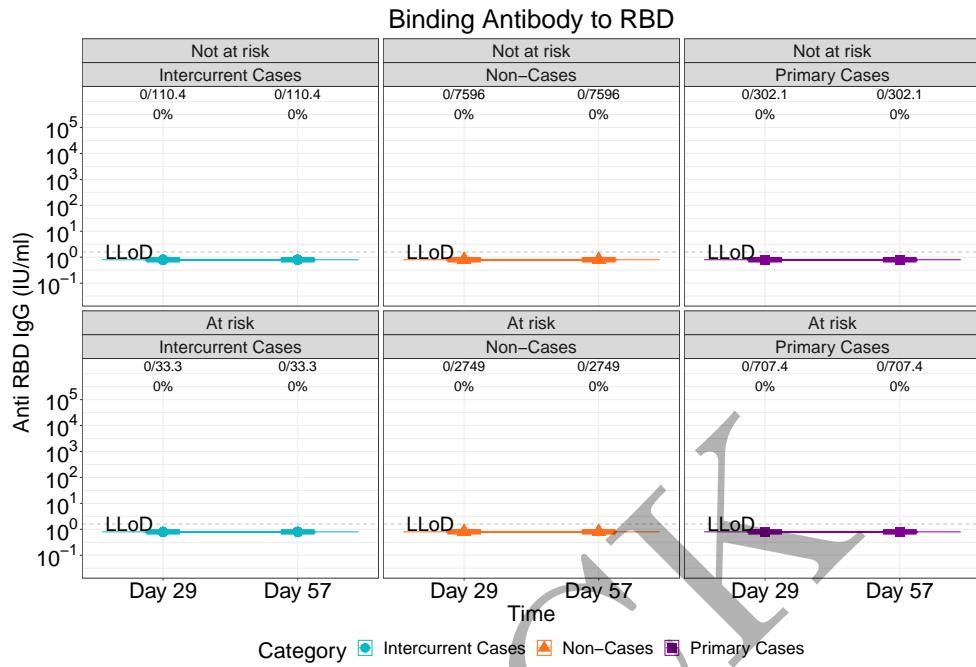


Figure 2.80: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

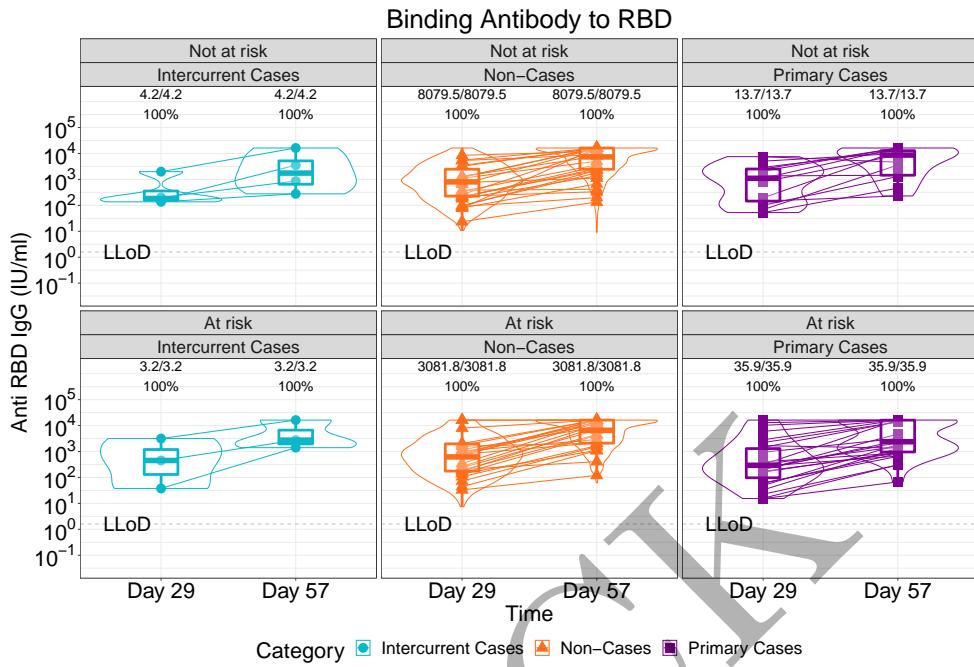


Figure 2.81: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

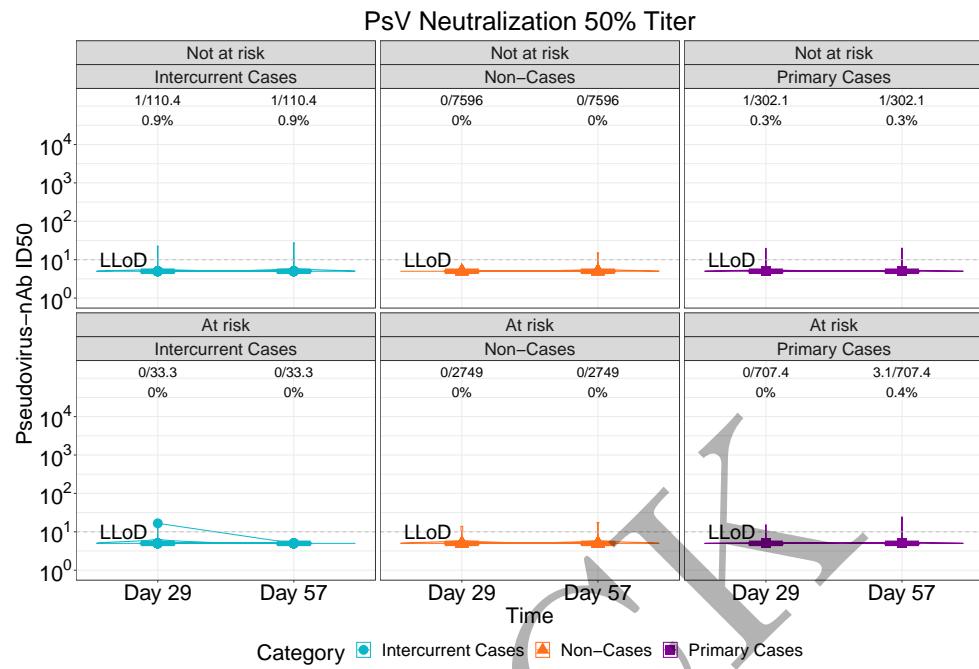


Figure 2.82: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

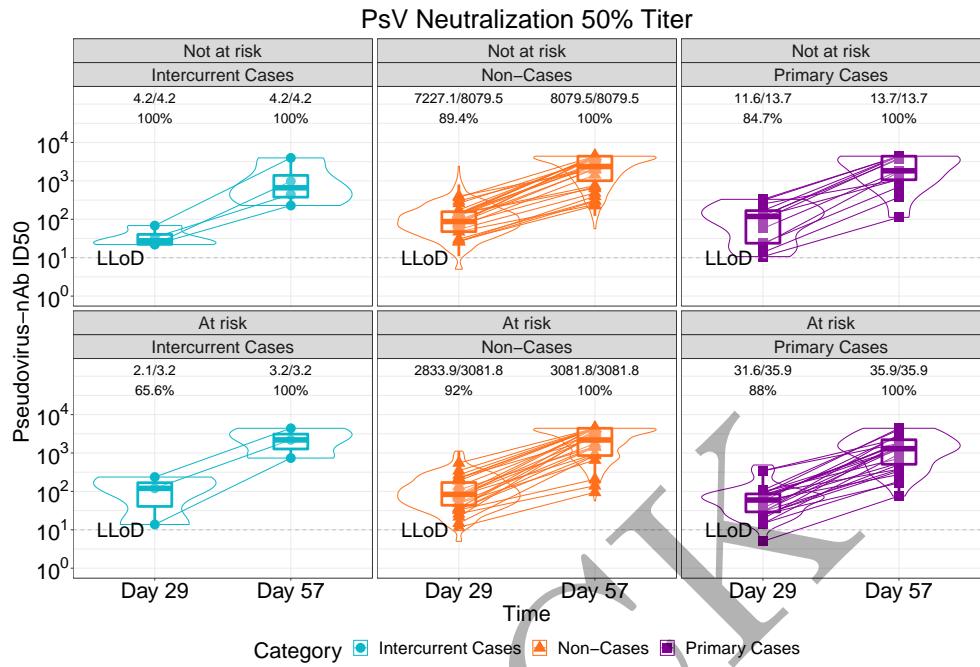


Figure 2.83: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

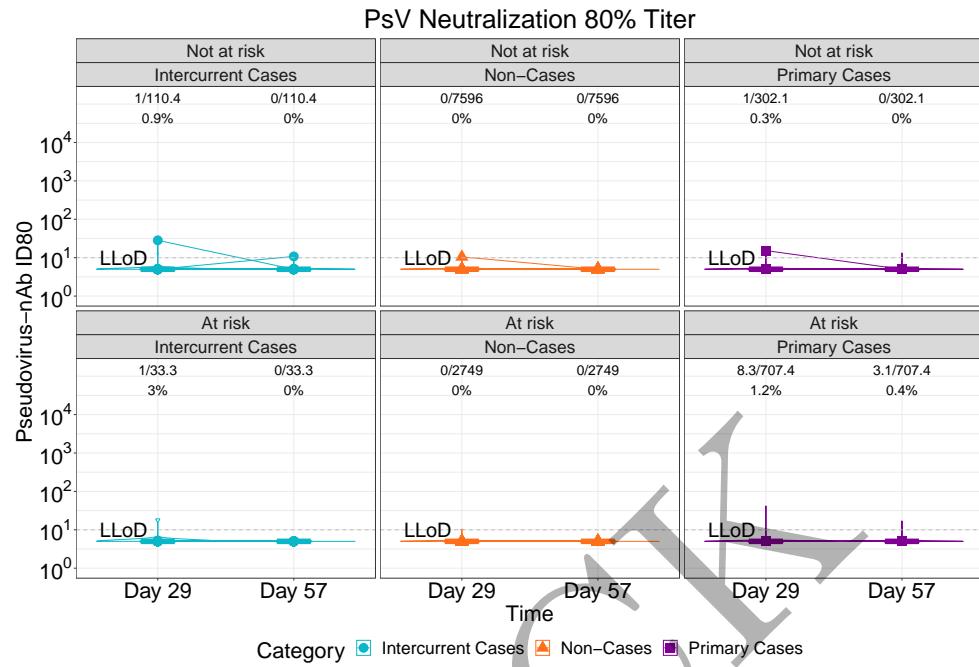


Figure 2.84: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

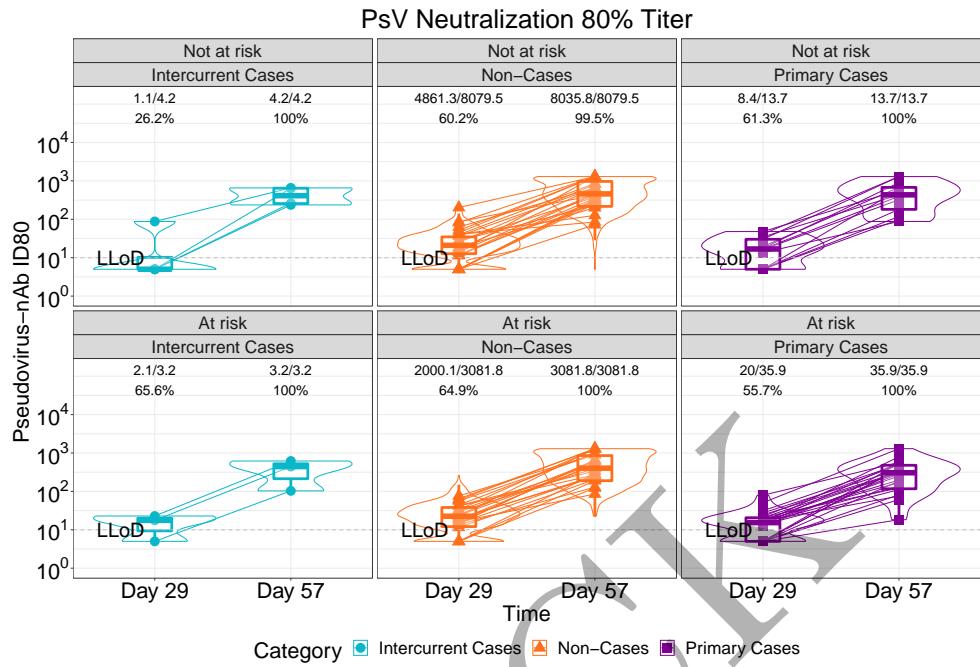


Figure 2.85: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

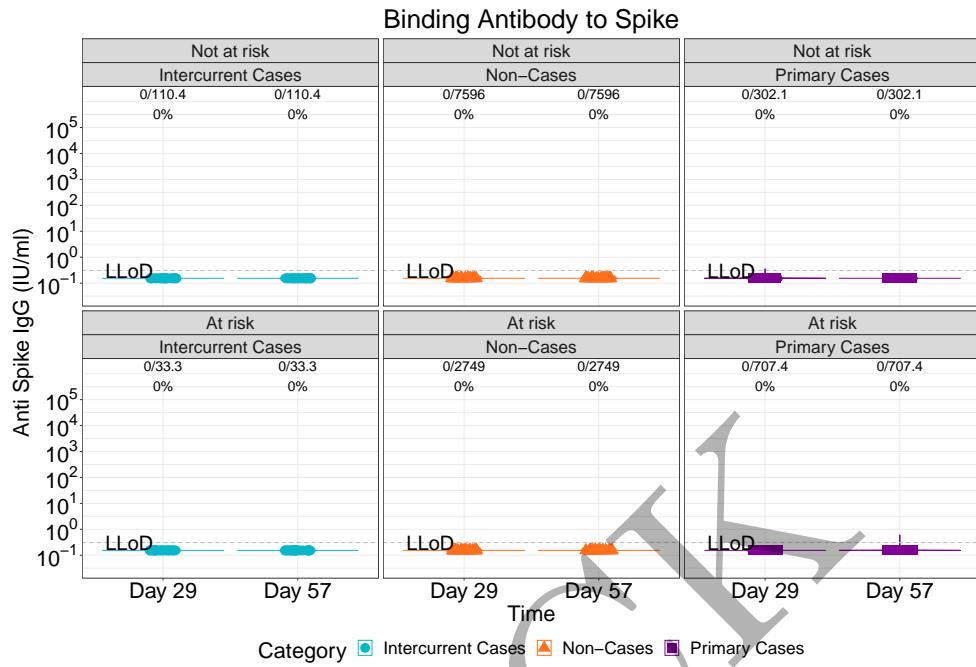


Figure 2.86: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

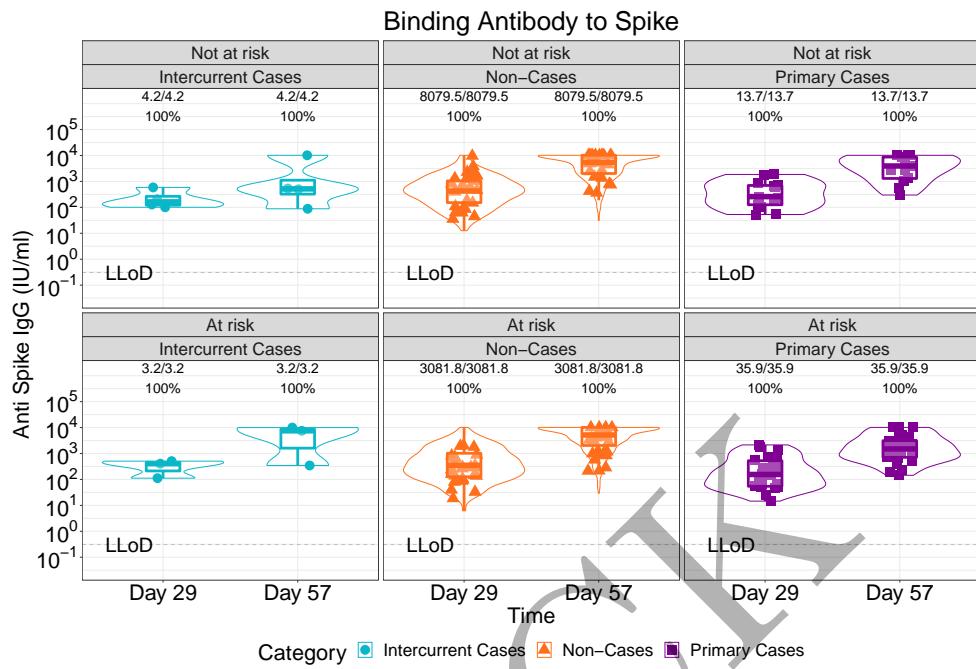


Figure 2.87: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

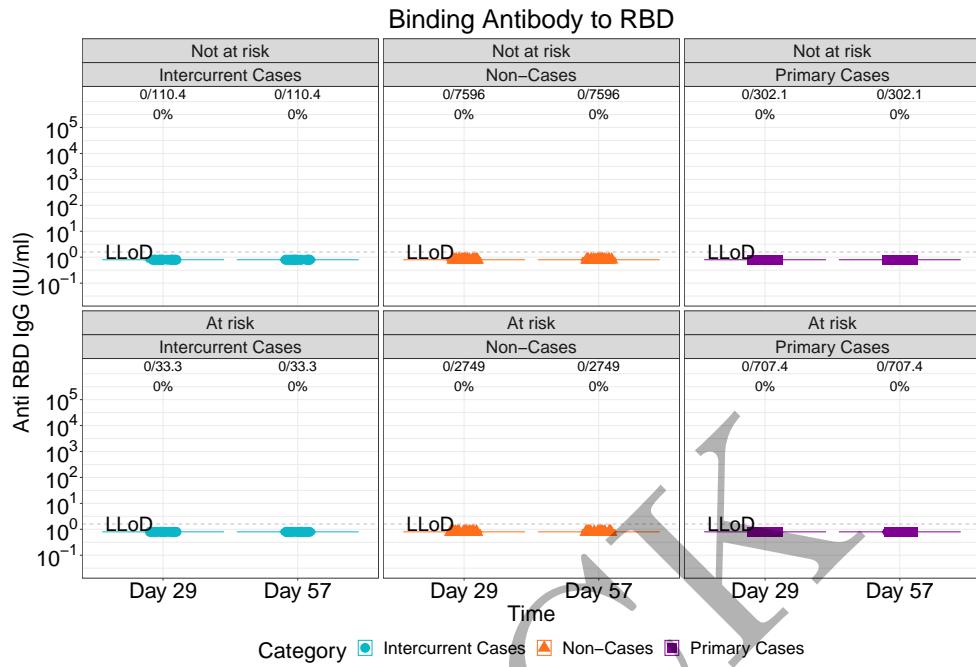


Figure 2.88: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

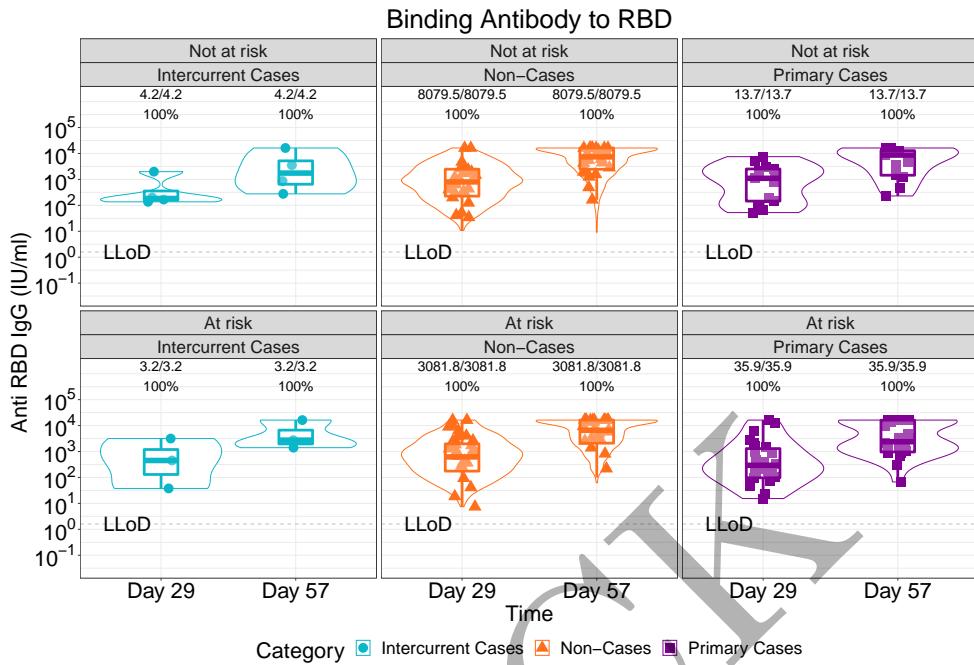


Figure 2.89: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

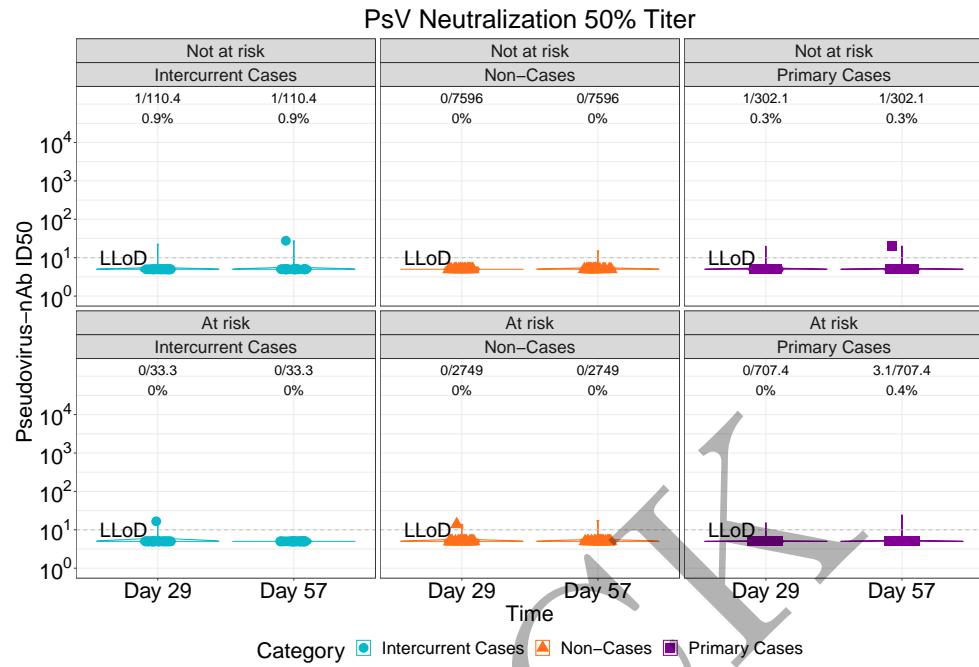


Figure 2.90: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

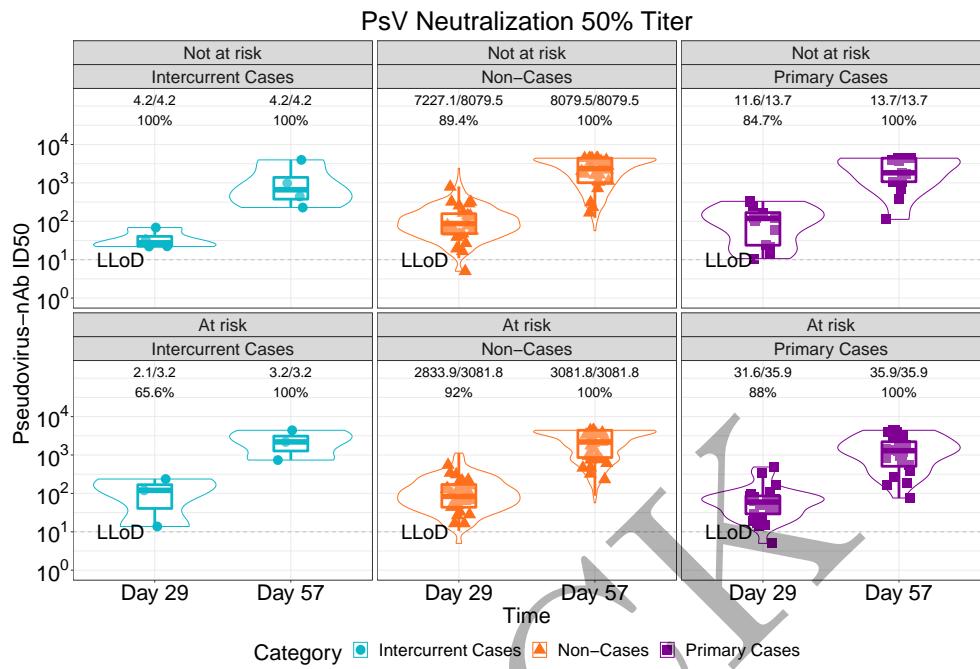


Figure 2.91: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

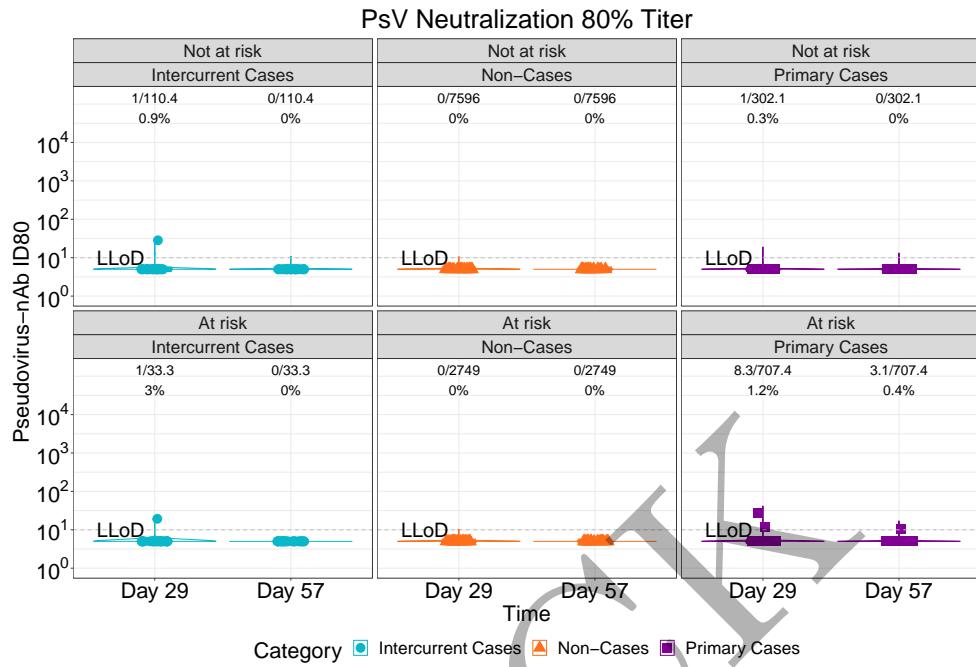


Figure 2.92: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

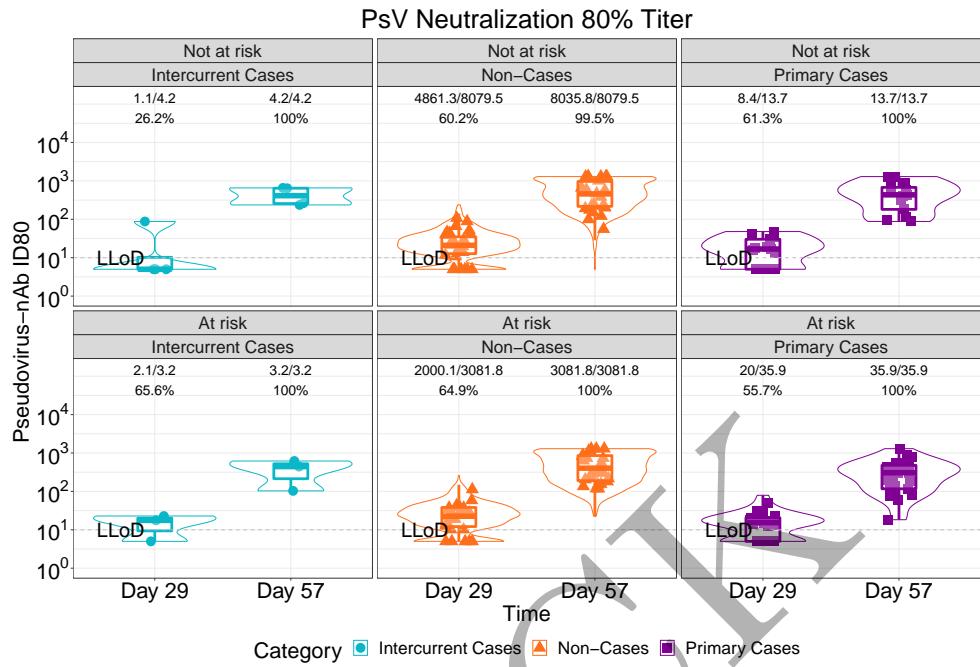


Figure 2.93: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

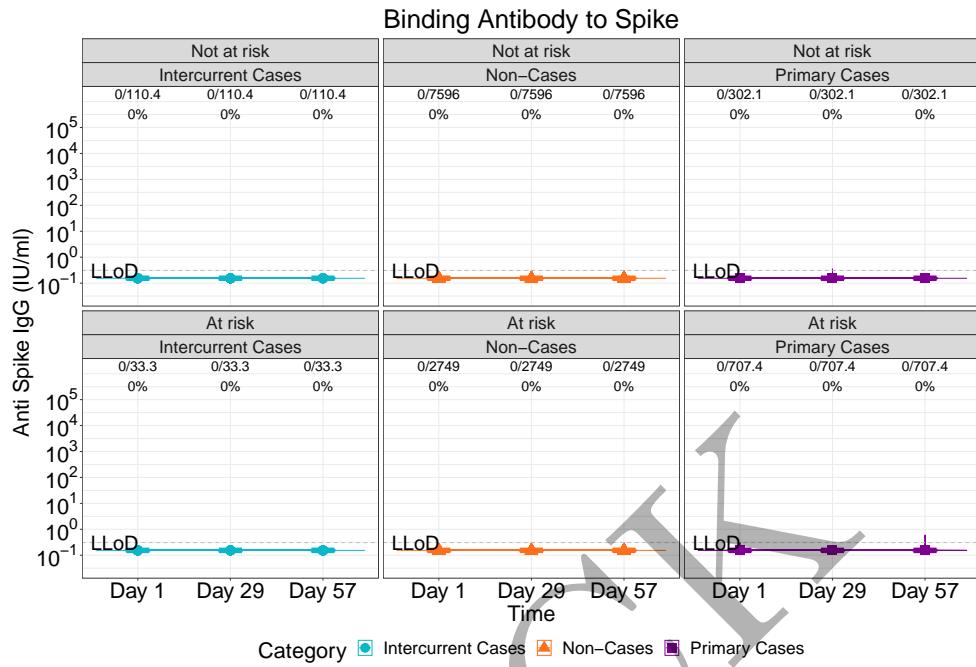


Figure 2.94: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

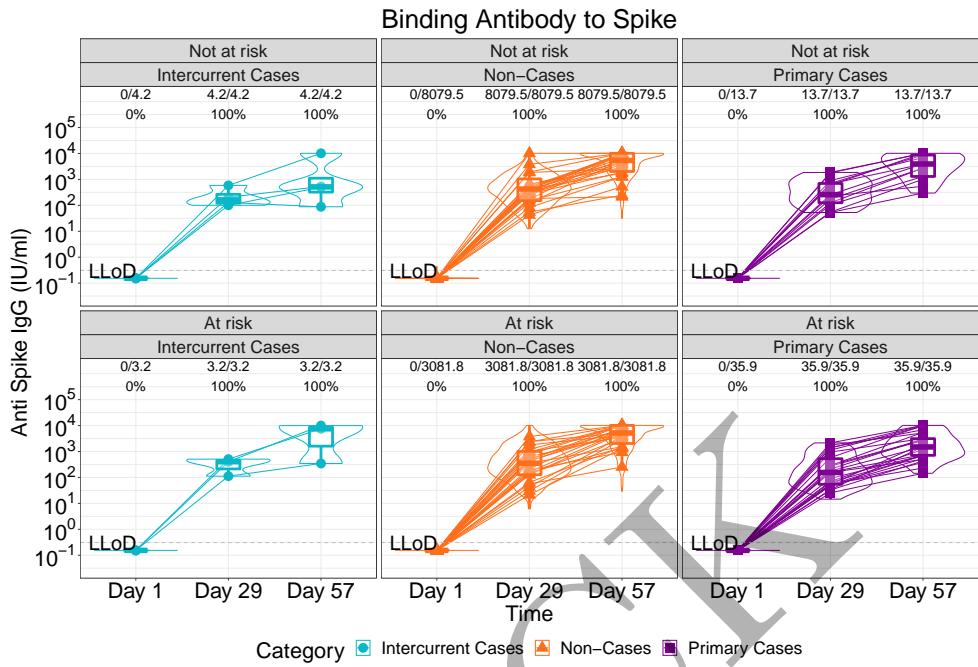


Figure 2.95: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

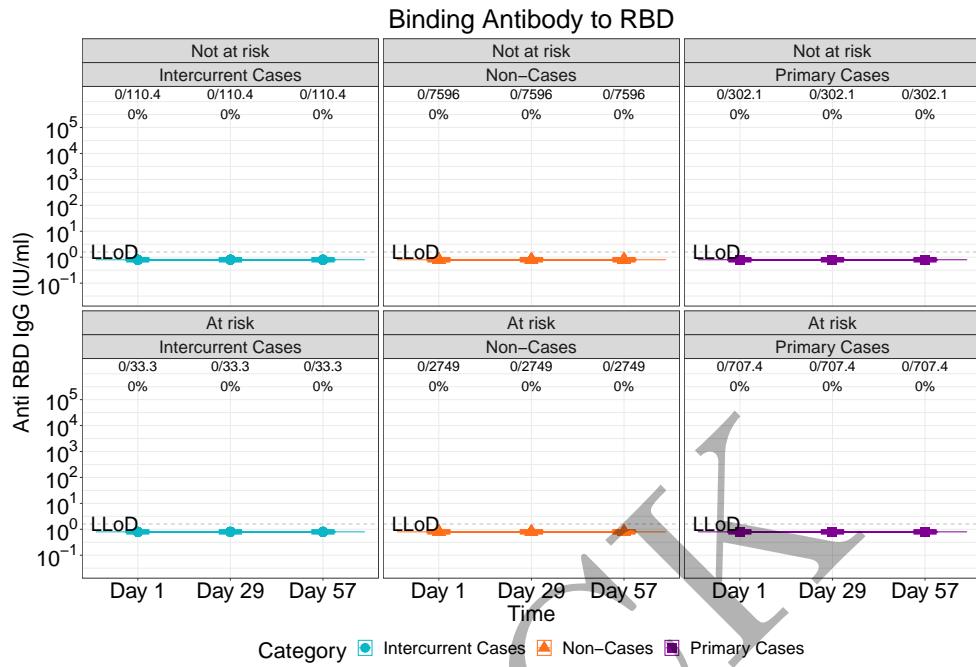


Figure 2.96: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

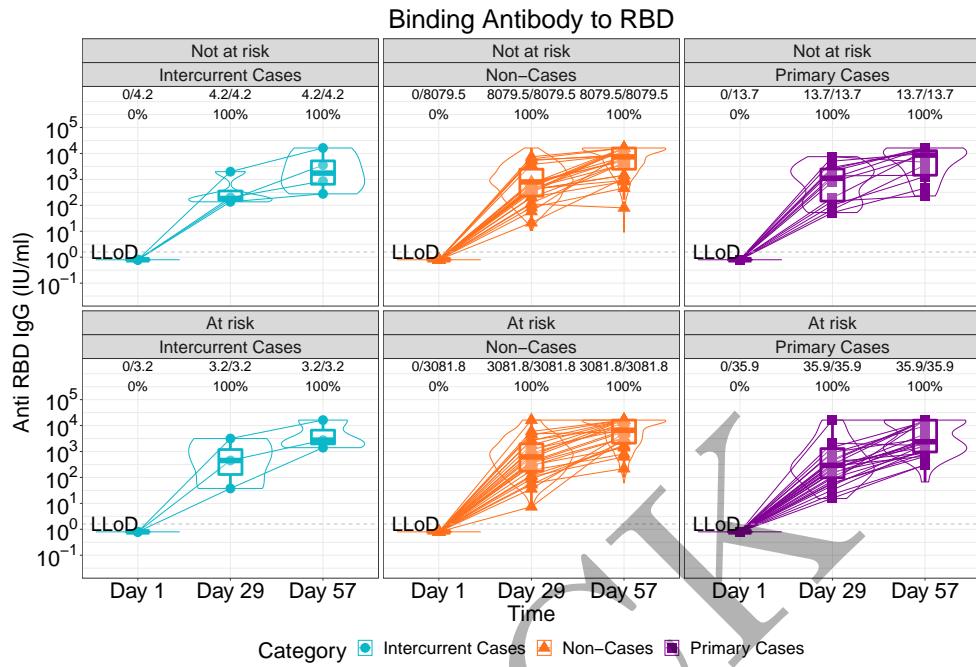


Figure 2.97: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

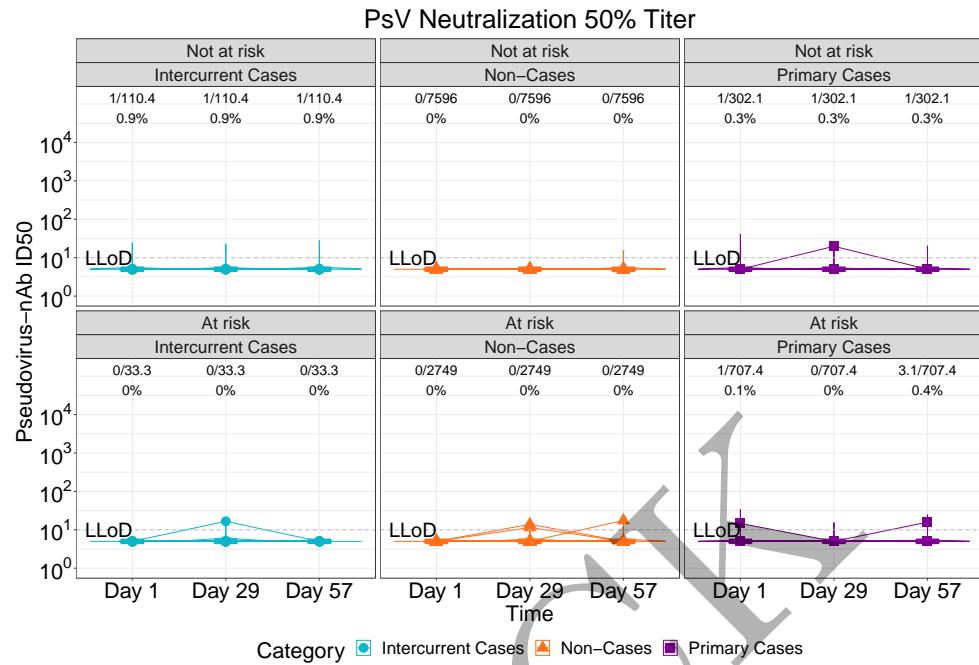


Figure 2.98: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

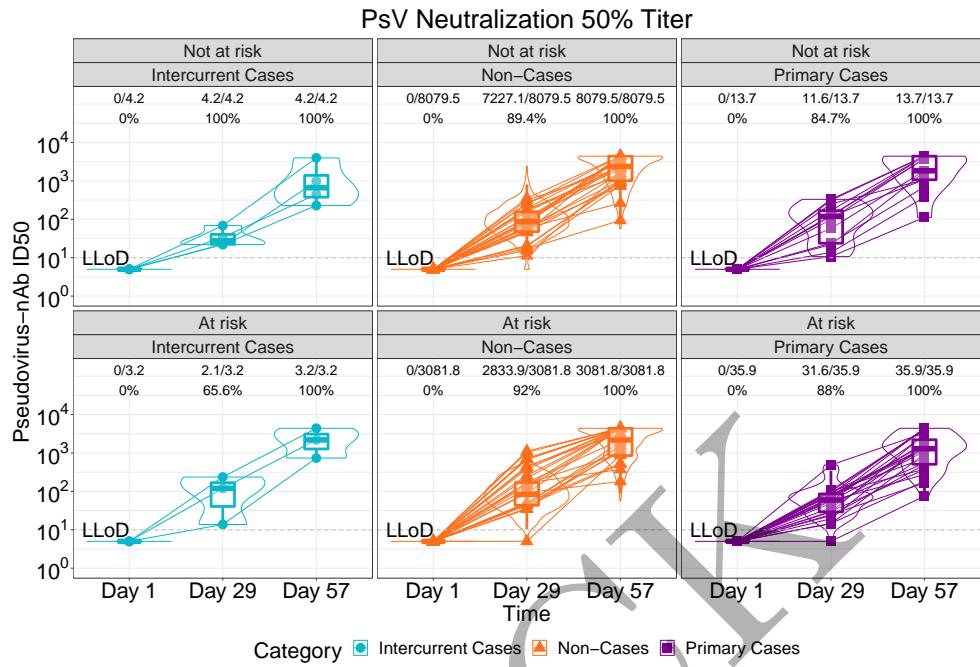


Figure 2.99: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

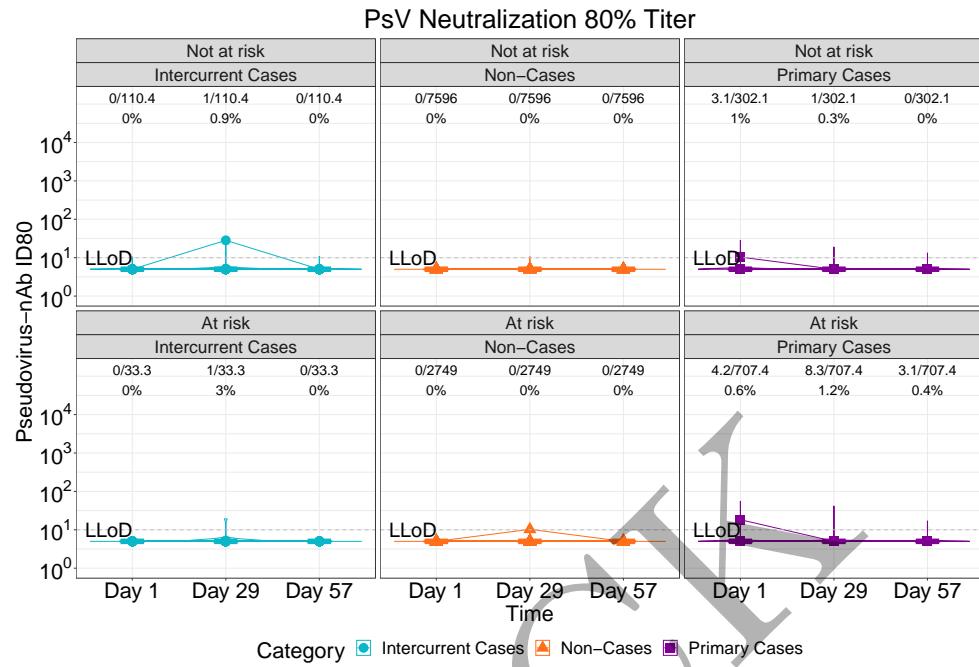


Figure 2.100: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

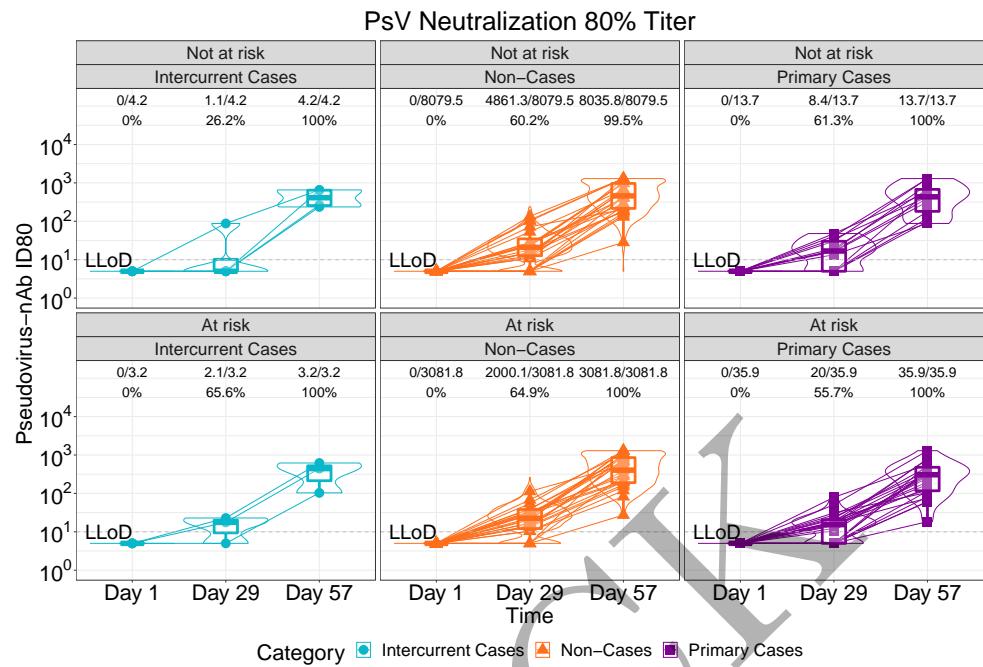


Figure 2.101: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

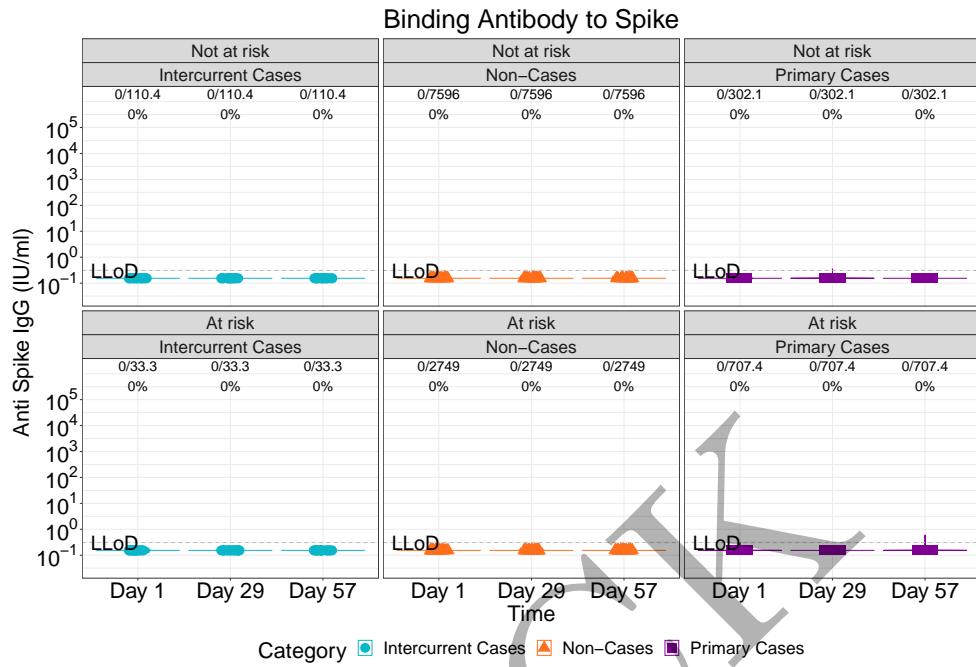


Figure 2.102: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

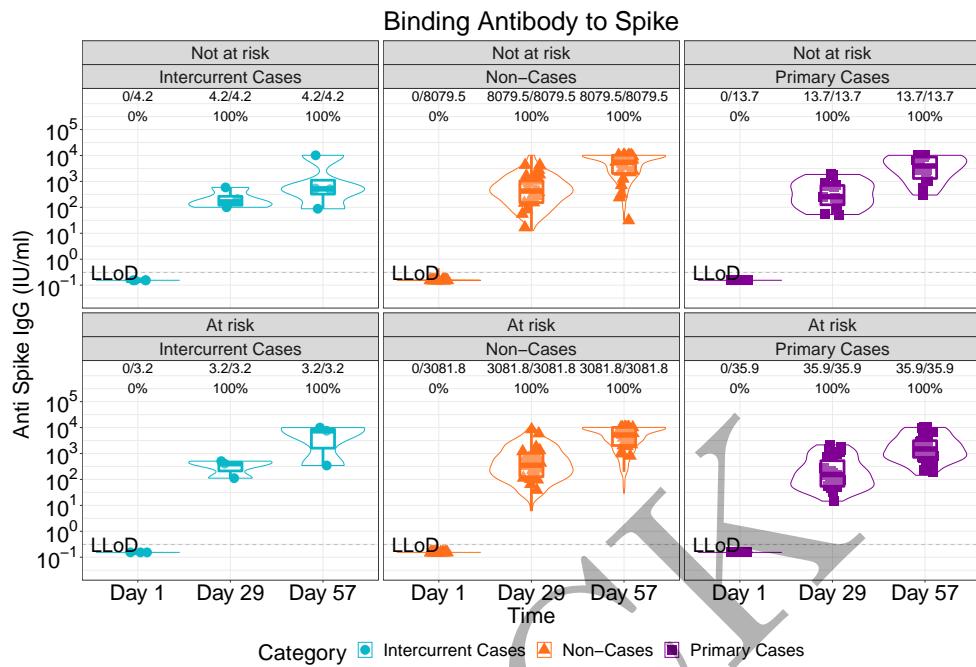


Figure 2.103: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

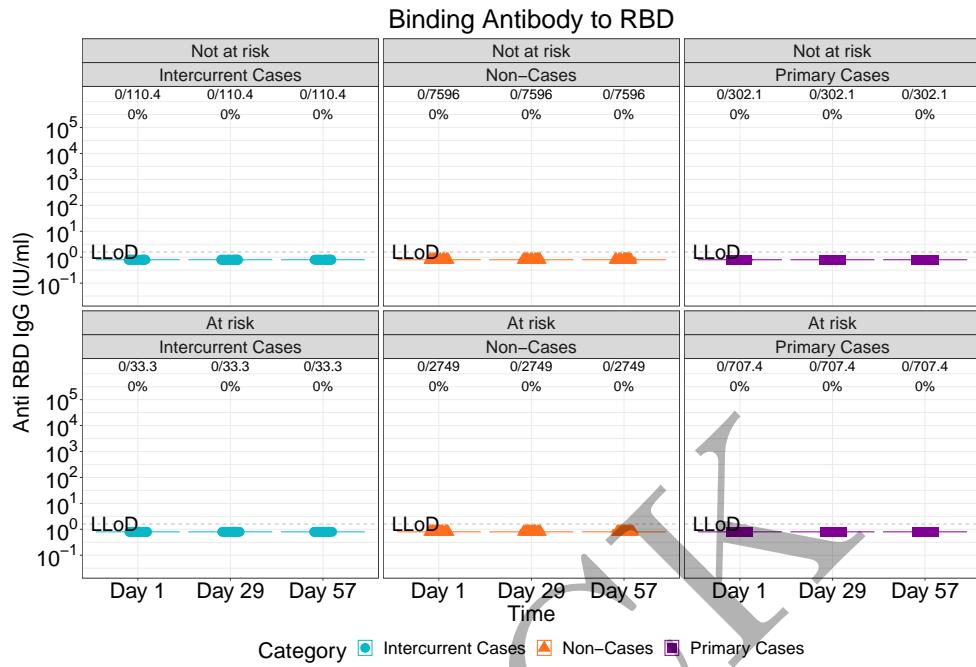


Figure 2.104: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

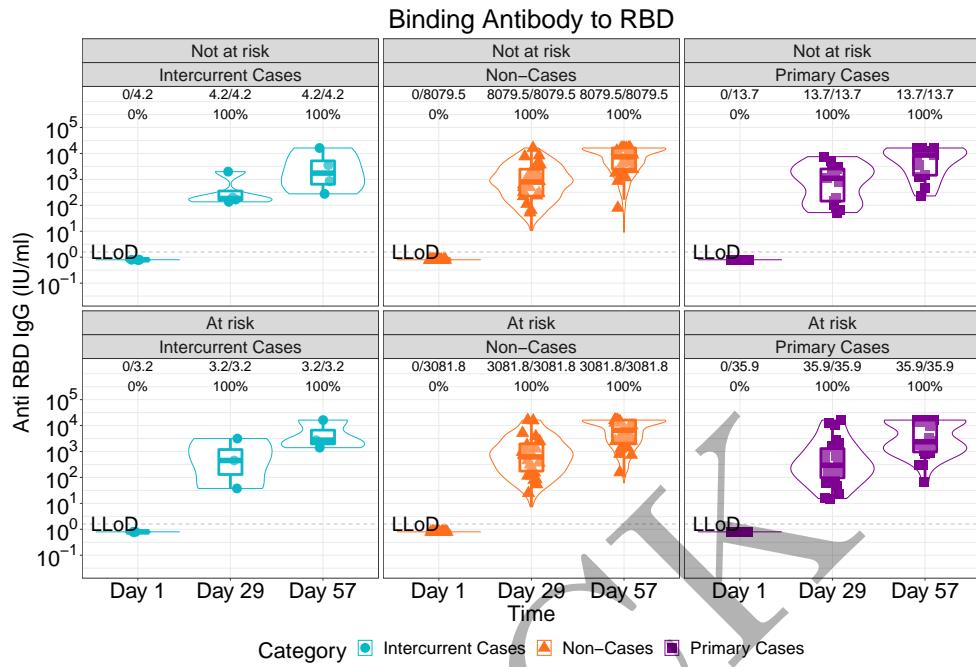


Figure 2.105: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

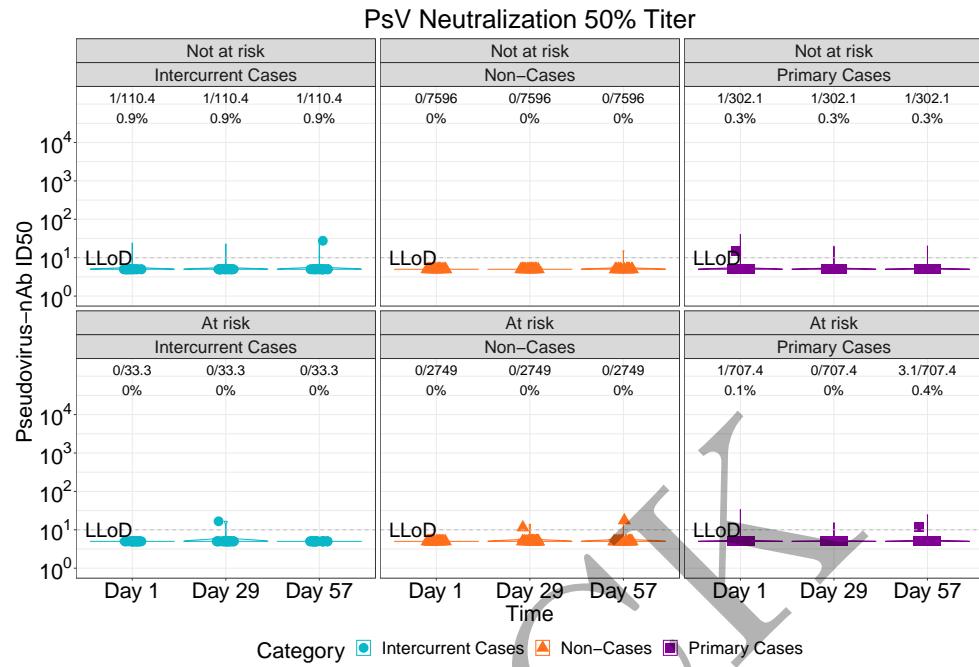


Figure 2.106: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

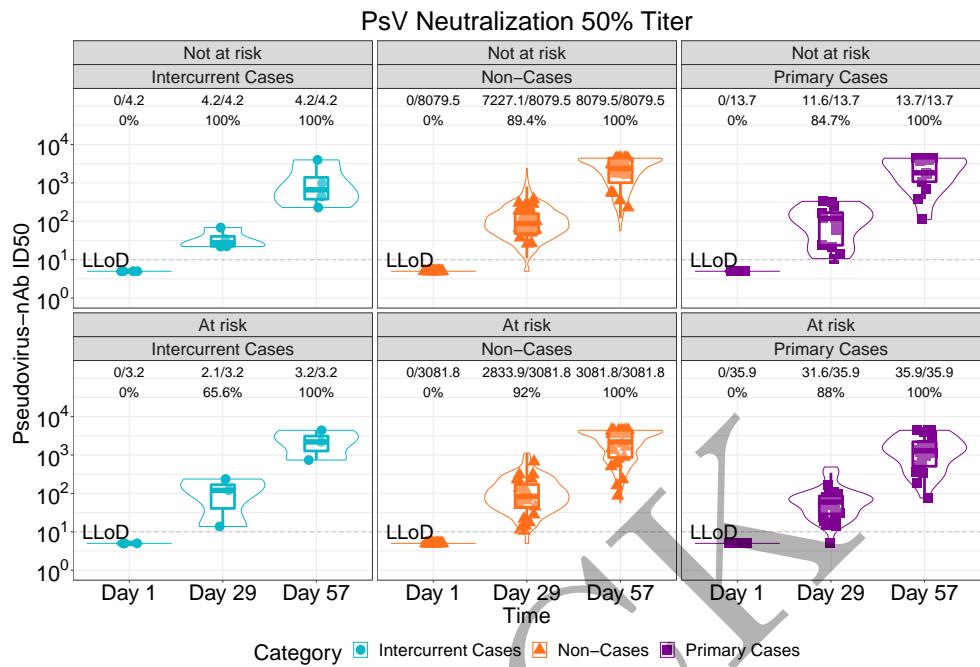


Figure 2.107: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

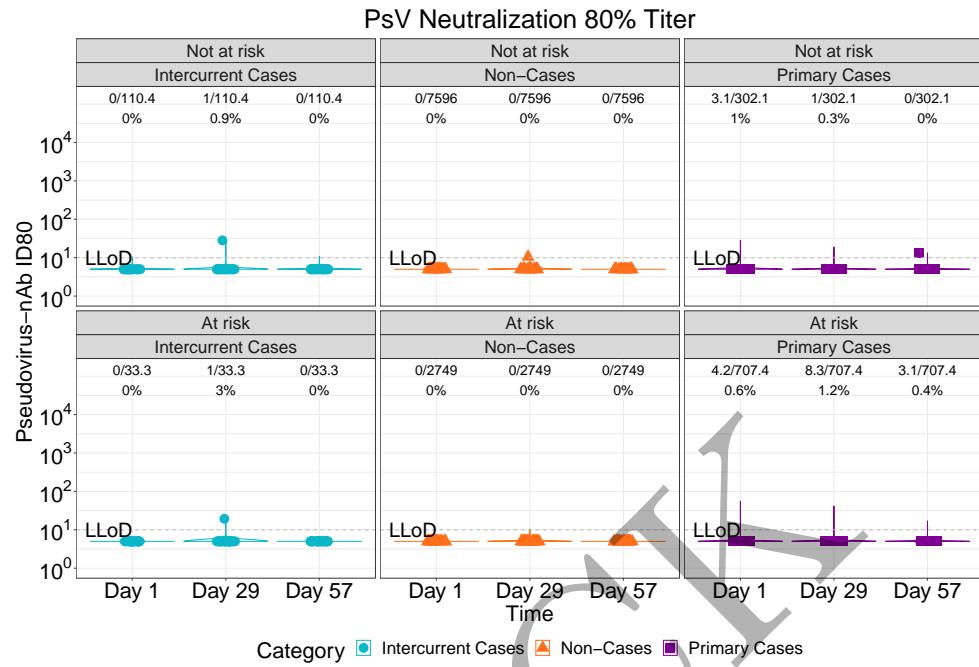


Figure 2.108: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

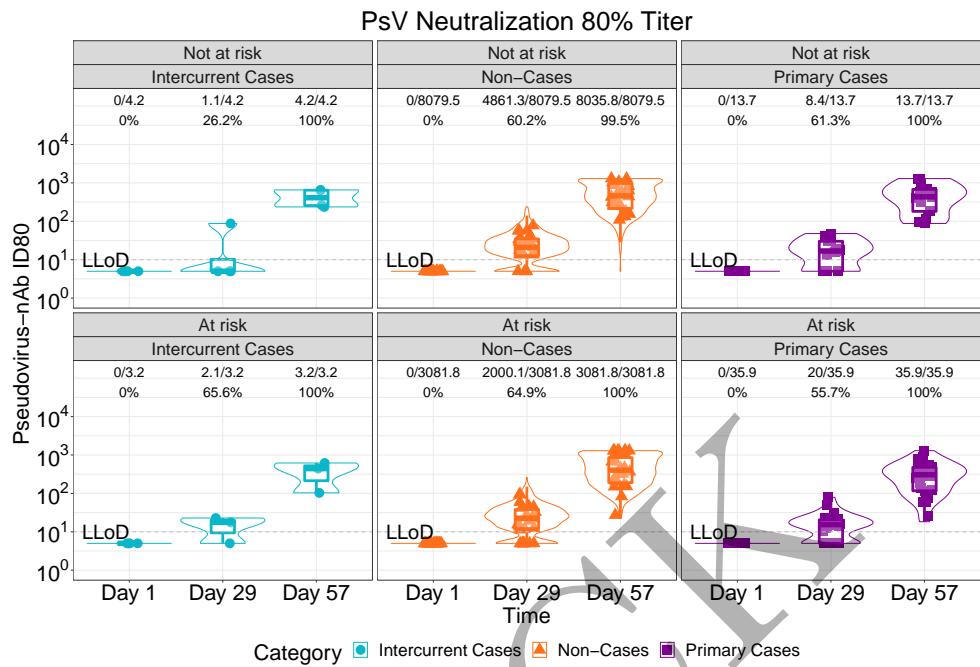


Figure 2.109: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

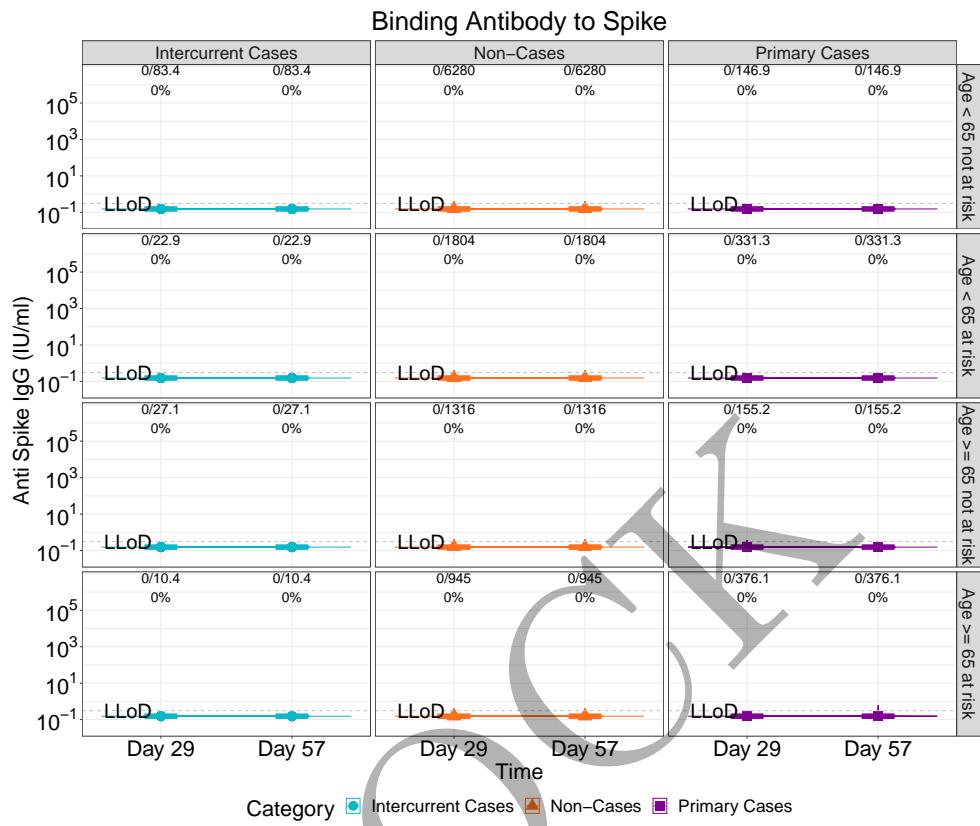


Figure 2.110: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

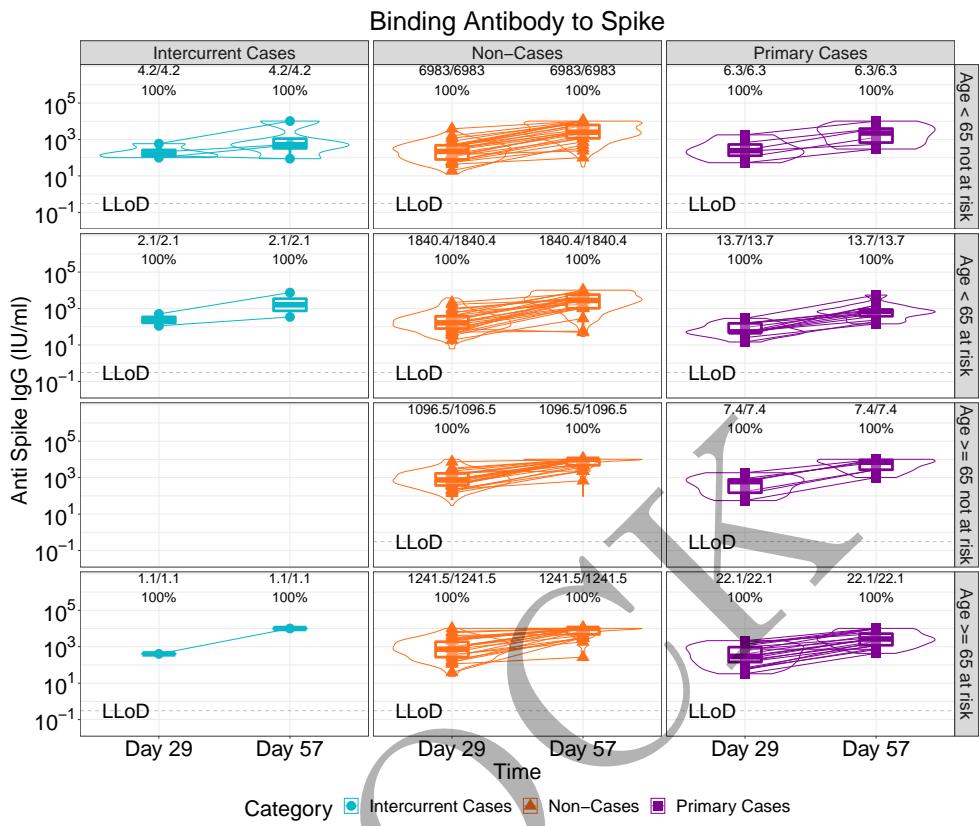


Figure 2.111: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

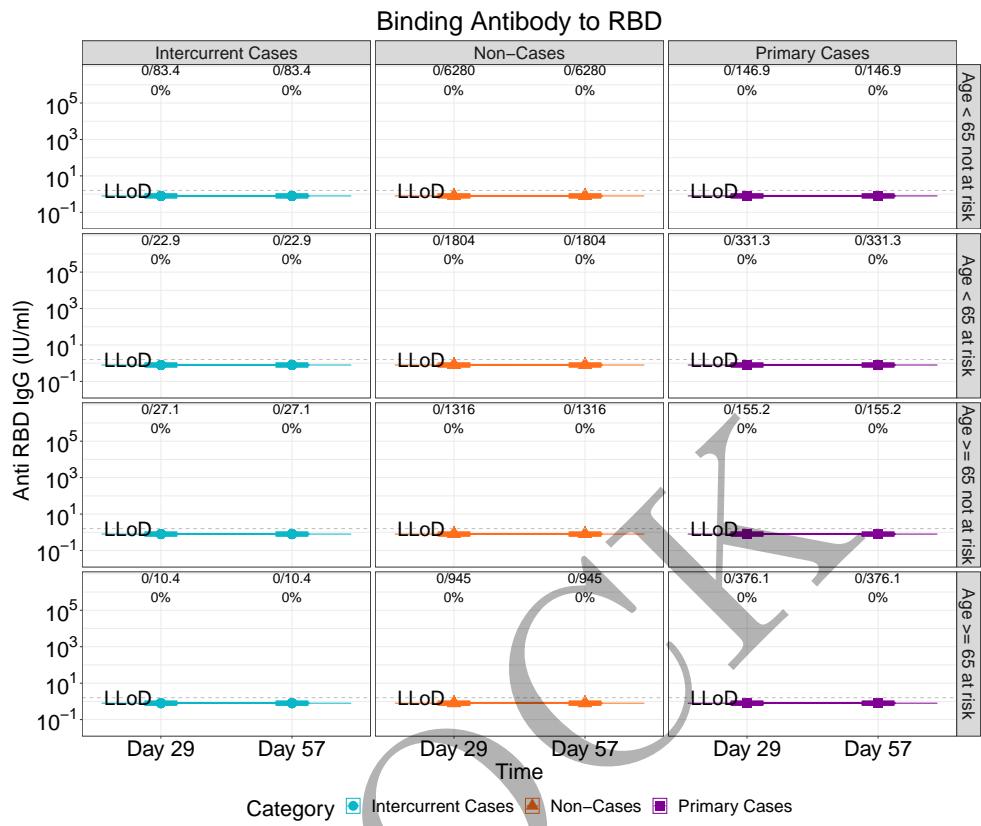


Figure 2.112: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

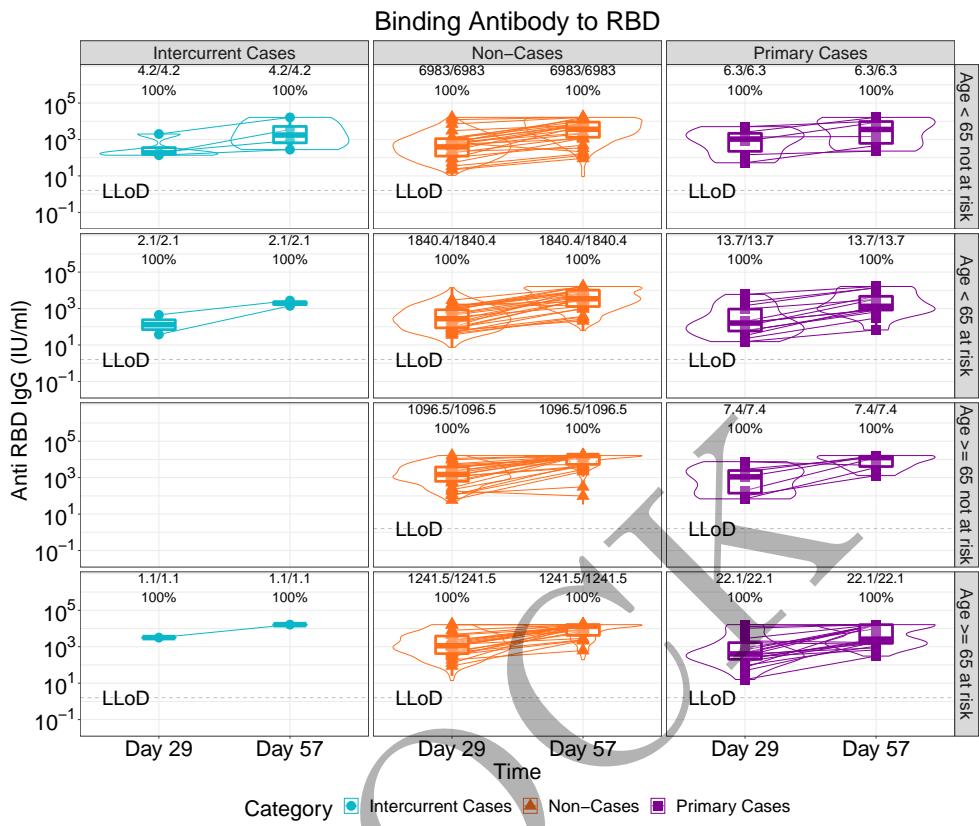


Figure 2.113: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

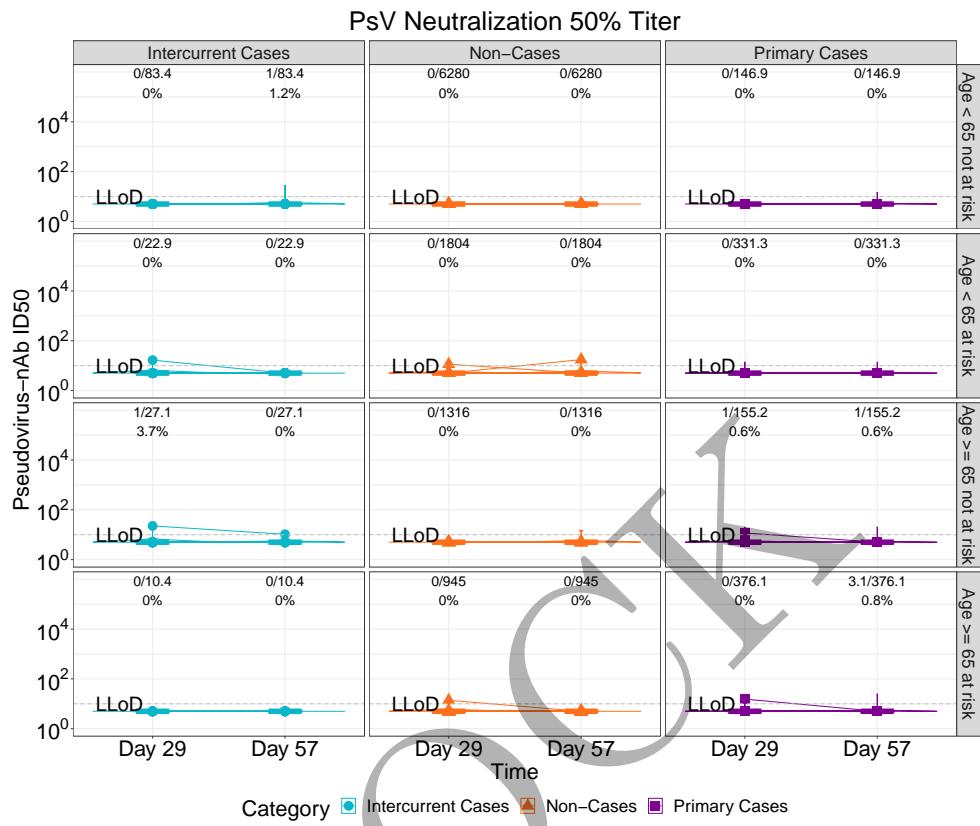


Figure 2.114: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1)

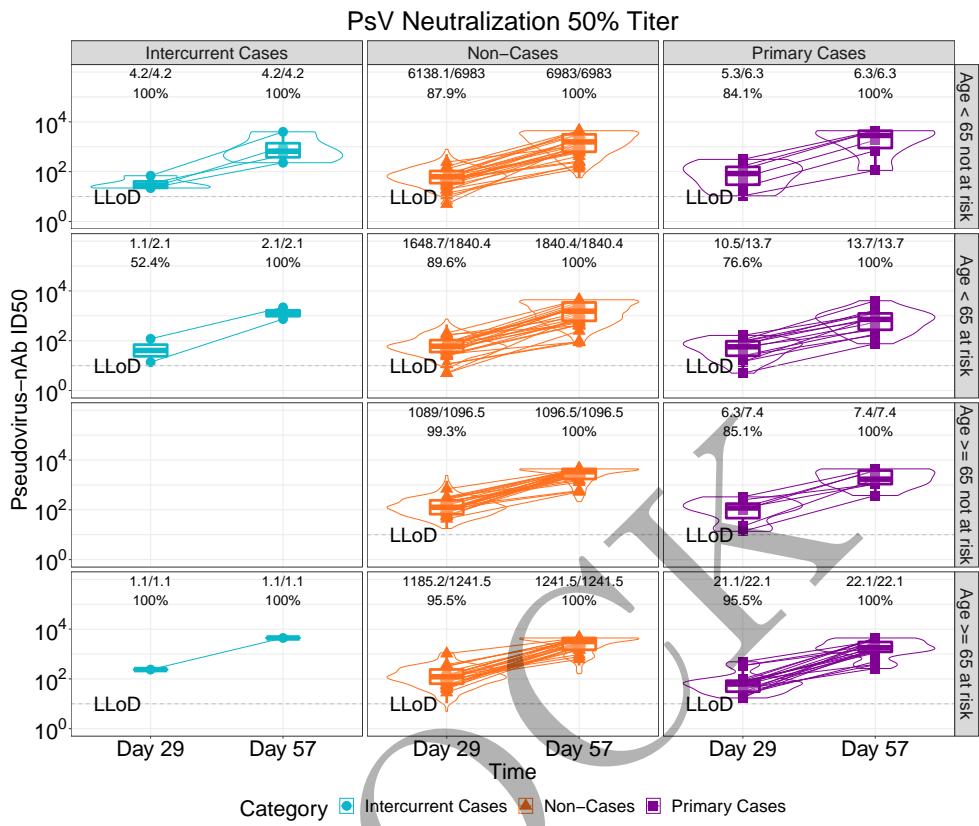


Figure 2.115: lineplots of Pseudovirus Neutralization ID<sub>50</sub>: baseline negative vaccine arm by age and risk condition (version 1)

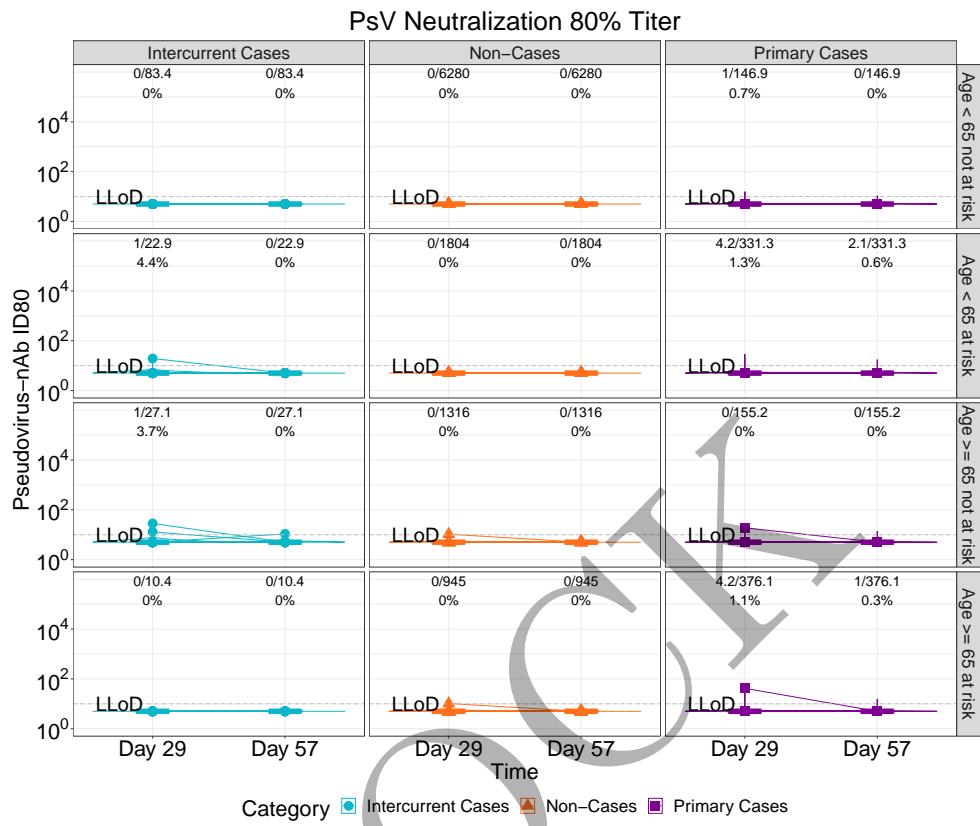


Figure 2.116: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

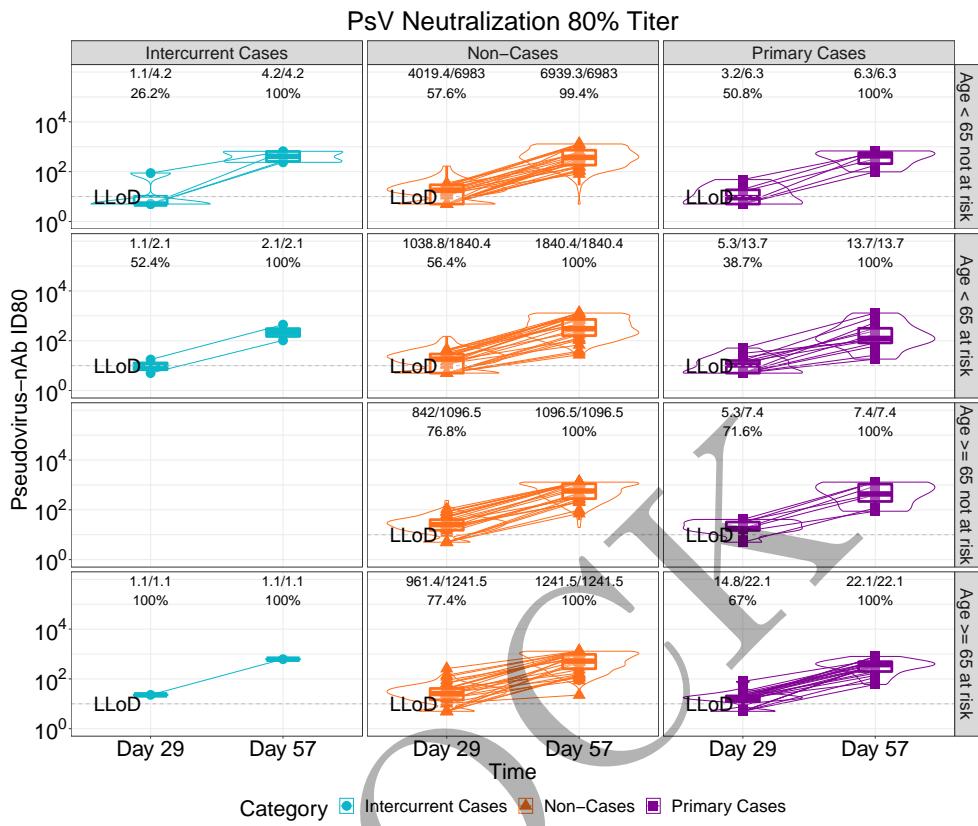


Figure 2.117: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

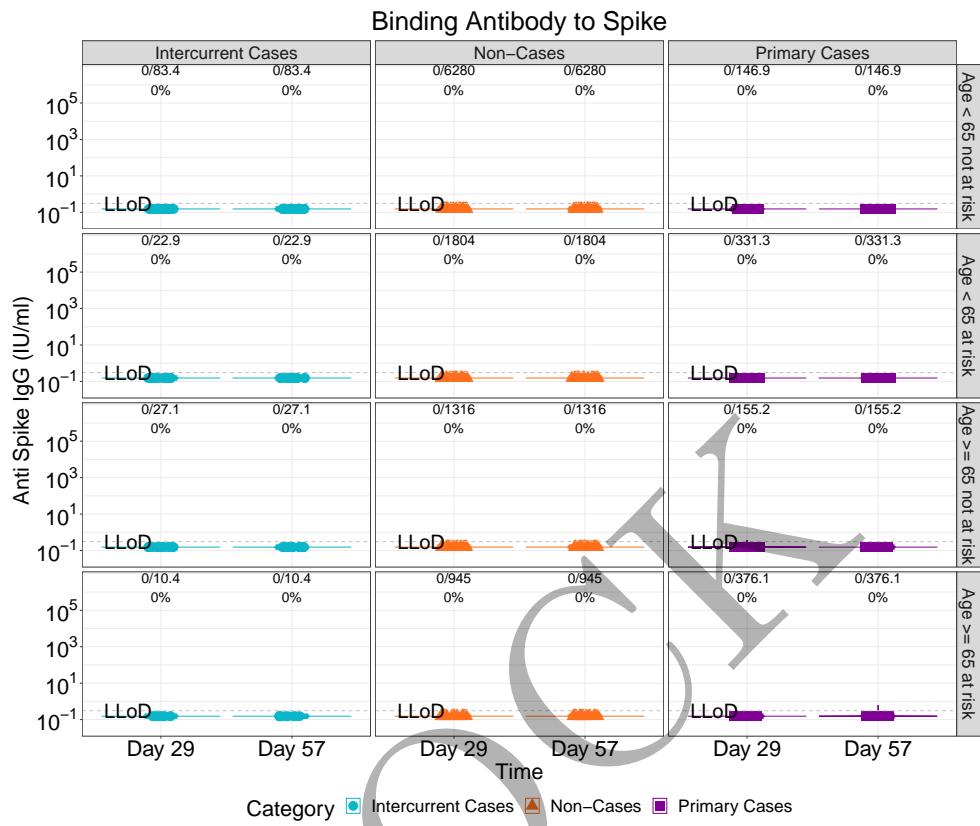


Figure 2.118: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

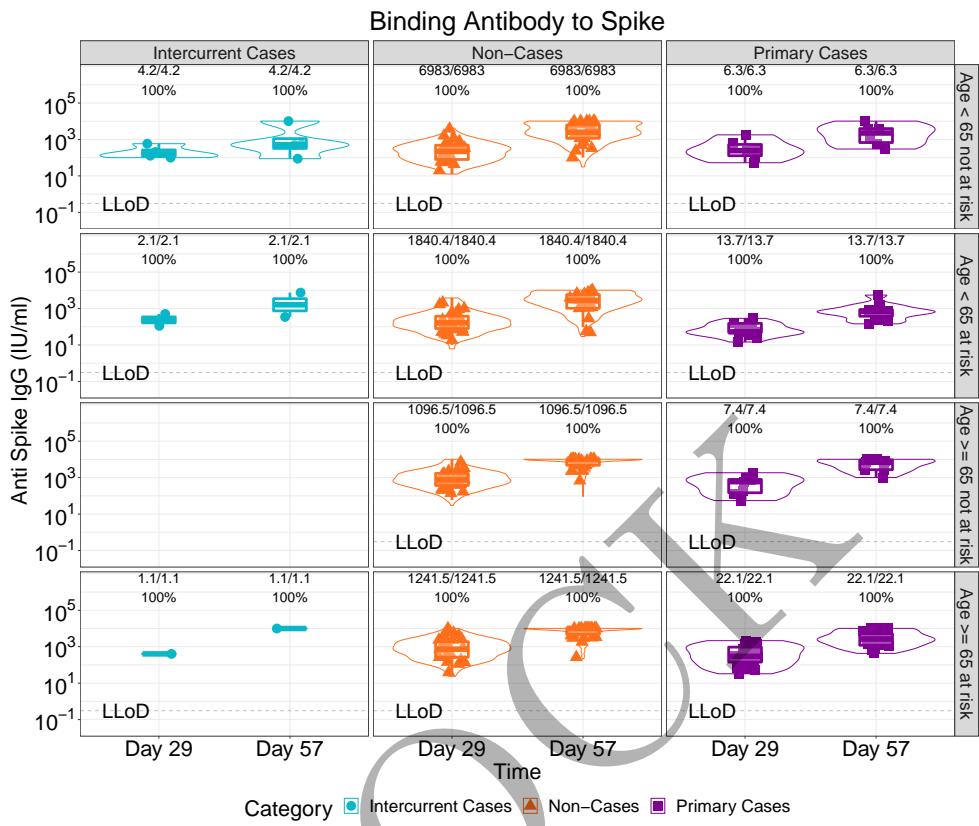


Figure 2.119: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

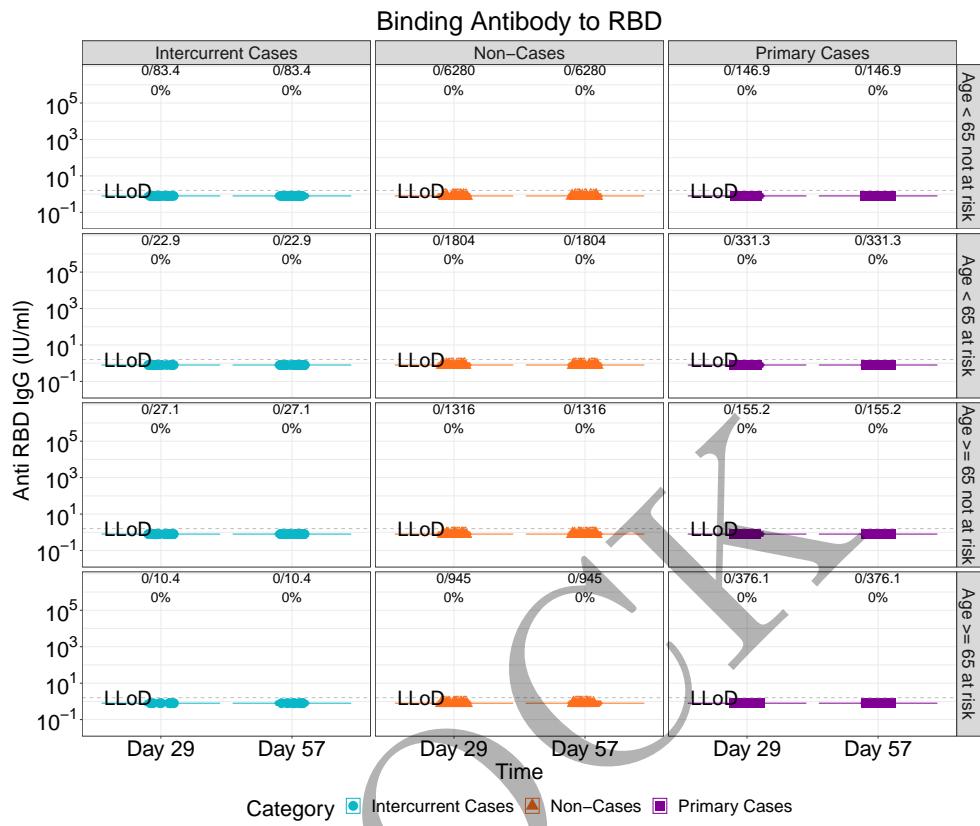


Figure 2.120: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

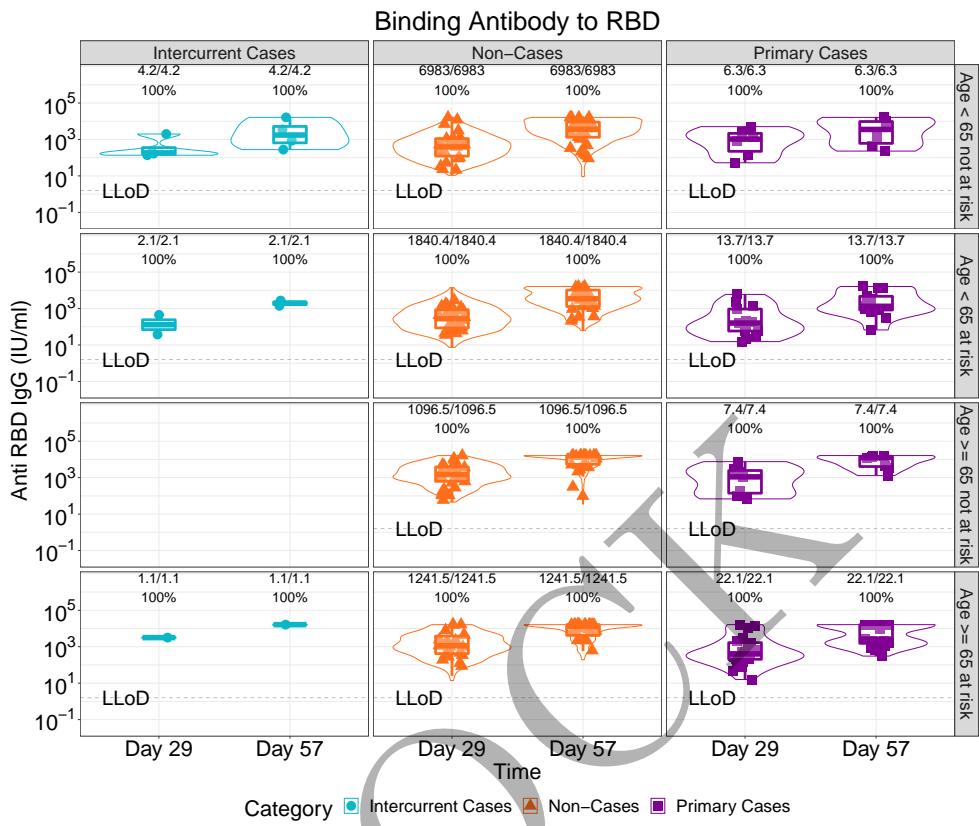


Figure 2.121: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

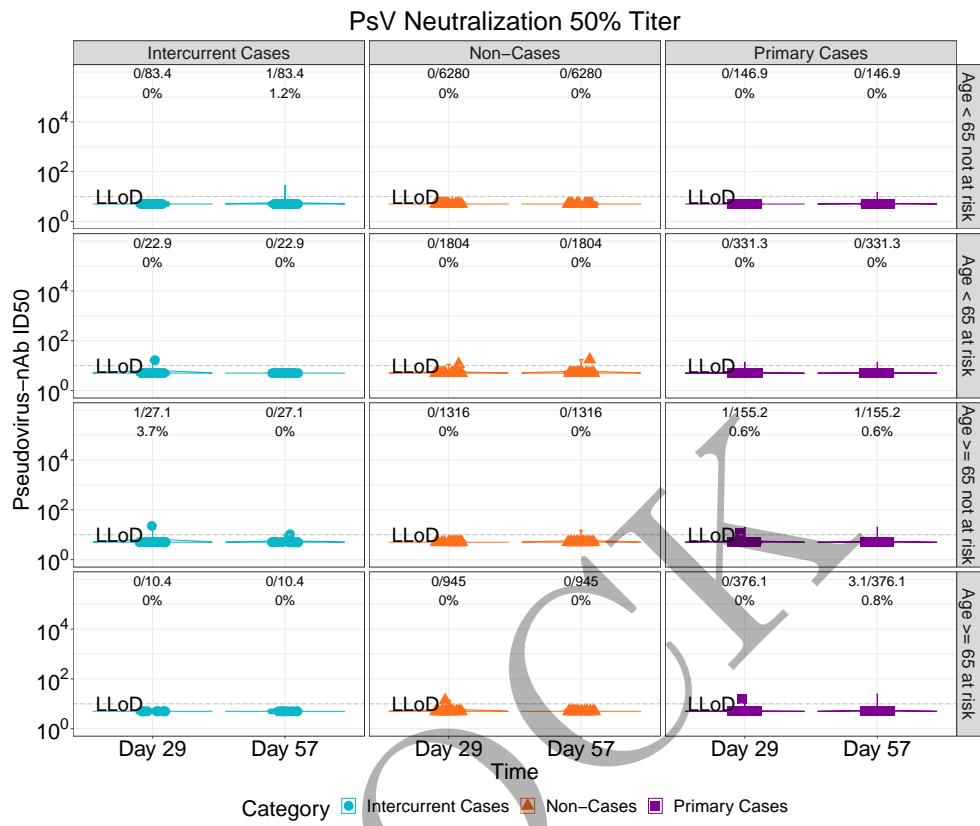


Figure 2.122: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1)

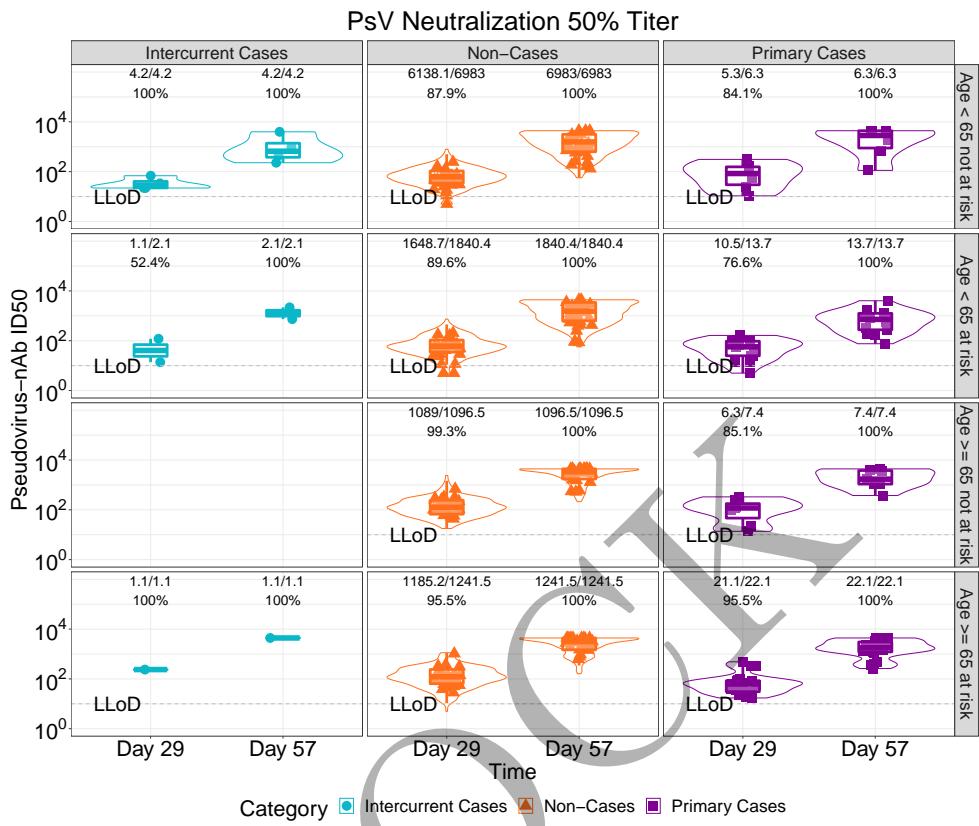


Figure 2.123: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1)

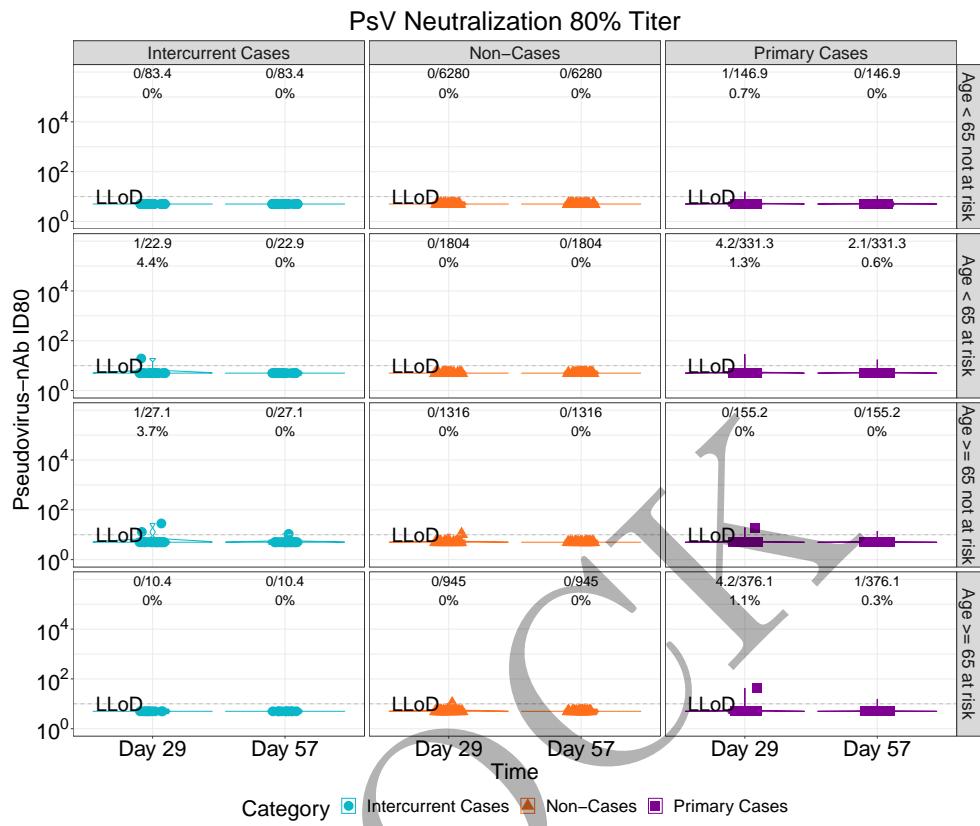


Figure 2.124: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

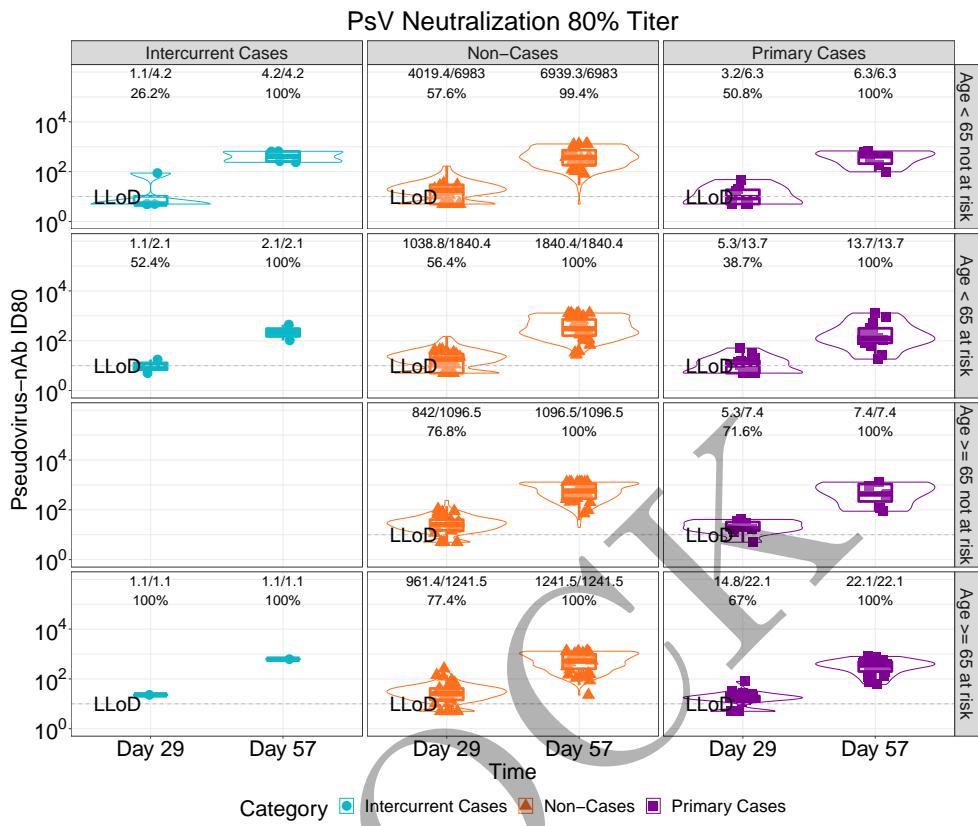


Figure 2.125: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

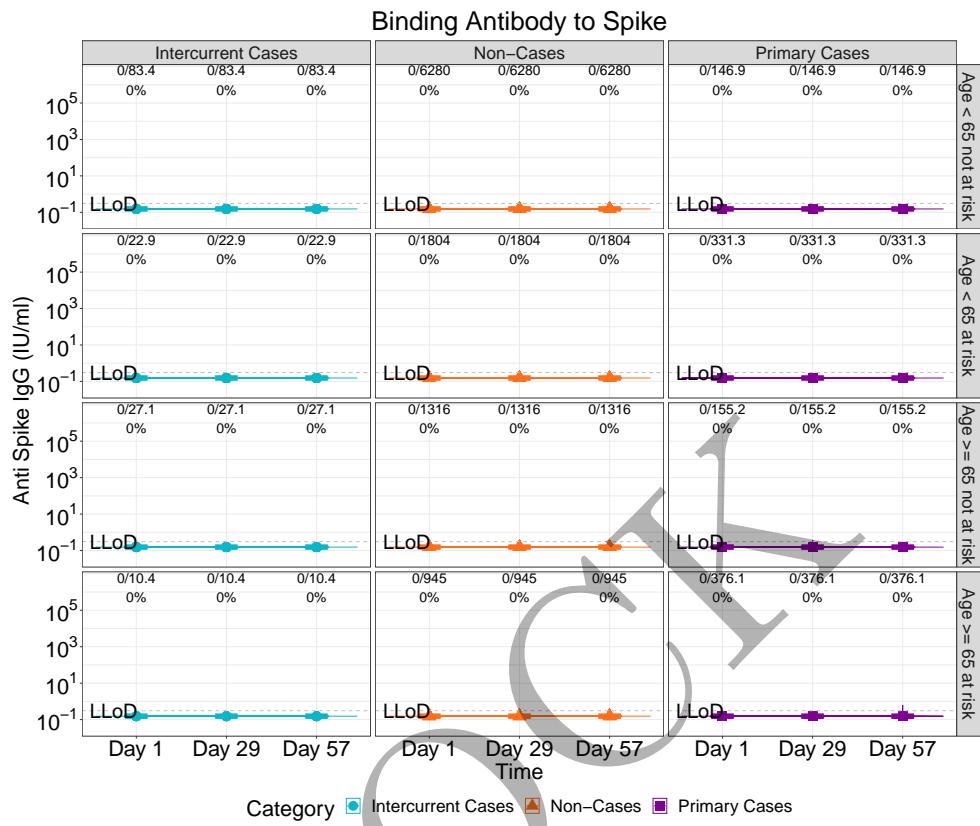


Figure 2.126: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

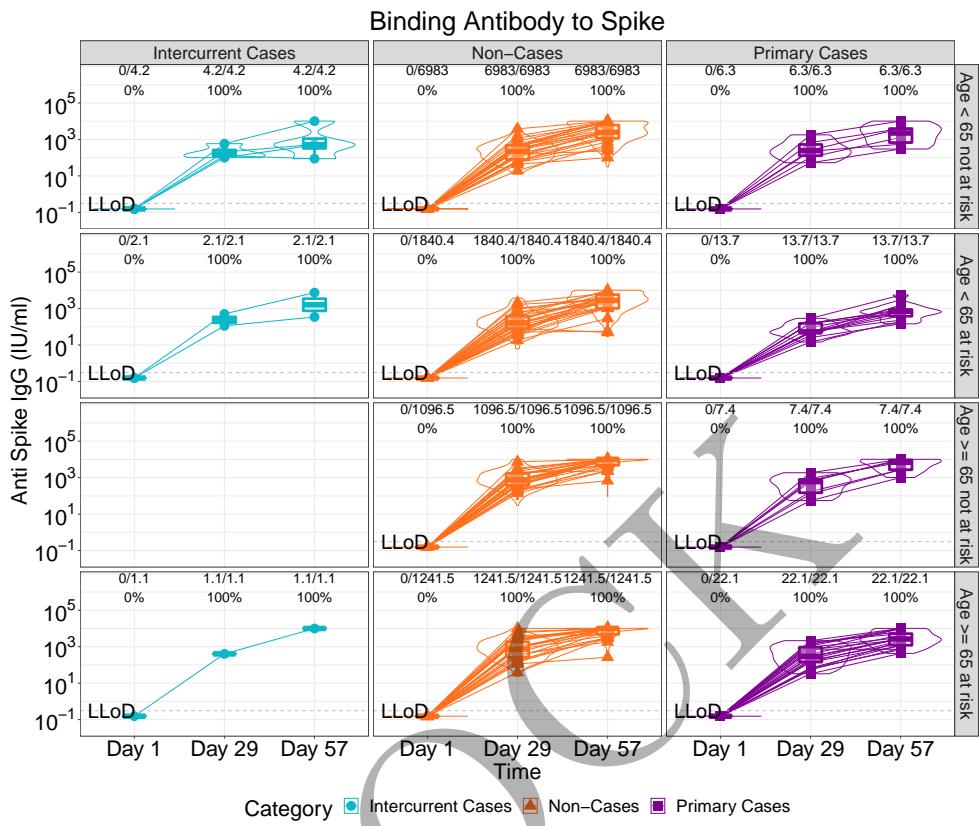


Figure 2.127: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

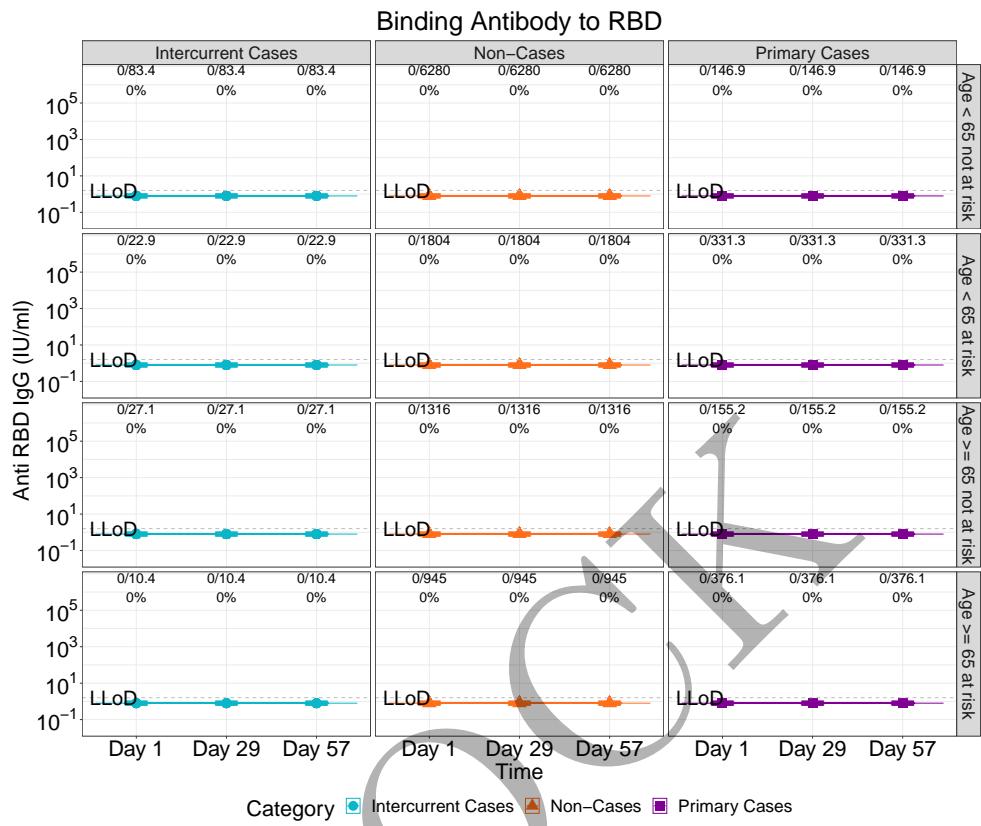


Figure 2.128: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

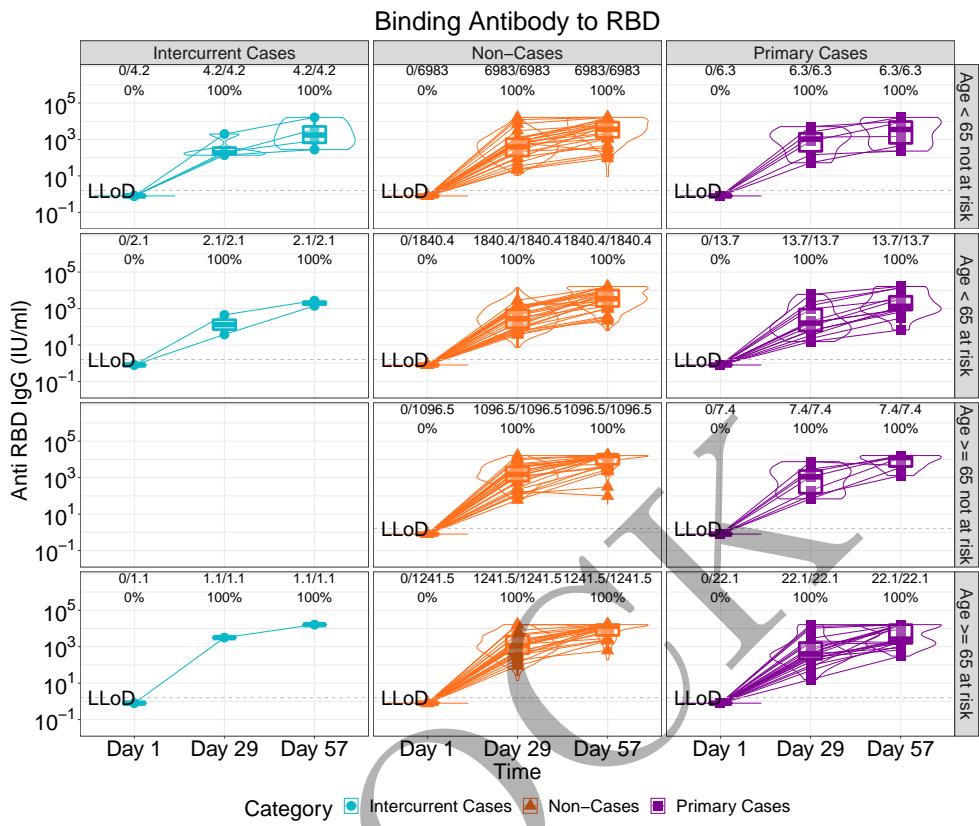


Figure 2.129: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

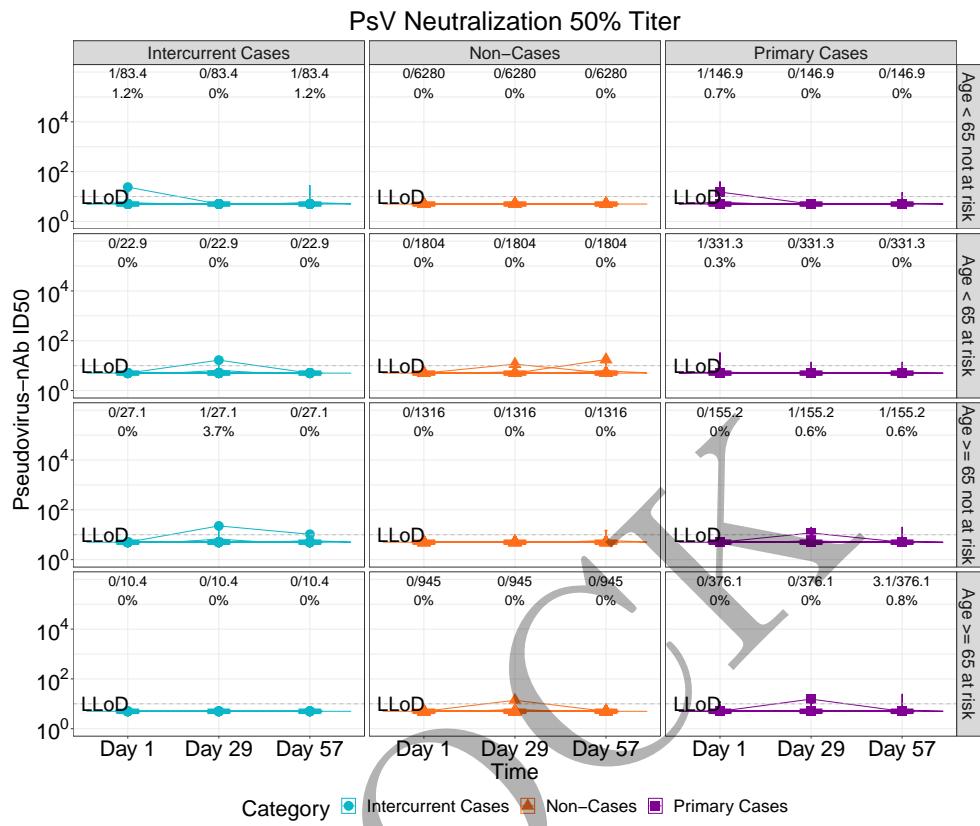


Figure 2.130: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

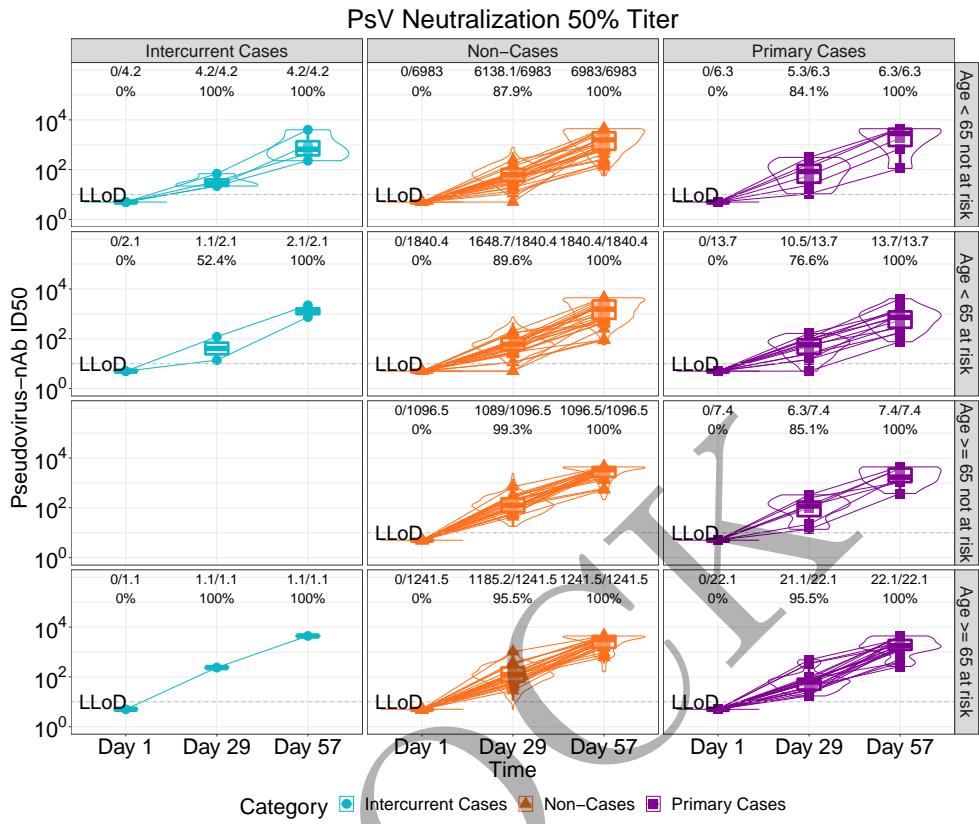


Figure 2.131: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2)

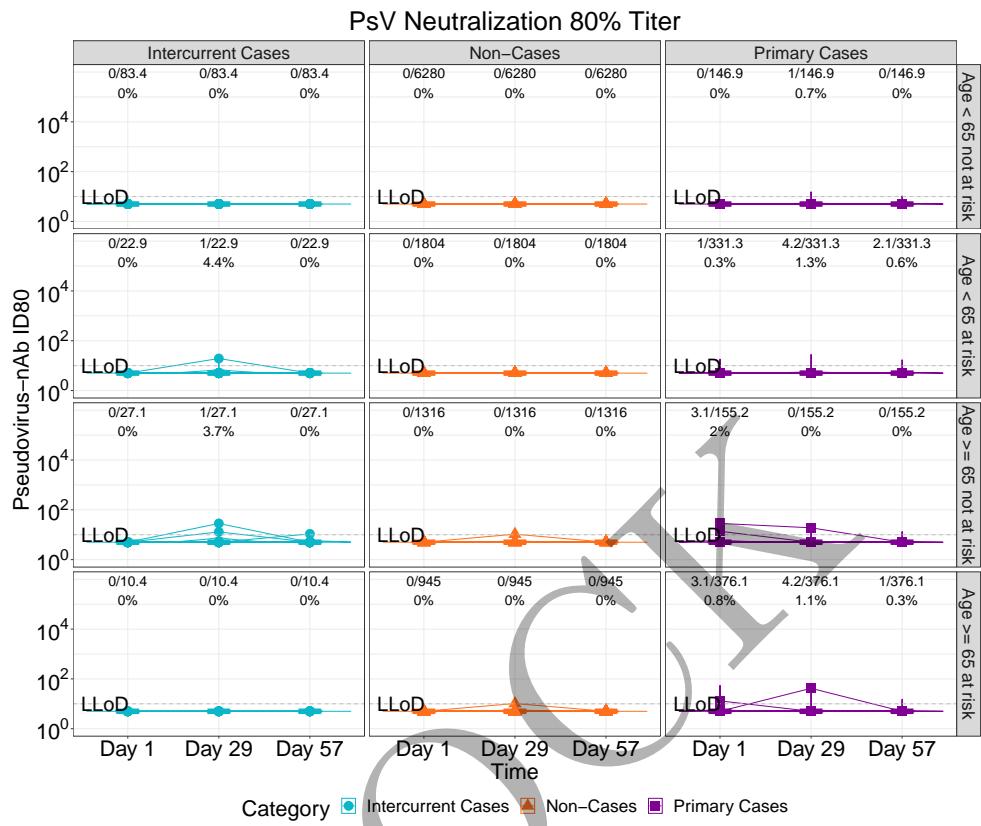


Figure 2.132: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

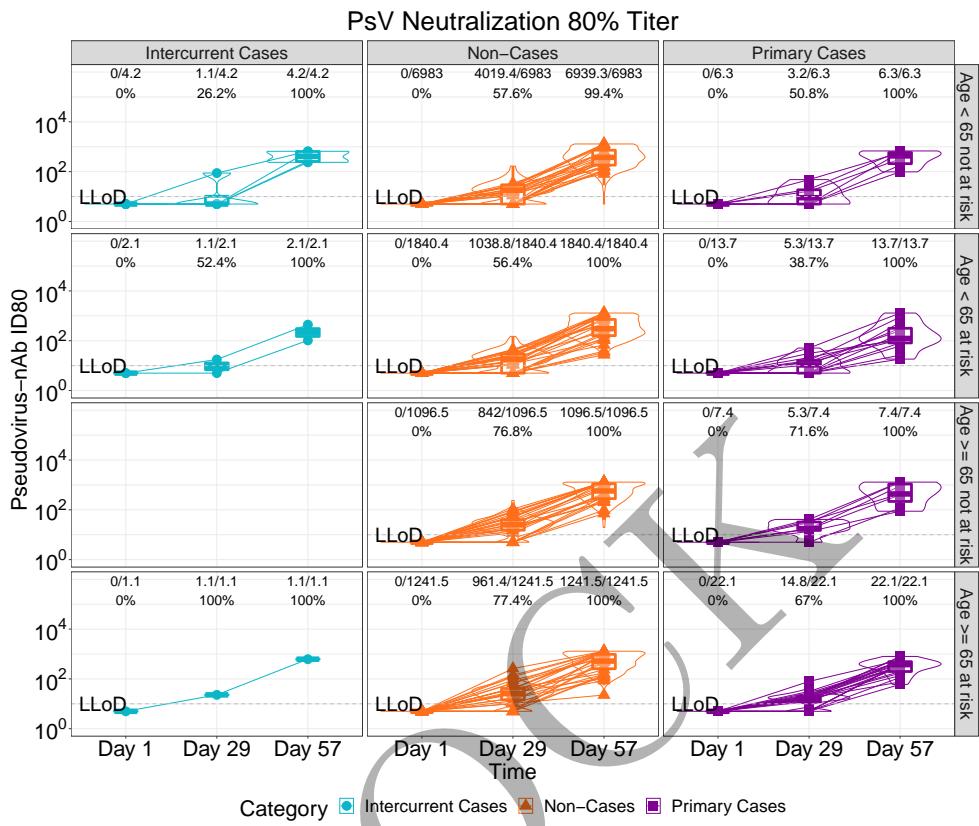


Figure 2.133: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

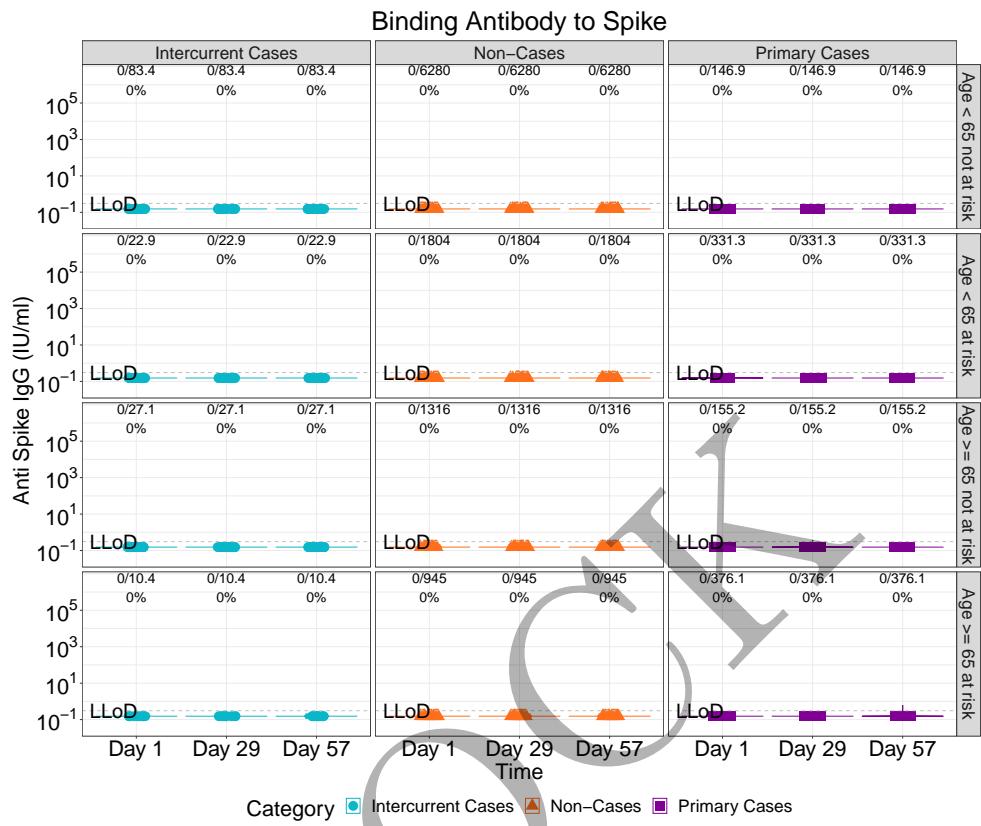


Figure 2.134: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

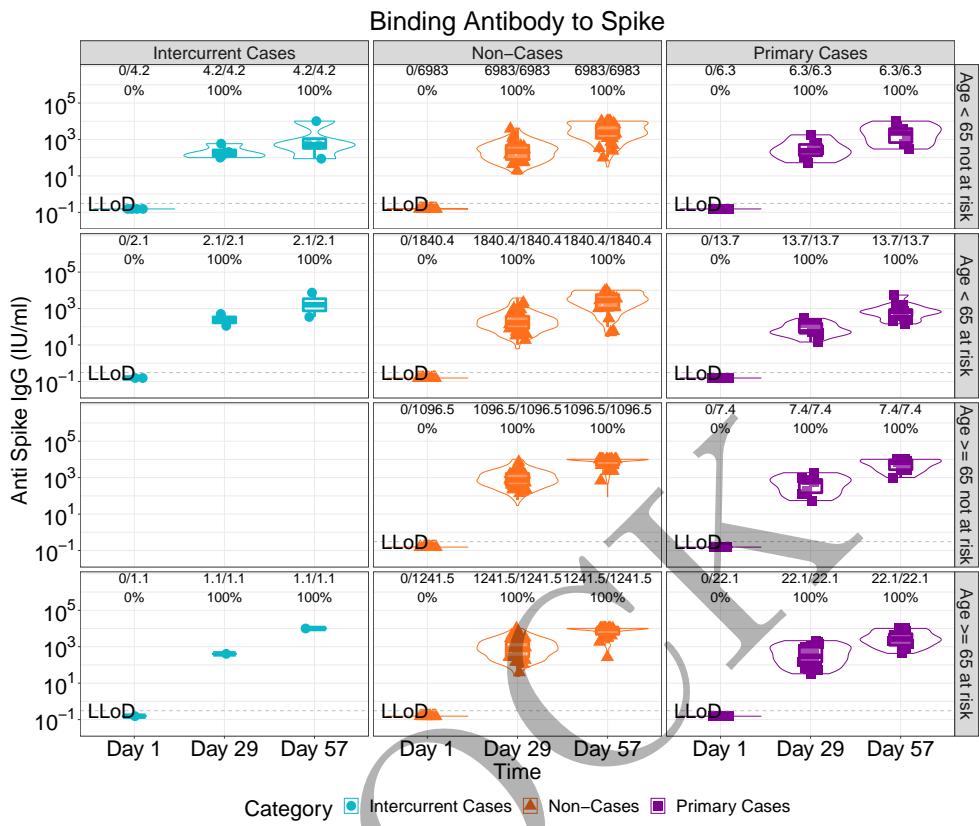


Figure 2.135: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

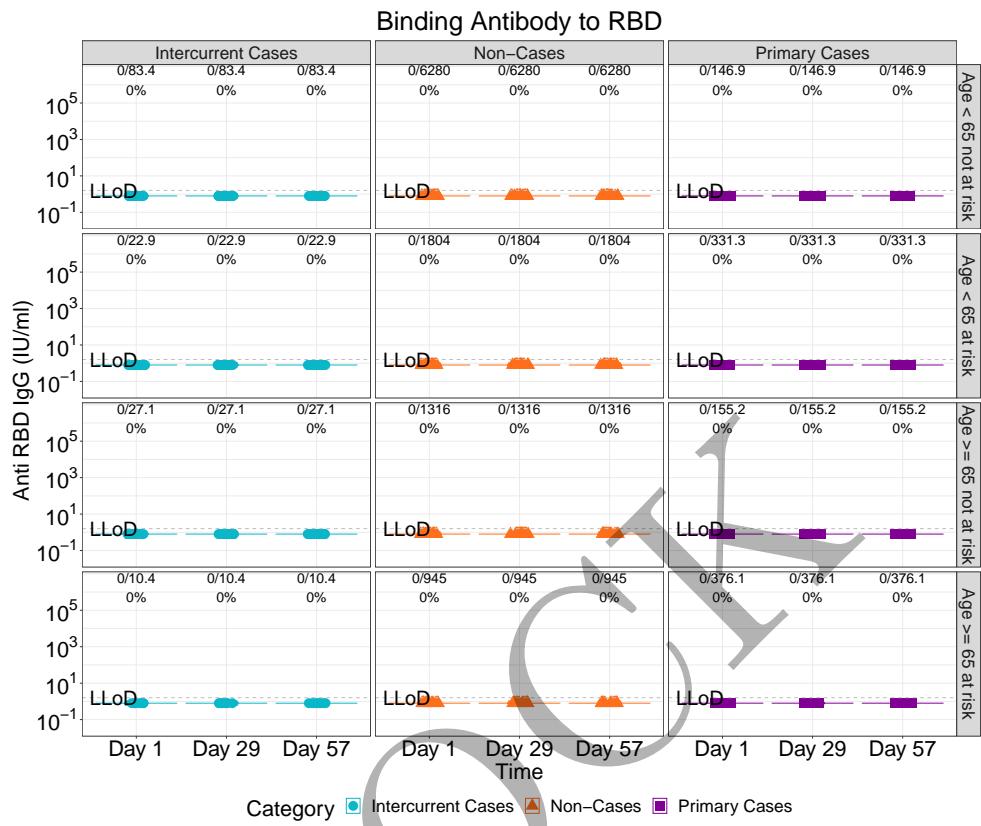


Figure 2.136: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

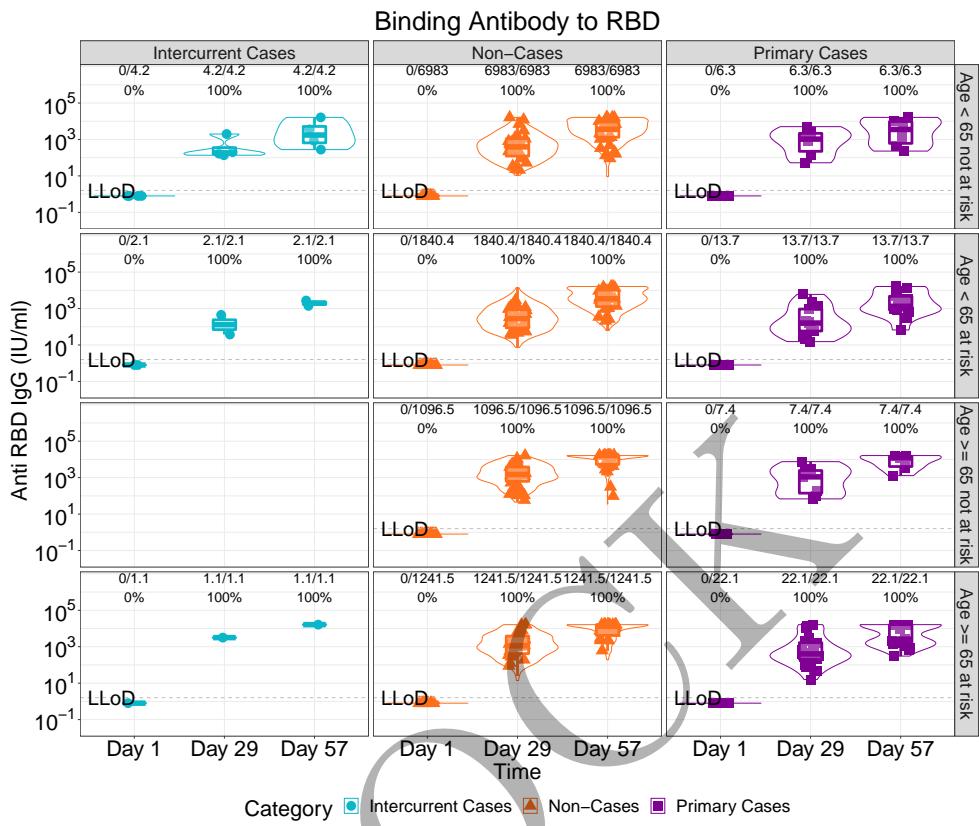


Figure 2.137: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

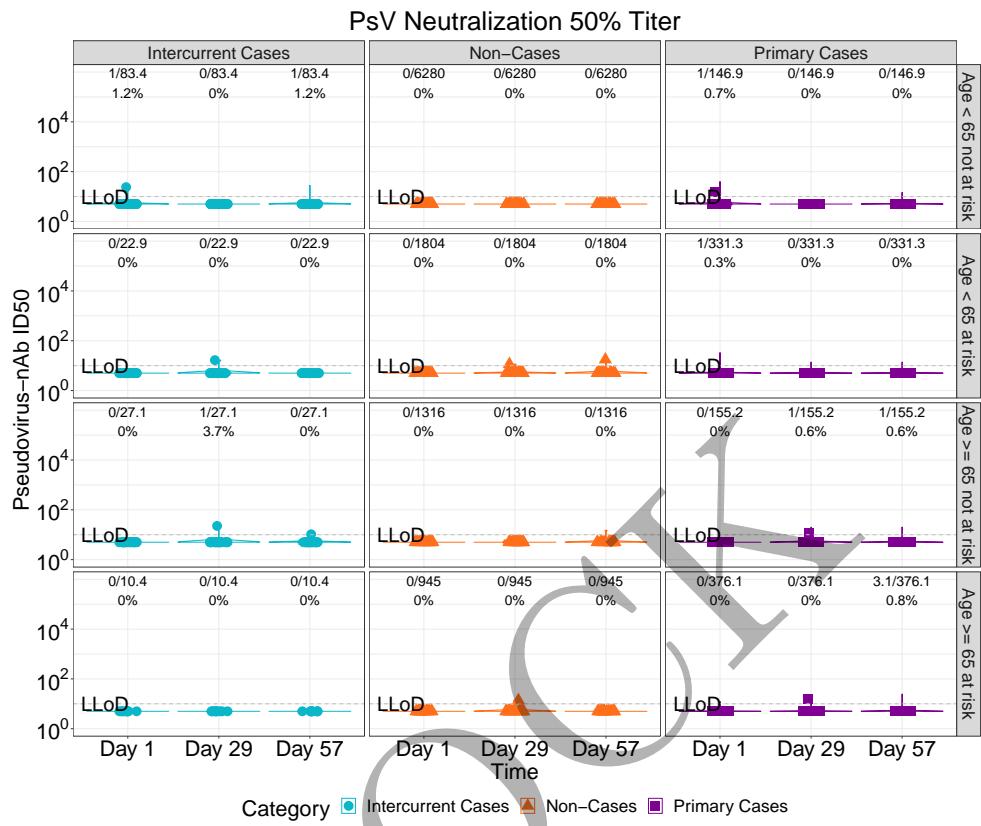


Figure 2.138: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

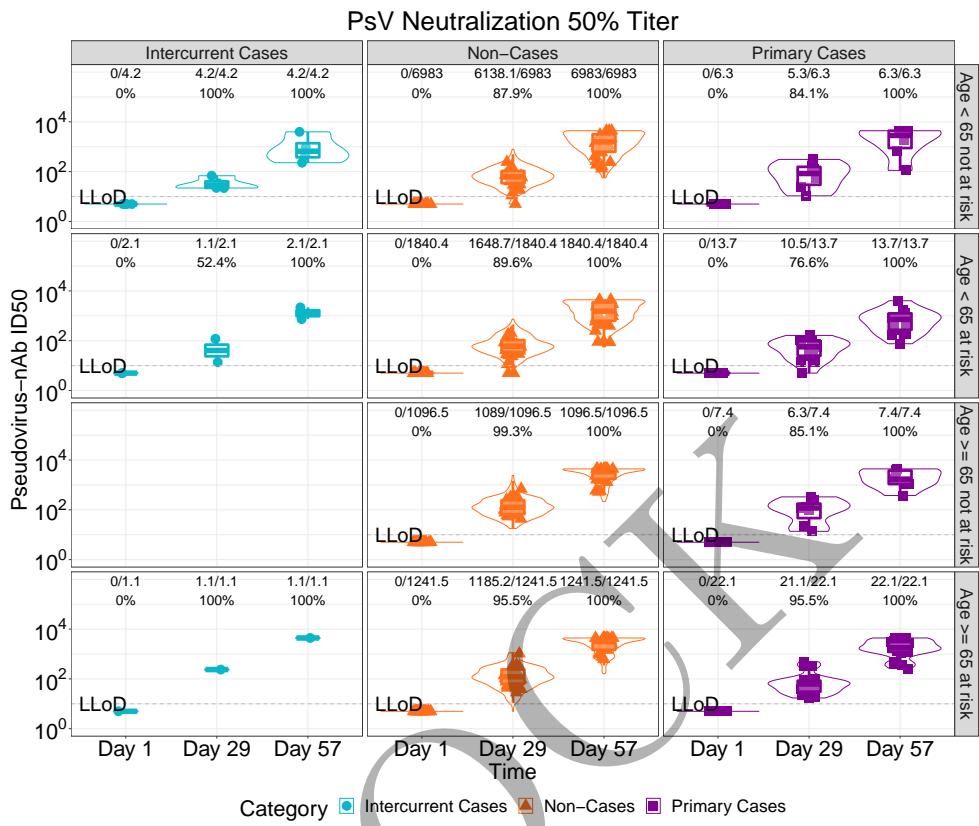


Figure 2.139: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2)

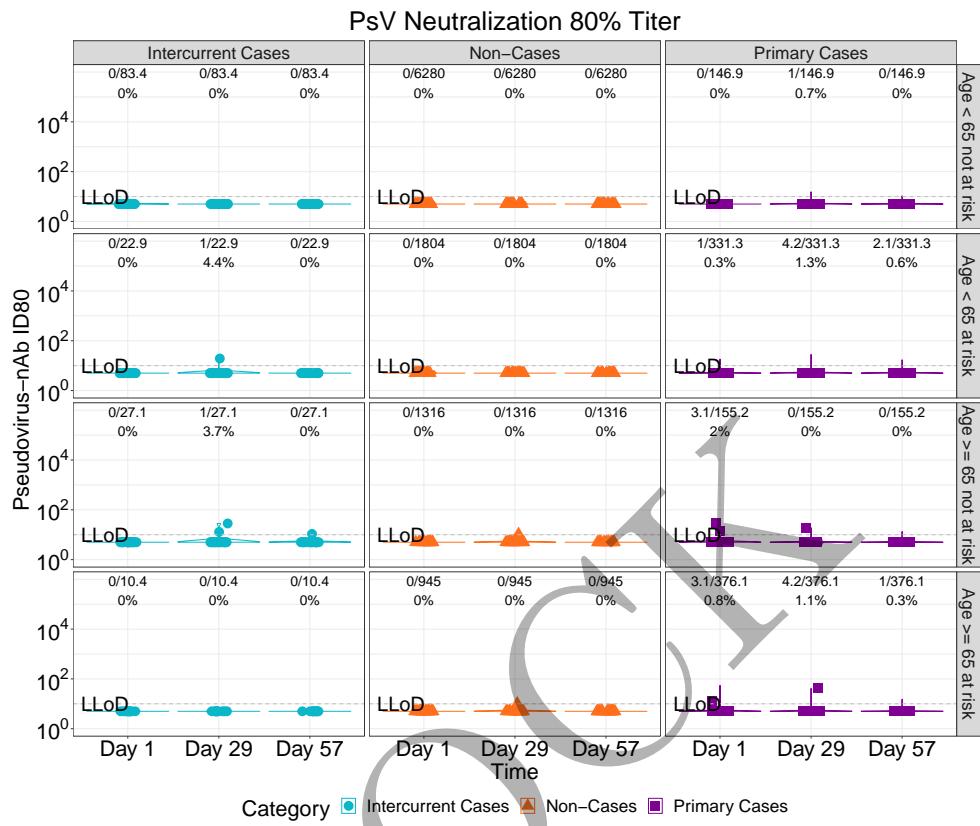


Figure 2.140: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

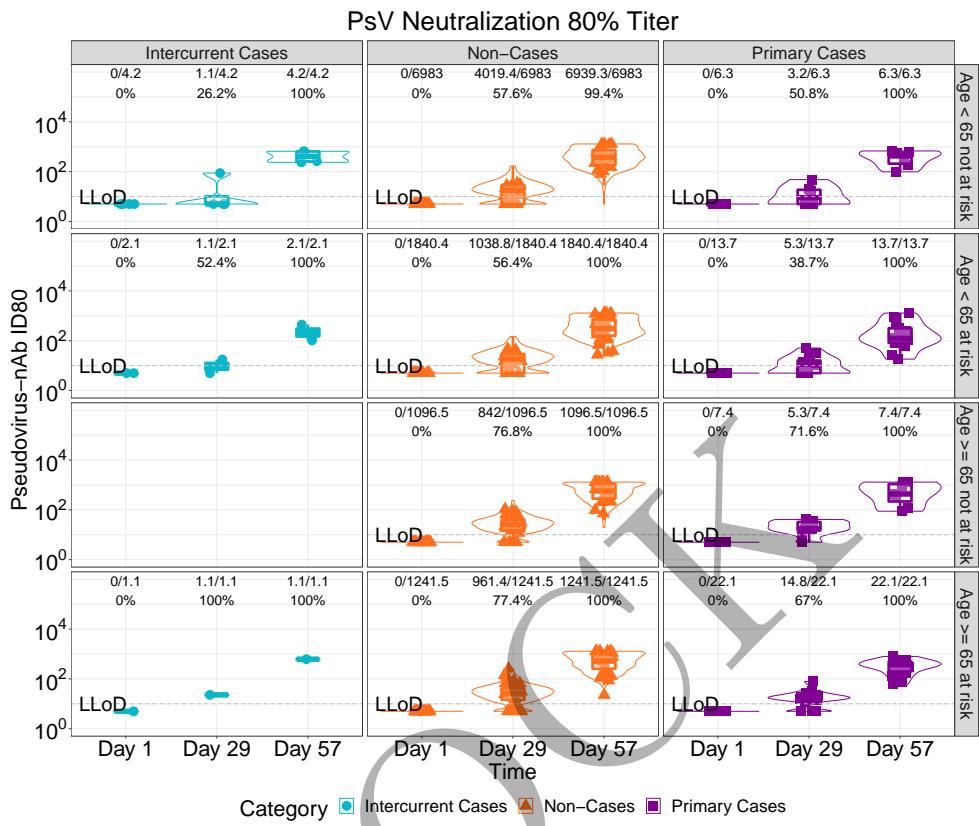


Figure 2.141: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

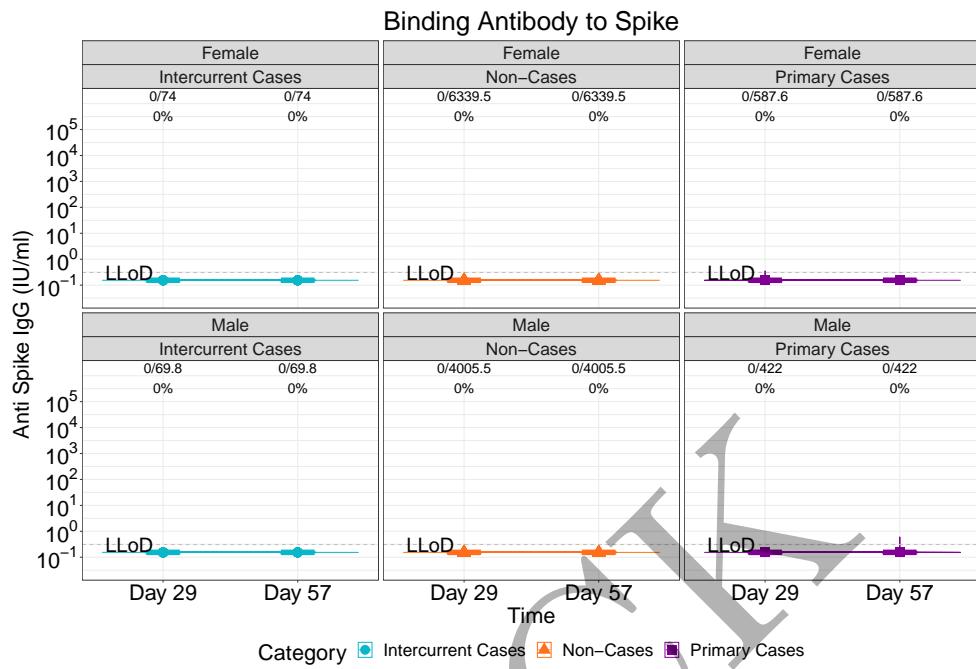


Figure 2.142: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

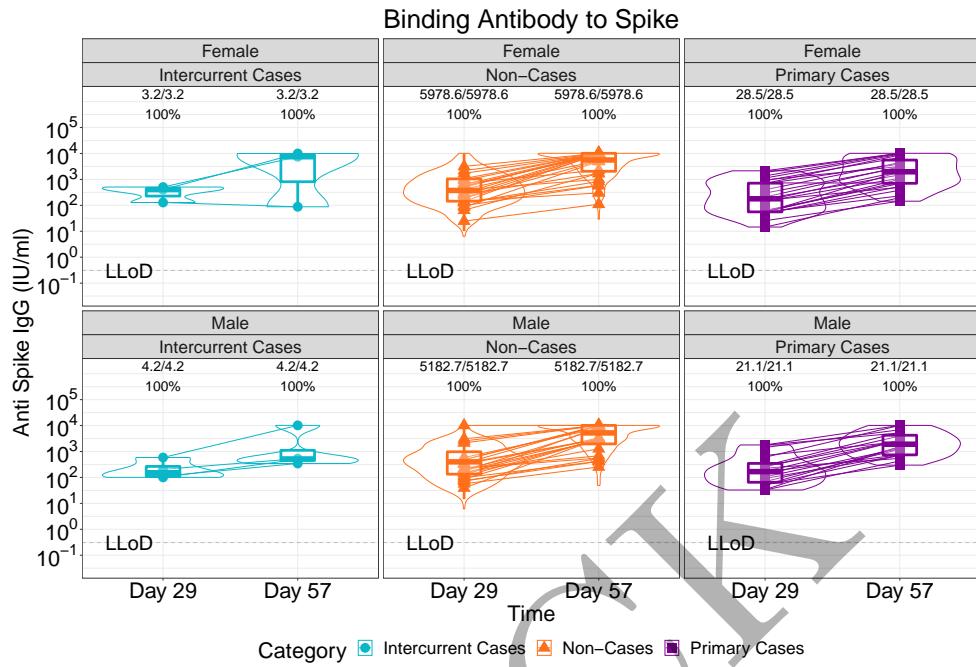


Figure 2.143: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

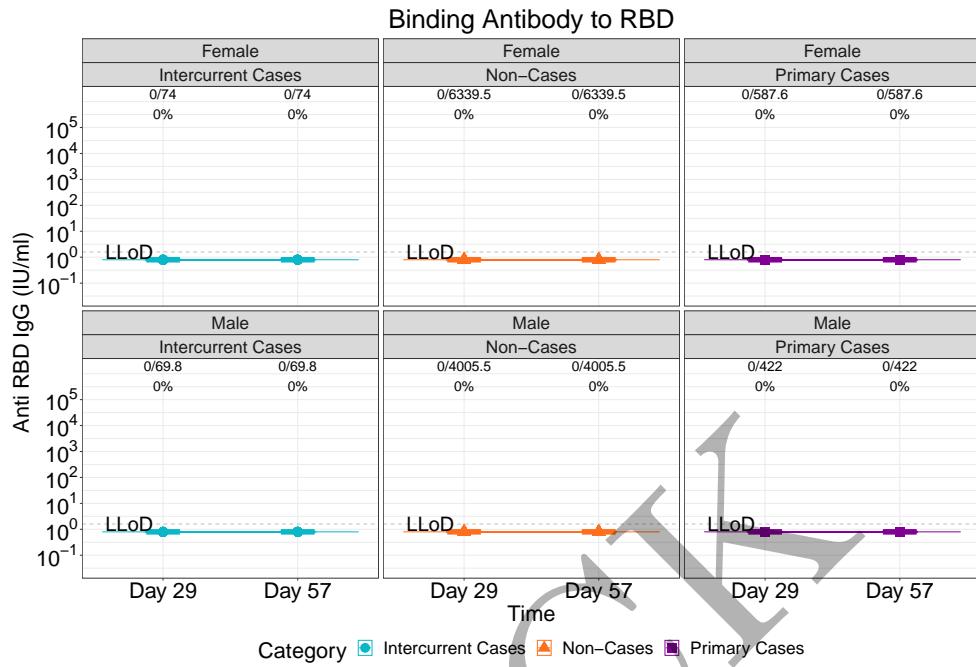


Figure 2.144: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

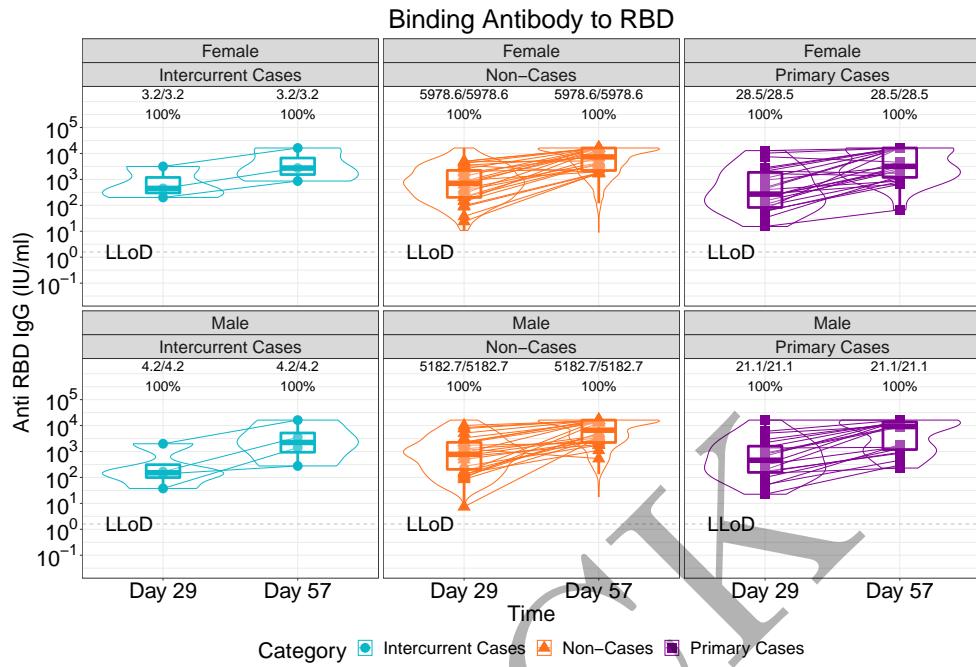


Figure 2.145: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

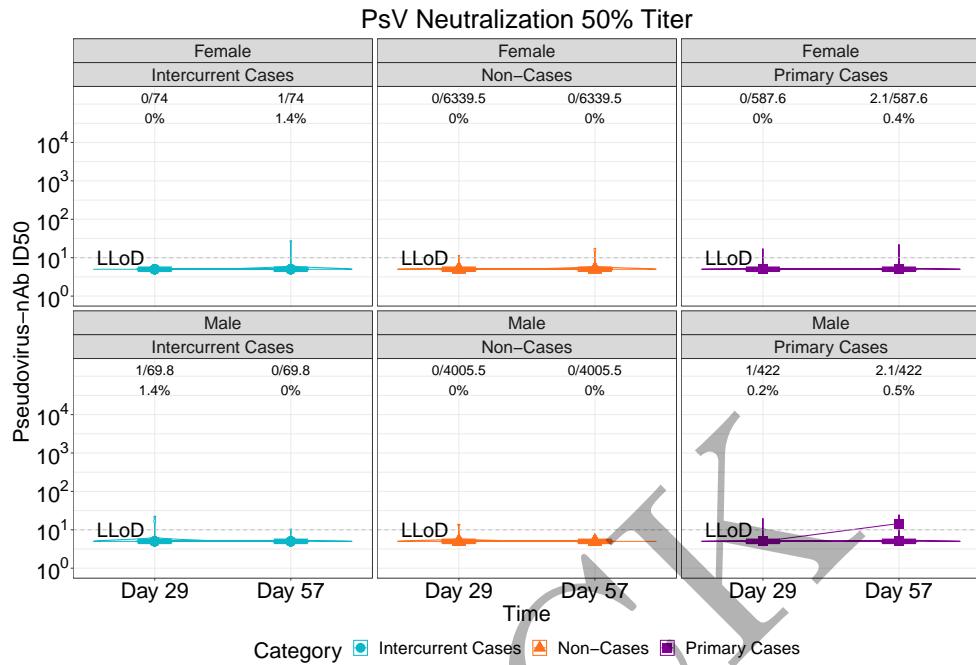


Figure 2.146: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

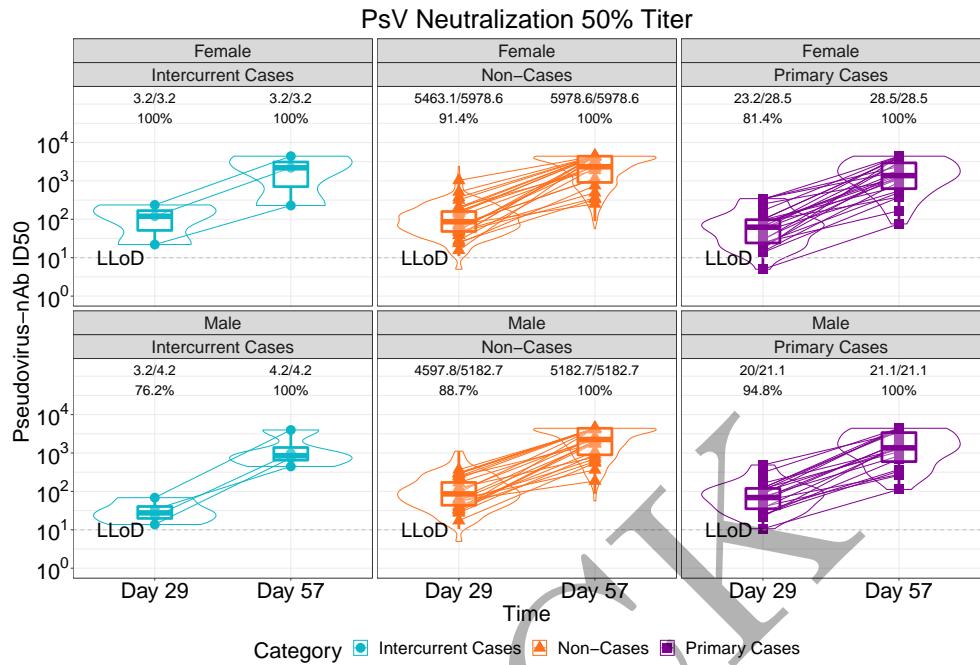


Figure 2.147: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

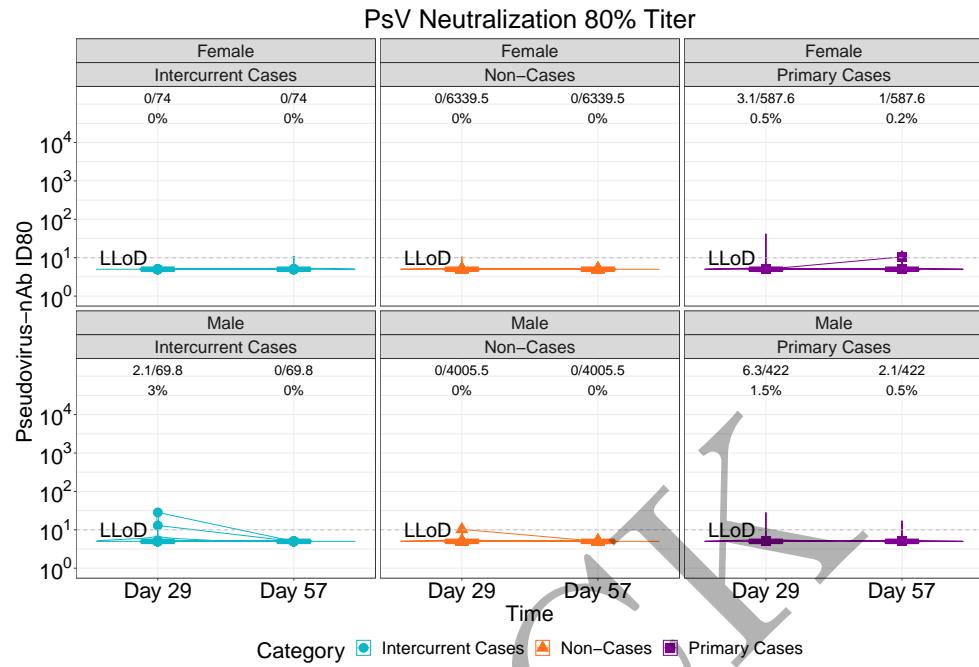


Figure 2.148: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

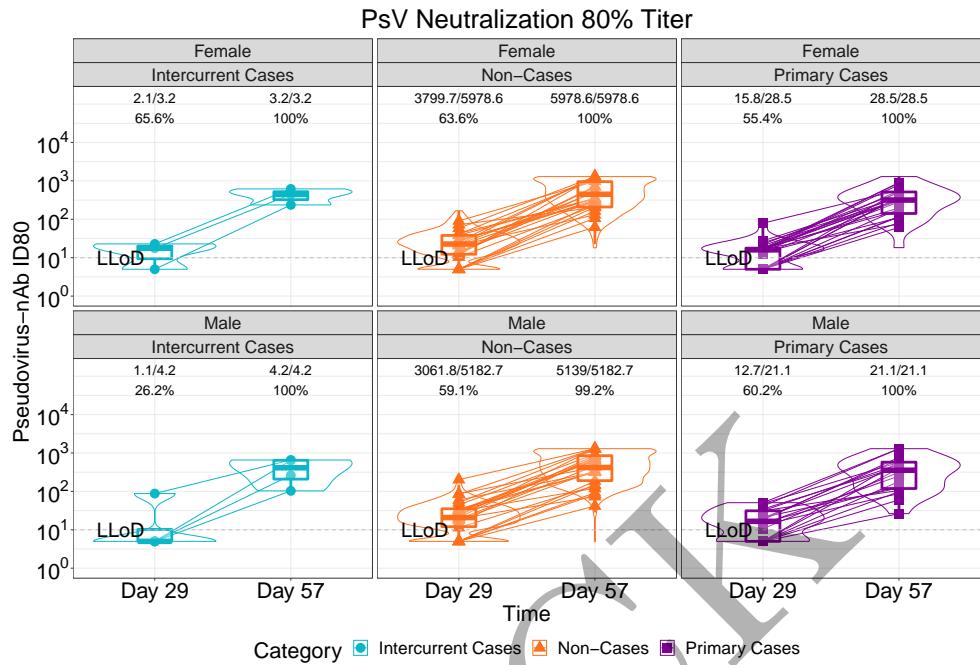


Figure 2.149: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

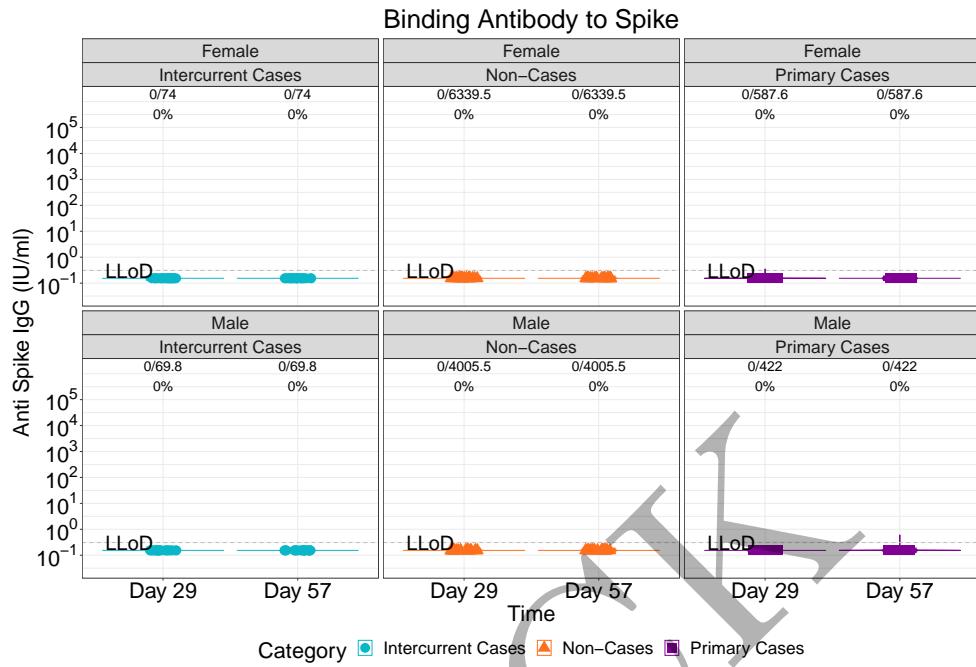


Figure 2.150: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

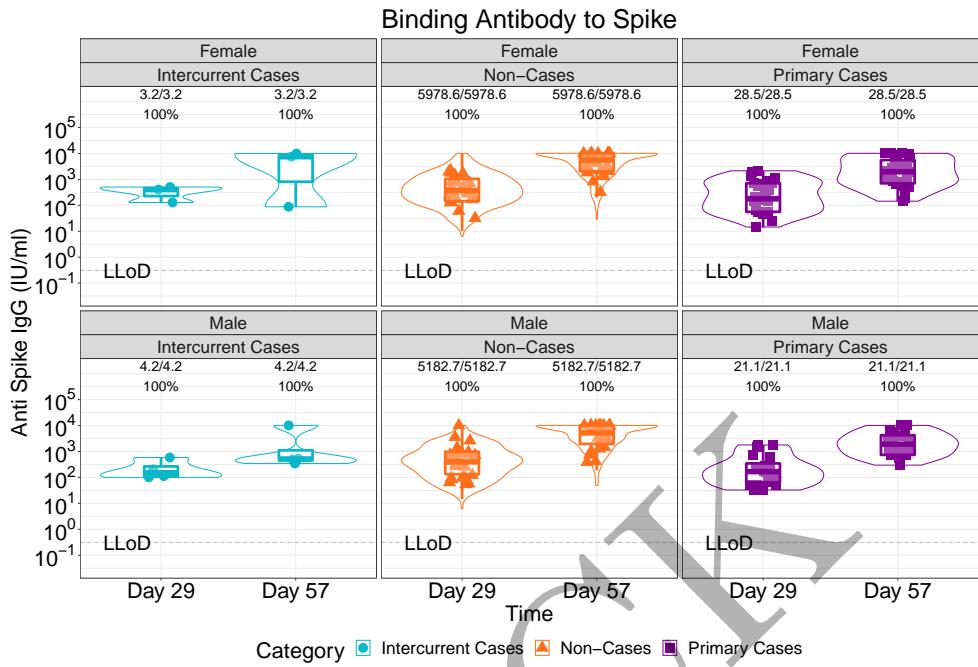


Figure 2.151: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

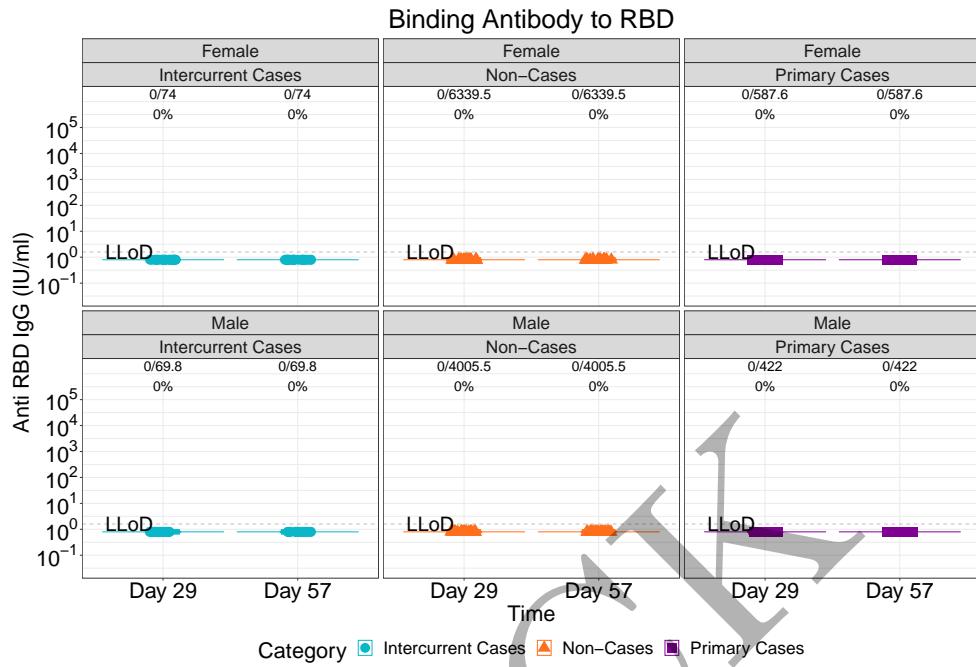


Figure 2.152: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

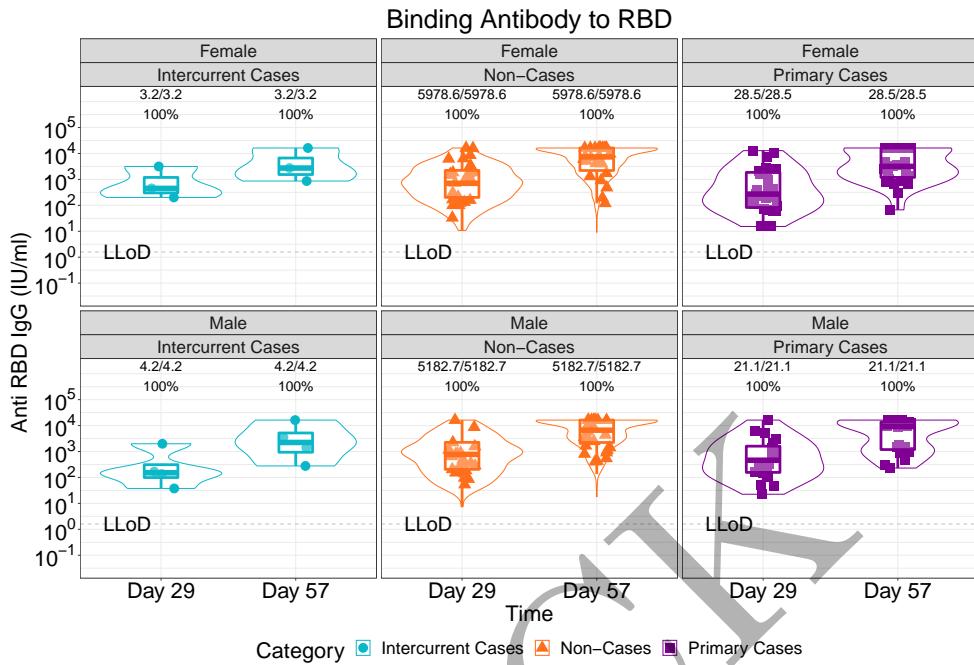


Figure 2.153: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

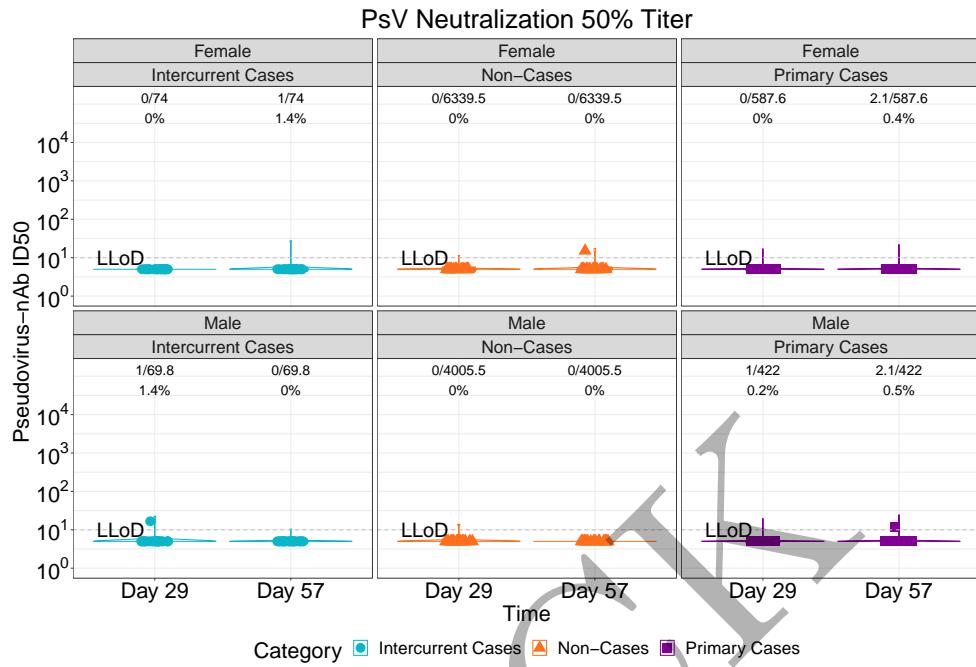


Figure 2.154: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

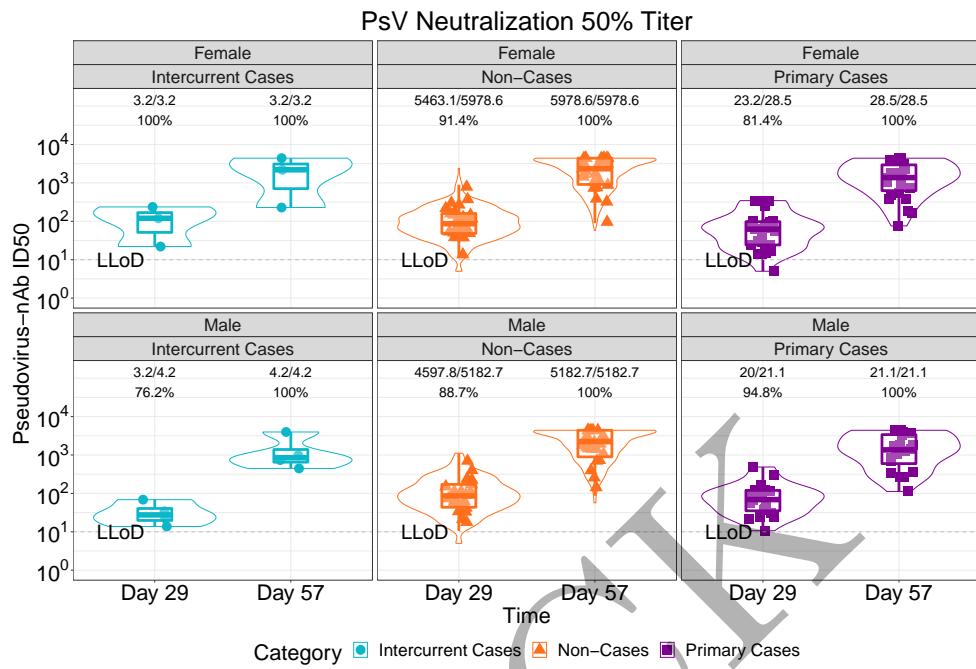


Figure 2.155: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

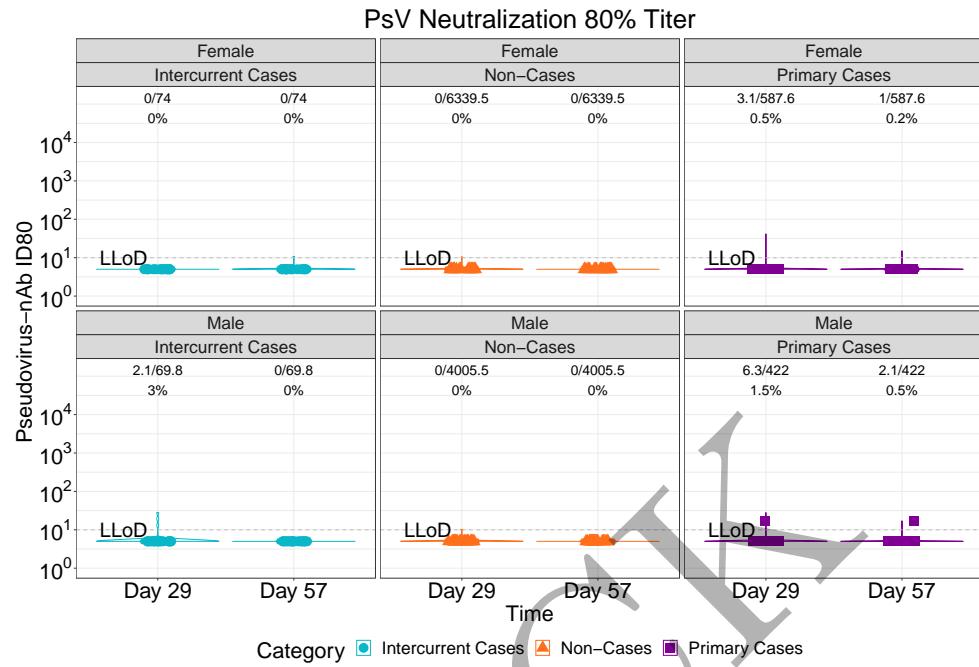


Figure 2.156: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

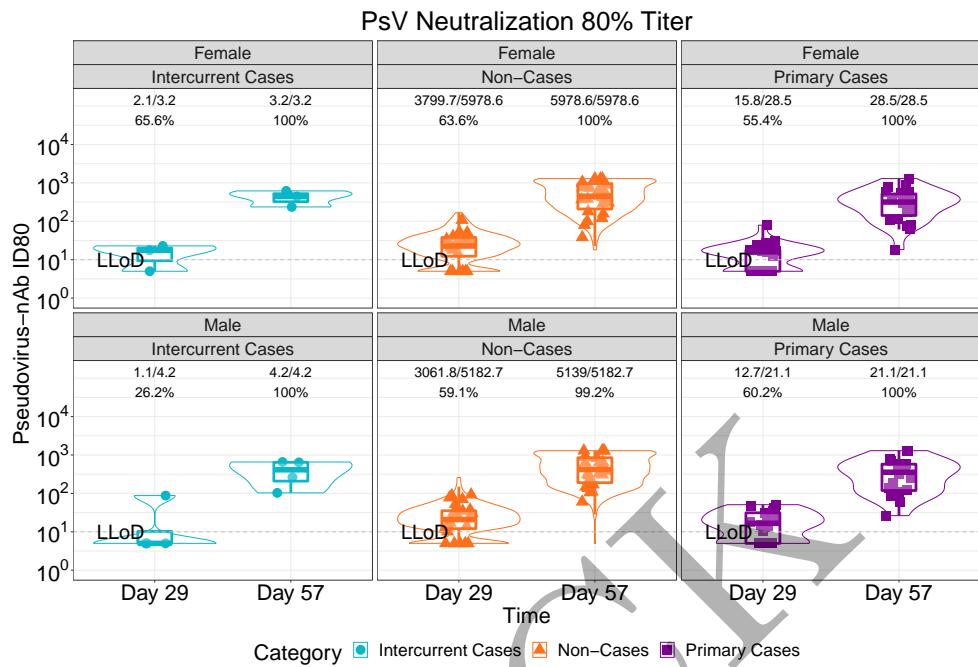


Figure 2.157: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

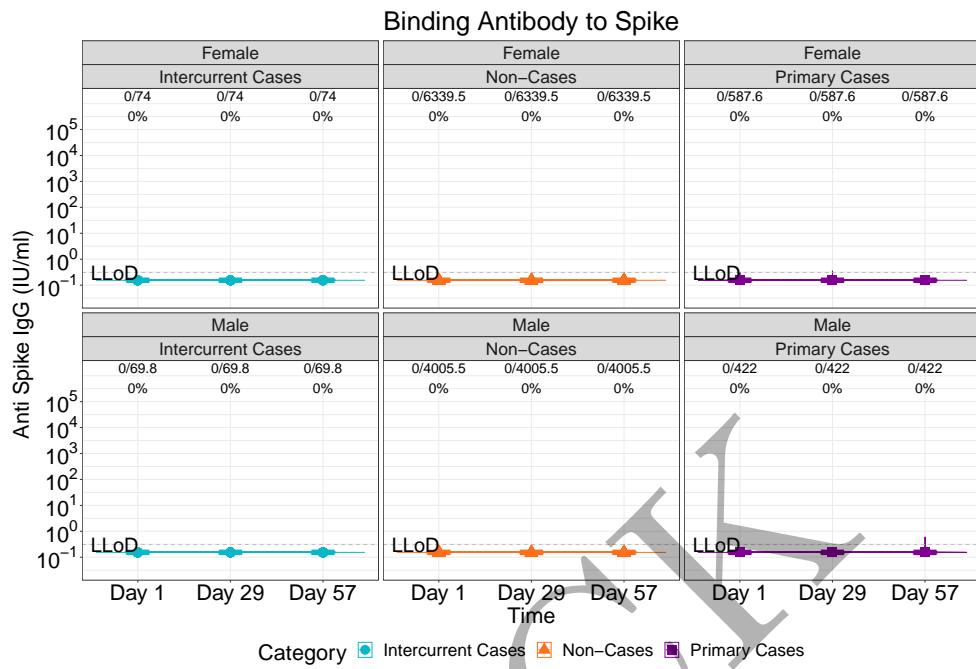


Figure 2.158: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

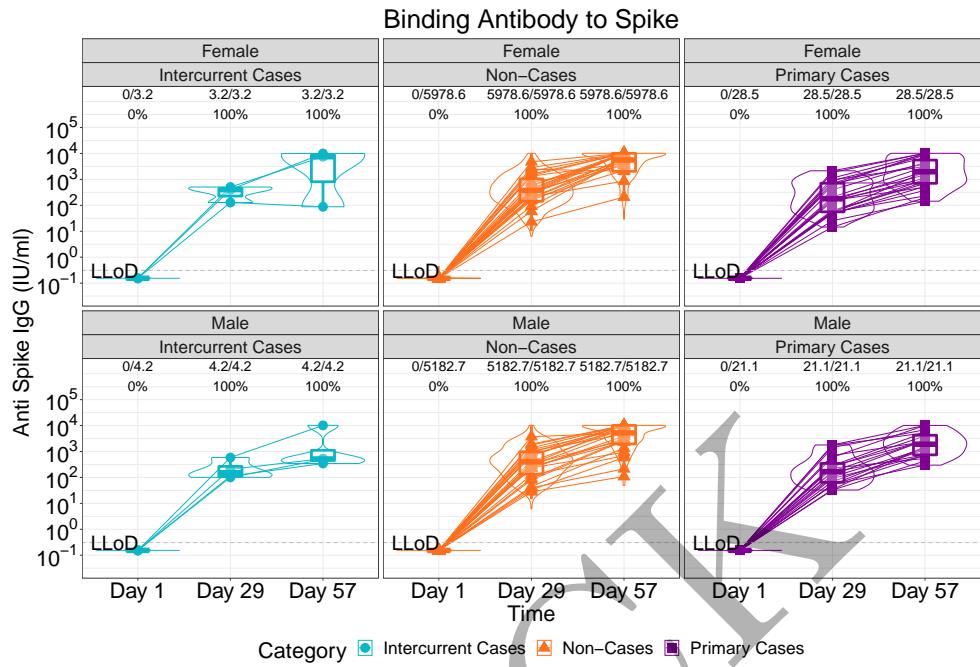


Figure 2.159: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

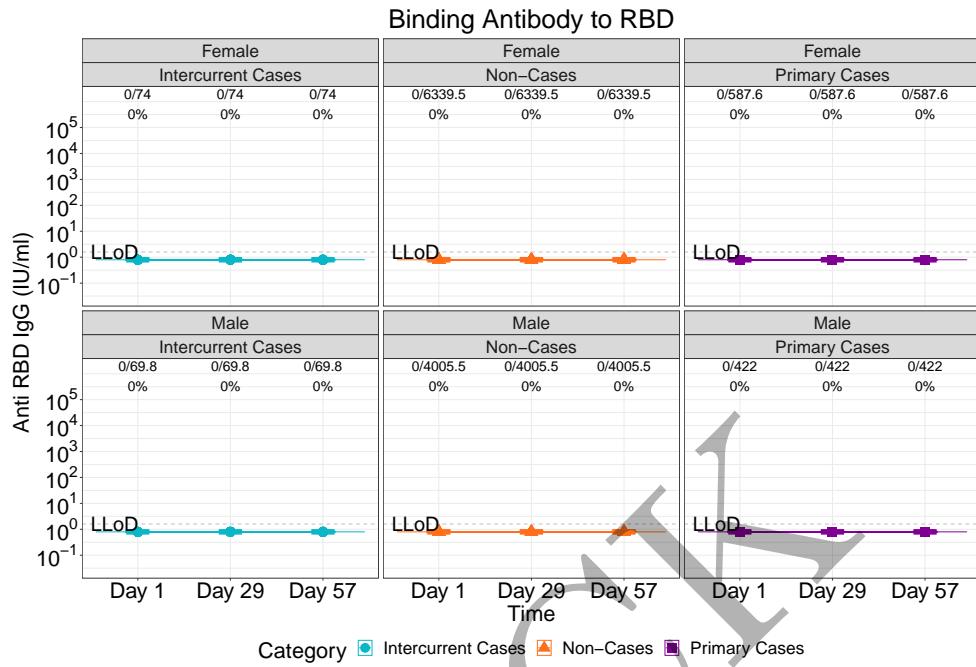


Figure 2.160: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

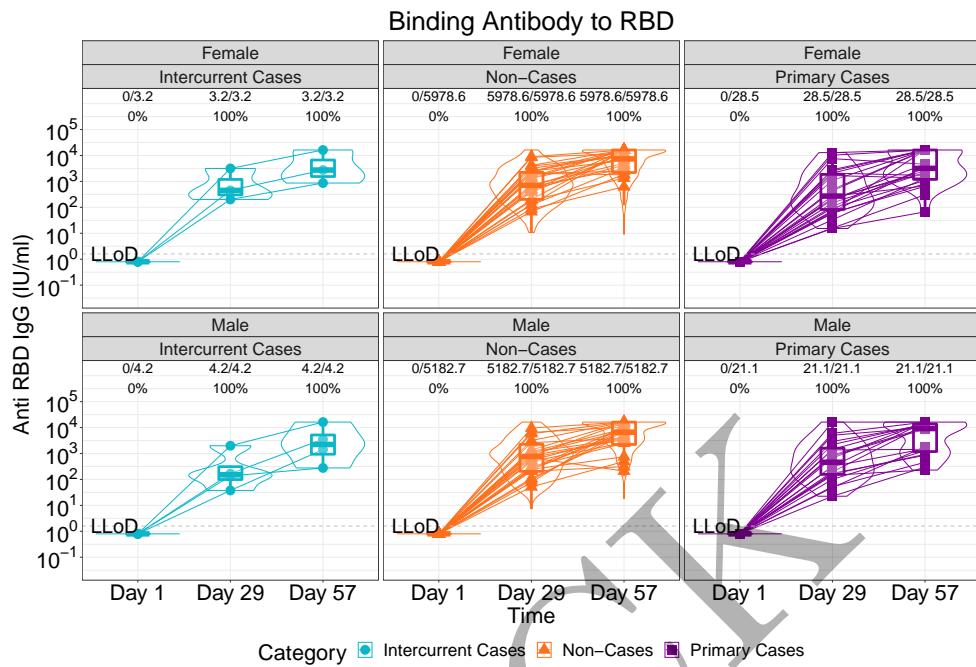


Figure 2.161: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

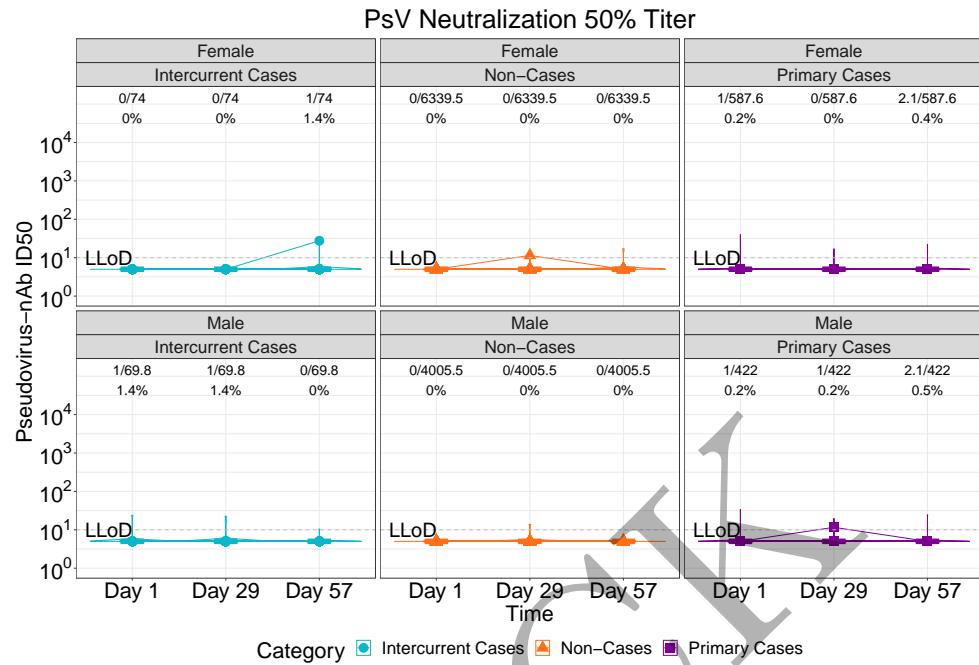


Figure 2.162: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

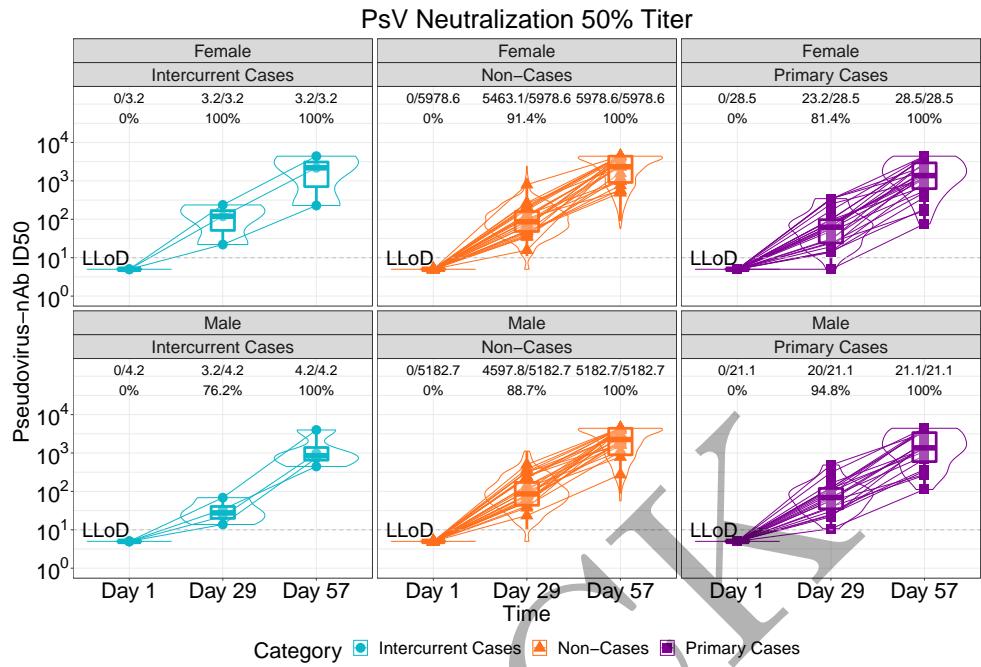


Figure 2.163: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

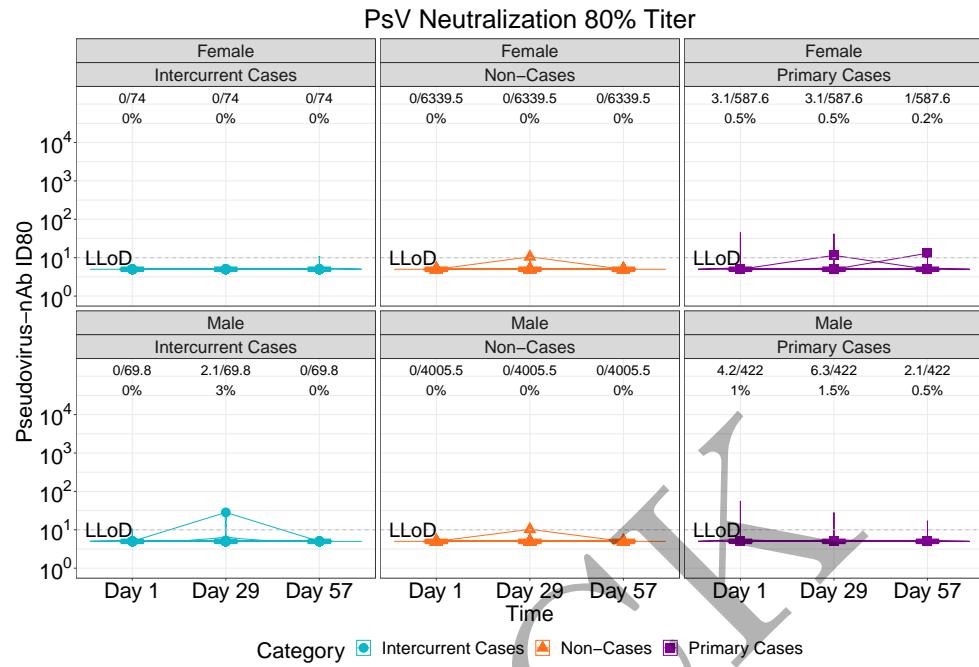


Figure 2.164: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

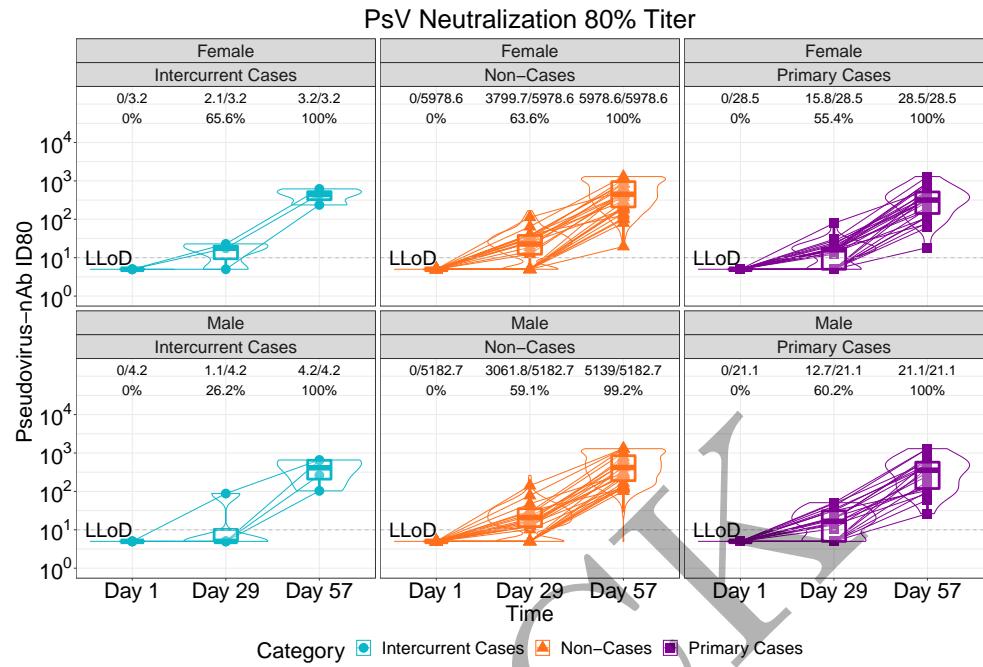


Figure 2.165: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

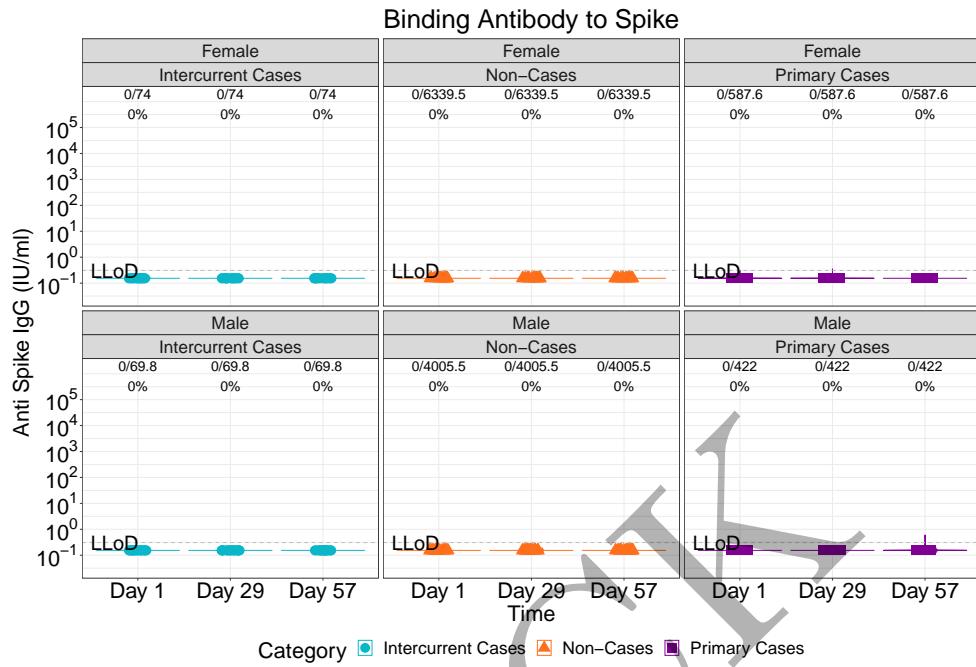


Figure 2.166: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

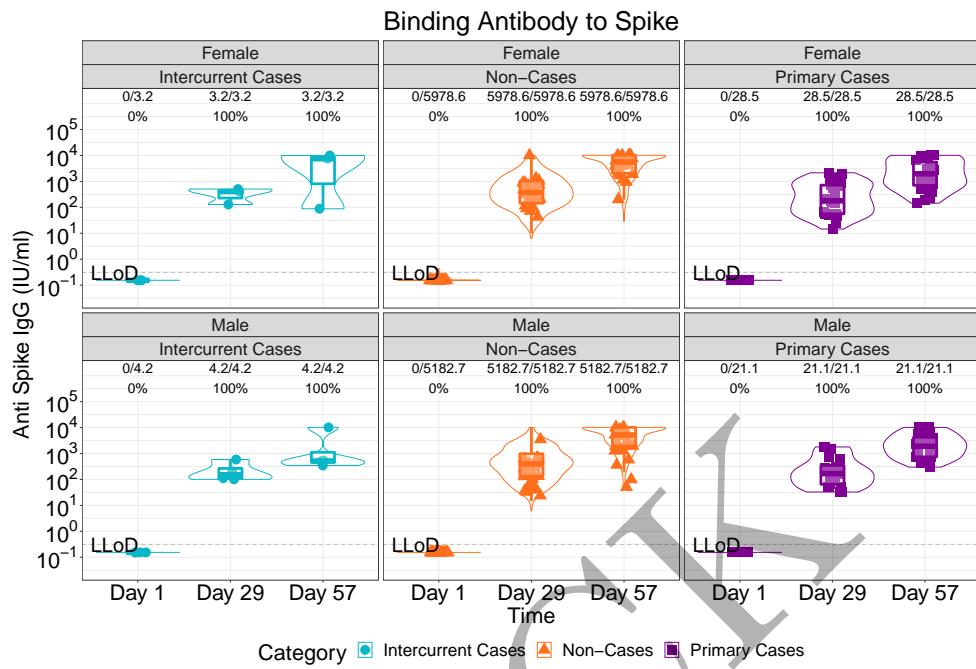


Figure 2.167: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

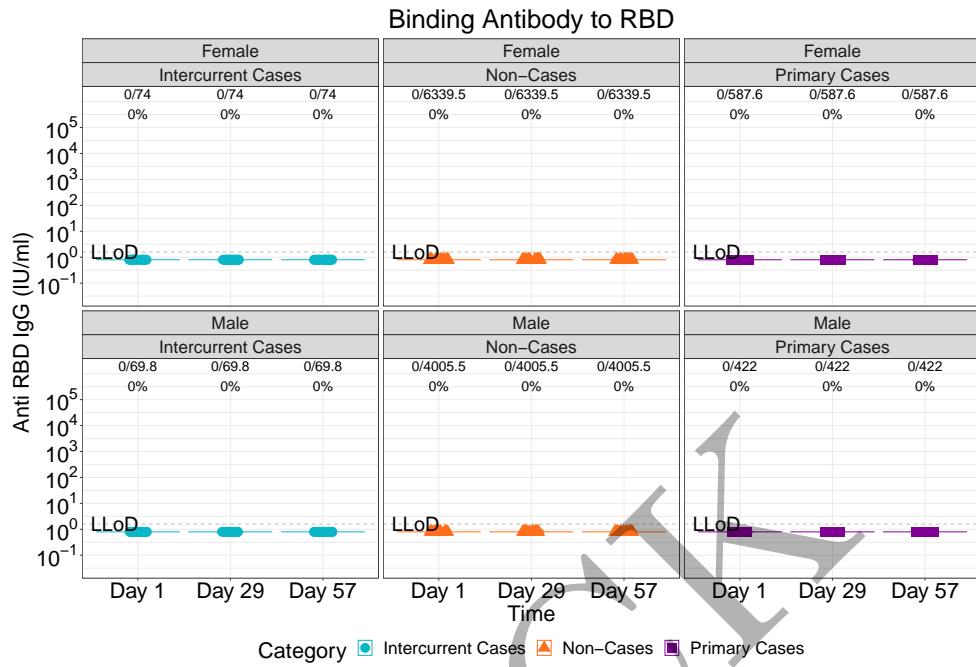


Figure 2.168: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

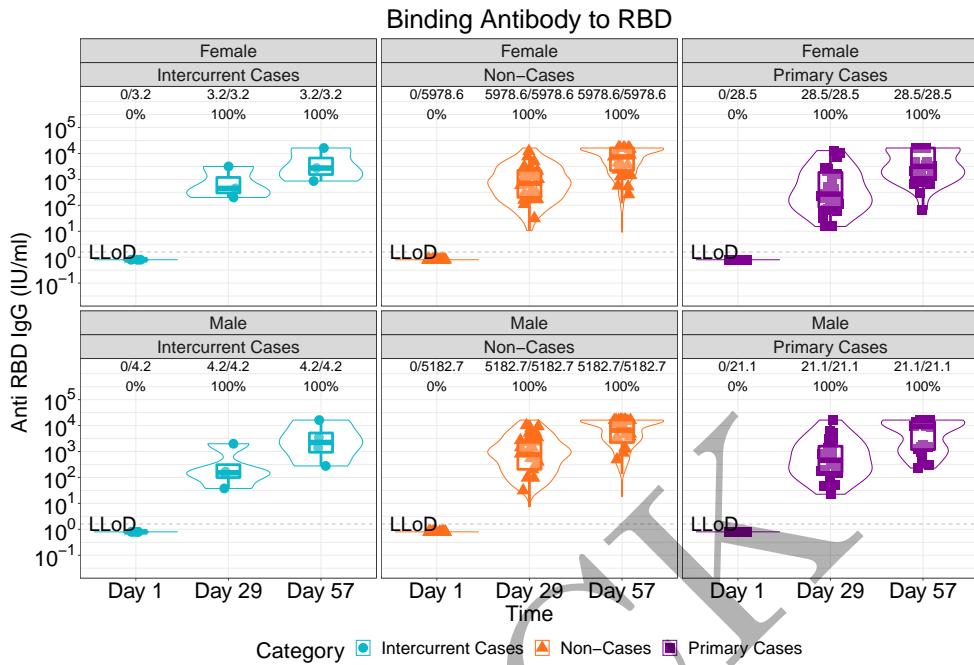


Figure 2.169: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

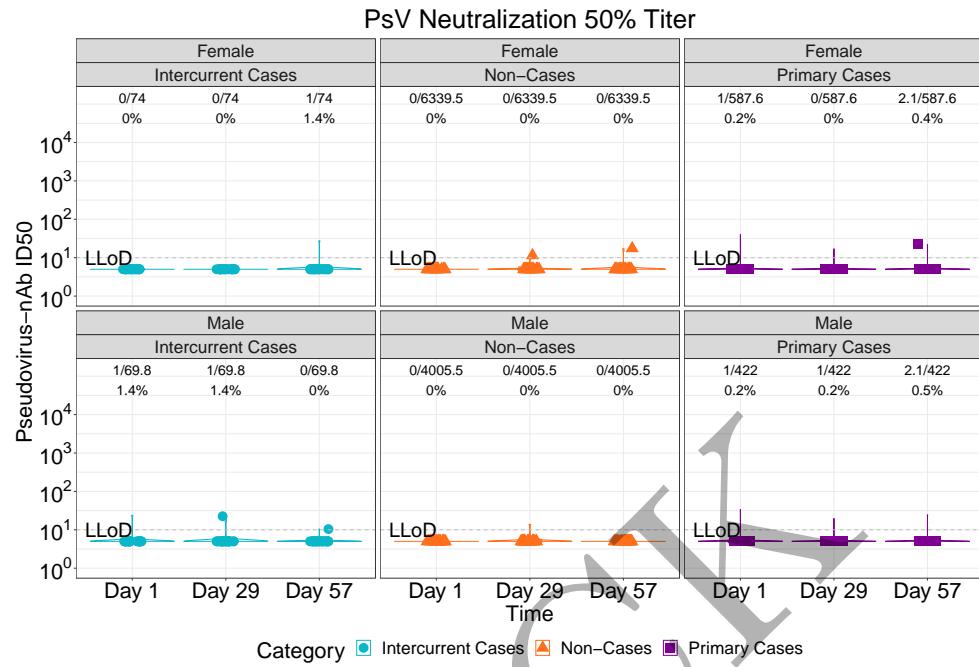


Figure 2.170: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

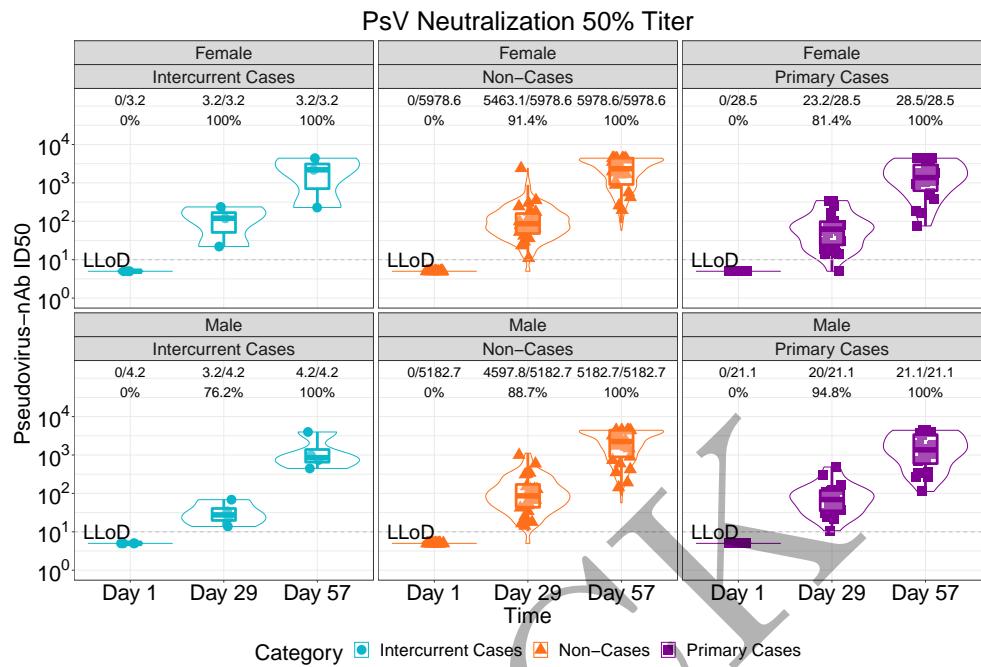


Figure 2.171: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

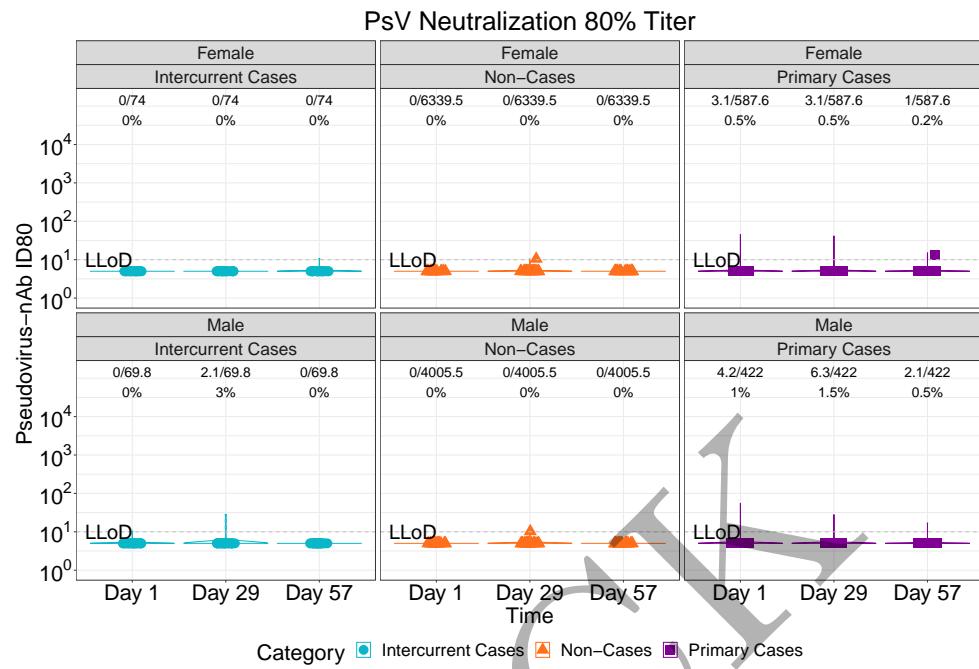


Figure 2.172: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

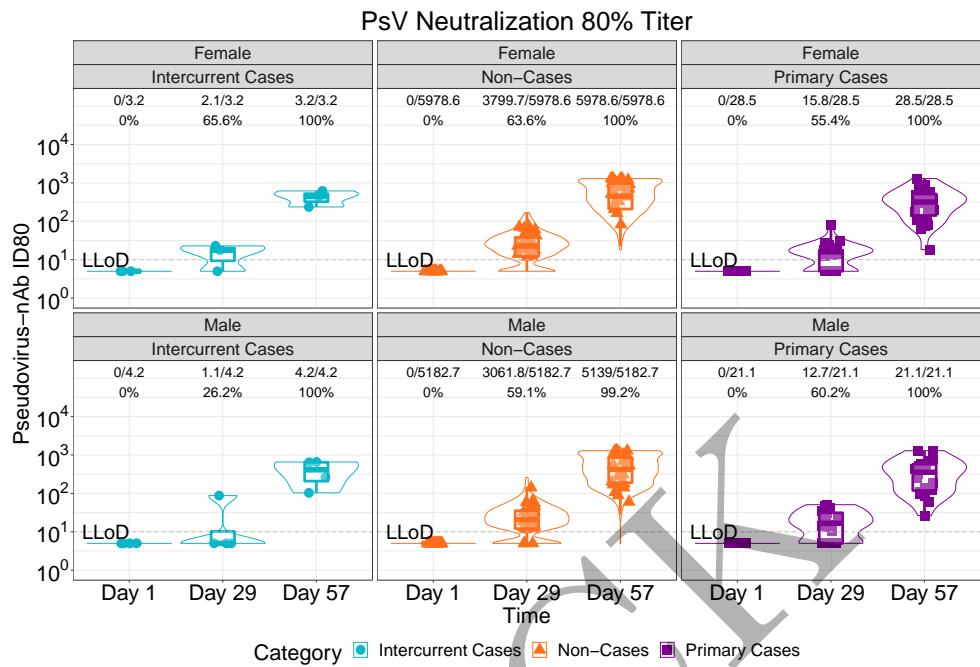


Figure 2.173: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

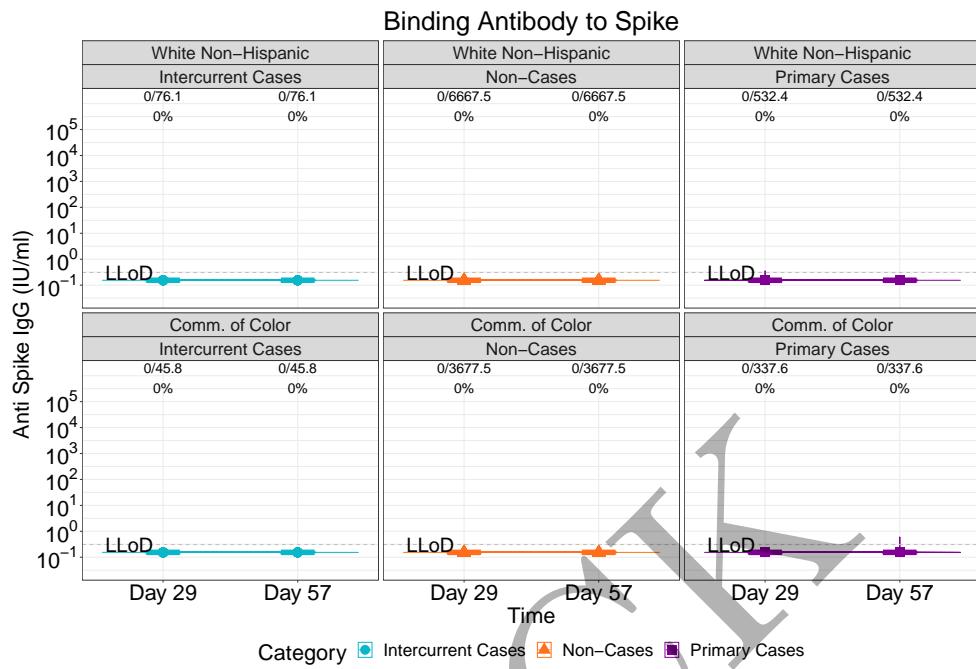


Figure 2.174: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

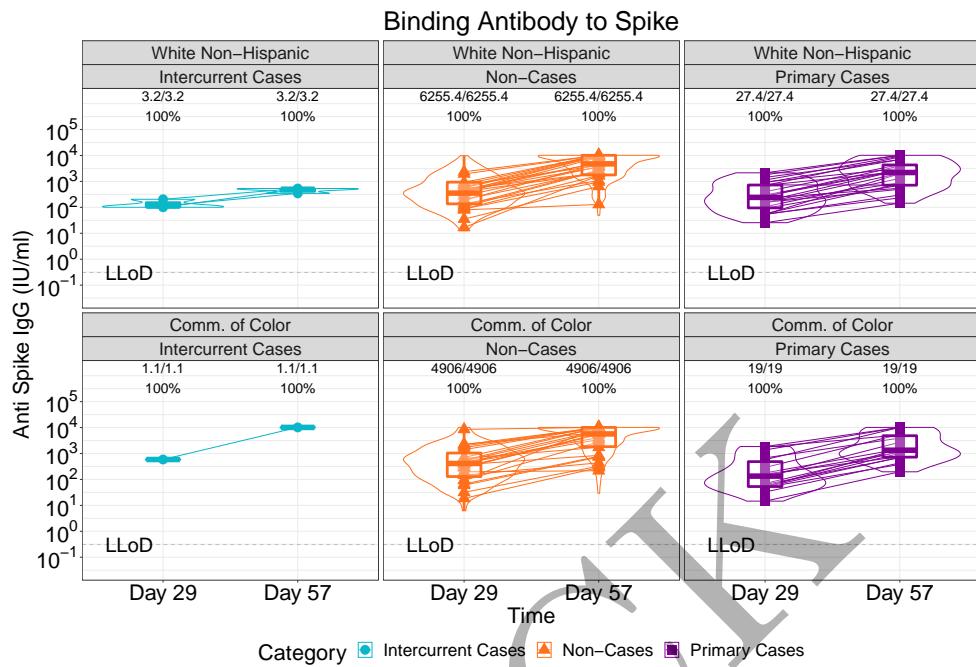


Figure 2.175: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

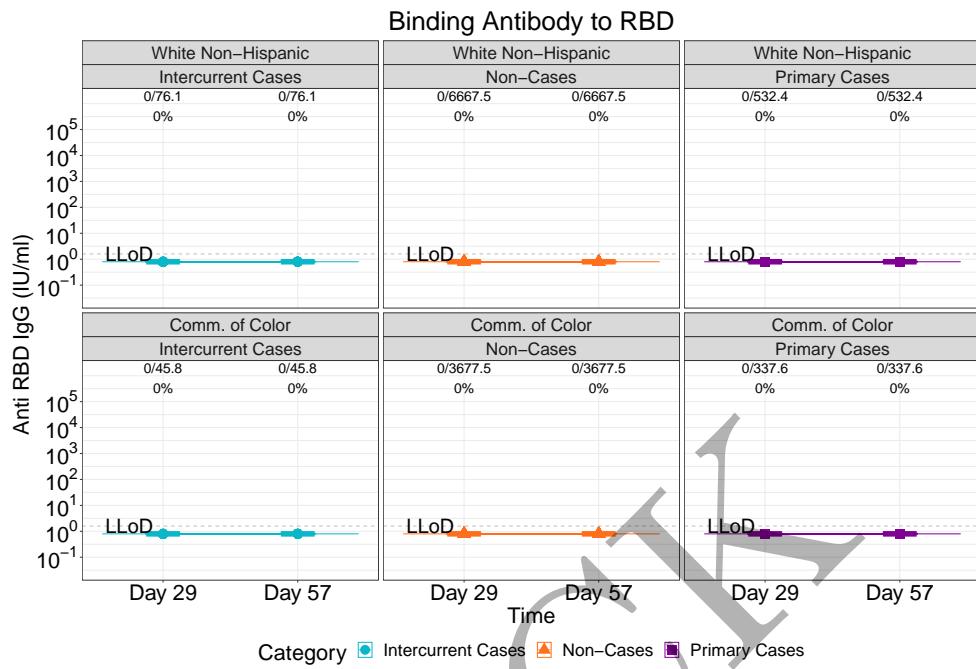


Figure 2.176: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

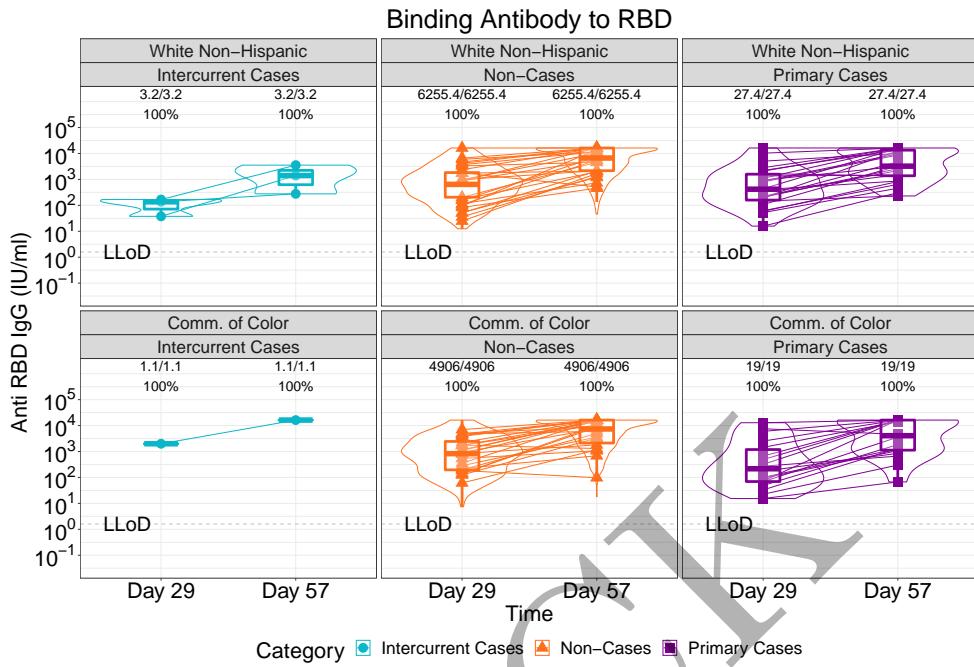


Figure 2.177: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

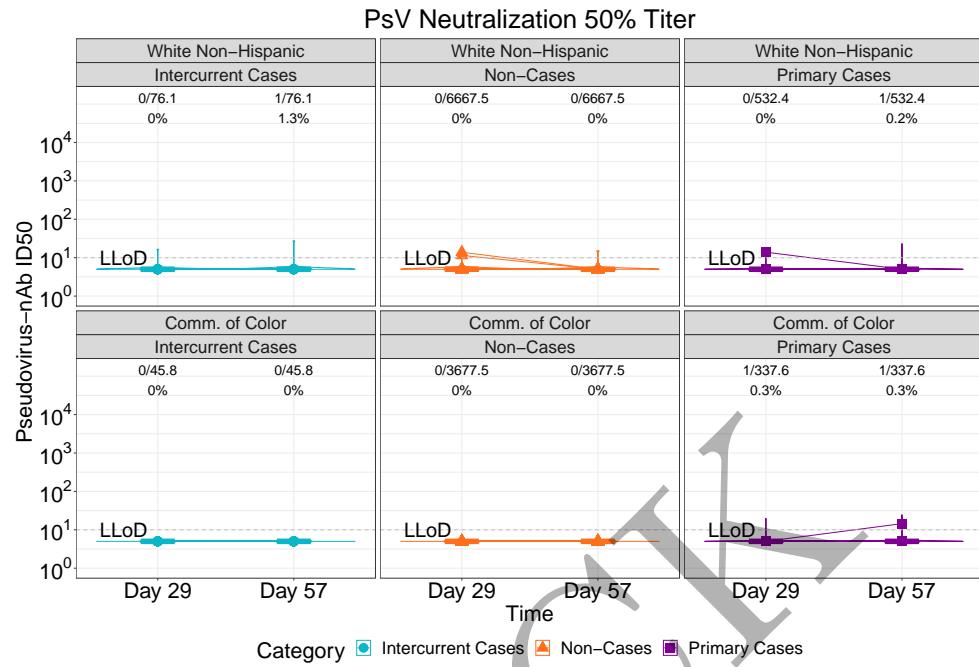


Figure 2.178: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

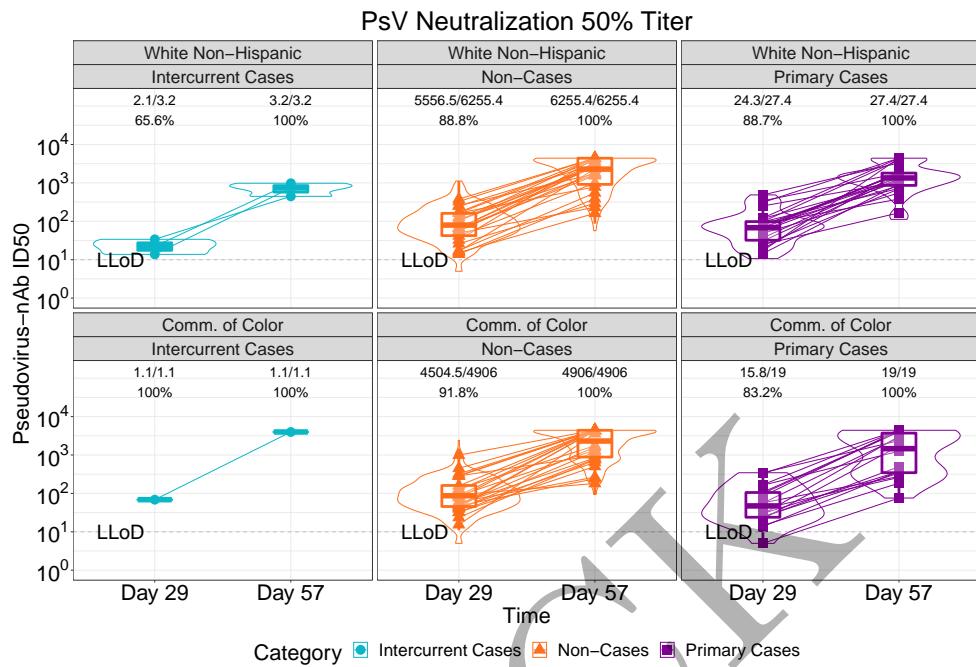


Figure 2.179: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

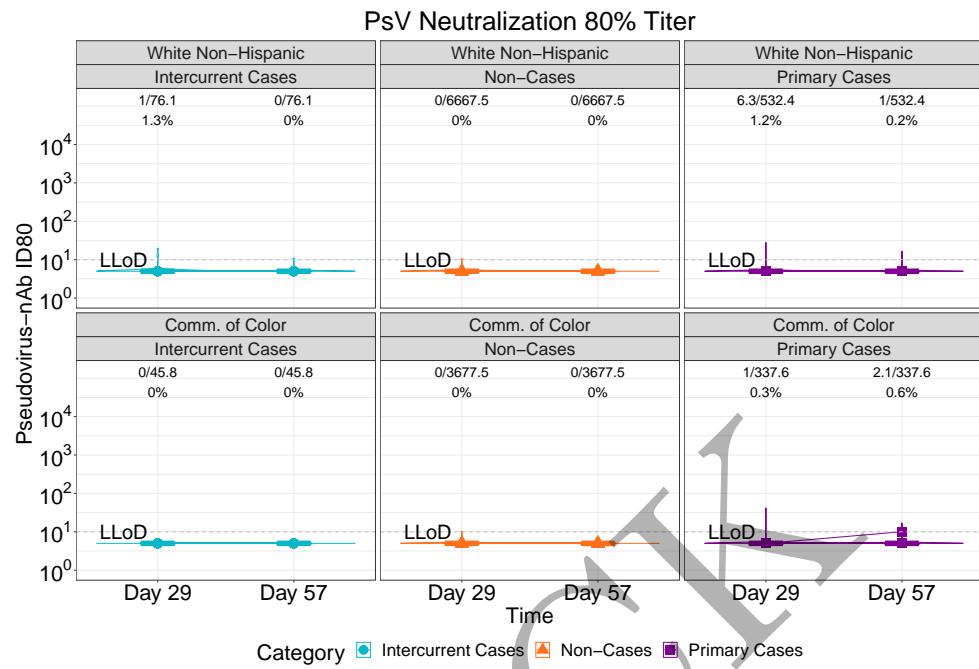


Figure 2.180: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

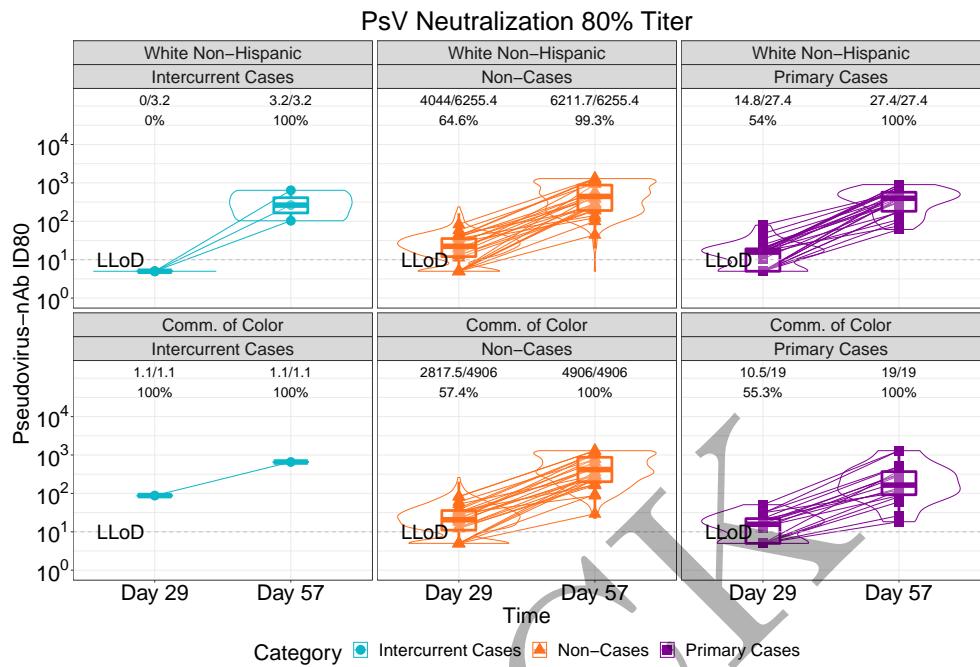


Figure 2.181: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

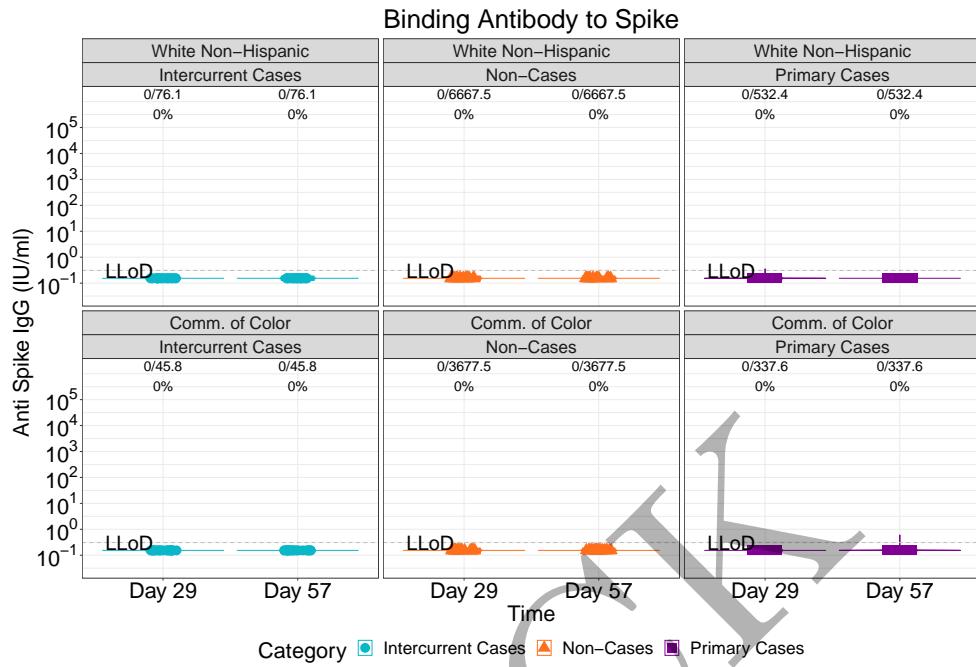


Figure 2.182: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

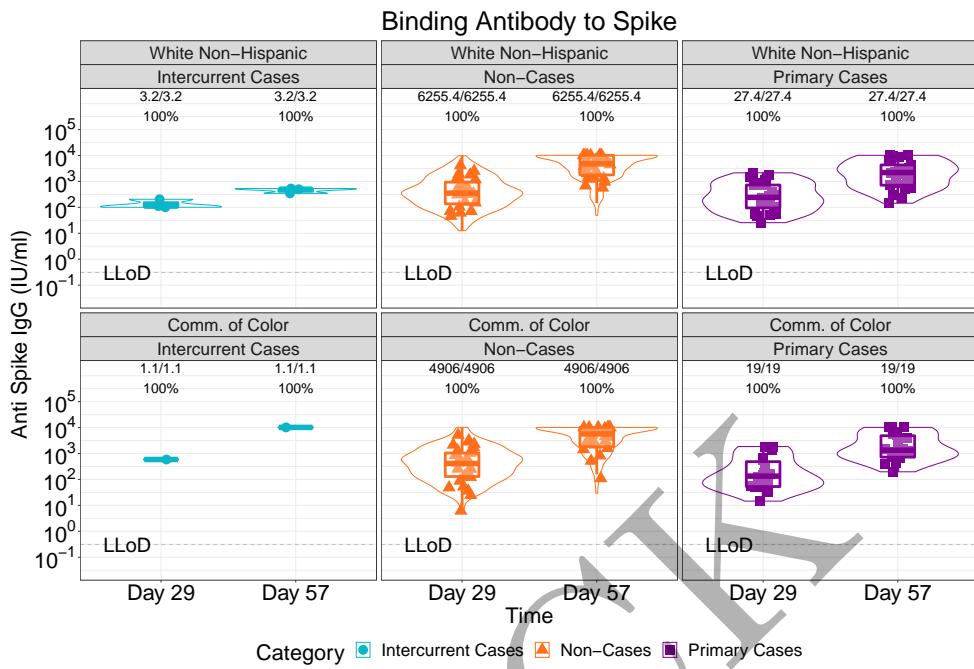


Figure 2.183: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

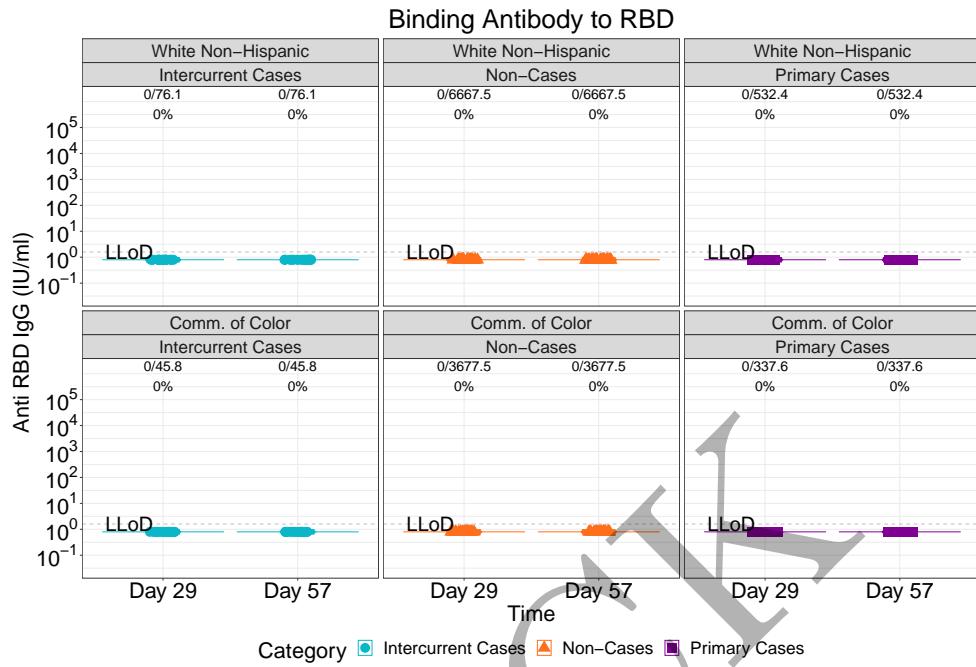


Figure 2.184: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

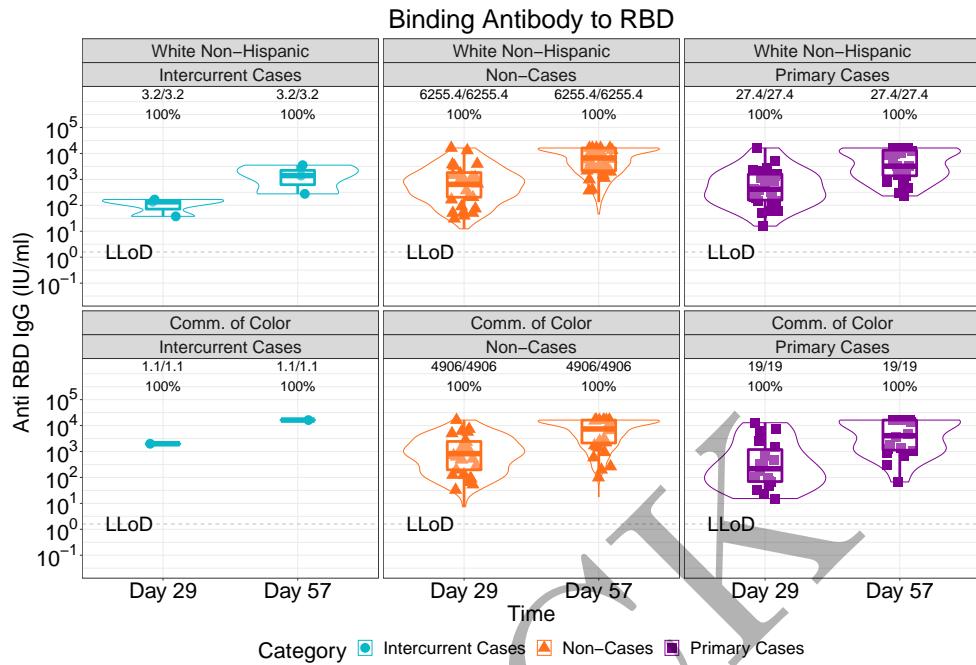


Figure 2.185: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

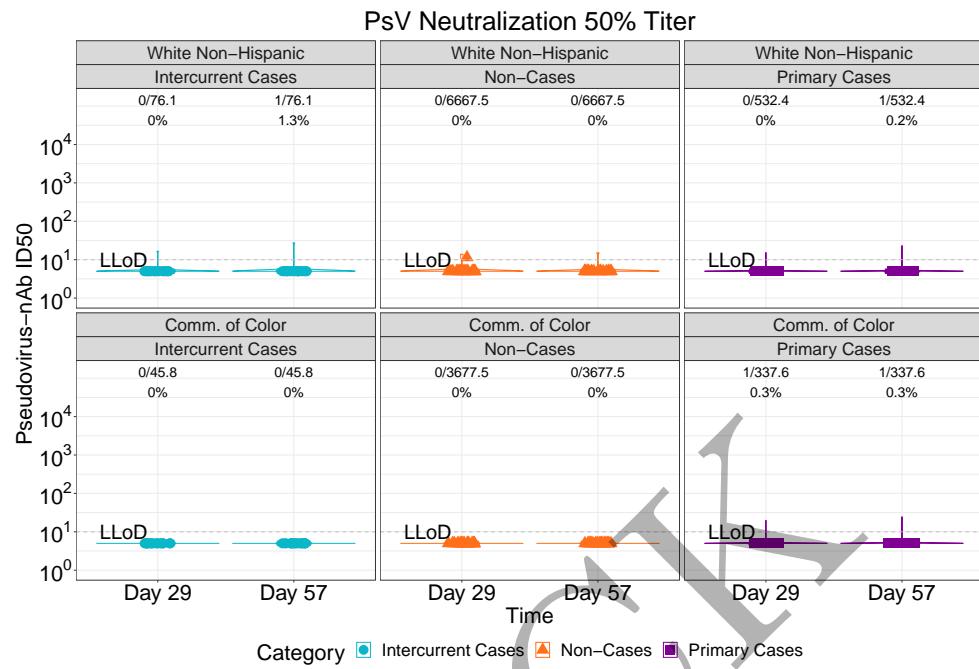


Figure 2.186: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

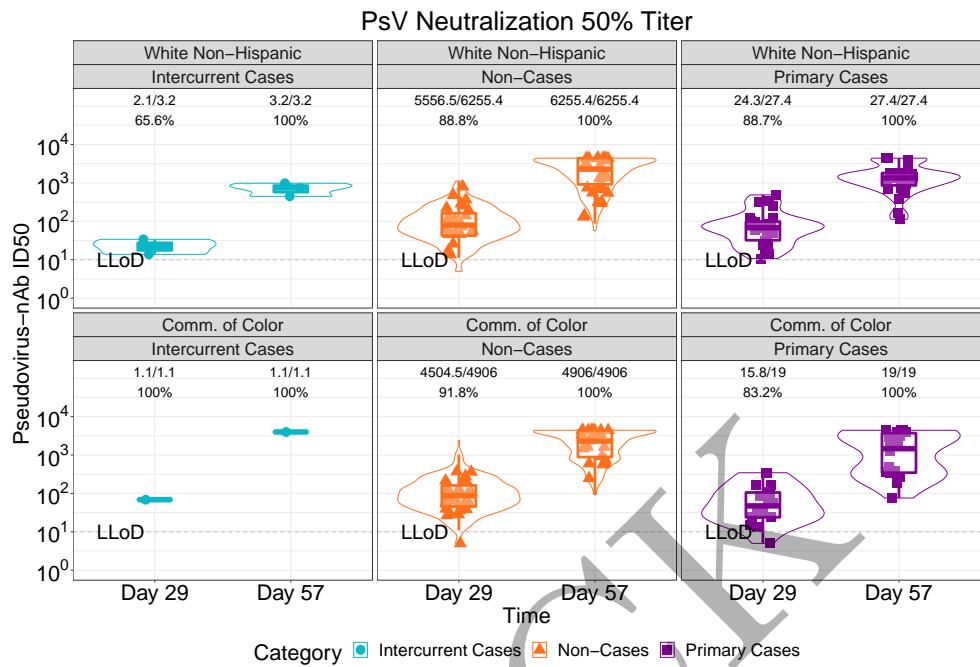


Figure 2.187: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

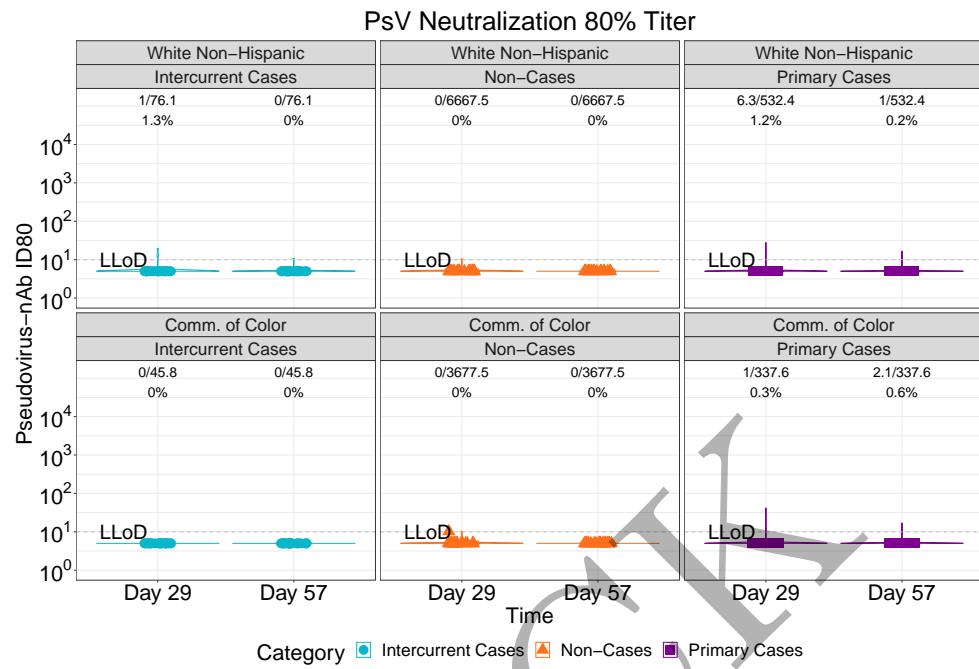


Figure 2.188: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

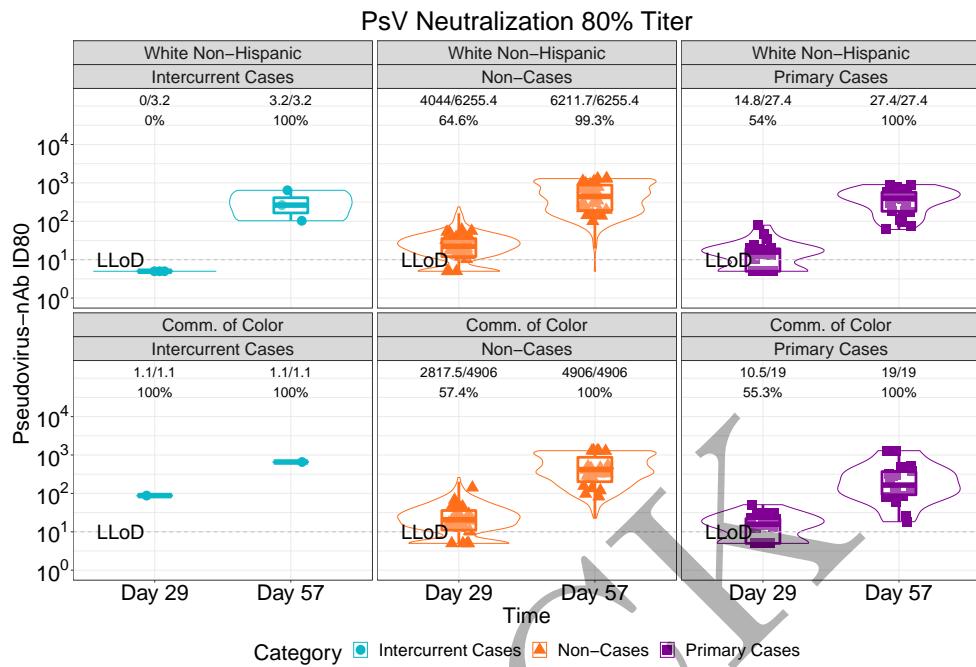


Figure 2.189: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

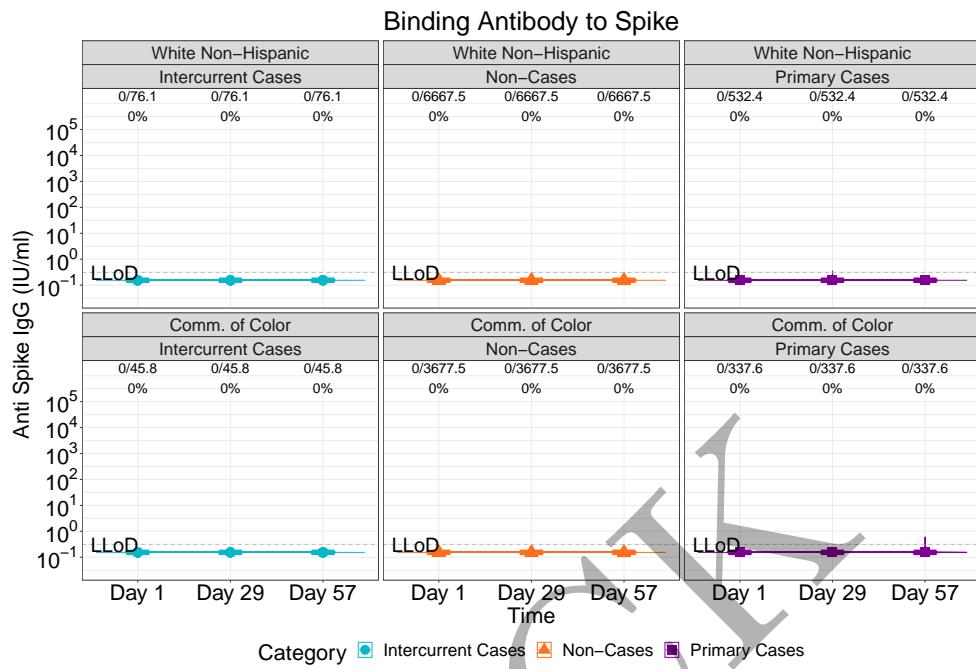


Figure 2.190: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

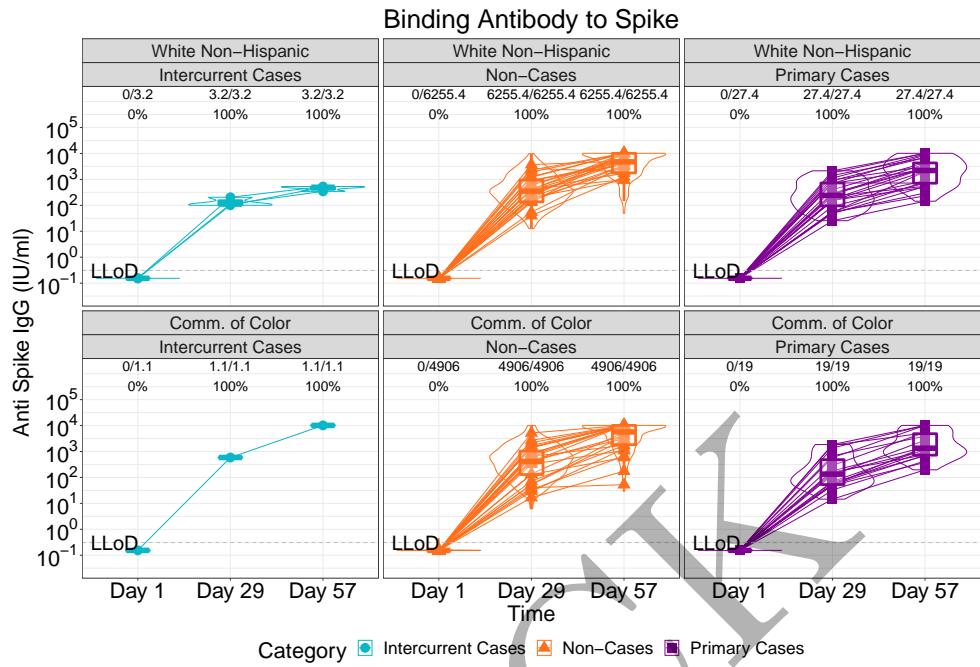


Figure 2.191: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

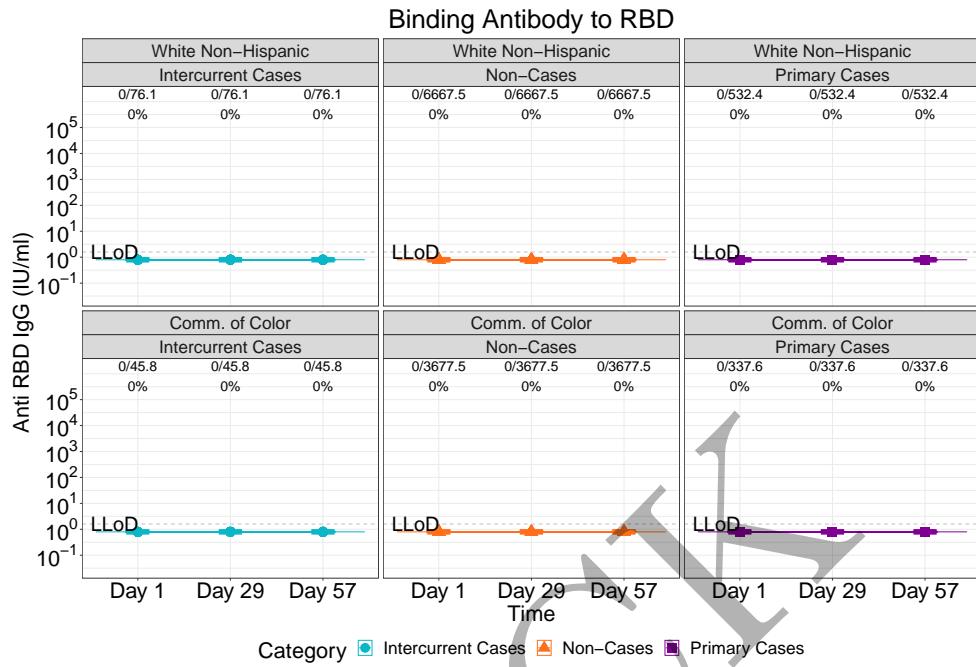


Figure 2.192: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

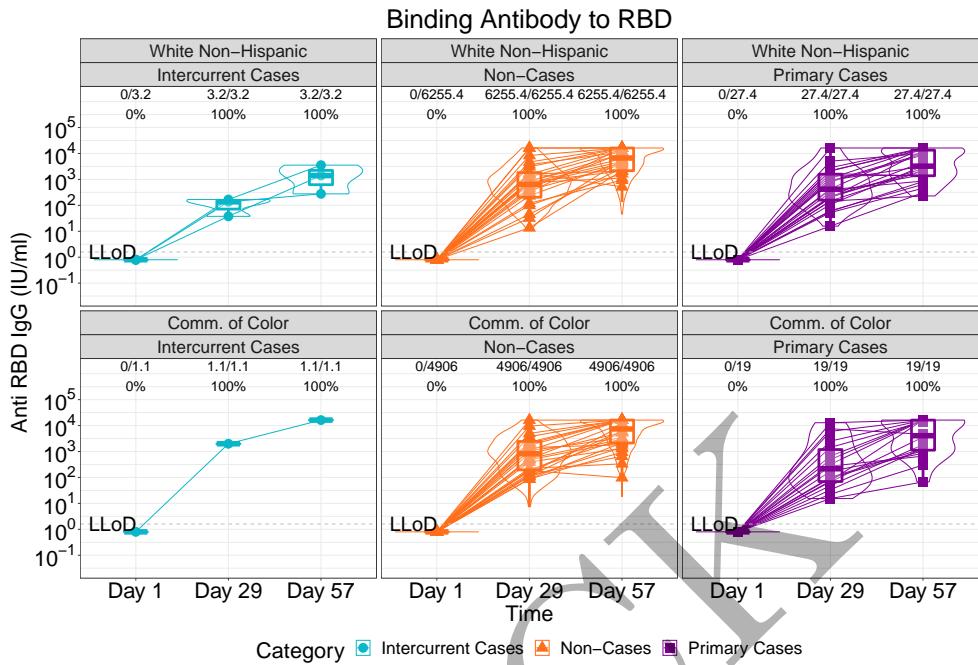


Figure 2.193: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

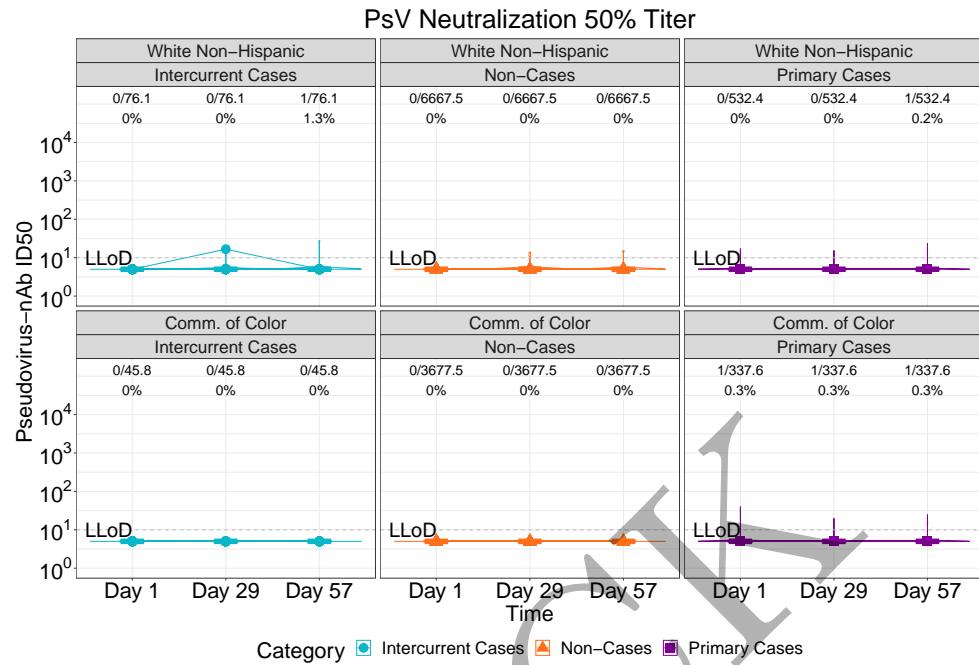


Figure 2.194: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

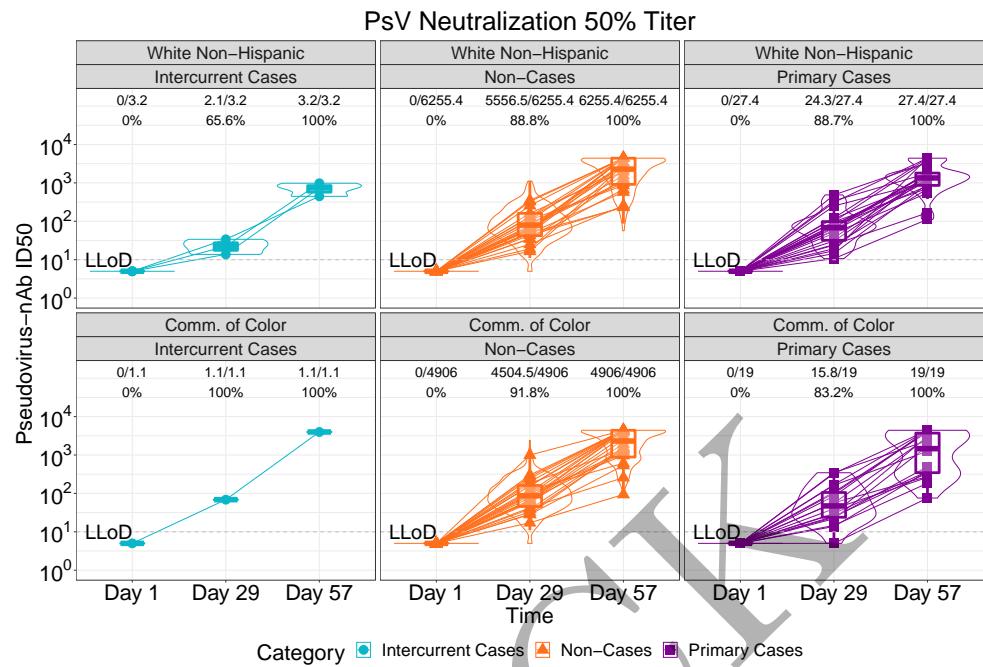


Figure 2.195: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

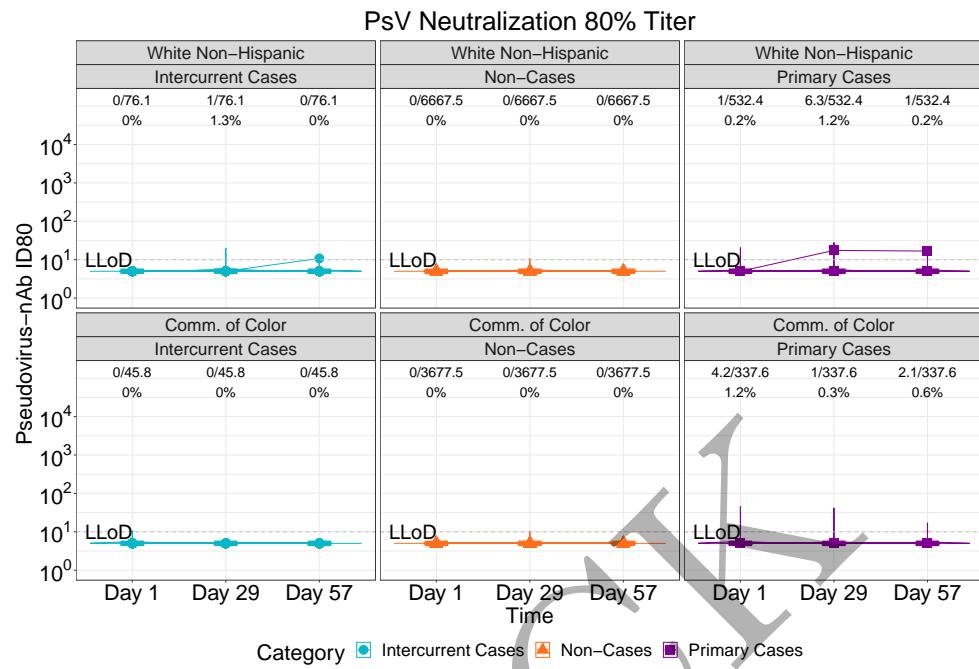


Figure 2.196: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

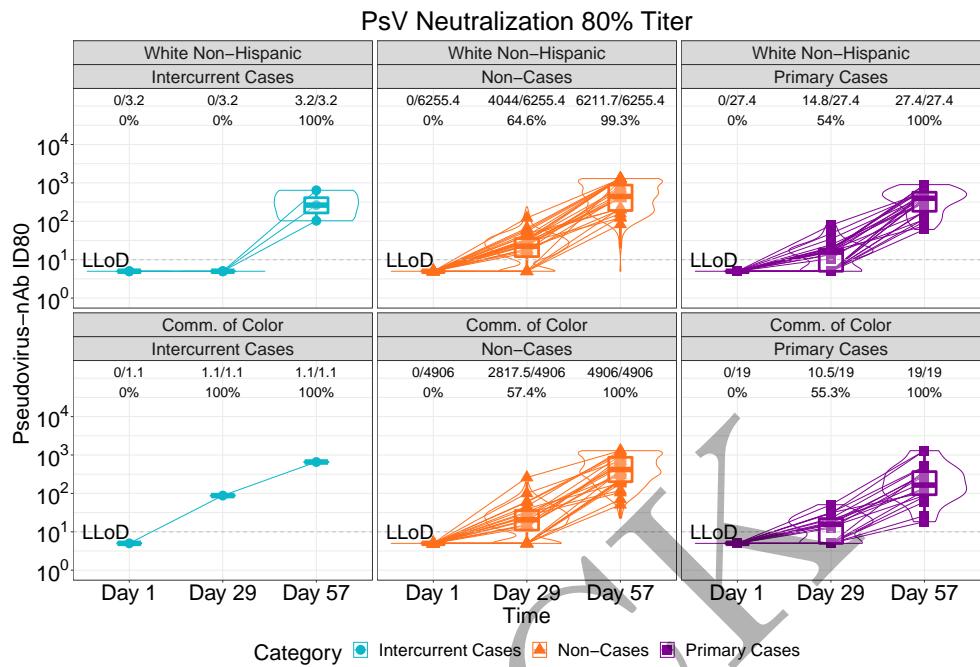


Figure 2.197: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

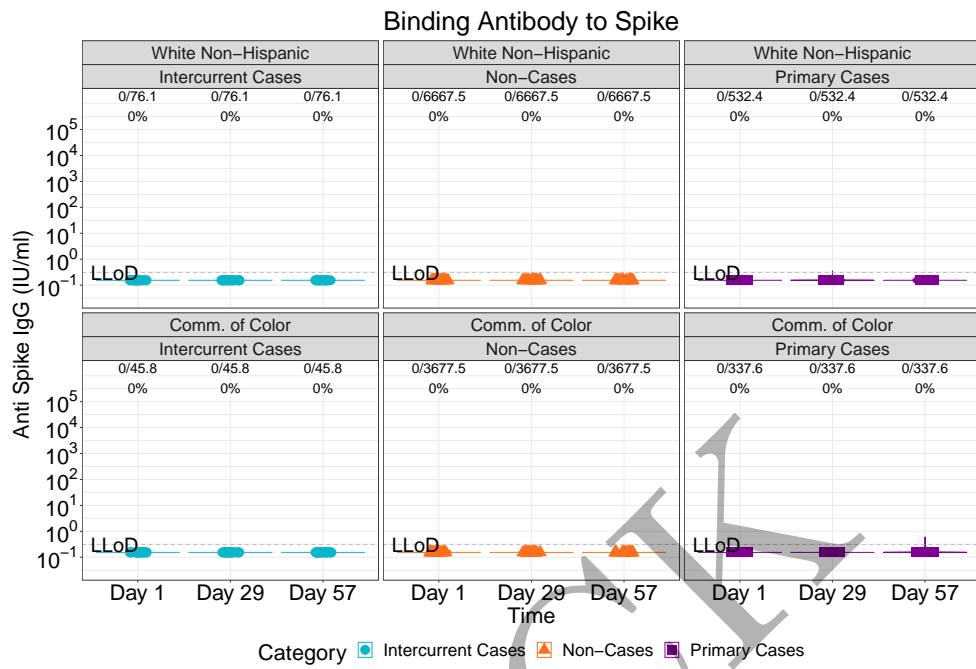


Figure 2.198: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

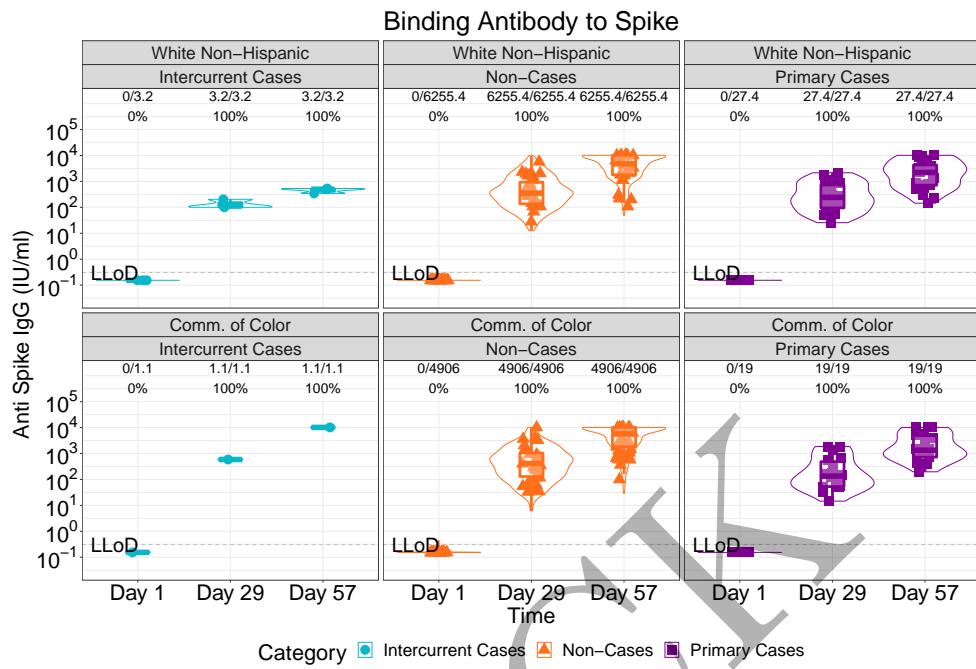


Figure 2.199: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

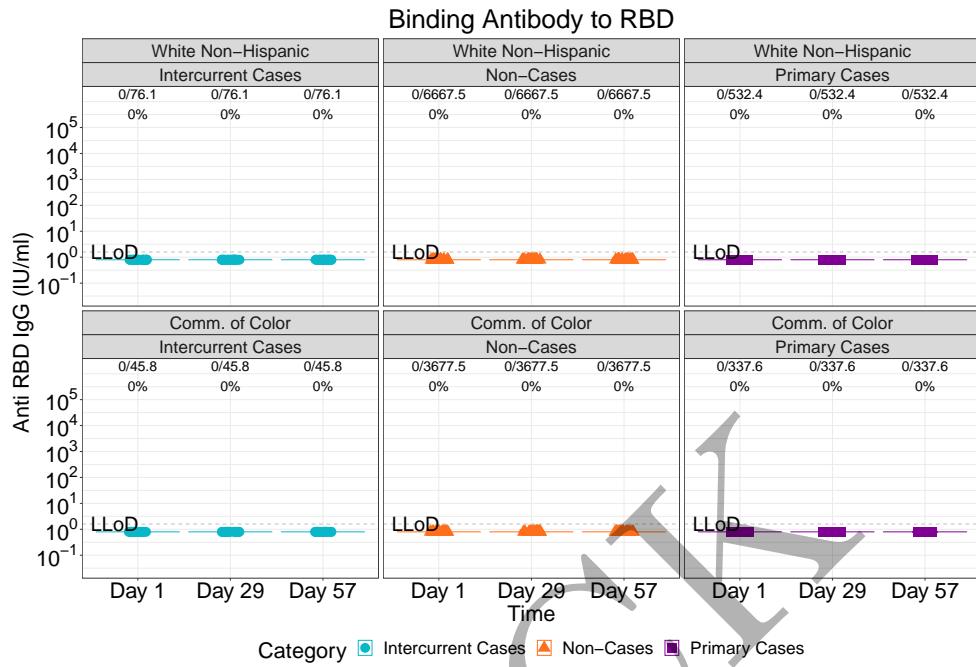


Figure 2.200: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

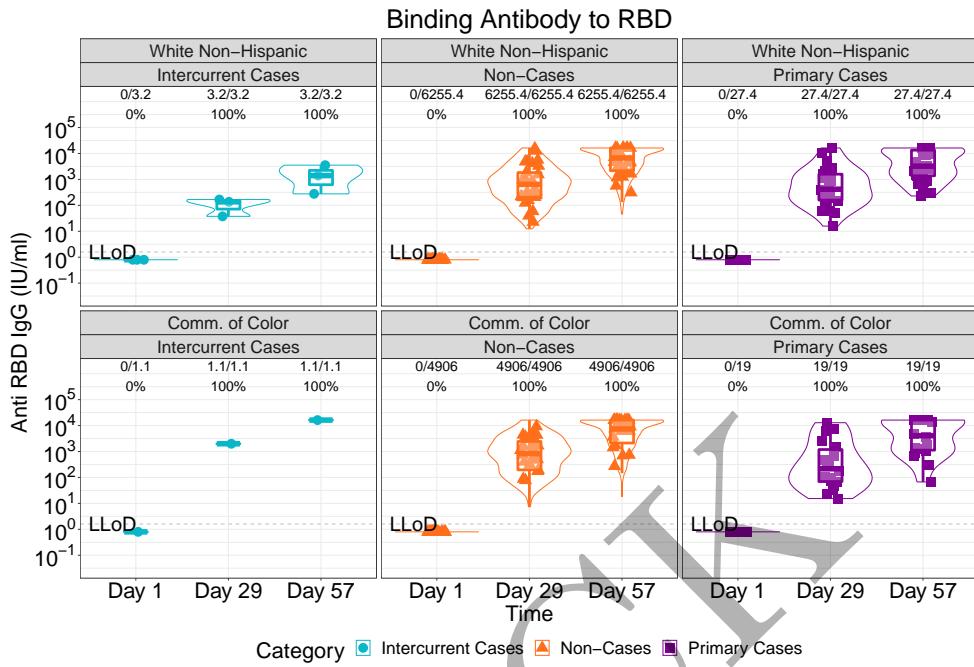


Figure 2.201: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

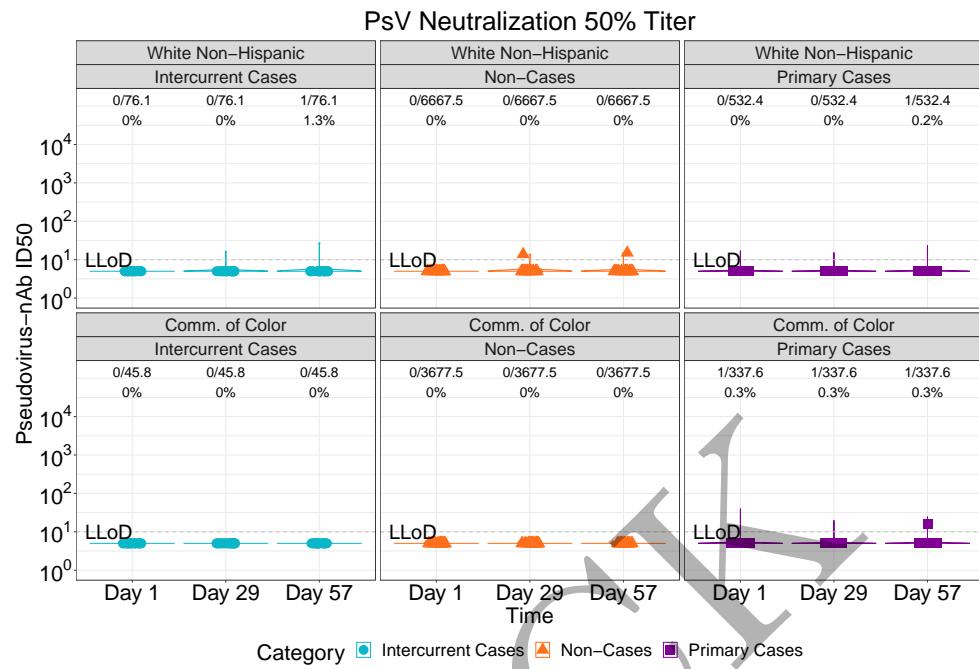


Figure 2.202: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

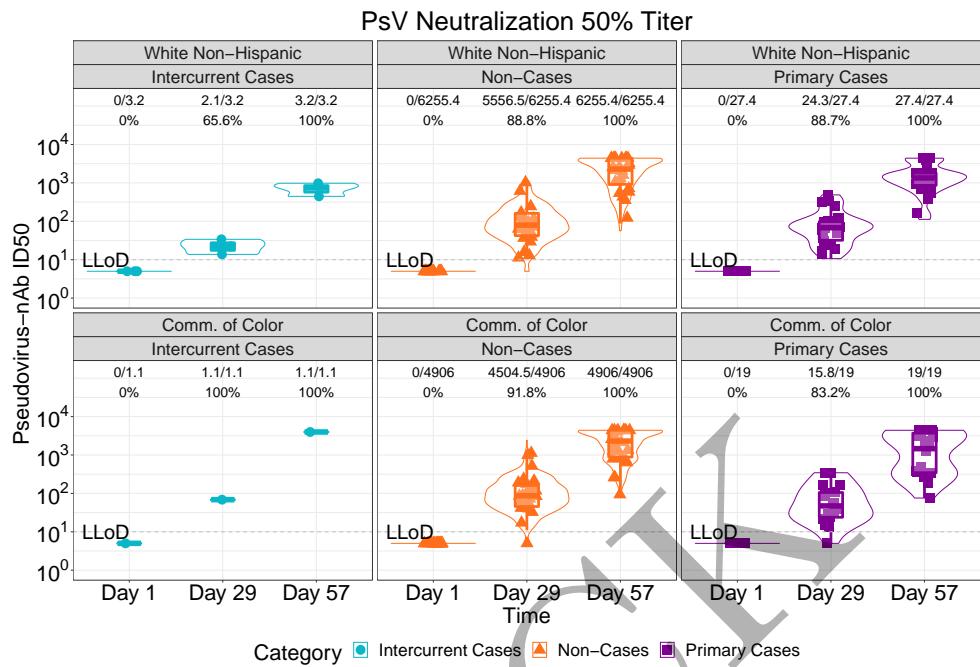


Figure 2.203: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

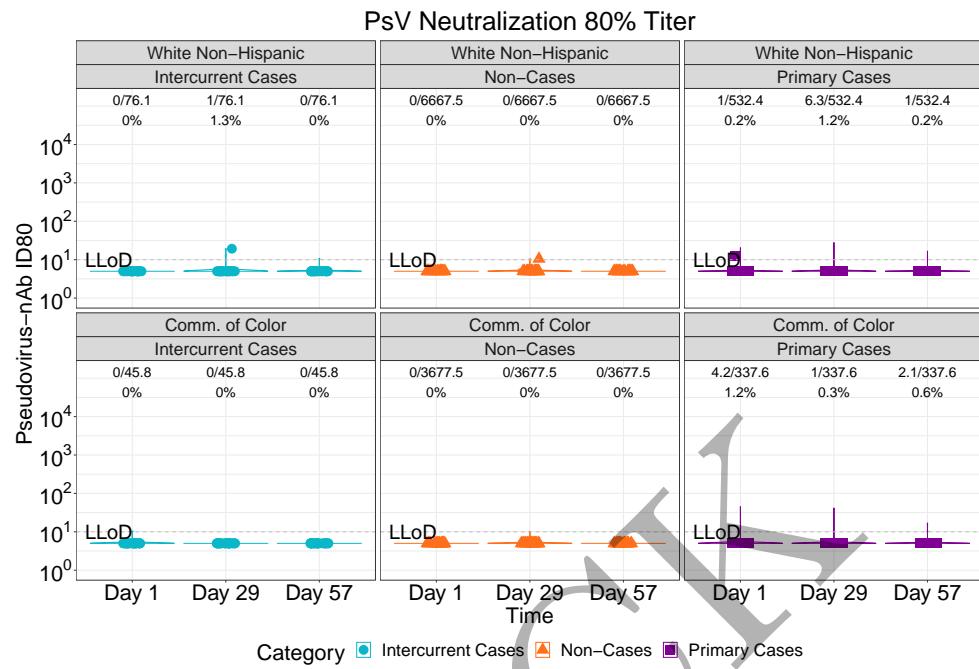


Figure 2.204: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

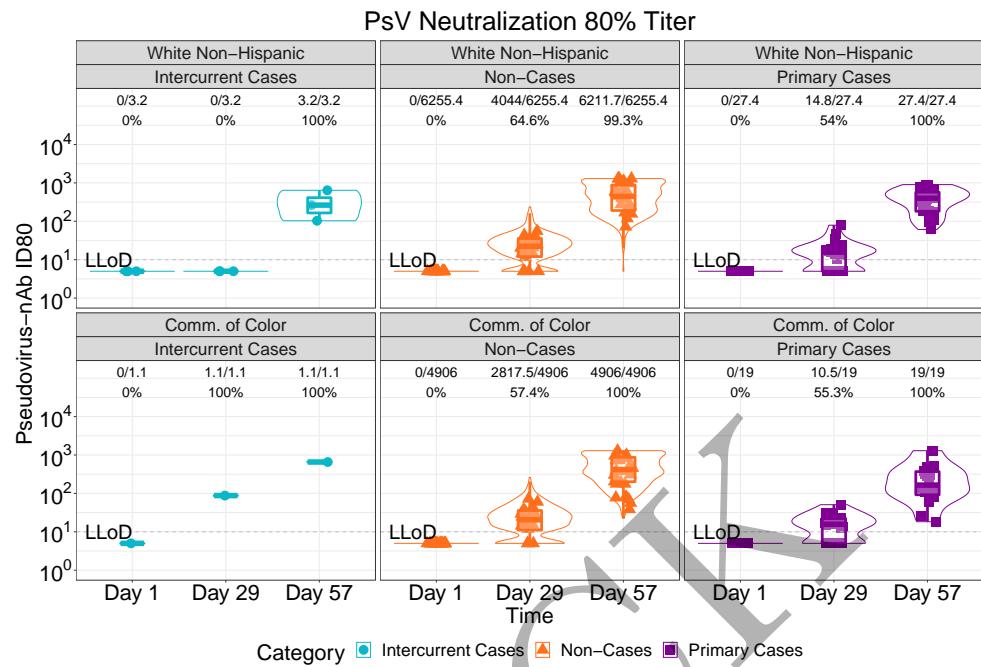


Figure 2.205: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

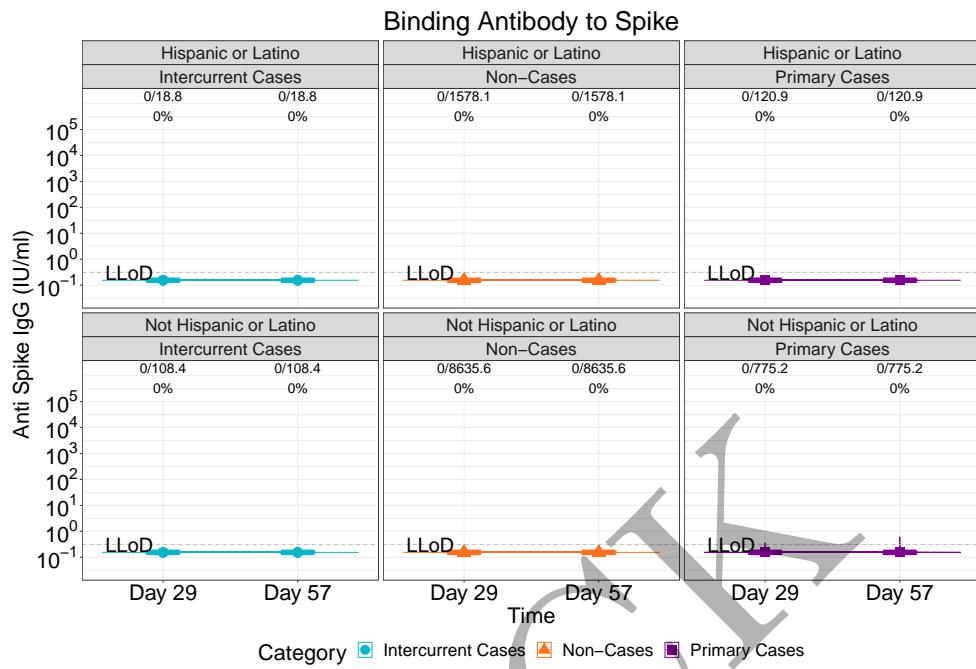


Figure 2.206: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

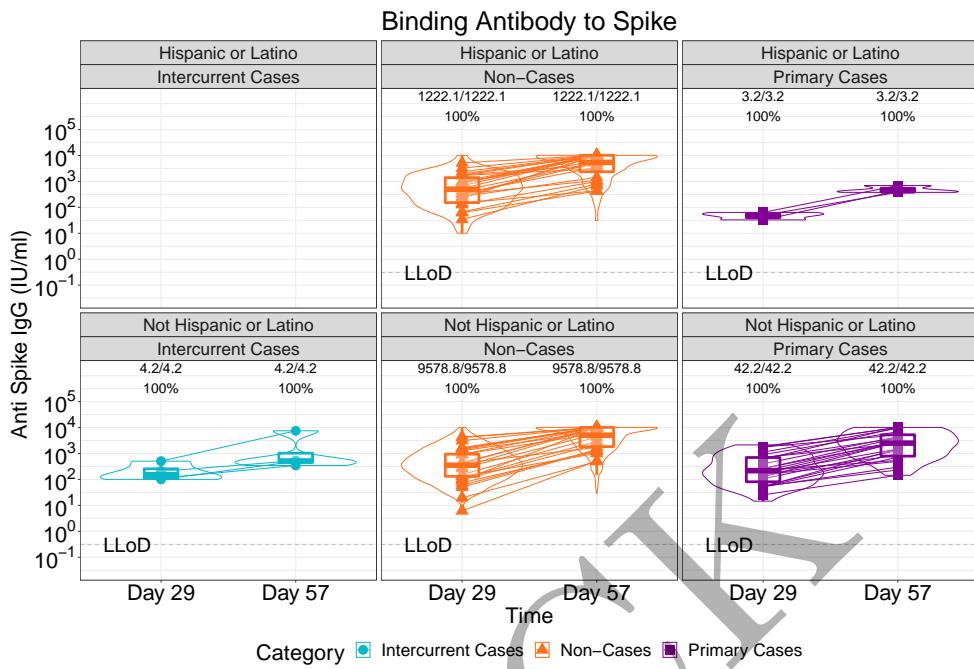


Figure 2.207: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

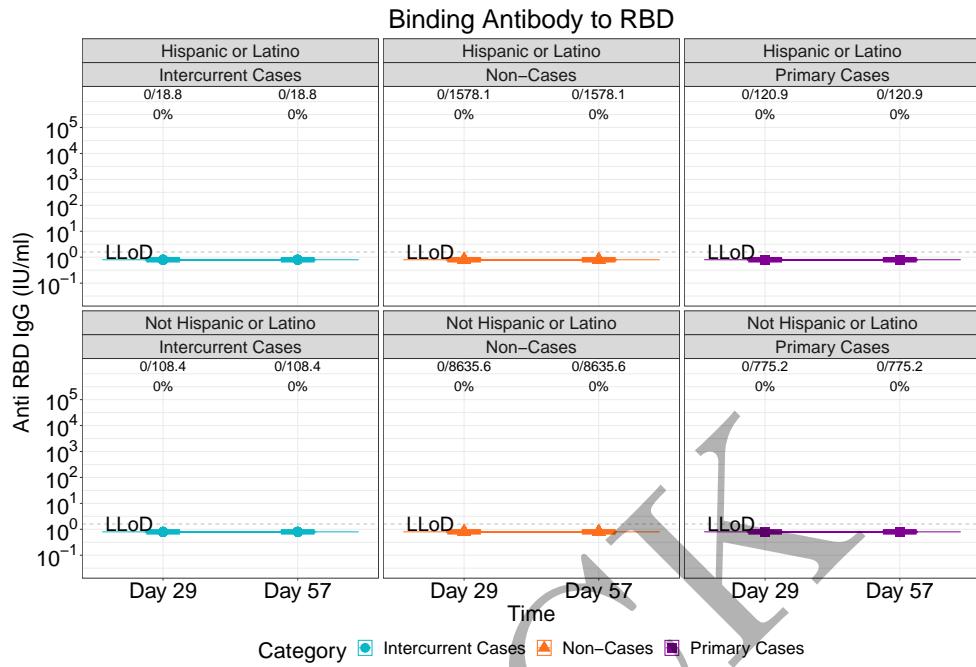


Figure 2.208: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

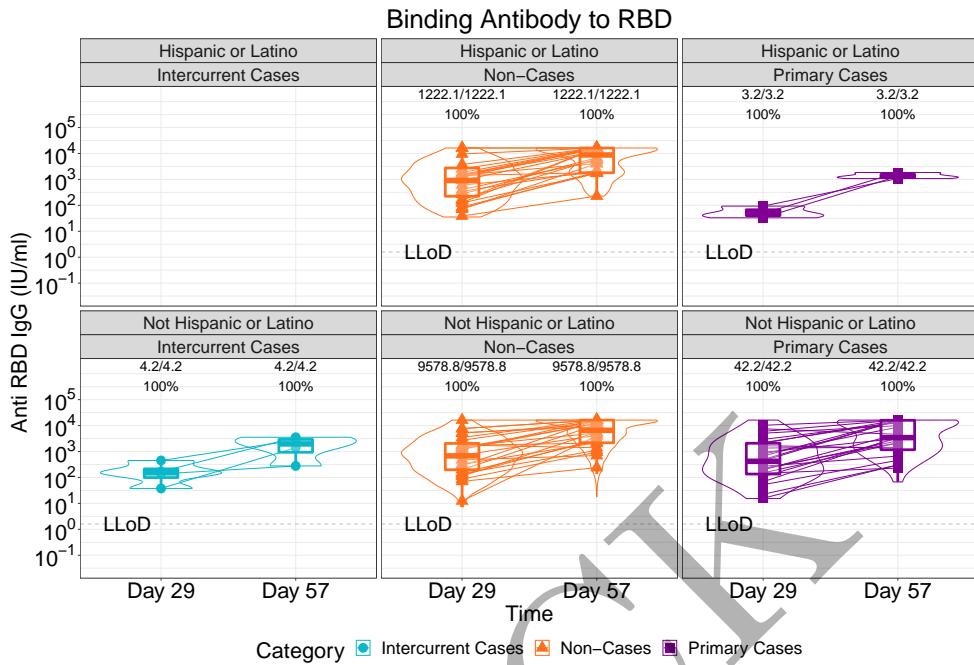


Figure 2.209: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

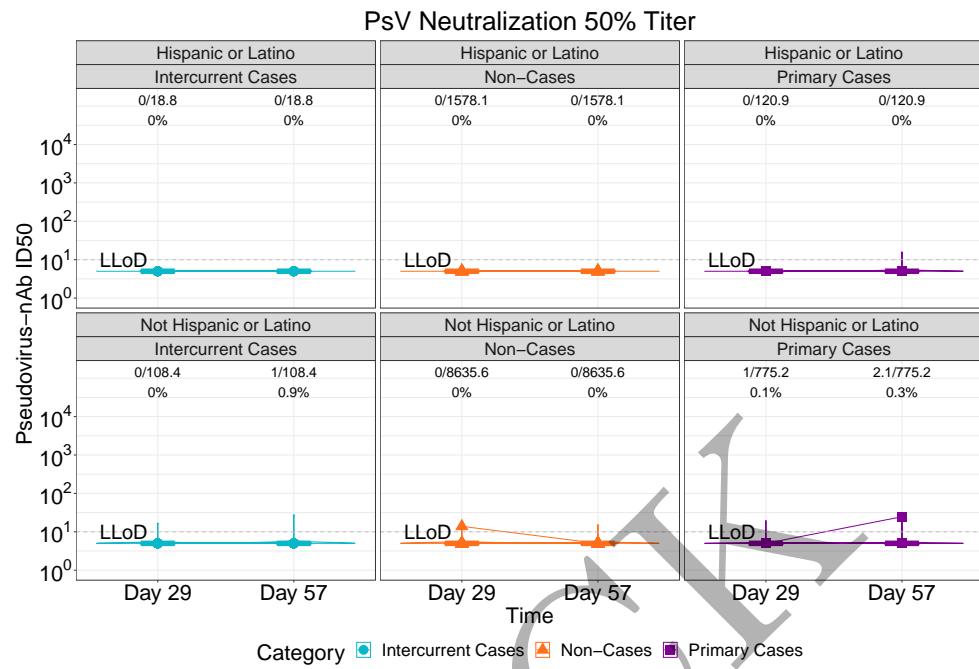


Figure 2.210: lineplots of Pseudovirus Neutralization ID<sub>50</sub>: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

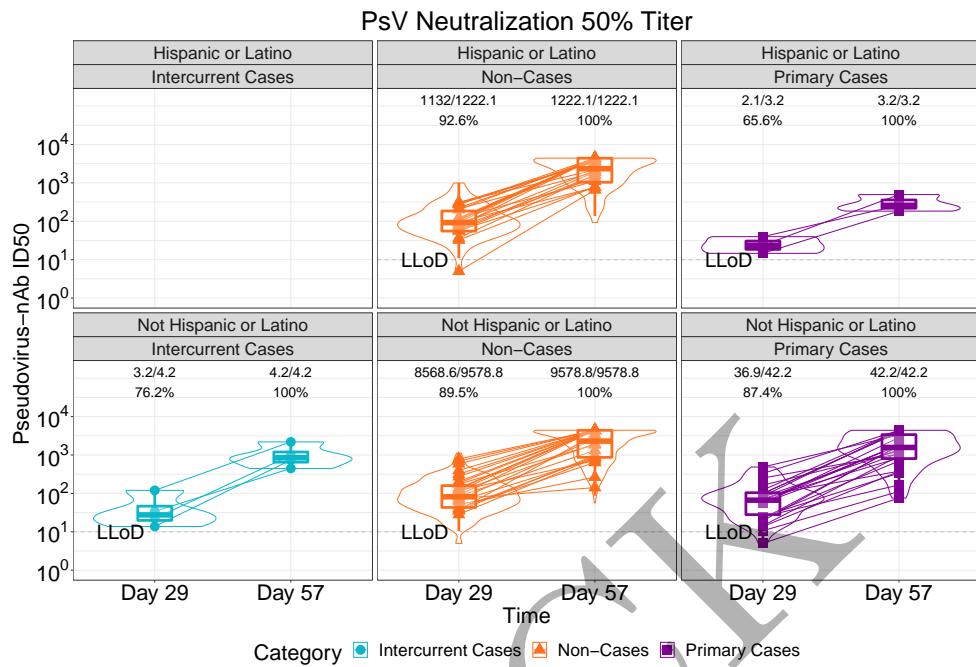


Figure 2.211: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

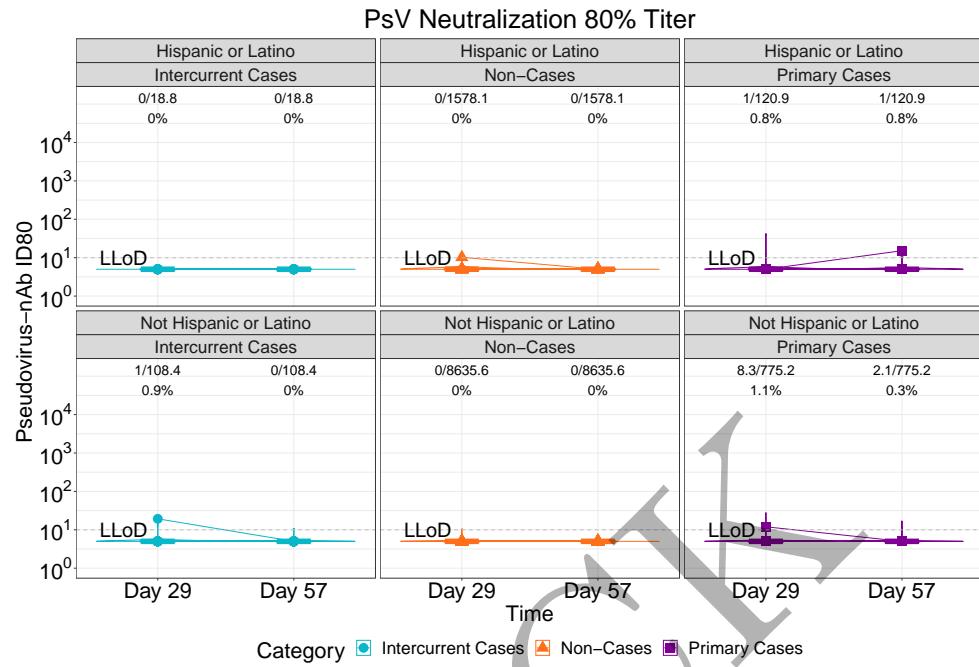


Figure 2.212: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

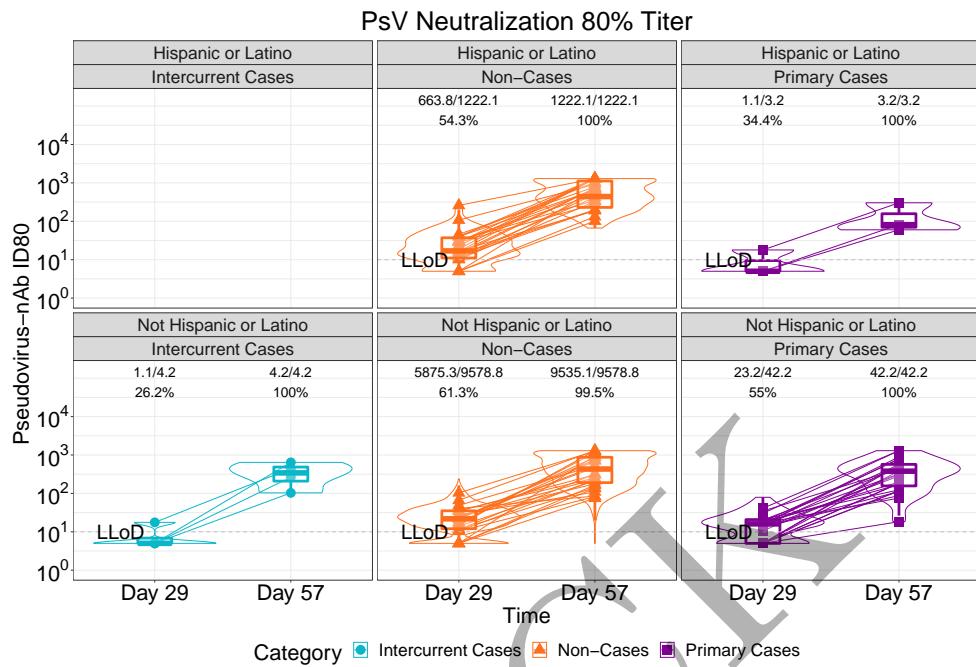


Figure 2.213: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

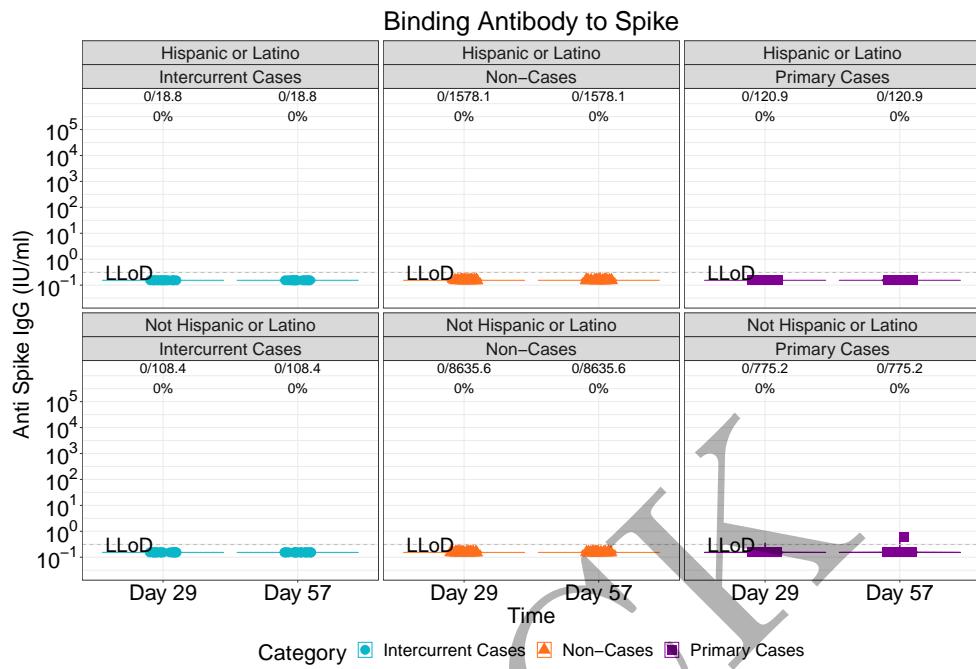


Figure 2.214: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

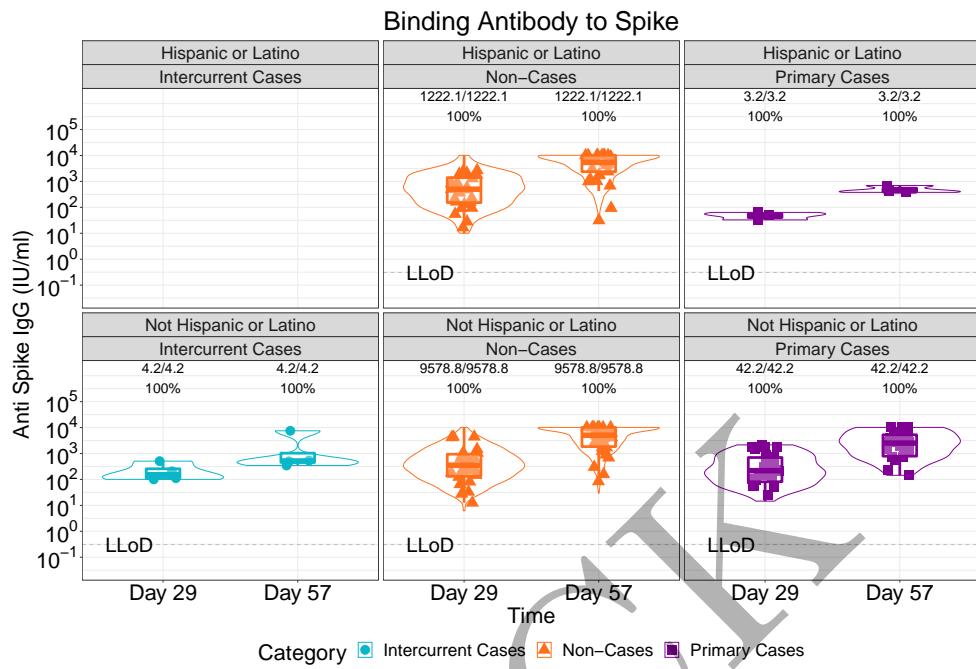


Figure 2.215: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

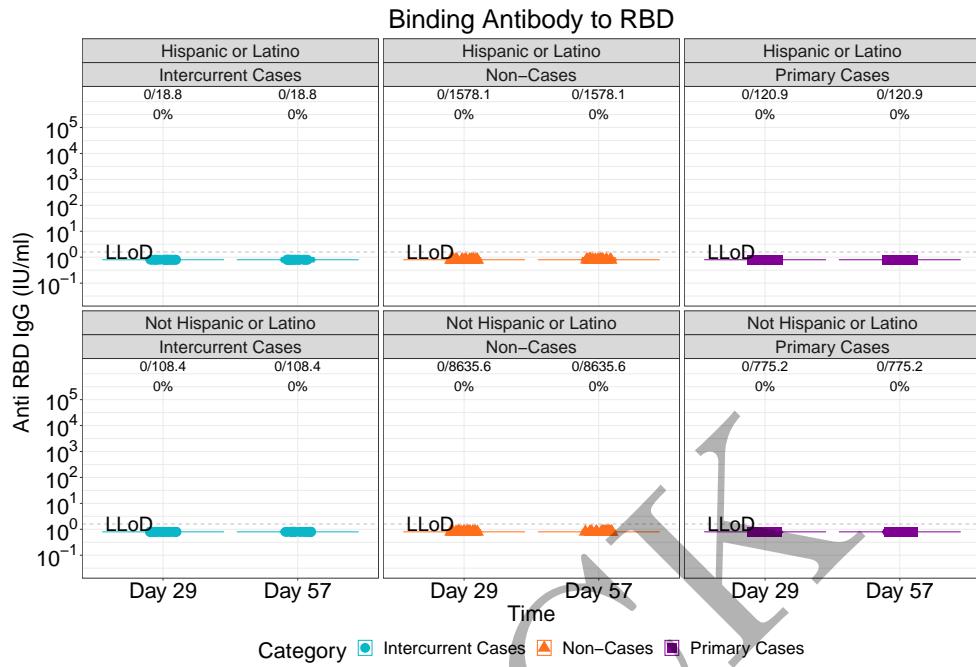


Figure 2.216: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

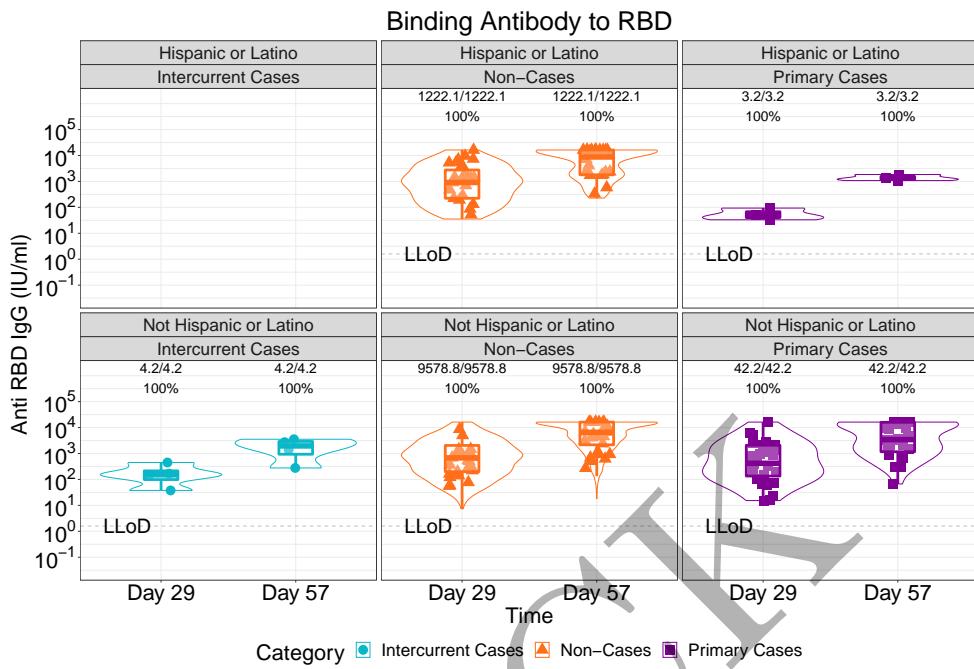


Figure 2.217: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

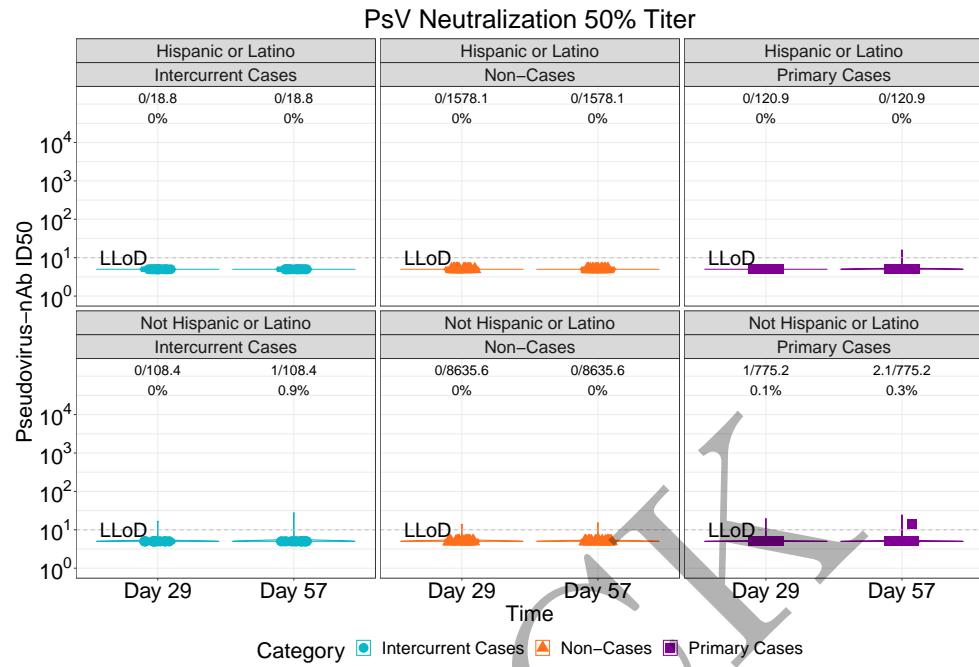


Figure 2.218: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

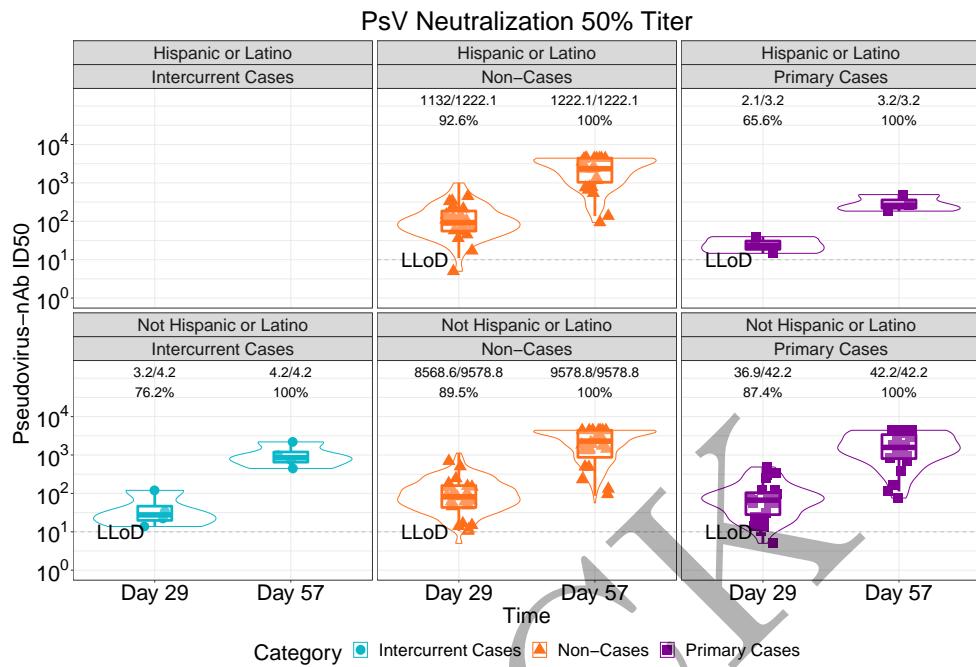


Figure 2.219: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

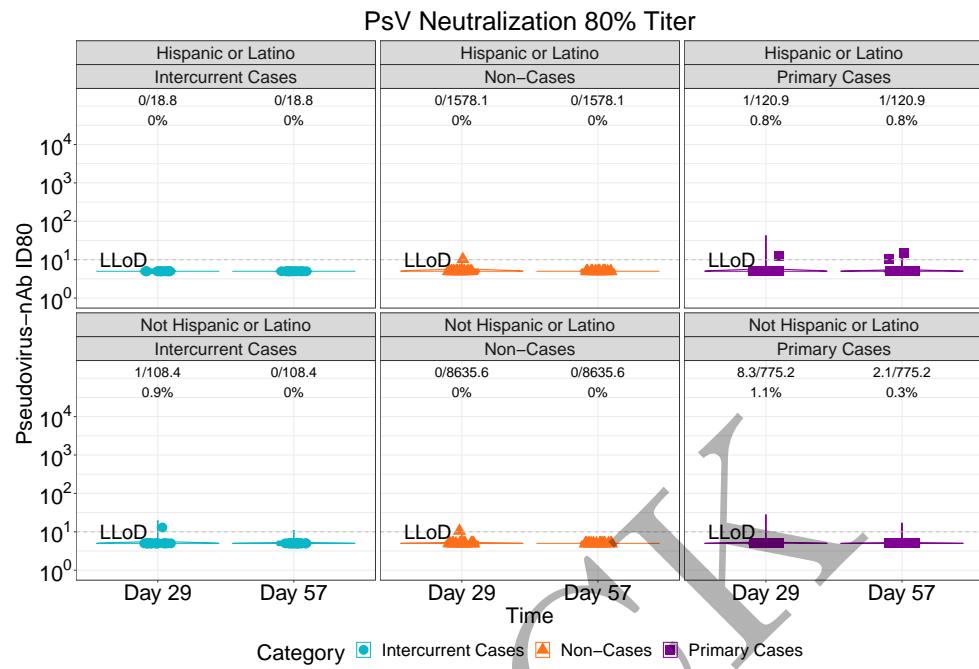


Figure 2.220: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

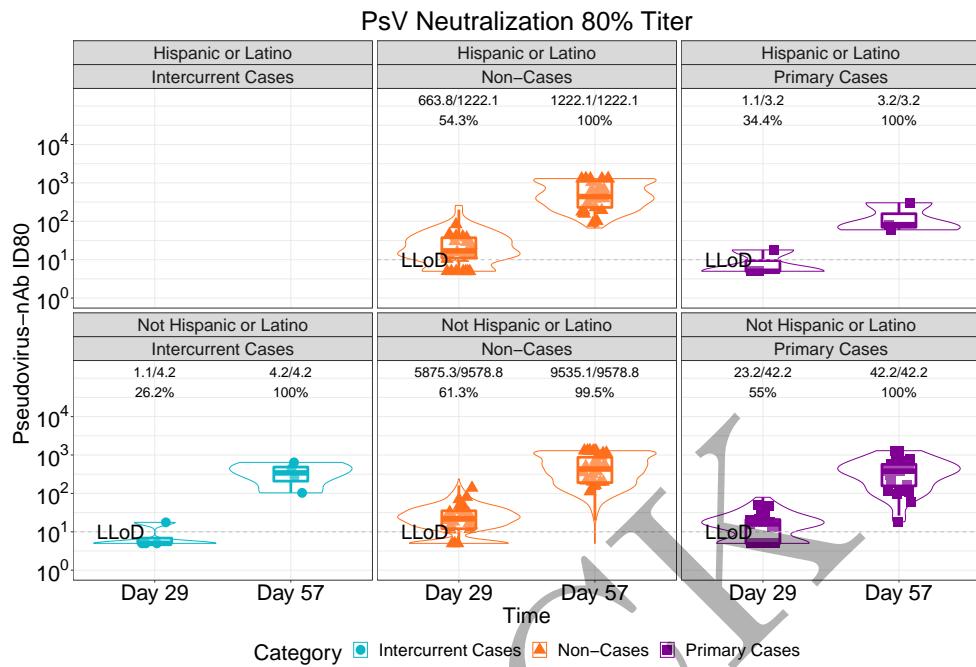


Figure 2.221: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

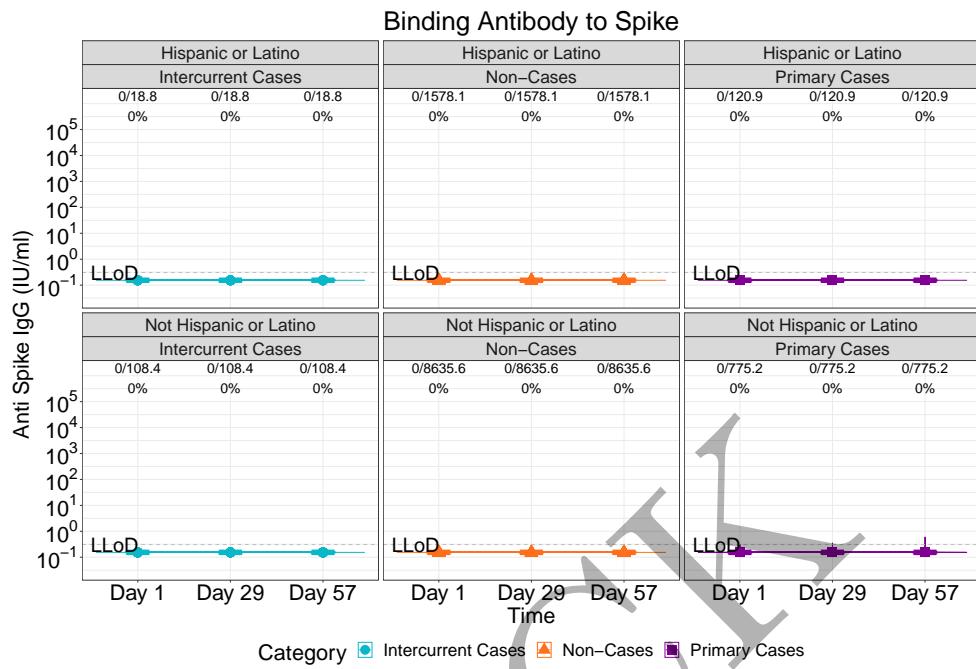


Figure 2.222: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

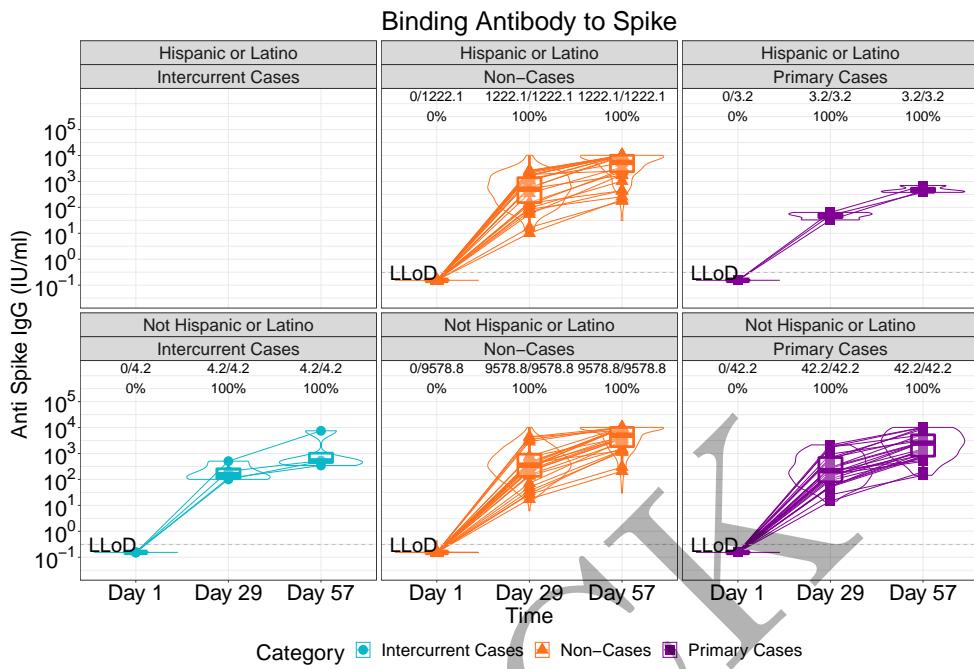


Figure 2.223: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

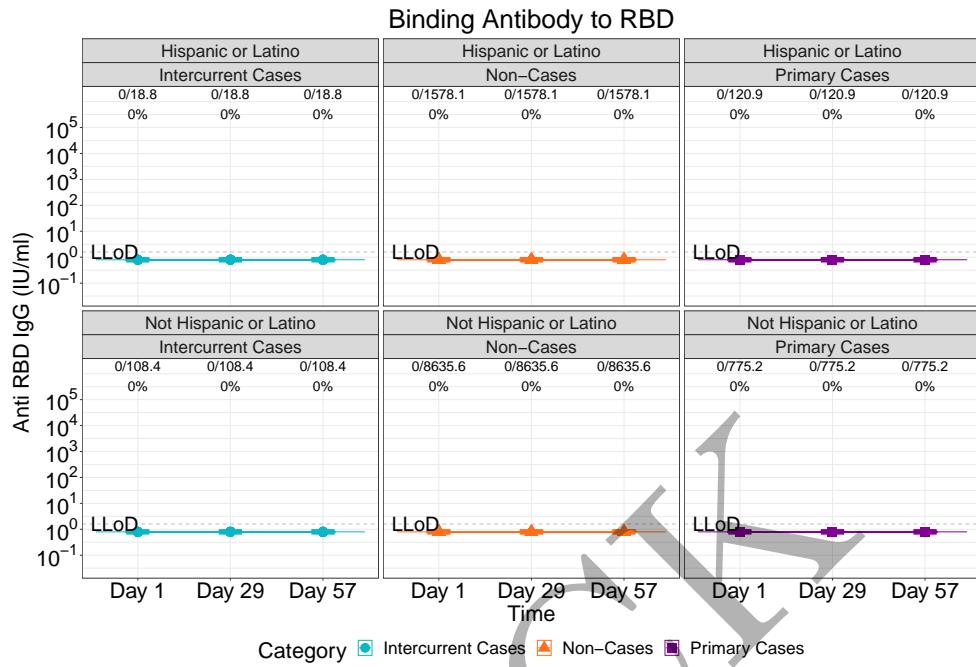


Figure 2.224: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

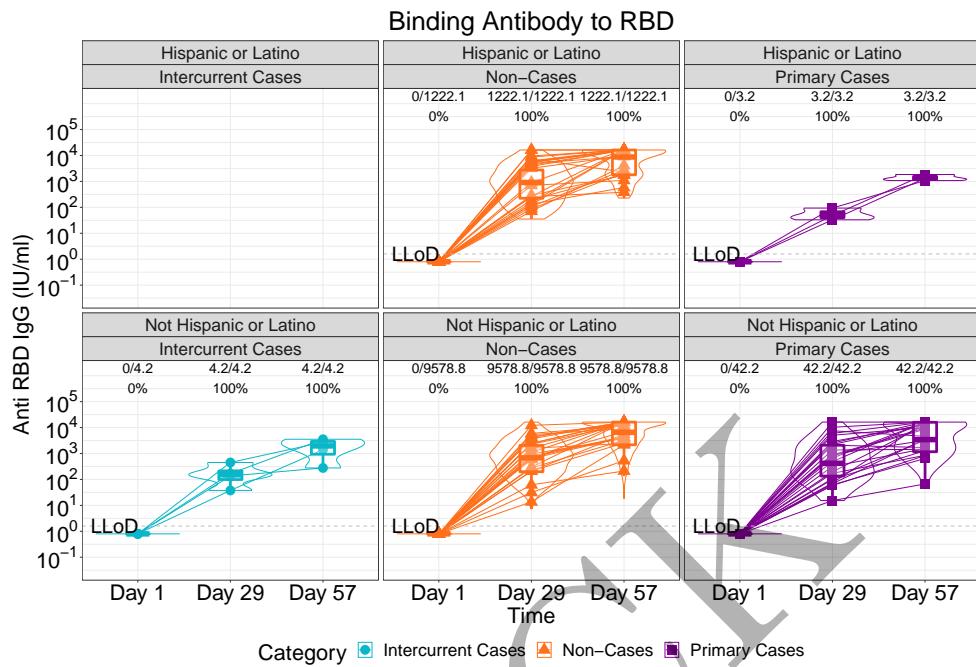


Figure 2.225: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

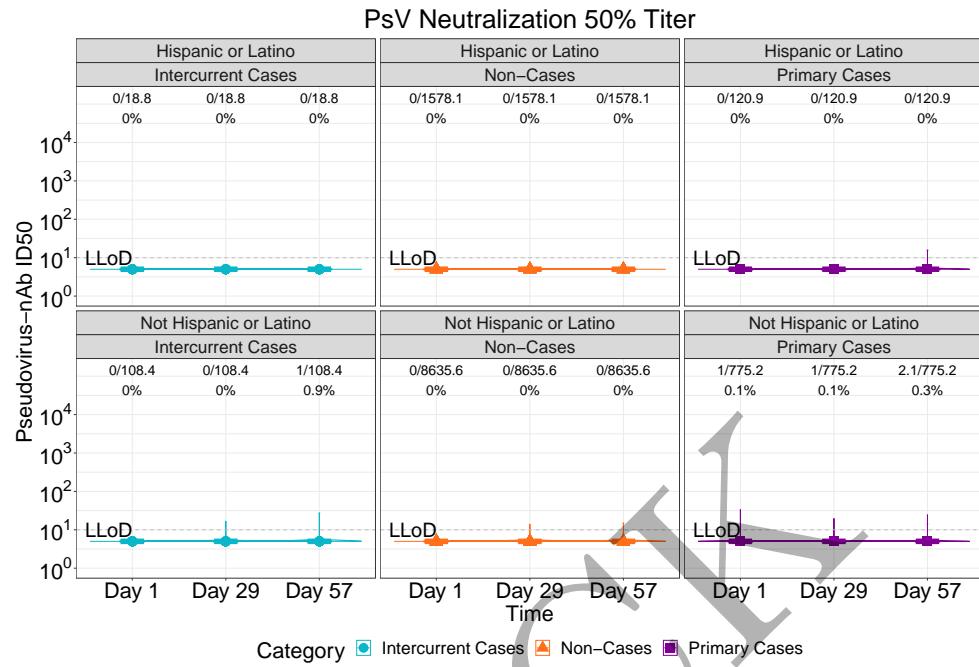


Figure 2.226: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

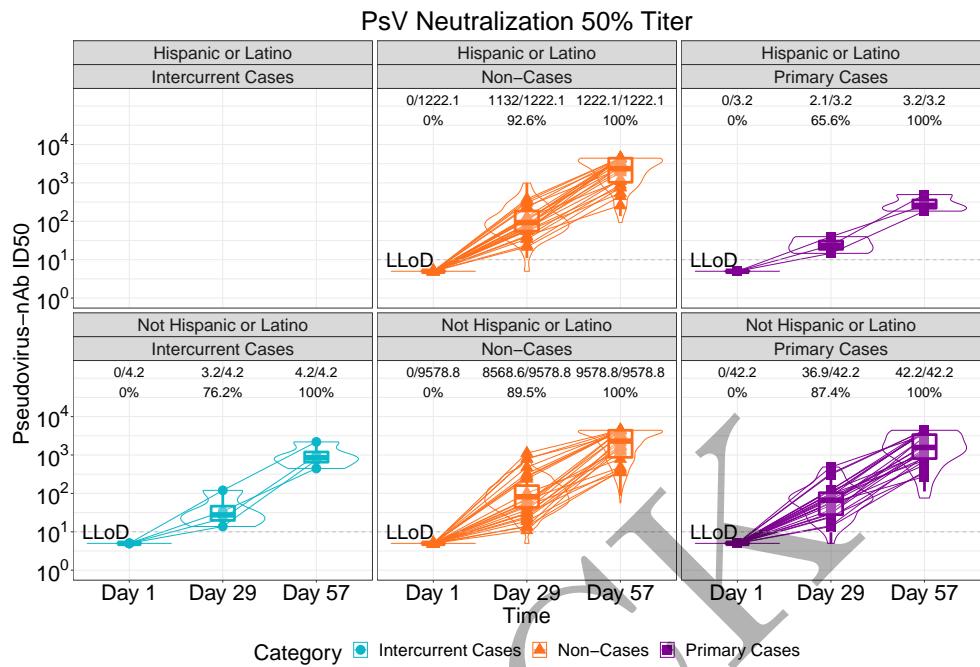


Figure 2.227: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

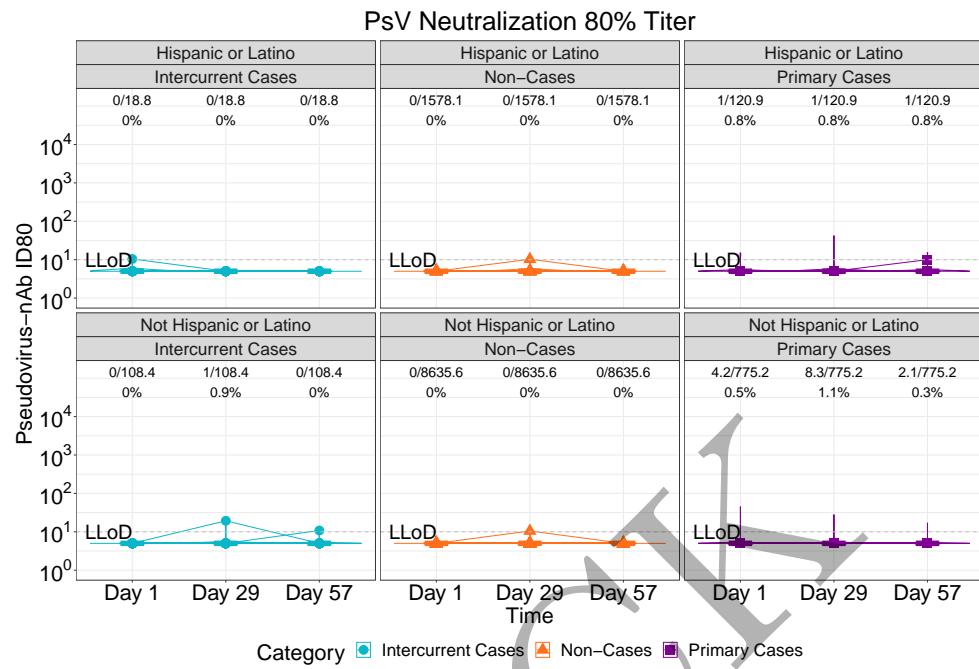


Figure 2.228: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

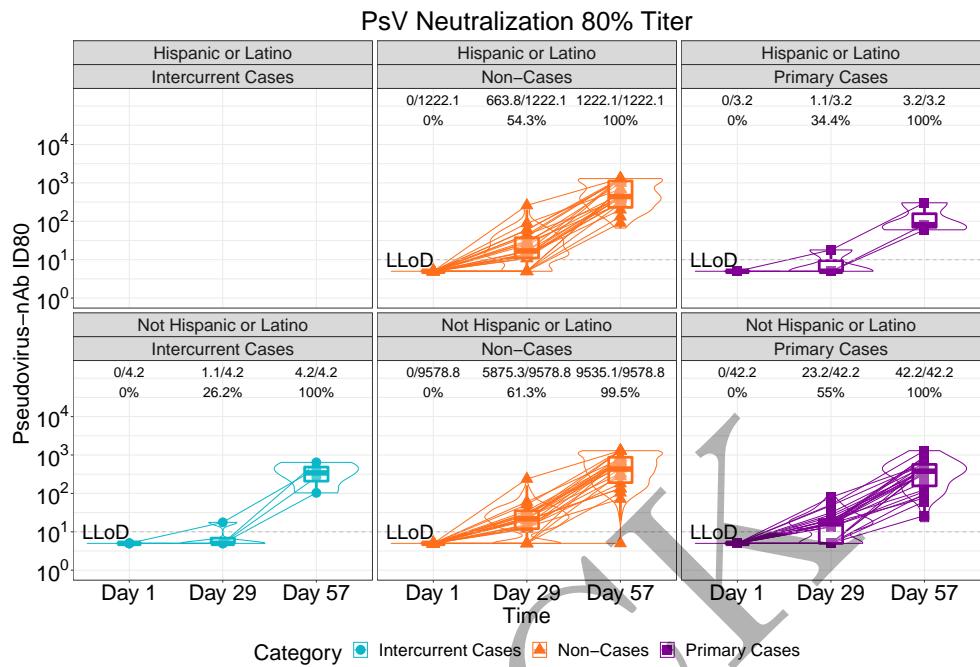


Figure 2.229: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

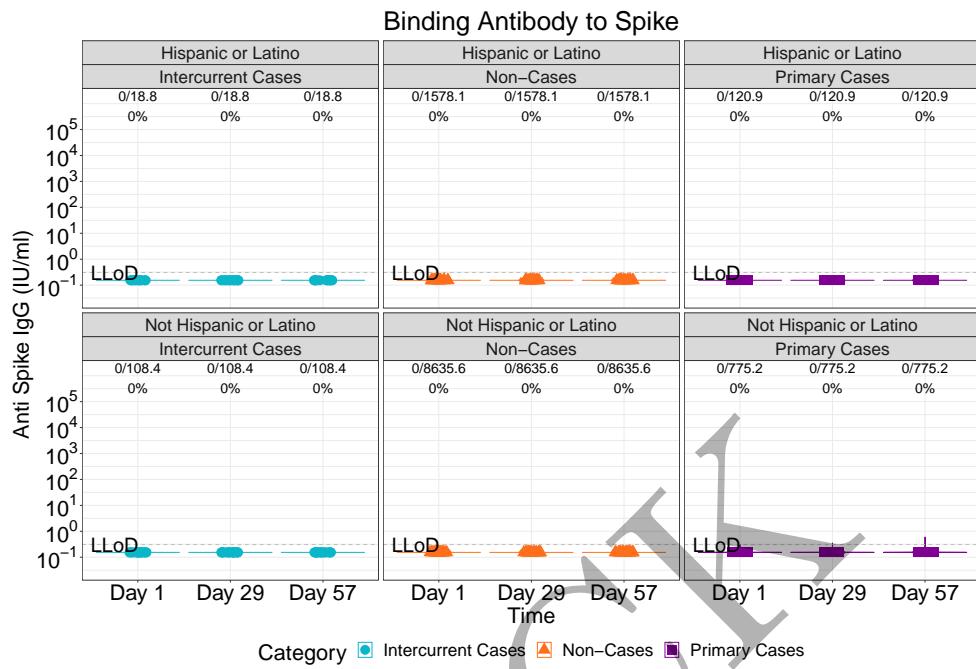


Figure 2.230: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

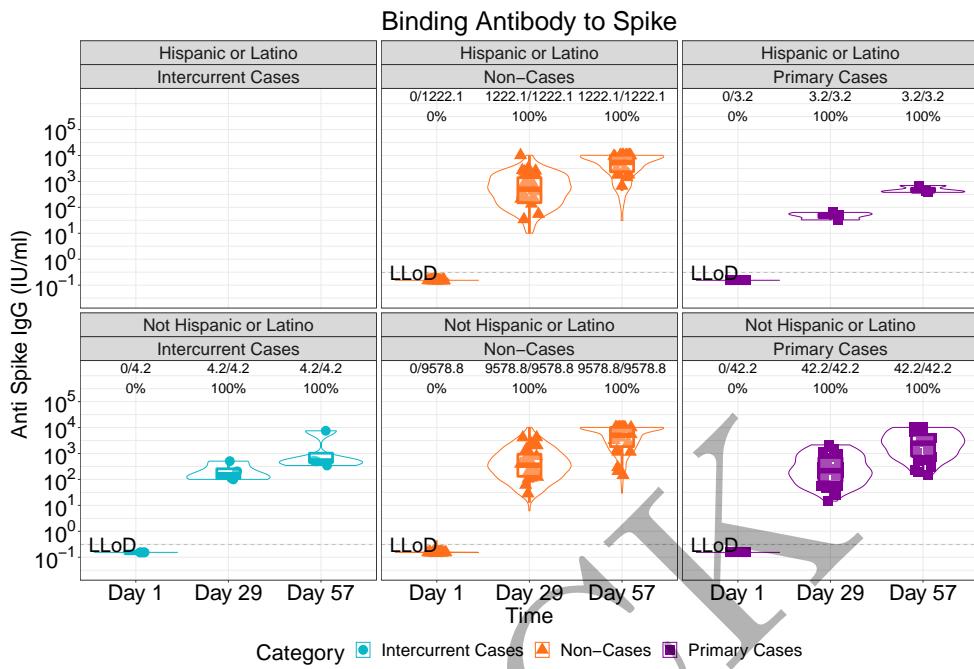


Figure 2.231: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

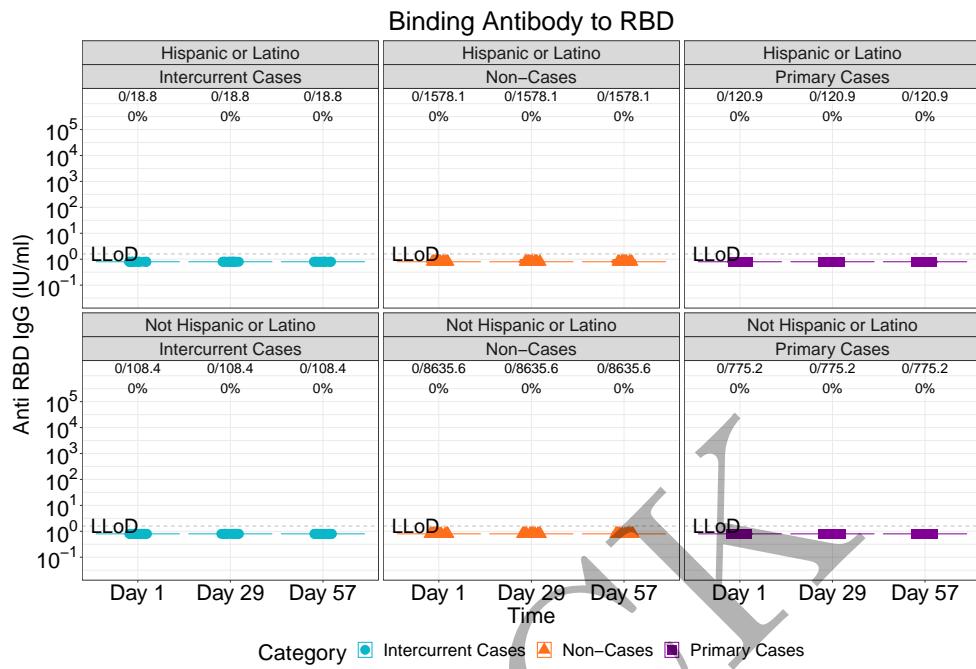


Figure 2.232: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

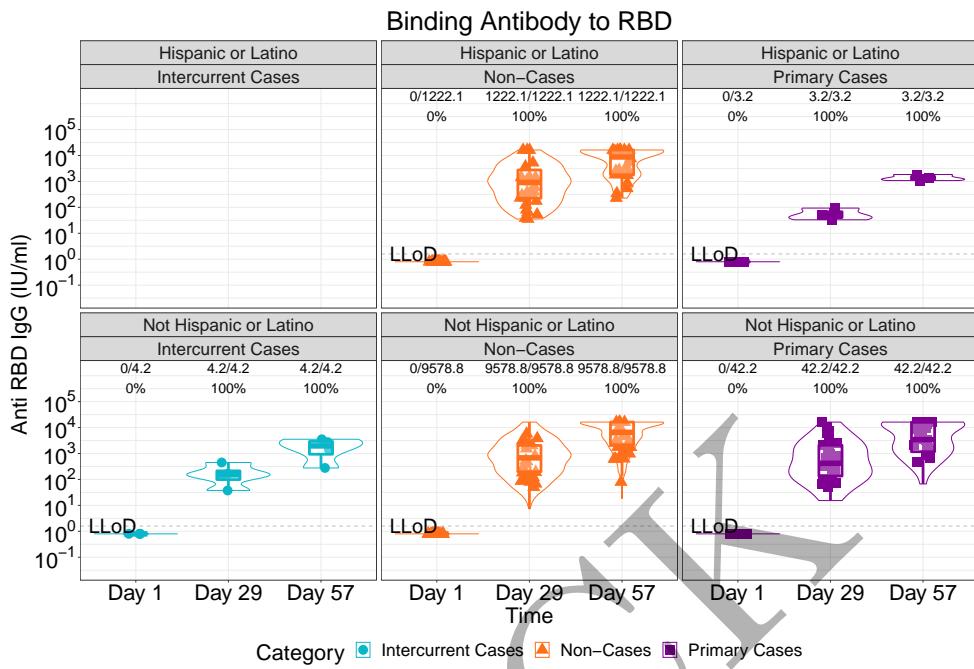


Figure 2.233: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

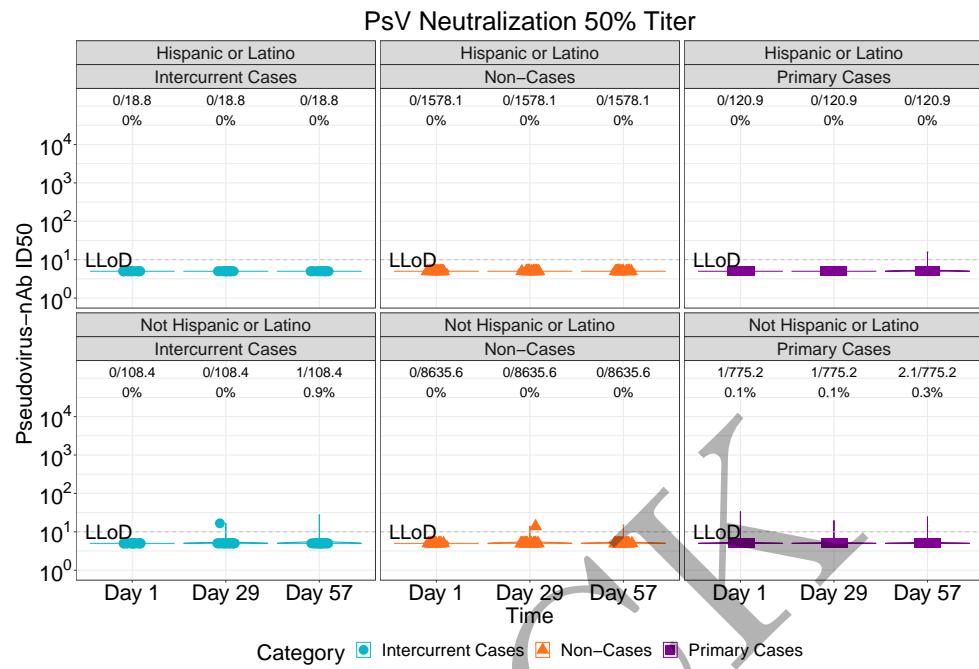


Figure 2.234: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

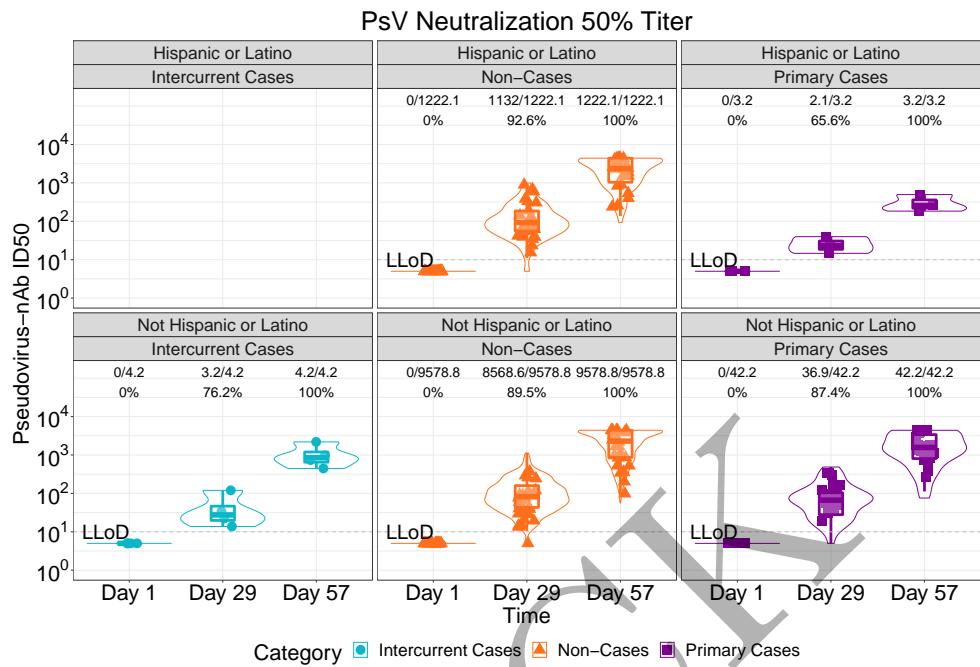


Figure 2.235: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

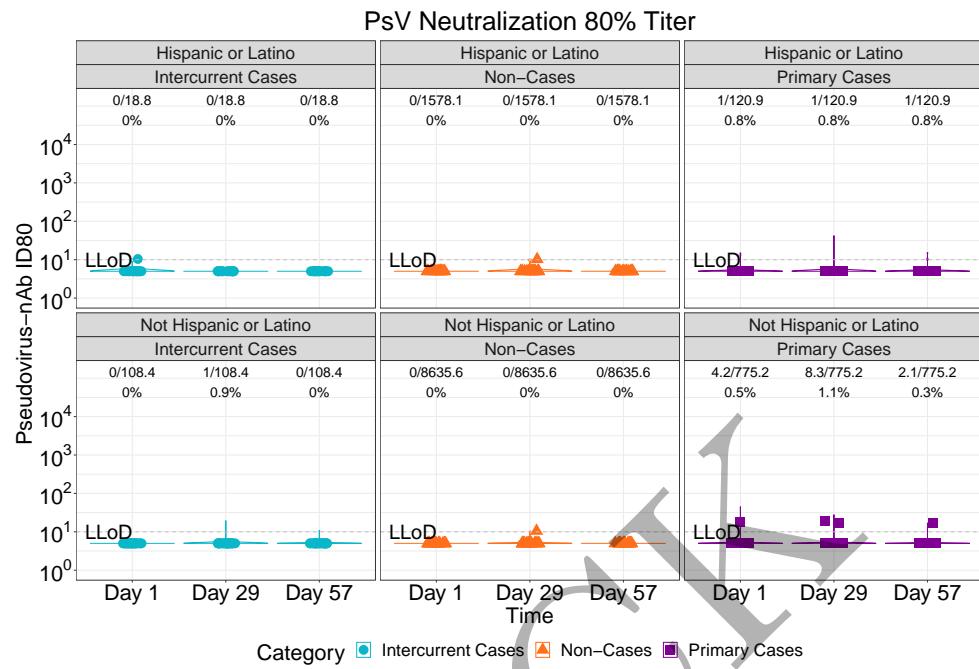


Figure 2.236: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

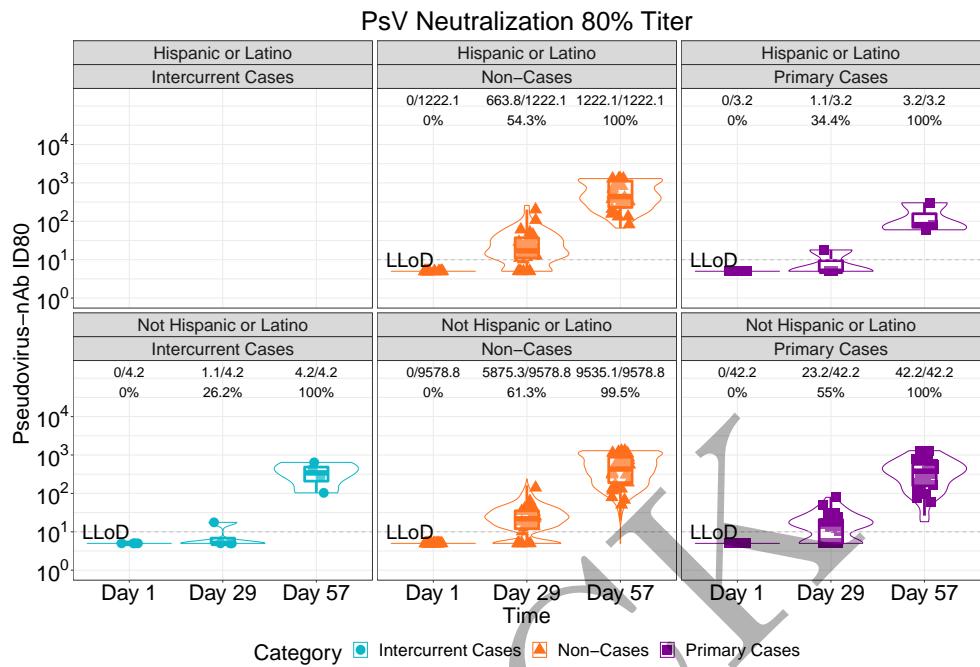


Figure 2.237: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

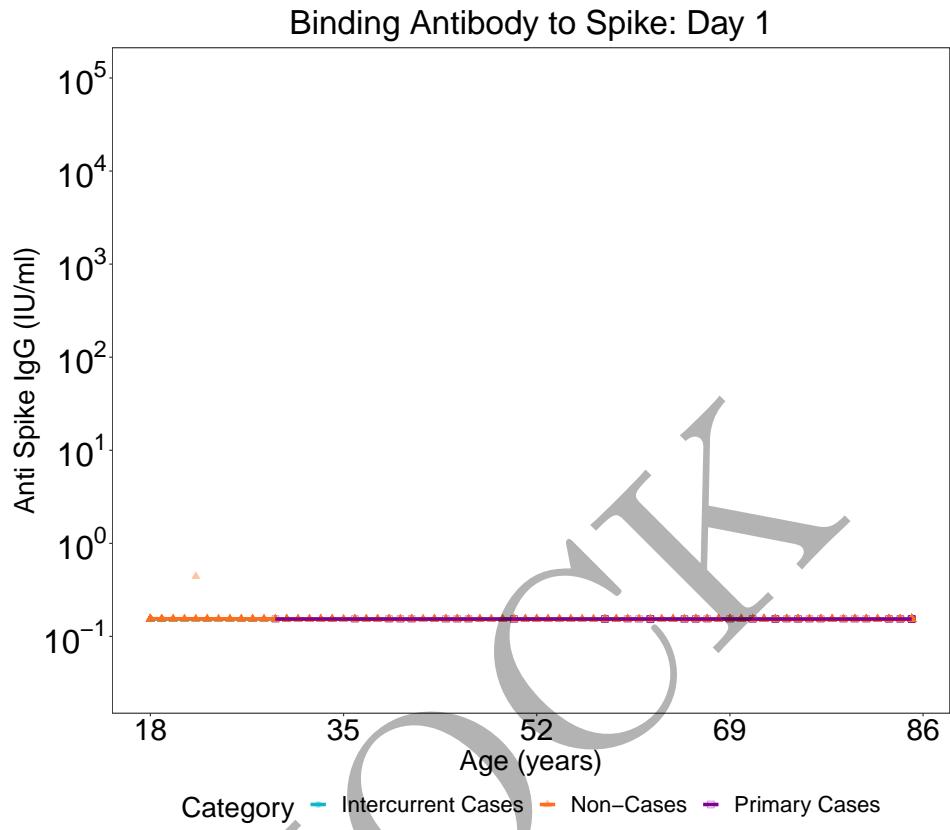


Figure 2.238: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1

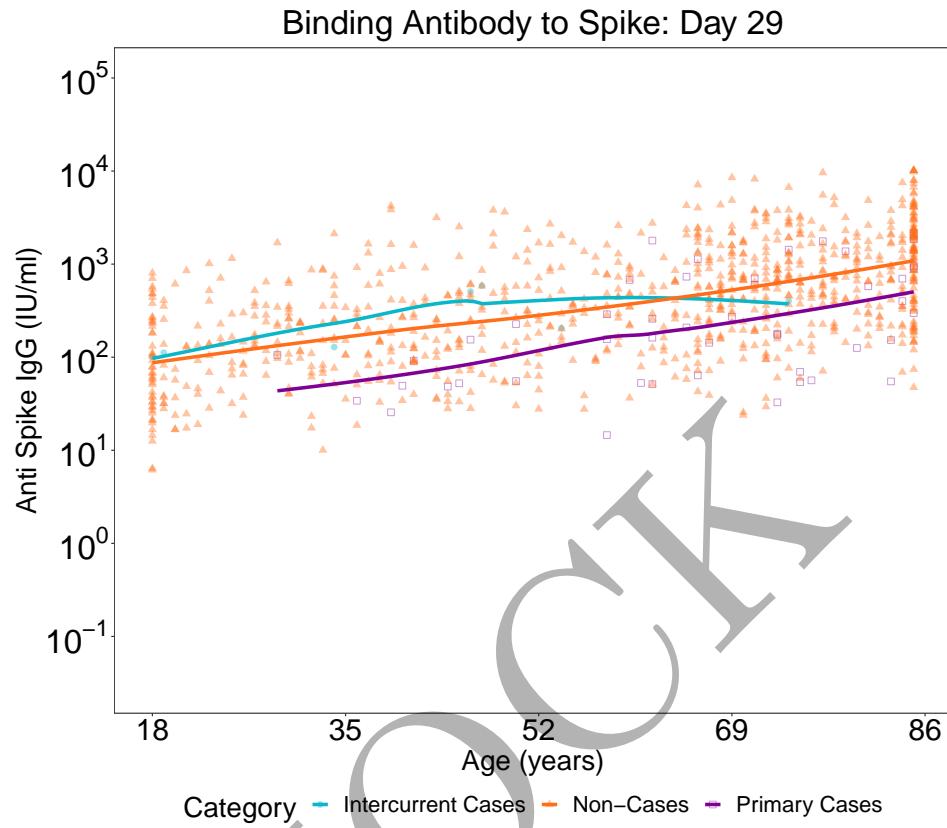


Figure 2.239: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29

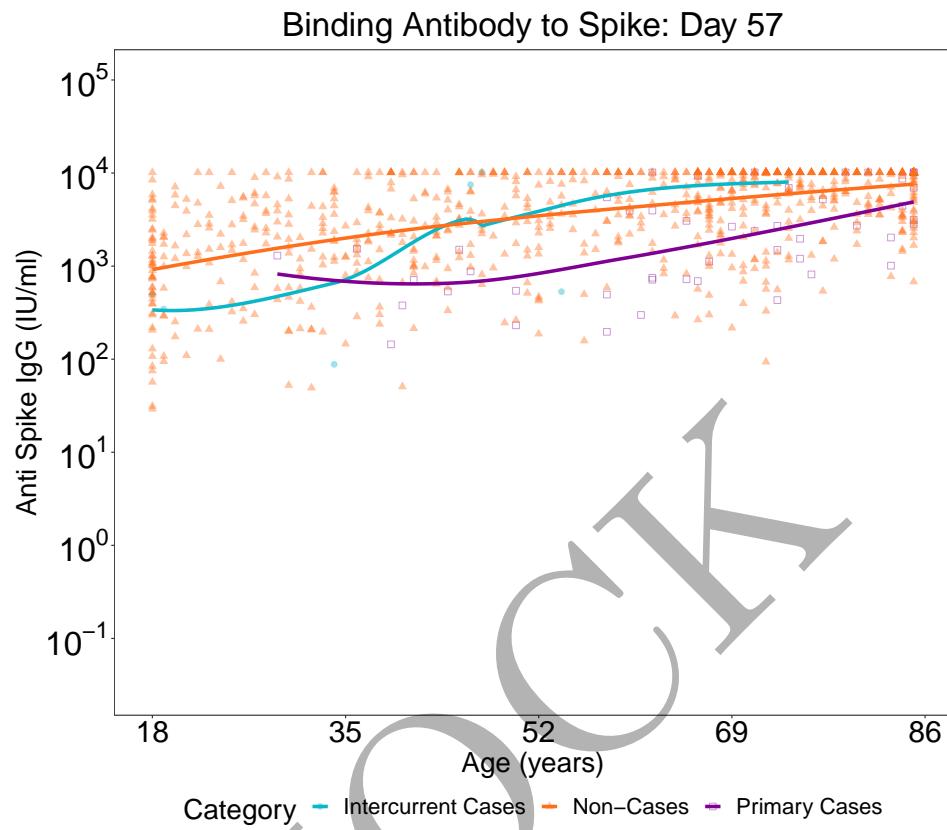


Figure 2.240: scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57

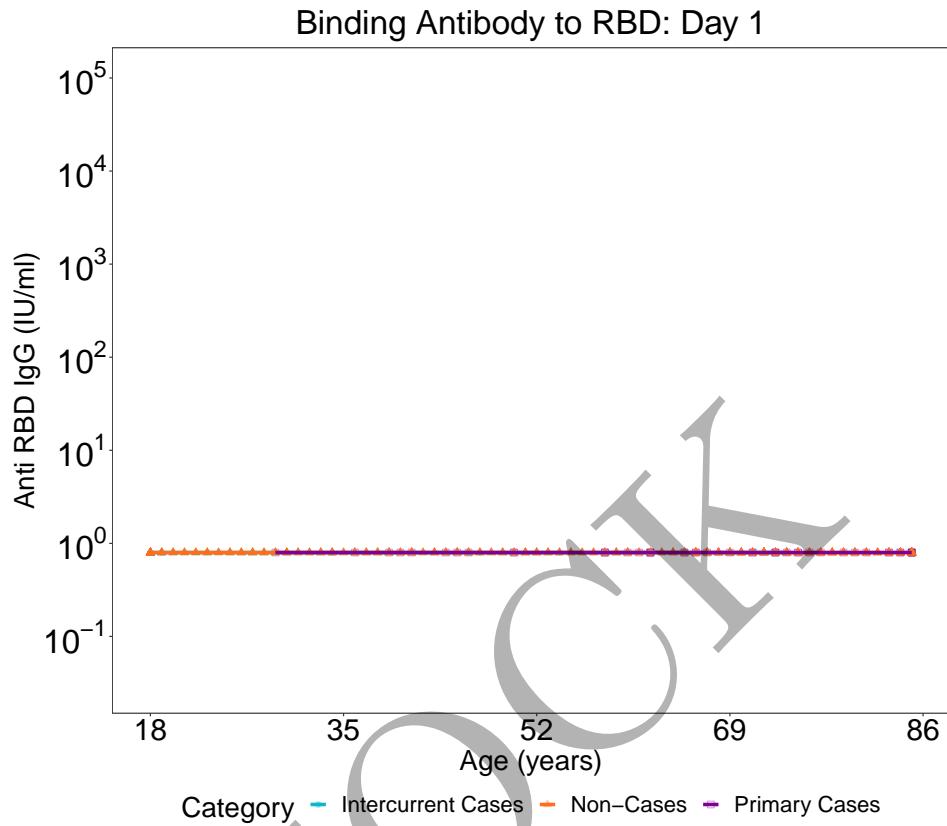


Figure 2.241: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1

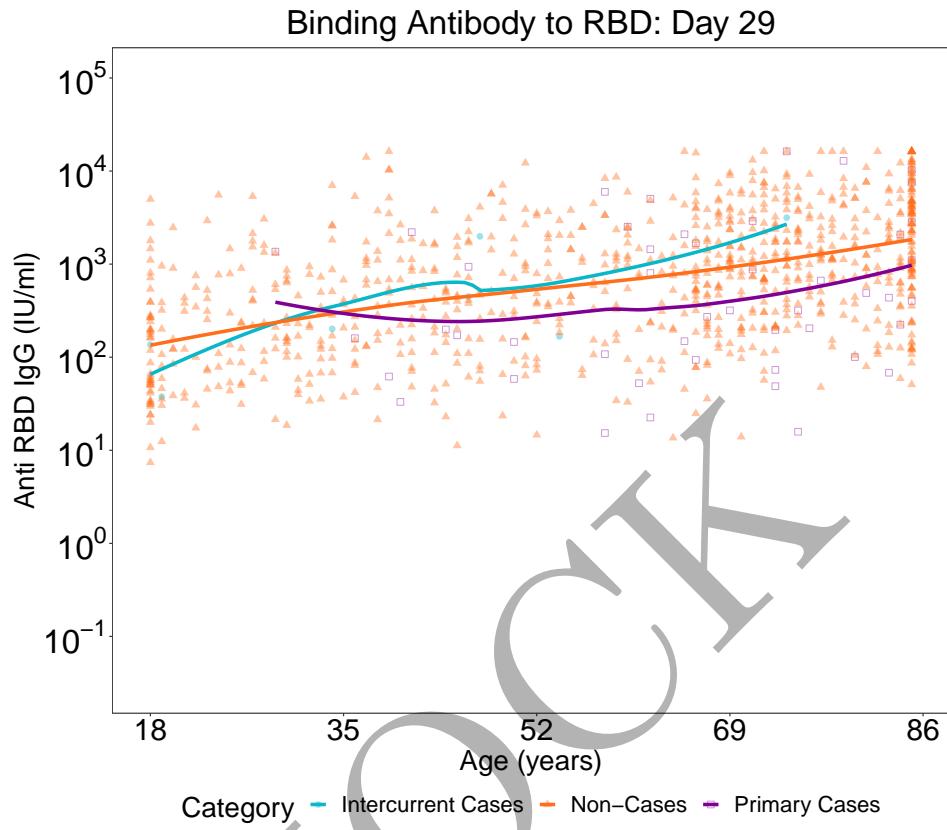


Figure 2.242: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29

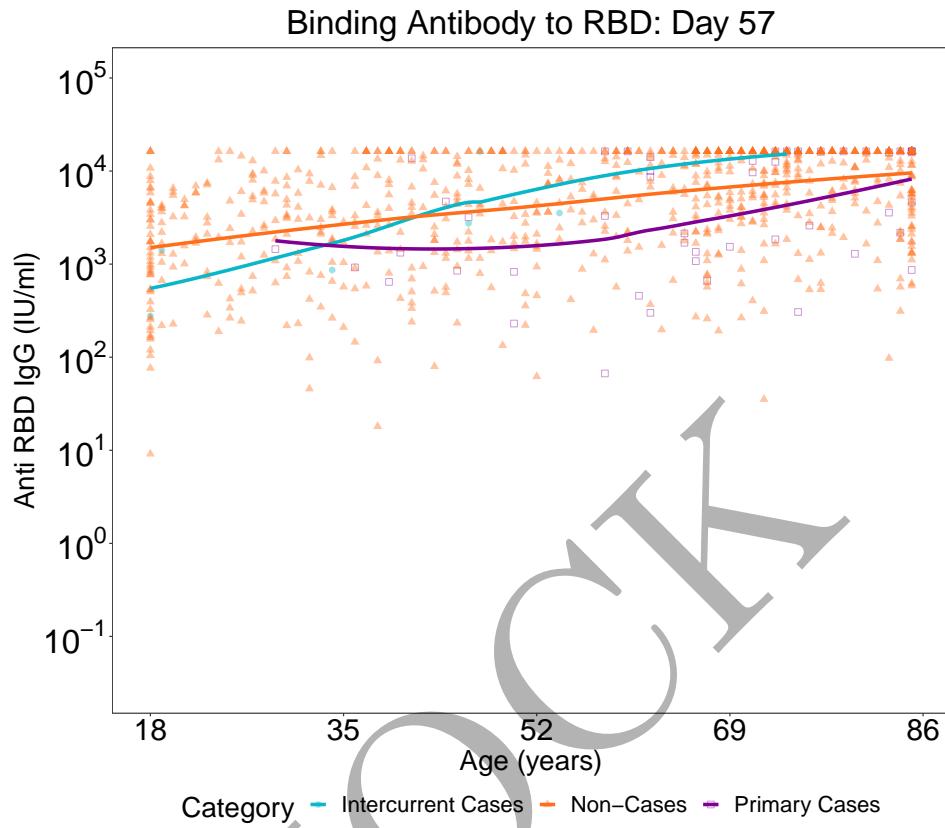


Figure 2.243: scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57

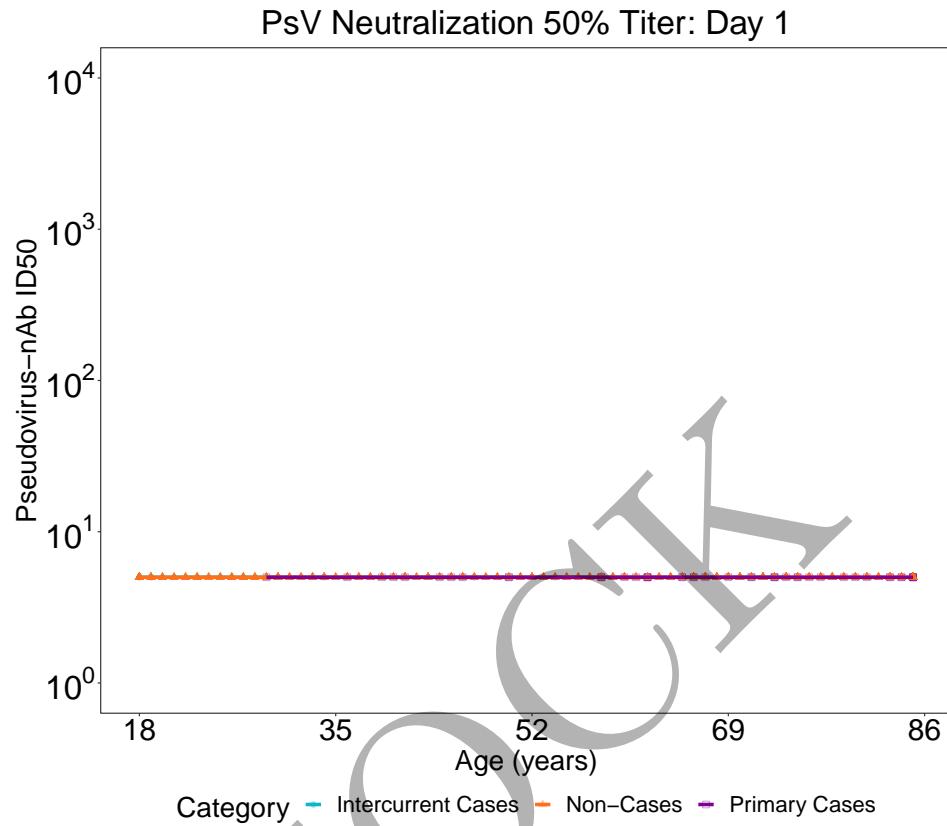


Figure 2.244: scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1

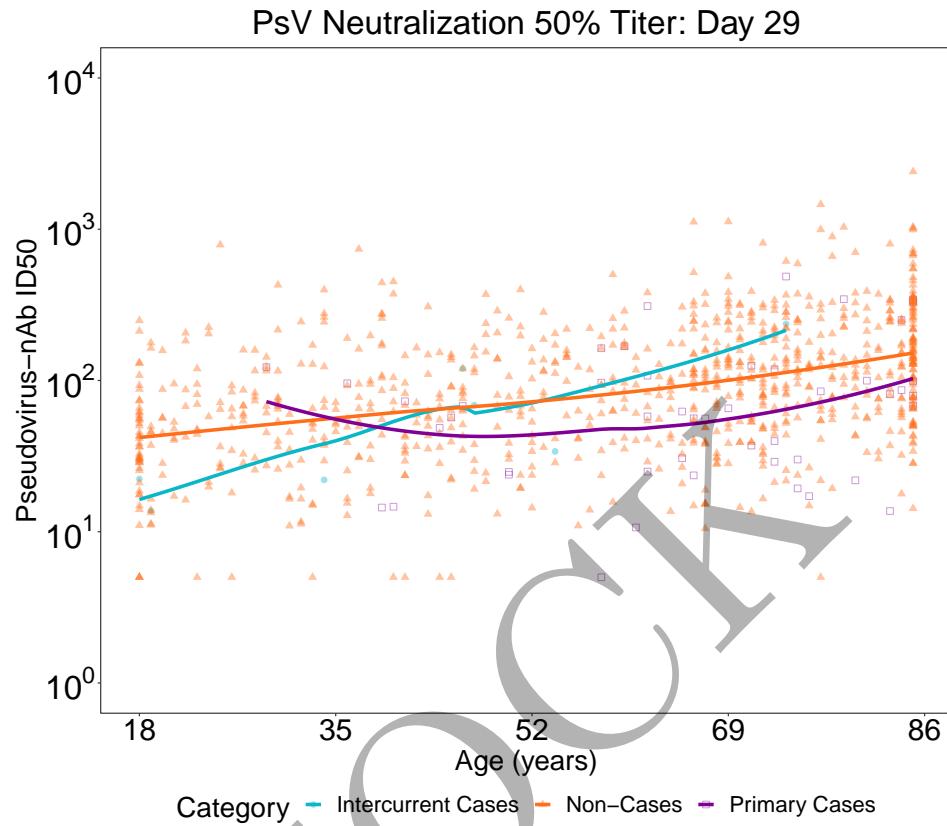


Figure 2.245: scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29

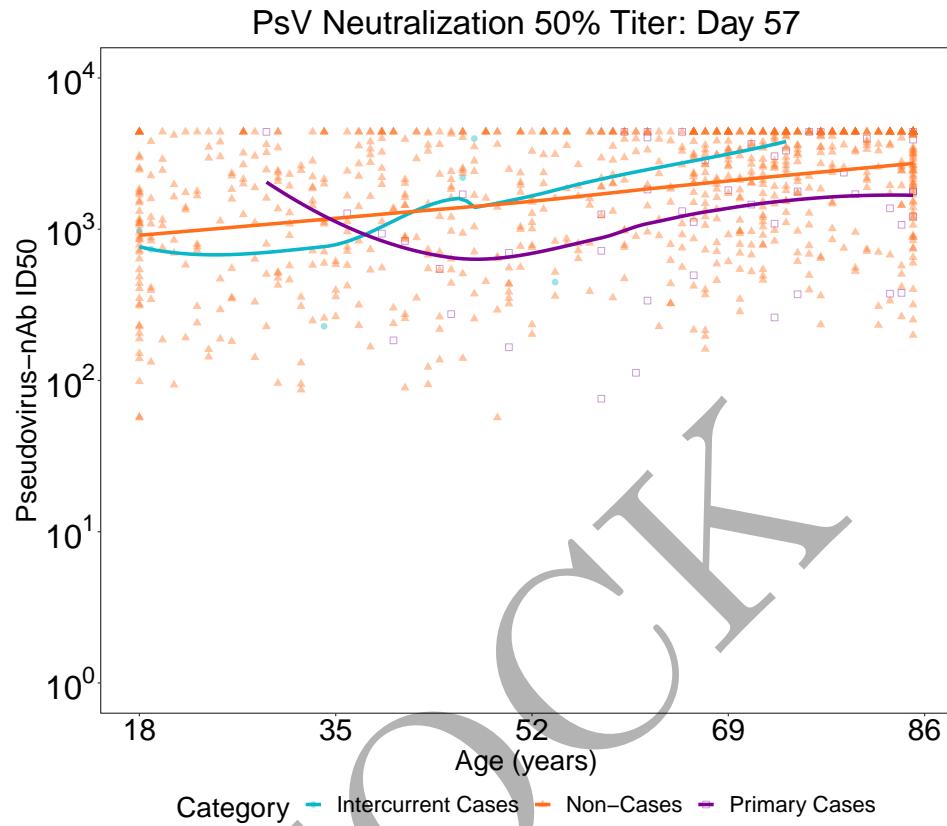


Figure 2.246: scatterplots of Pseudovirus Neutralization ID<sub>50</sub>: baseline negative vaccine arm at day 57

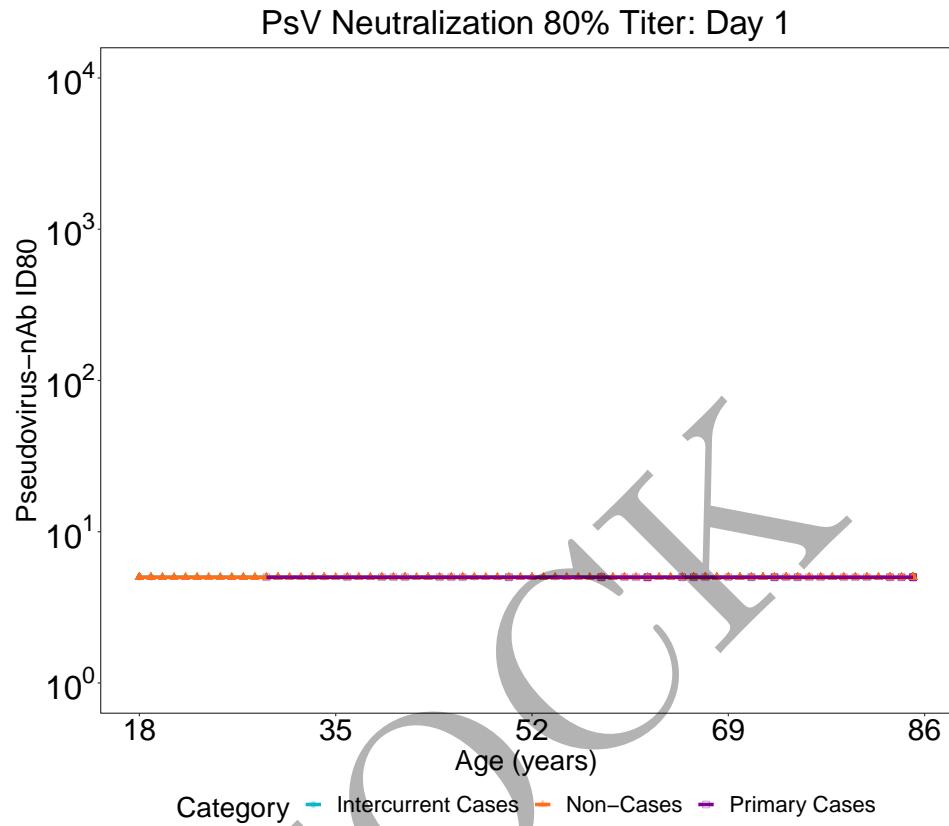


Figure 2.247: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1

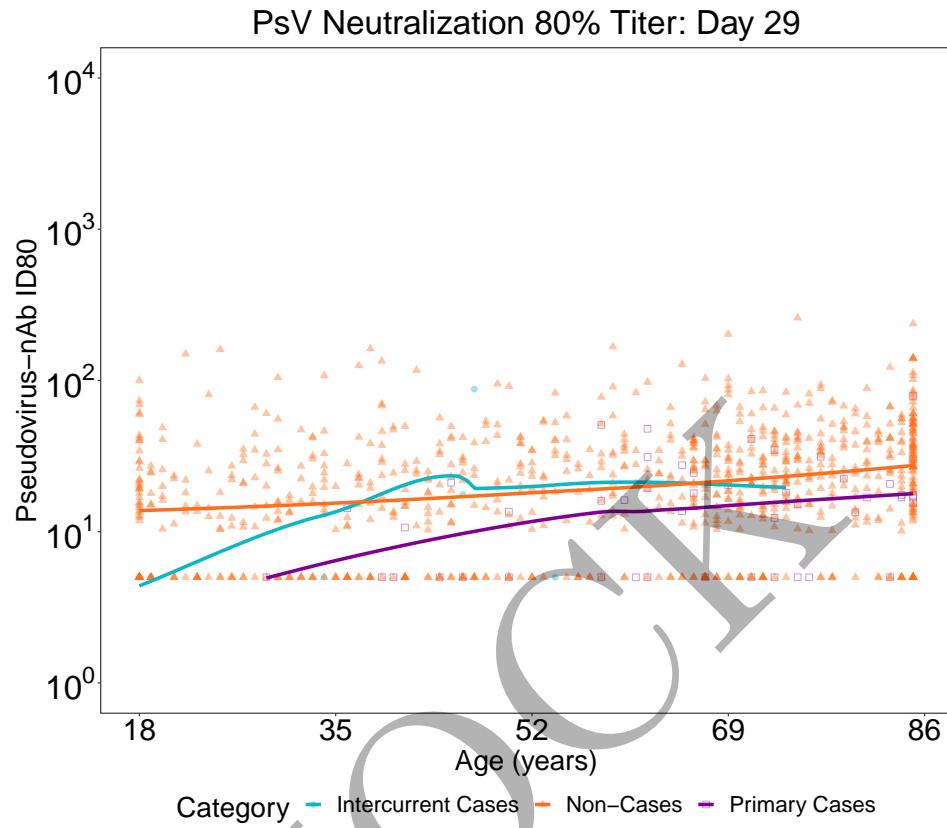


Figure 2.248: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29

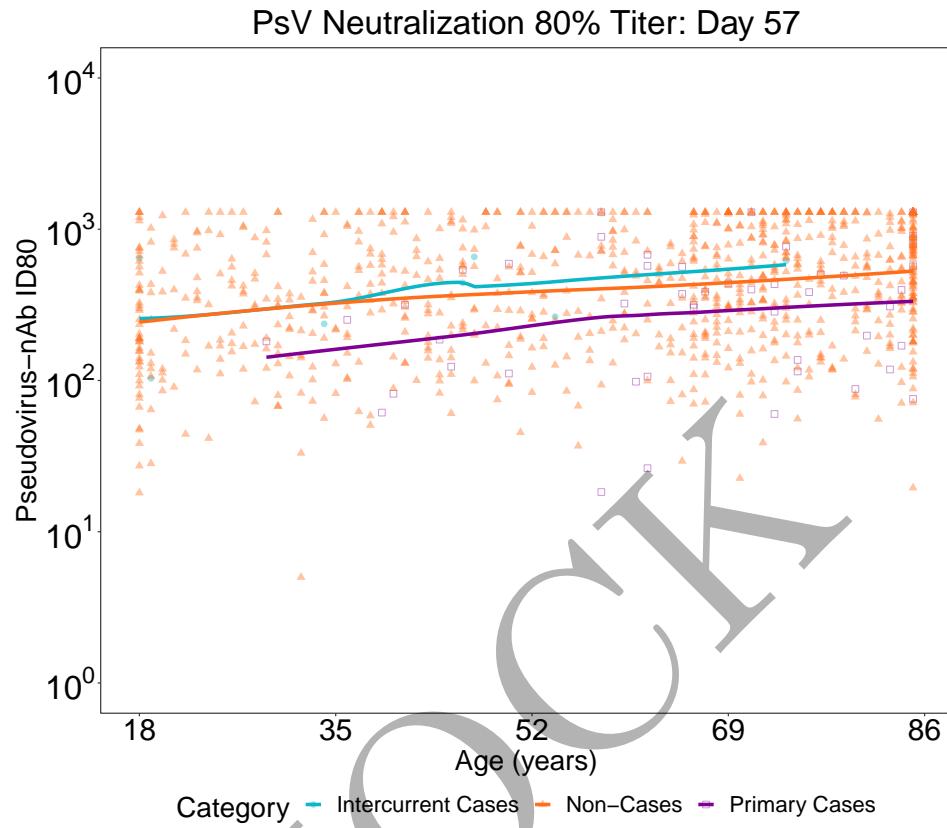


Figure 2.249: scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57

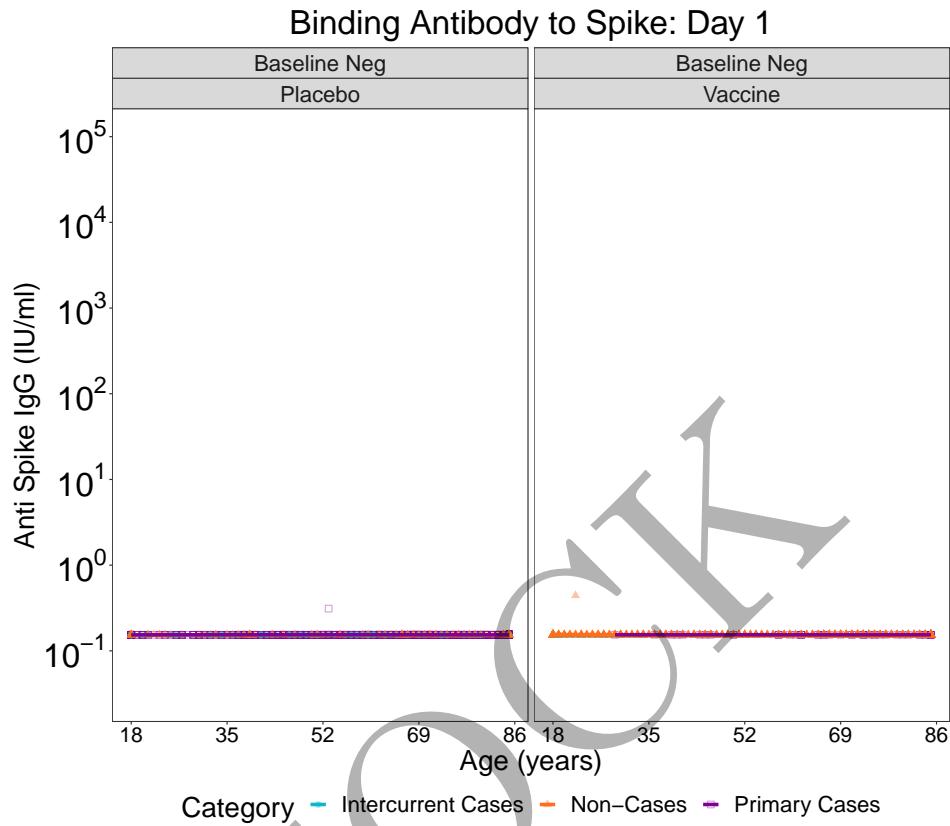


Figure 2.250: scatterplots of Binding Antibody to Spike: by arm at day 1

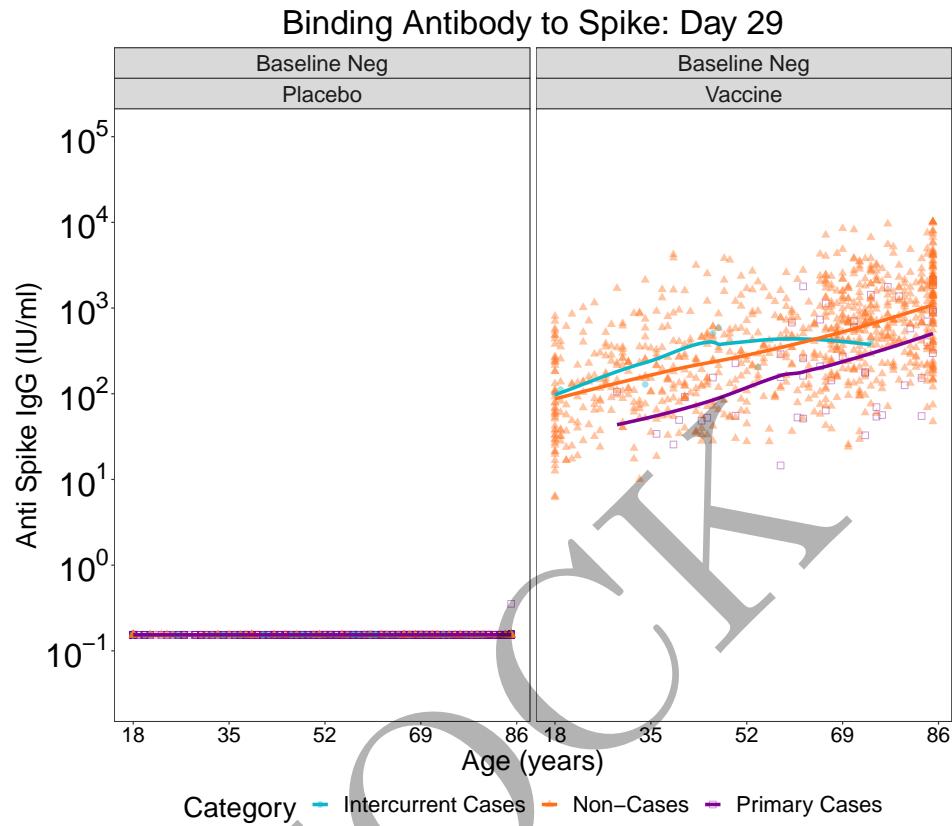


Figure 2.251: scatterplots of Binding Antibody to Spike: by arm at day 29

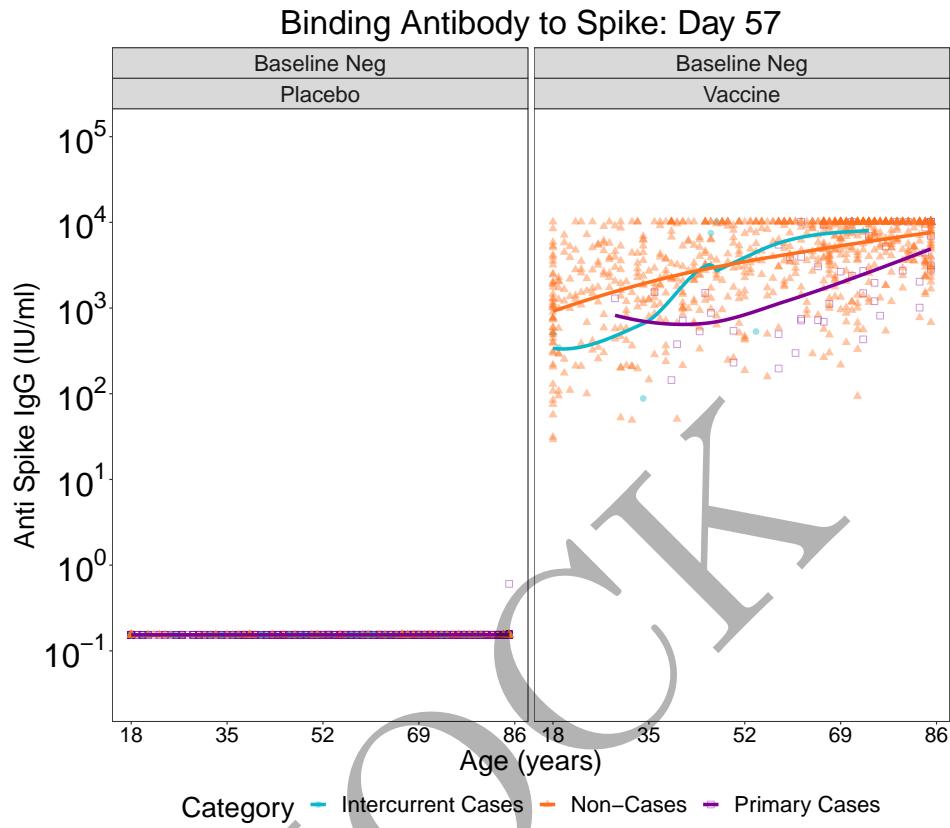


Figure 2.252: scatterplots of Binding Antibody to Spike: by arm at day 57

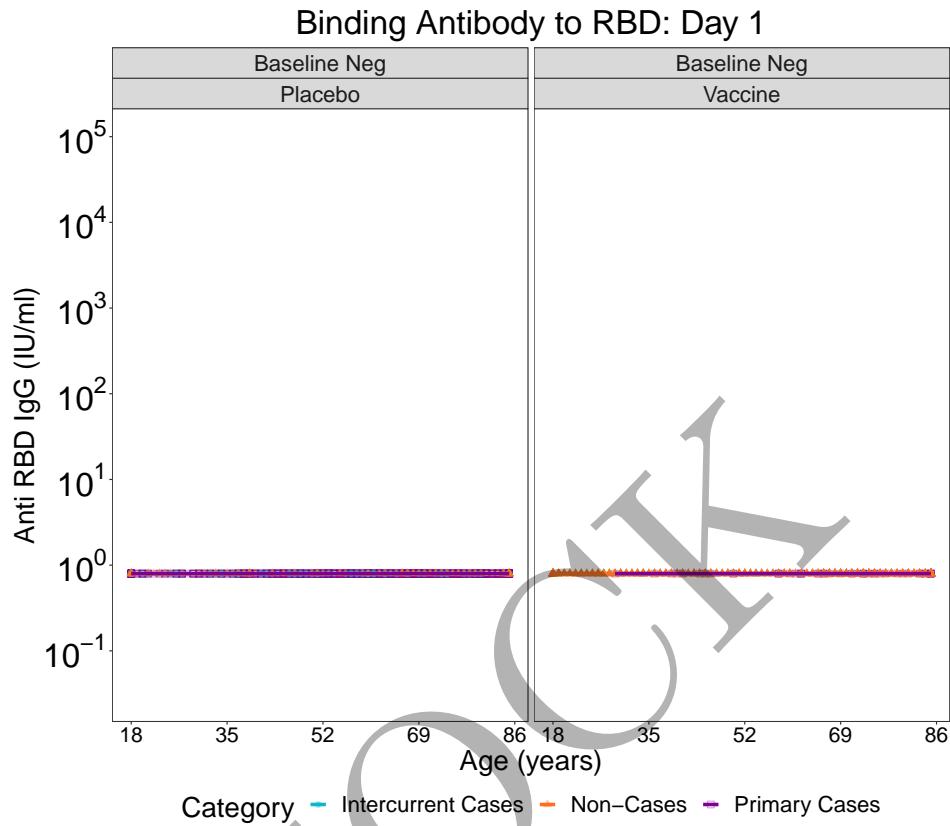


Figure 2.253: scatterplots of Binding Antibody to RBD: by arm at day 1

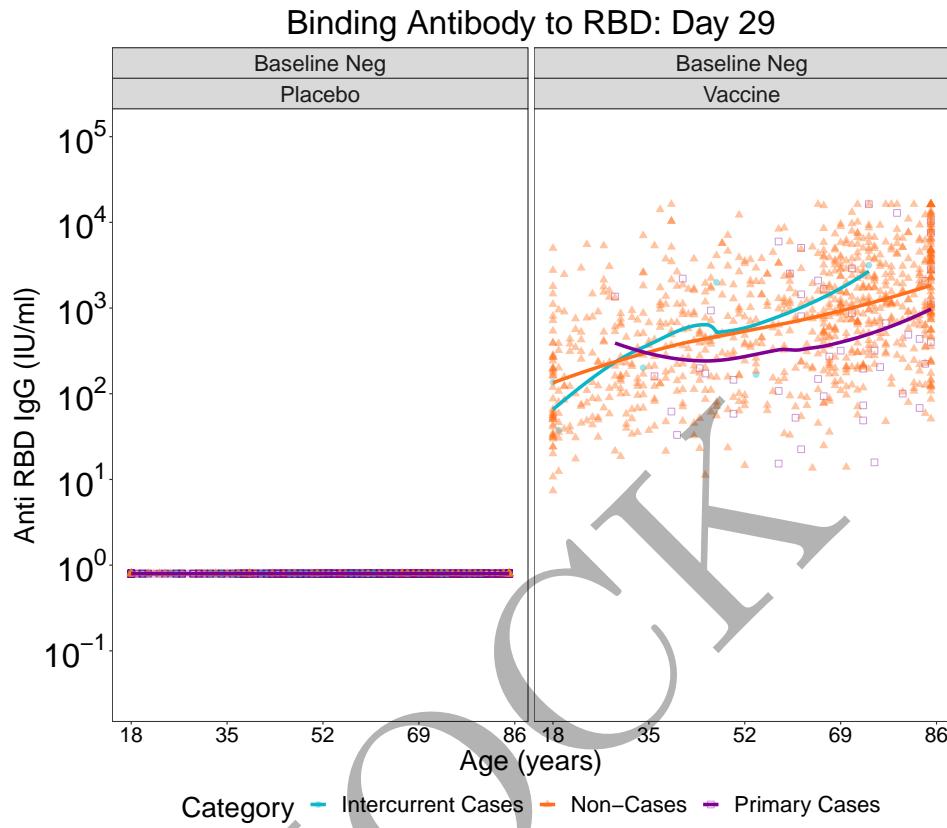


Figure 2.254: scatterplots of Binding Antibody to RBD: by arm at day 29

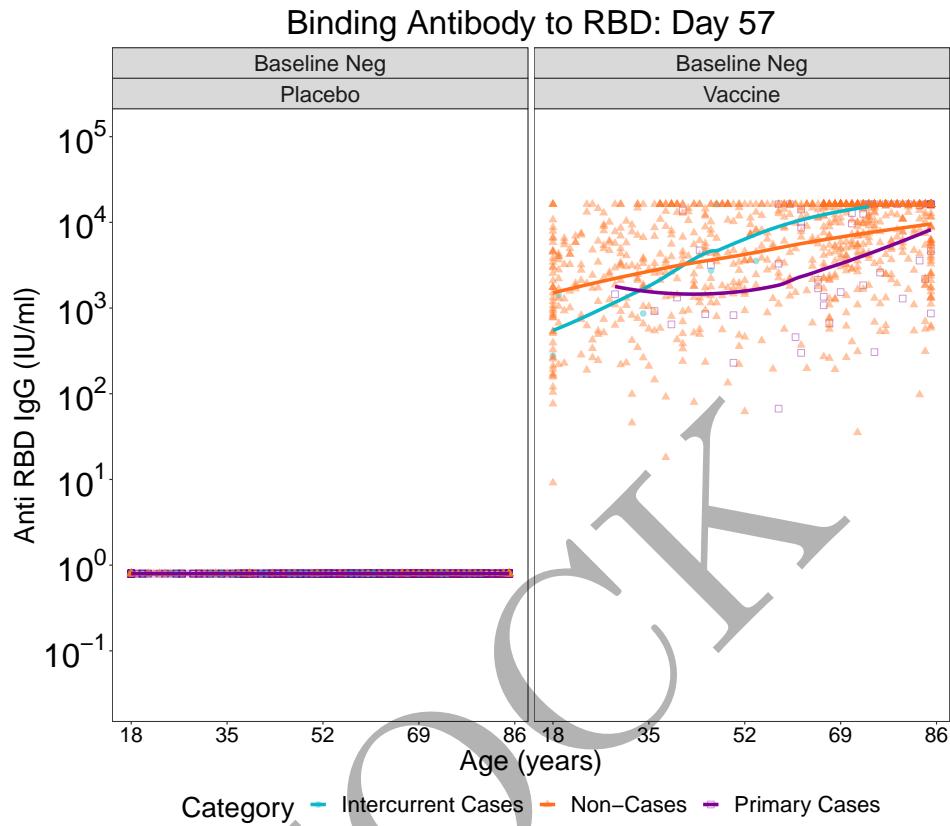


Figure 2.255: scatterplots of Binding Antibody to RBD: by arm at day 57

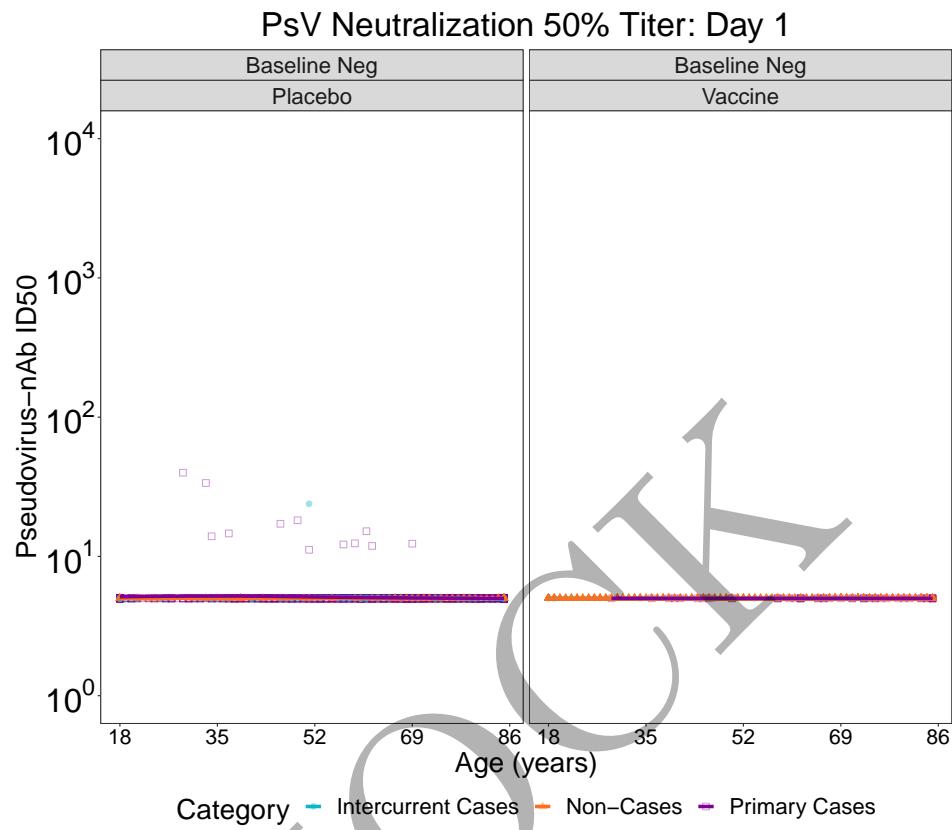


Figure 2.256: scatterplots of Pseudovirus Neutralization ID50: by arm at day 1

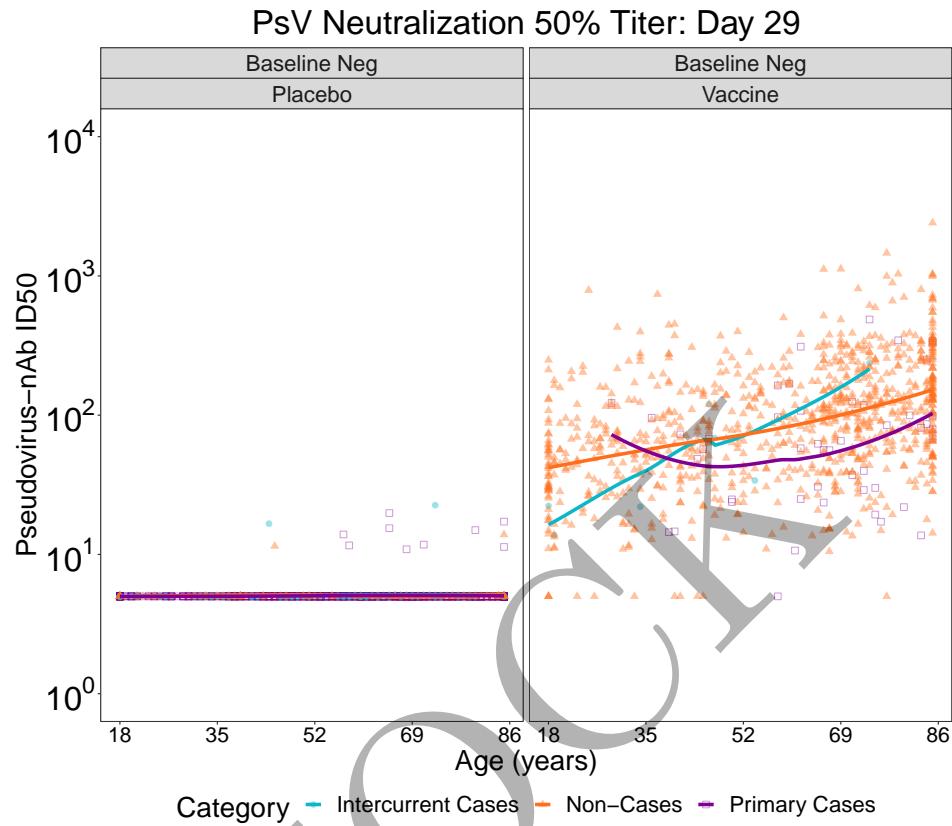


Figure 2.257: scatterplots of Pseudovirus Neutralization ID50: by arm at day 29

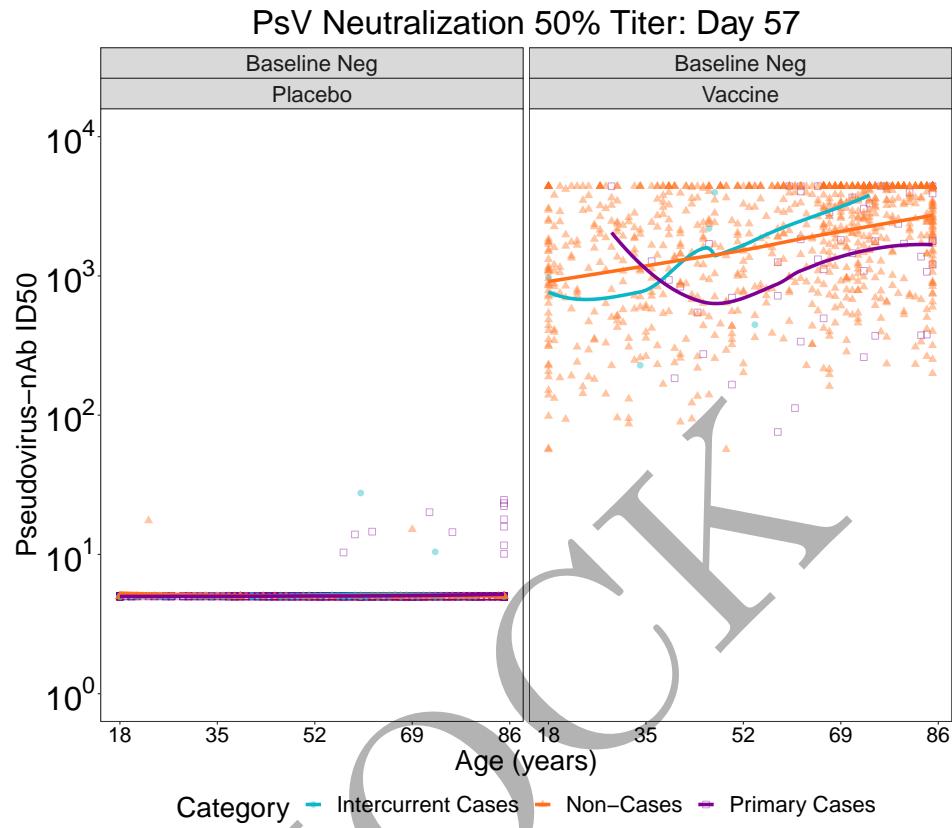


Figure 2.258: scatterplots of Pseudovirus Neutralization ID50: by arm at day 57

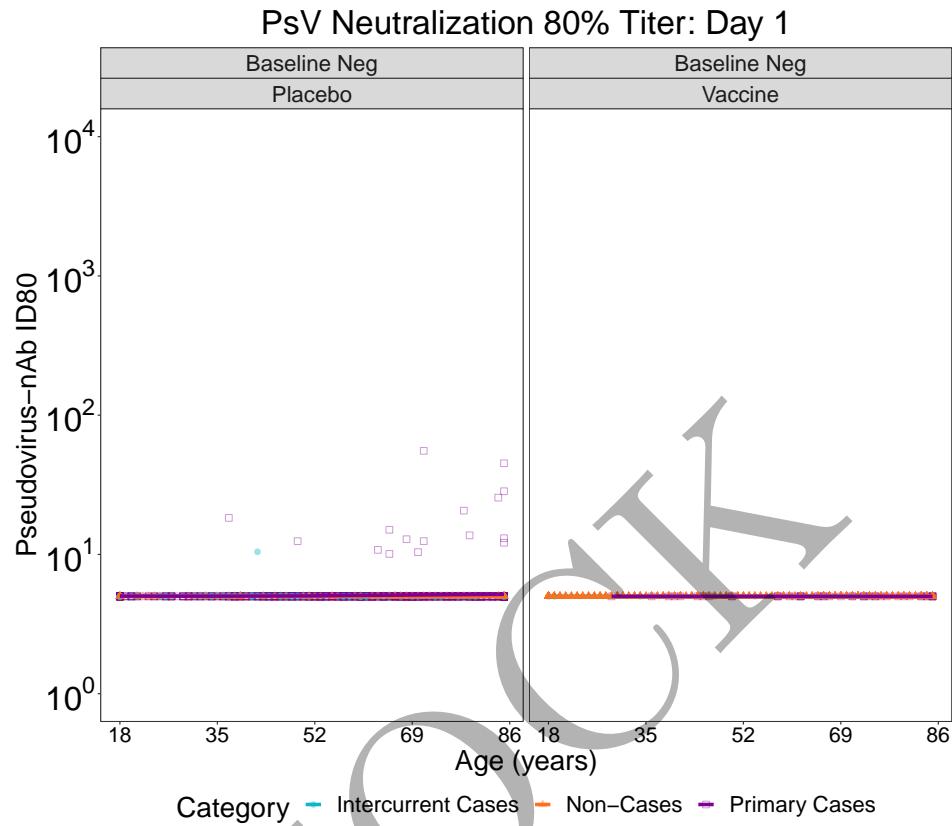


Figure 2.259: scatterplots of Pseudovirus Neutralization ID80: by arm at day 1

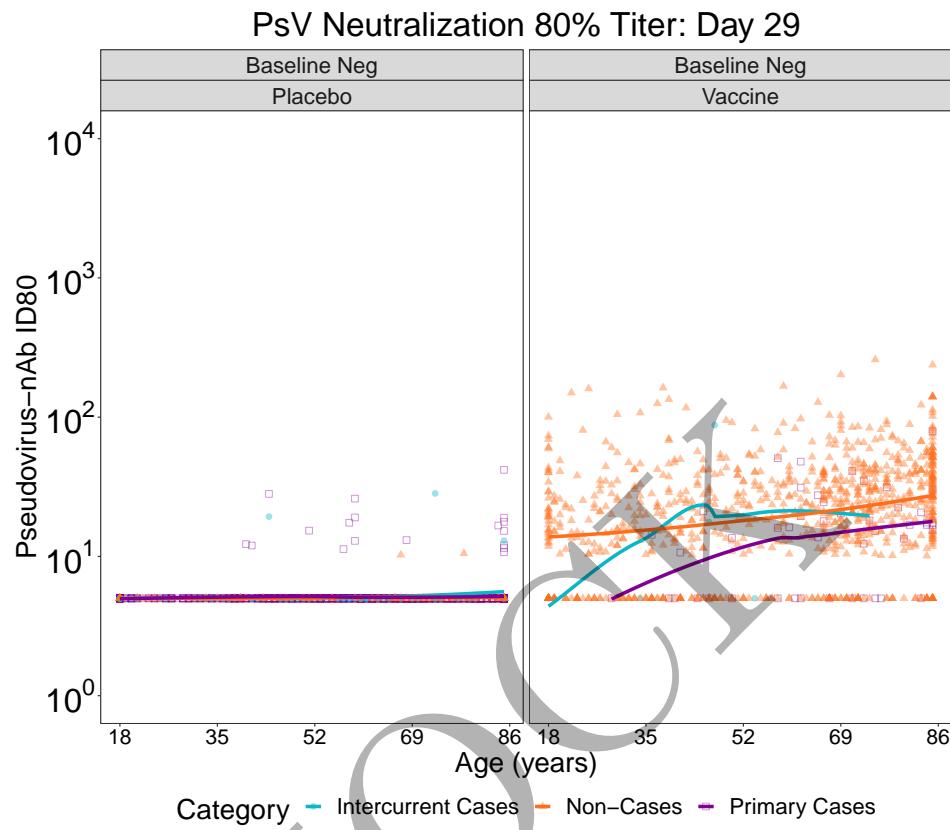


Figure 2.260: scatterplots of Pseudovirus Neutralization ID80: by arm at day 29

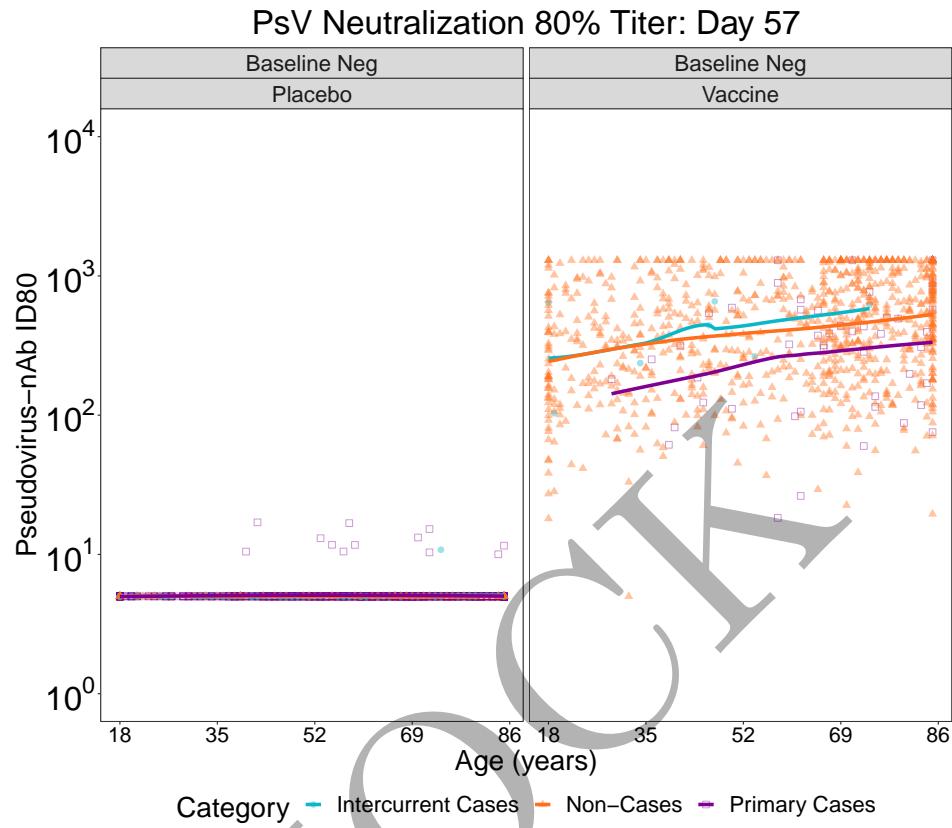


Figure 2.261: scatterplots of Pseudovirus Neutralization ID80: by arm at day 57

# 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.

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	Pt. Est.	Haz. Ratio 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.

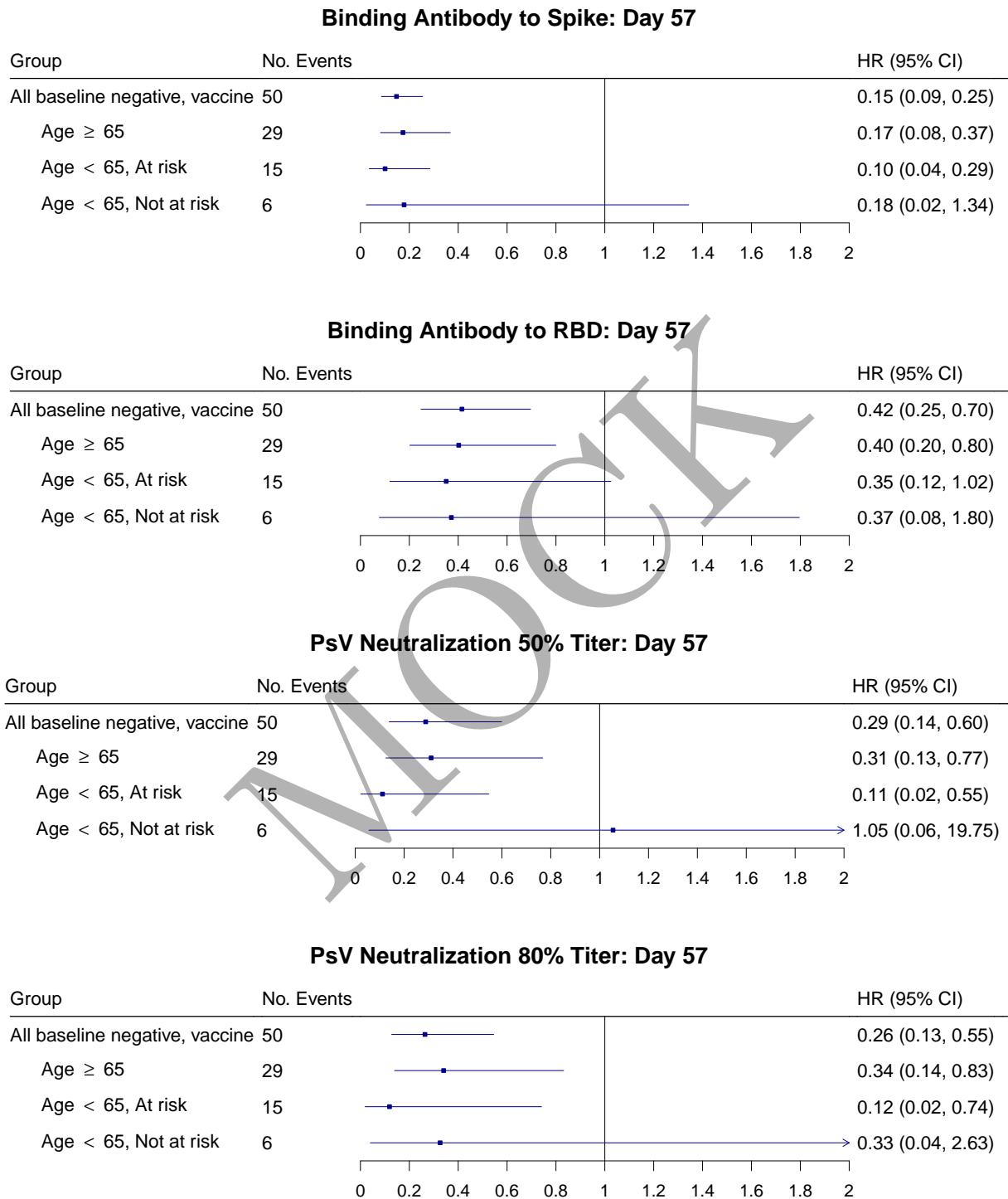


Figure 3.1: Forest plots of hazard ratios per 10-fold increase in the marker among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

### Binding Antibody to Spike: Day 57

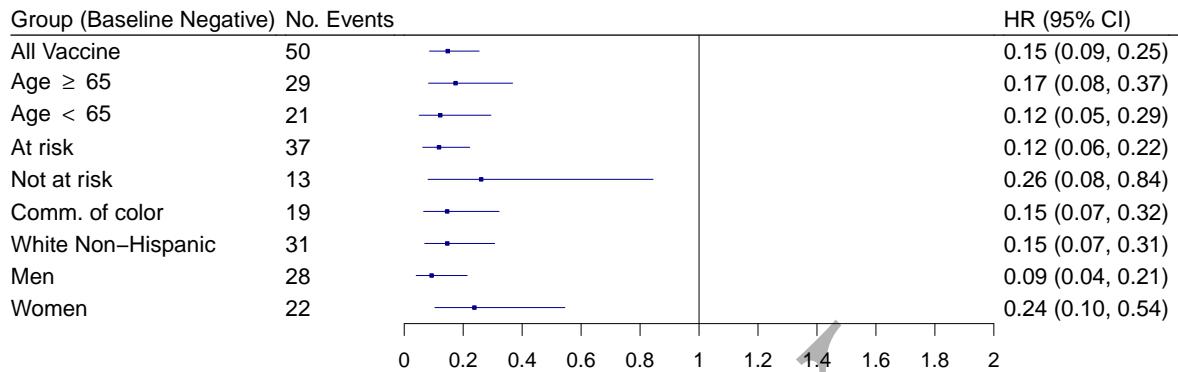


Figure 3.2: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### Binding Antibody to RBD: Day 57

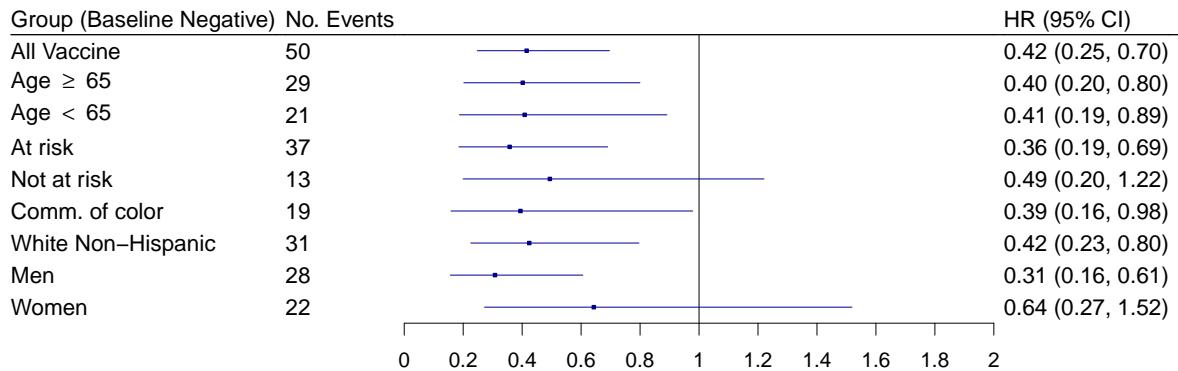


Figure 3.3: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### PsV Neutralization 50% Titer: Day 57

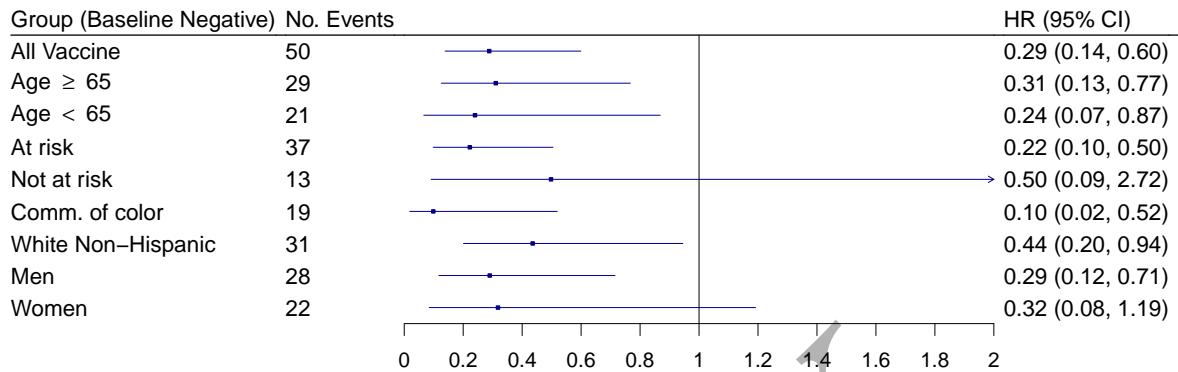


Figure 3.4: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID50 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### PsV Neutralization 80% Titer: Day 57

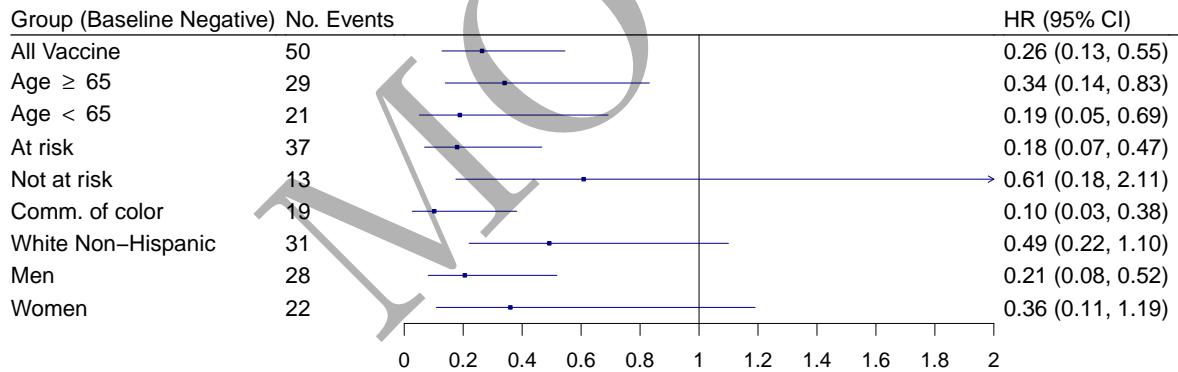


Figure 3.5: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### 3.2 Marginalized risk and controlled vaccine efficacy plots

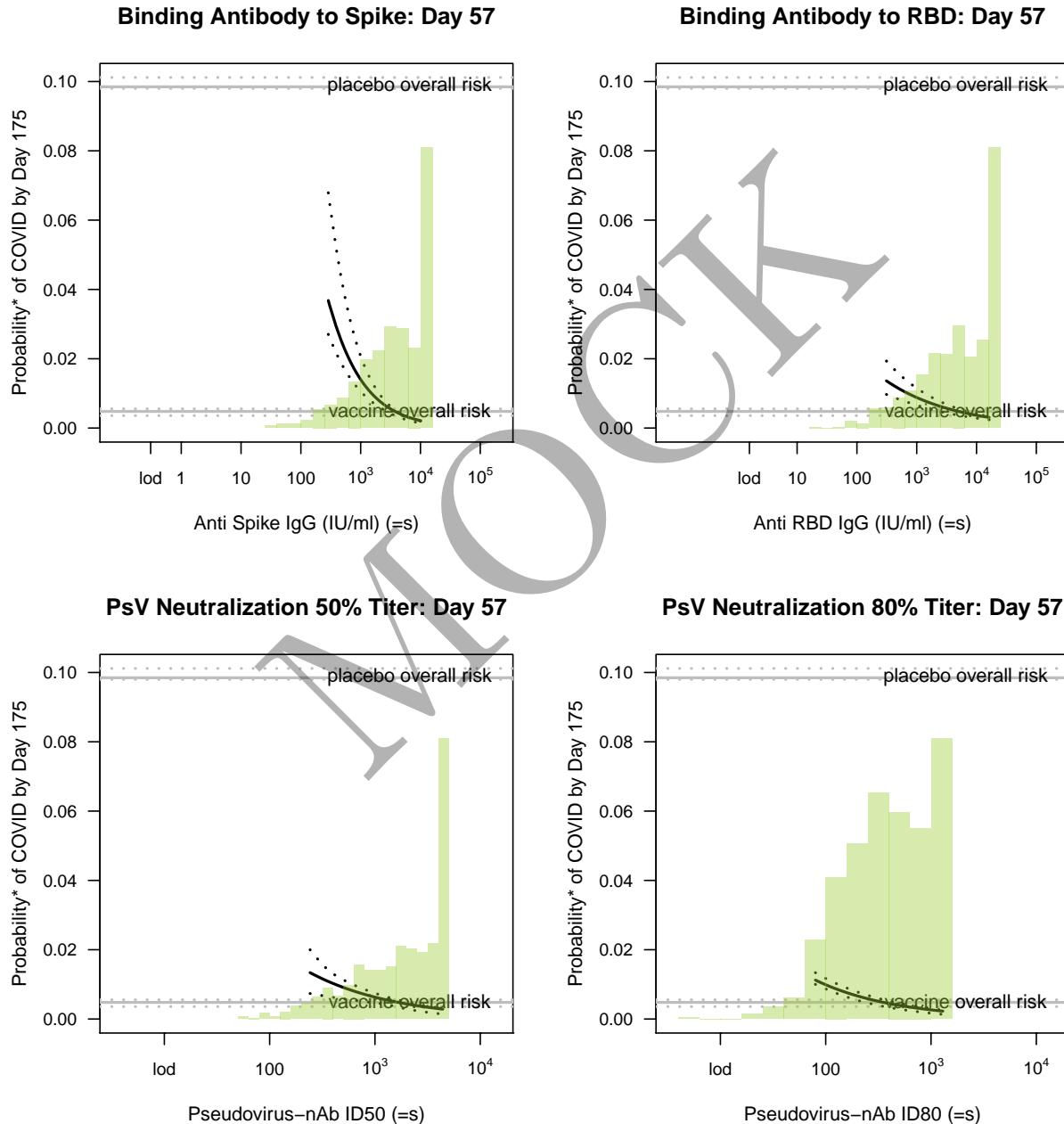


Figure 3.6: Marginalized cumulative risk by Day 175 as functions of Day 57 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 175 and its 95% point-wise 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.

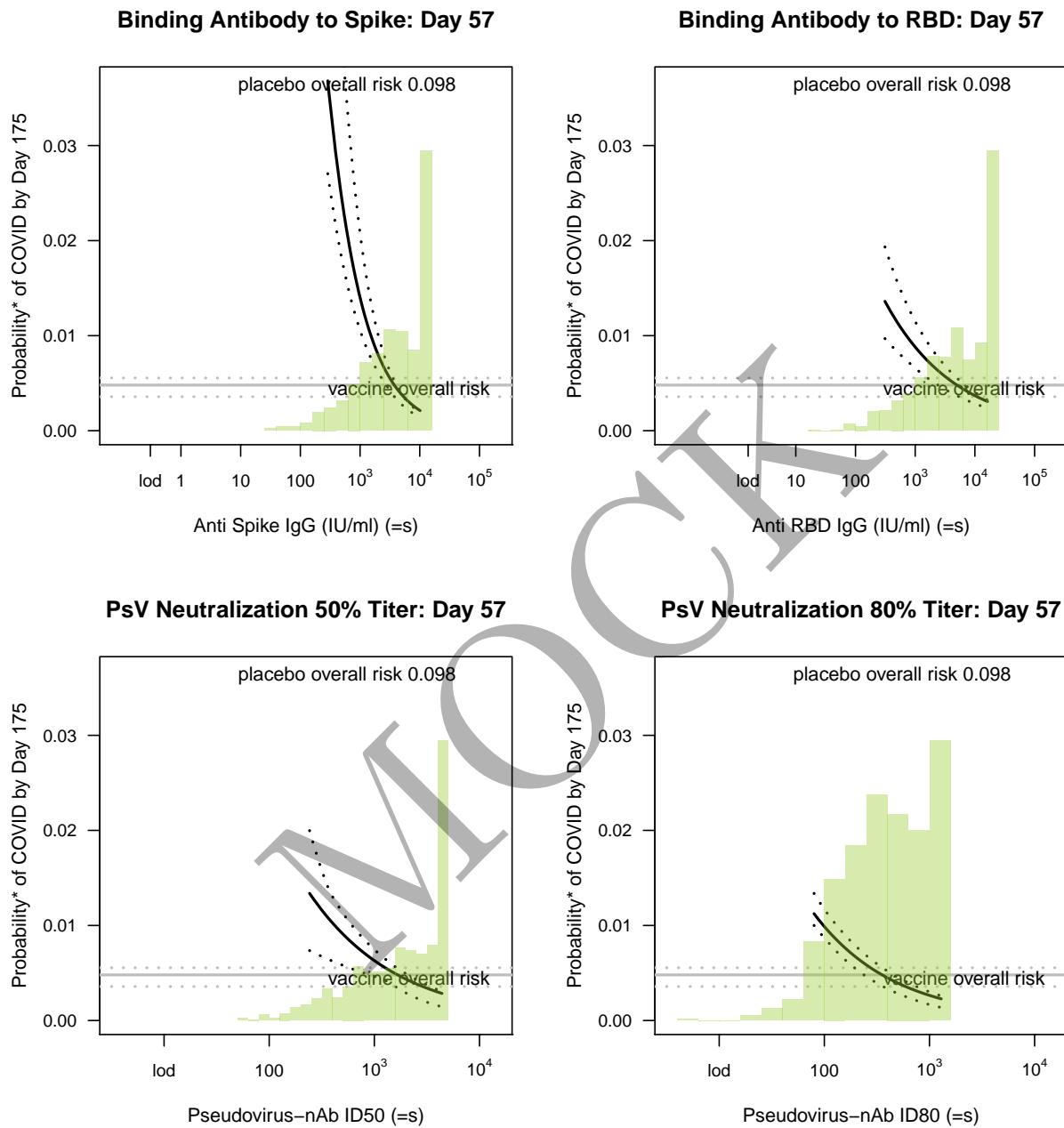


Figure 3.7: Marginalized cumulative risk by Day 175 as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 175 and its 95% point-wise 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.

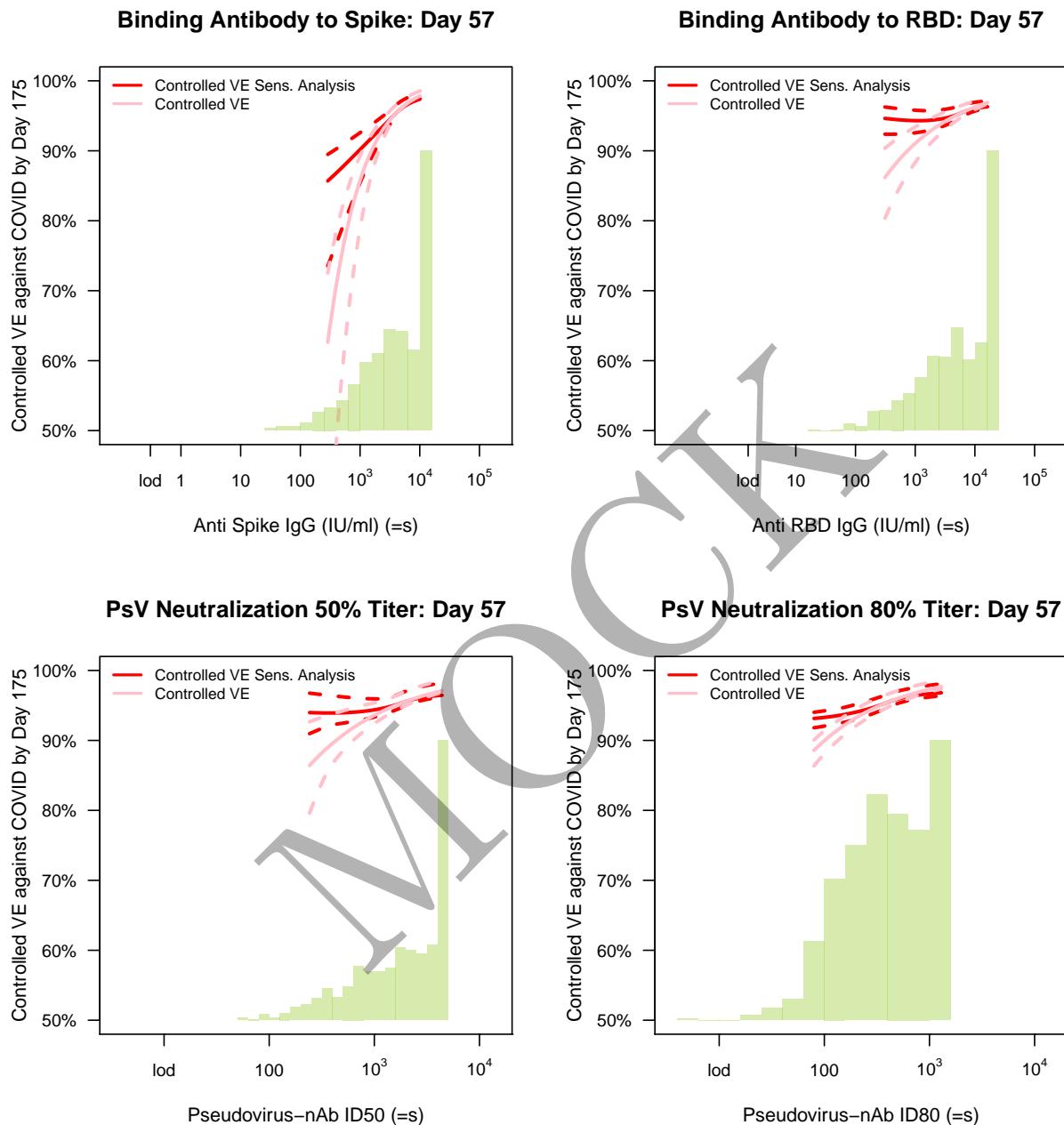


Figure 3.8: Controlled VE with sensitivity analysis as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $lod = 0.3, 1.6, 10, 10$  for bAb Spike,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

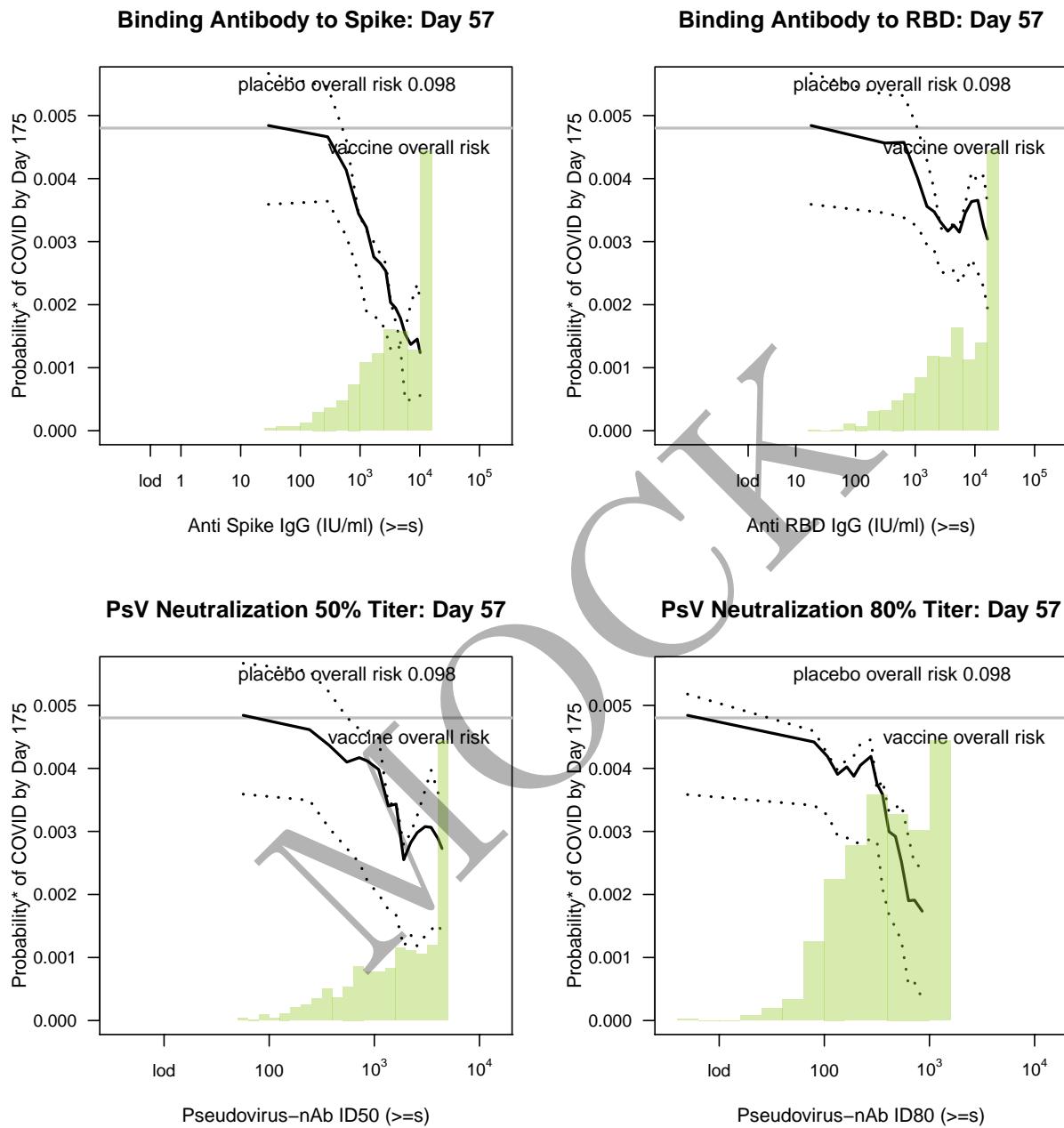


Figure 3.9: Marginalized cumulative risk by Day 175 as functions of Day 57 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of 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.

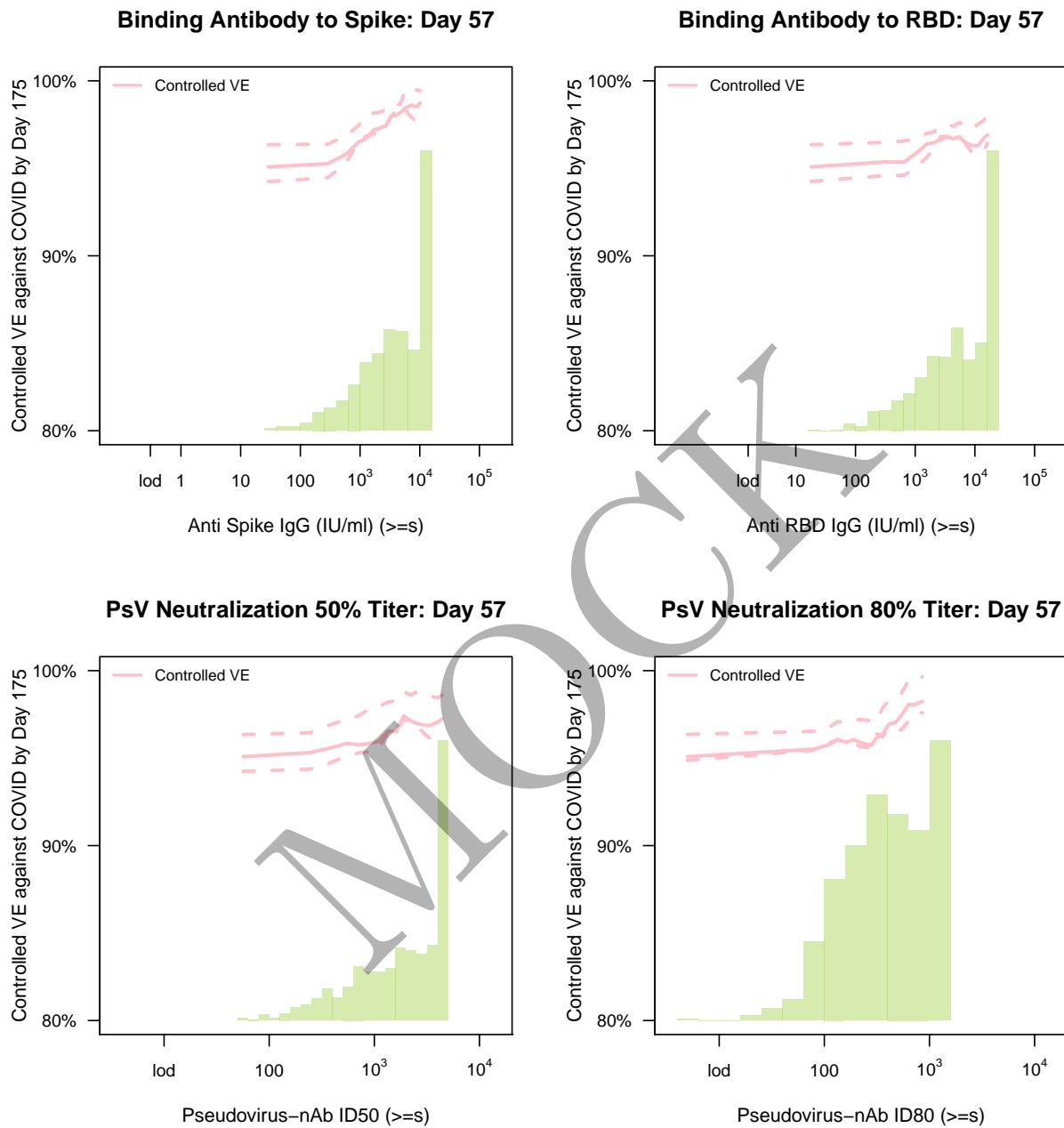


Figure 3.10: Controlled VE as functions of Day 57 markers ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $lod = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb ID50,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

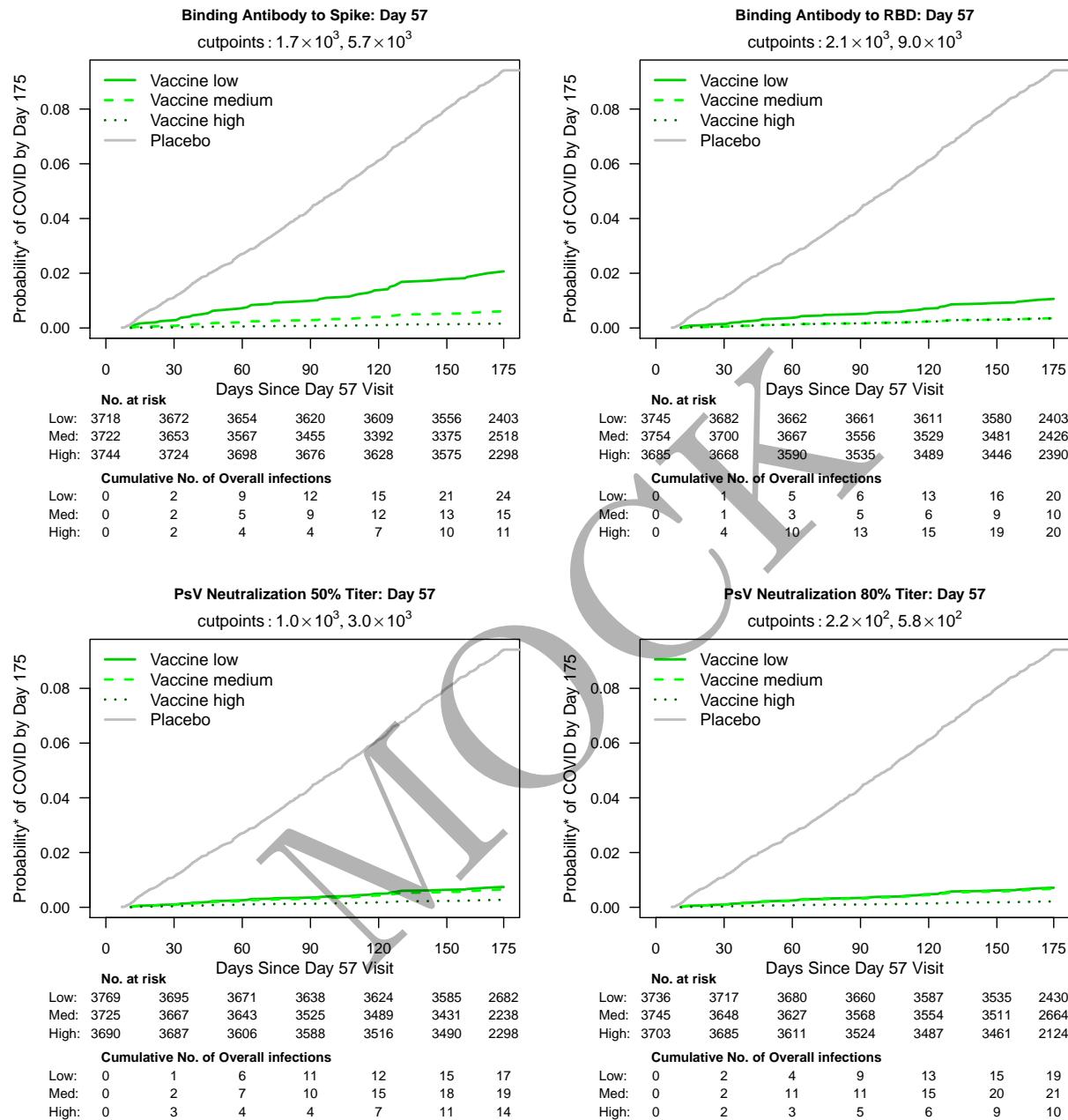


Figure 3.11: Marginalized cumulative incidence rate curves for trichotomized Day 57 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

MOCK

# 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.

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.

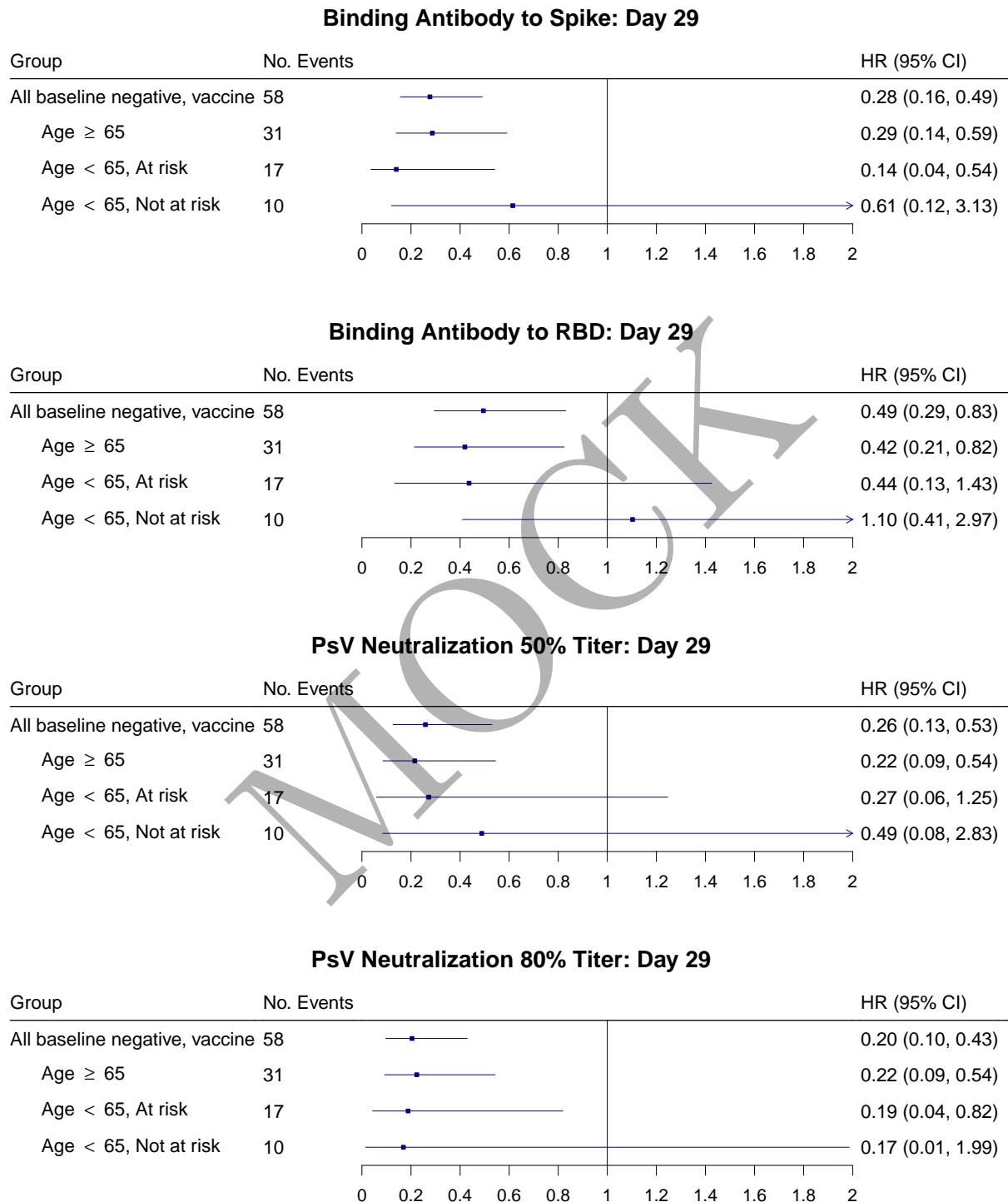


Figure 4.1: Forest plots of hazard ratios per 10-fold increase in the marker among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

### Binding Antibody to Spike: Day 29

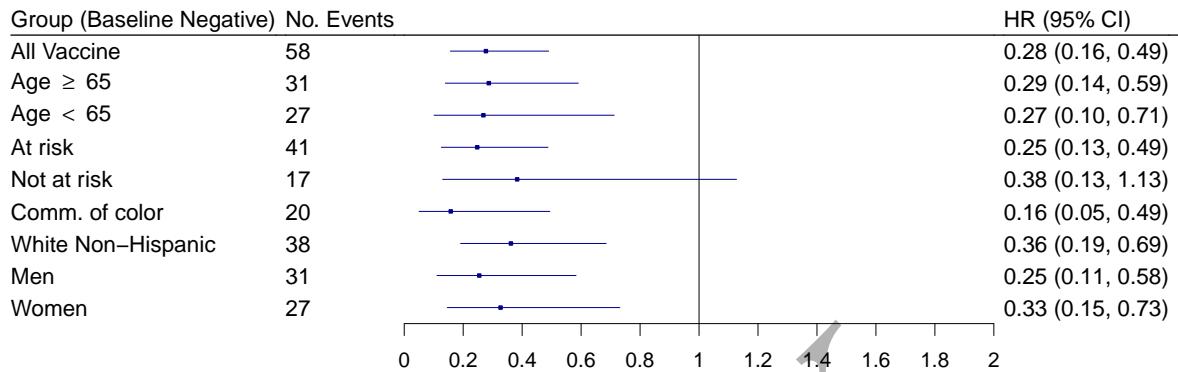


Figure 4.2: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### Binding Antibody to RBD: Day 29

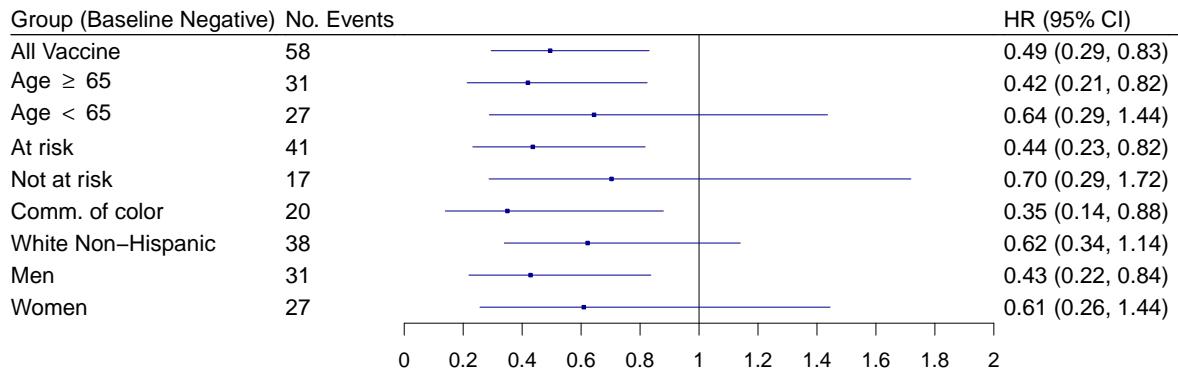


Figure 4.3: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

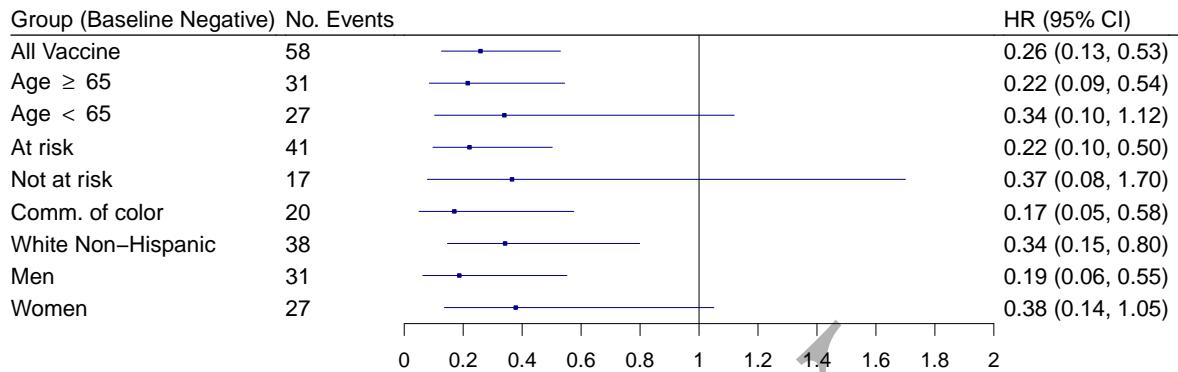
**PsV Neutralization 50% Titer: Day 29**

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.

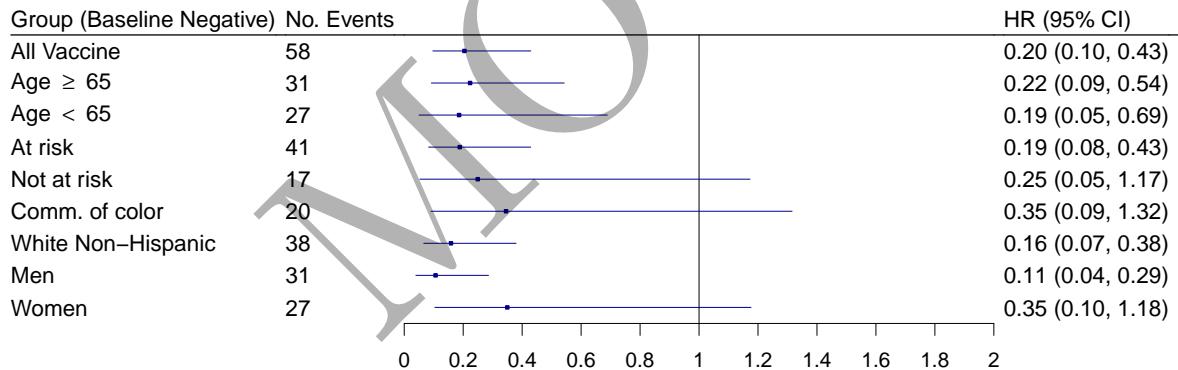
**PsV Neutralization 80% Titer: Day 29**

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

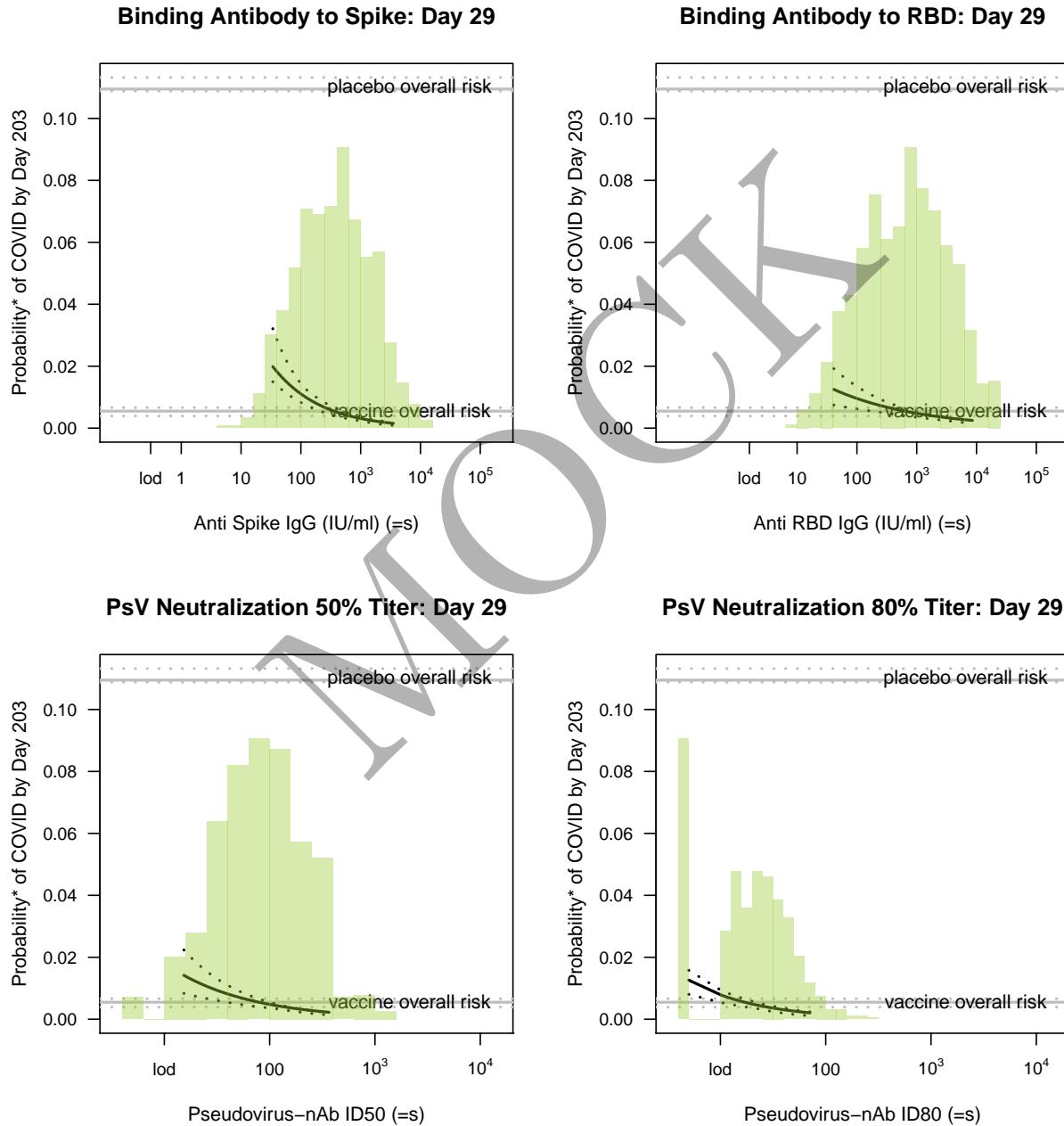


Figure 4.6: Marginalized cumulative risk by Day 203 as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 203 and its 95% point-wise 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.

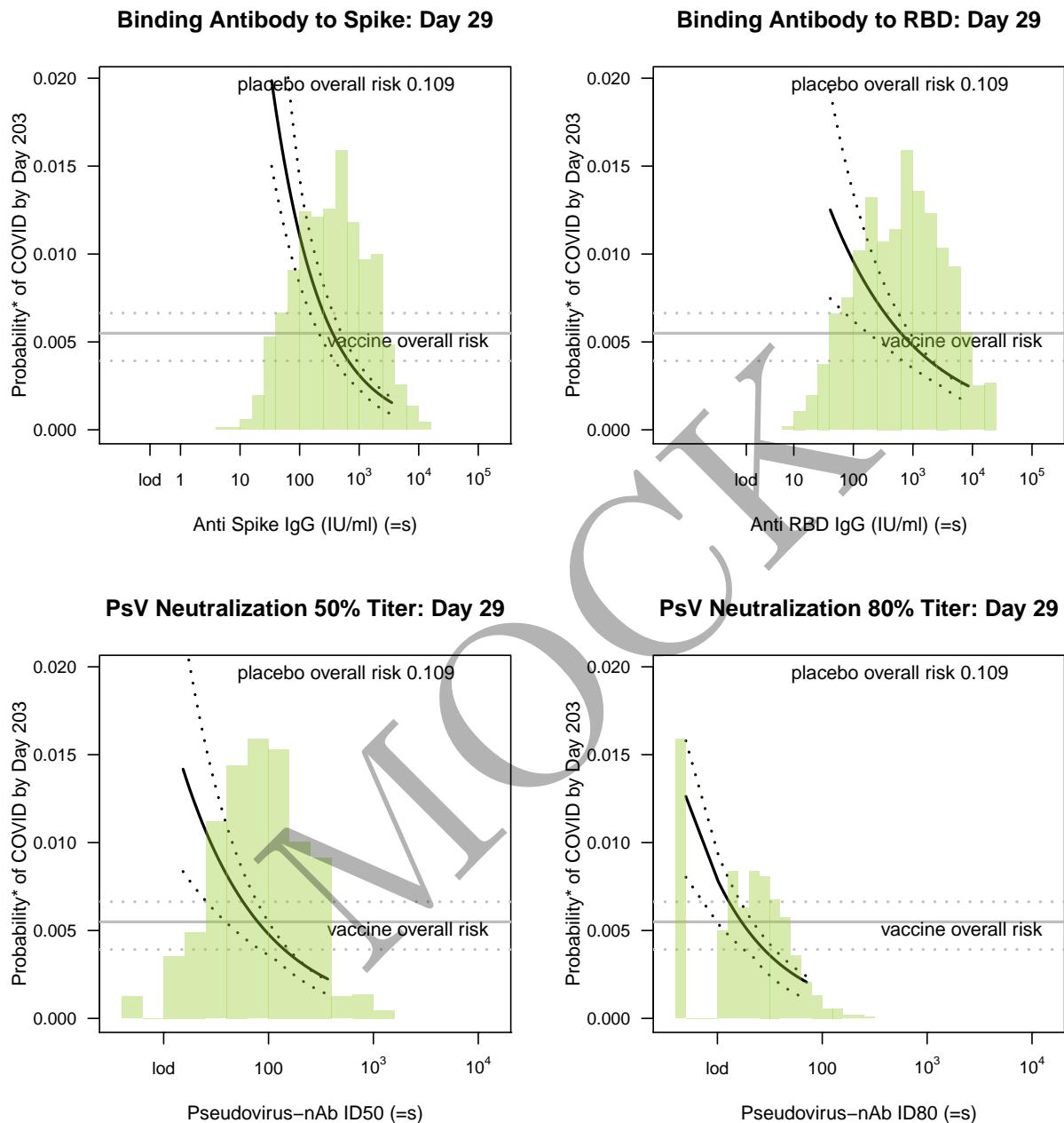


Figure 4.7: Marginalized cumulative risk by Day 203 as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 203 and its 95% point-wise 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.

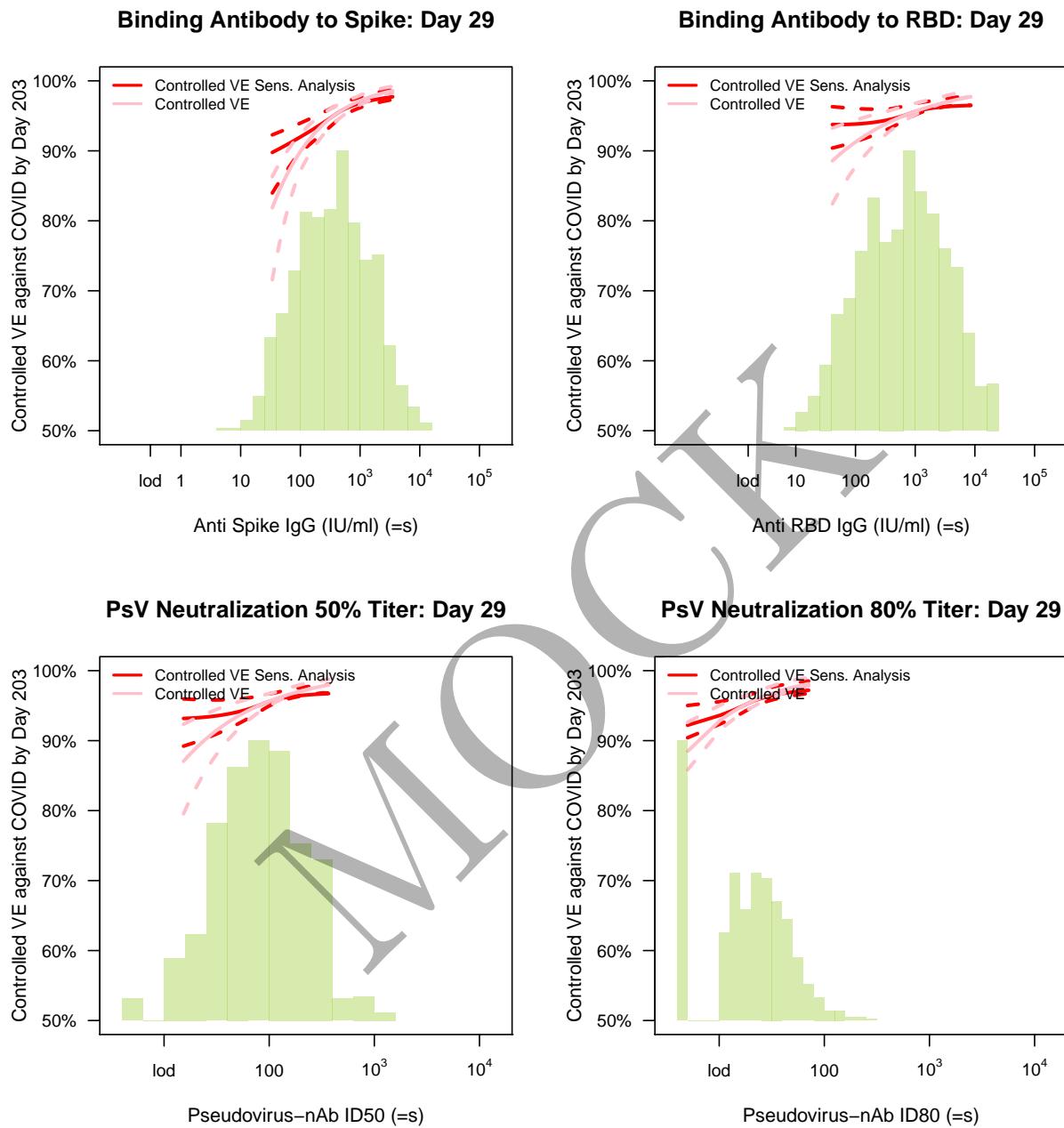


Figure 4.8: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 10, 10 for bAb Spike, bAb RBD,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

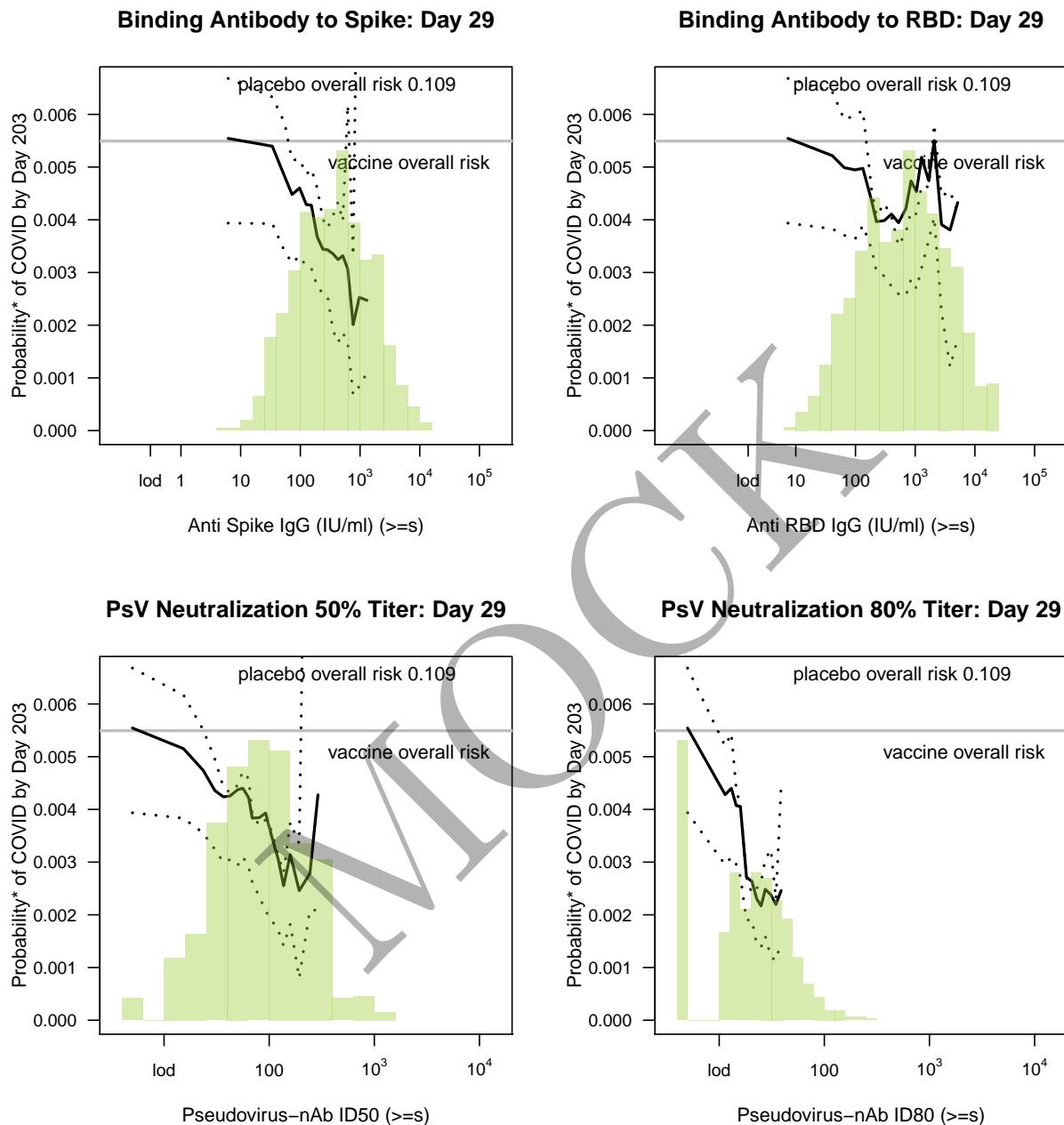


Figure 4.9: Marginalized cumulative risk by Day 203 as functions of Day 29 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of 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.

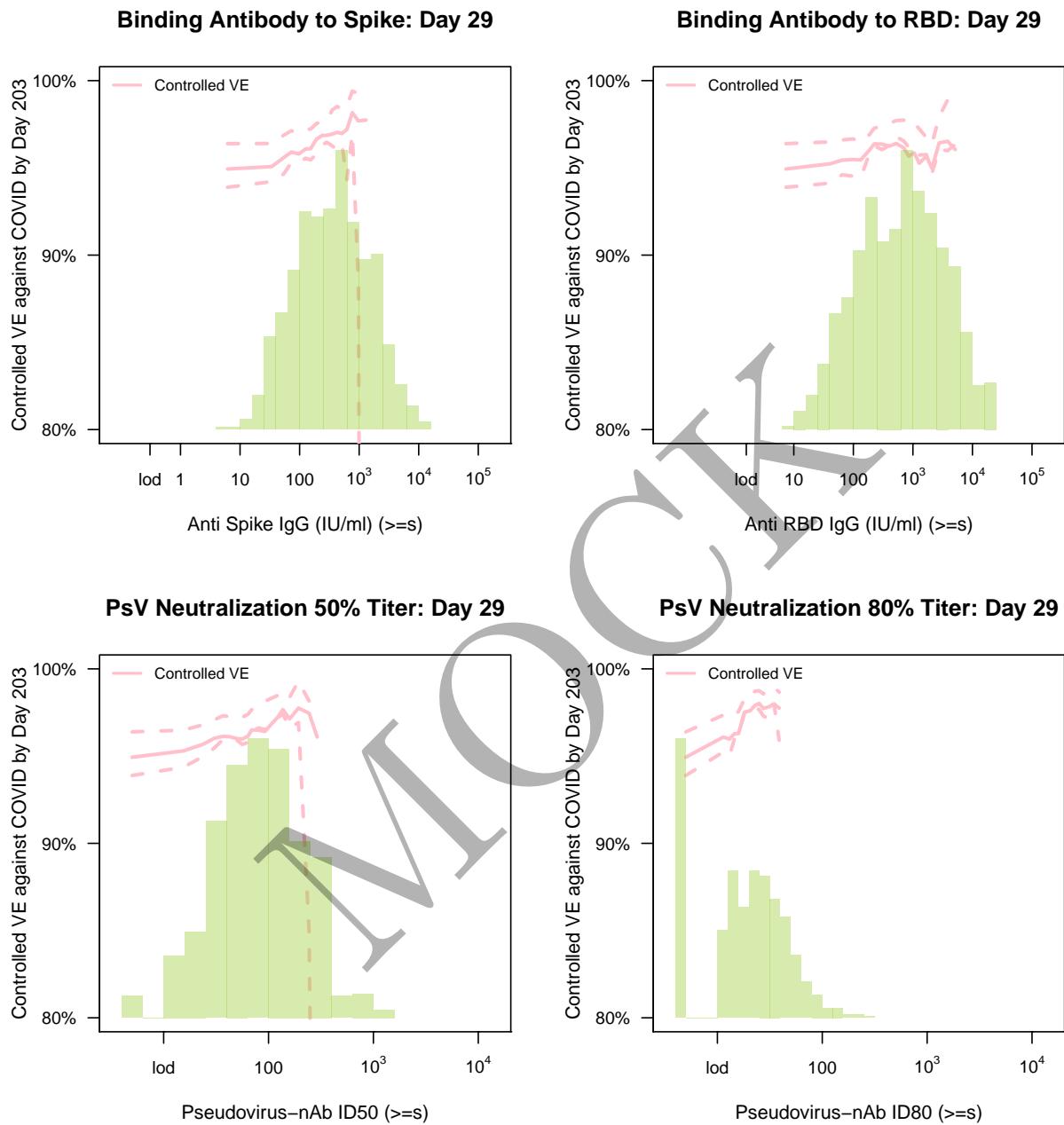


Figure 4.10: Controlled VE as functions of Day 29 markers ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid.  $l_{od} = 0.3, 1.6, 10, 10$  for bAb Spike, bAb RBD, PsV nAb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

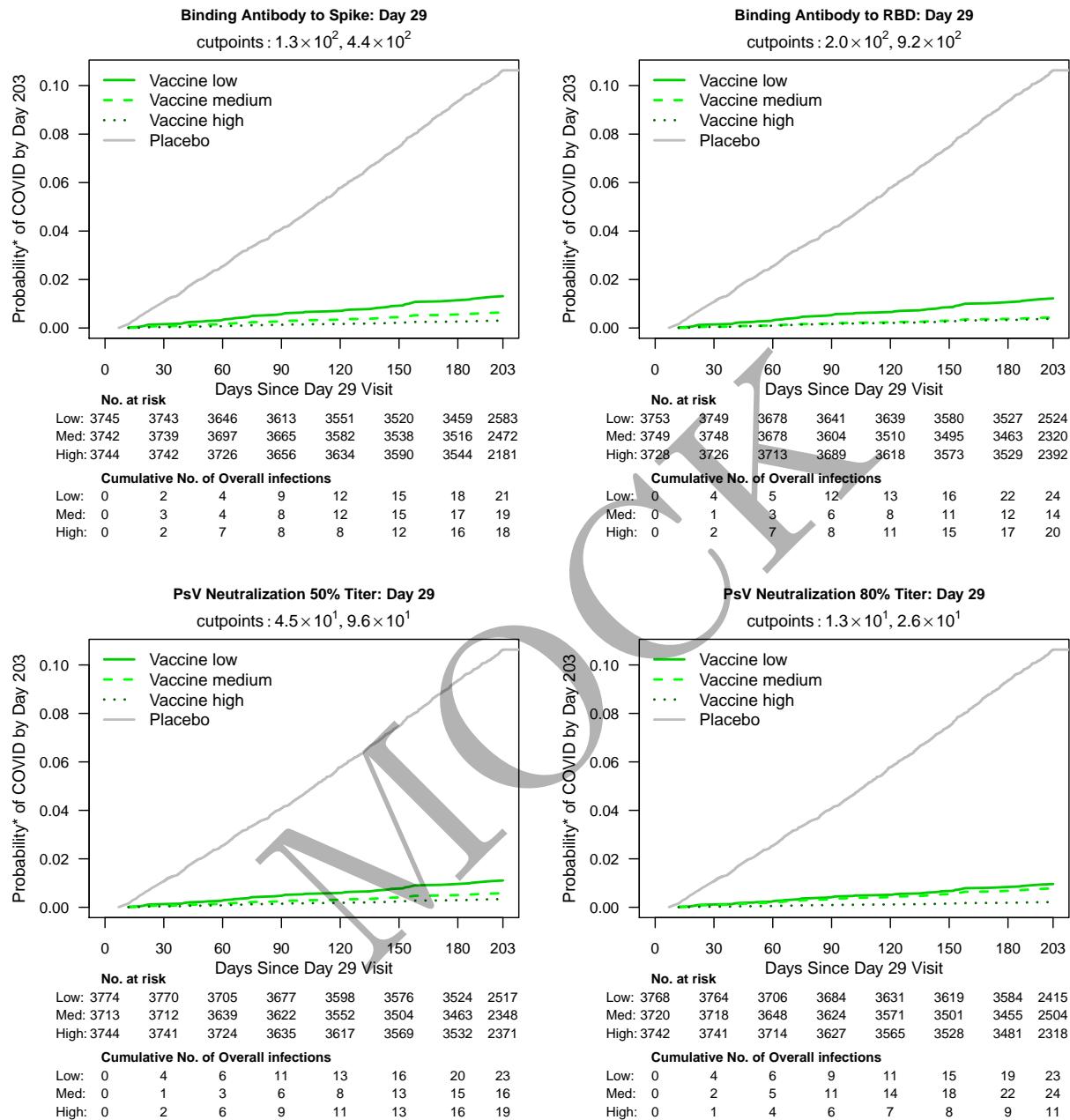


Figure 4.11: Marginalized cumulative incidence rate curves for trichotomized Day 29 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

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

MOCK

### 5.1.1 Day 57 Spike protein binding antibody

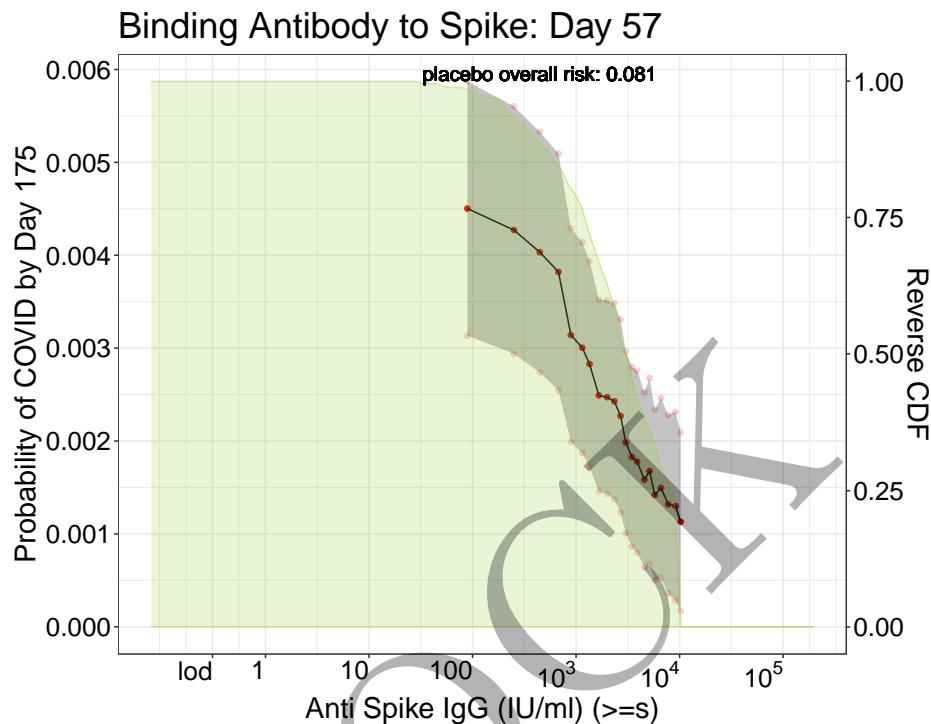


Figure 5.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

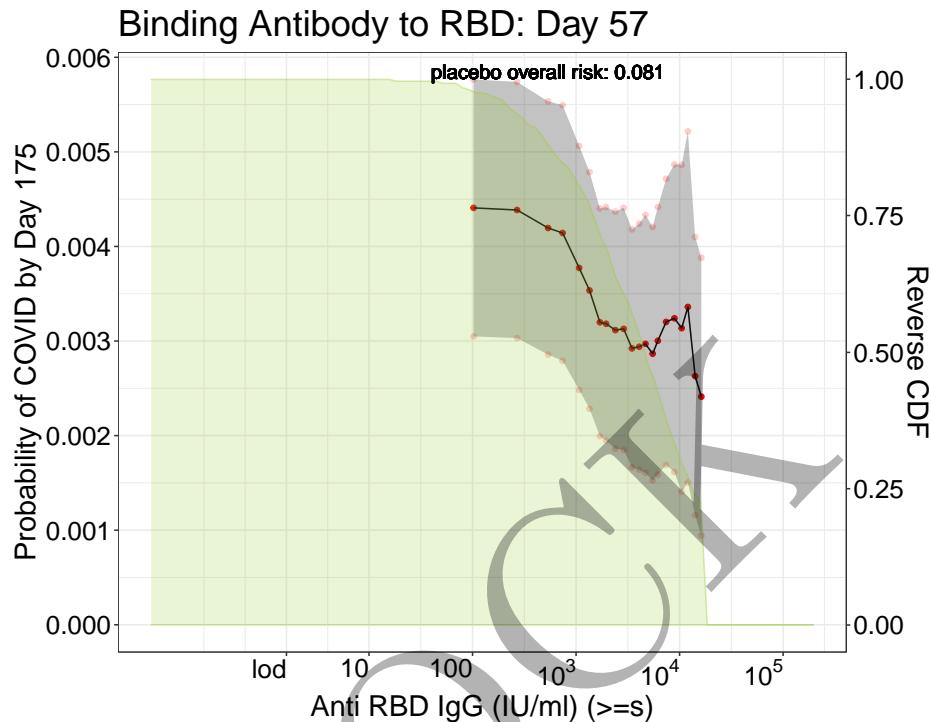


Figure 5.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

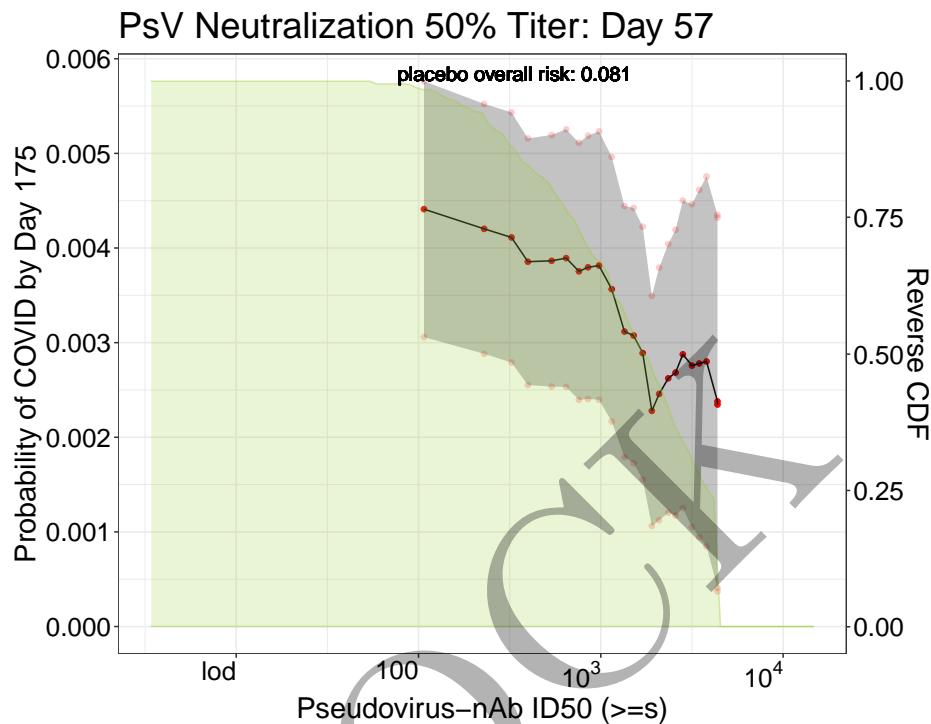


Figure 5.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

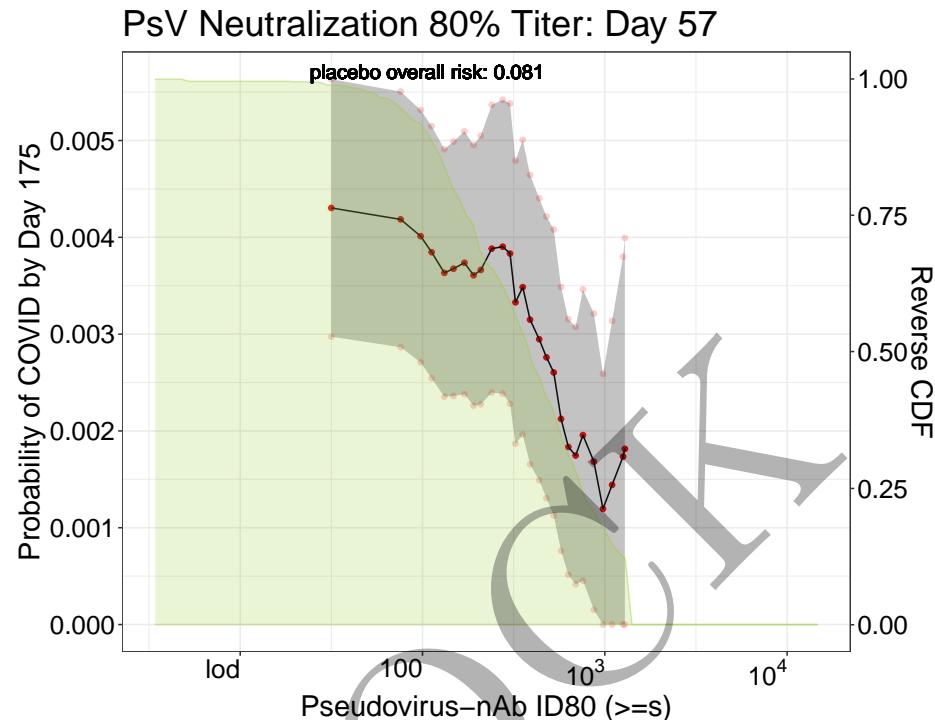


Figure 5.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

MOCK

### 5.2.1 Day 29 Spike protein antibody

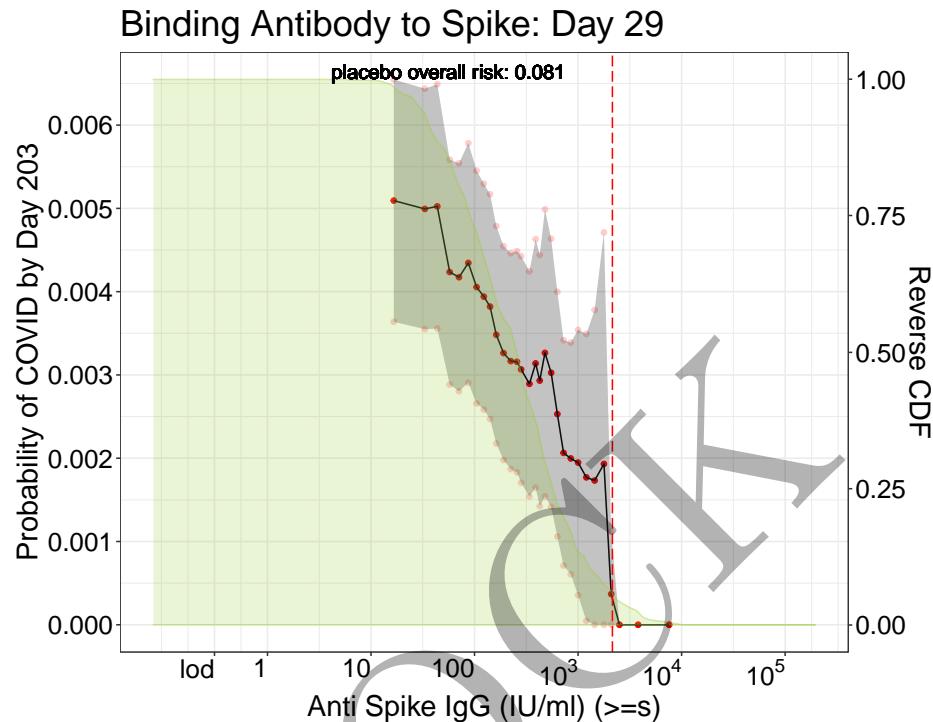


Figure 5.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

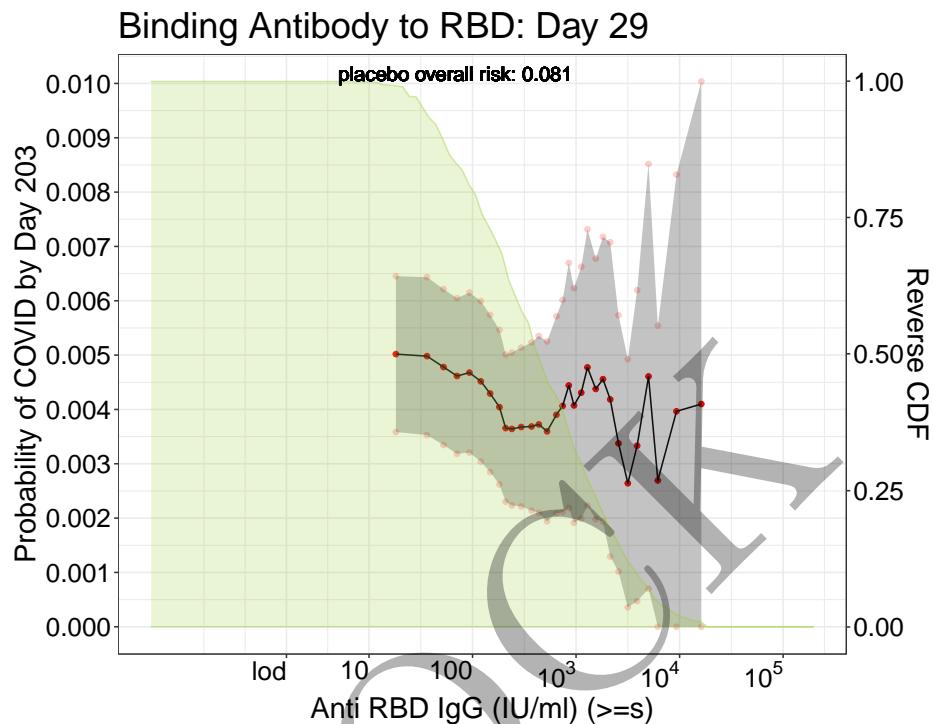


Figure 5.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

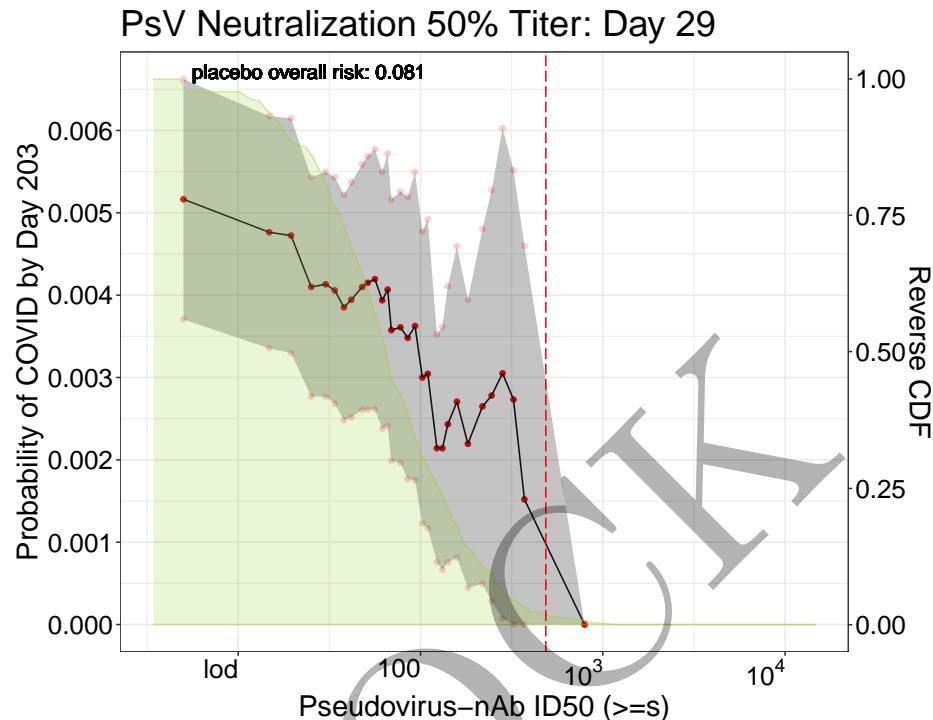


Figure 5.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

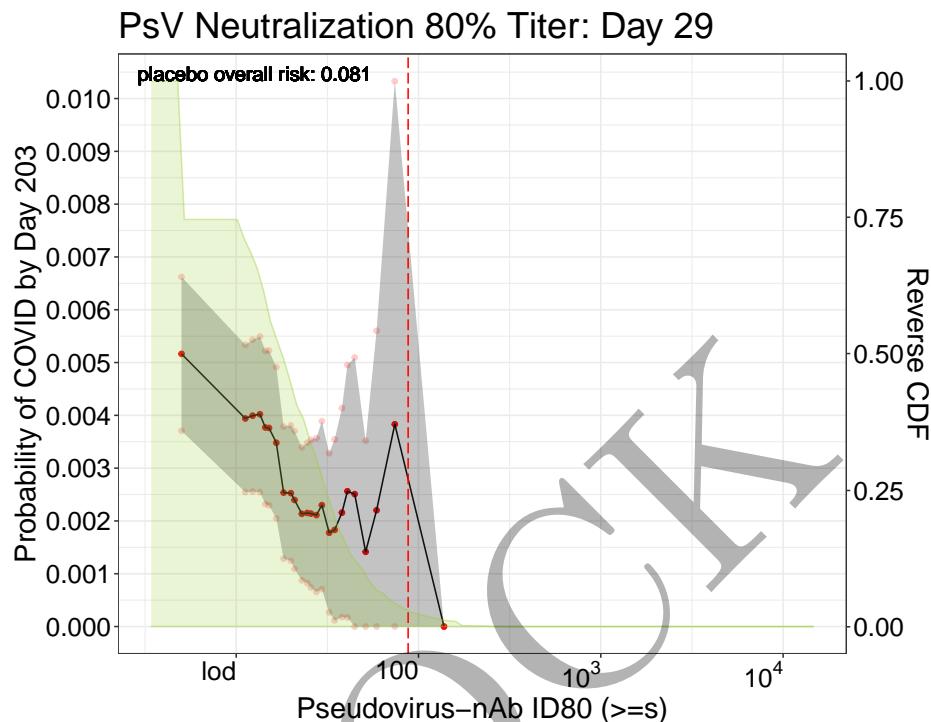


Figure 5.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

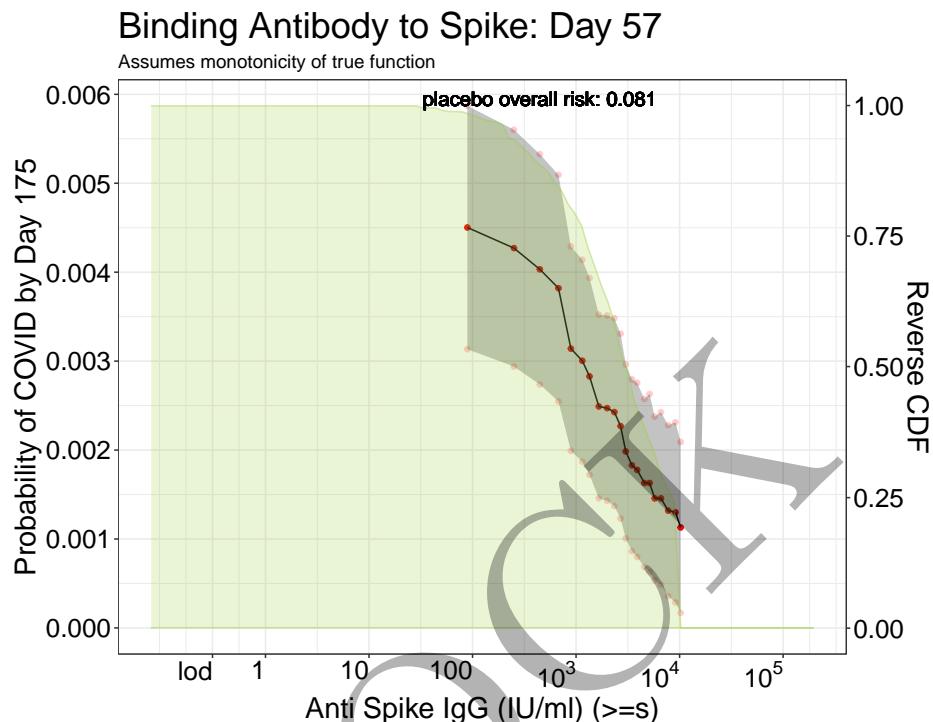


Figure 5.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted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

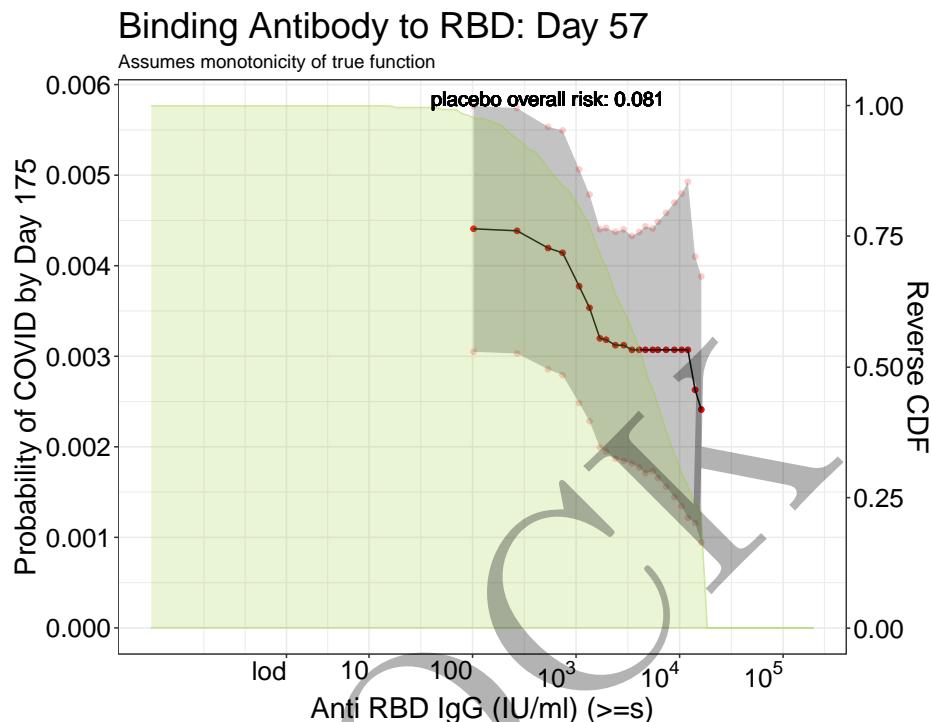


Figure 5.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using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

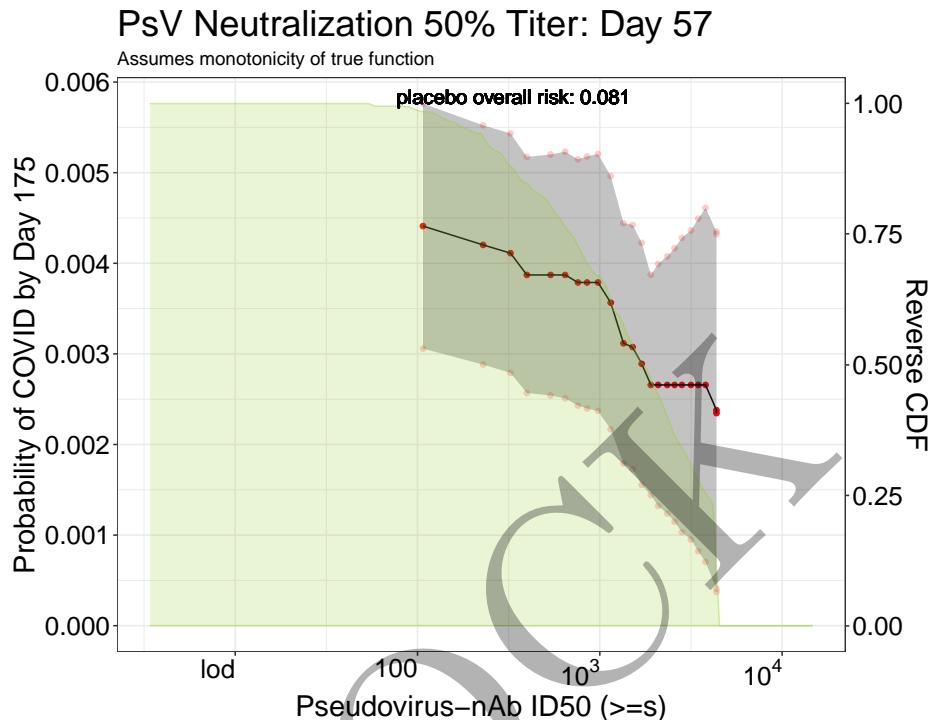


Figure 5.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

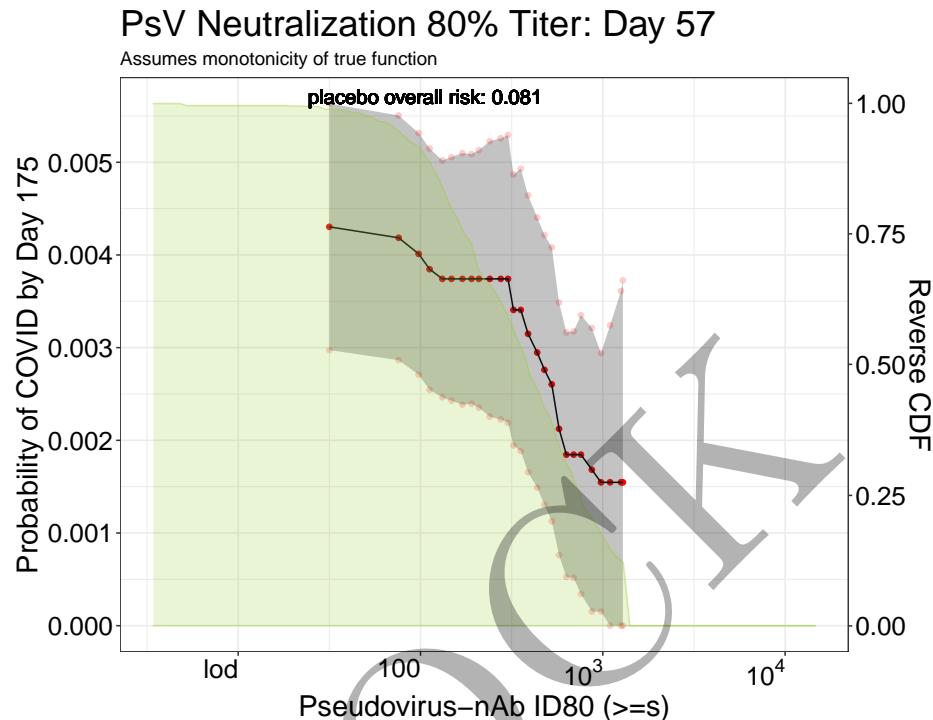


Figure 5.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

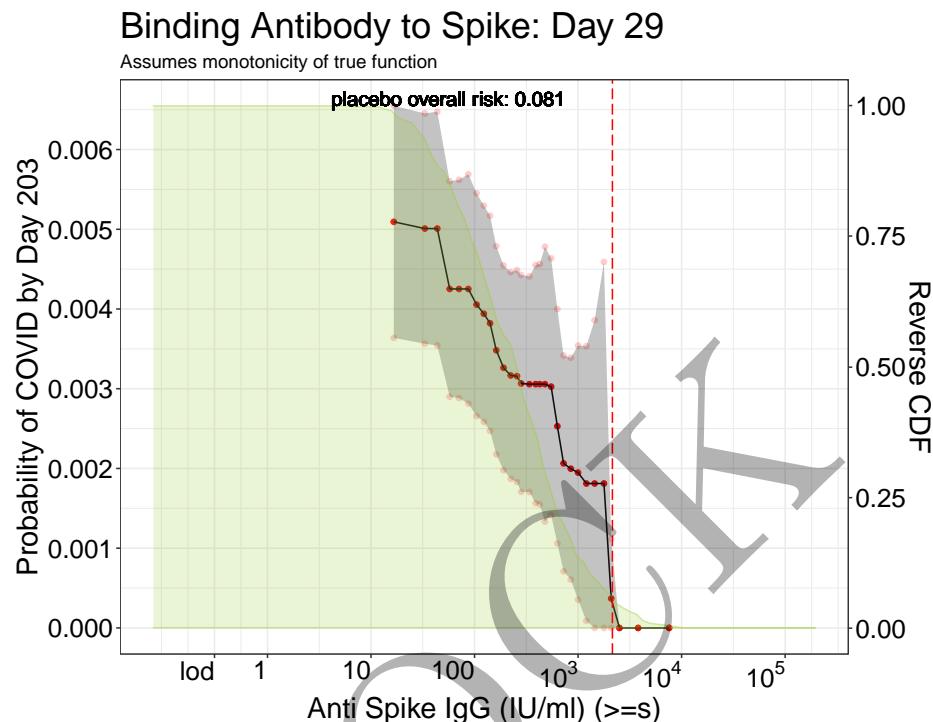


Figure 5.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using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

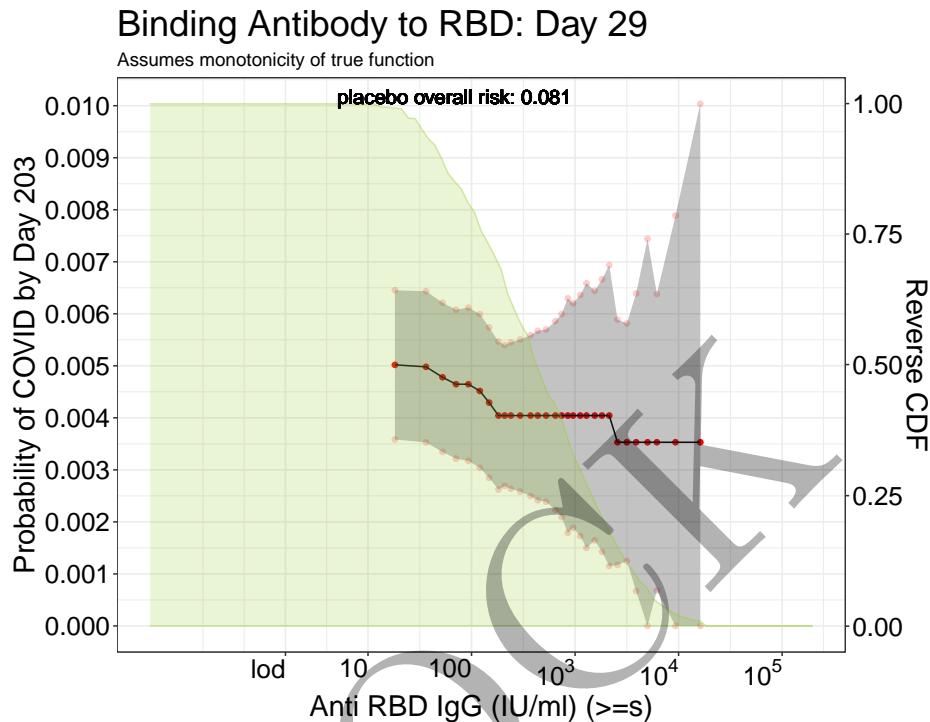


Figure 5.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using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

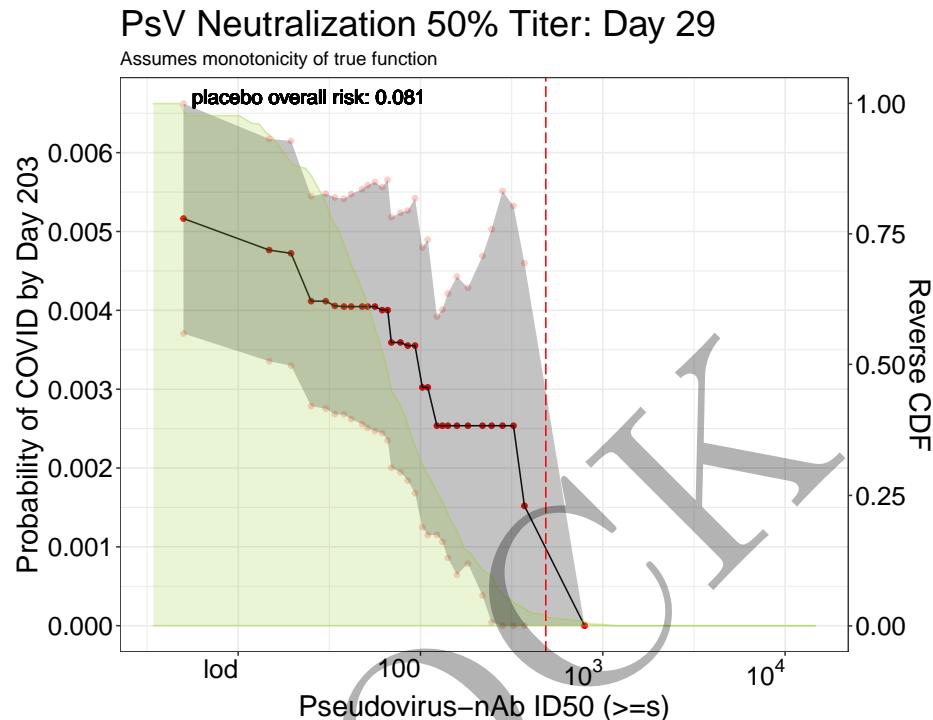


Figure 5.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

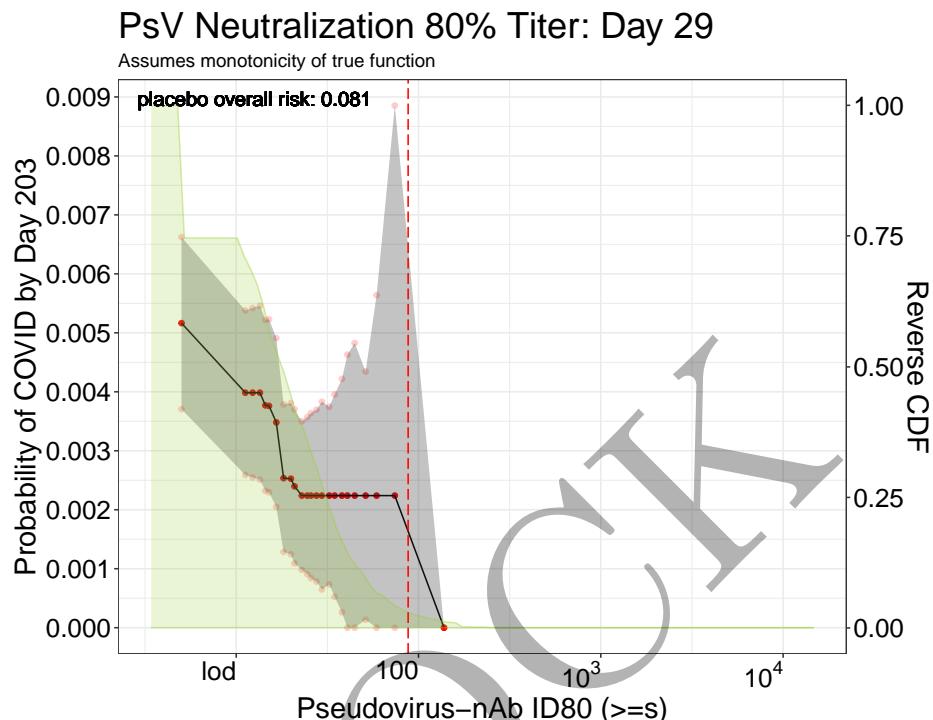


Figure 5.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

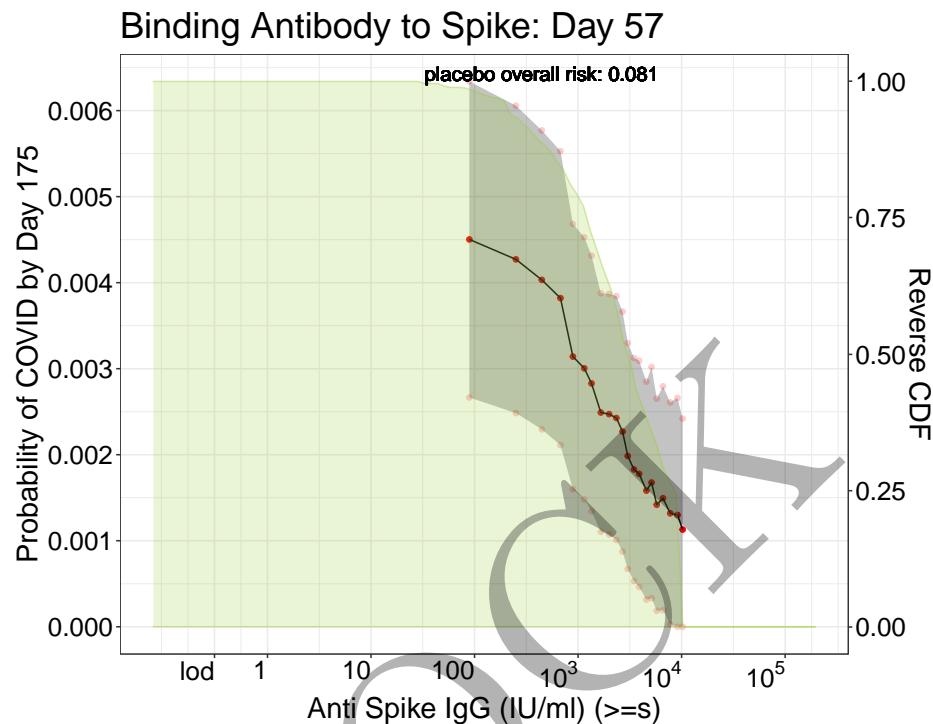


Figure 5.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

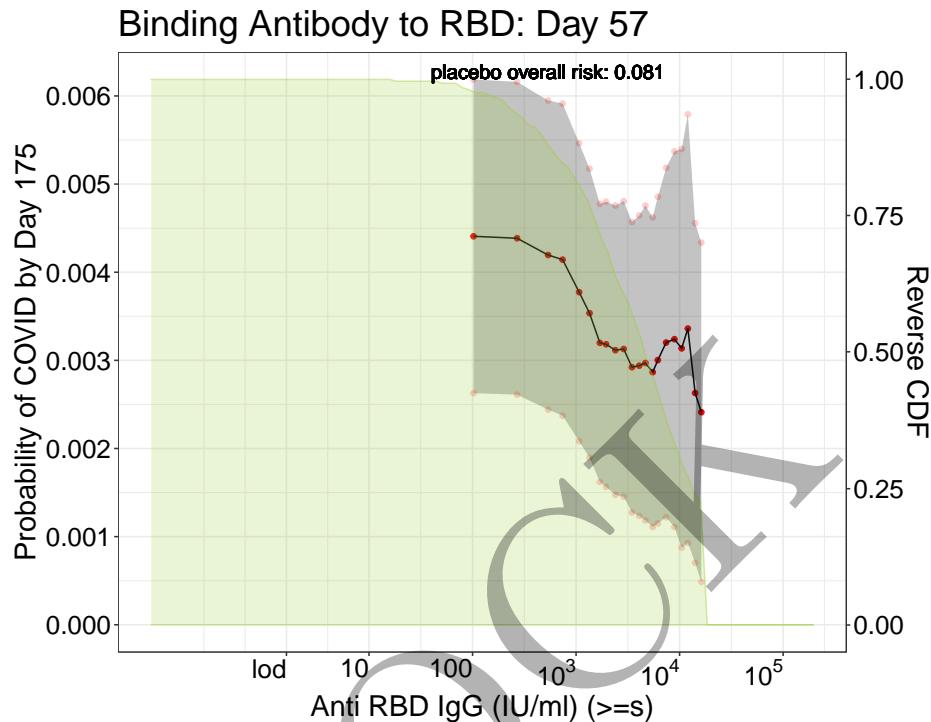


Figure 5.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

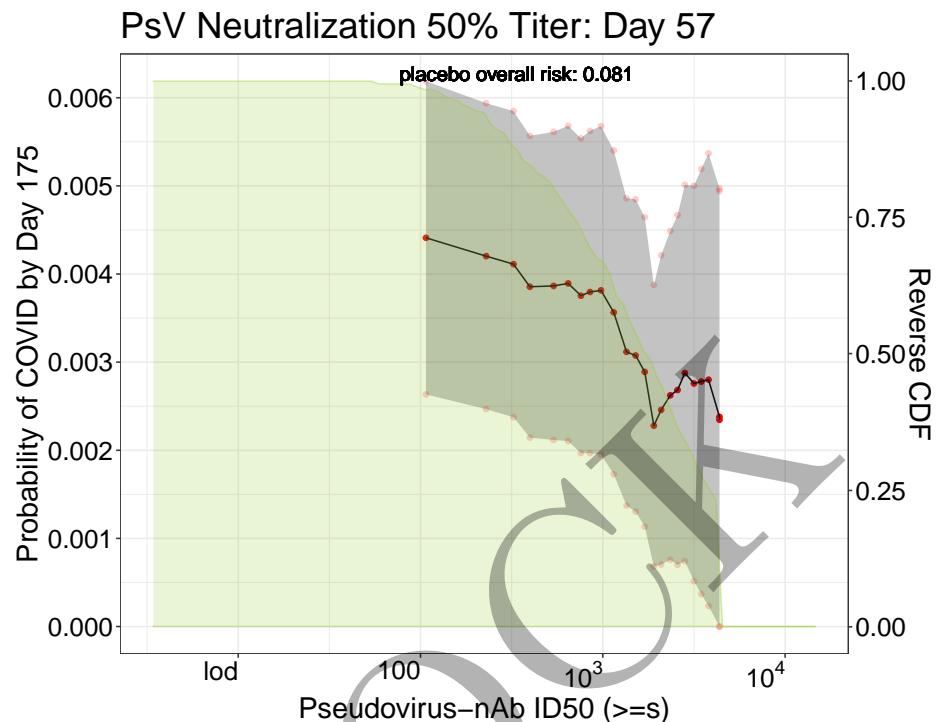


Figure 5.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

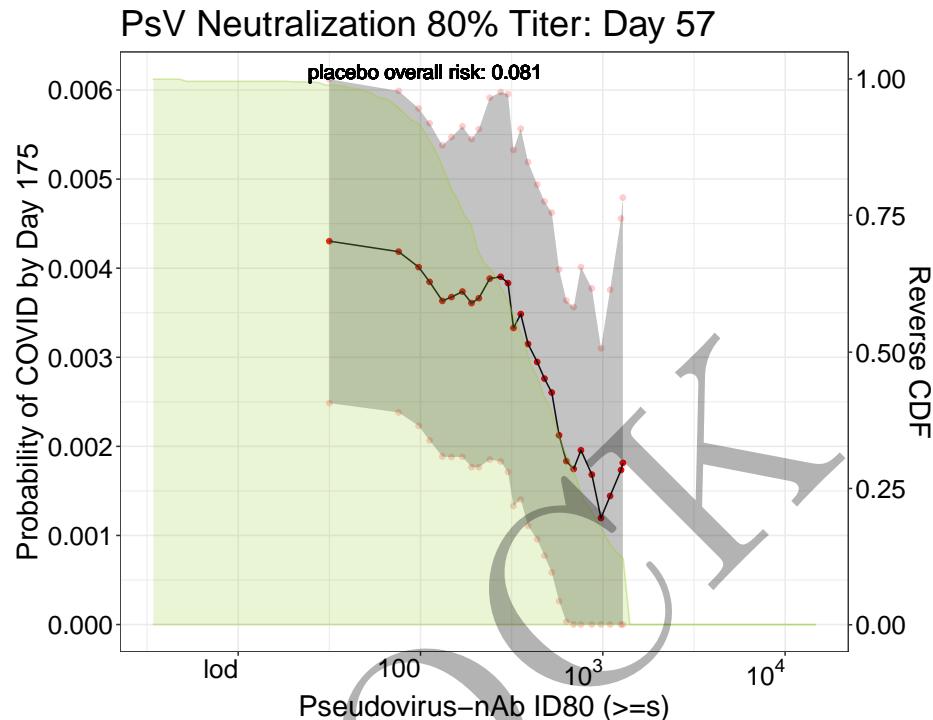


Figure 5.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

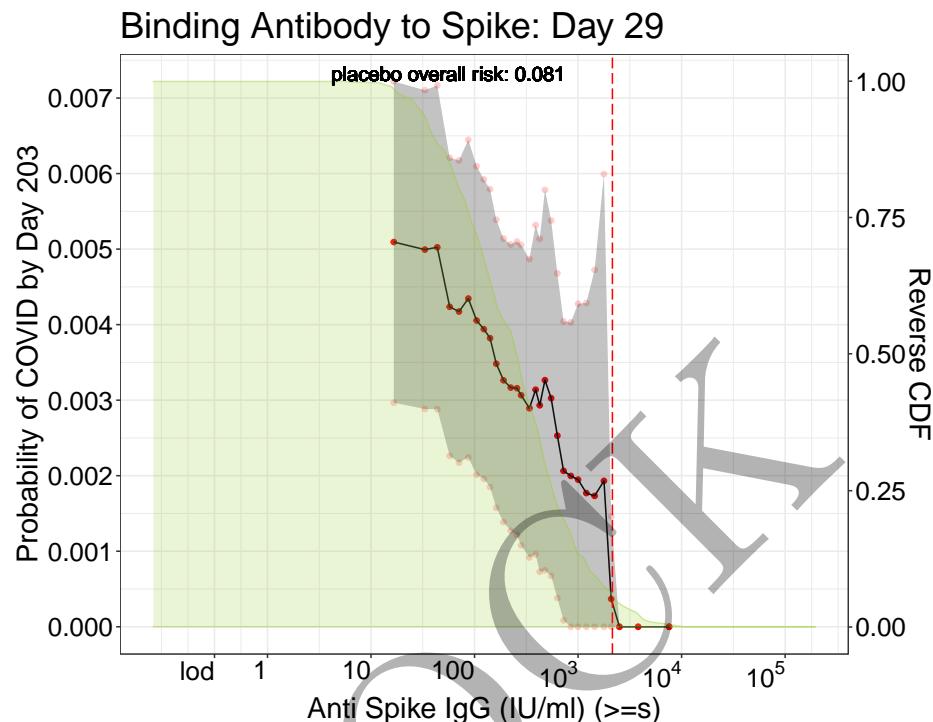


Figure 5.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

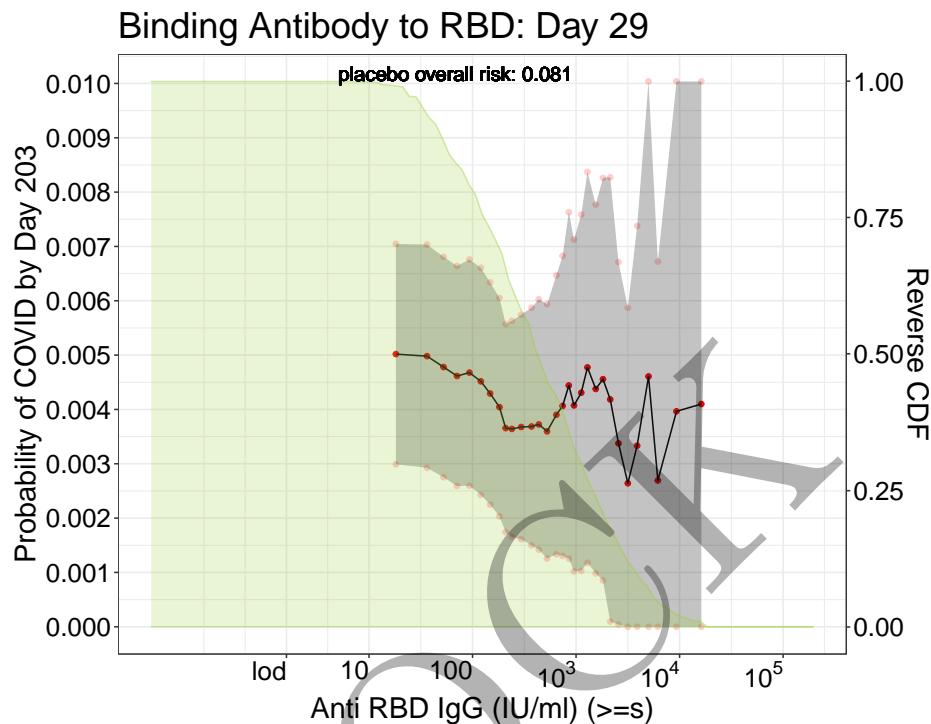


Figure 5.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

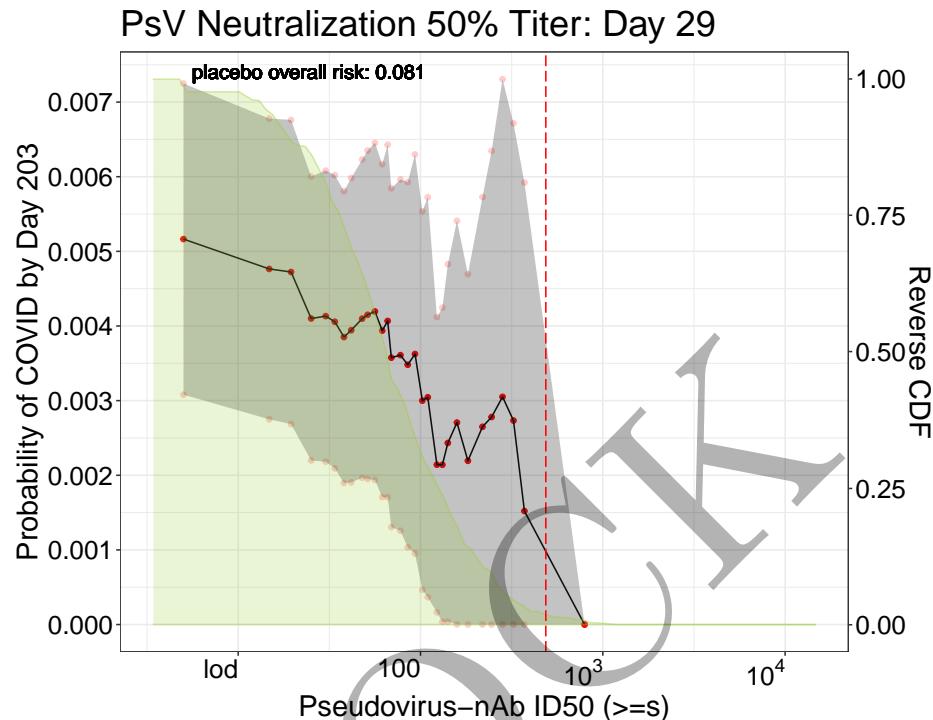


Figure 5.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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)

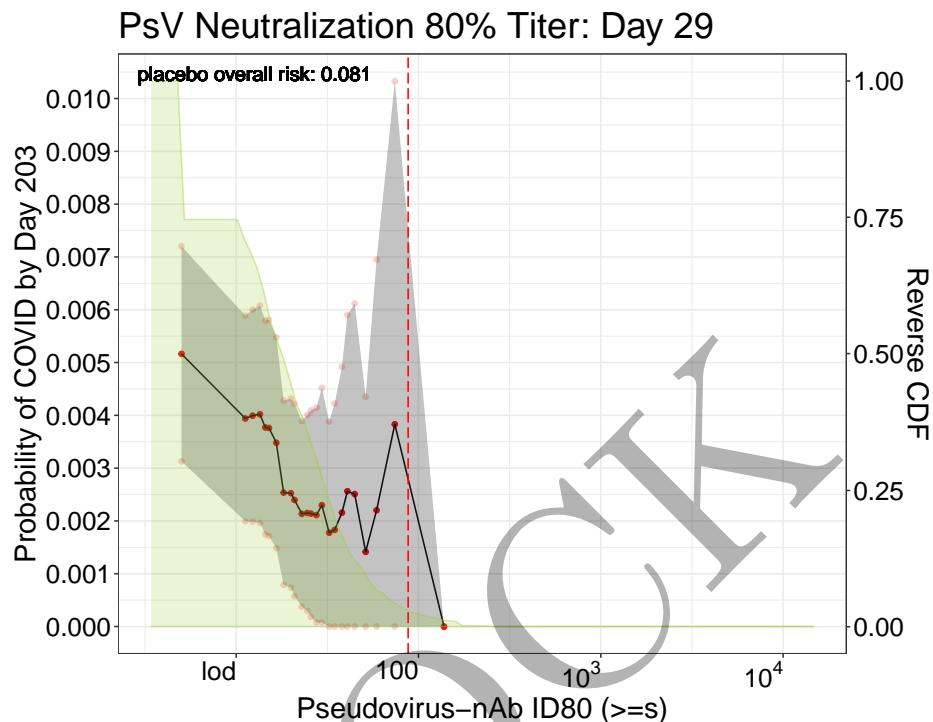


Figure 5.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

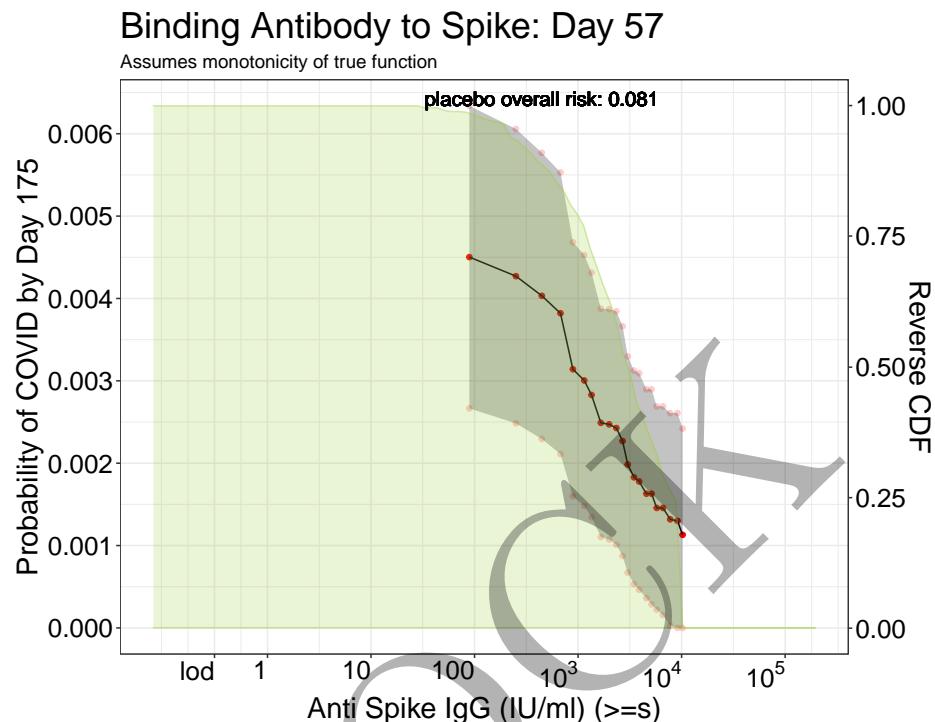


Figure 5.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are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

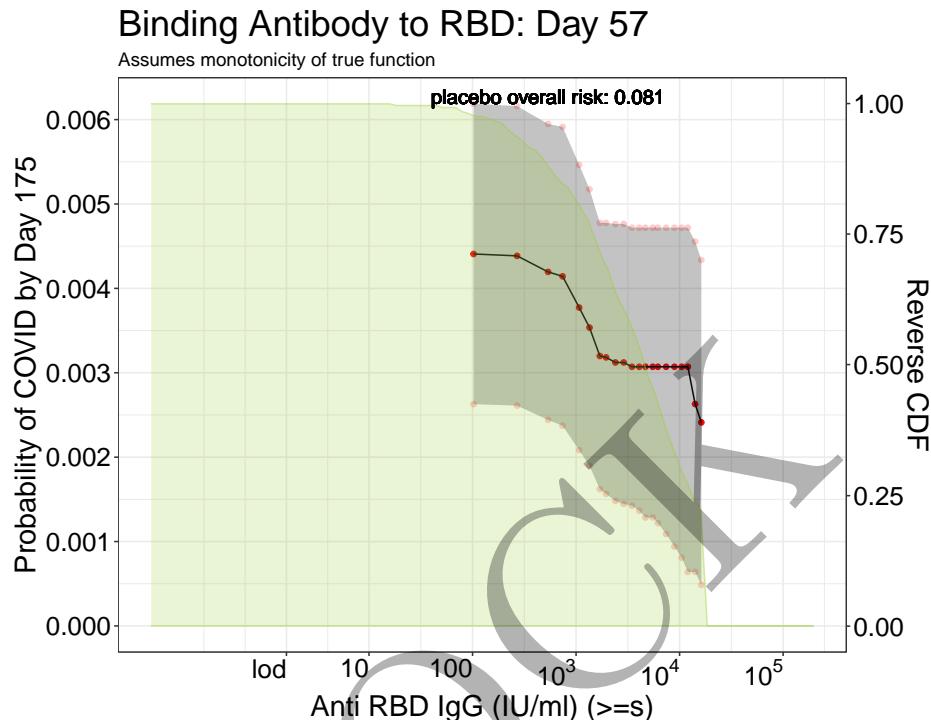


Figure 5.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted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

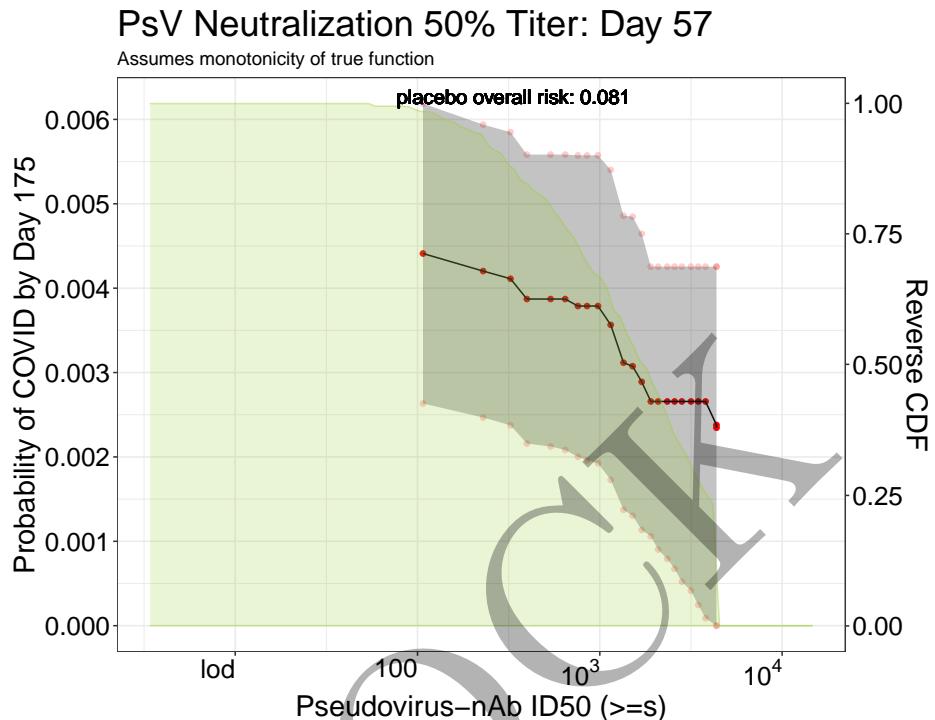


Figure 5.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

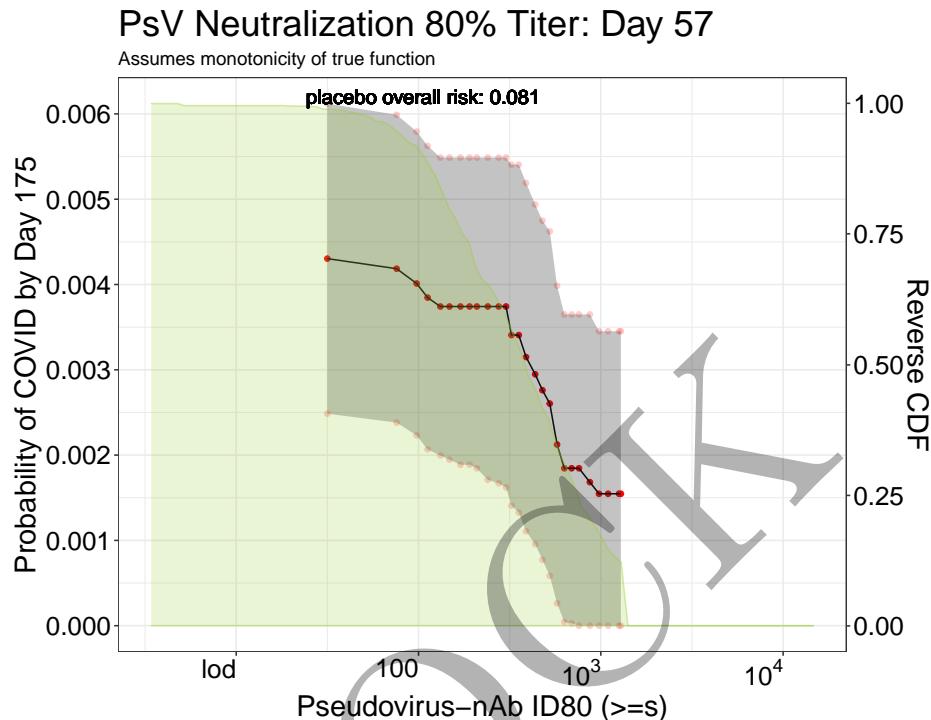


Figure 5.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence 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	$3.17 * 10^1$	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	0.00189	0.00560
2.379	$2.39 * 10^2$	0.00374	0.00171	0.00577
2.515	$3.27 * 10^2$	0.00341	0.00141	0.00540
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	$6.85 * 10^2$	0.00185	0.00003	0.00366
2.994	$9.86 * 10^2$	0.00155	0.00000	0.00345
3.112	$1.29 * 10^3$	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

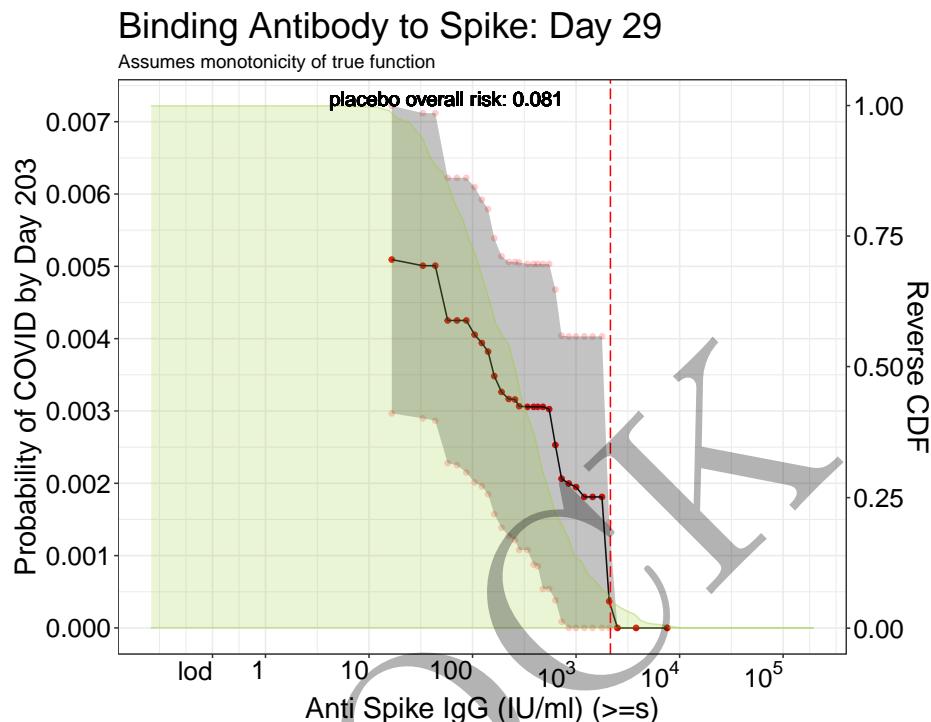


Figure 5.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted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

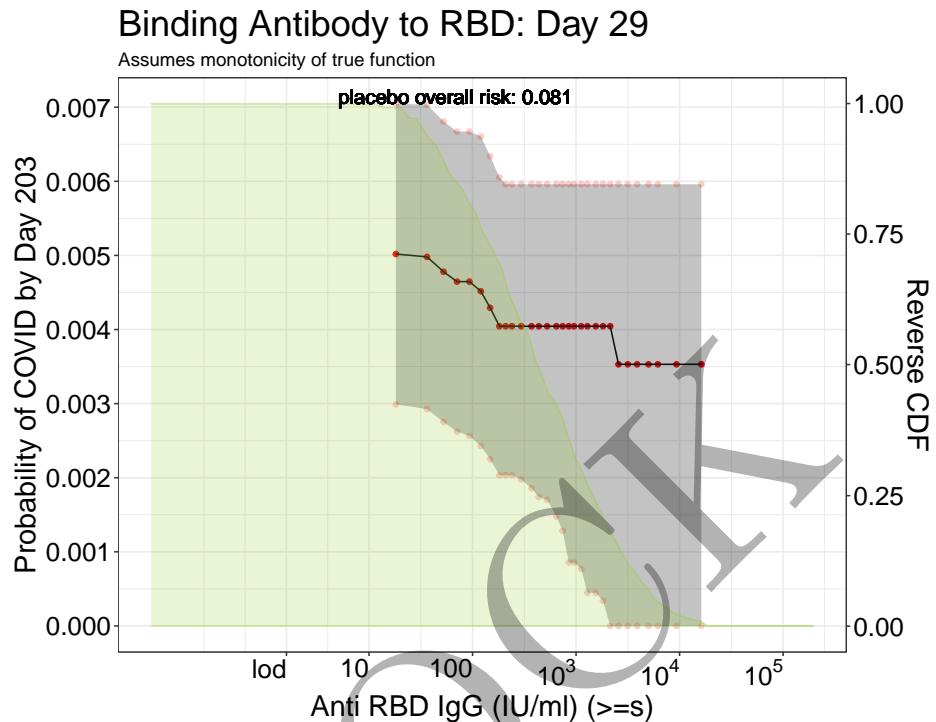


Figure 5.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted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

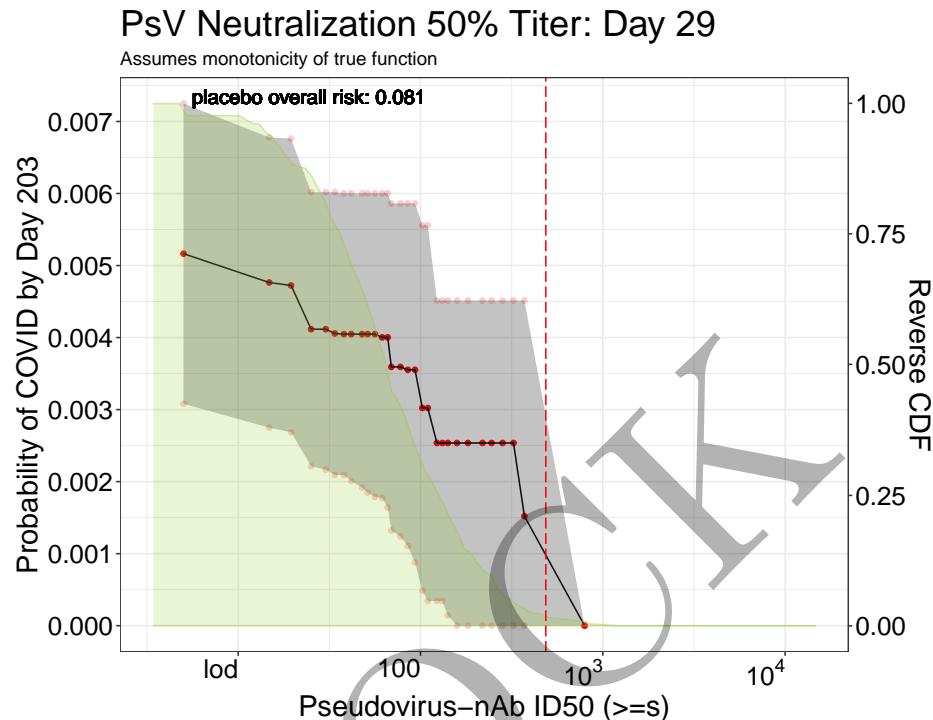


Figure 5.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

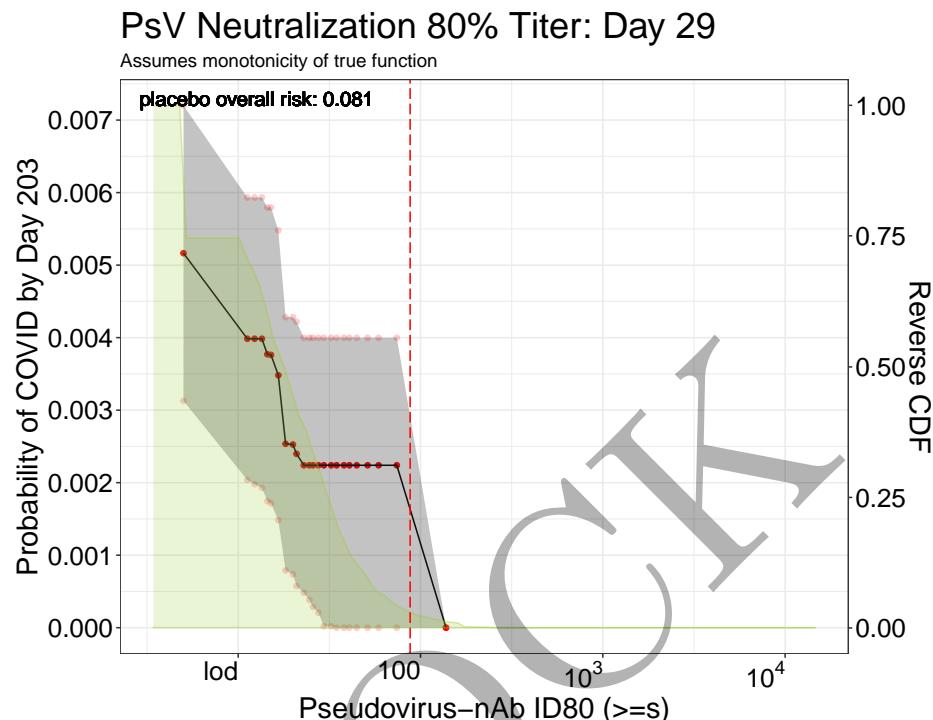


Figure 5.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence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

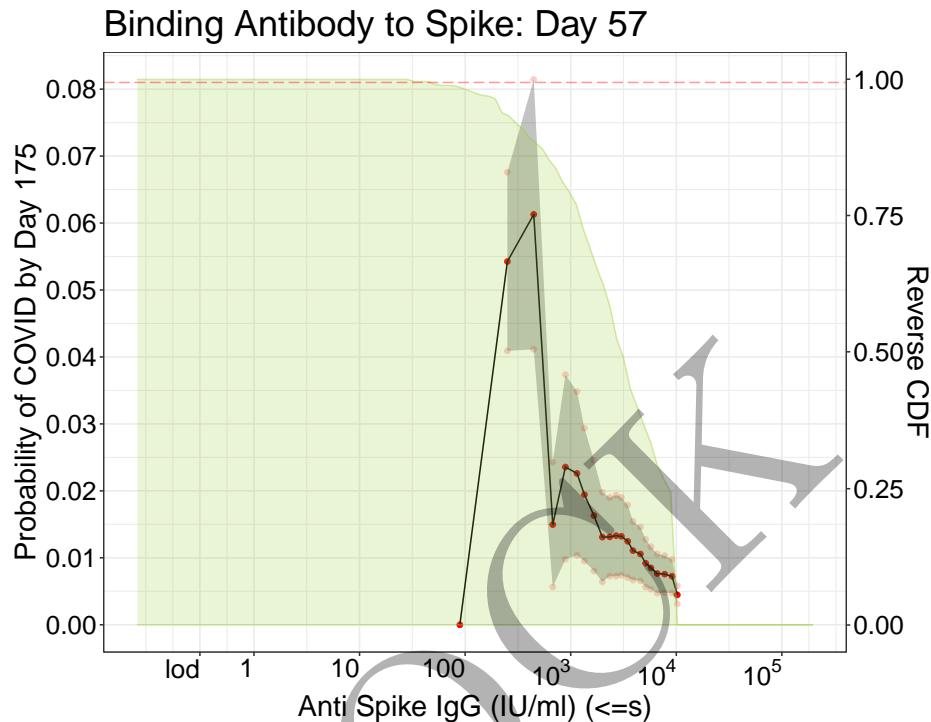


Figure 6.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

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

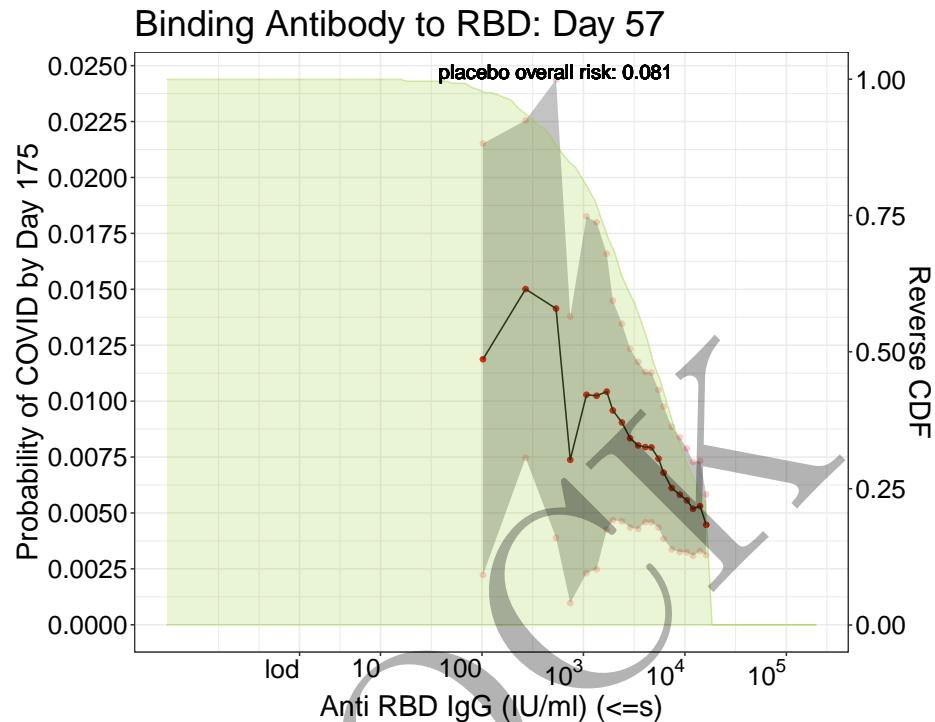


Figure 6.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

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)

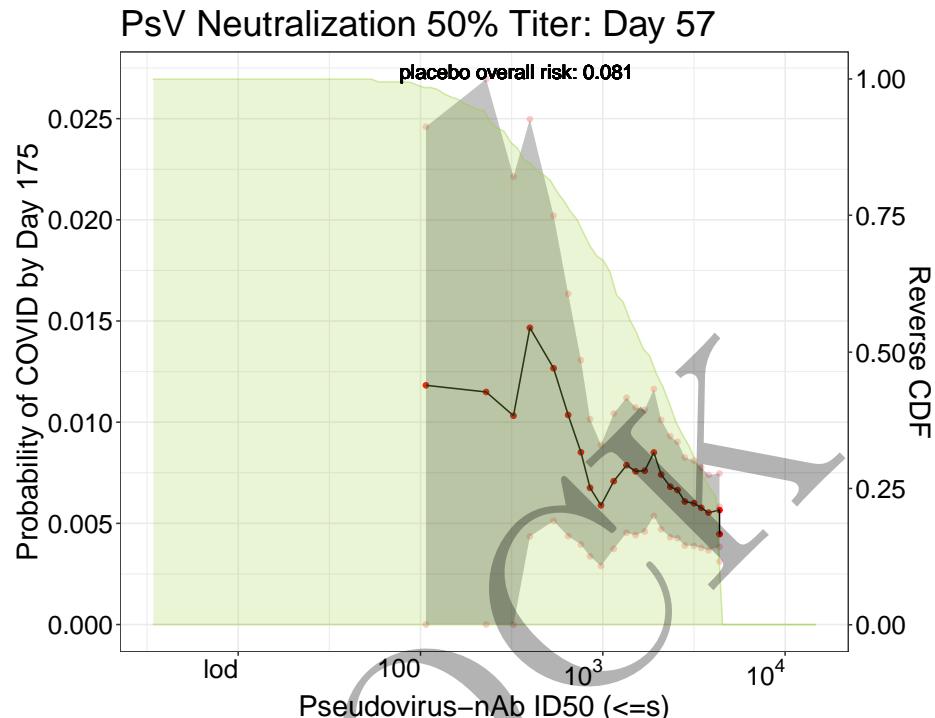


Figure 6.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

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)

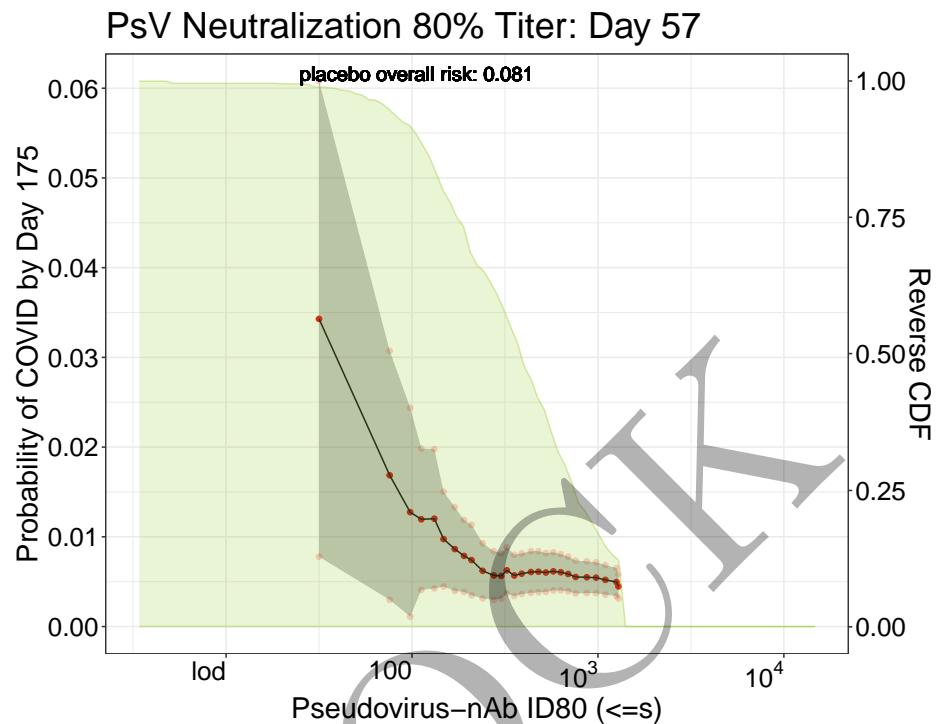


Figure 6.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

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

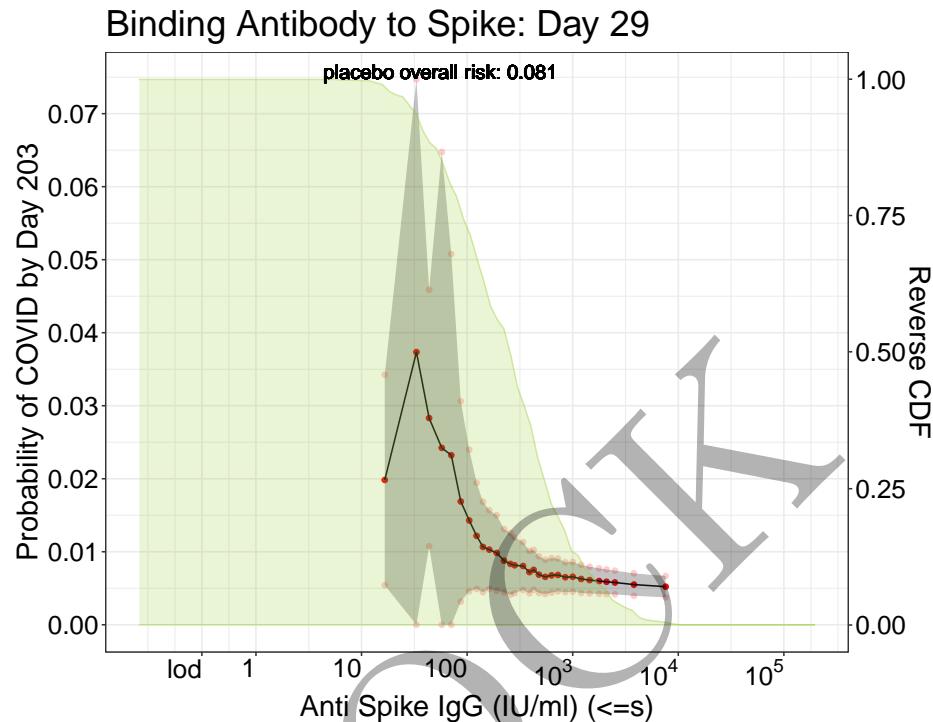


Figure 6.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

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

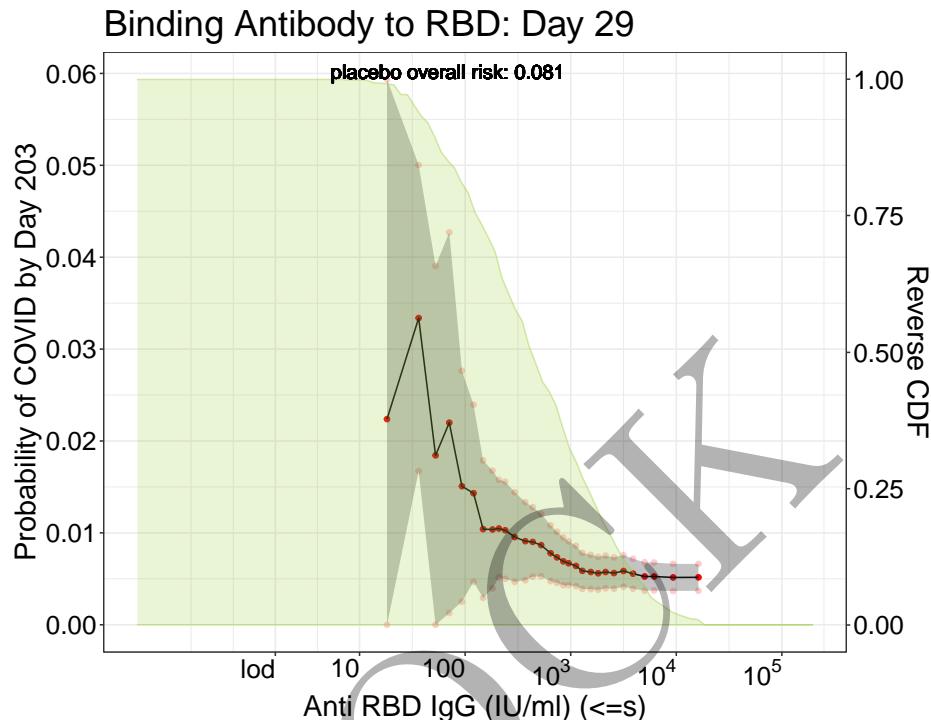


Figure 6.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

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)

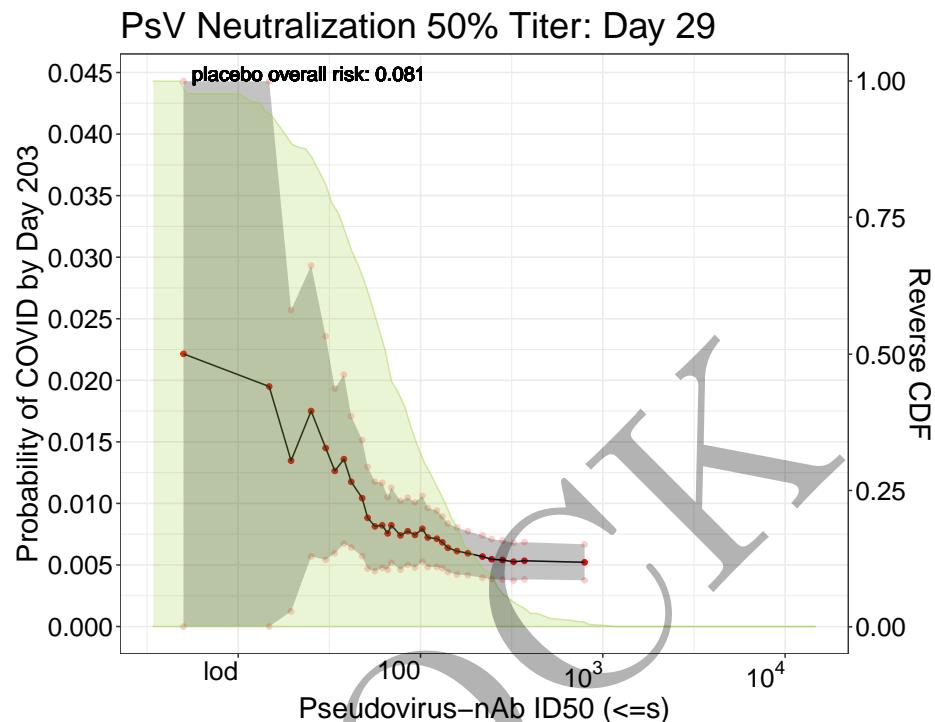


Figure 6.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

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)

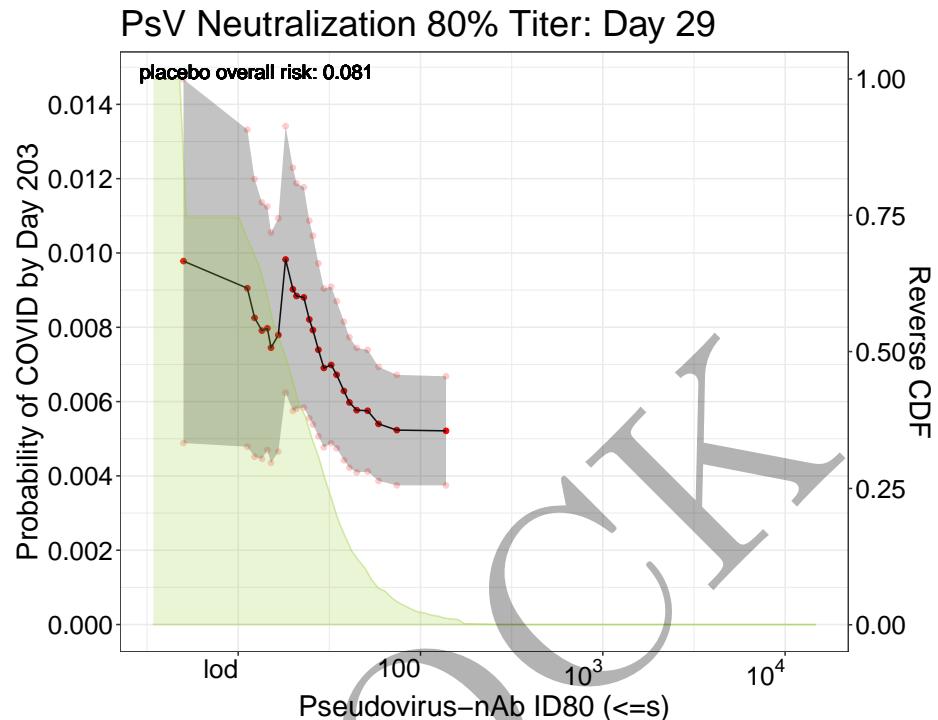


Figure 6.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

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

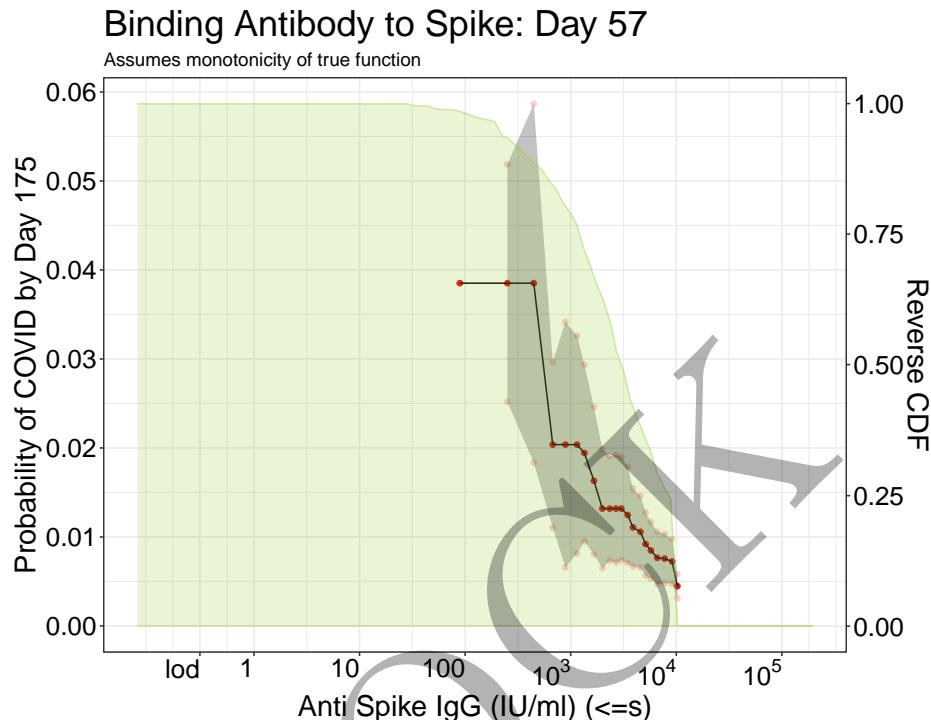


Figure 6.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

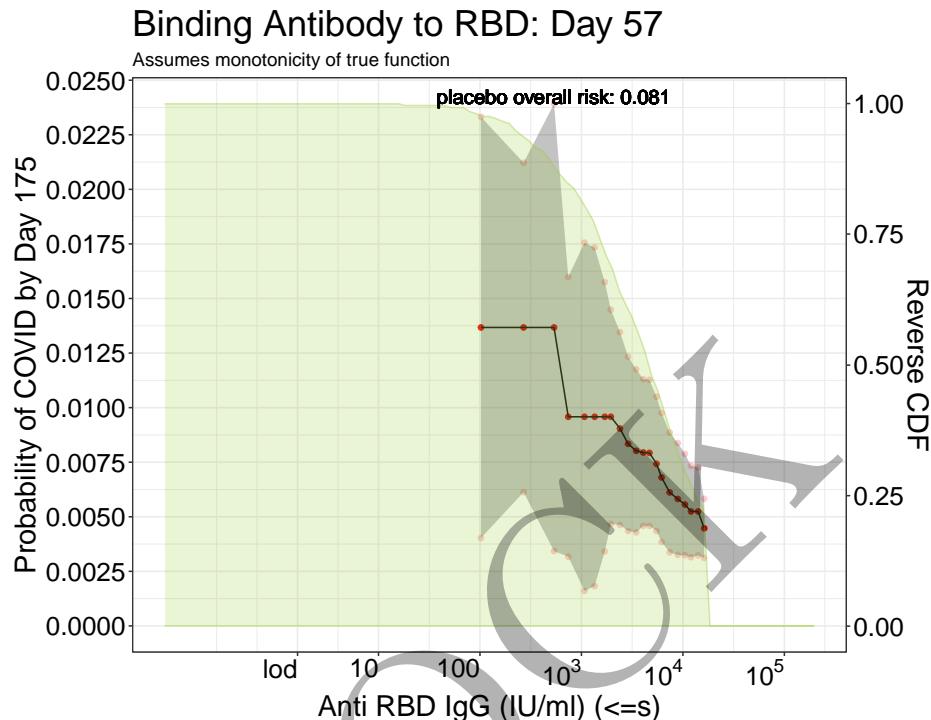


Figure 6.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

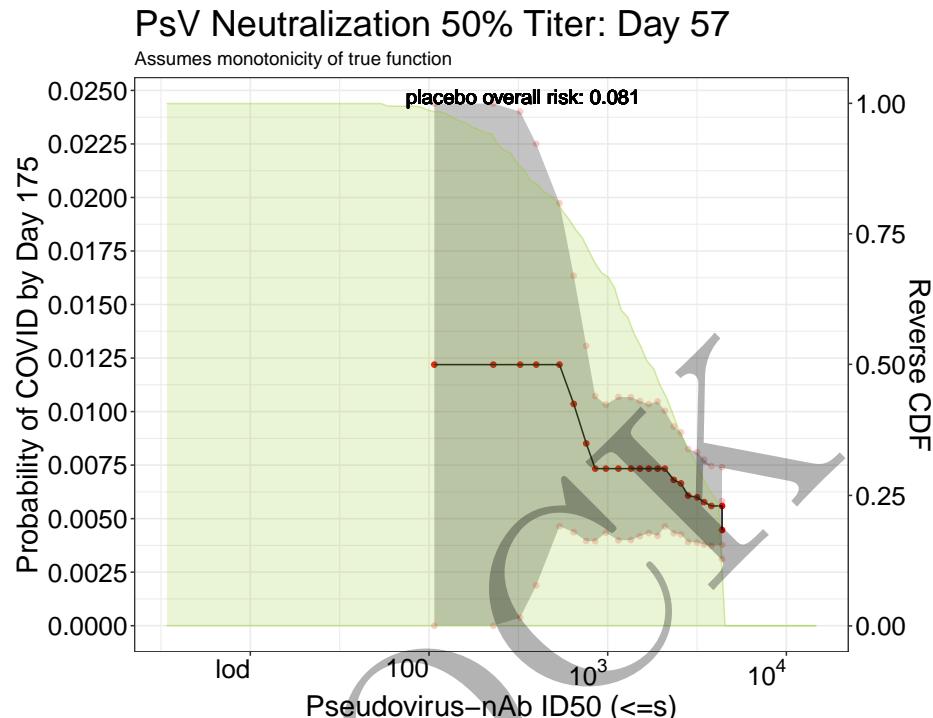


Figure 6.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

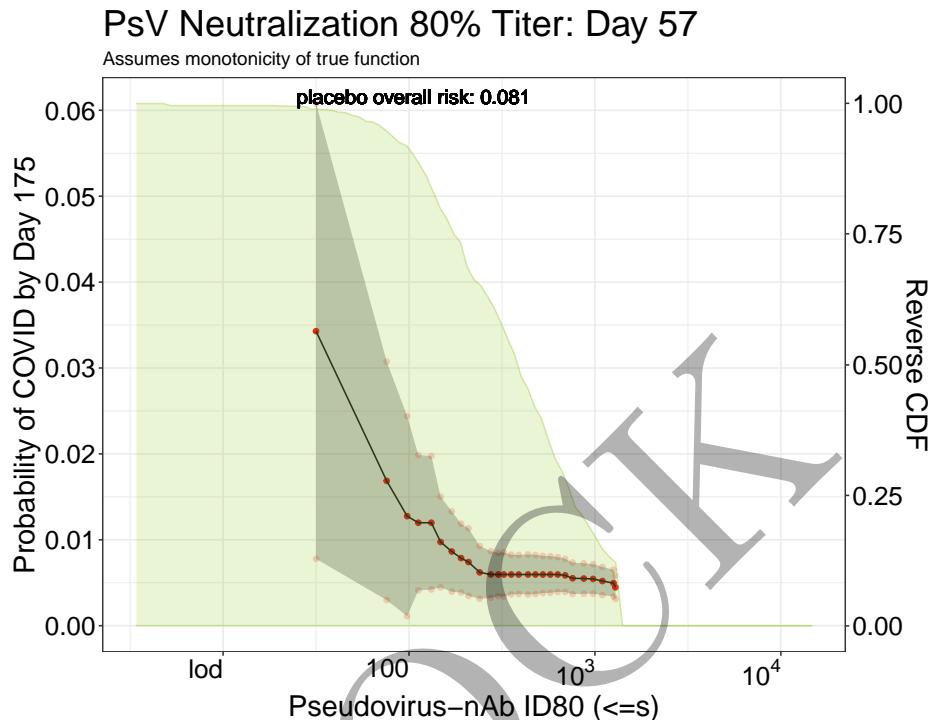


Figure 6.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

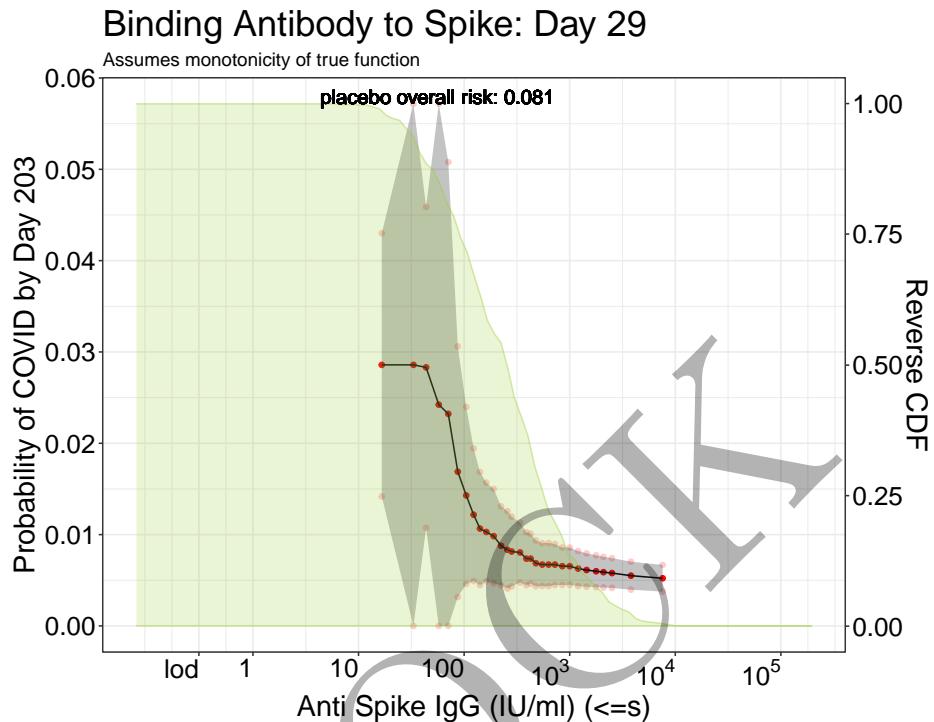


Figure 6.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

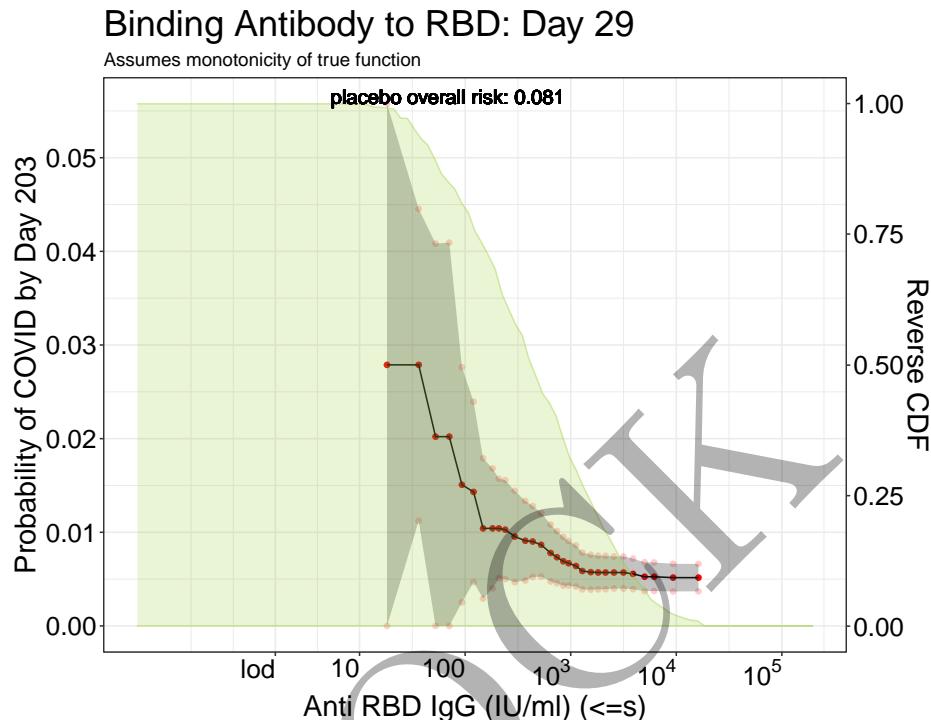


Figure 6.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

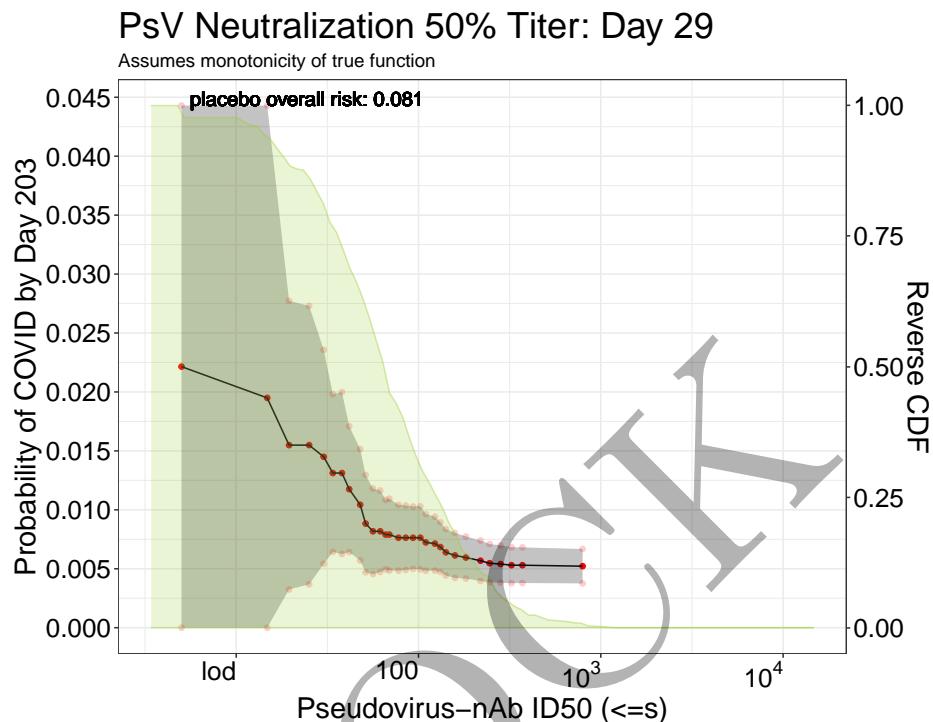


Figure 6.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

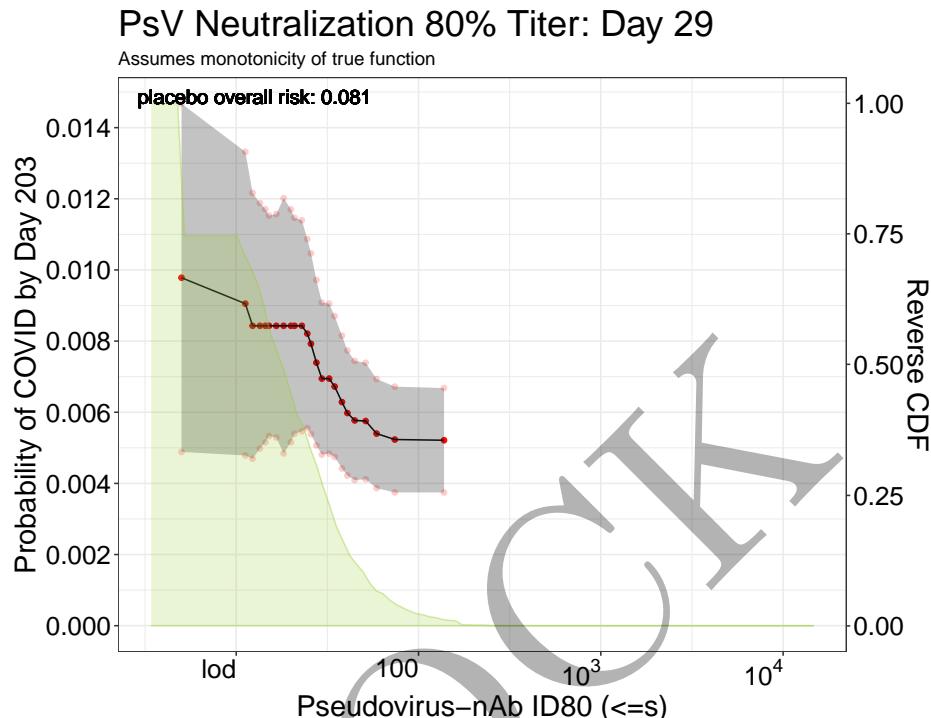


Figure 6.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

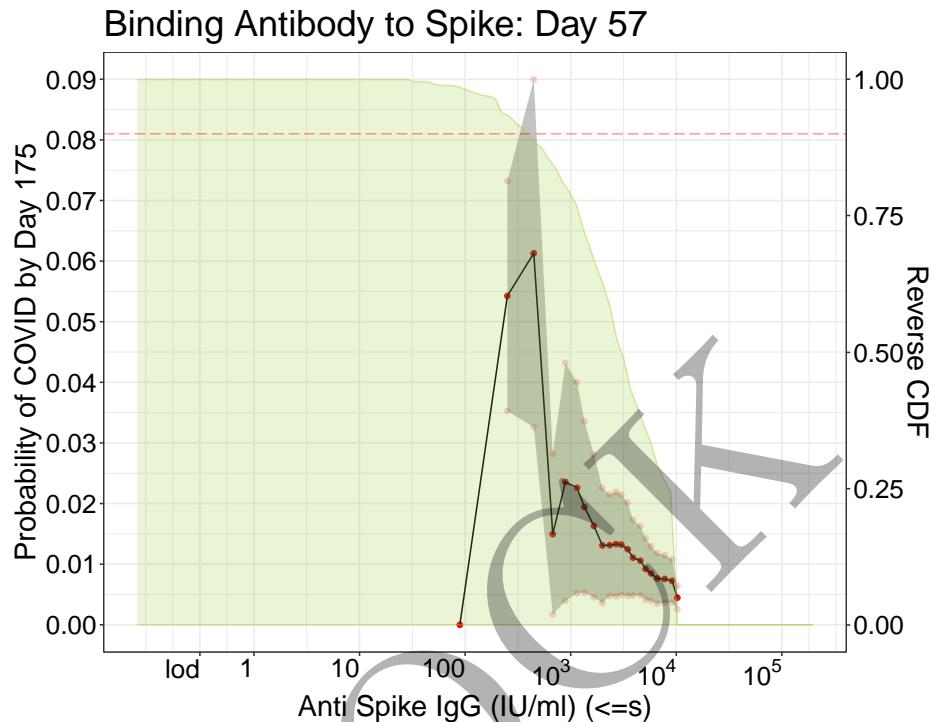


Figure 6.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

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

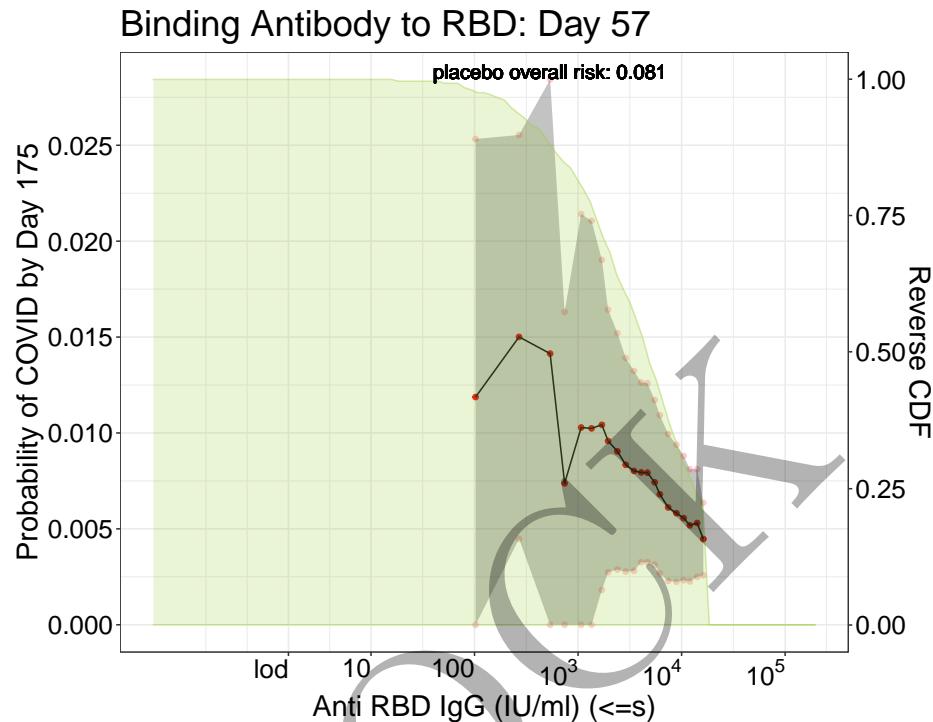


Figure 6.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

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)

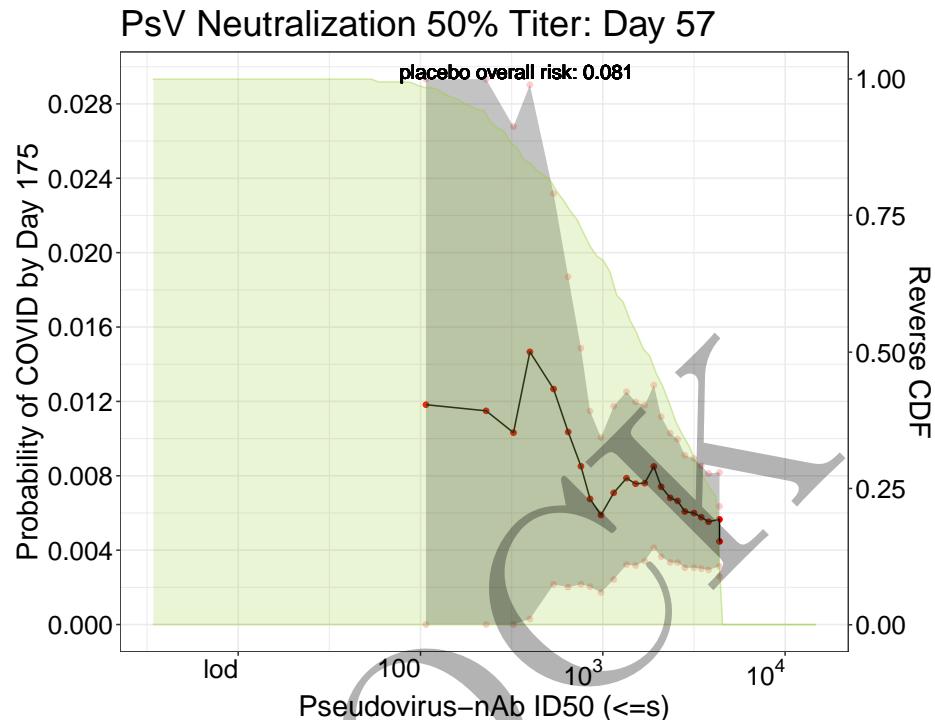


Figure 6.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

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)

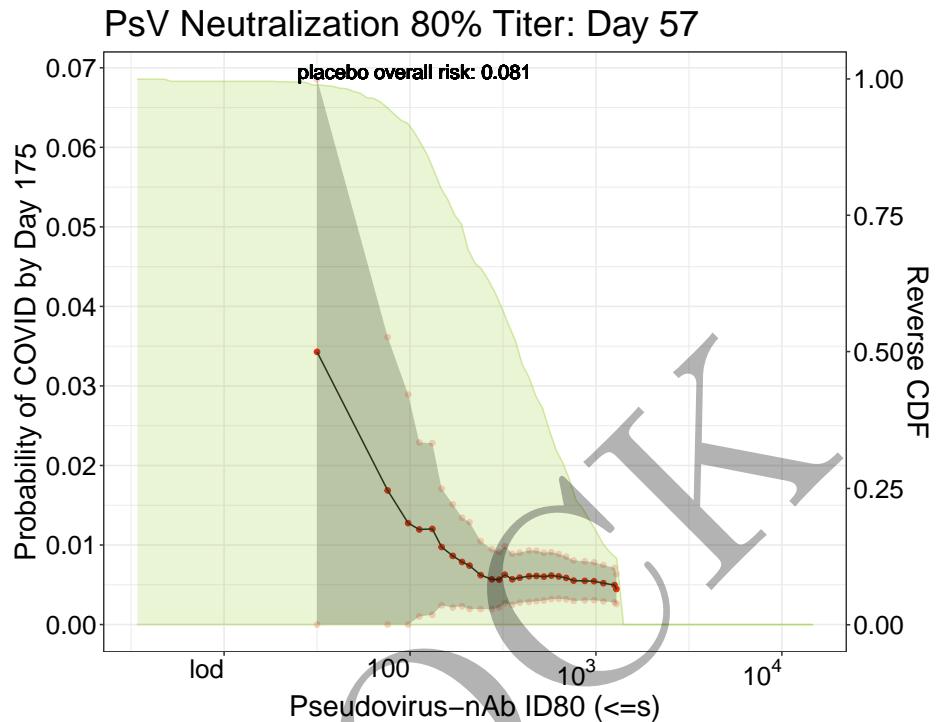


Figure 6.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

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

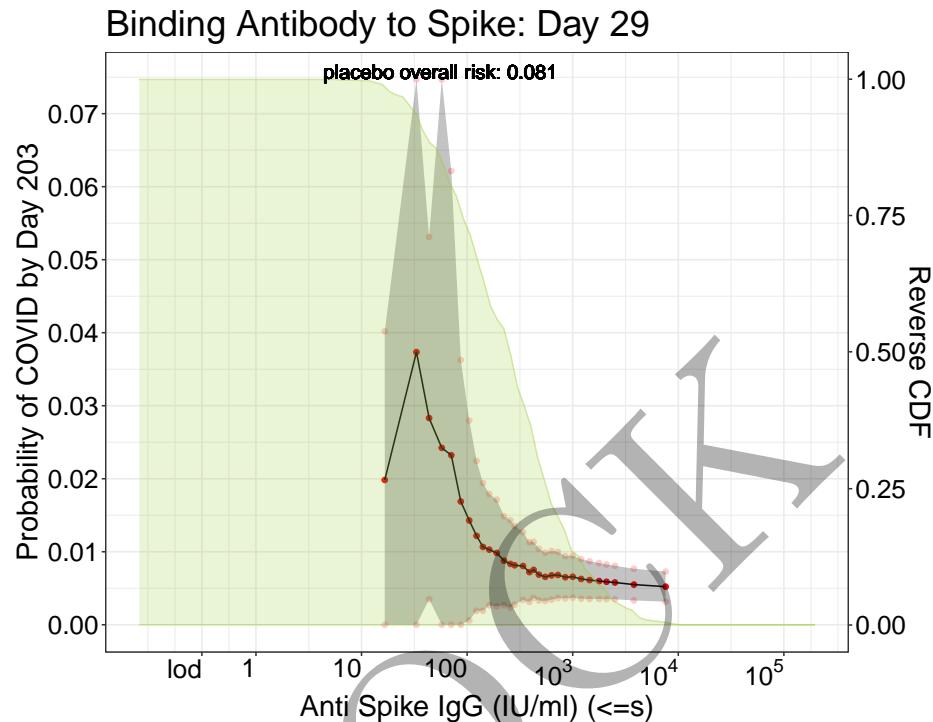


Figure 6.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

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

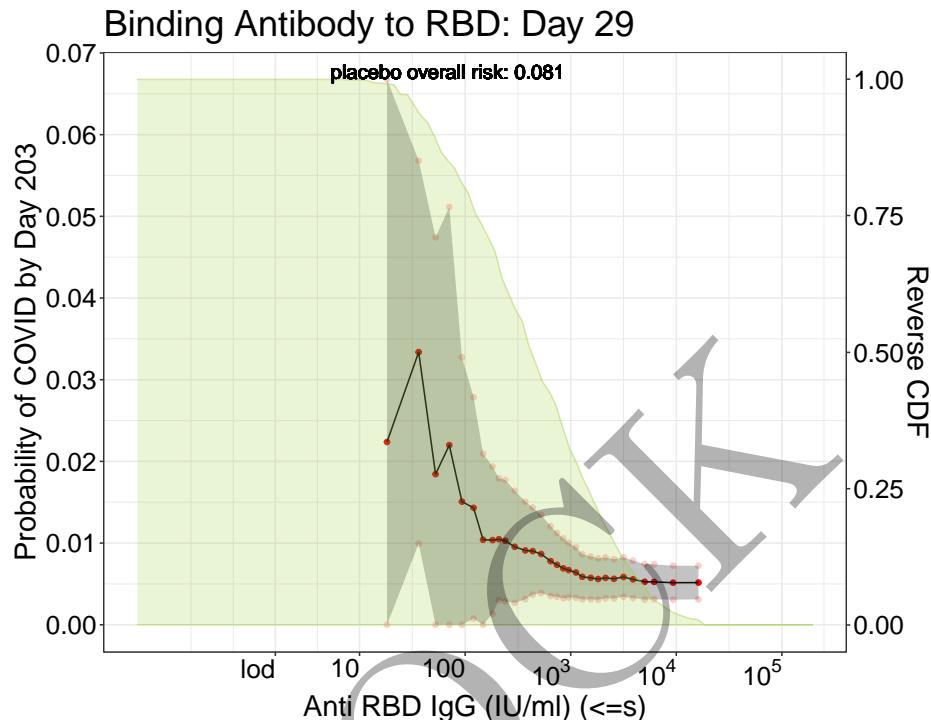


Figure 6.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

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)

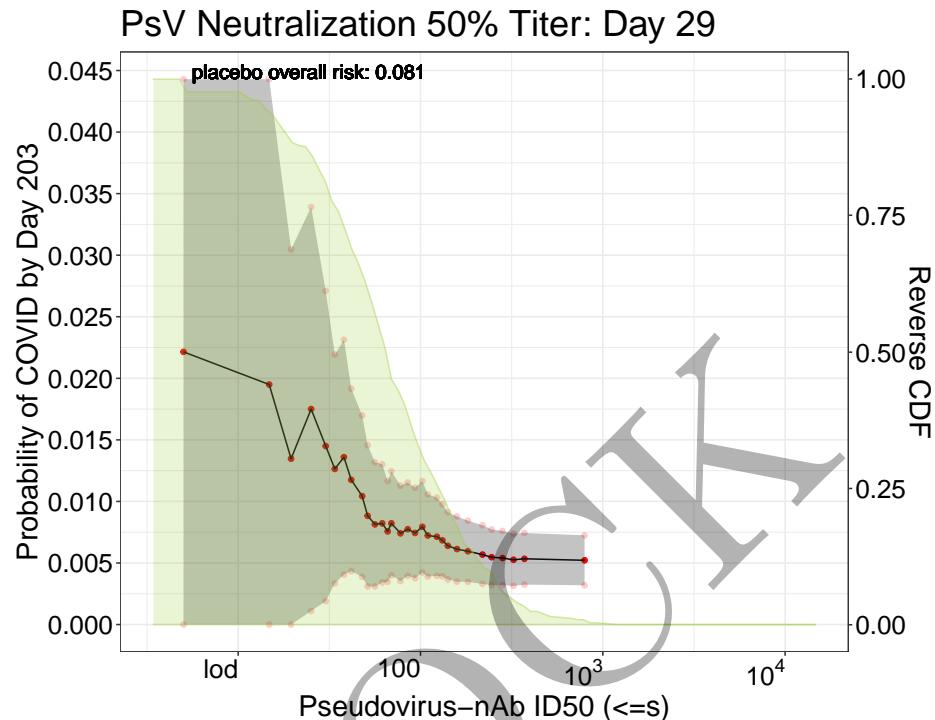


Figure 6.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

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)

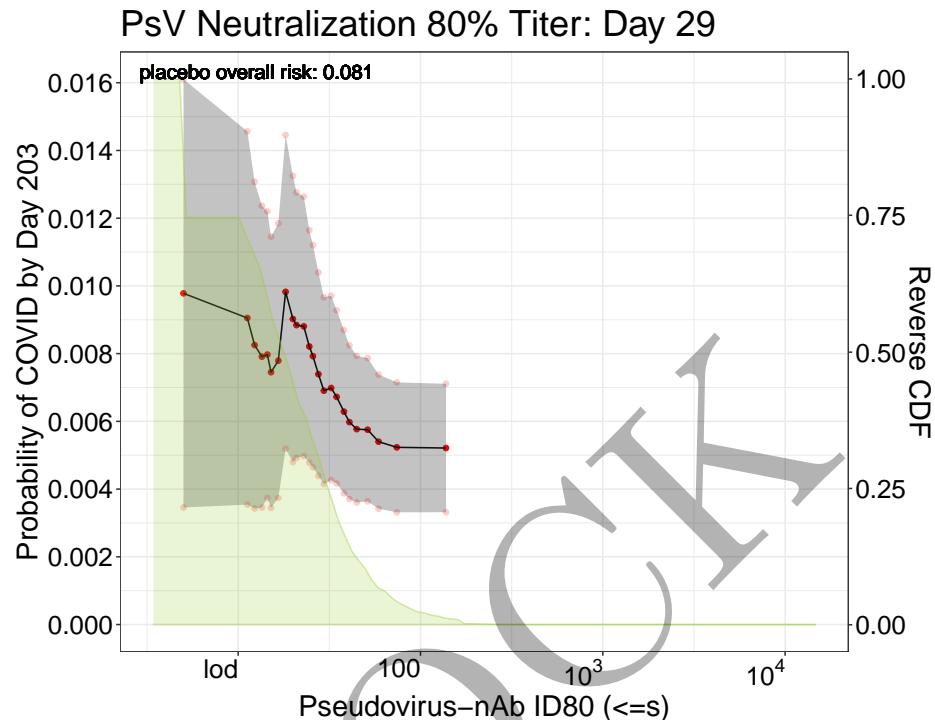


Figure 6.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

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

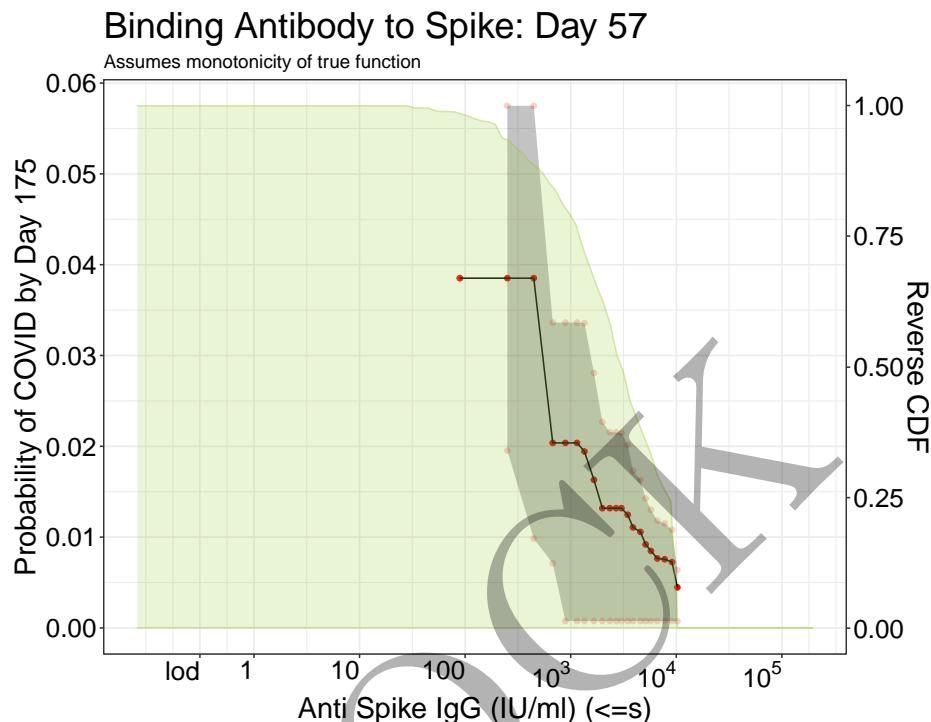


Figure 6.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

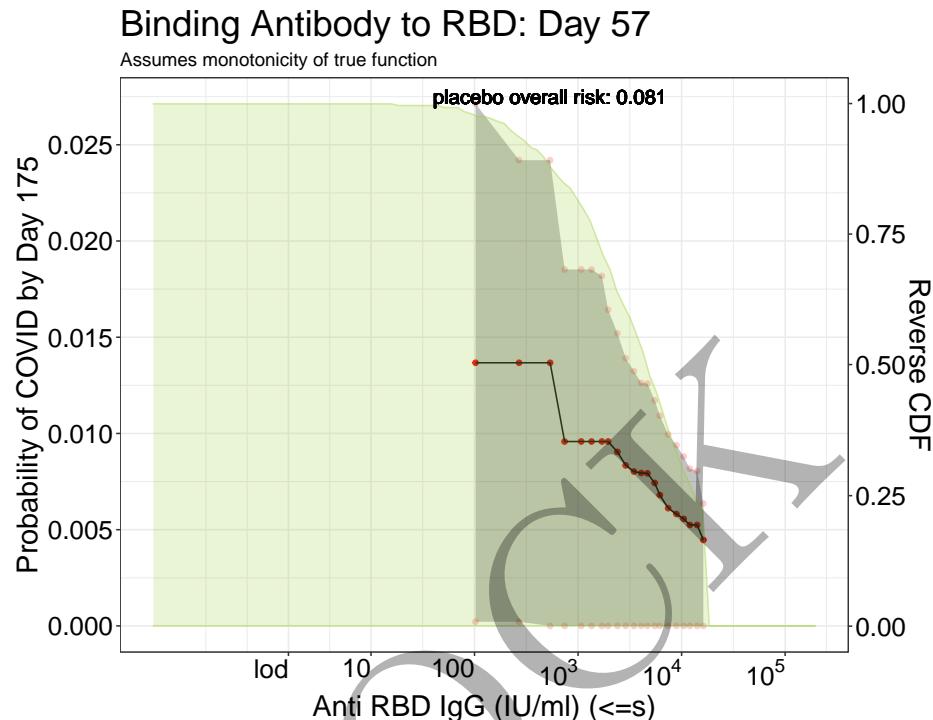


Figure 6.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

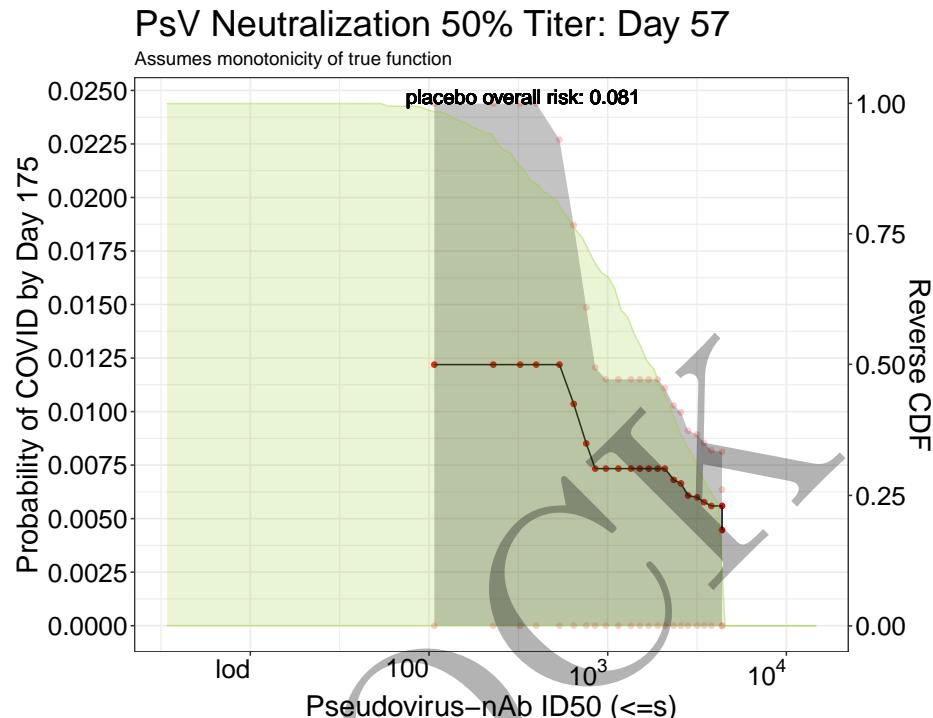


Figure 6.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

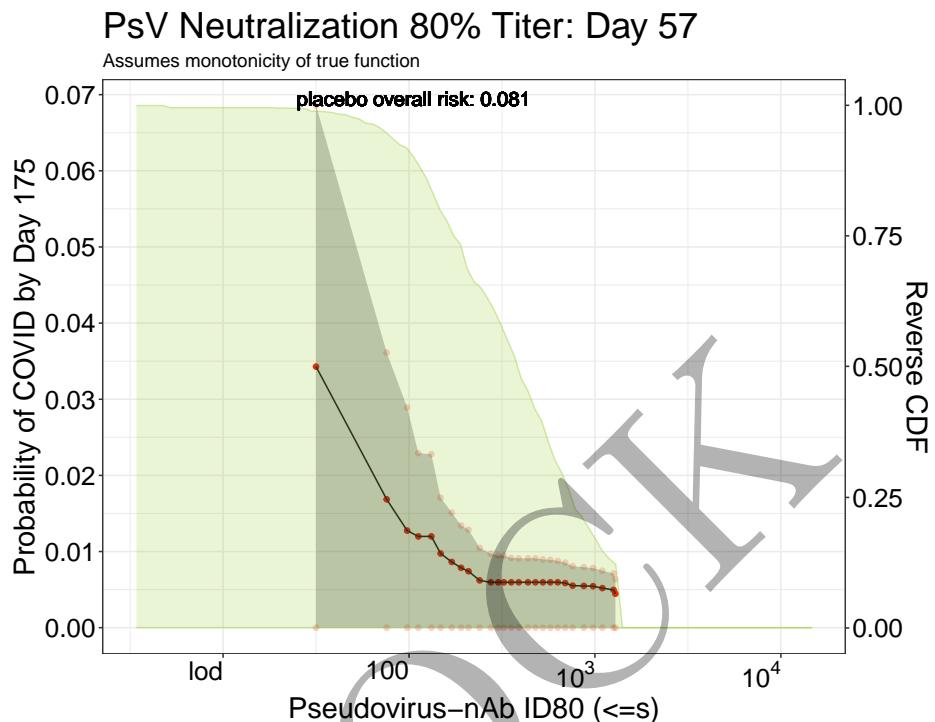


Figure 6.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

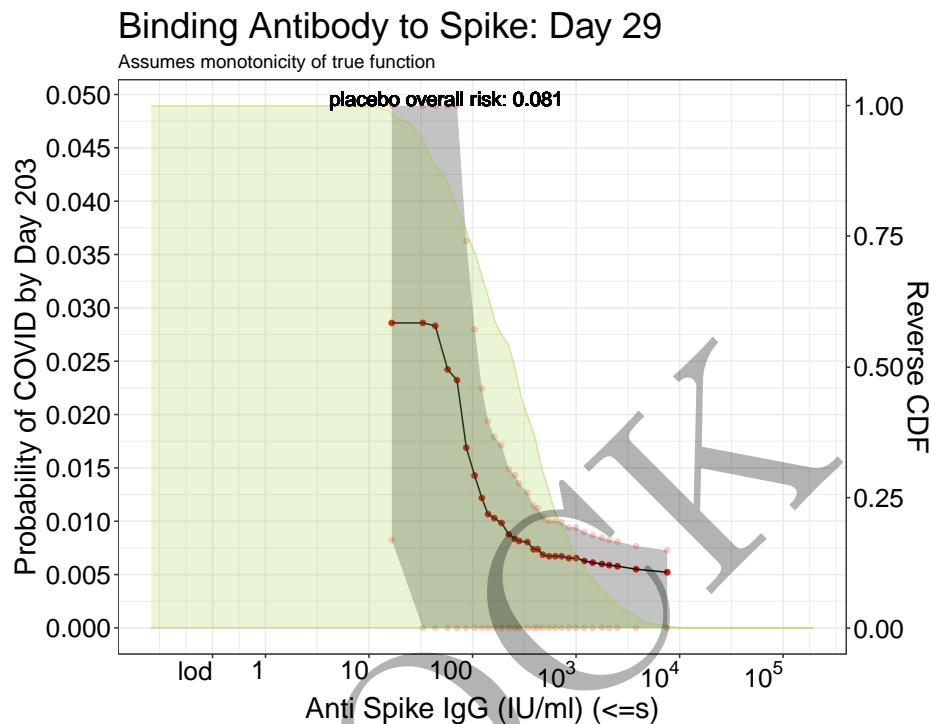


Figure 6.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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

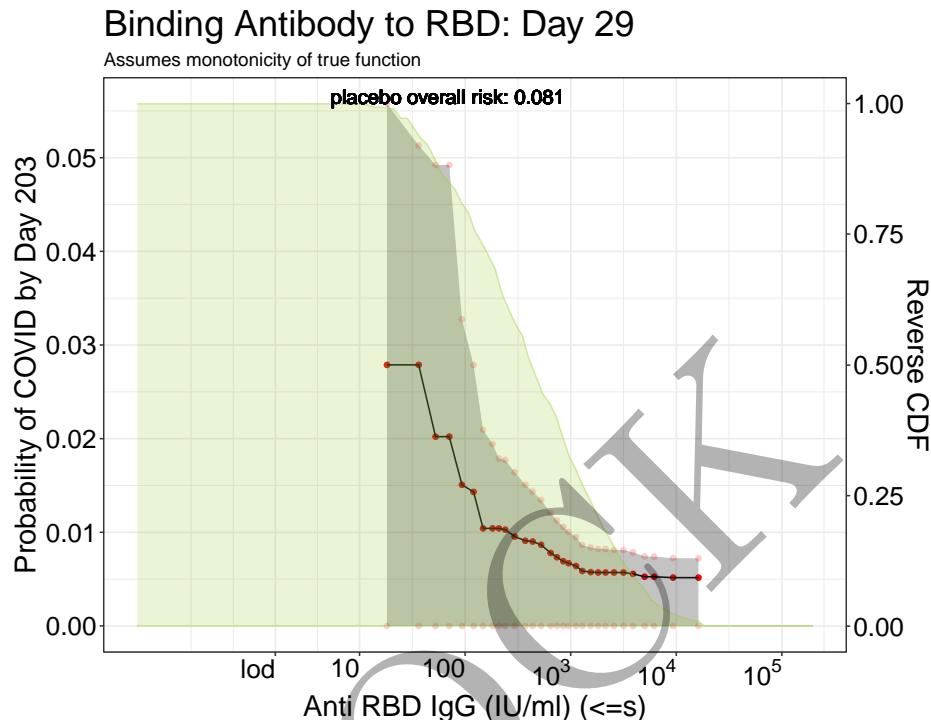


Figure 6.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

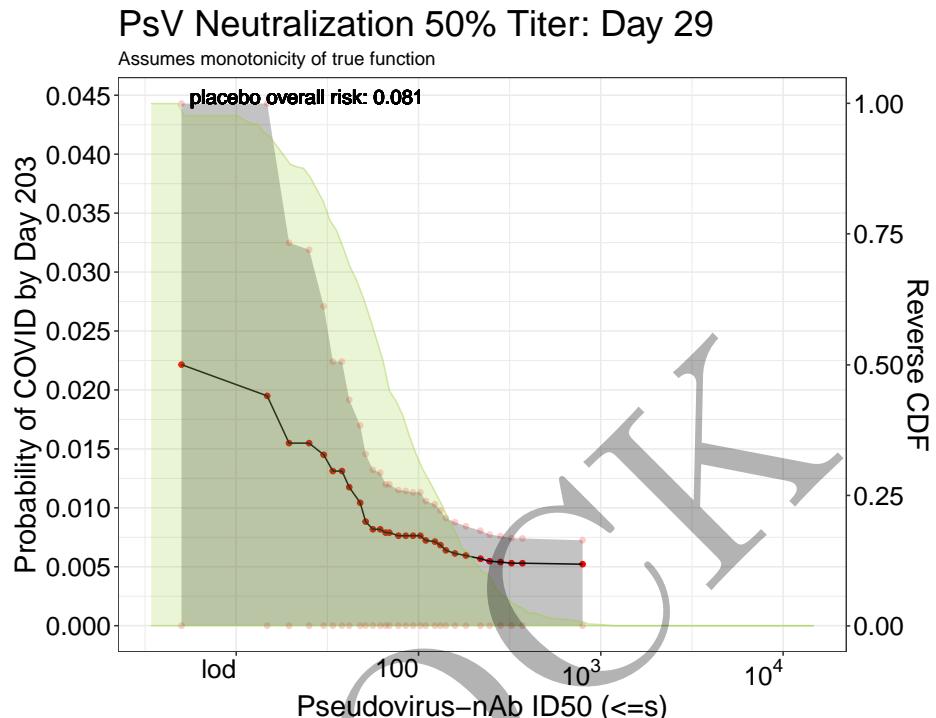


Figure 6.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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)

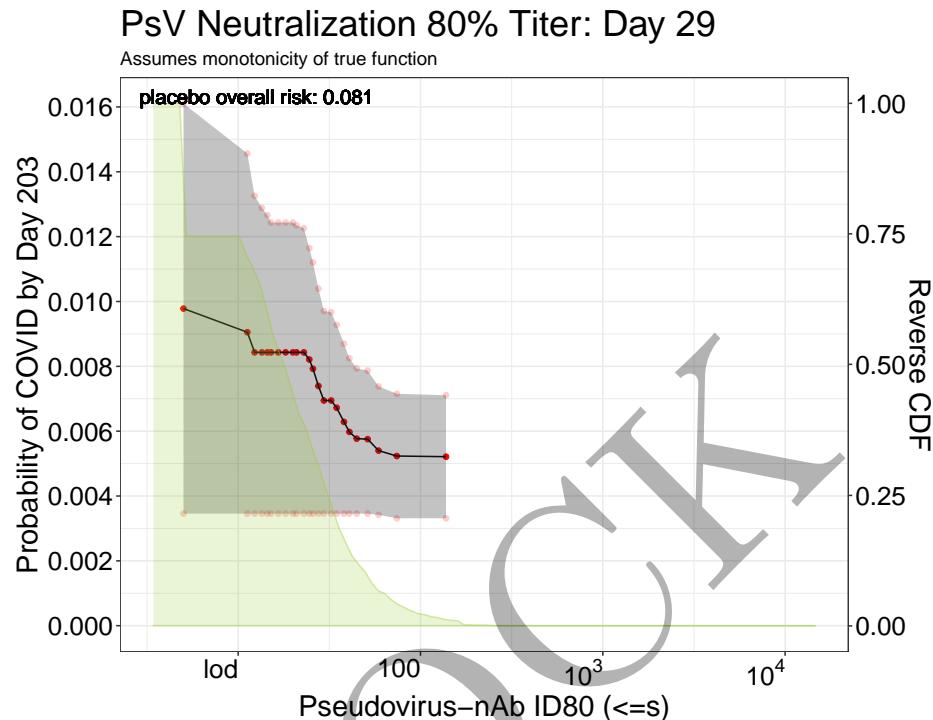


Figure 6.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

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 90ec6c8e8cc1ff6382a6ad0330a025d084c0a132. A diff of the changes introduced by that commit may be viewed at [https://github.com/CoVPN/correlates\\_reporting/commit/90ec6c8e8cc1ff6382a6ad0330a025d084c0a132](https://github.com/CoVPN/correlates_reporting/commit/90ec6c8e8cc1ff6382a6ad0330a025d084c0a132)
- 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