

# COVID-19 Correlates of Risk Analysis Report

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March 07, 2021



# Contents

1	Graphical Description of Antibody Marker Data	9
1.1	Boxplots . . . . .	9
1.2	Weighted RCDF plots . . . . .	9
1.3	Weighted RCDF plots showing threshold correlate concentration for overall vaccine efficacy . . . . .	9
1.4	Spaghetti plots . . . . .	9
1.5	Violin and line plots . . . . .	9
2	Day 57 Univariate CoR: Cox Models of Risk	281
2.1	Hazard ratios . . . . .	281
2.2	Marginalized risk and controlled vaccine efficacy plots . . . . .	287
3	Day 29 Univariate CoR: Cox Models of Risk	293
3.1	Hazard ratios . . . . .	293
3.2	Marginalized risk and controlled vaccine efficacy plots . . . . .	299
4	Univariate CoR: Nonparametric Threshold Modeling	305



# List of Tables

2.1	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* . . . . .	281
2.2	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* . . . . .	282
3.1	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* . . . . .	293
3.2	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* . . . . .	294
4.1	Table of risk estimates for range of thresholds of Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. . . . .	307
4.2	Table of risk estimates for range of thresholds of Day 57 Spike protein antibody activity levels with point-wise 95% simultaneous confidence intervals. . . . .	308
4.3	Table of risk estimates for range of thresholds of Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. . . . .	311
4.4	Table of risk estimates for range of thresholds of Day 57 RBD binding antibody activity levels with point-wise 95% simultaneous confidence intervals. . . . .	312
4.5	Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. . . . .	315
4.6	Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% simultaneous confidence intervals. . . . .	316
4.7	Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. . . . .	319
4.8	Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% simultaneous confidence intervals. . . . .	320

4.9	Table of risk estimates for range of thresholds of Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. . . . .	323
4.10	Table of risk estimates for range of thresholds of Day 29 Spike protein antibody activity levels with point-wise 95% simultaneous confidence intervals. . . . .	324
4.11	Table of risk estimates for range of thresholds of Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. . . . .	327
4.12	Table of risk estimates for range of thresholds of Day 29 RBD binding antibody activity levels with point-wise 95% simultaneous confidence intervals. . . . .	328
4.13	Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. . . . .	331
4.14	Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% simultaneous confidence intervals. . . . .	332
4.15	Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. . . . .	335
4.16	Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% simultaneous confidence intervals. . . . .	336

# List of Figures

1.1 (Mock data) Boxplots of D29 Ab markers: baseline negative vaccine arm by event status . . . . .	10
1.2 (Mock data) Boxplots of D57 Ab markers: baseline negative vaccine arm by event status . . . . .	11
1.3 (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status . . . . .	12
1.4 (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status . . . . .	13
1.5 (Mock data) Boxplots of D29 Ab markers: baseline positive vaccine arm by event status . . . . .	14
1.6 (Mock data) Boxplots of D57 Ab markers: baseline positive vaccine arm by event status . . . . .	15
1.7 (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status . . . . .	16
1.8 (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status . . . . .	17
1.9 (Mock data) RCDF plots for D29 Ab markers: baseline negative by treatment arm and event status. . . . .	18
1.10 (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline negative by treatment arm and D29 event status. . . . .	19
1.11 (Mock data) RCDF plots for D57 Ab markers: baseline negative by treatment arm and D57 event status. . . . .	20
1.12 (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline negative by treatment arm and D57 event status. . . . .	21
1.13 (Mock data) RCDF plots for D29 Ab markers: baseline positive by treatment arm and event status. . . . .	22

1.14 (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline positive by treatment arm and D29 event status. . . . .	23
1.15 (Mock data) RCDF plots for D57 Ab markers: baseline positive by treatment arm and D57 event status. . . . .	24
1.16 (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline positive by treatment arm and D57 event status. . . . .	25
1.17 (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline negative vaccine arm . . . . .	26
1.18 (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline negative vaccine arm . . . . .	26
1.19 (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline negative vaccine arm . . . . .	27
1.20 (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline negative vaccine arm . . . . .	27
1.21 (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline positive vaccine arm . . . . .	28
1.22 (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline positive vaccine arm . . . . .	28
1.23 (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline positive vaccine arm . . . . .	29
1.24 (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline positive vaccine arm . . . . .	29
1.25 (Mock data) Spaghetti Plots of Marker Trajectory: baseline negative vaccine arm . . . . .	30
1.26 (Mock data) Spaghetti Plots of Marker Trajectory: baseline positive vaccine arm . . . . .	31
1.27 (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints) . . . . .	32
1.28 (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints) . . . . .	33
1.29 (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints) . . . . .	34
1.30 (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints) . . . . .	35
1.31 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints) . . . . .	36
1.32 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (2 timepoints) . . . . .	37
1.33 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints) . . . . .	38
1.34 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (2 timepoints) . . . . .	39

## LIST OF FIGURES

9

1.35 (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints) . . . . .	40
1.36 (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints) . . . . .	41
1.37 (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints) . . . . .	42
1.38 (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints) . . . . .	43
1.39 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints) . . . . .	44
1.40 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vac- cine arm (2 timepoints) . . . . .	45
1.41 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints) . . . . .	46
1.42 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vac- cine arm (2 timepoints) . . . . .	47
1.43 (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints) . . . . .	48
1.44 (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints) . . . . .	49
1.45 (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints) . . . . .	50
1.46 (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints) . . . . .	51
1.47 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints) . . . . .	52
1.48 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (3 timepoints) . . . . .	53
1.49 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints) . . . . .	54
1.50 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (3 timepoints) . . . . .	55
1.51 (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints) . . . . .	56
1.52 (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints) . . . . .	57
1.53 (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints) . . . . .	58

1.54 (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints) . . . . .	59
1.55 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints) . . . . .	60
1.56 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vac- cine arm (3 timepoints) . . . . .	61
1.57 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints) . . . . .	62
1.58 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vac- cine arm (3 timepoints) . . . . .	63
1.59 (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints) . . . . .	64
1.60 (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints) . . . . .	65
1.61 (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints) . . . . .	66
1.62 (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints) . . . . .	67
1.63 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints) . . . . .	68
1.64 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (2 timepoints) . . . . .	69
1.65 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints) . . . . .	70
1.66 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints) . . . . .	71
1.67 (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints) . . . . .	72
1.68 (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints) . . . . .	73
1.69 (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints) . . . . .	74
1.70 (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints) . . . . .	75
1.71 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints) . . . . .	76
1.72 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vac- cine arm by age (2 timepoints) . . . . .	77

1.73 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints) . . . . .	78
1.74 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints) . . . . .	79
1.75 (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints) . . . . .	80
1.76 (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints) . . . . .	81
1.77 (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints) . . . . .	82
1.78 (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints) . . . . .	83
1.79 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints) . . . . .	84
1.80 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints) . . . . .	85
1.81 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints) . . . . .	86
1.82 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints) . . . . .	87
1.83 (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints) . . . . .	88
1.84 (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints) . . . . .	89
1.85 (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints) . . . . .	90
1.86 (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints) . . . . .	91
1.87 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints) . . . . .	92
1.88 (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints) . . . . .	93
1.89 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints) . . . . .	94
1.90 (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints) . . . . .	95
1.91 (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	96

1.92 (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	97
1.93 (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	98
1.94 (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	99
1.95 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	100
1.96 (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	101
1.97 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	102
1.98 (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	103
1.99 (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	104
1.100(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	105
1.101(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	106
1.102(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	107
1.103(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	108
1.104(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	109
1.105(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints) . . . . .	110
1.106(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints) . . . . .	111
1.107(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	112
1.108(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	113
1.109(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	114
1.110(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	115

1.111(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	116
1.112(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	117
1.113(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	118
1.114(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	119
1.115(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	120
1.116(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	121
1.117(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	122
1.118(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	123
1.119(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	124
1.120(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	125
1.121(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints) . . . . .	126
1.122(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints) . . . . .	127
1.123(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	128
1.124(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	129
1.125(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	130
1.126(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	131
1.127(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	132
1.128(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	133
1.129(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	134

1.130(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	135
1.131(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	136
1.132(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	137
1.133(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	138
1.134(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	139
1.135(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	140
1.136(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	141
1.137(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints) . . . . .	142
1.138(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints) . . . . .	143
1.139(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	144
1.140(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	145
1.141(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	146
1.142(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	147
1.143(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	148
1.144(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	149
1.145(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	150
1.146(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	151
1.147(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	152
1.148(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	153

1.149(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	154
1.150(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	155
1.151(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	156
1.152(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	157
1.153(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints) . . . . .	158
1.154(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints) . . . . .	159
1.155(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	160
1.156(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	161
1.157(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	162
1.158(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	163
1.159(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	164
1.160(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	165
1.161(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	166
1.162(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	167
1.163(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	168
1.164(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	169
1.165(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	170
1.166(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	171
1.167(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	172

1.168(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	173
1.169(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints) . . . . .	174
1.170(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints) . . . . .	175
1.171(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	176
1.172(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	177
1.173(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	178
1.174(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	179
1.175(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	180
1.176(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	181
1.177(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	182
1.178(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	183
1.179(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	184
1.180(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	185
1.181(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	186
1.182(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	187
1.183(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	188
1.184(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	189
1.185(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints) . . . . .	190
1.186(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints) . . . . .	191

1.187(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	192
1.188(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	193
1.189(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	194
1.190(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	195
1.191(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	196
1.192(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	197
1.193(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	198
1.194(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	199
1.195(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	200
1.196(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	201
1.197(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	202
1.198(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	203
1.199(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	204
1.200(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	205
1.201(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints) . . . . .	206
1.202(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints) . . . . .	207
1.203(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	208
1.204(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	209
1.205(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	210

1.206(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	211
1.207(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	212
1.208(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	213
1.209(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	214
1.210(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	215
1.211(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	216
1.212(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	217
1.213(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	218
1.214(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	219
1.215(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	220
1.216(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	221
1.217(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints) . . . . .	222
1.218(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints) . . . . .	223
1.219(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	224
1.220(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	225
1.221(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	226
1.222(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	227
1.223(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	228
1.224(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	229

1.225(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	230
1.226(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	231
1.227(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	232
1.228(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	233
1.229(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	234
1.230(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . . . .	235
1.231(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) . .	236
1.232(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . .	237
1.233(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints) .	238
1.234(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints) . . .	239
1.235(Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	240
1.236(Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	241
1.237(Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	242
1.238(Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	243
1.239(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	244
1.240(Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	245
1.241(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	246
1.242(Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	247
1.243(Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	248

1.244(Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	249
1.245(Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	250
1.246(Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	251
1.247(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	252
1.248(Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	253
1.249(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	254
1.250(Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints) . . . . .	255
1.251(Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1 . . . . .	256
1.252(Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29 . . . . .	257
1.253(Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57 . . . . .	258
1.254(Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1 . . . . .	259
1.255(Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29 . . . . .	260
1.256(Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57 . . . . .	261
1.257(Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1 . . . . .	262
1.258(Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29 . . . . .	263
1.259(Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 57 . . . . .	264
1.260(Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1 . . . . .	265
1.261(Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29 . . . . .	266
1.262(Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57 . . . . .	267

1.263(Mock data) scatterplots of Binding Antibody to Spike: by arm at day 1 . . . . .	268
1.264(Mock data) scatterplots of Binding Antibody to Spike: by arm at day 29 . . . . .	269
1.265(Mock data) scatterplots of Binding Antibody to Spike: by arm at day 57 . . . . .	270
1.266(Mock data) scatterplots of Binding Antibody to RBD: by arm at day 1 . . . . .	271
1.267(Mock data) scatterplots of Binding Antibody to RBD: by arm at day 29 . . . . .	272
1.268(Mock data) scatterplots of Binding Antibody to RBD: by arm at day 57 . . . . .	273
1.269(Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 1 . . . . .	274
1.270(Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 29 . . . . .	275
1.271(Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 57 . . . . .	276
1.272(Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 1 . . . . .	277
1.273(Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 29 . . . . .	278
1.274(Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 57 . . . . .	279
2.1 Forest plots of hazard ratios among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals. . . . .	283
2.2 Forest plots of hazard ratios of 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. . . . .	284
2.3 Forest plots of hazard ratios of 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. . . . .	285
2.4 Forest plots of hazard ratios of 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. . . . .	285
2.5 Forest plots of hazard ratios of 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. . . . .	286
2.6 Marginalized cumulative risk by Day 172 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 172 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection. . . . .	288
2.7 Marginalized cumulative risk by Day 57 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 172 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection. . . . .	289

2.8	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: lower limit of detection. . . . .	290
2.9	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. . . . .	291
3.1	Forest plots of hazard ratios among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals. . . . .	295
3.2	Forest plots of hazard ratios of 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. . . . .	296
3.3	Forest plots of hazard ratios of 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. . . . .	297
3.4	Forest plots of hazard ratios of 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. . . . .	297
3.5	Forest plots of hazard ratios of 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. . . . .	298
3.6	Marginalized cumulative risk by Day 200 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 200 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection. . . . .	300
3.7	Marginalized cumulative risk by Day 29 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 200 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection. . . . .	301
3.8	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: lower limit of detection. . . . .	302
3.9	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. . . . .	303

4.1	Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	306
4.2	Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	307
4.3	Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	308
4.4	Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	309
4.5	Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	310
4.6	Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	311
4.7	Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	312
4.8	Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	313
4.9	Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	314
4.10	Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	315

4.11 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	316
4.12 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	317
4.13 Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	318
4.14 Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	319
4.15 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	320
4.16 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	321
4.17 Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	322
4.18 Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	323
4.19 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	324

4.20 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	325
4.21 Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	326
4.22 Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	327
4.23 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	328
4.24 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	329
4.25 Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	330
4.26 Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	331
4.27 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	332
4.28 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	333

4.29 Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	334
4.30 Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	335
4.31 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	336
4.32 Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. . . . .	337

# Chapter 1

## Graphical Description of Antibody Marker Data

### 1.1 Boxplots

1.1.1 Baseline seronegative

1.1.2 Baseline seropositive

### 1.2 Weighted RCDF plots

1.2.1 Baseline seronegative

1.2.2 Baseline seropositive

### 1.3 Weighted RCDF plots showing threshold correlate concentration for overall vaccine efficacy

1.3.1 Baseline seronegative

1.3.2 Baseline seropositive

### 1.4 Spaghetti plots

### 1.5 Violin and line plots

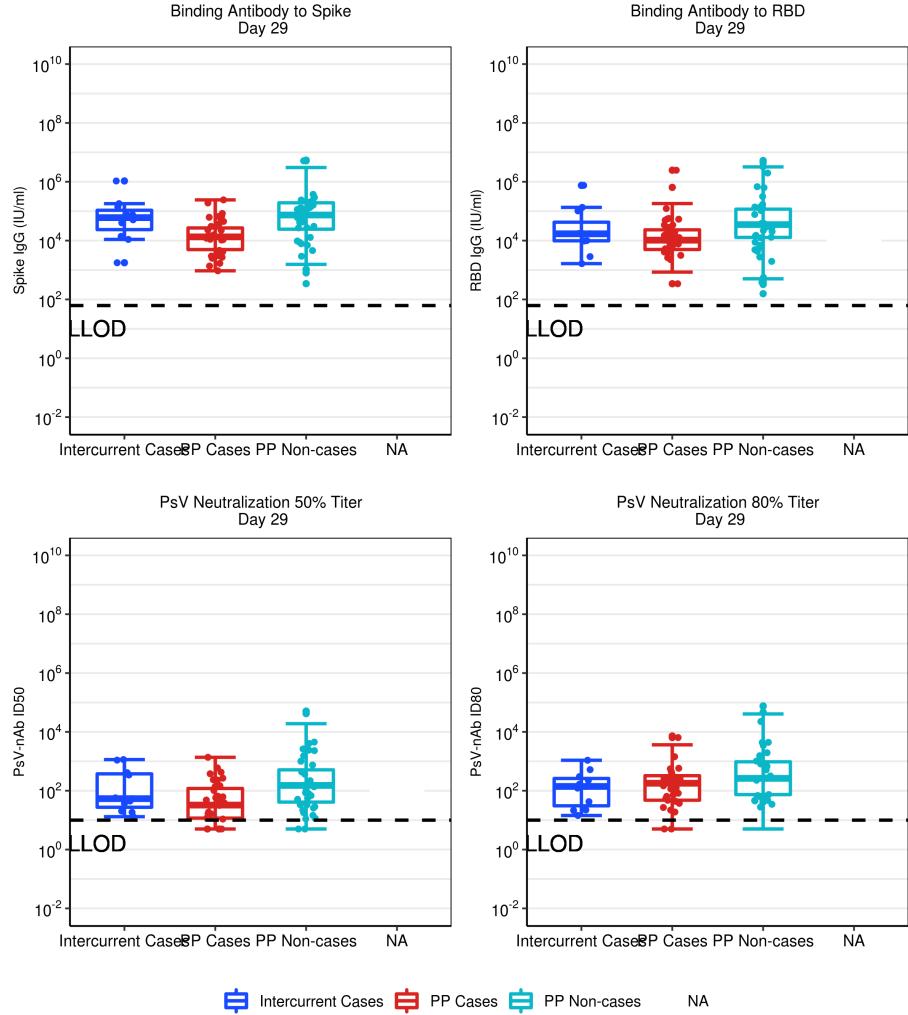


Figure 1.1: (Mock data) Boxplots of D29 Ab markers: baseline negative vaccine arm by event status

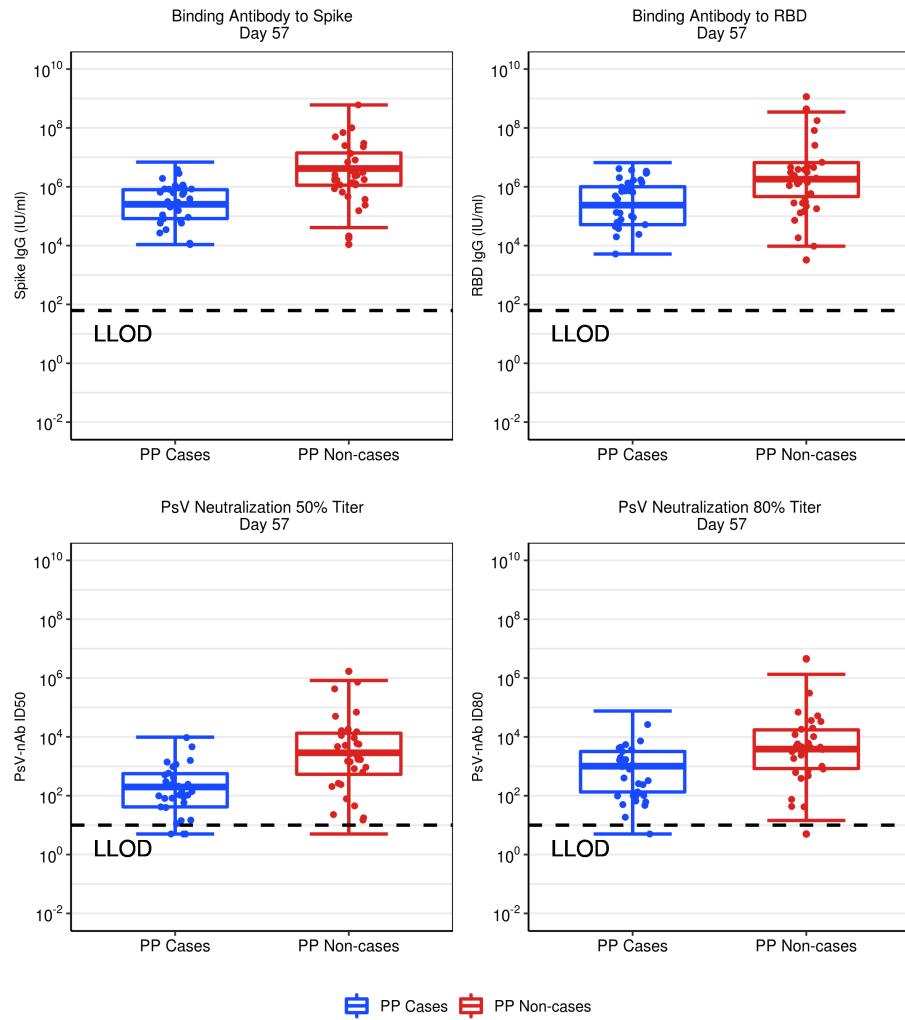


Figure 1.2: (Mock data) Boxplots of D57 Ab markers: baseline negative vaccine arm by event status

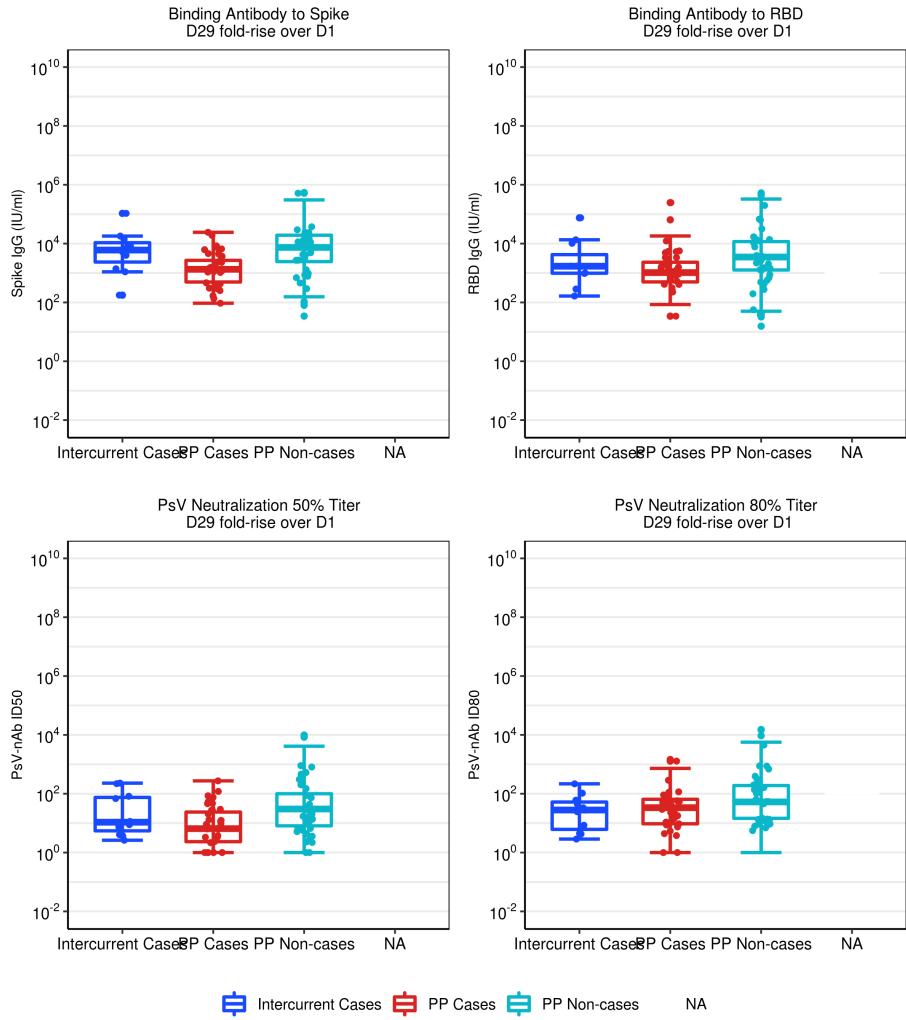


Figure 1.3: (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status

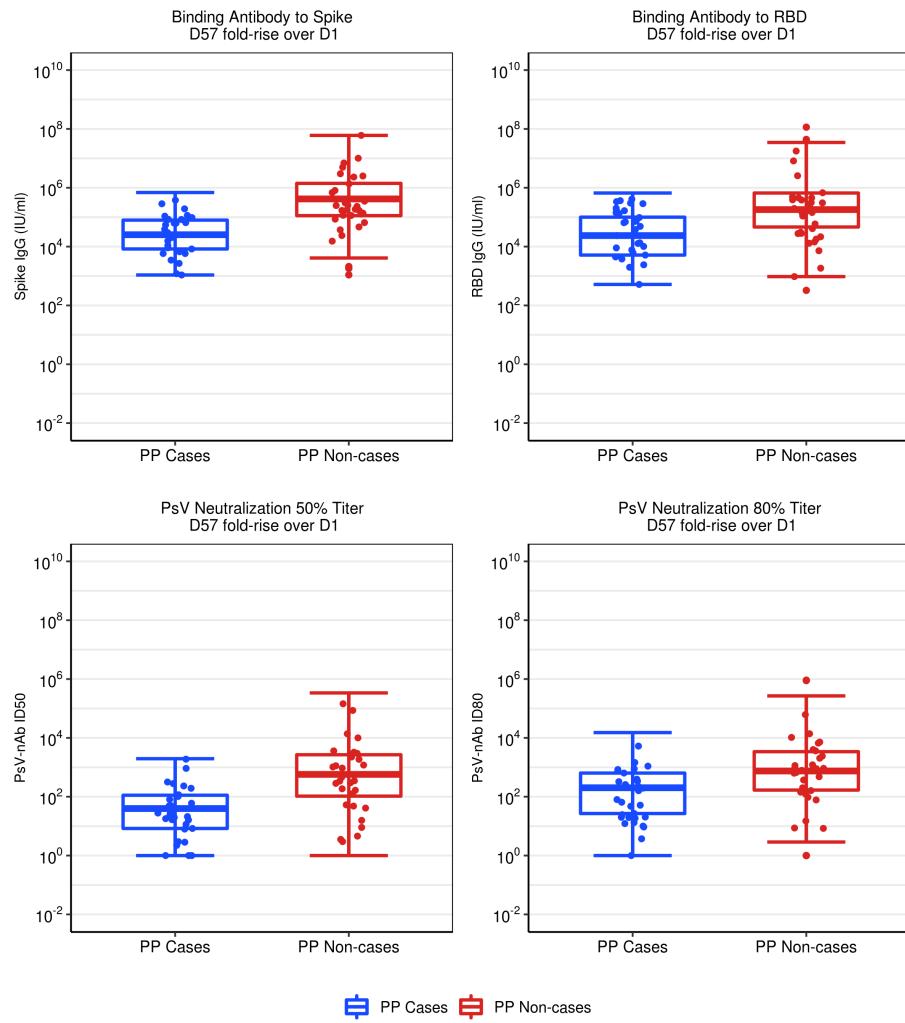


Figure 1.4: (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status

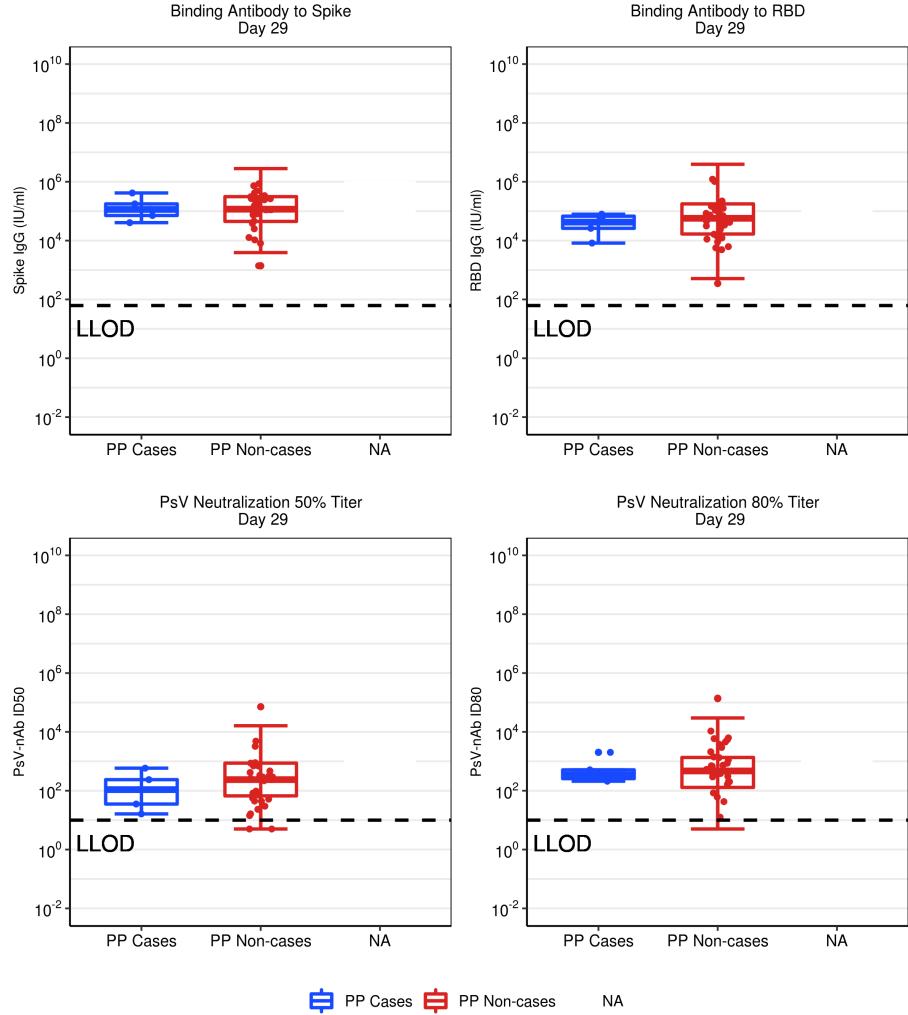


Figure 1.5: (Mock data) Boxplots of D29 Ab markers: baseline positive vaccine arm by event status

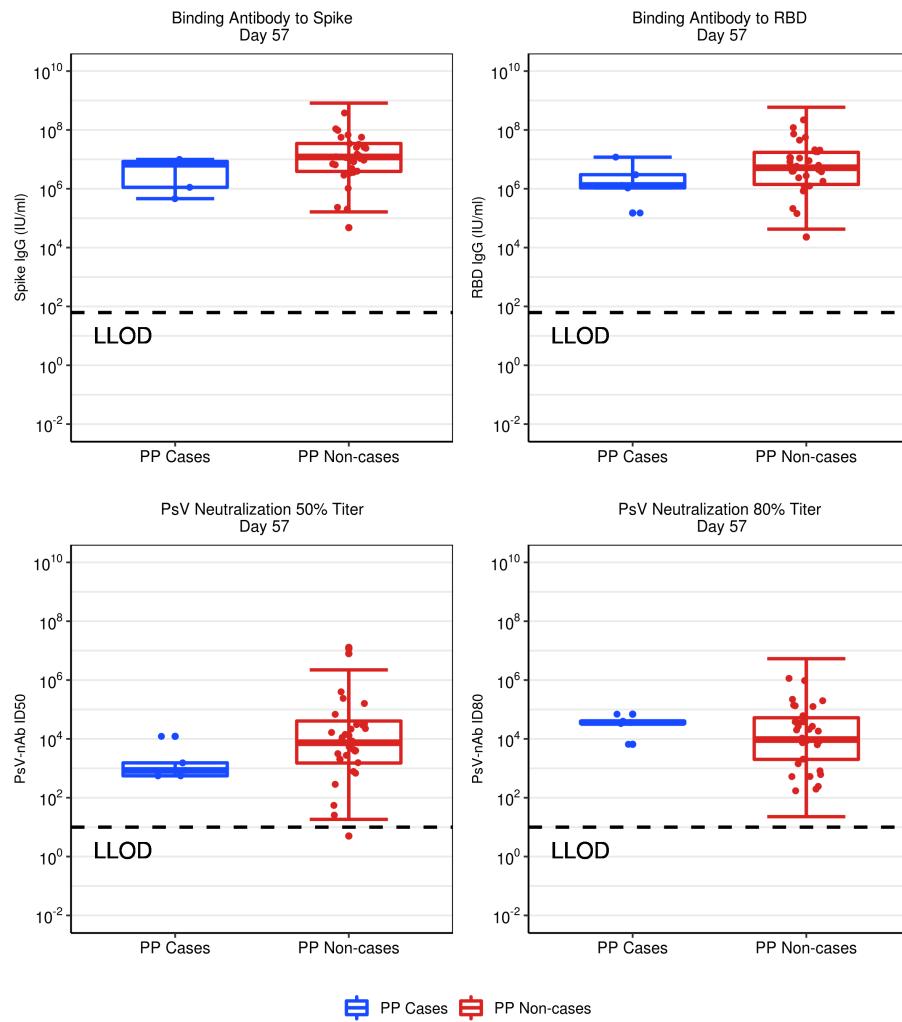


Figure 1.6: (Mock data) Boxplots of D57 Ab markers: baseline positive vaccine arm by event status

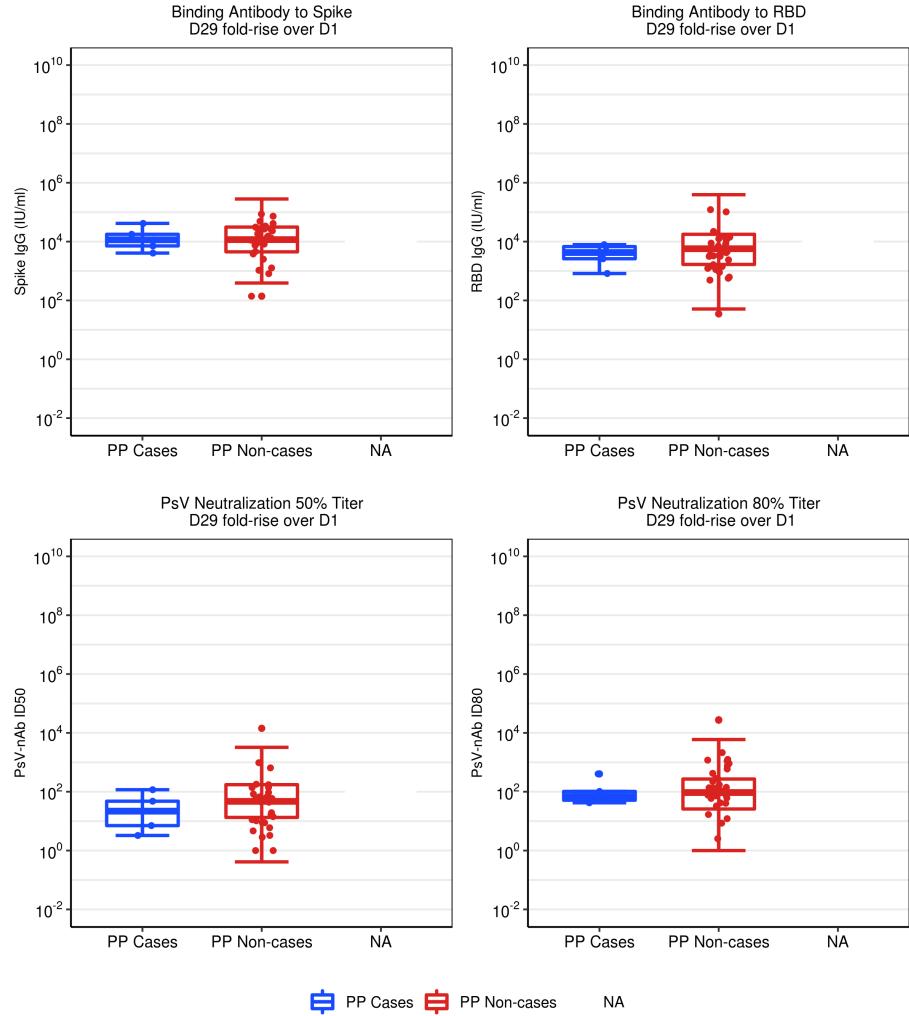


Figure 1.7: (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status

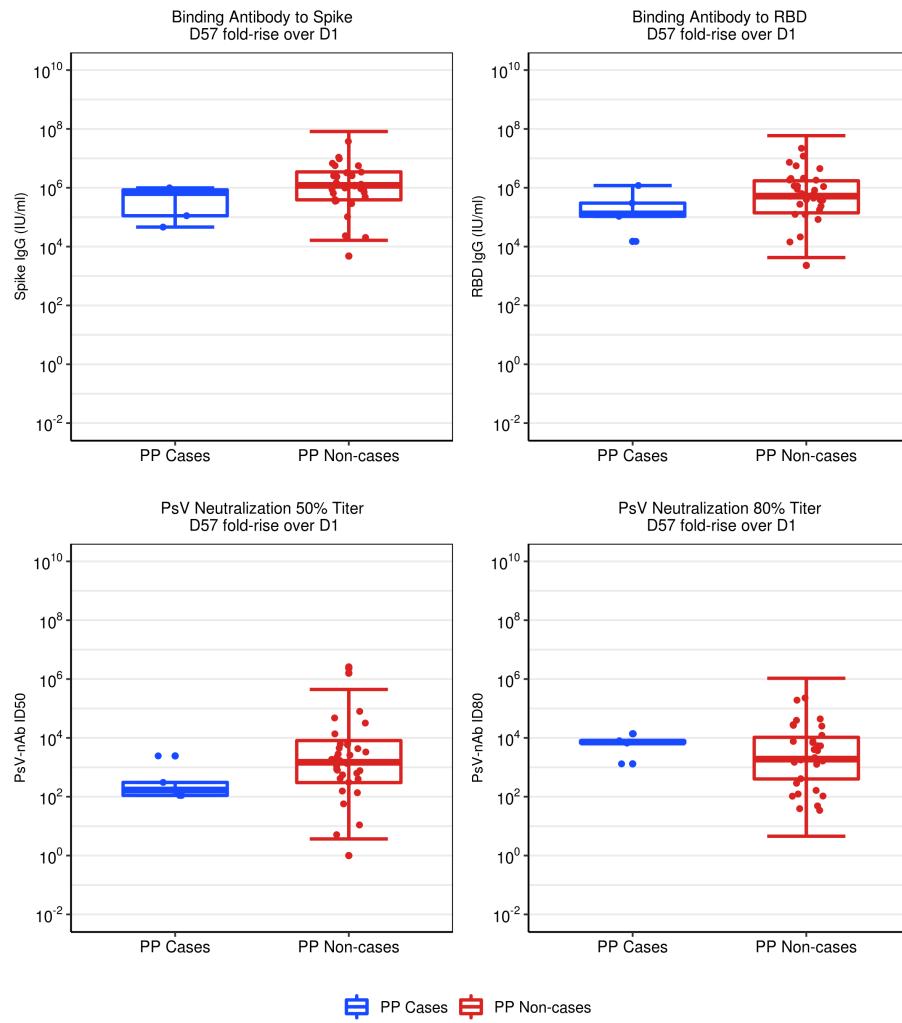


Figure 1.8: (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status

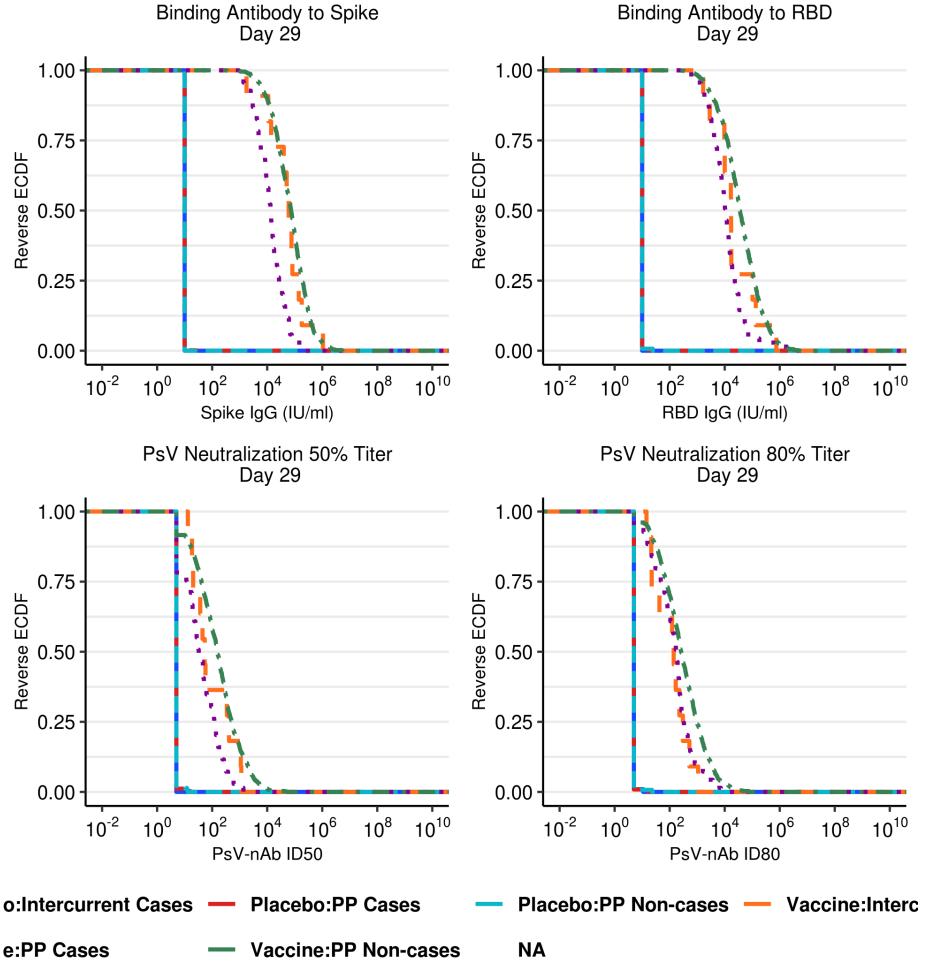


Figure 1.9: (Mock data) RCDF plots for D29 Ab markers: baseline negative by treatment arm and event status.

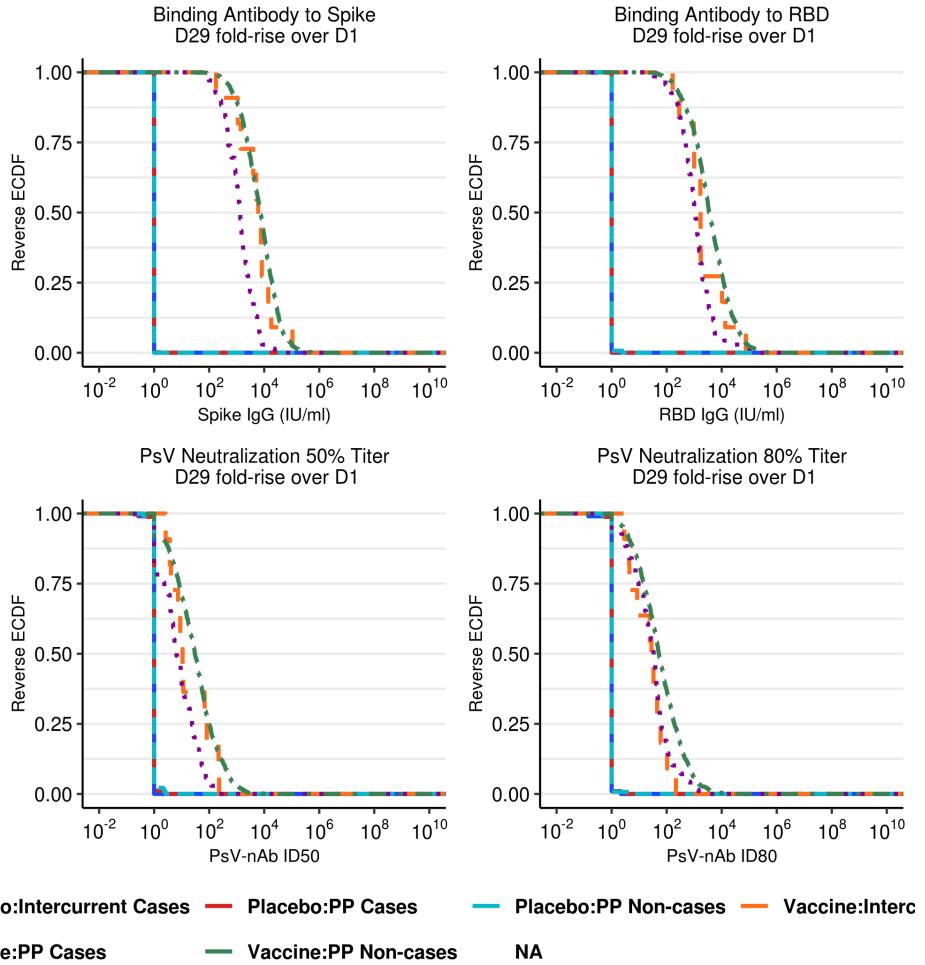


Figure 1.10: (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline negative by treatment arm and D29 event status.

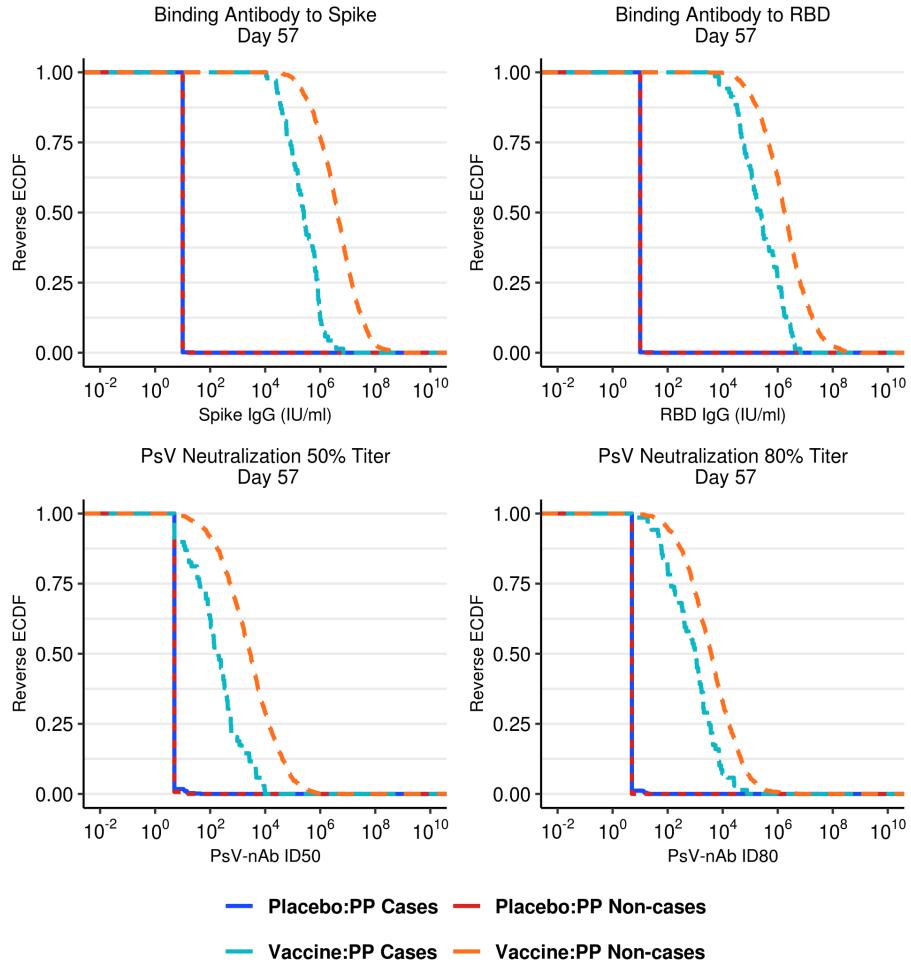


Figure 1.11: (Mock data) RCDF plots for D57 Ab markers: baseline negative by treatment arm and D57 event status.

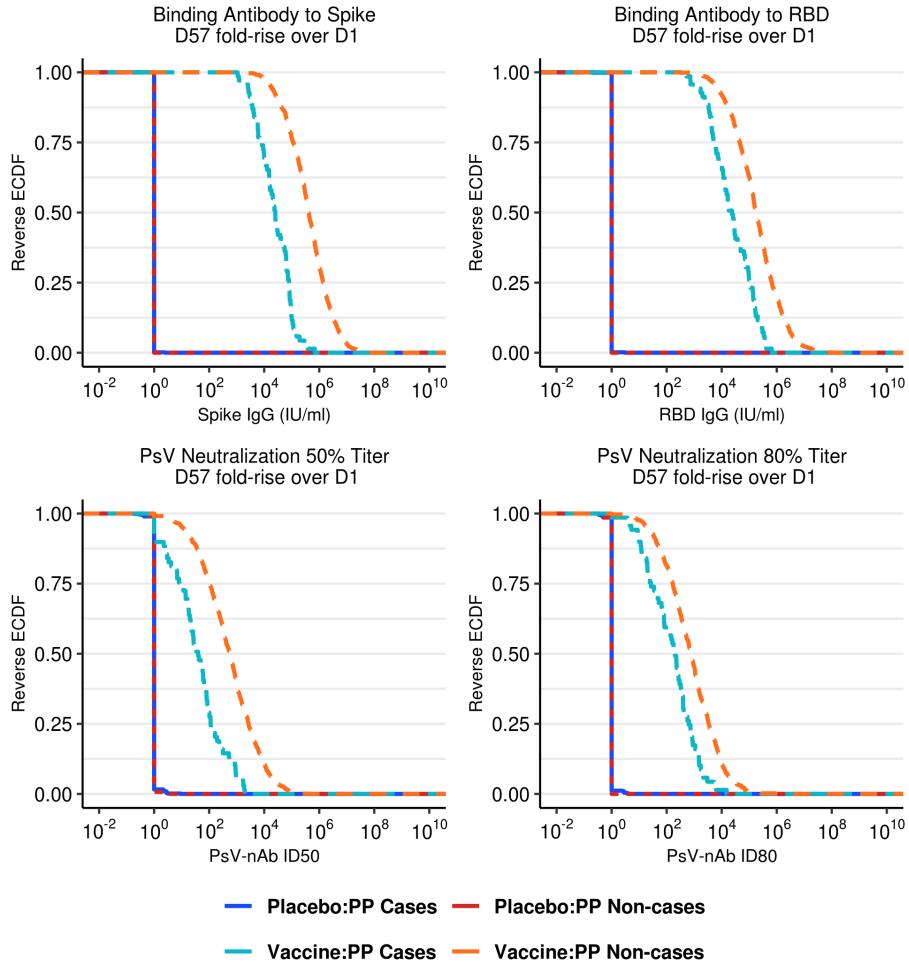


Figure 1.12: (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline negative by treatment arm and D57 event status.

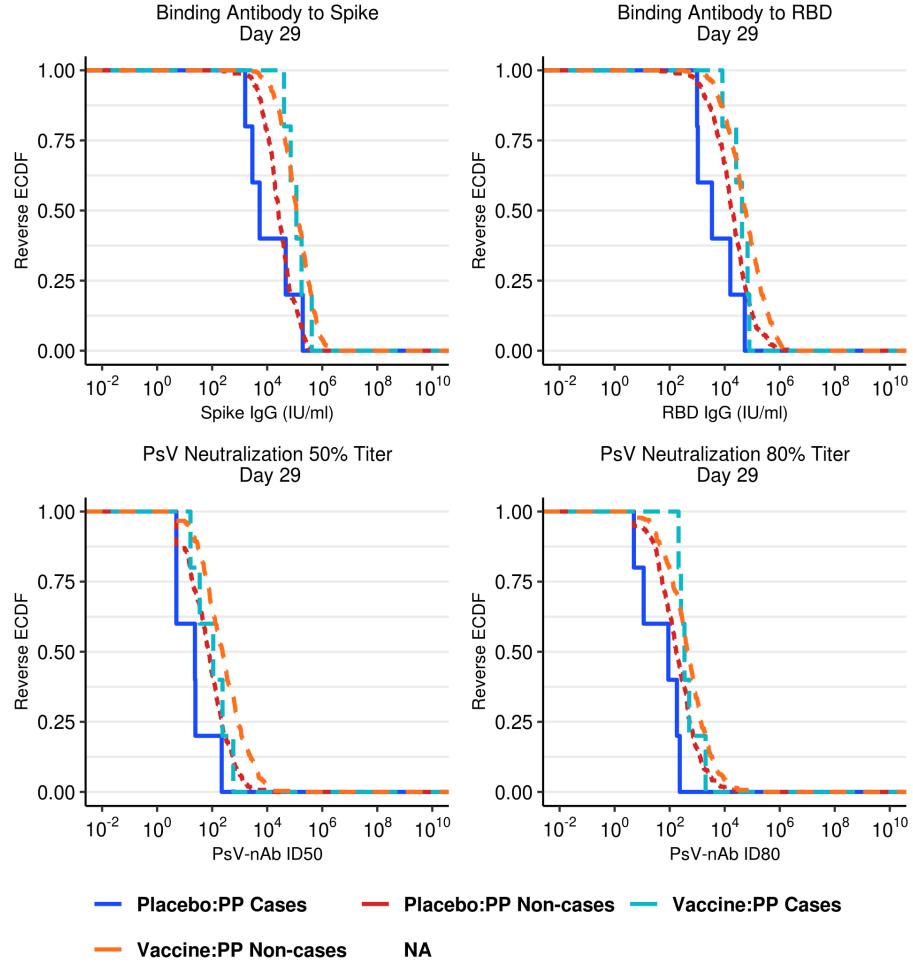


Figure 1.13: (Mock data) RCDF plots for D29 Ab markers: baseline positive by treatment arm and event status.

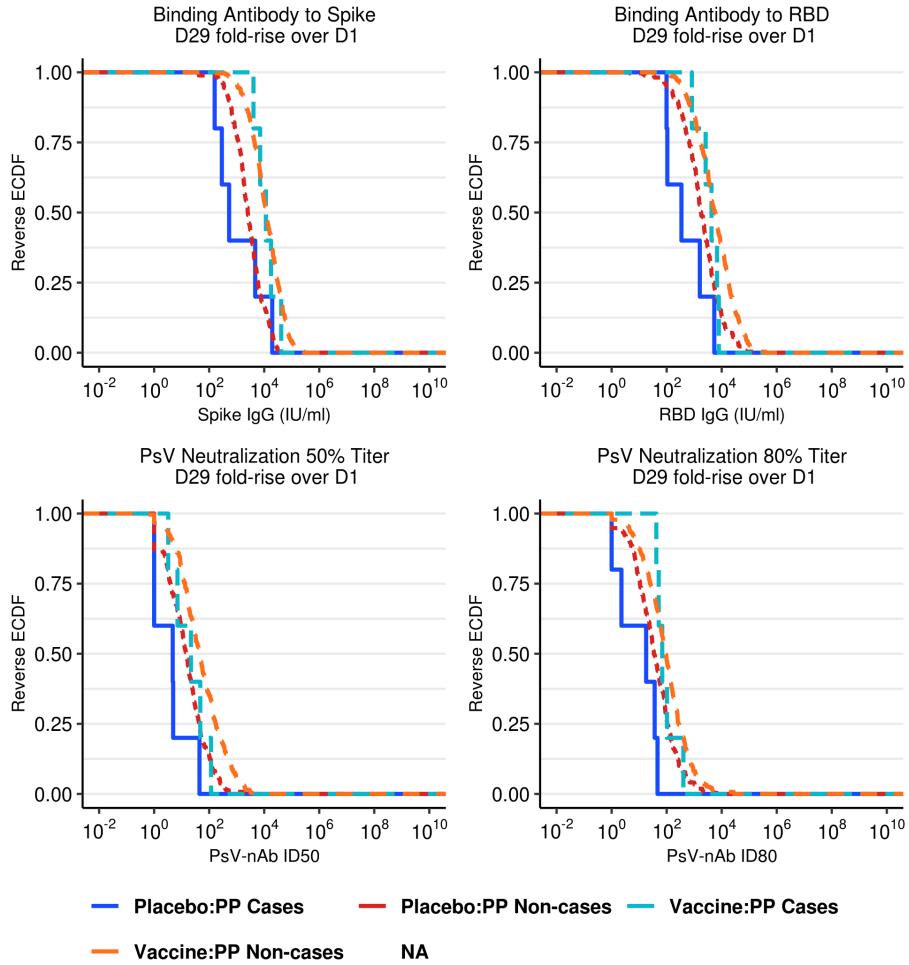


Figure 1.14: (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline positive by treatment arm and D29 event status.

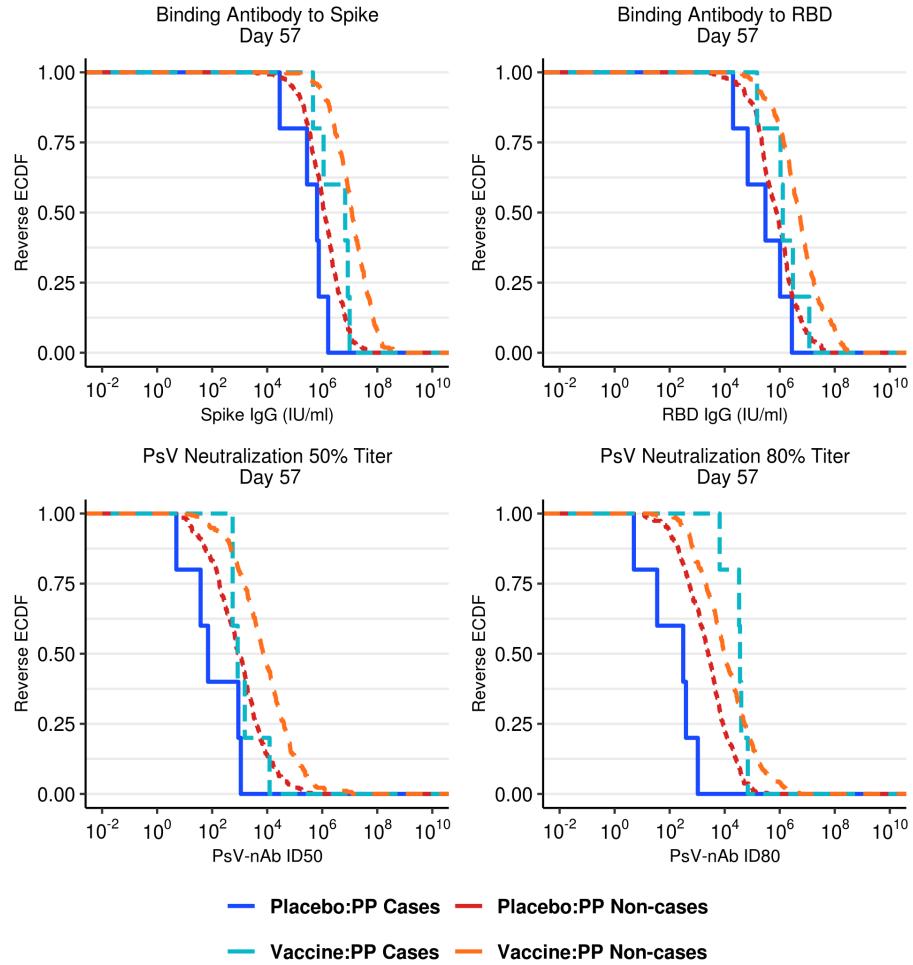


Figure 1.15: (Mock data) RCDF plots for D57 Ab markers: baseline positive by treatment arm and D57 event status.

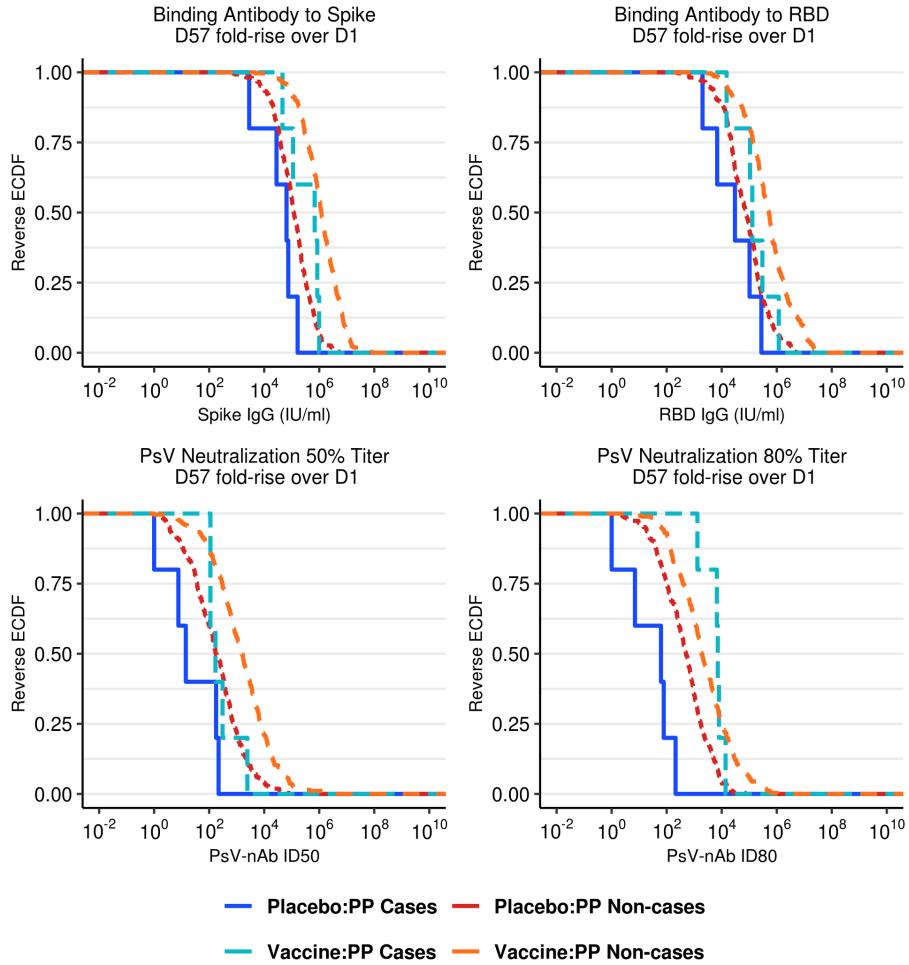


Figure 1.16: (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline positive by treatment arm and D57 event status.

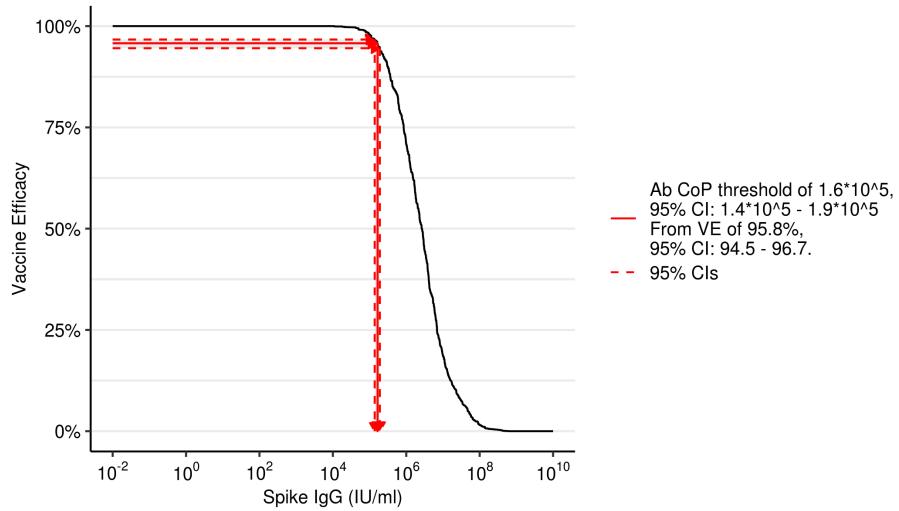


Figure 1.17: (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline negative vaccine arm

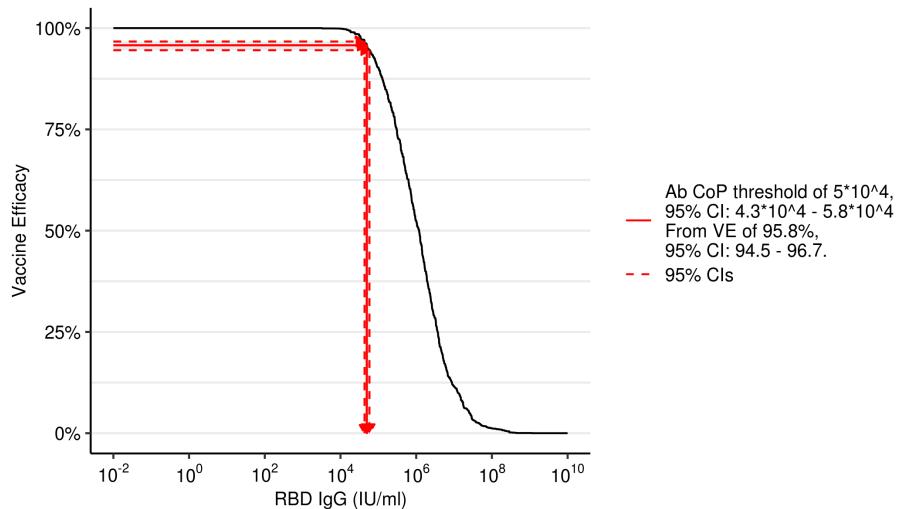


Figure 1.18: (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline negative vaccine arm

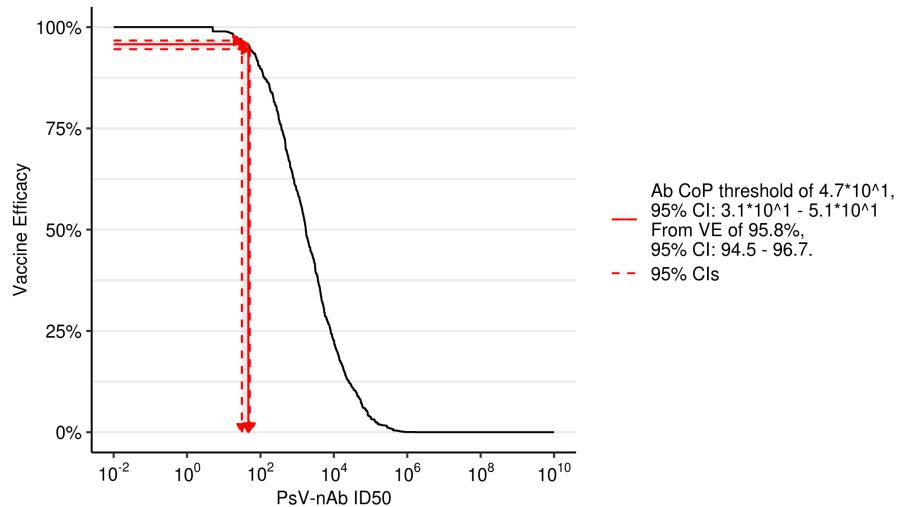


Figure 1.19: (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline negative vaccine arm

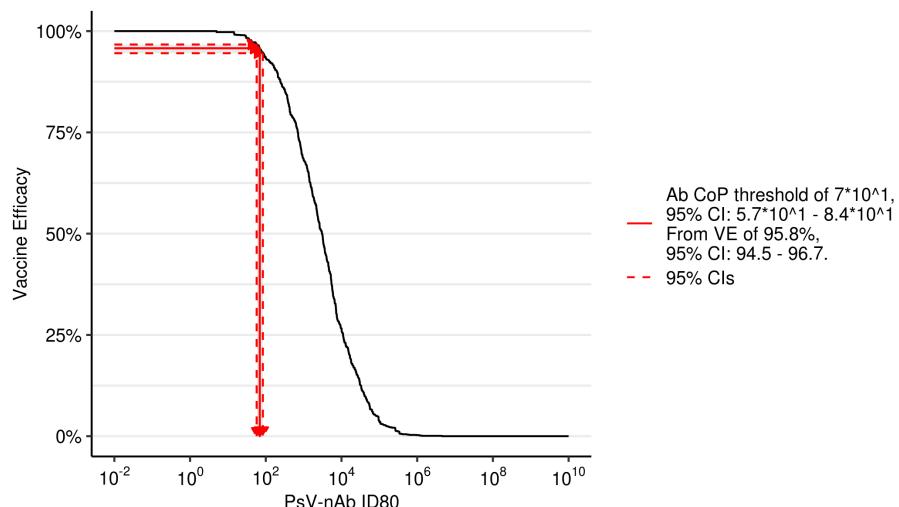


Figure 1.20: (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline negative vaccine arm

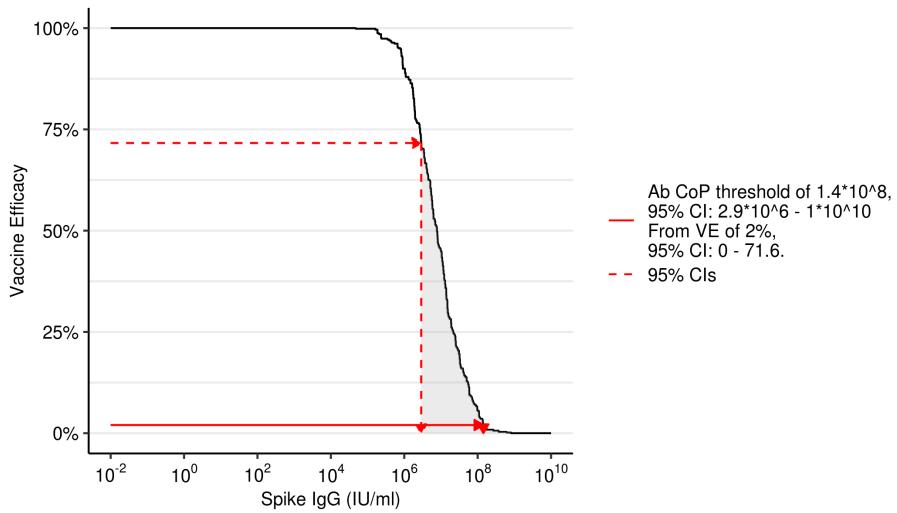


Figure 1.21: (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline positive vaccine arm

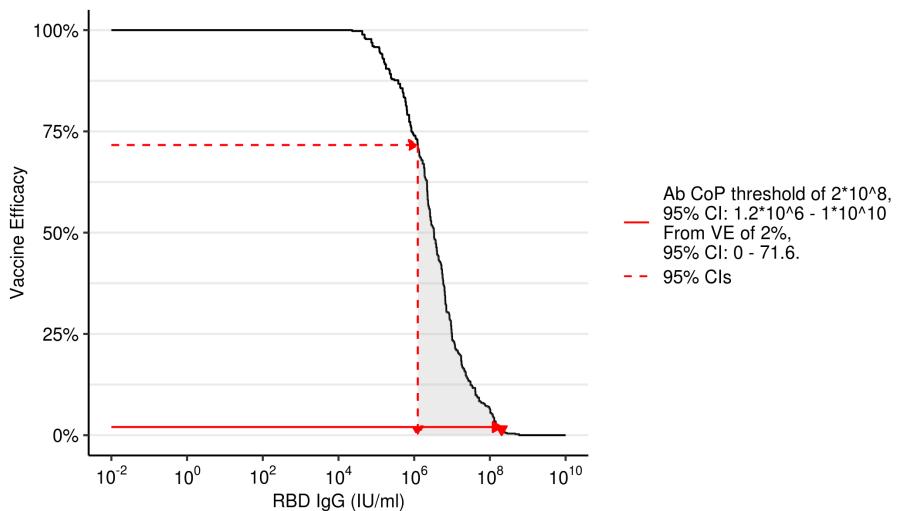


Figure 1.22: (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline positive vaccine arm

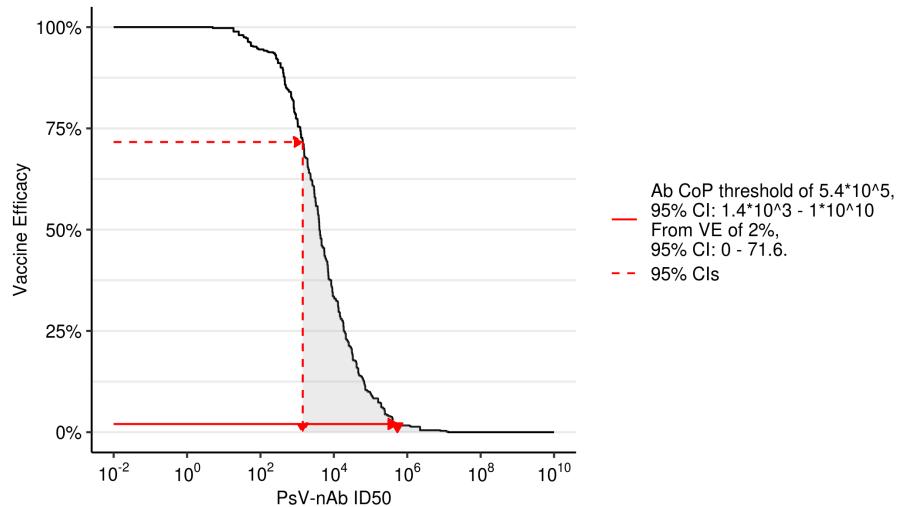


Figure 1.23: (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline positive vaccine arm

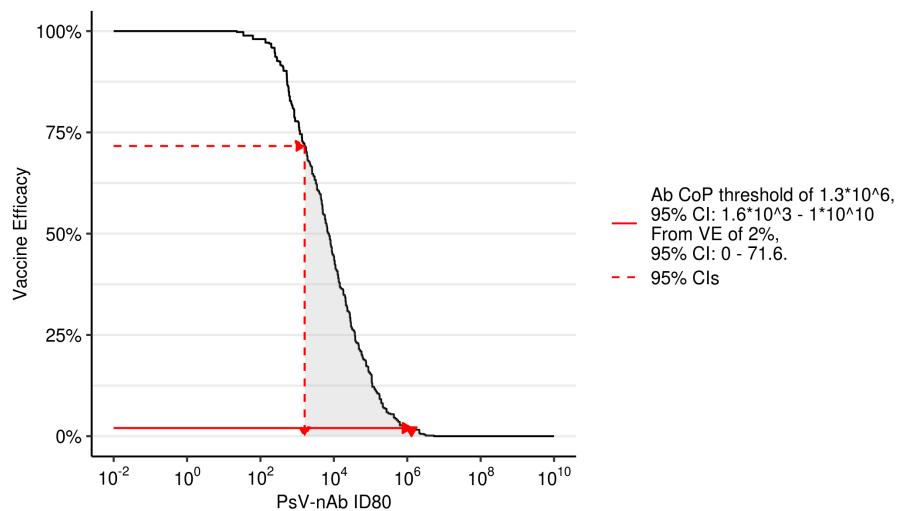


Figure 1.24: (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline positive vaccine arm

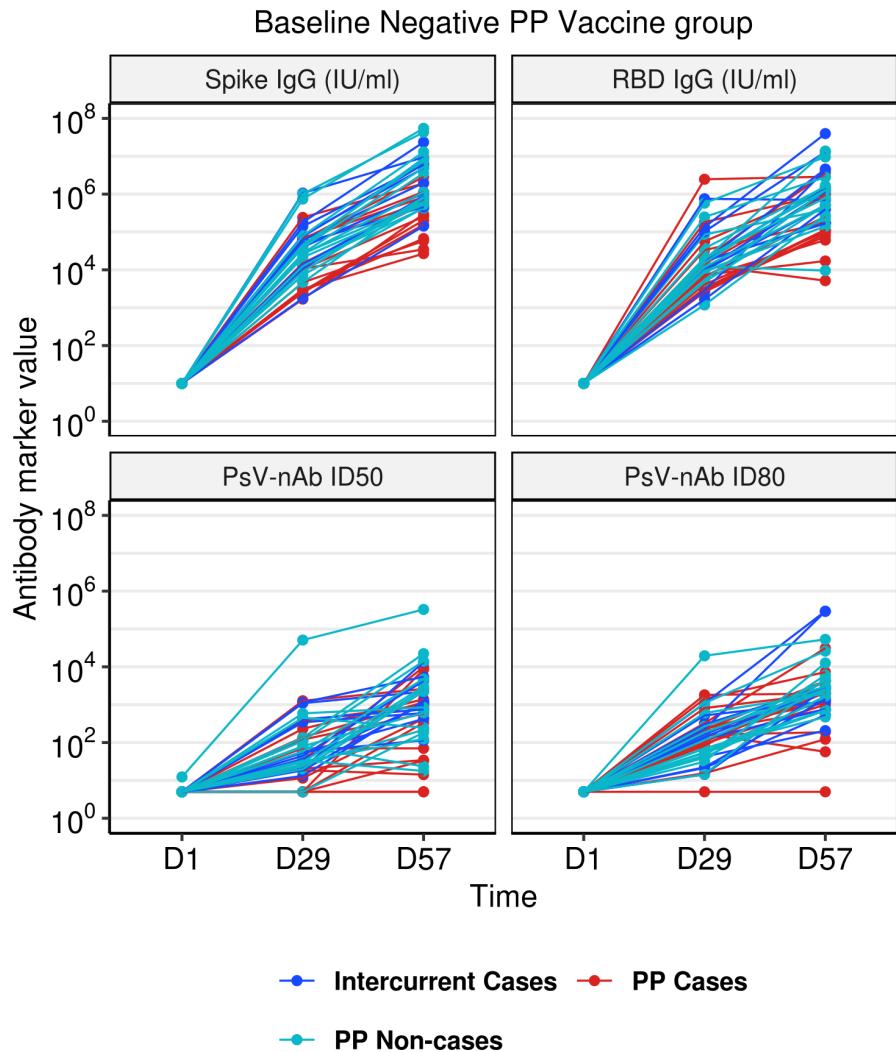


Figure 1.25: (Mock data) Spaghetti Plots of Marker Trajectory: baseline negative vaccine arm

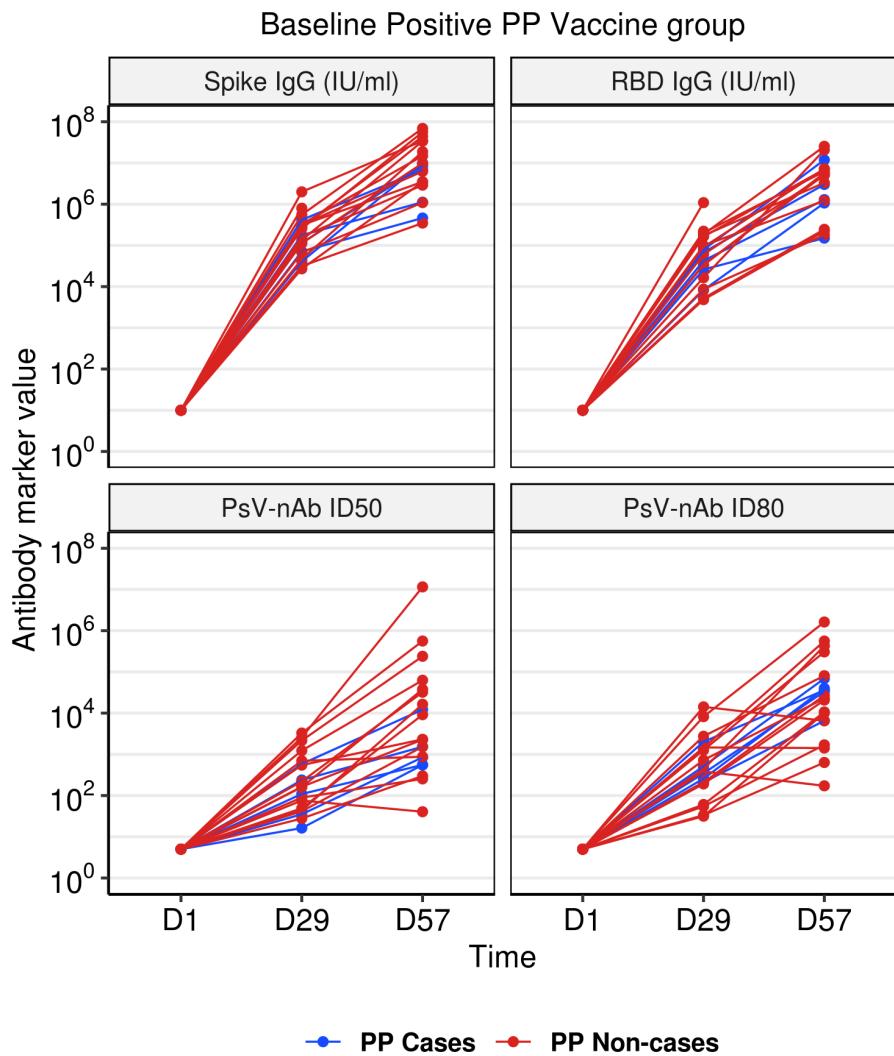


Figure 1.26: (Mock data) Spaghetti Plots of Marker Trajectory: baseline positive vaccine arm

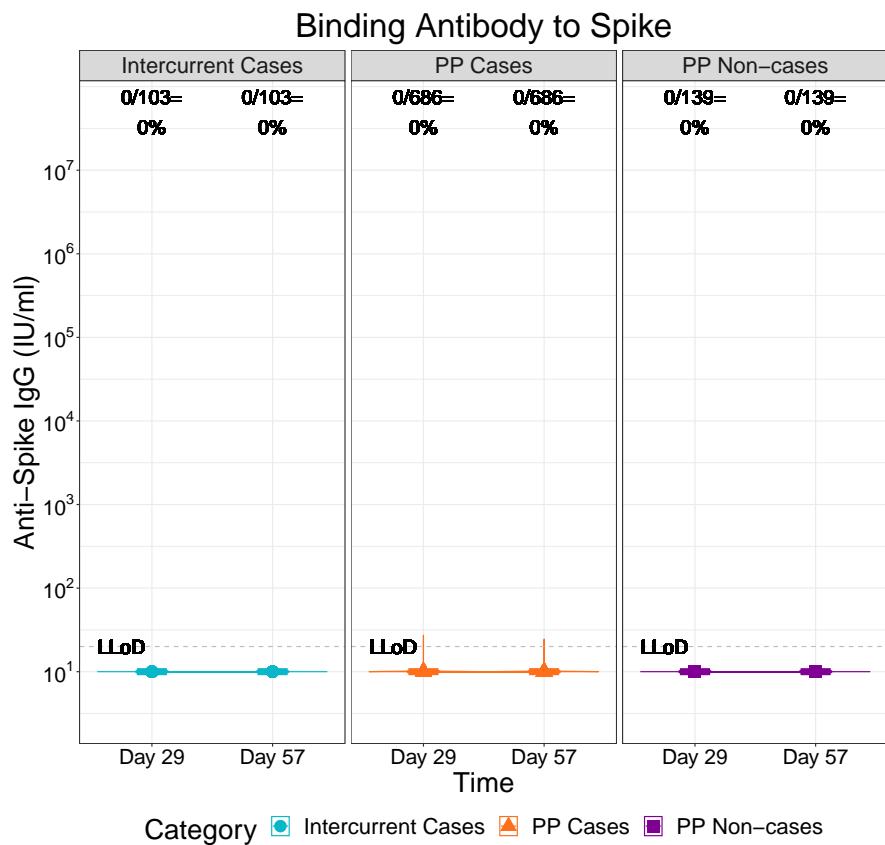


Figure 1.27: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints)

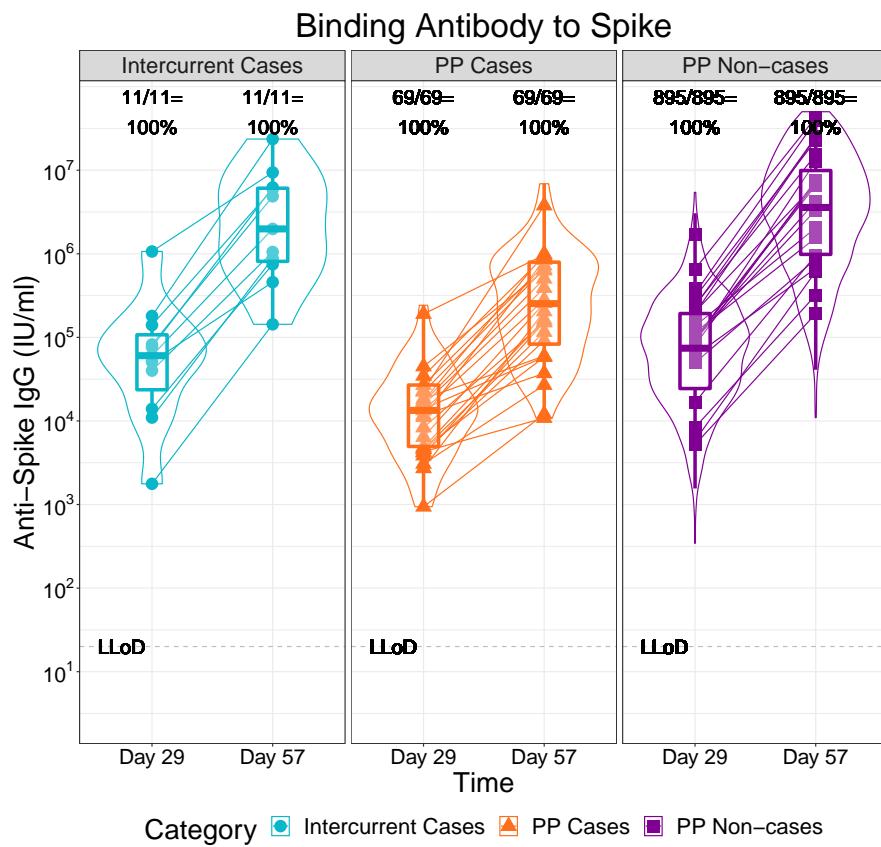


Figure 1.28: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints)

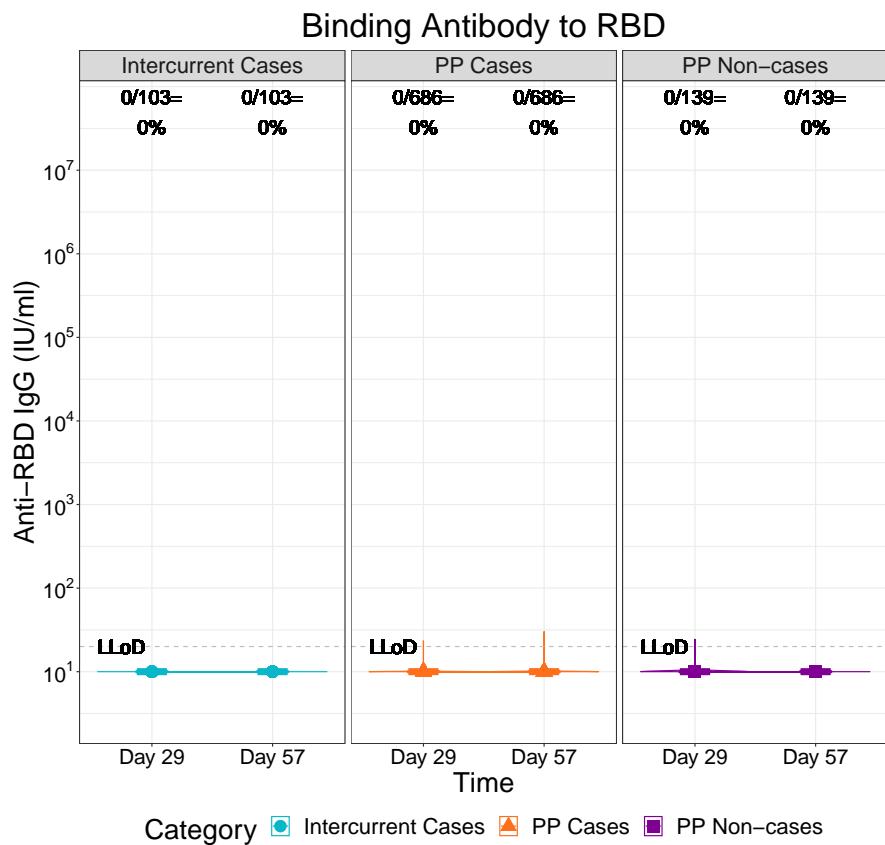


Figure 1.29: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints)

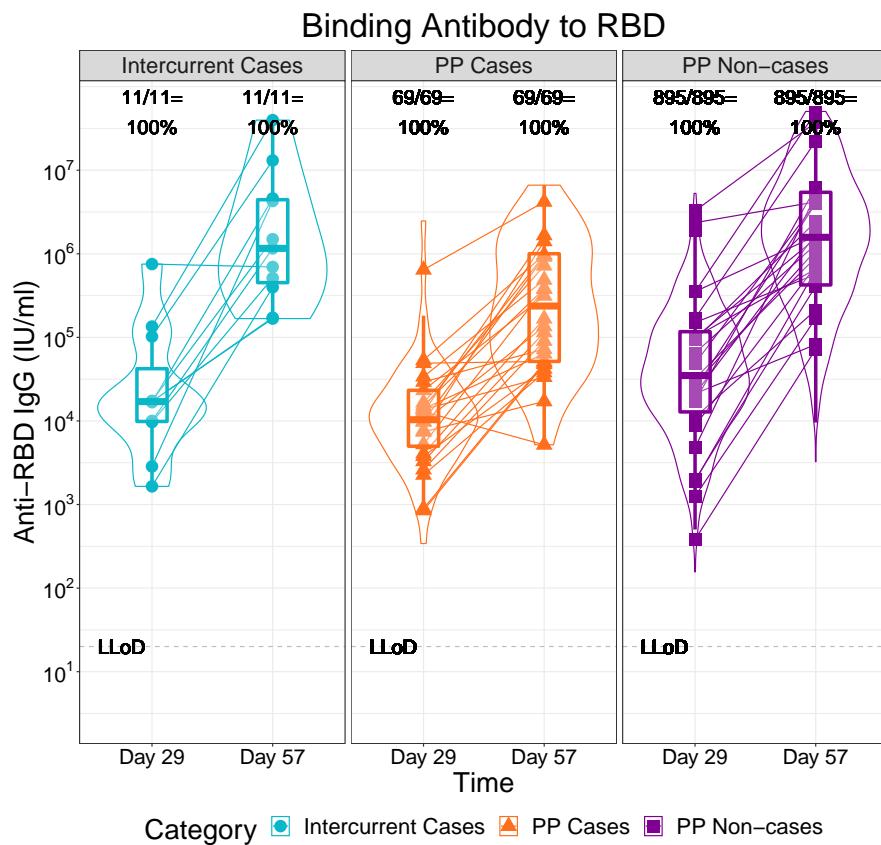


Figure 1.30: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints)

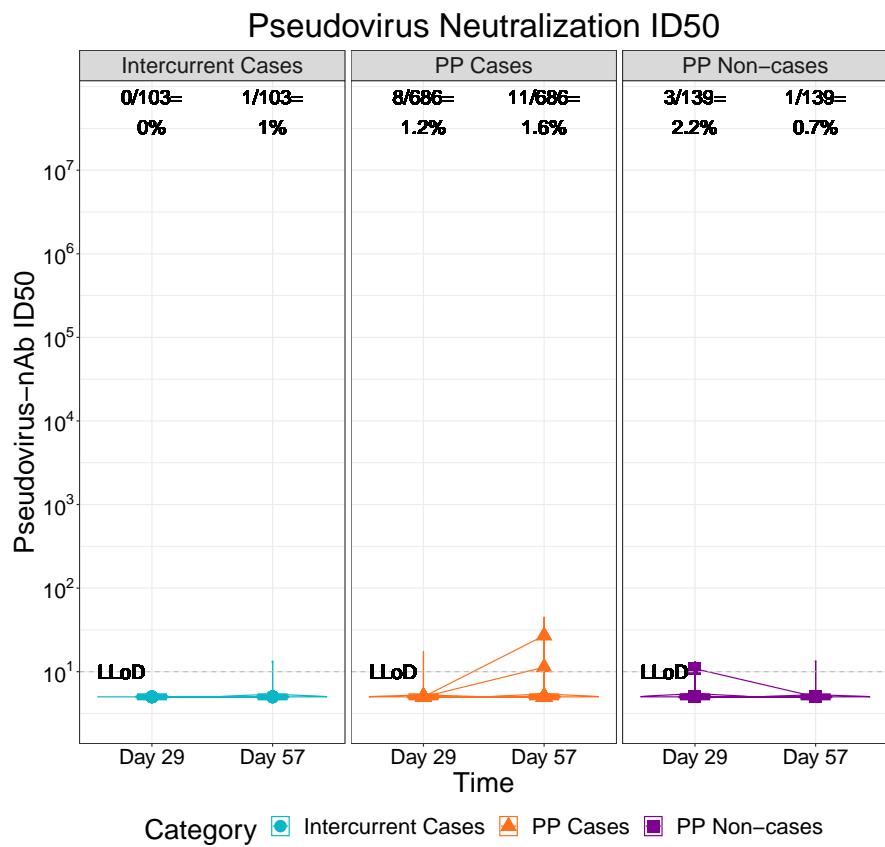


Figure 1.31: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints)

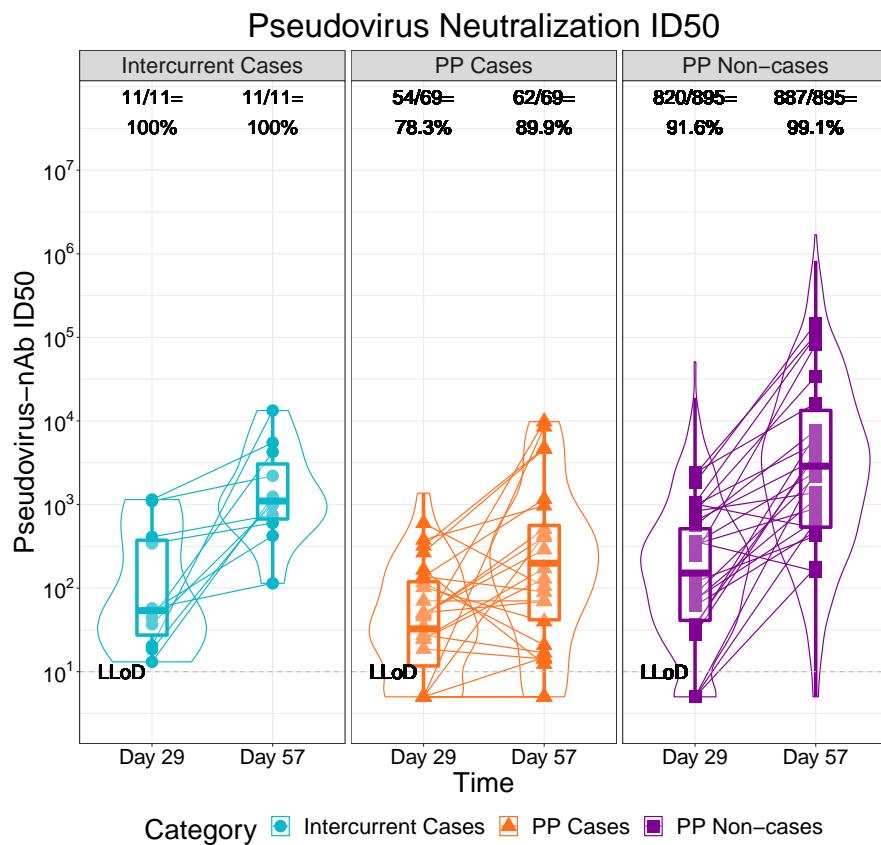


Figure 1.32: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (2 timepoints)

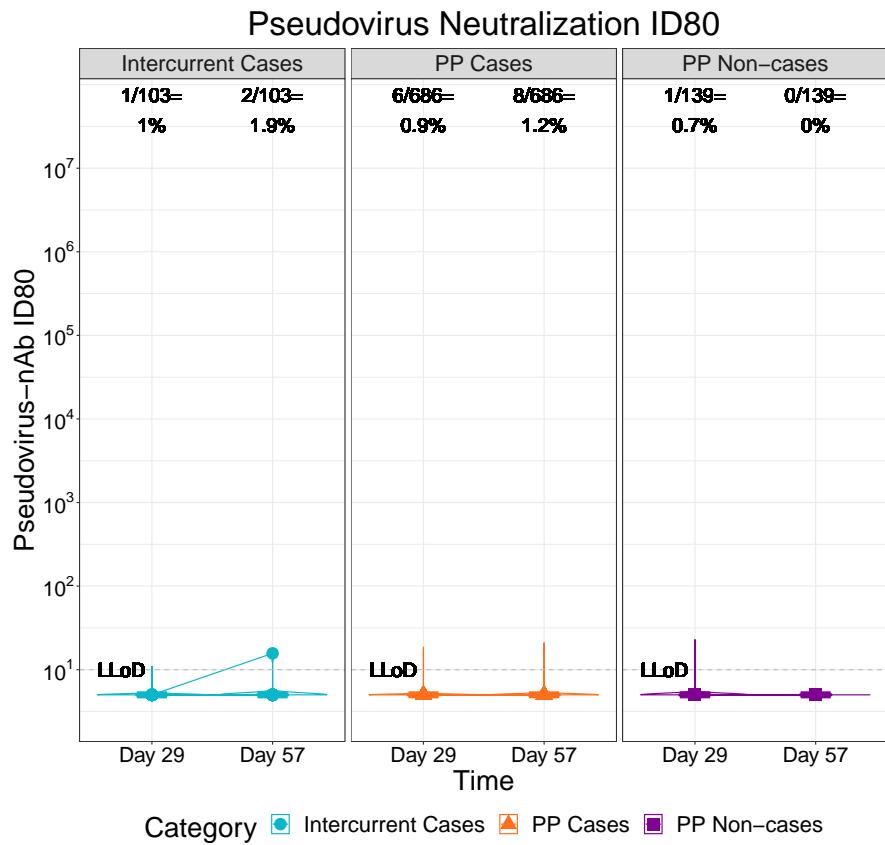


Figure 1.33: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints)

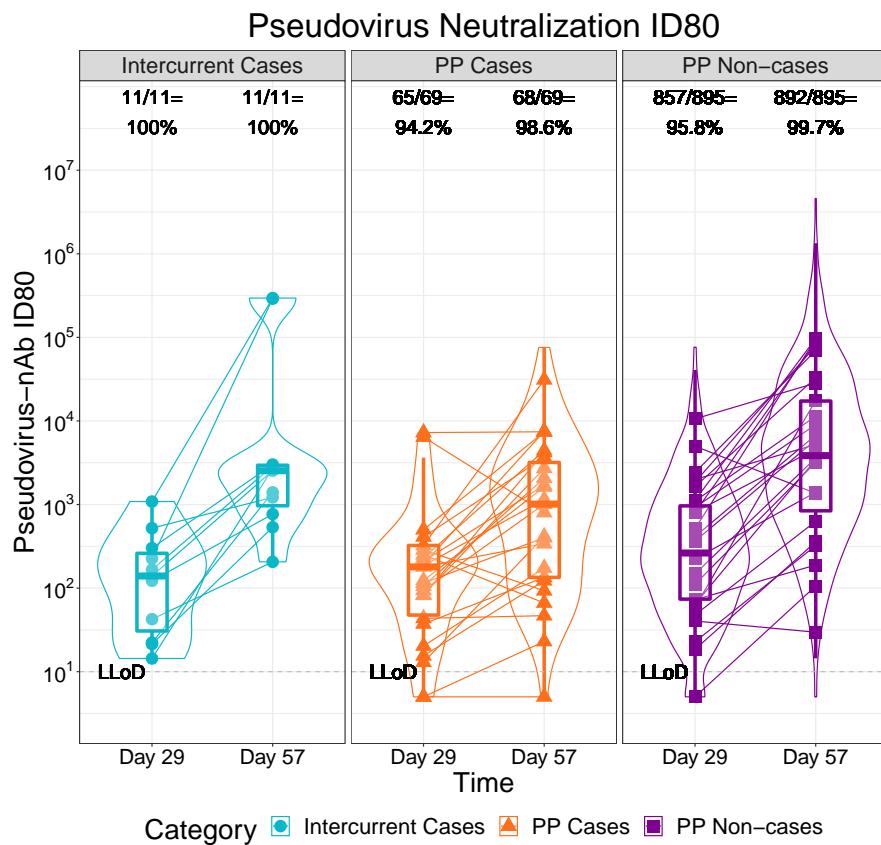


Figure 1.34: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (2 timepoints)

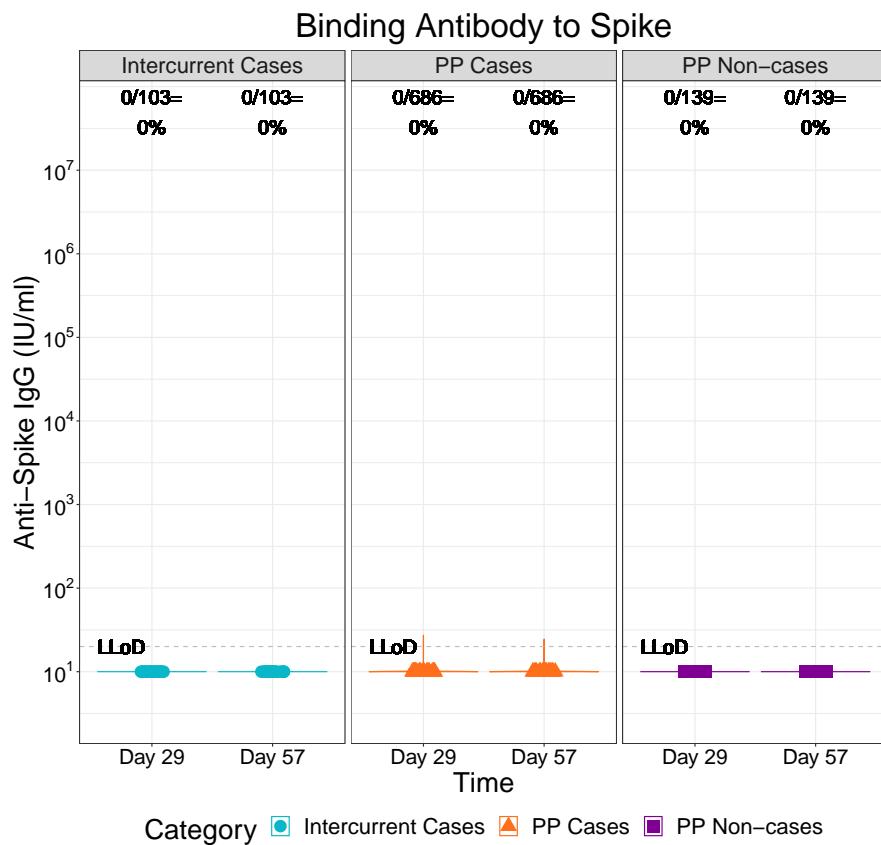


Figure 1.35: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints)

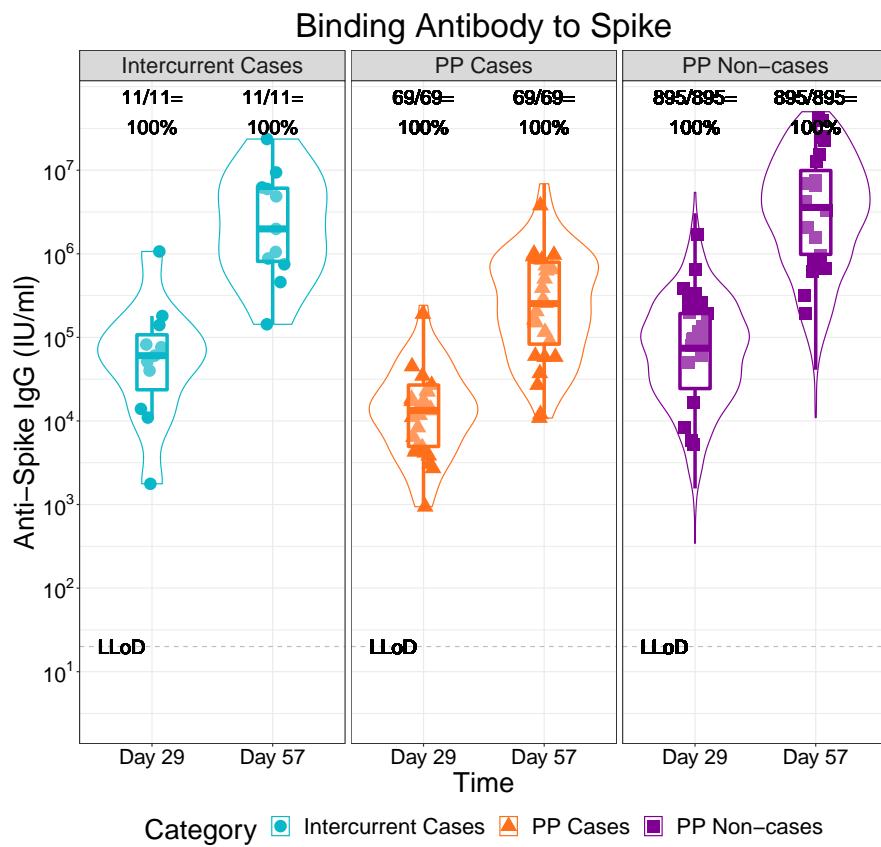


Figure 1.36: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints)

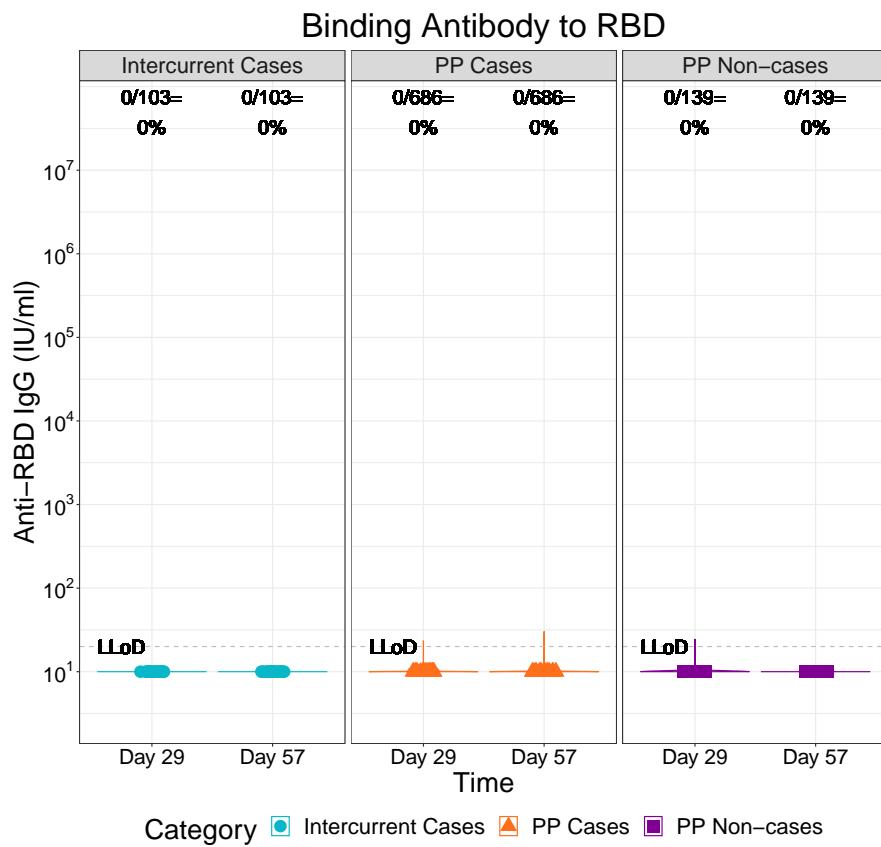


Figure 1.37: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints)

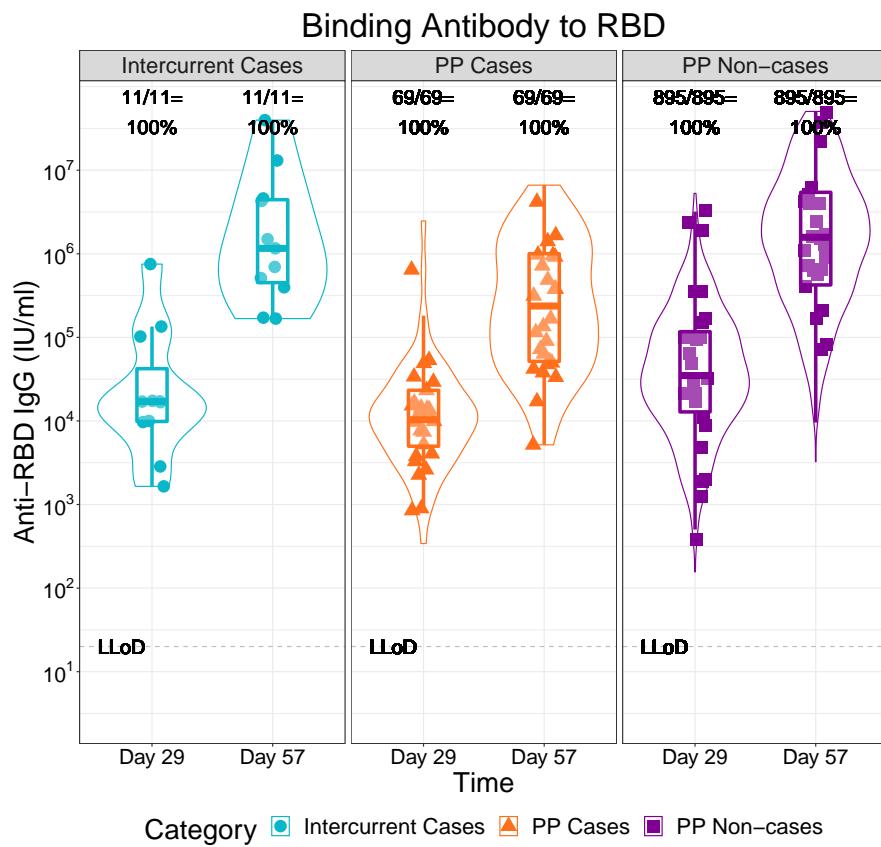


Figure 1.38: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints)

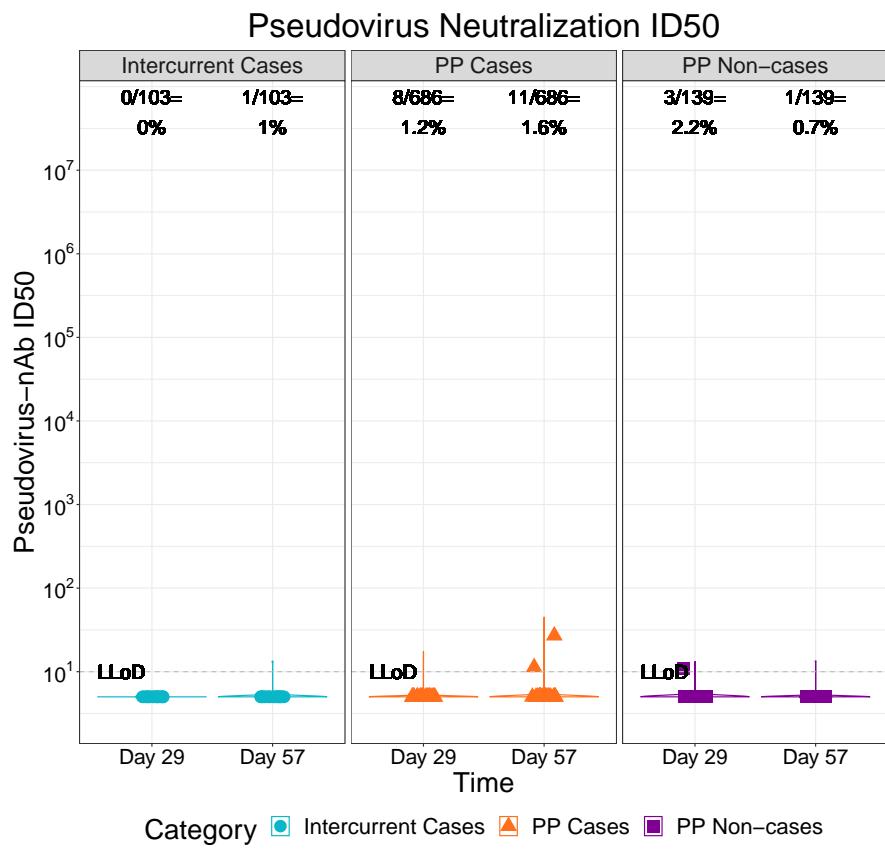


Figure 1.39: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints)

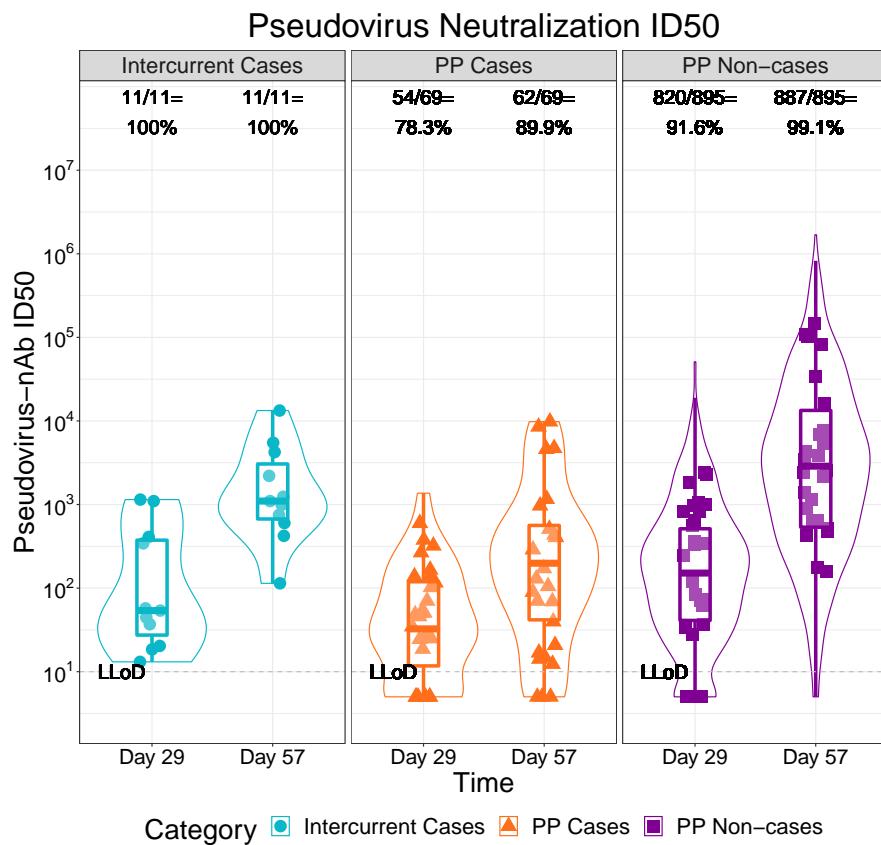


Figure 1.40: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (2 timepoints)

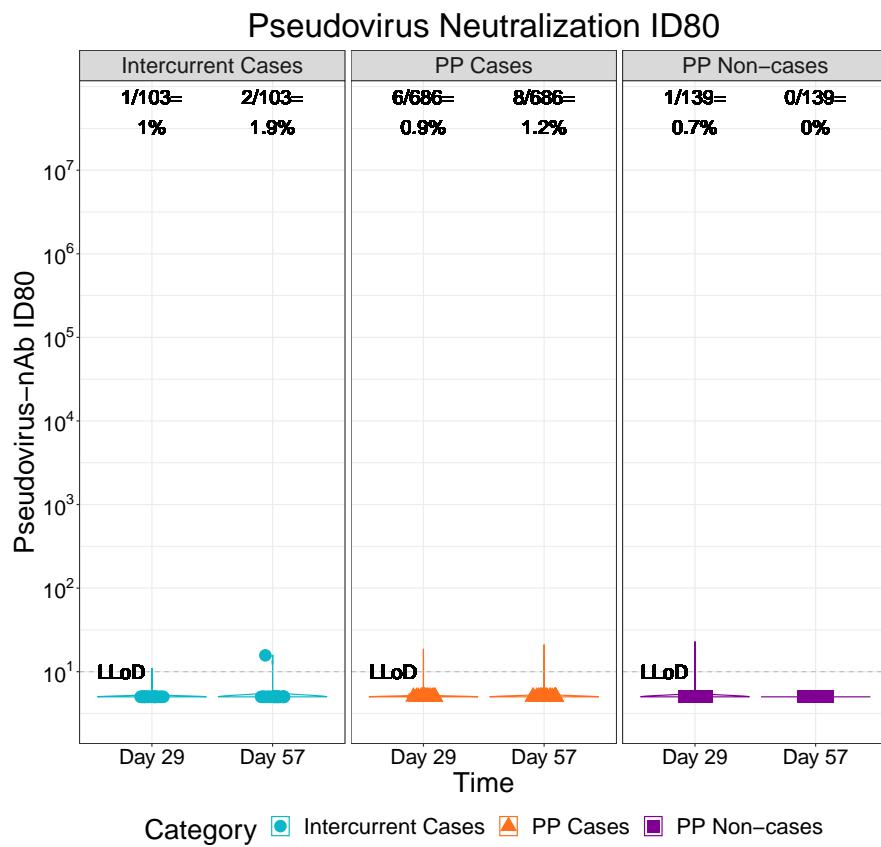


Figure 1.41: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints)

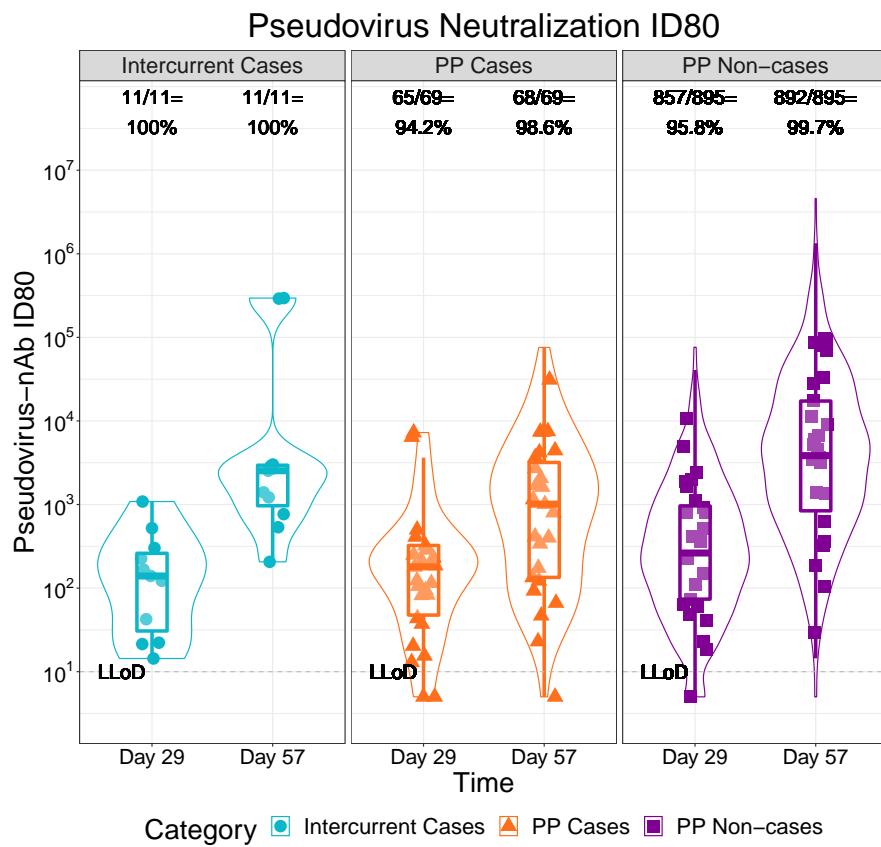


Figure 1.42: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (2 timepoints)

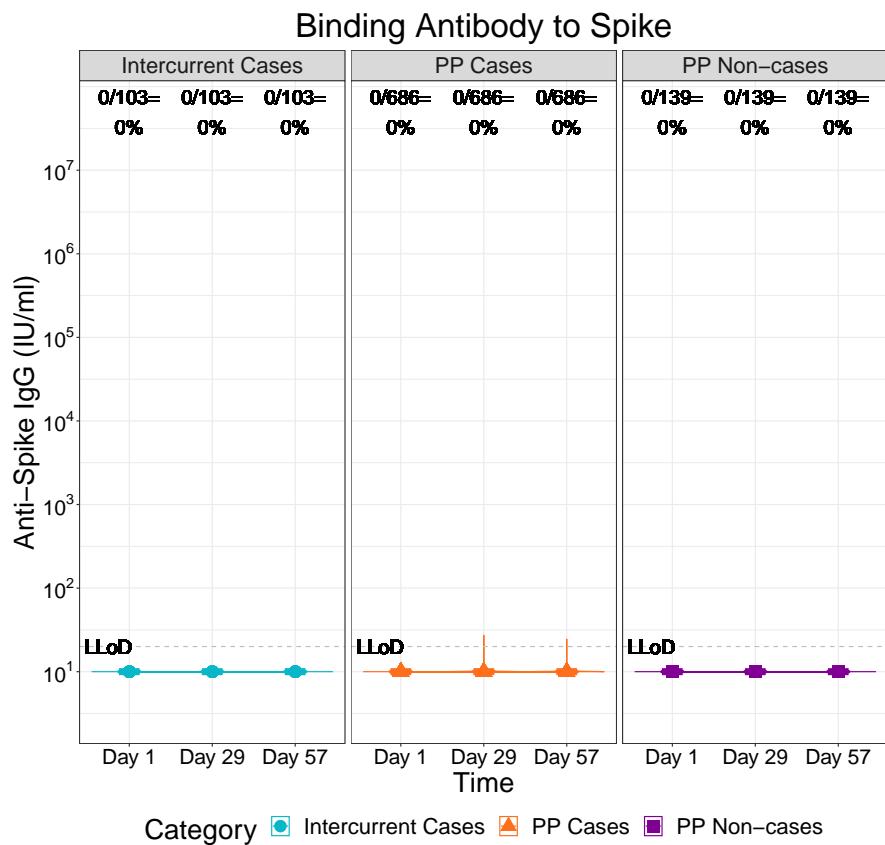


Figure 1.43: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints)

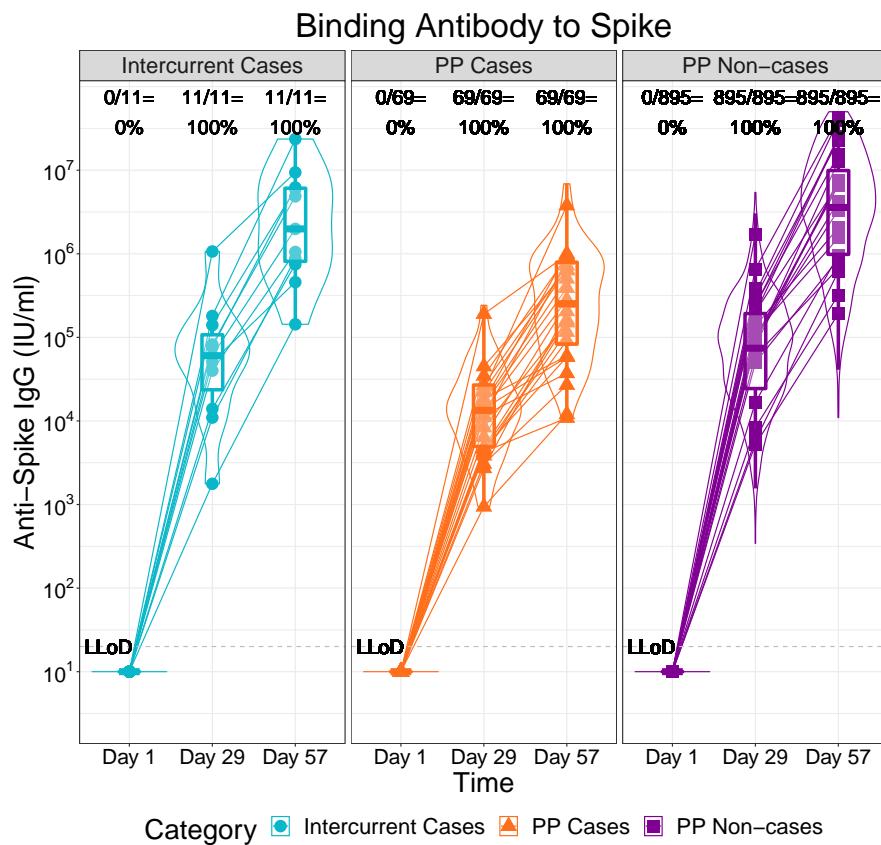


Figure 1.44: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints)

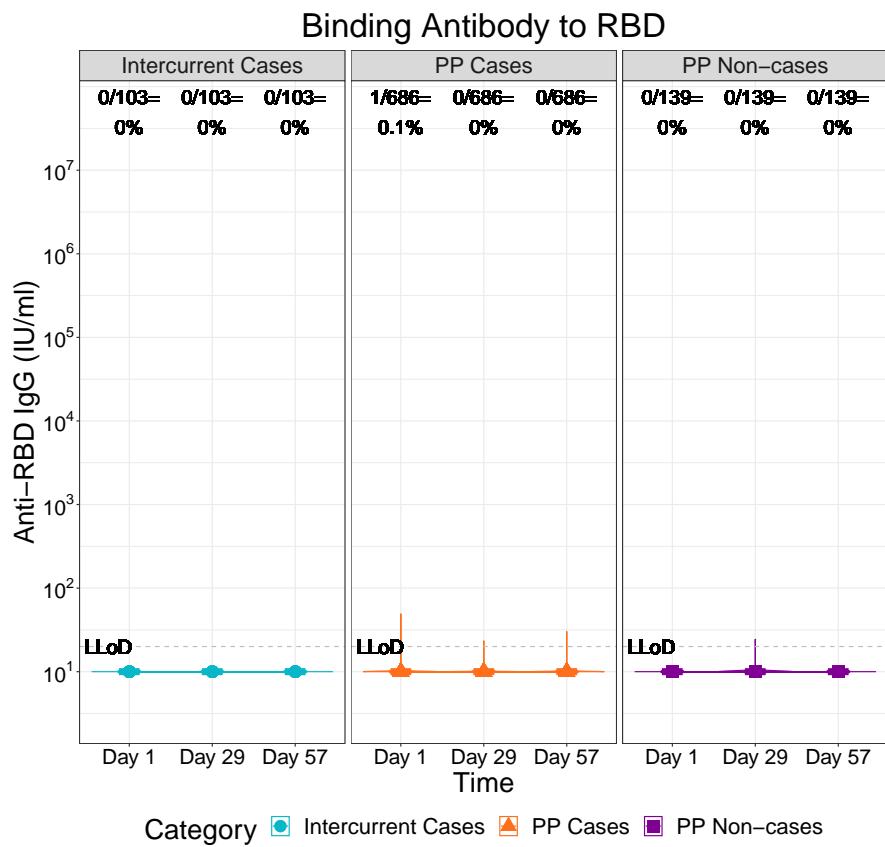


Figure 1.45: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints)

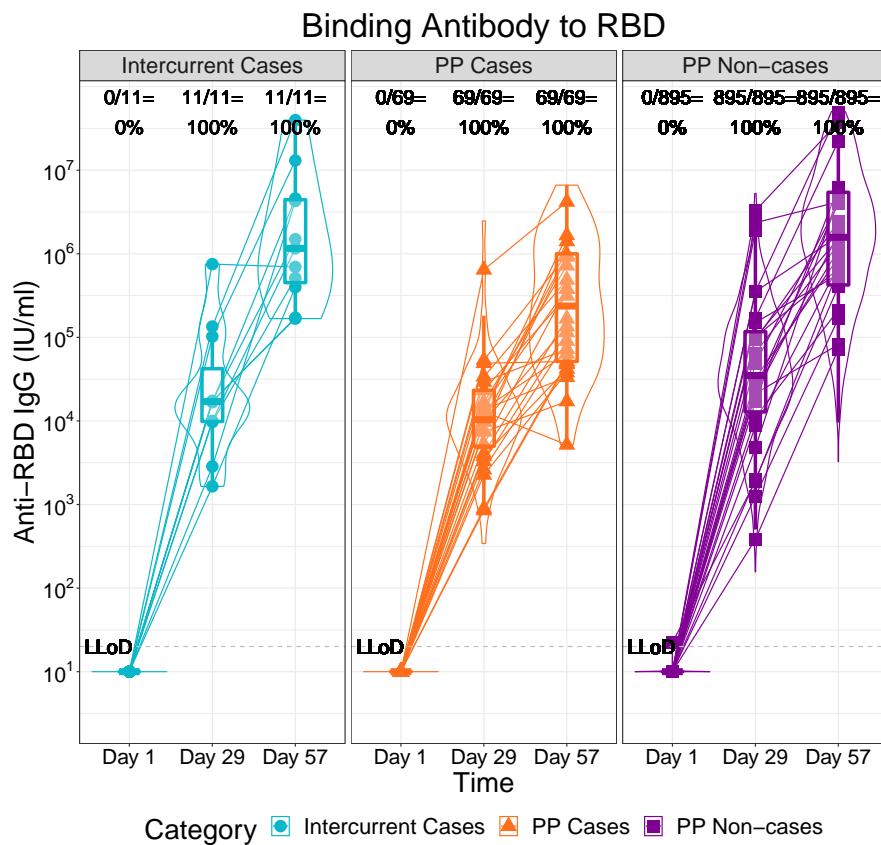


Figure 1.46: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints)

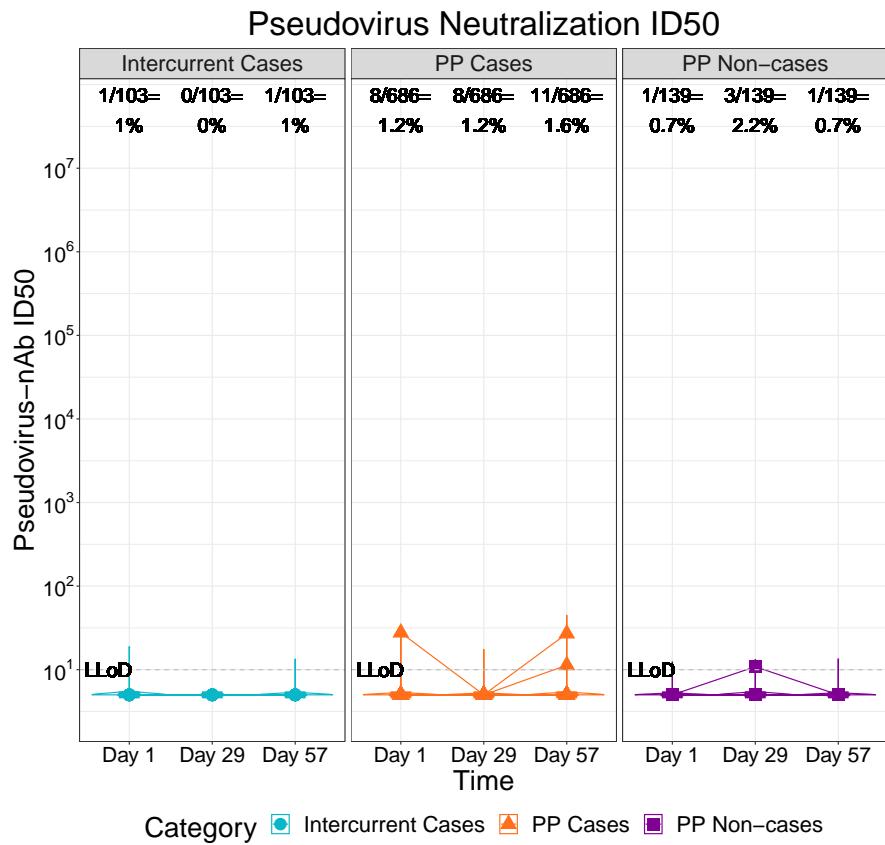


Figure 1.47: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints)

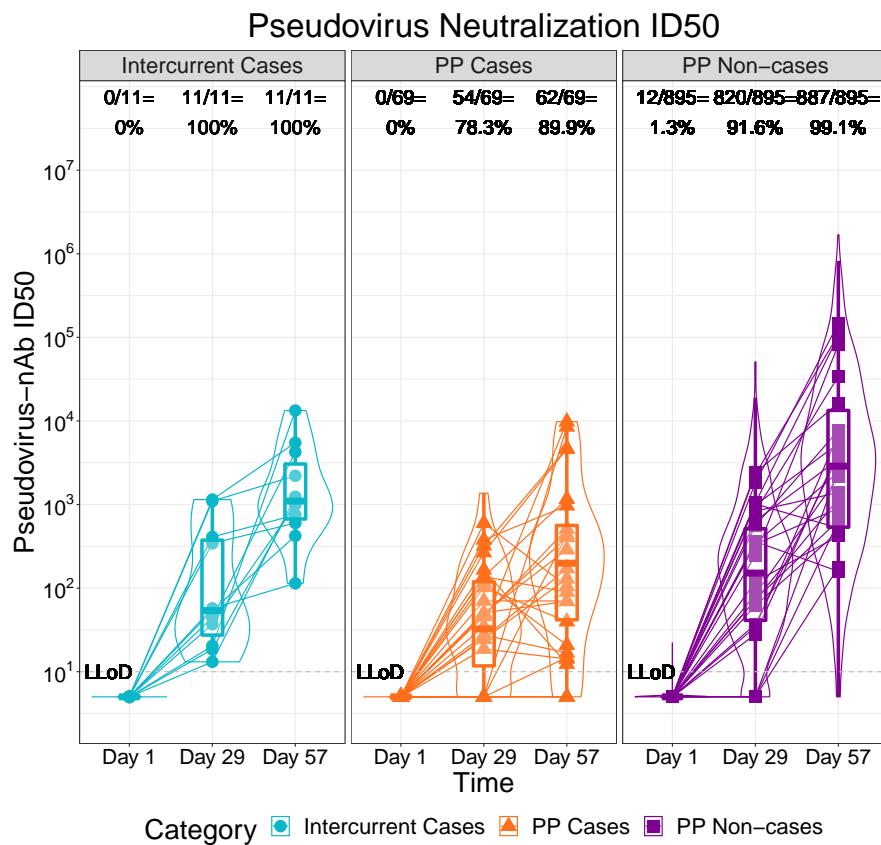


Figure 1.48: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (3 timepoints)

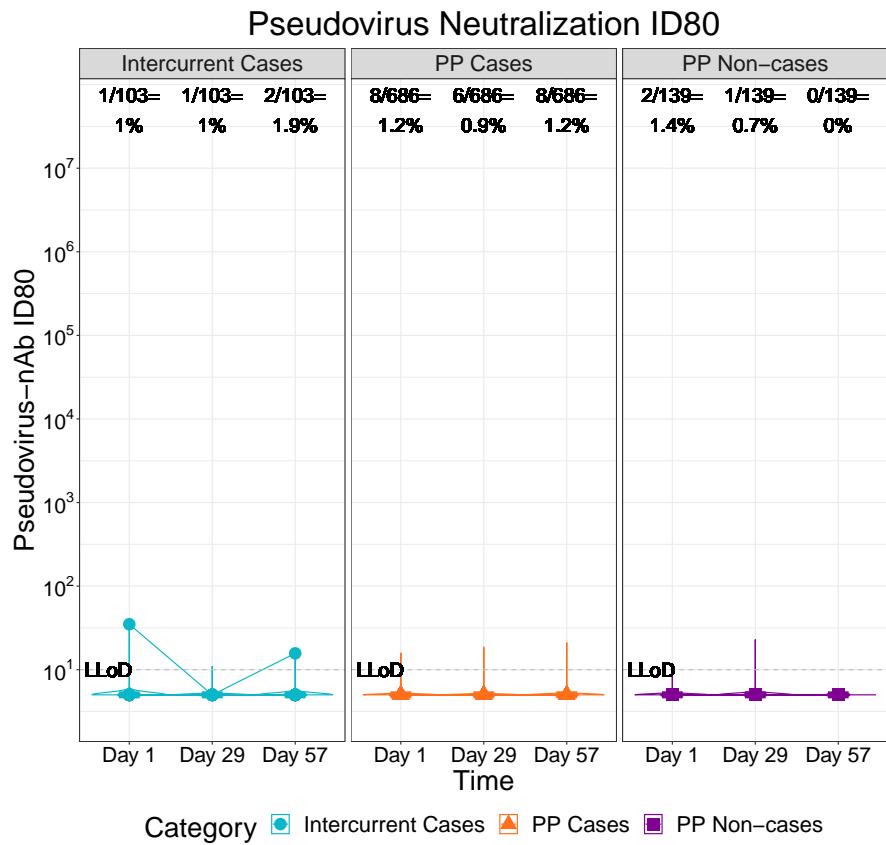


Figure 1.49: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints)

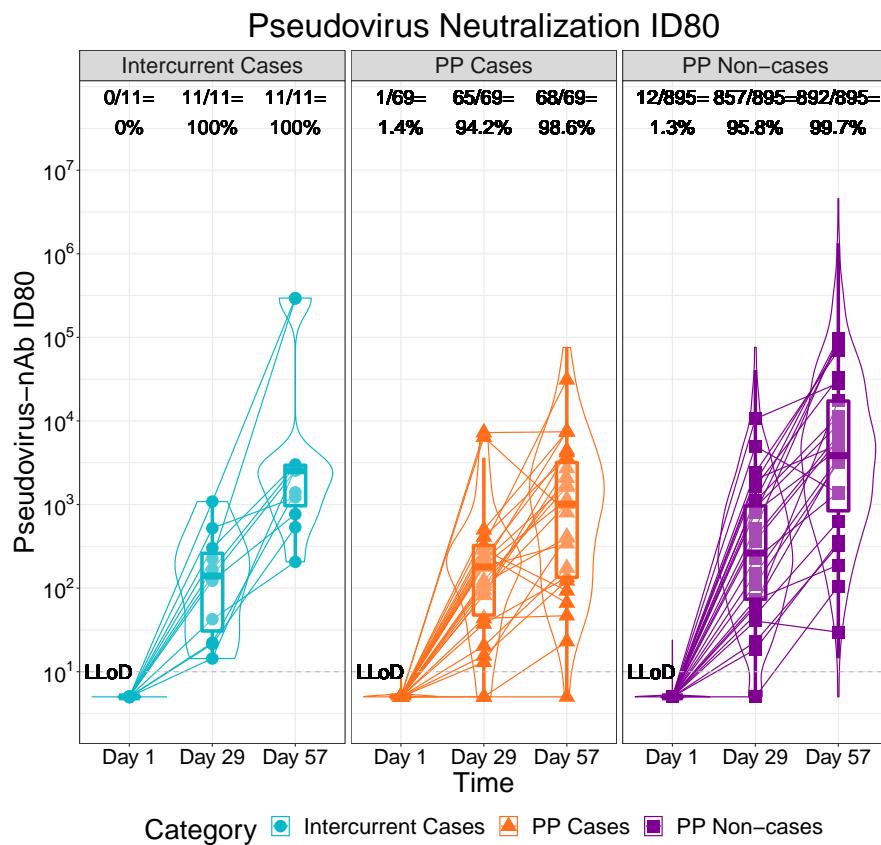


Figure 1.50: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (3 timepoints)

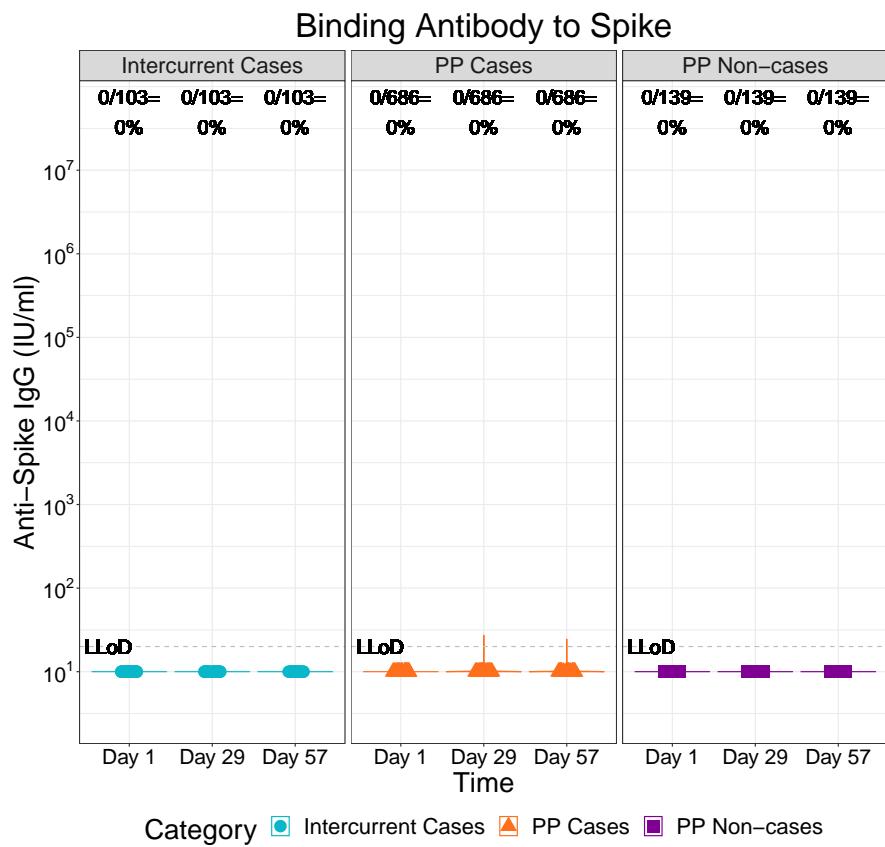


Figure 1.51: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints)

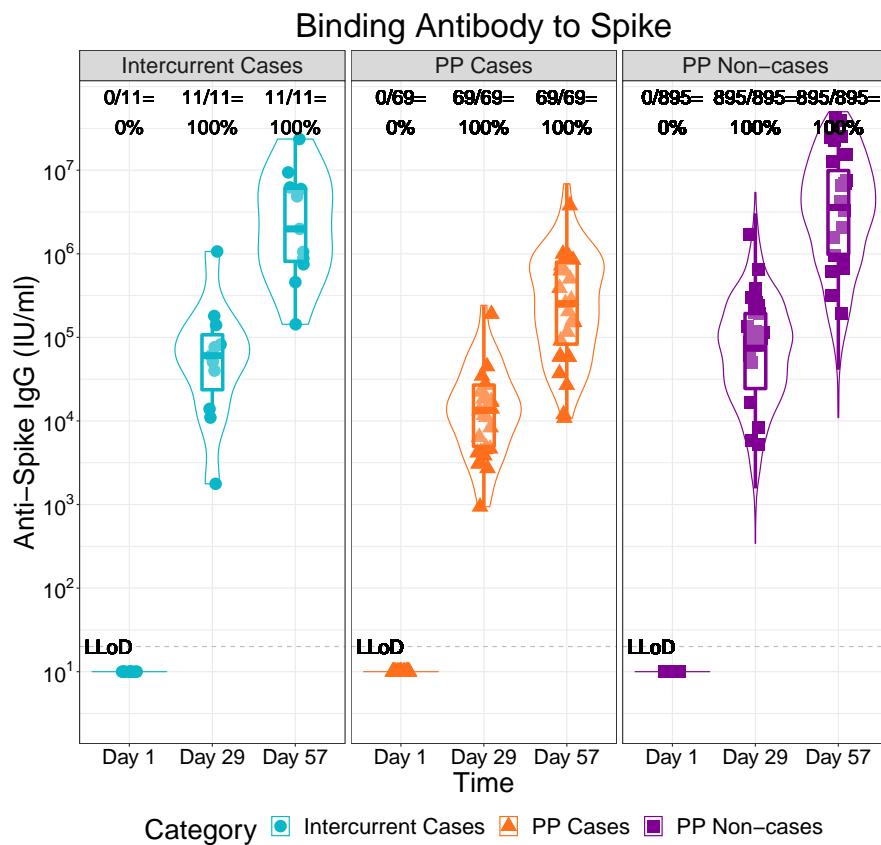


Figure 1.52: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints)

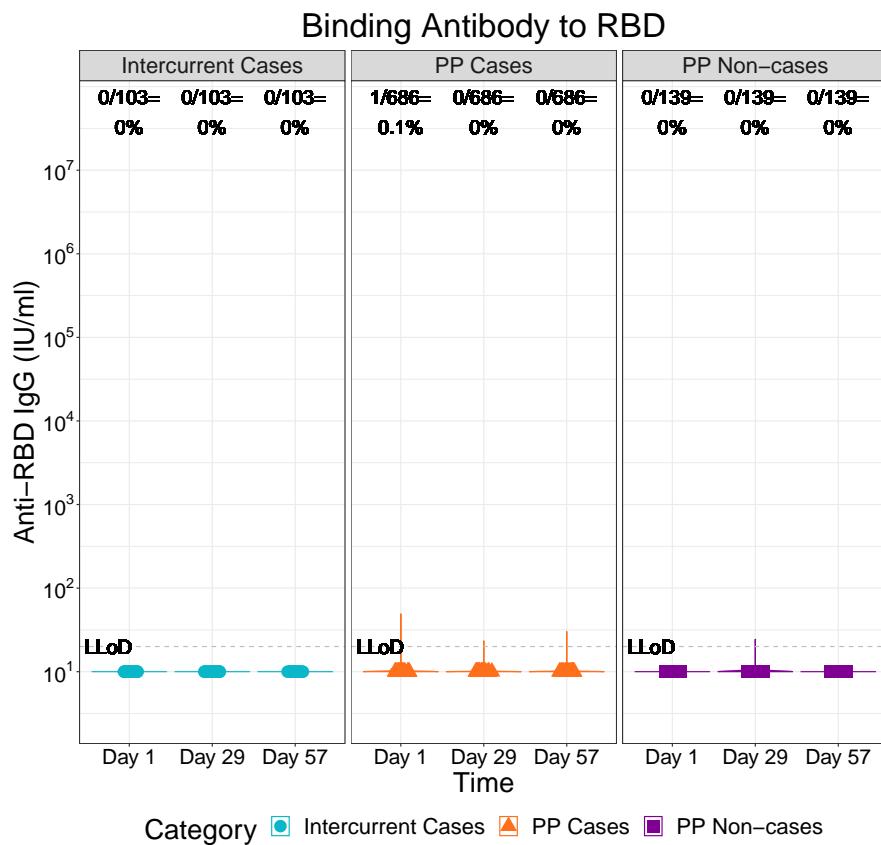


Figure 1.53: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints)

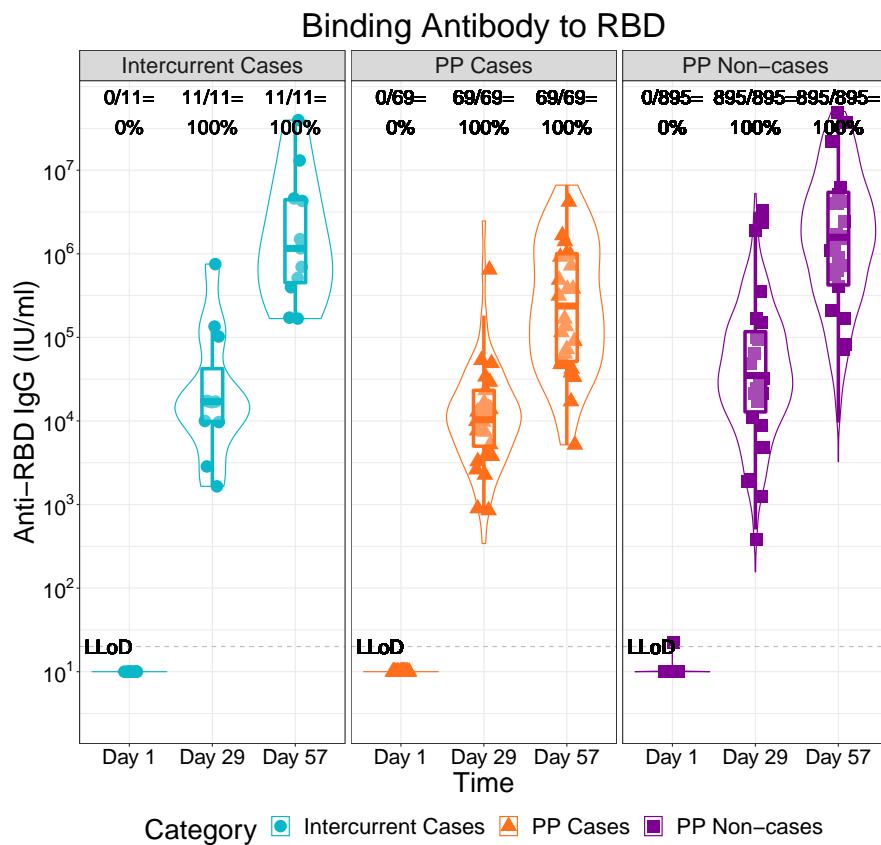


Figure 1.54: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints)

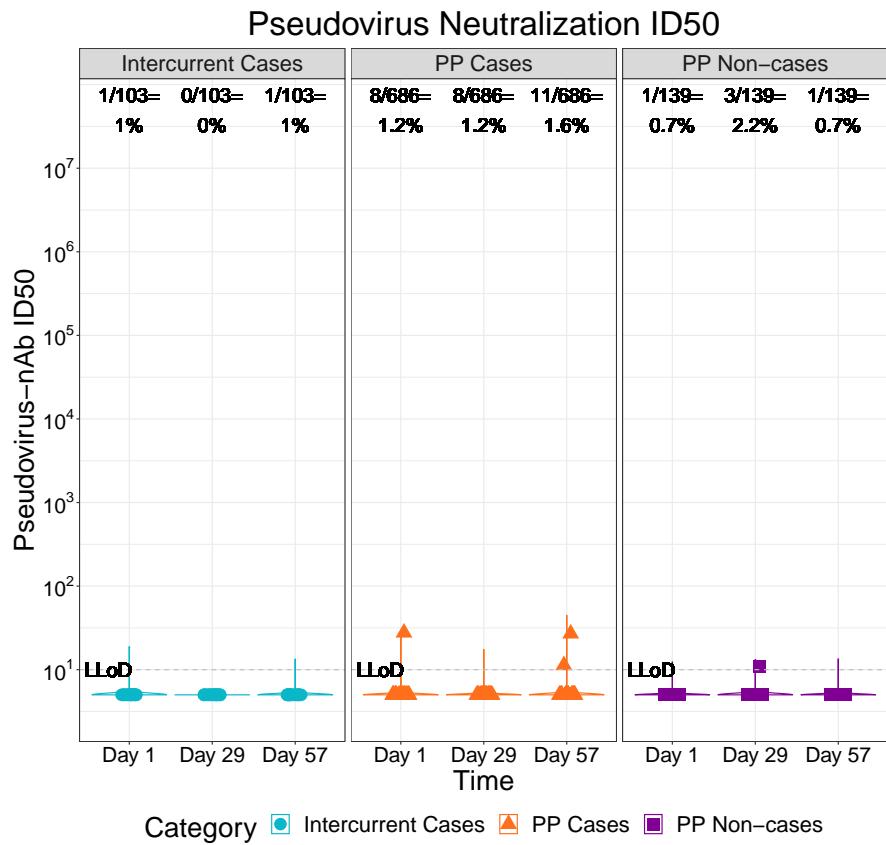


Figure 1.55: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints)

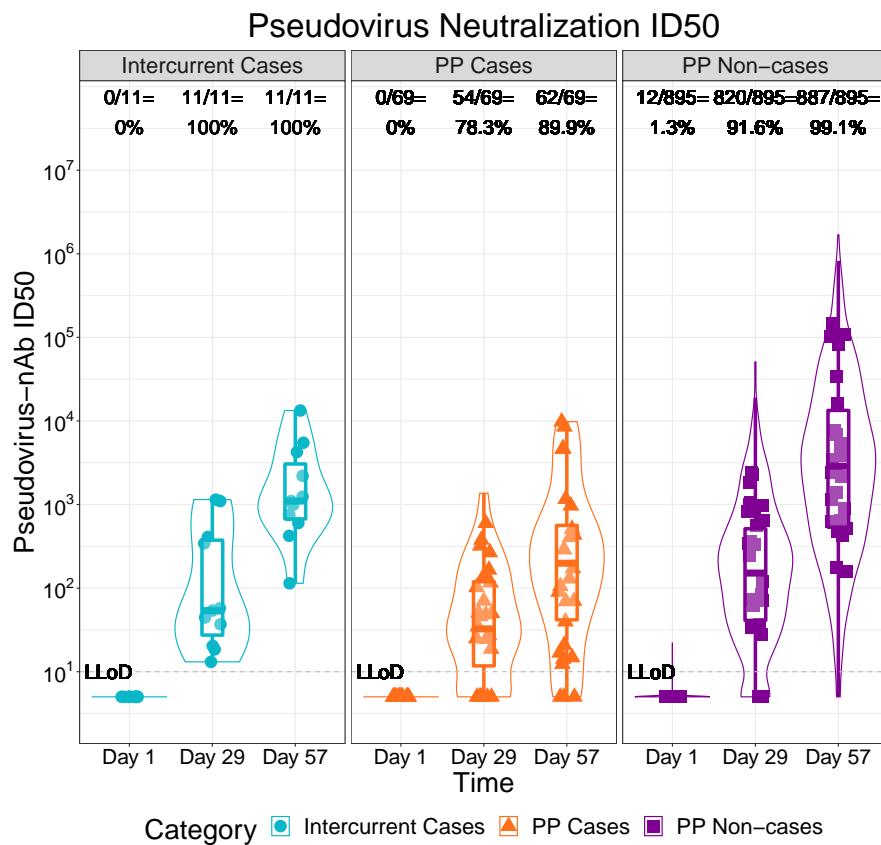


Figure 1.56: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (3 timepoints)

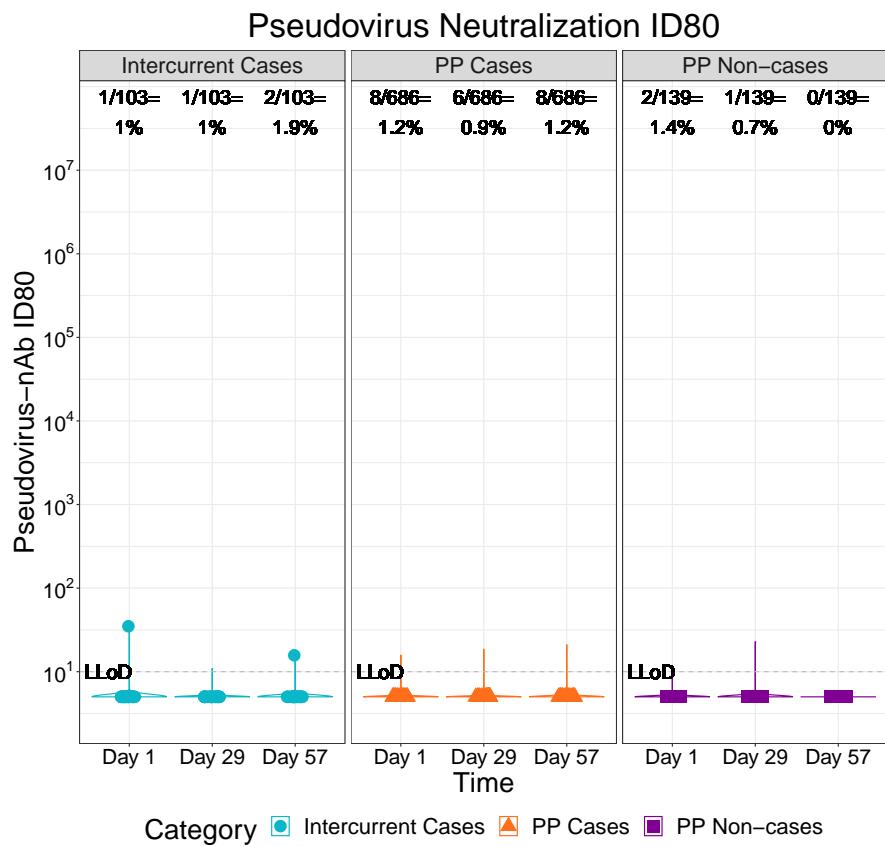


Figure 1.57: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints)

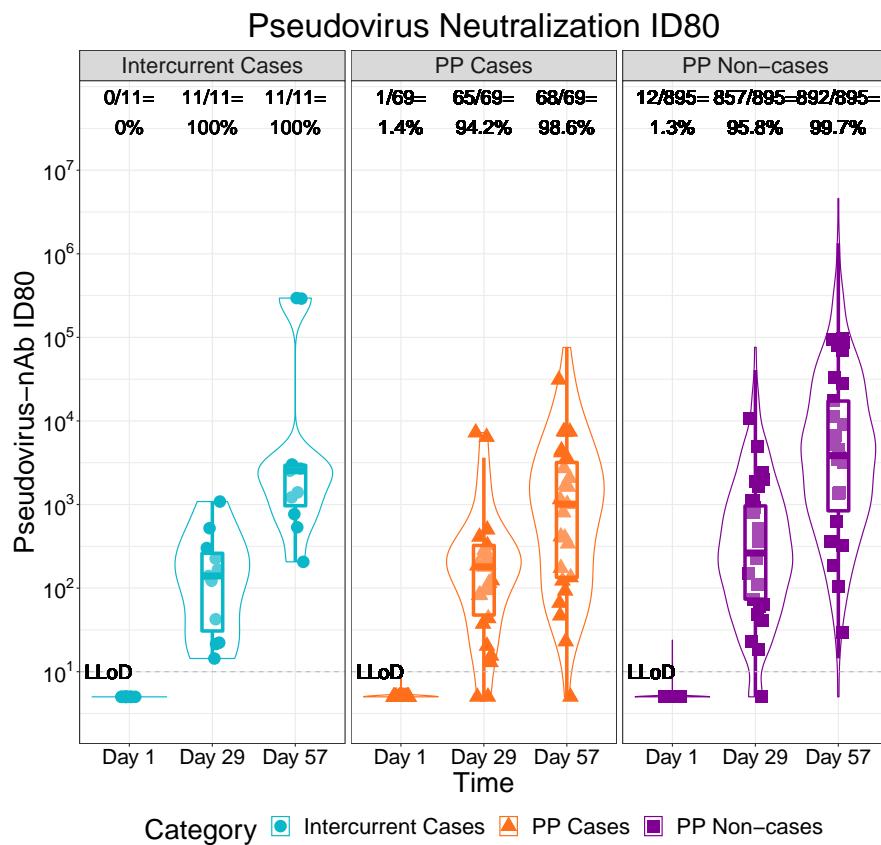


Figure 1.58: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (3 timepoints)

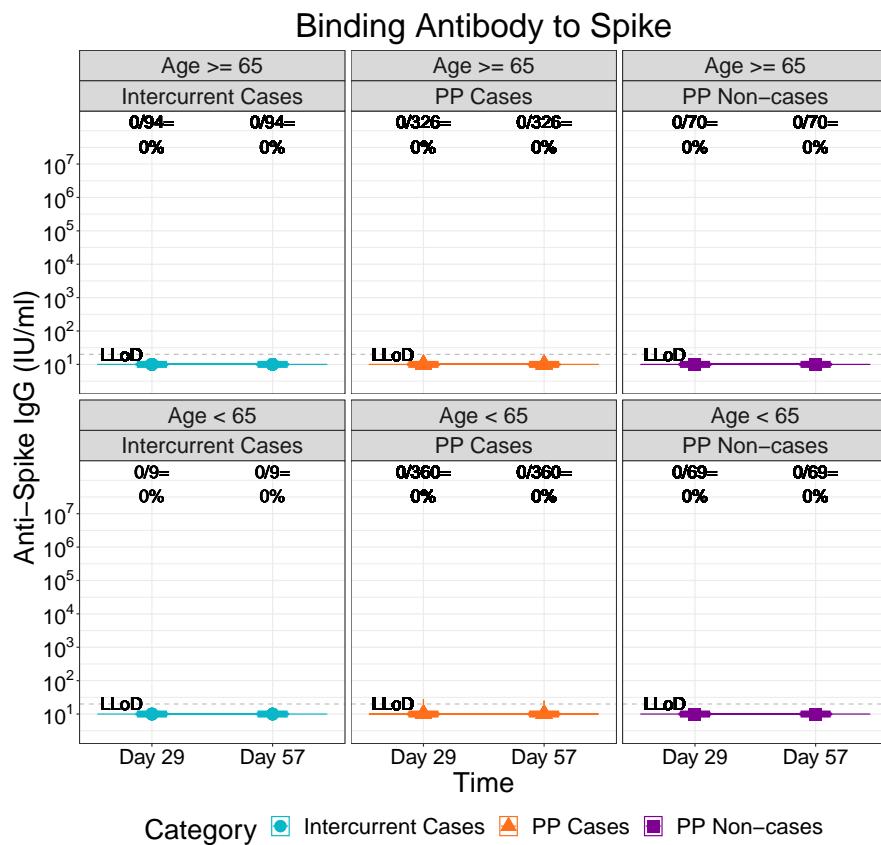


Figure 1.59: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints)

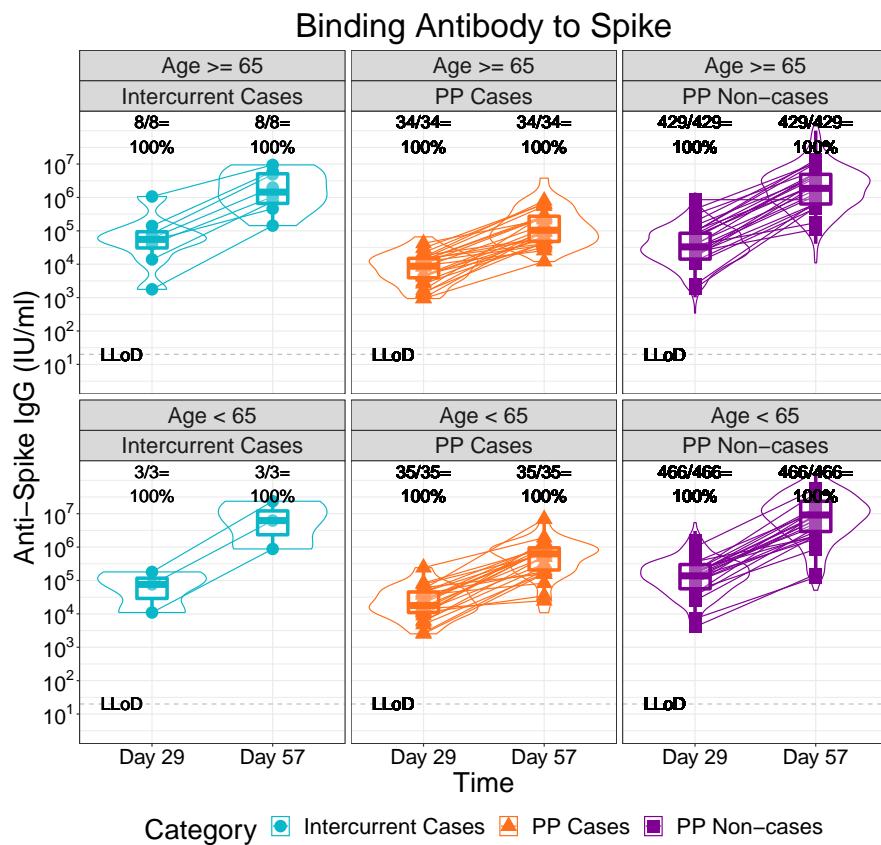


Figure 1.60: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints)

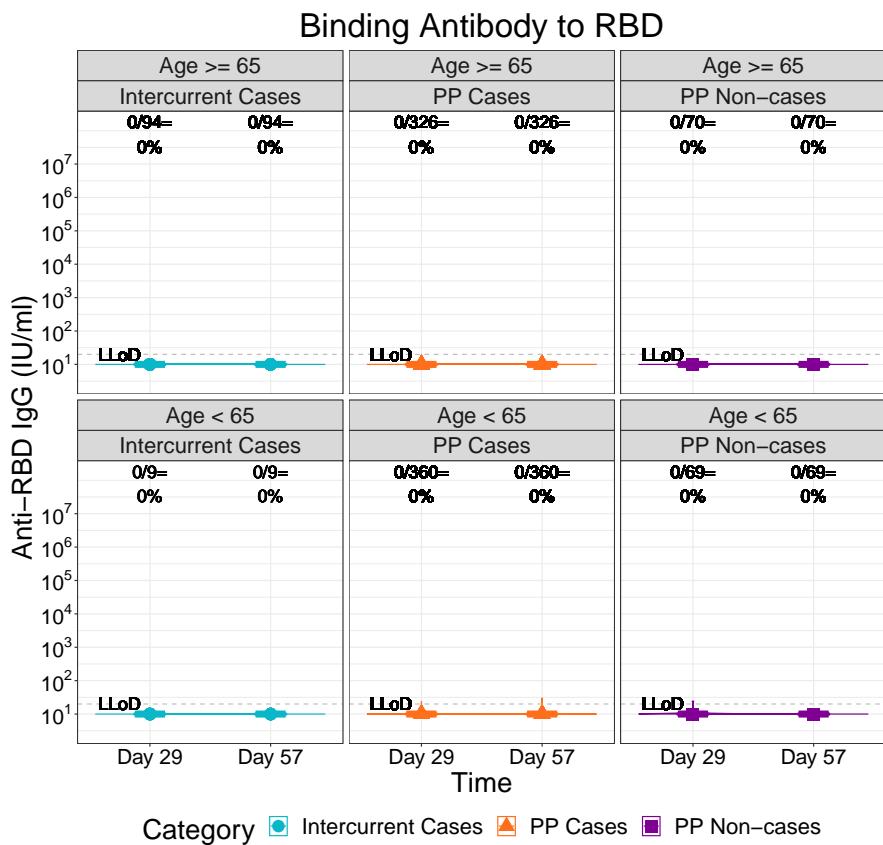


Figure 1.61: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints)

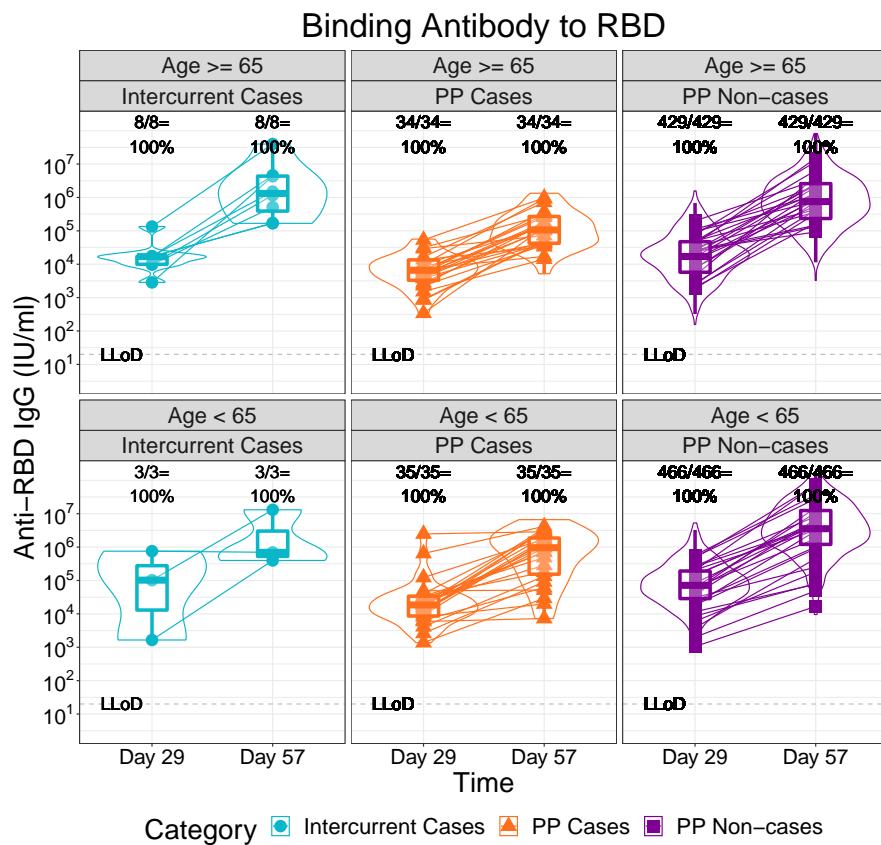


Figure 1.62: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints)

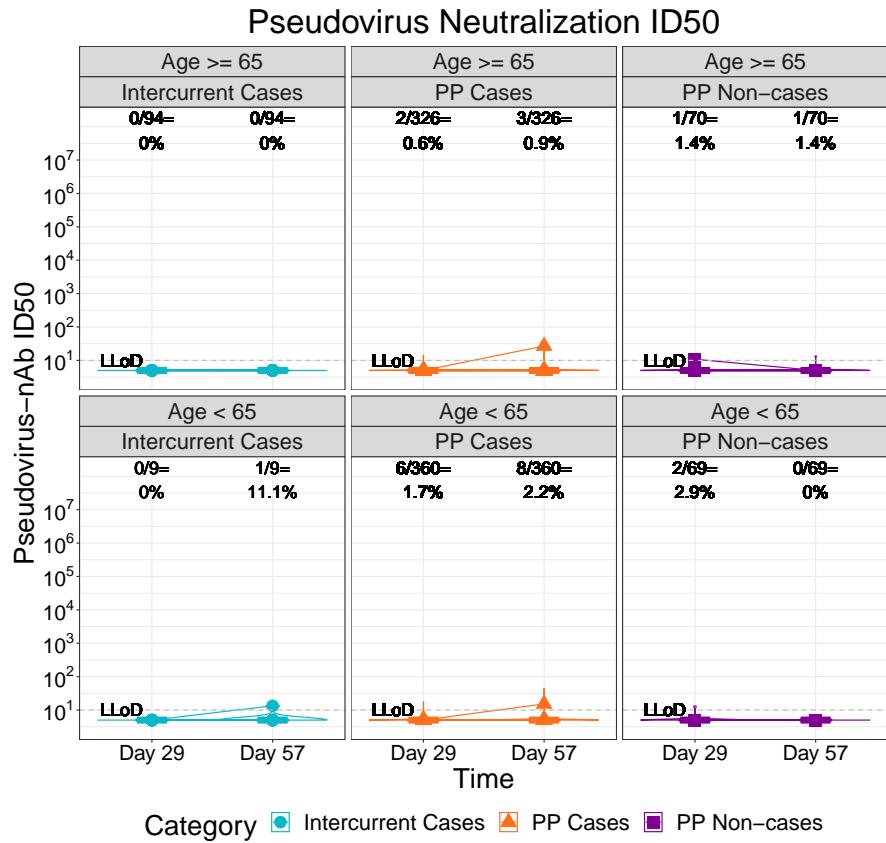


Figure 1.63: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints)

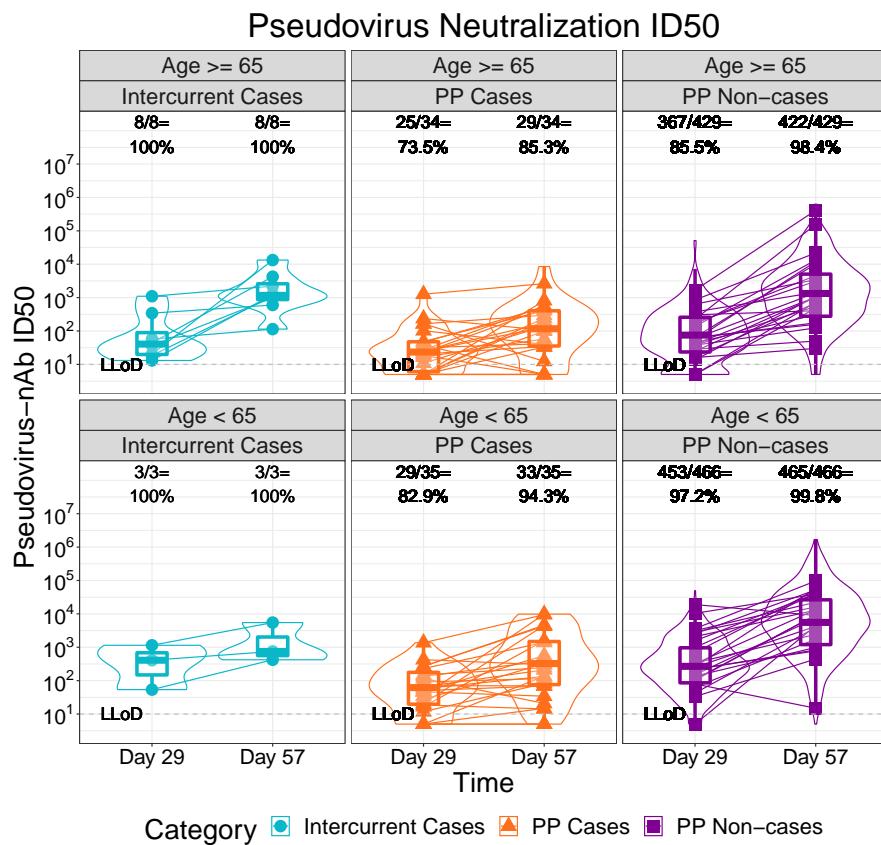


Figure 1.64: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (2 timepoints)

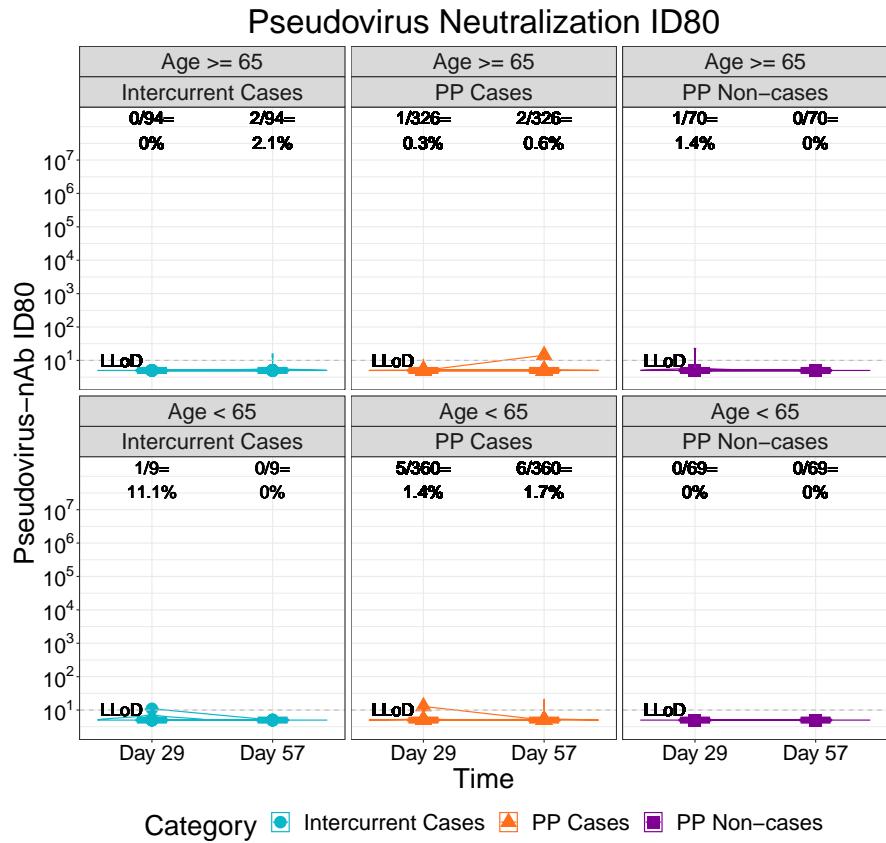


Figure 1.65: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints)

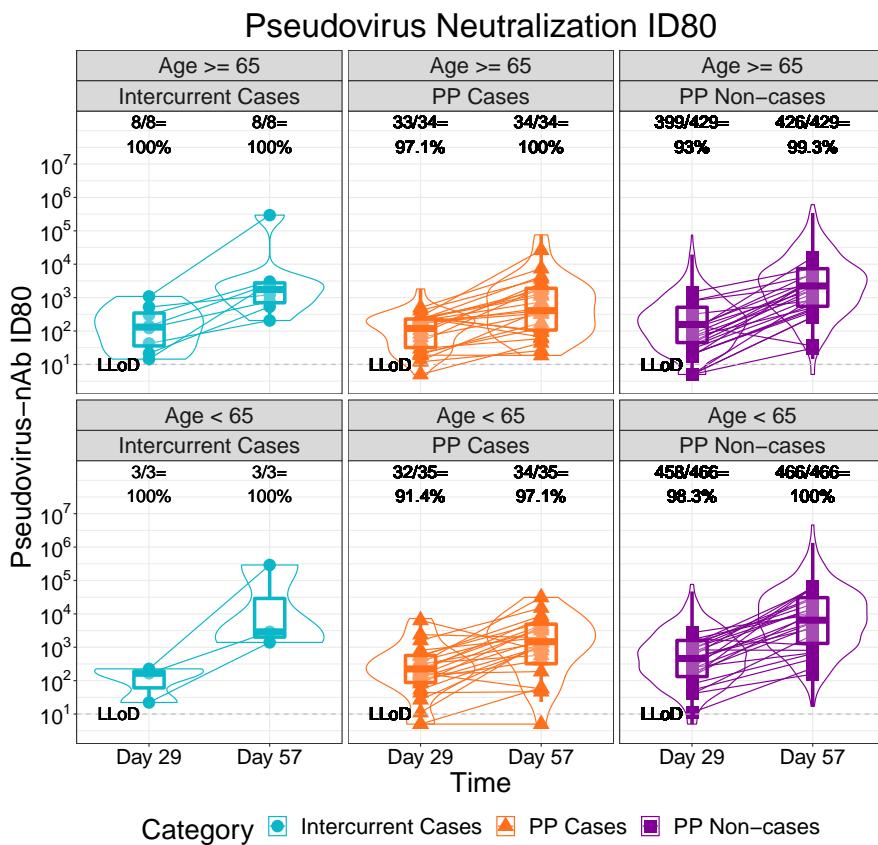


Figure 1.66: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints)

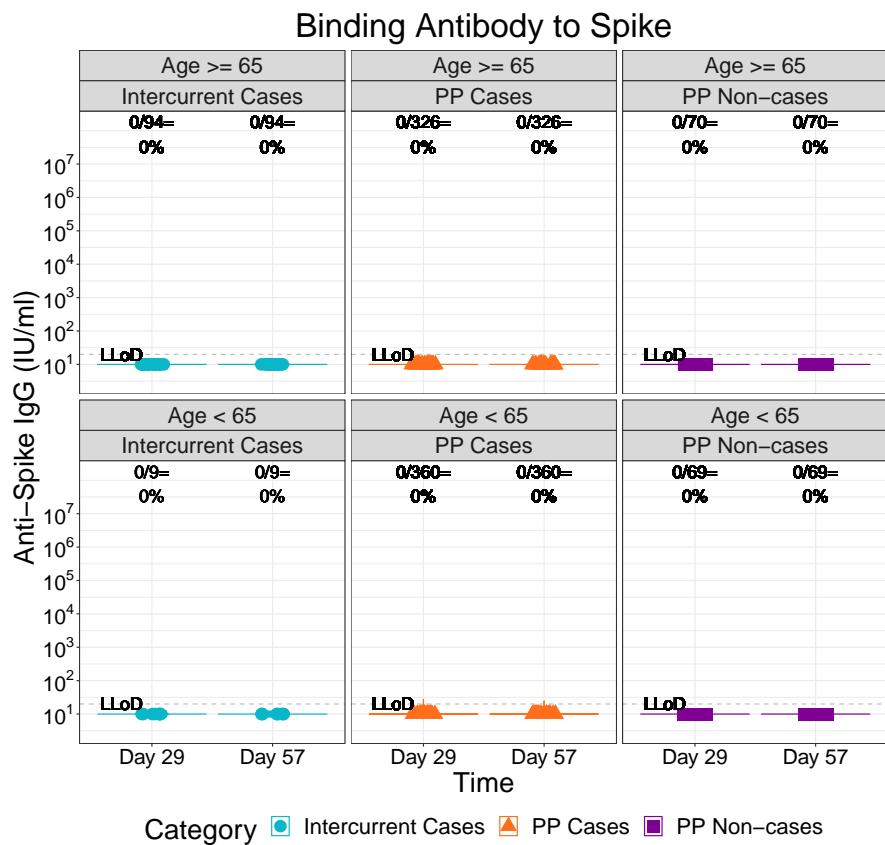


Figure 1.67: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints)

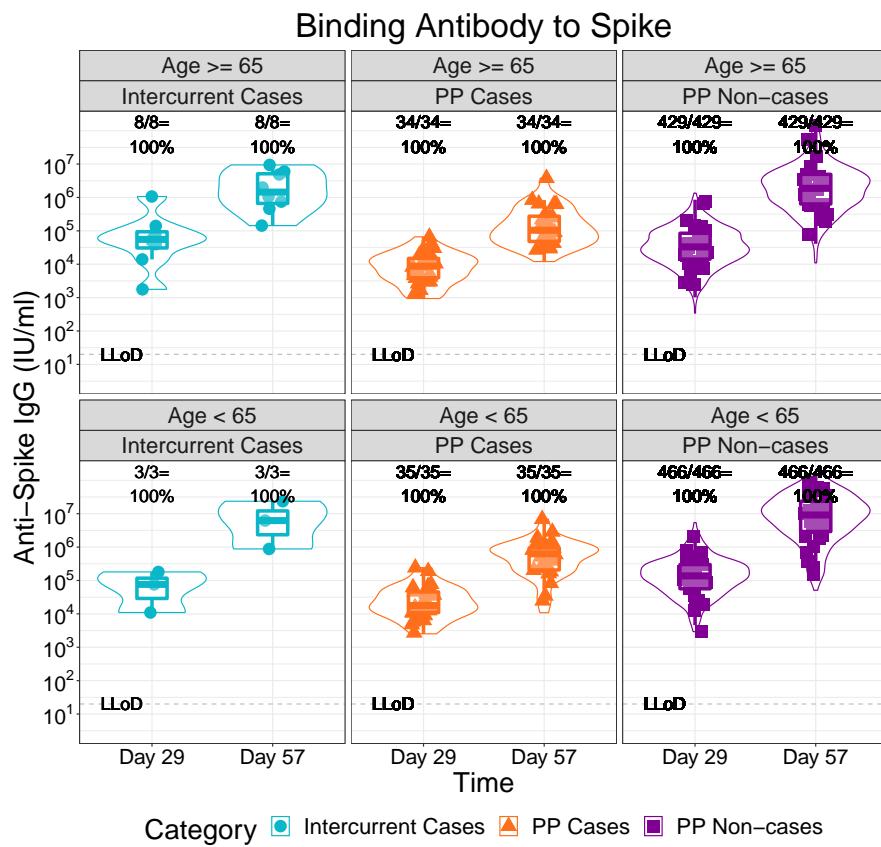


Figure 1.68: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints)

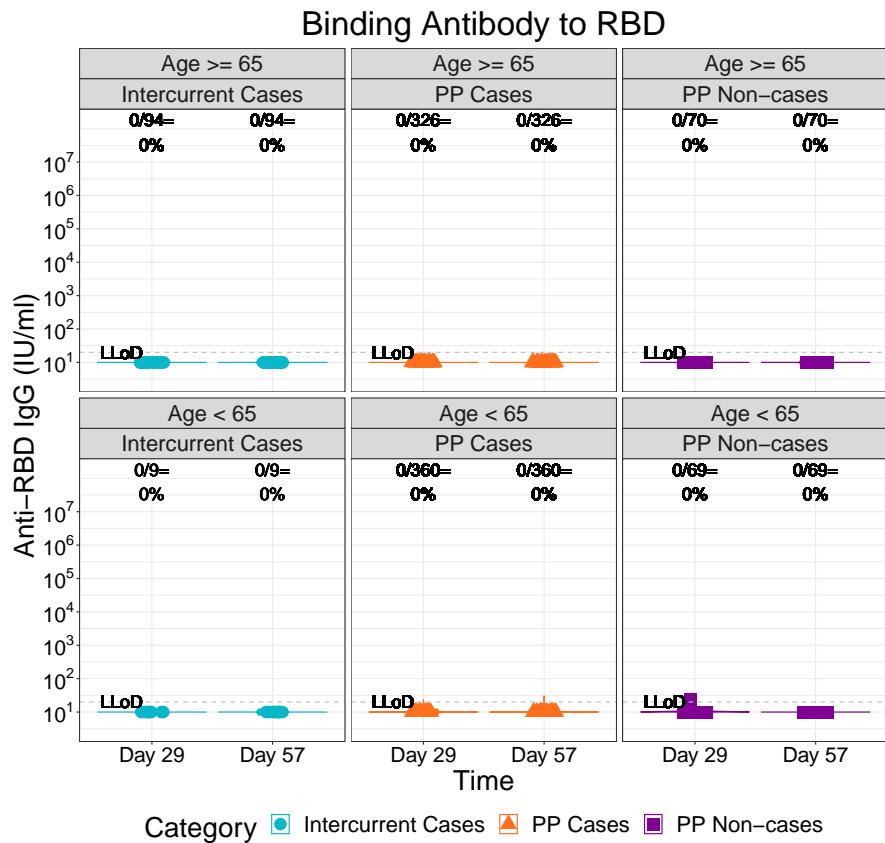


Figure 1.69: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints)

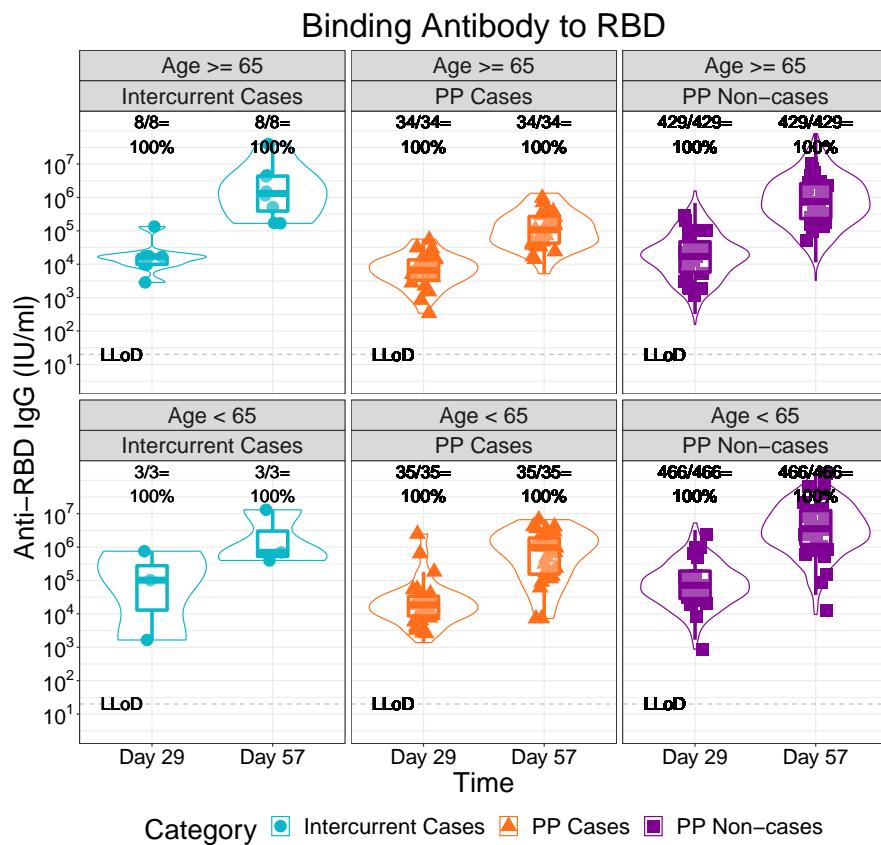


Figure 1.70: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints)

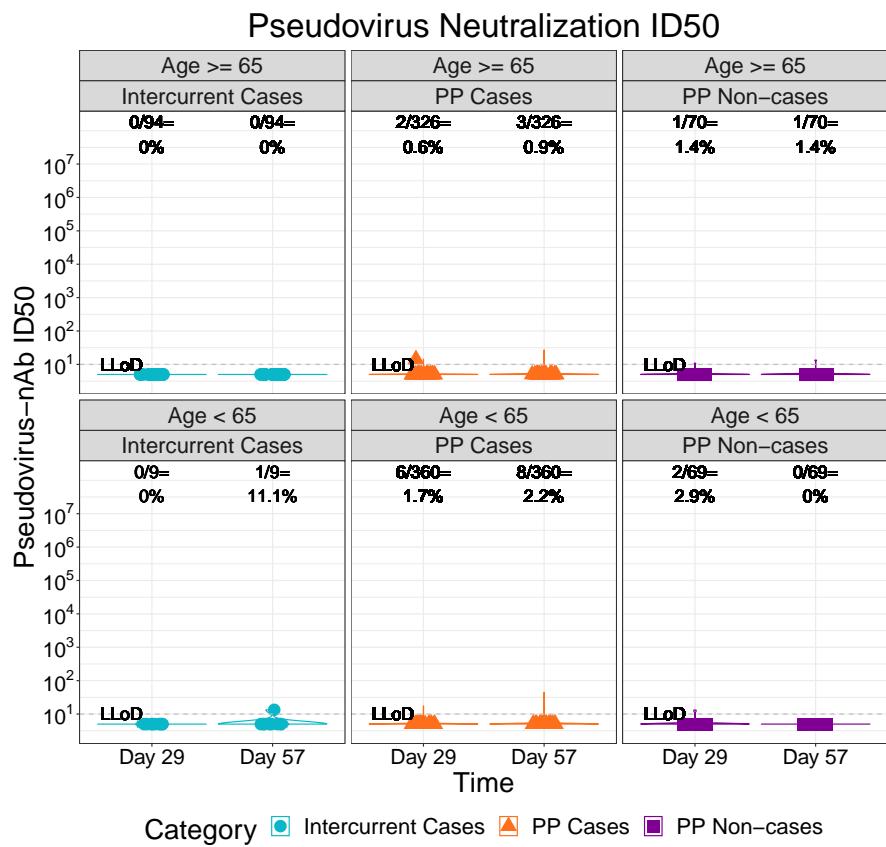


Figure 1.71: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints)

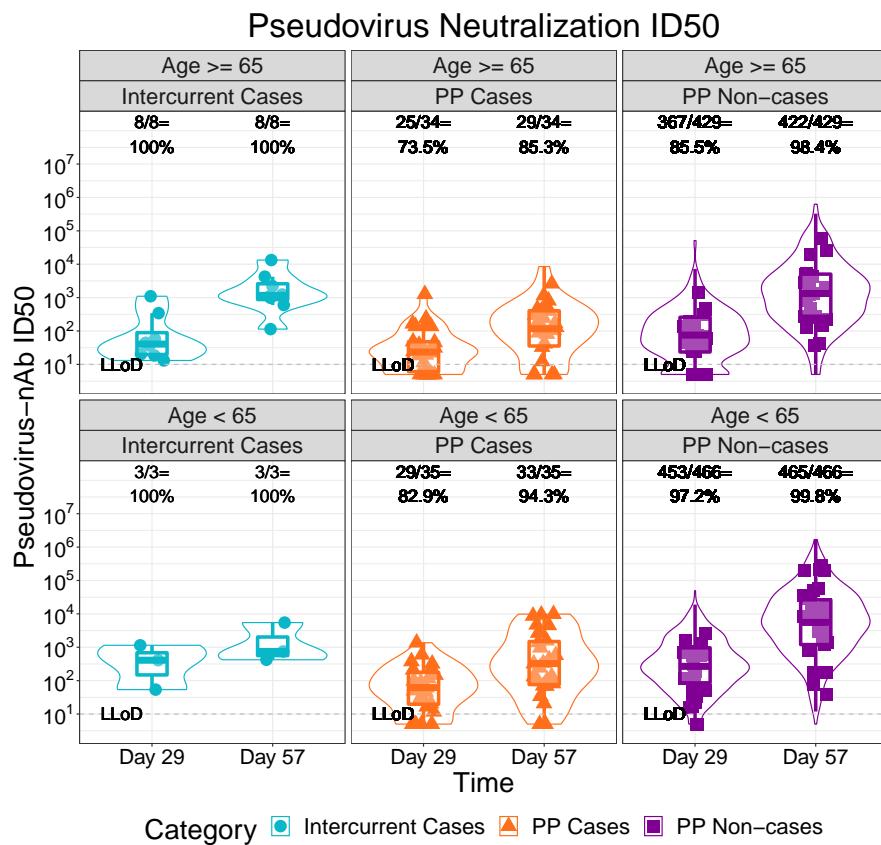


Figure 1.72: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (2 timepoints)

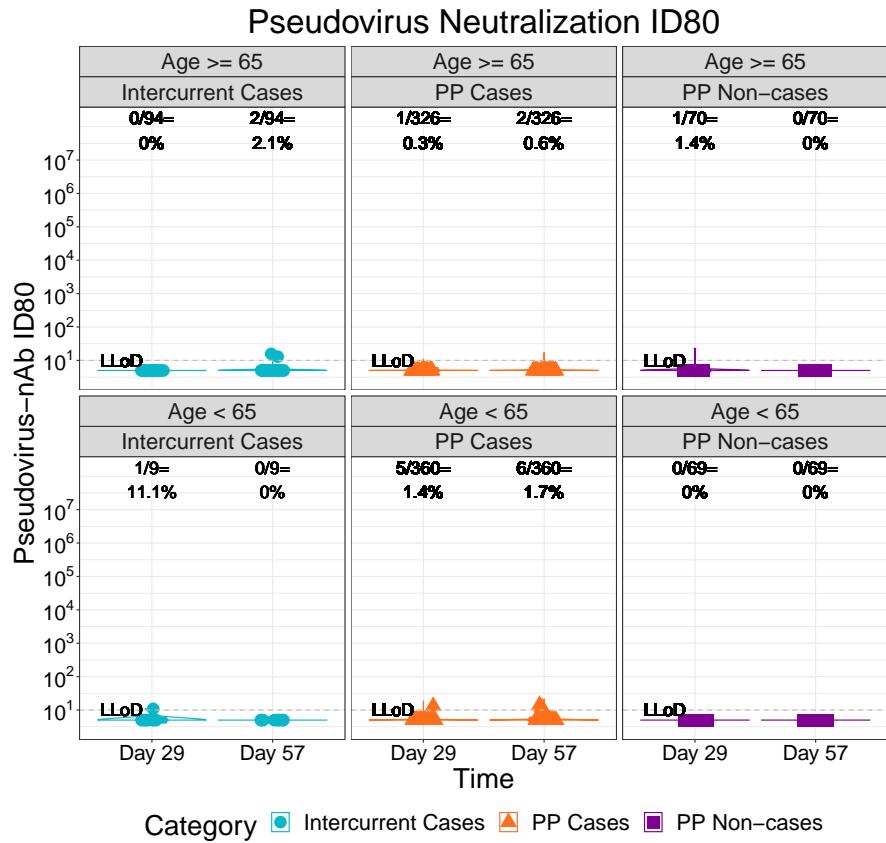


Figure 1.73: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints)

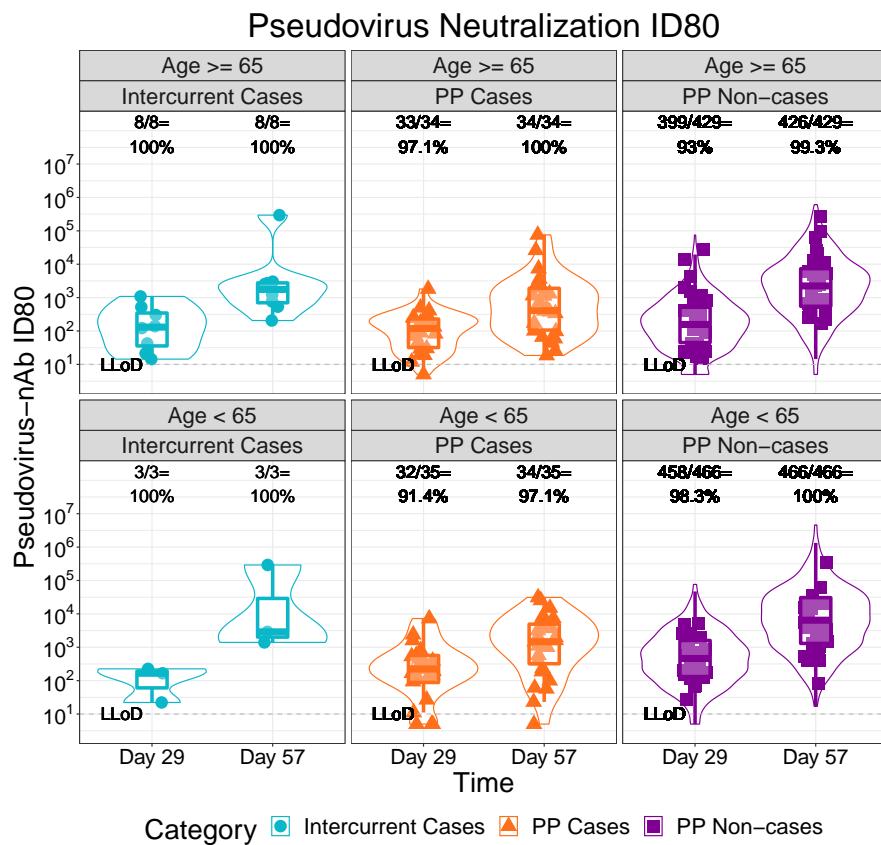


Figure 1.74: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints)

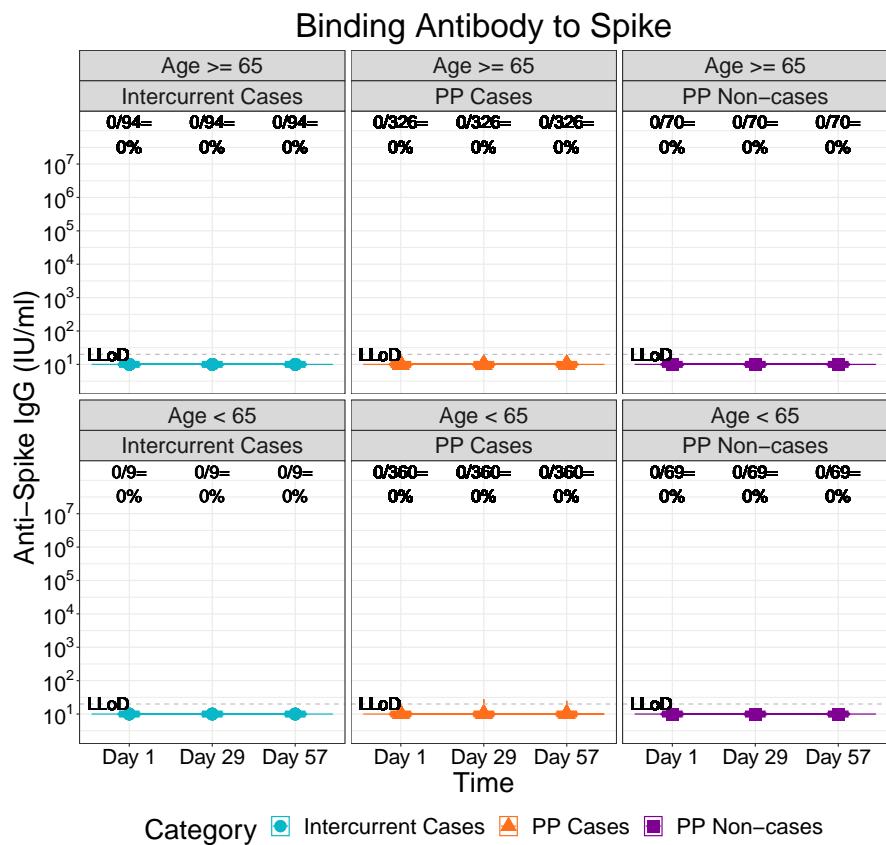


Figure 1.75: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints)

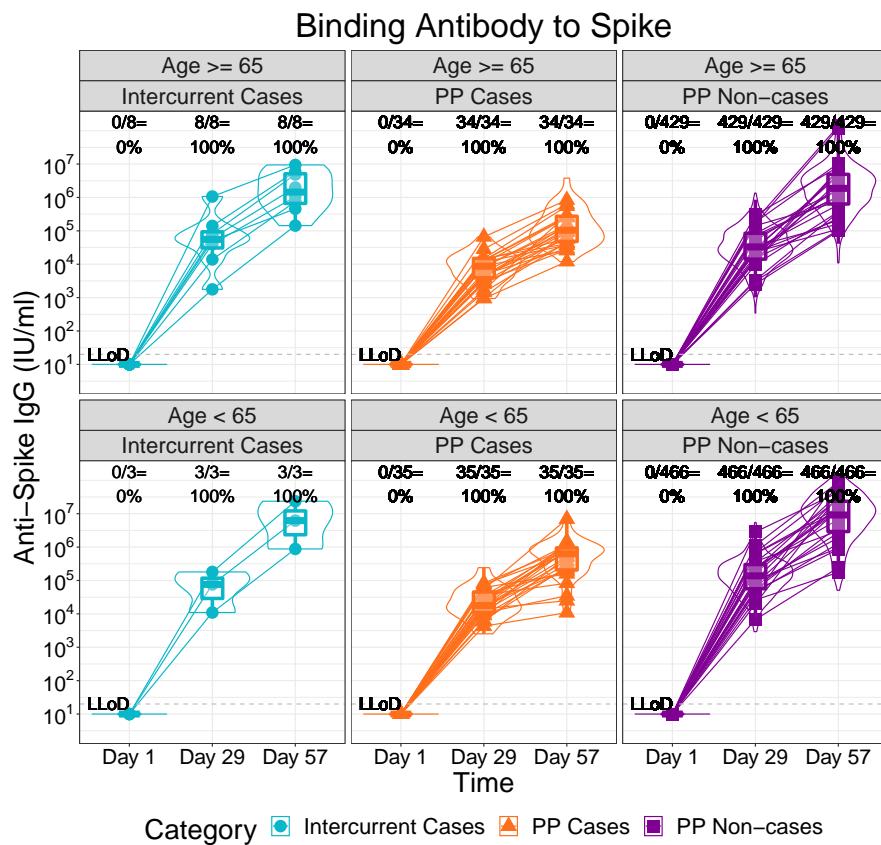


Figure 1.76: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints)

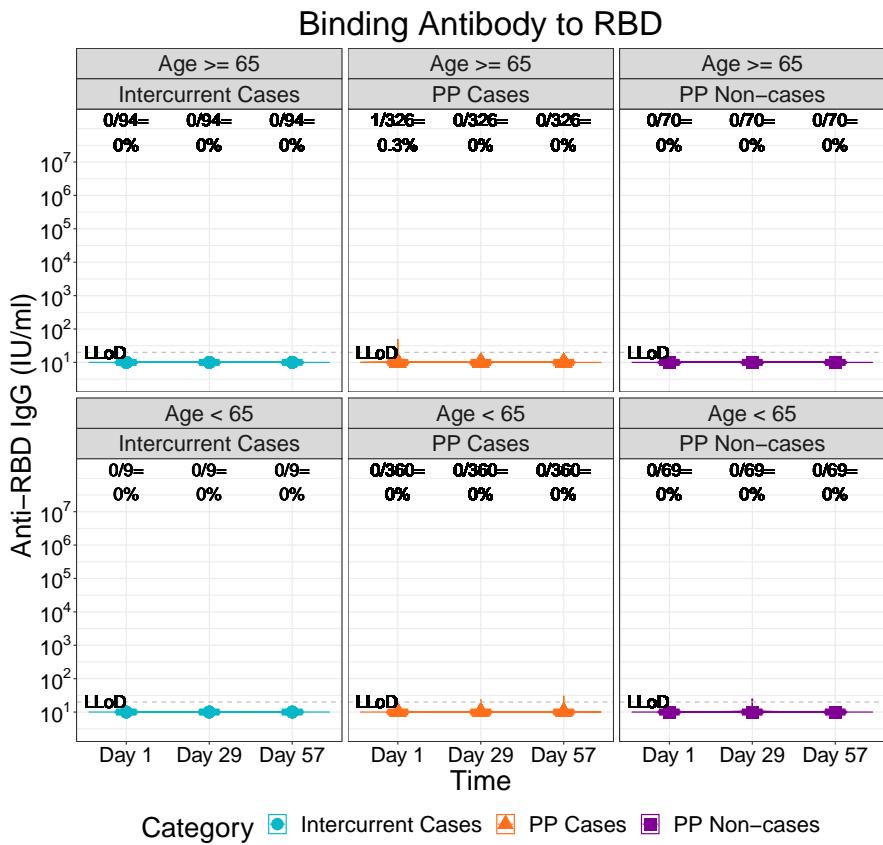


Figure 1.77: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints)

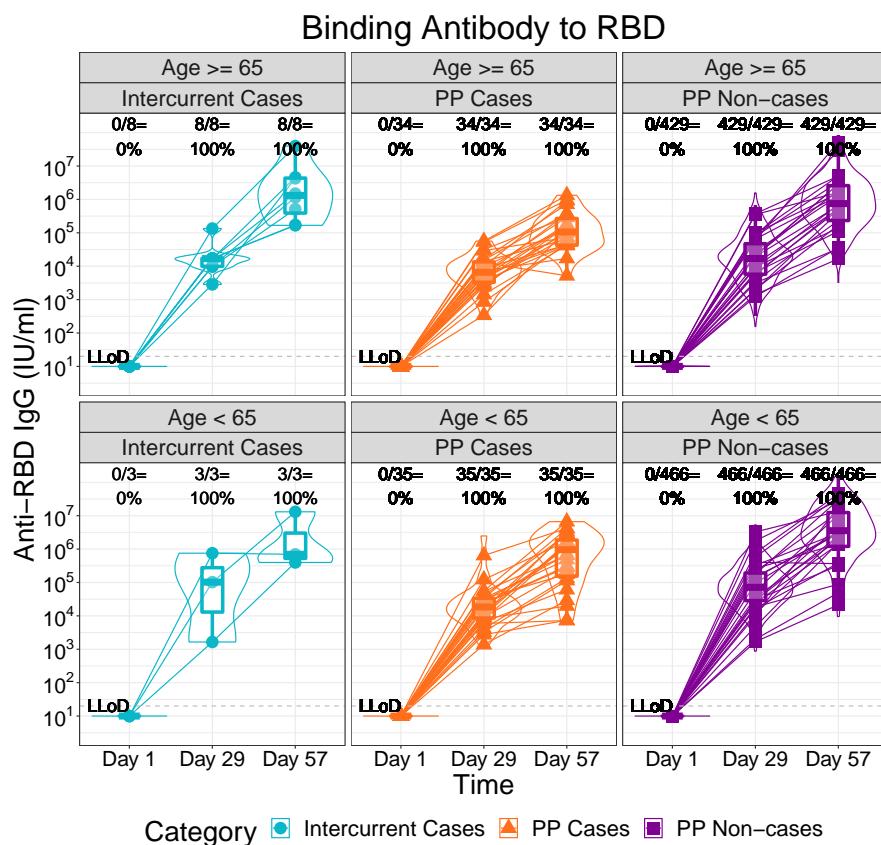


Figure 1.78: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints)

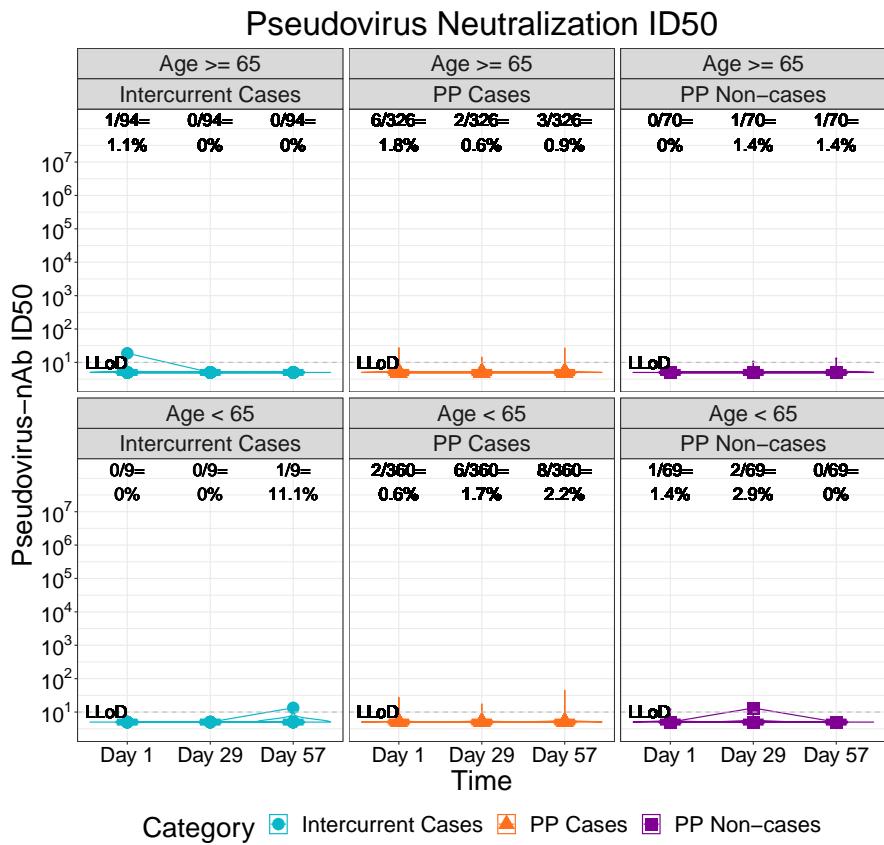


Figure 1.79: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints)

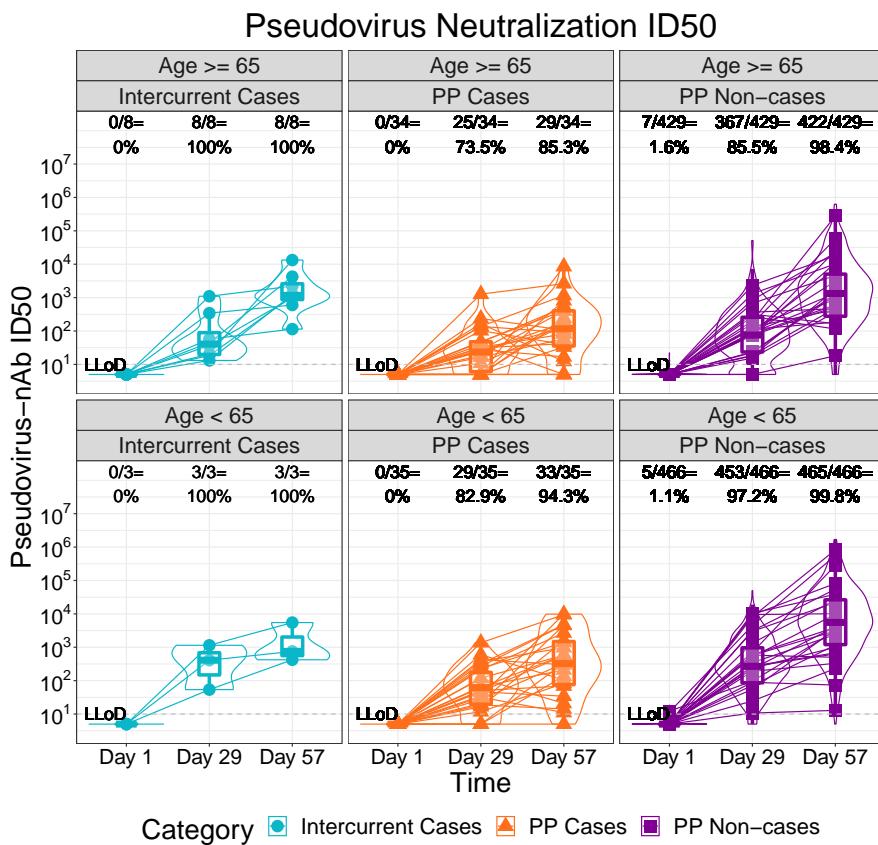


Figure 1.80: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints)

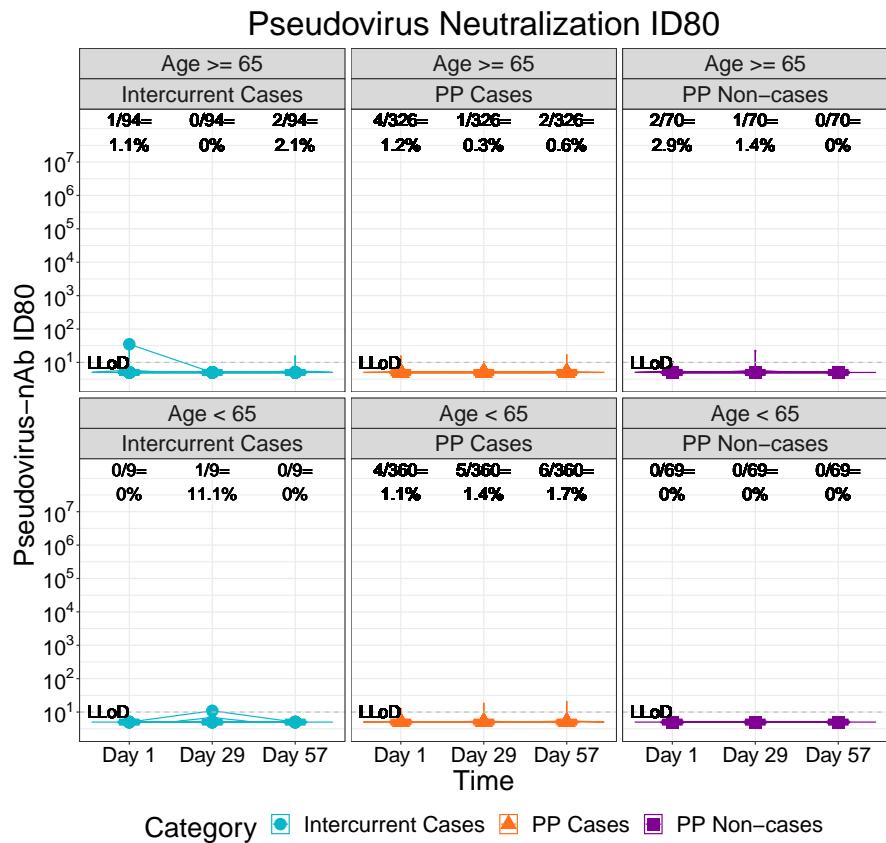


Figure 1.81: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints)

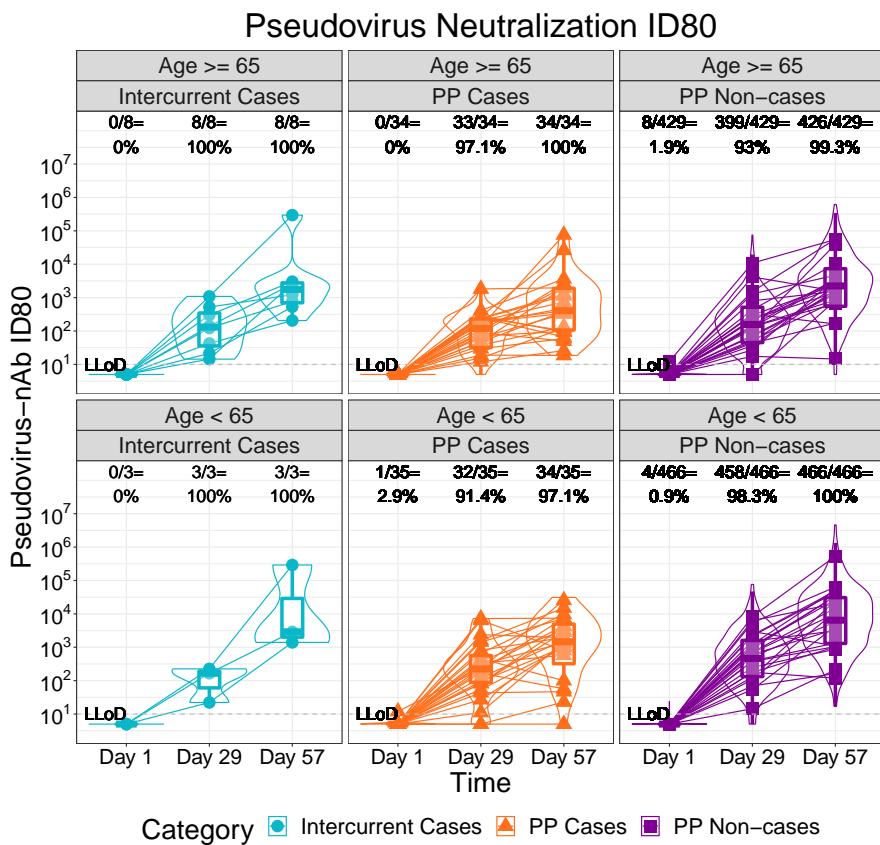


Figure 1.82: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints)

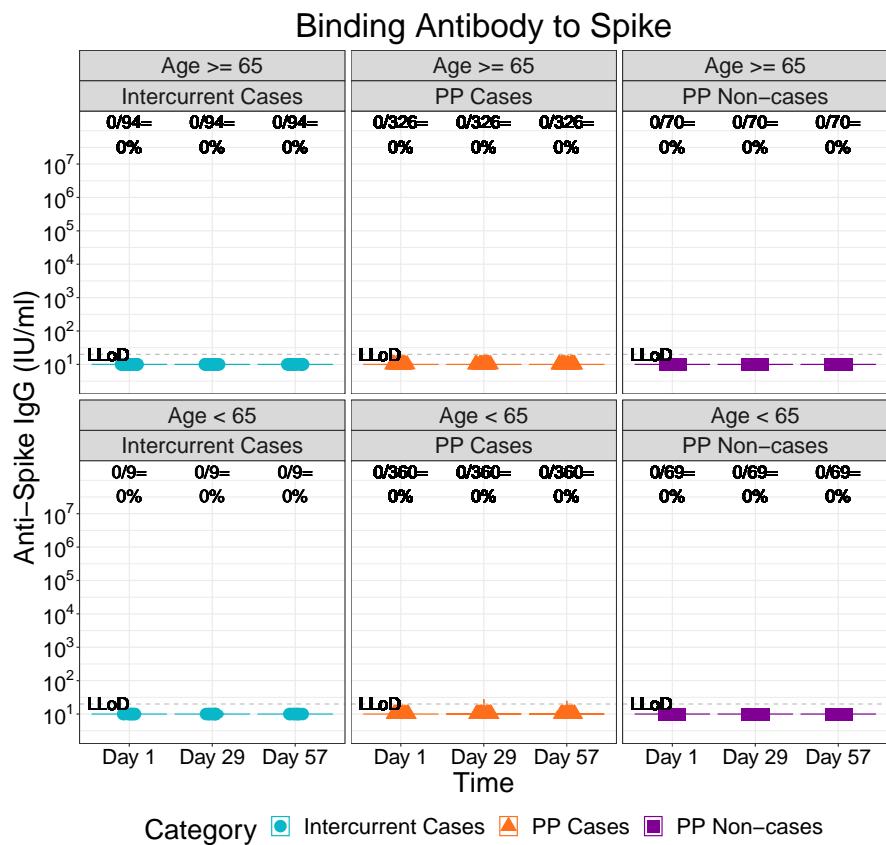


Figure 1.83: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints)

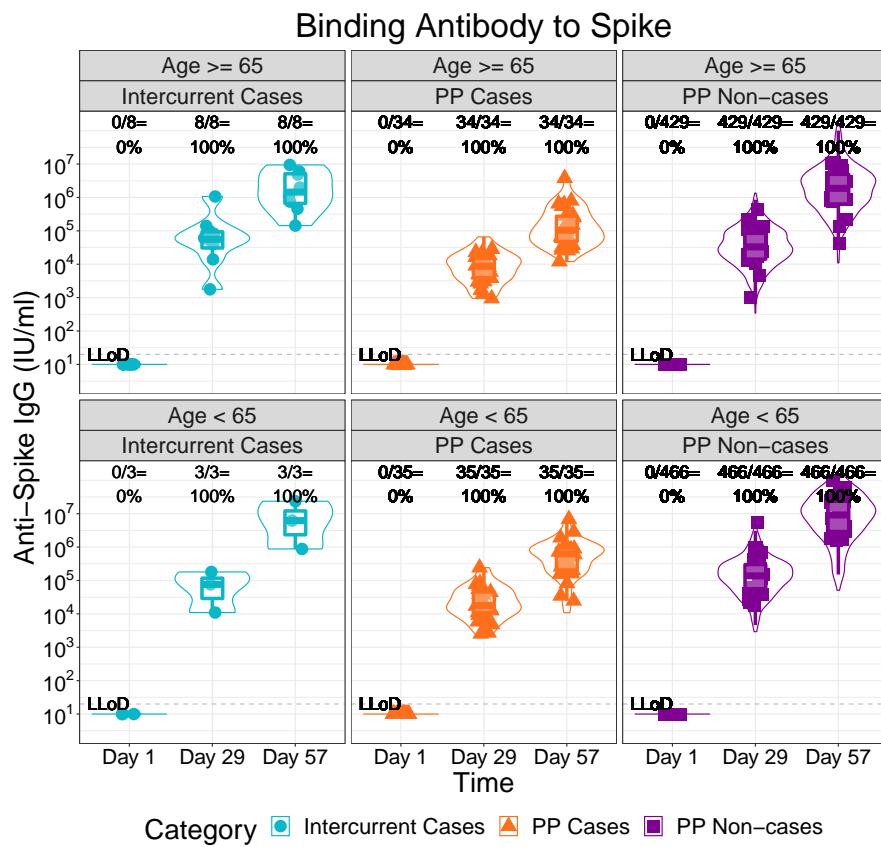


Figure 1.84: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints)

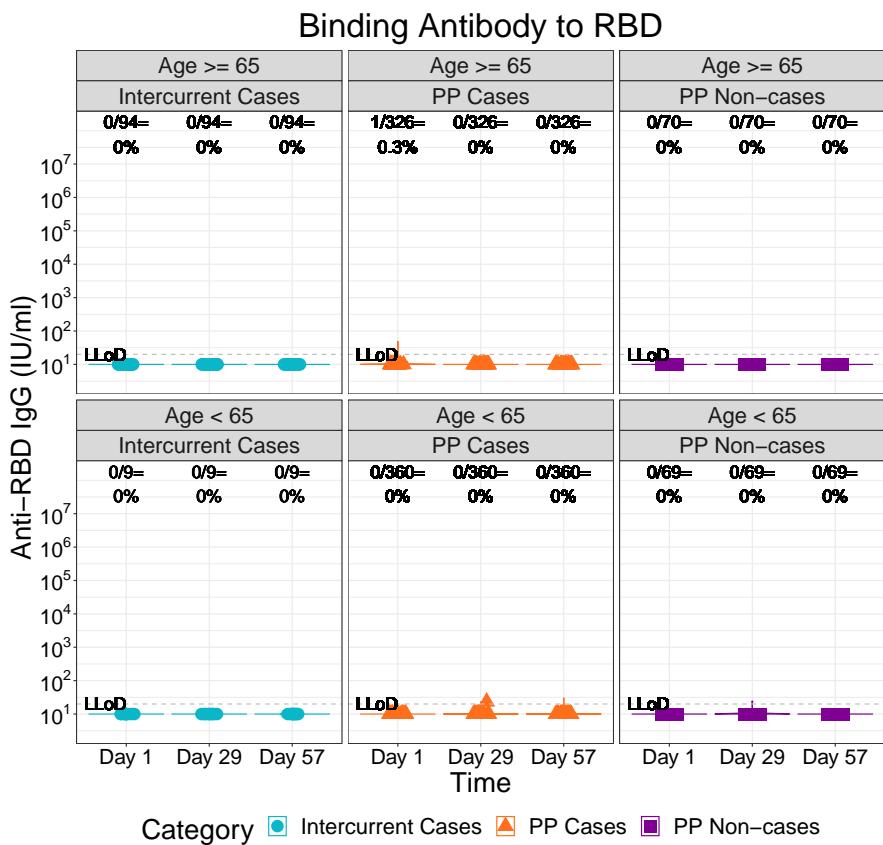


Figure 1.85: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints)

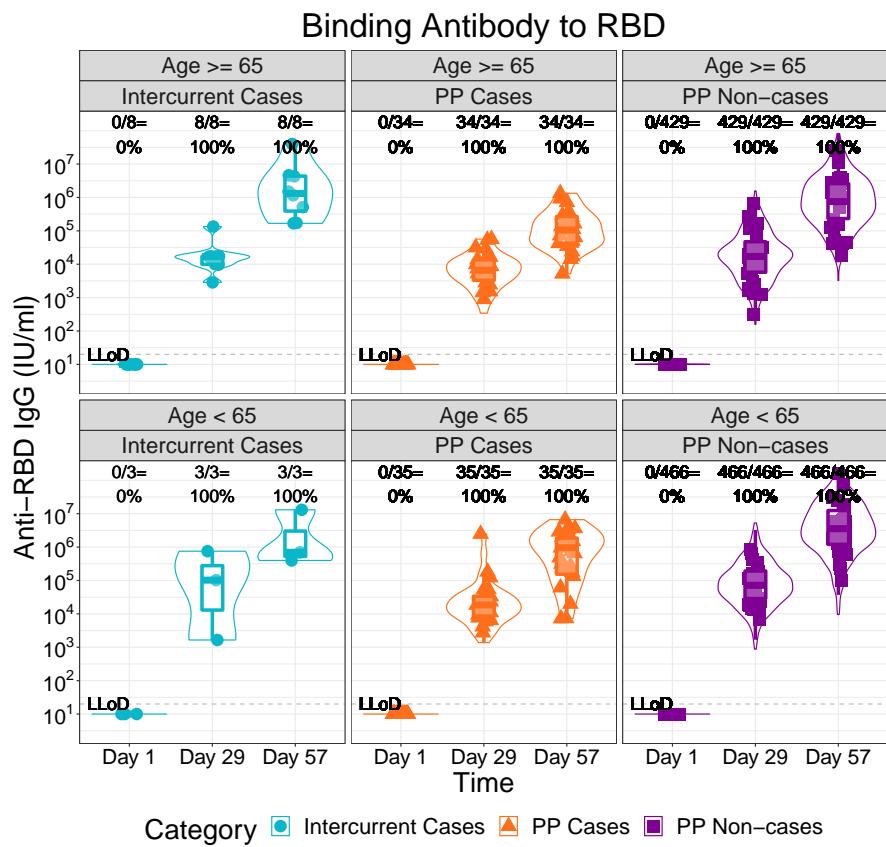


Figure 1.86: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints)

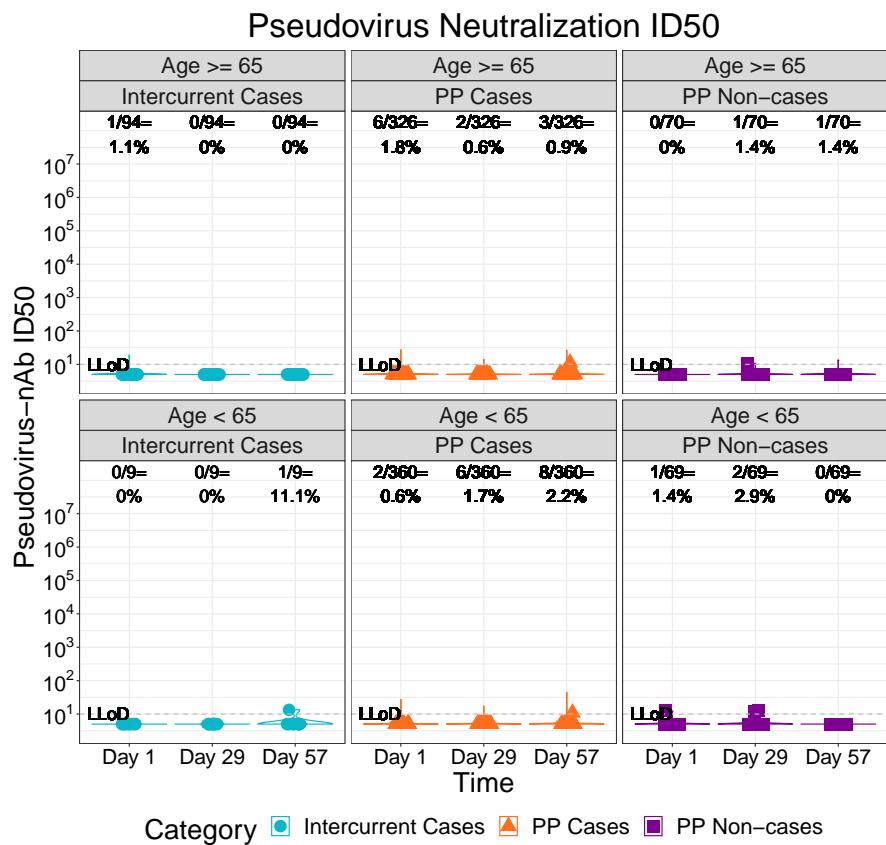


Figure 1.87: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints)

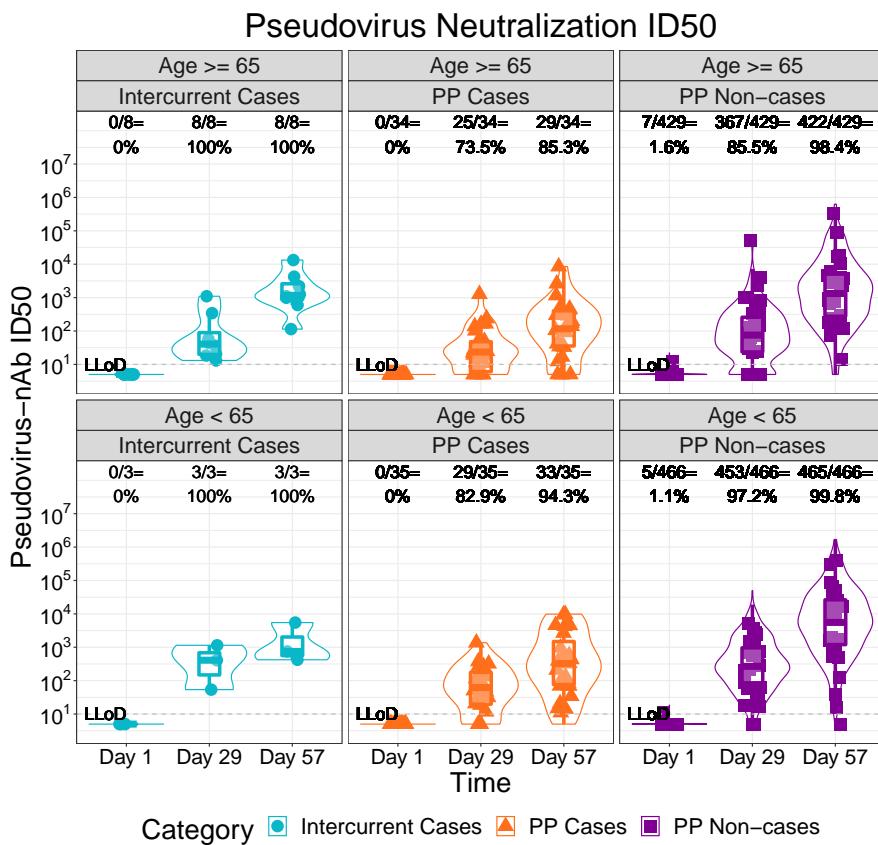


Figure 1.88: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints)

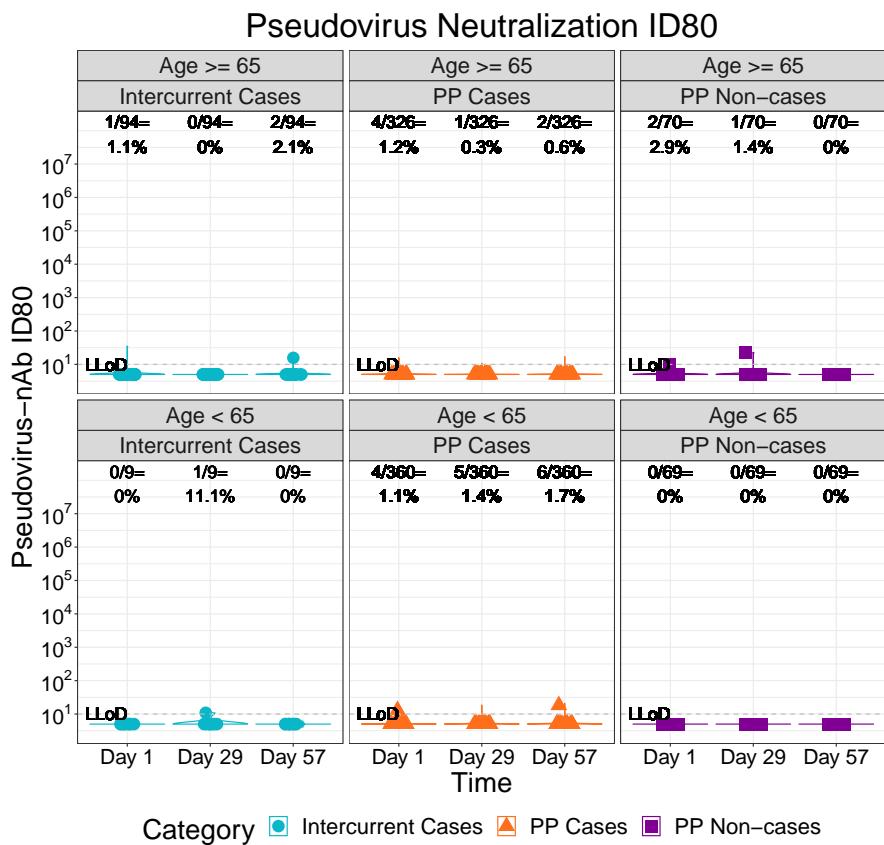


Figure 1.89: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints)

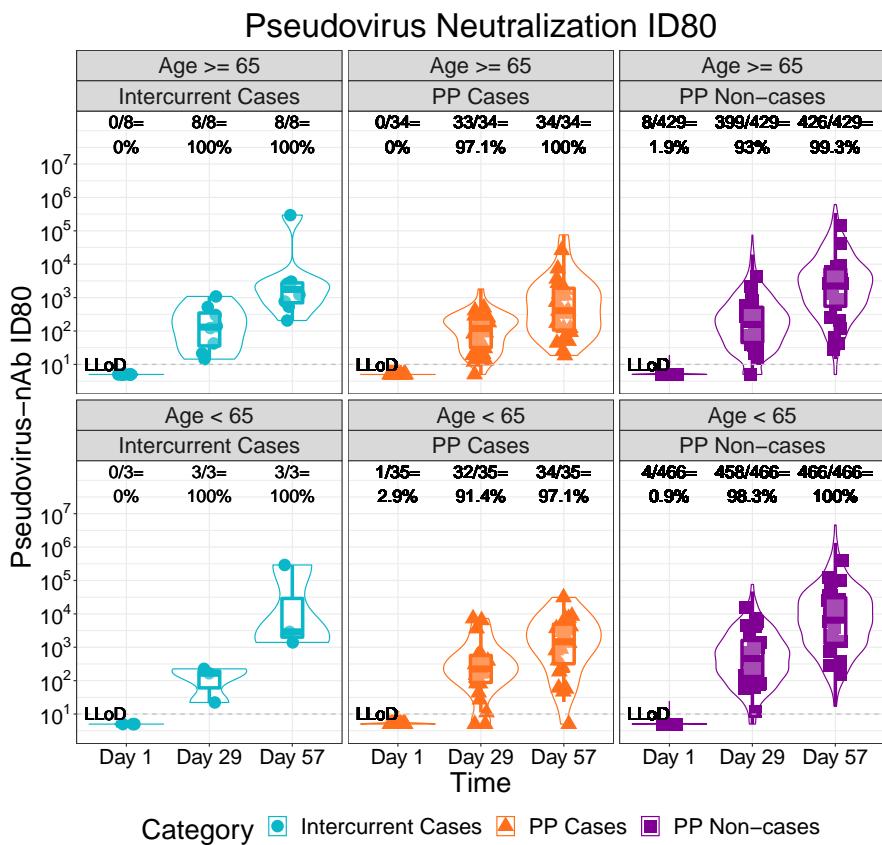


Figure 1.90: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints)

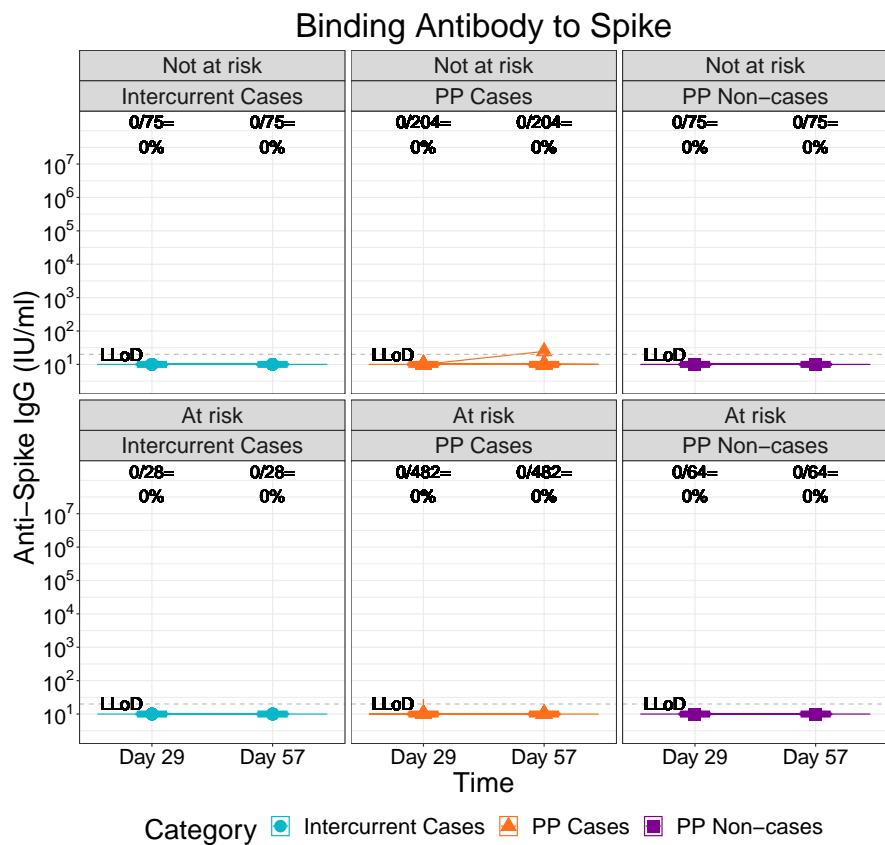


Figure 1.91: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints)

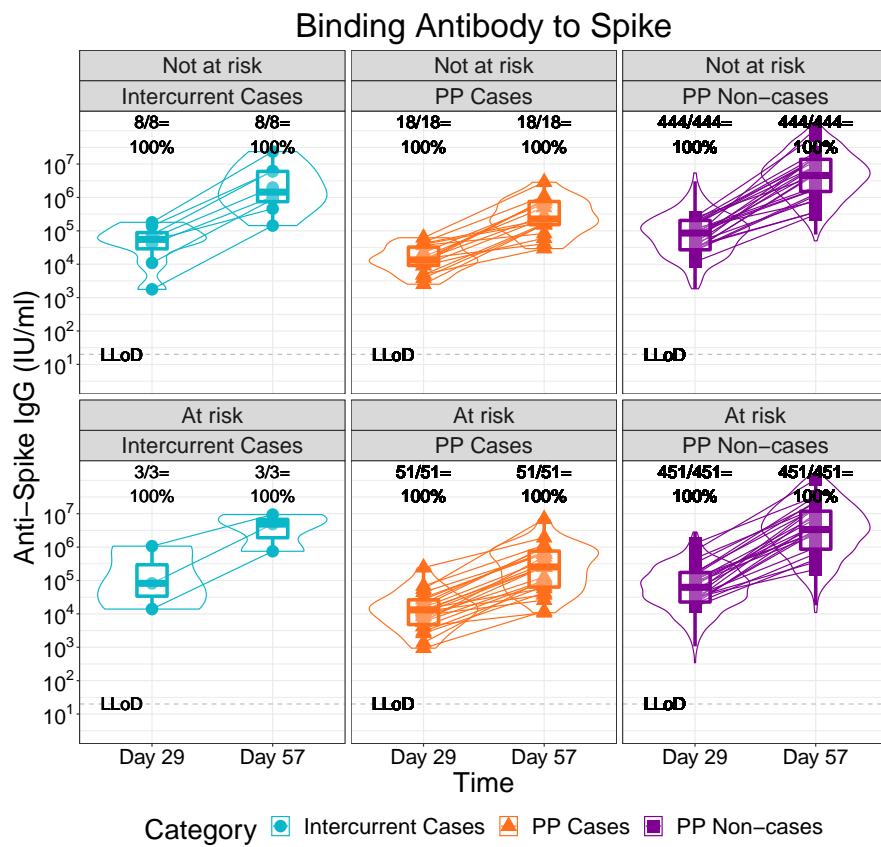


Figure 1.92: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints)

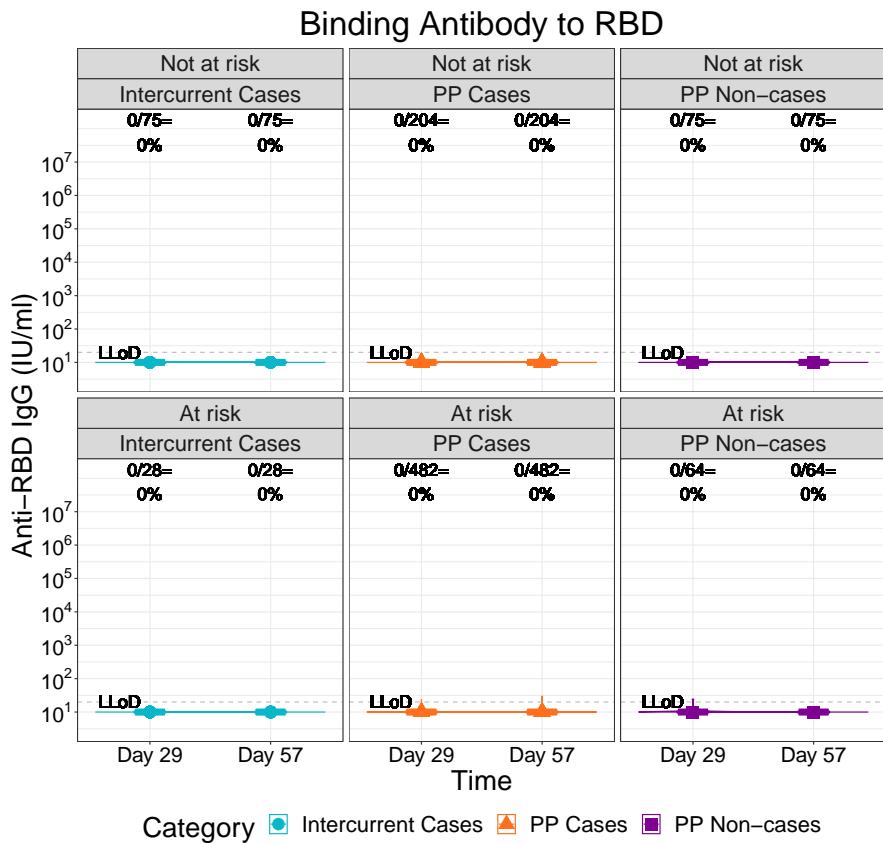


Figure 1.93: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints)

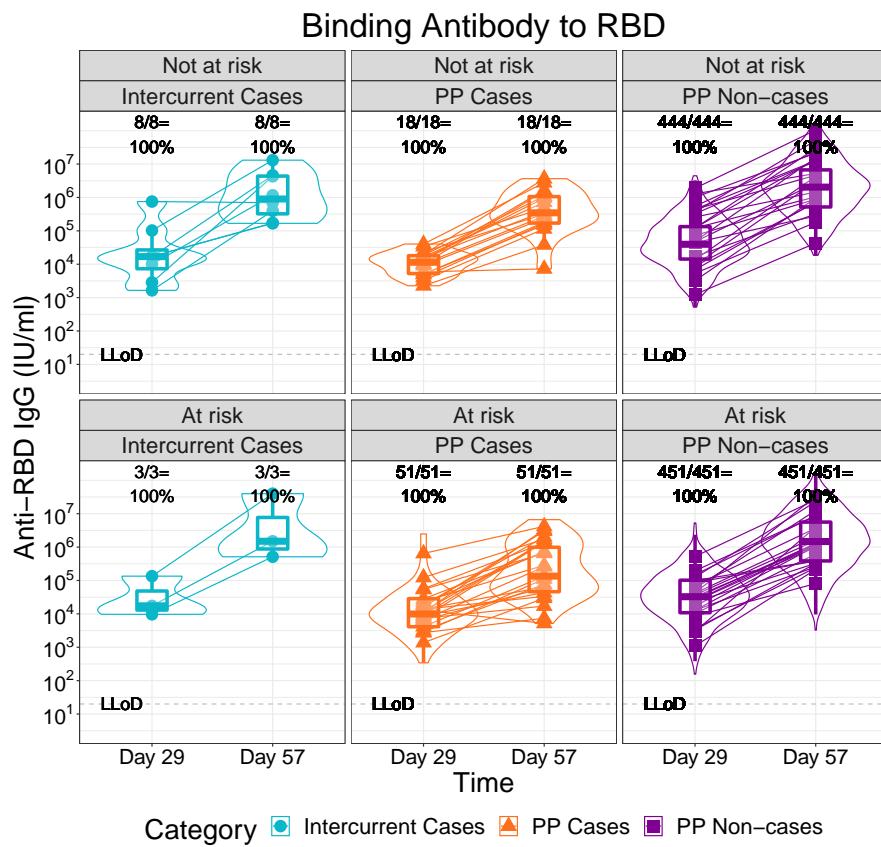


Figure 1.94: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints)

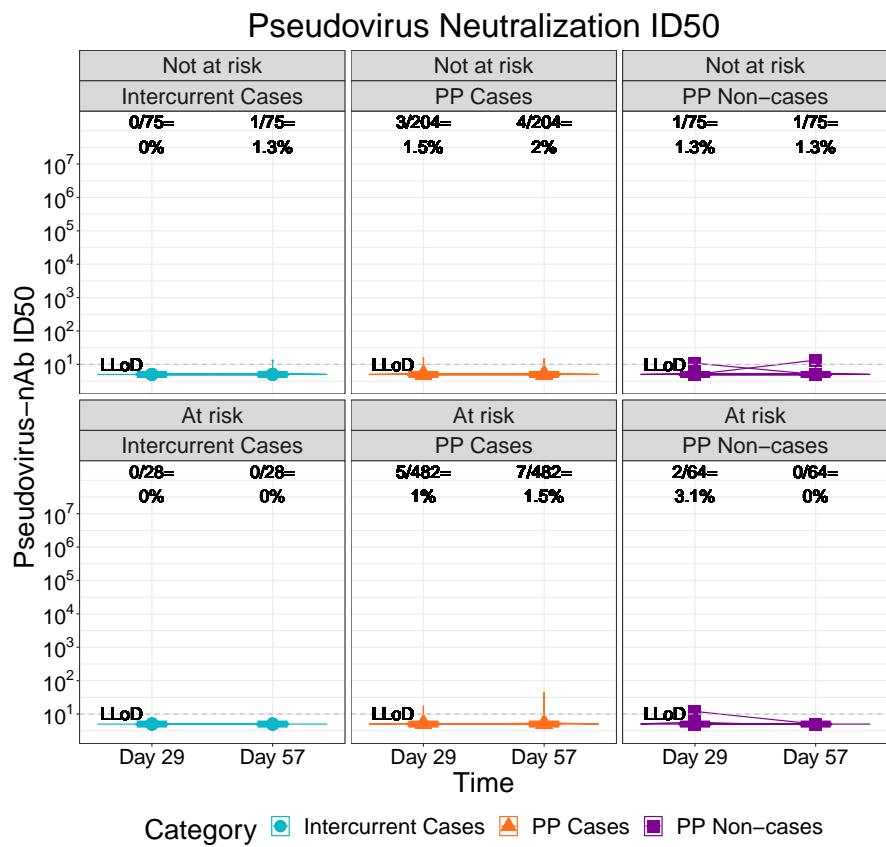


Figure 1.95: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints)

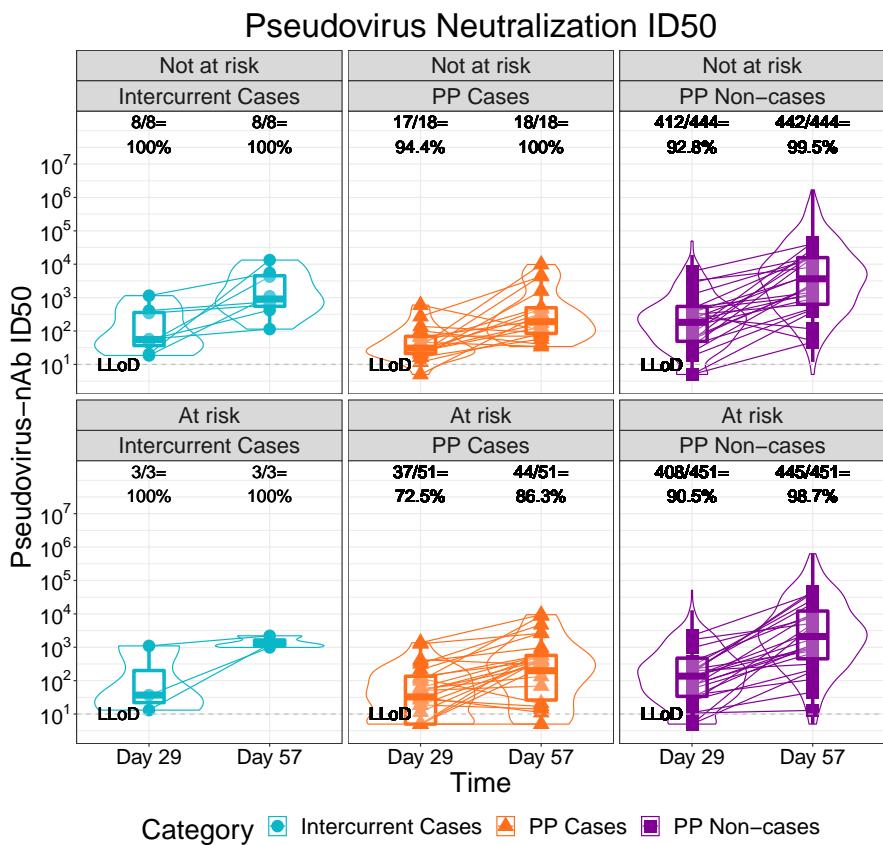


Figure 1.96: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints)

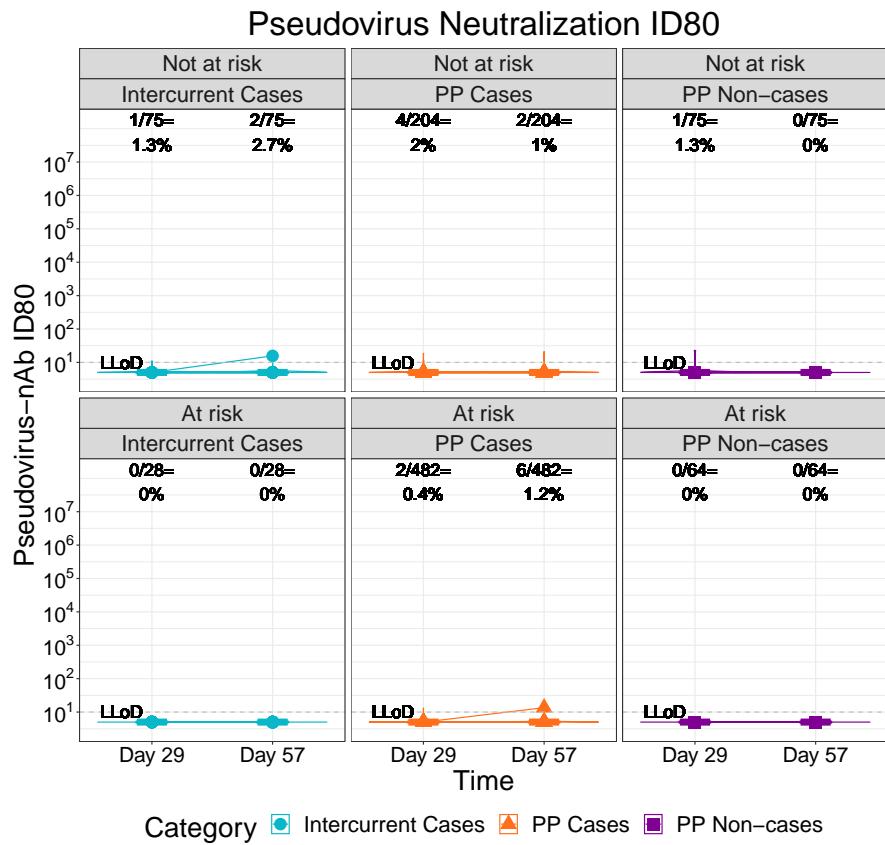


Figure 1.97: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints)

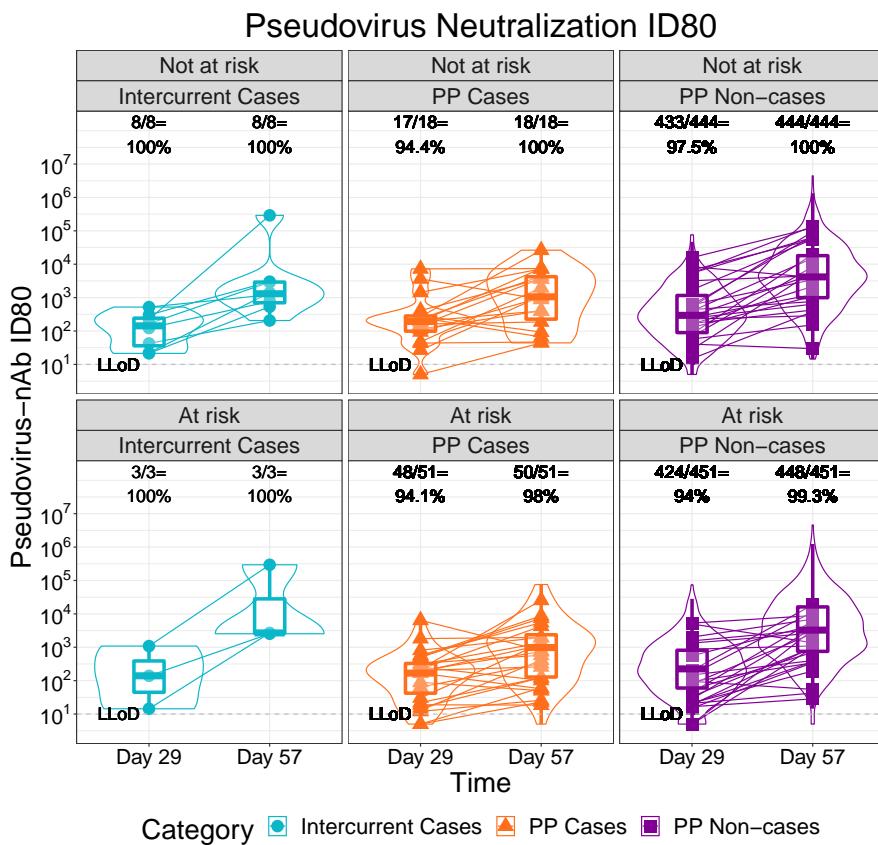


Figure 1.98: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints)

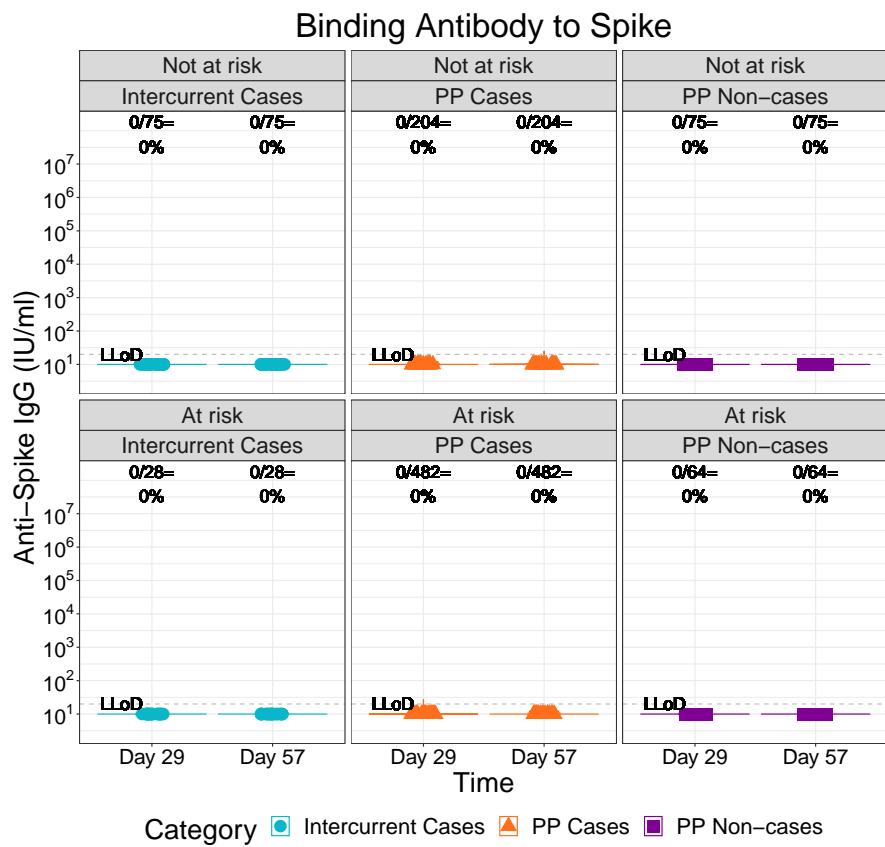


Figure 1.99: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints)

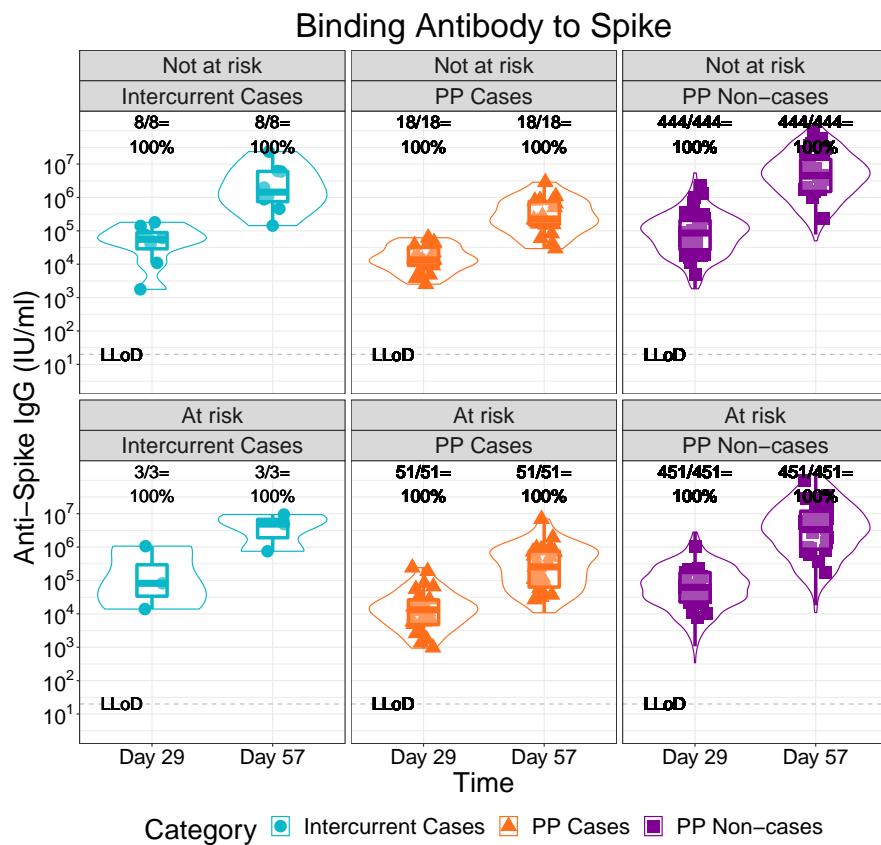


Figure 1.100: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints)

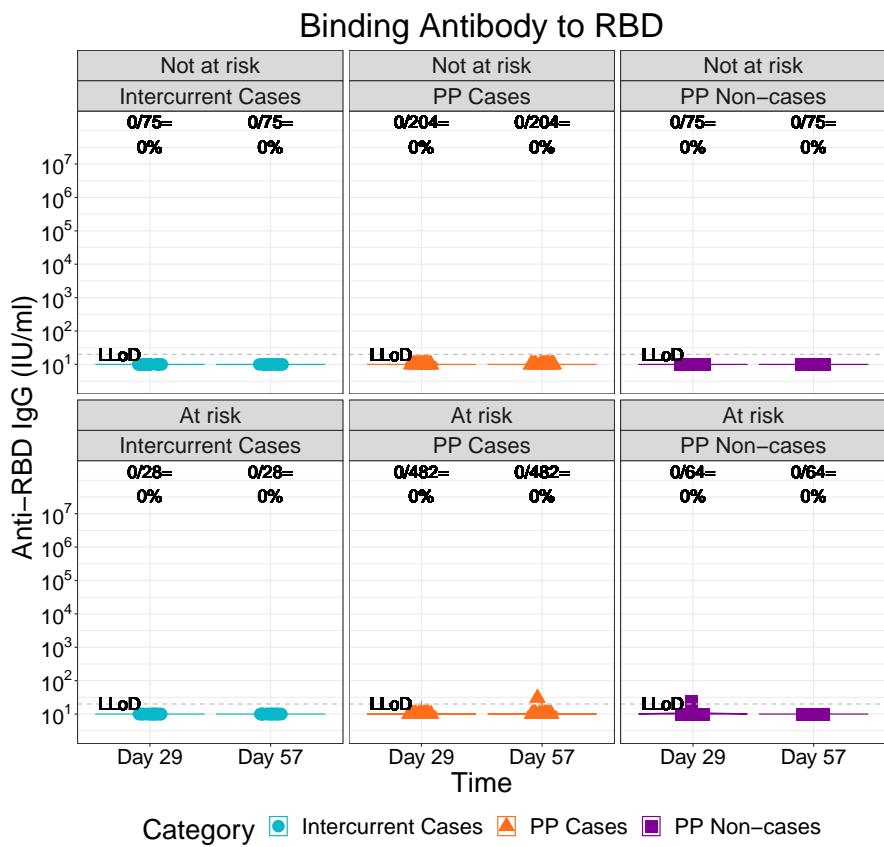


Figure 1.101: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints)

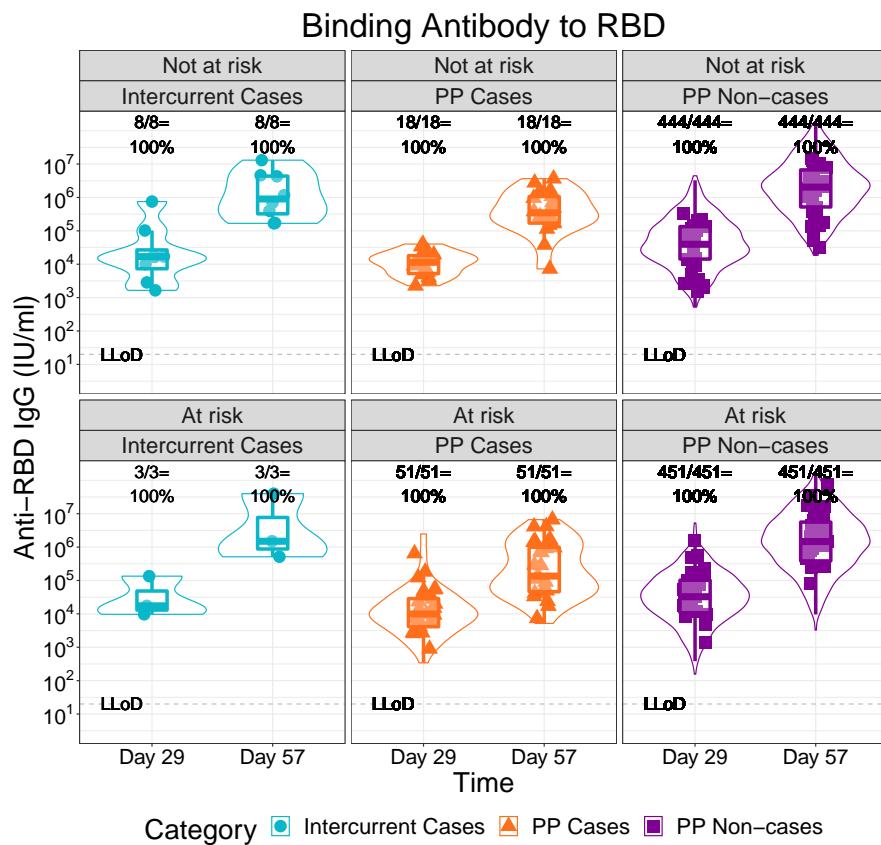


Figure 1.102: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints)

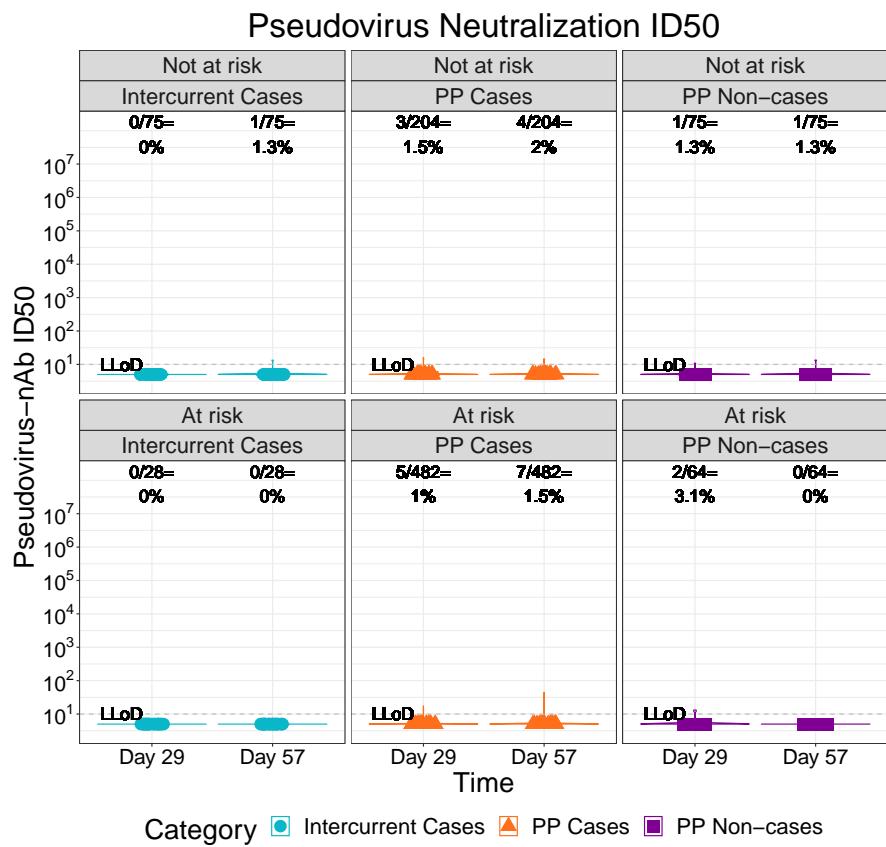


Figure 1.103: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints)

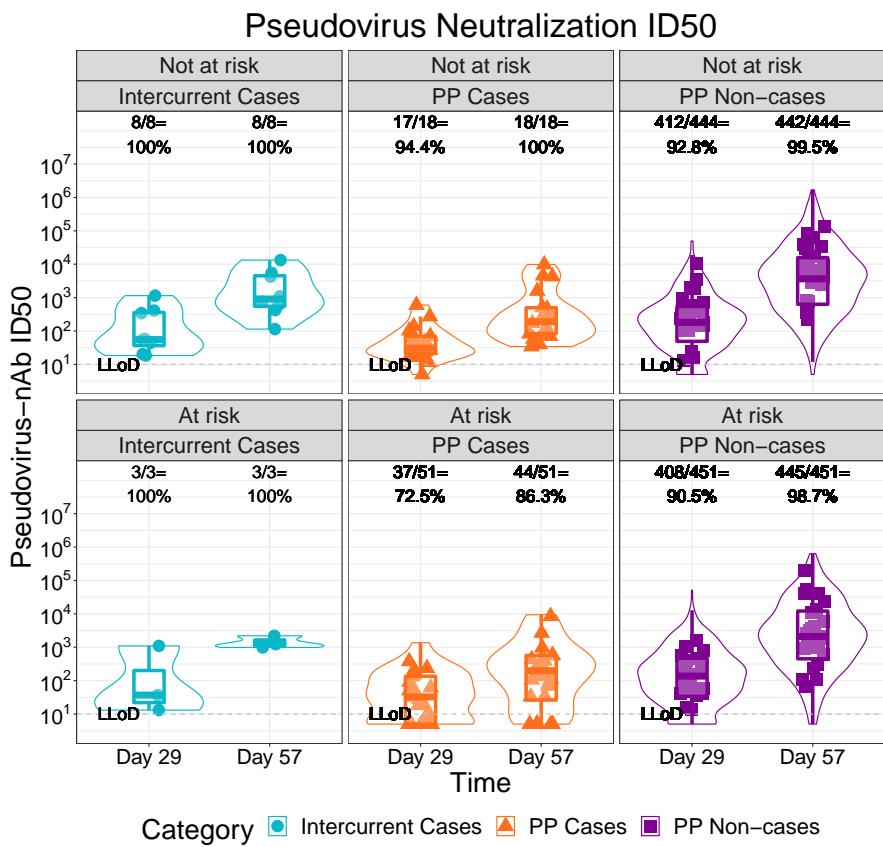


Figure 1.104: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints)

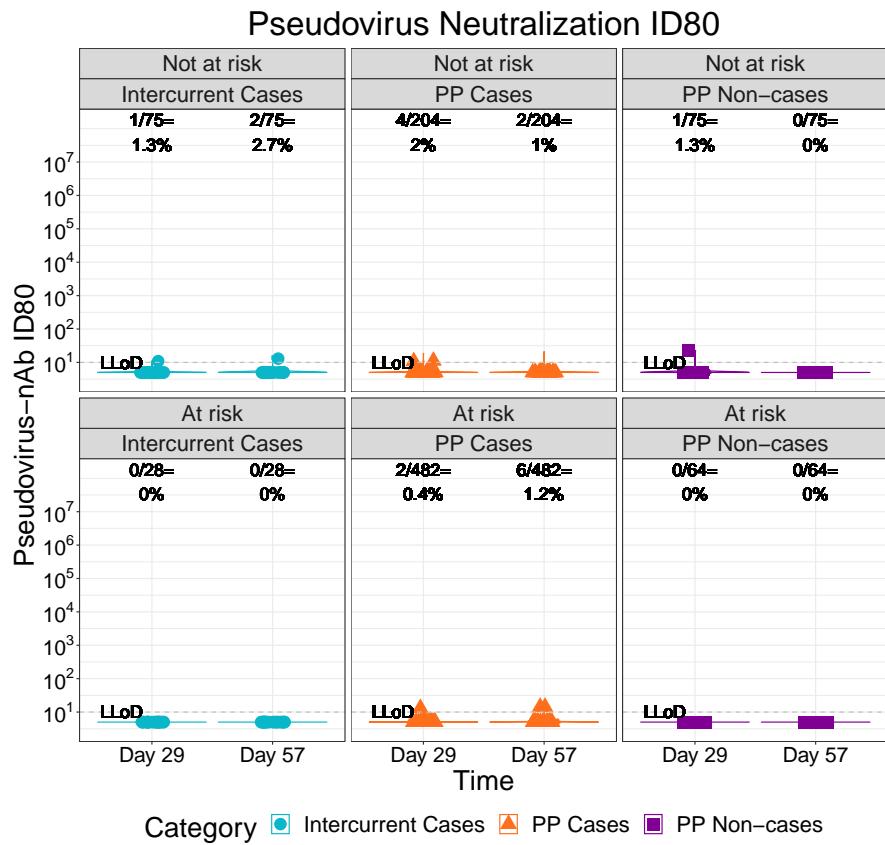


Figure 1.105: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints)

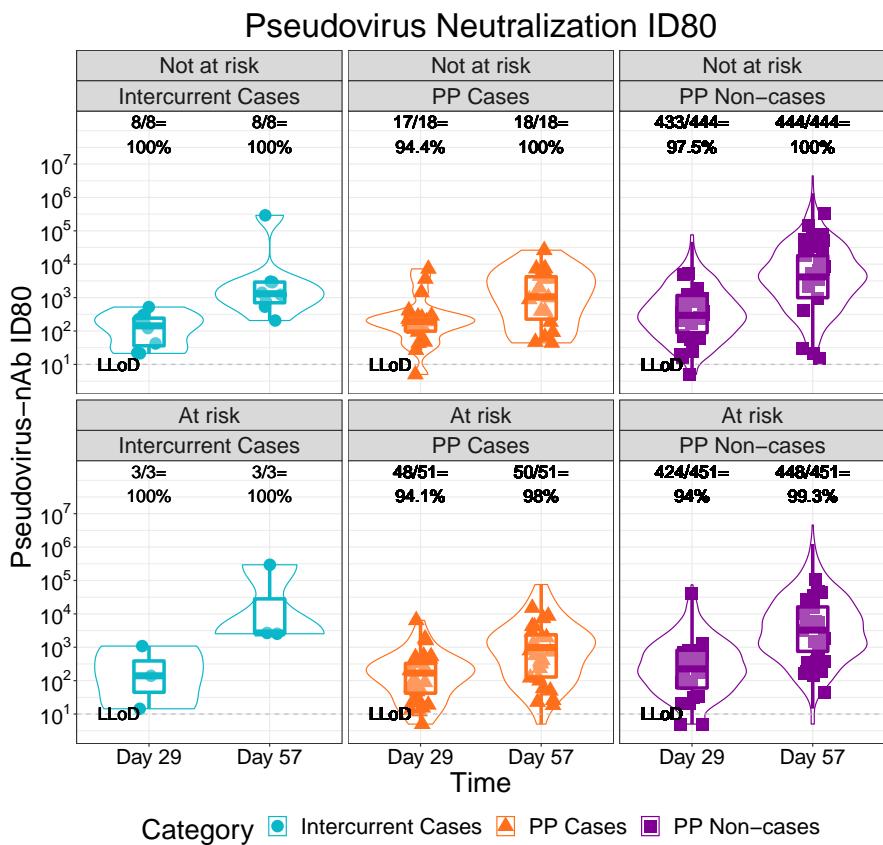


Figure 1.106: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints)

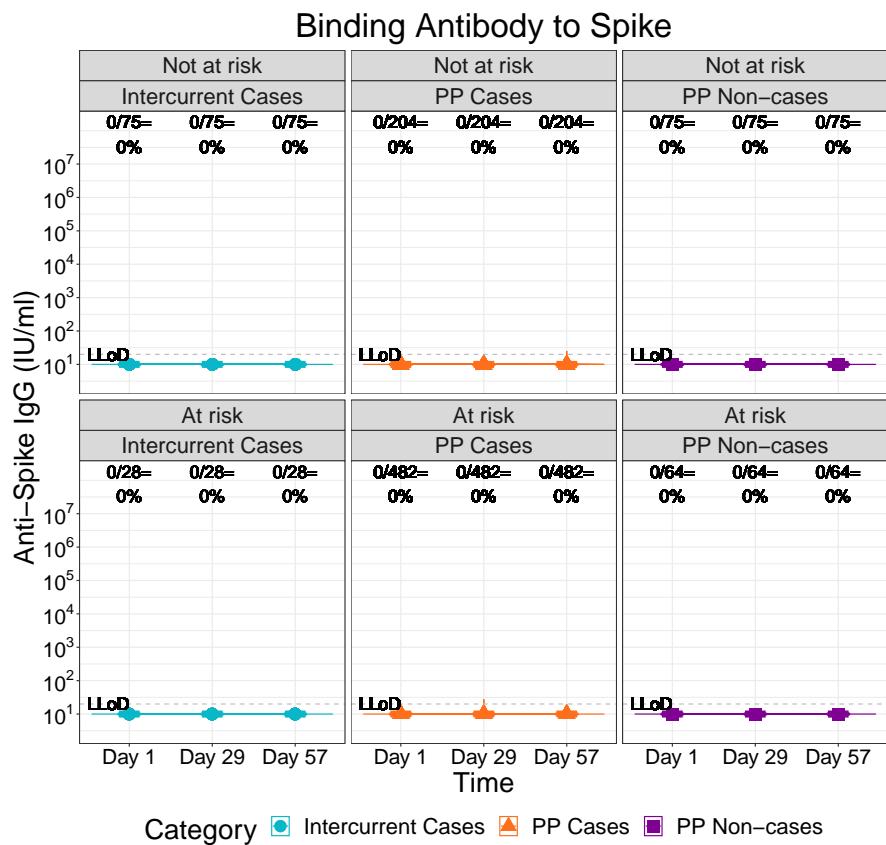


Figure 1.107: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints)

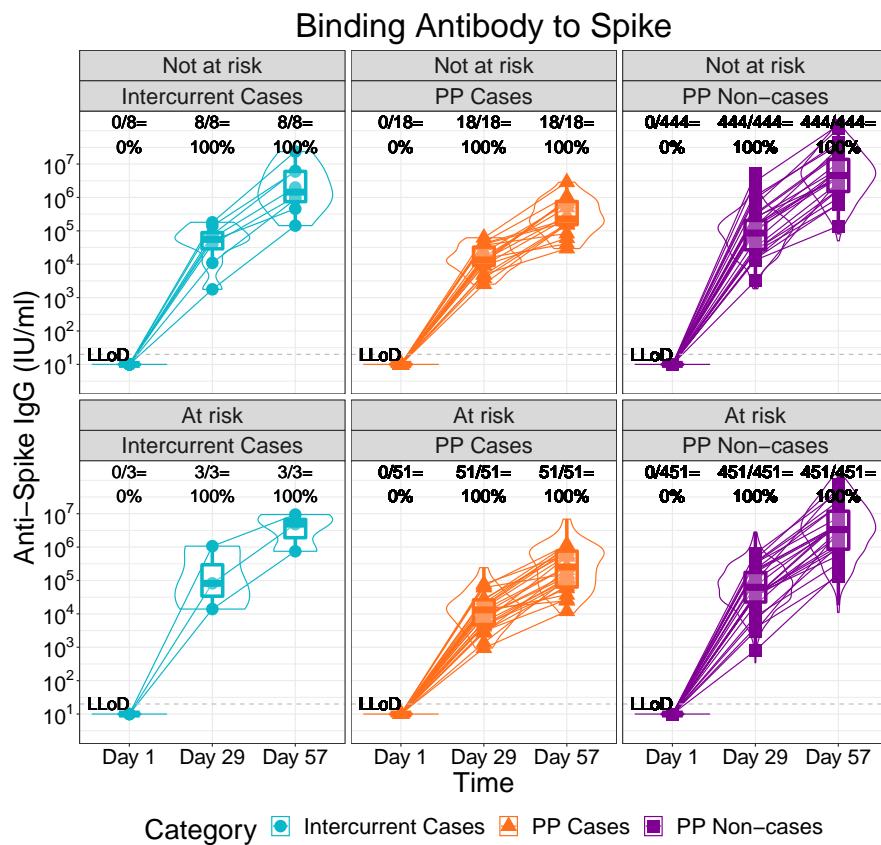


Figure 1.108: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints)

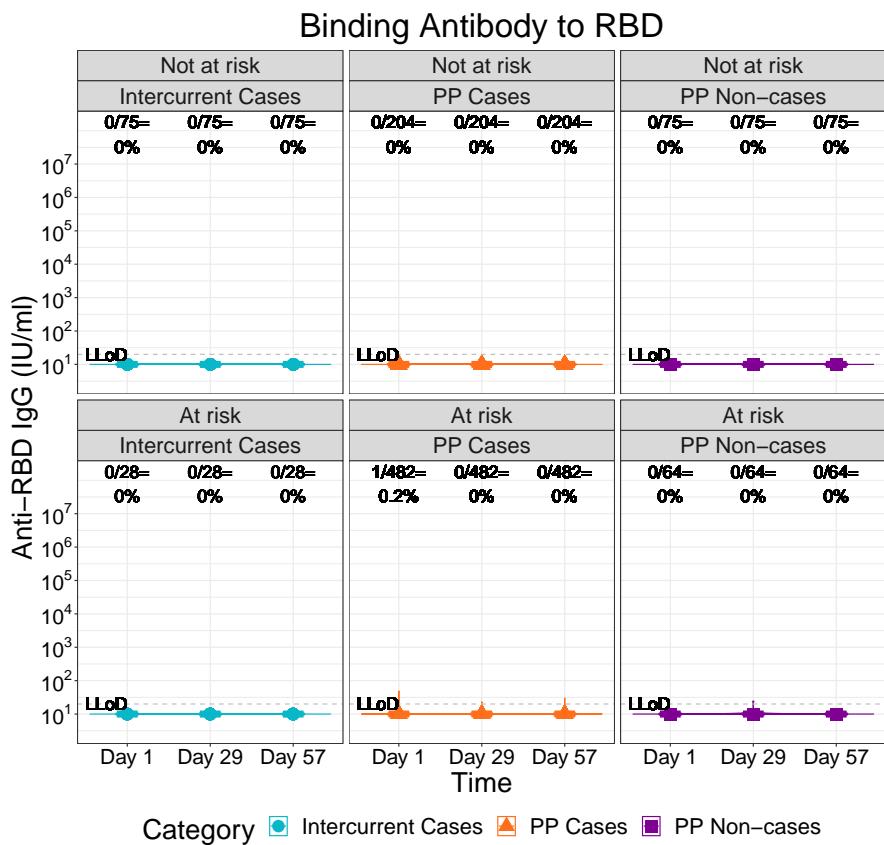


Figure 1.109: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints)

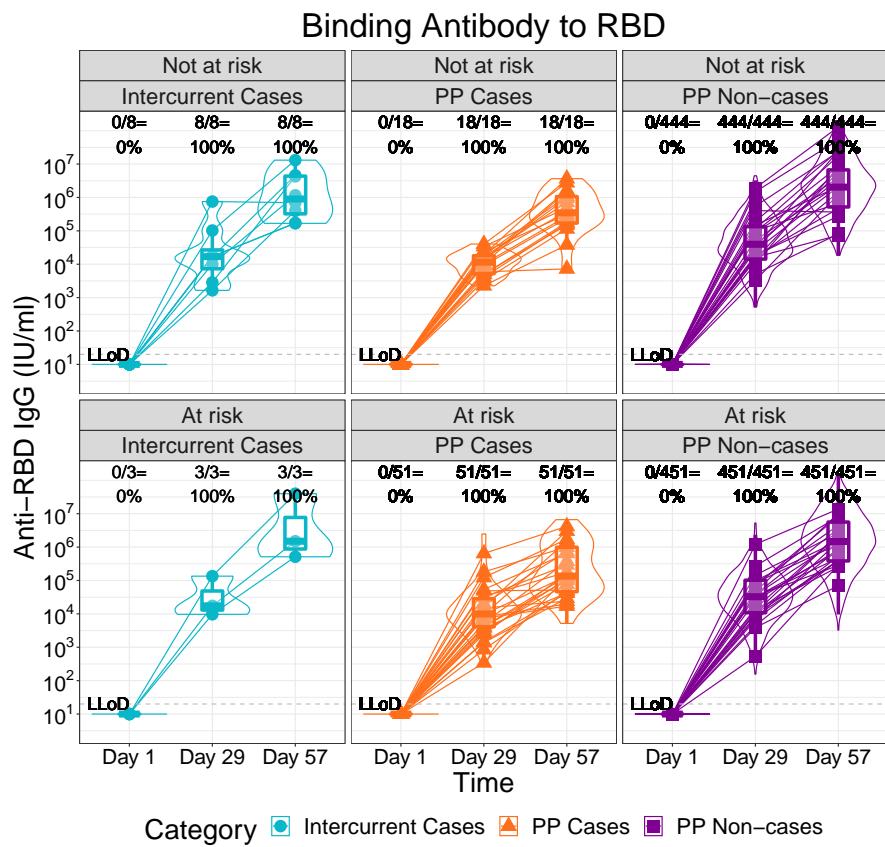


Figure 1.110: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints)

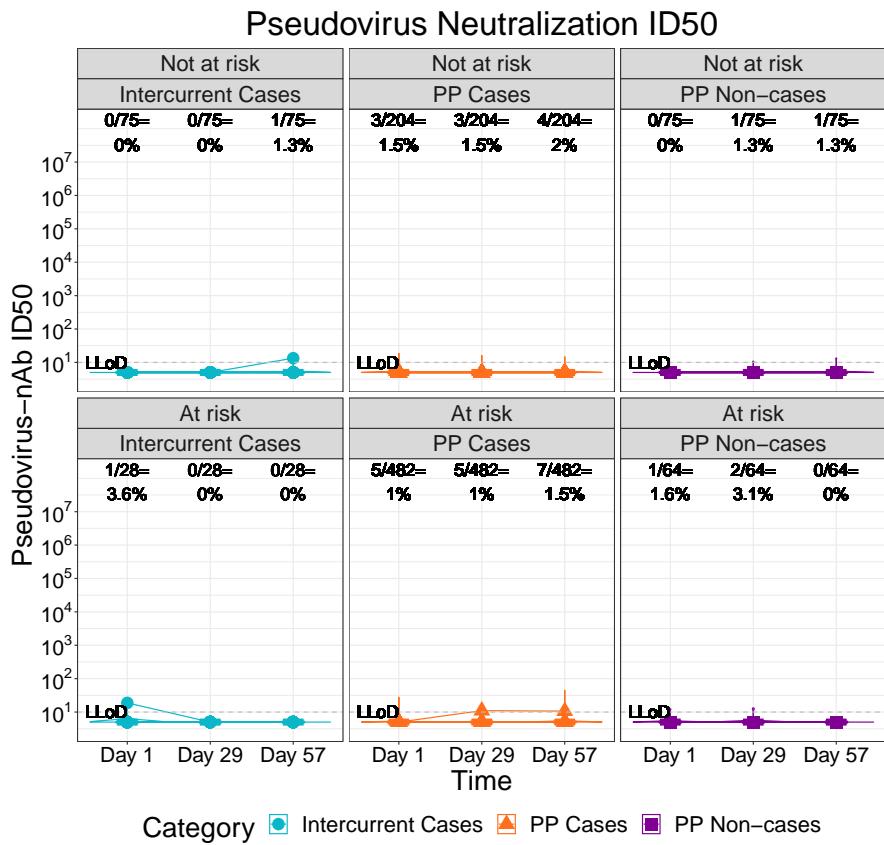


Figure 1.111: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints)

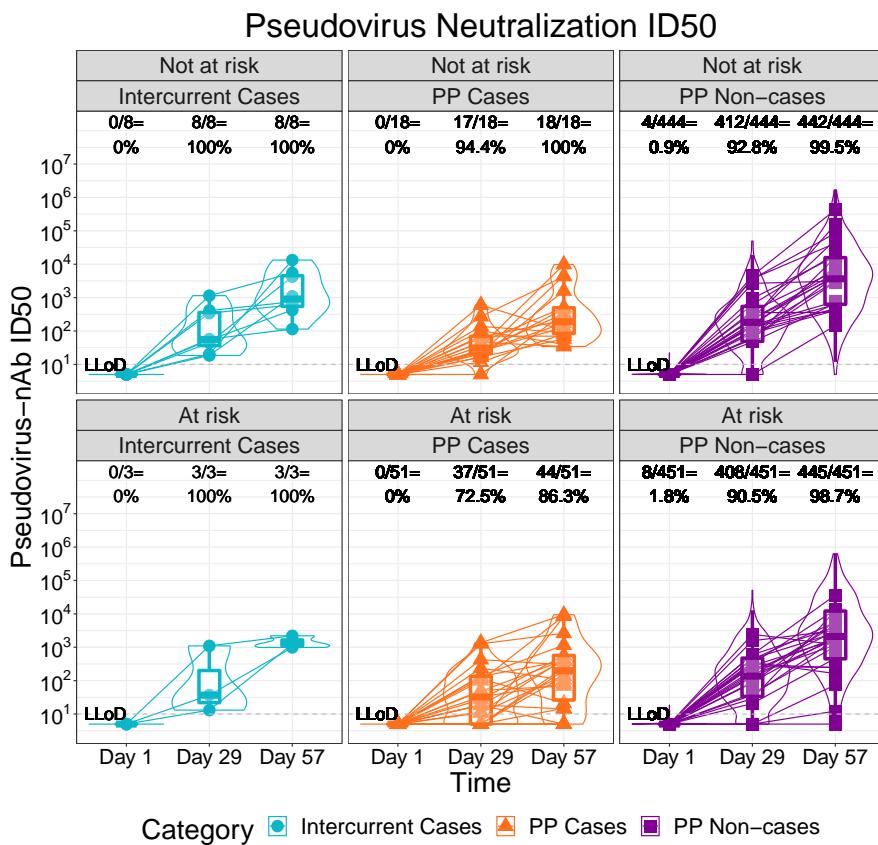


Figure 1.112: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints)

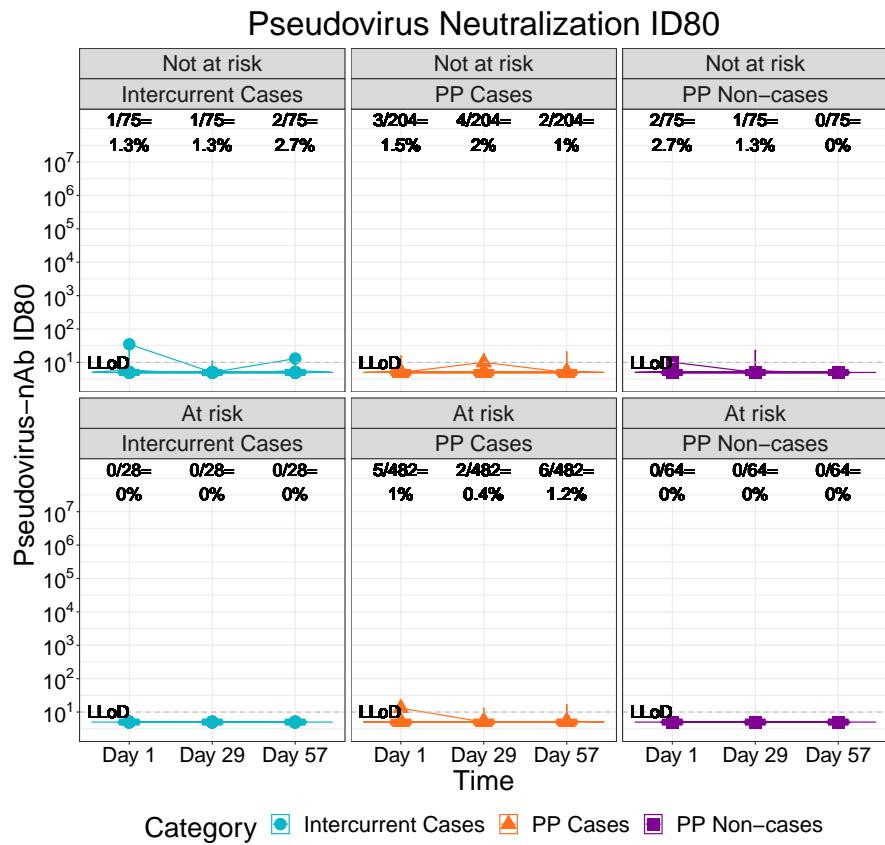


Figure 1.113: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints)

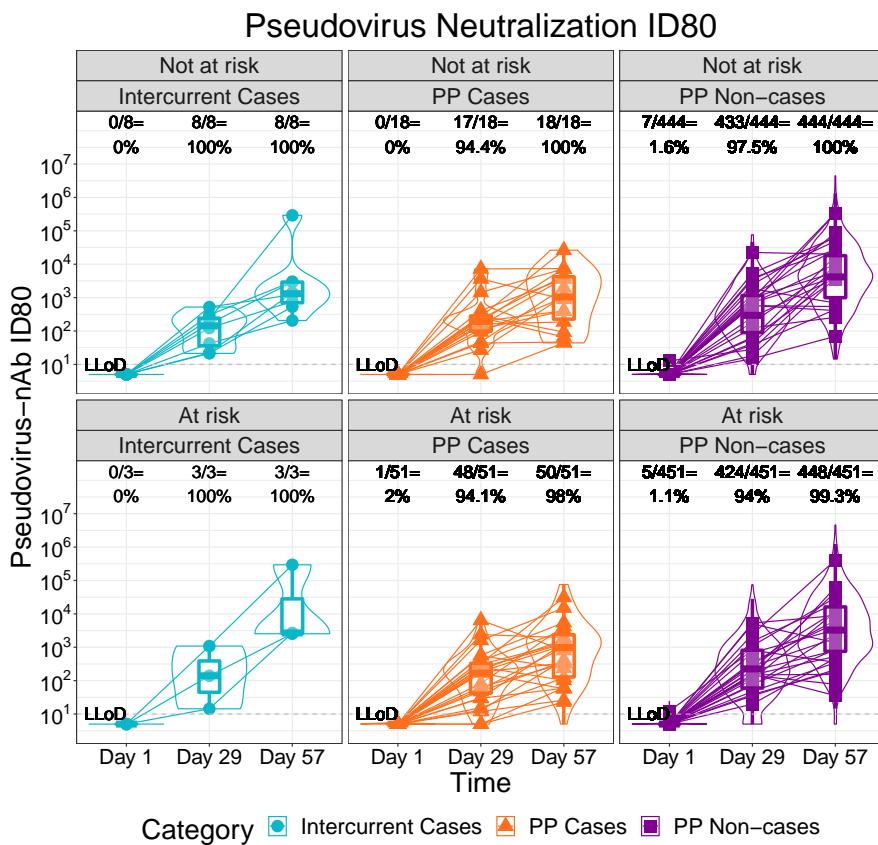


Figure 1.114: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints)

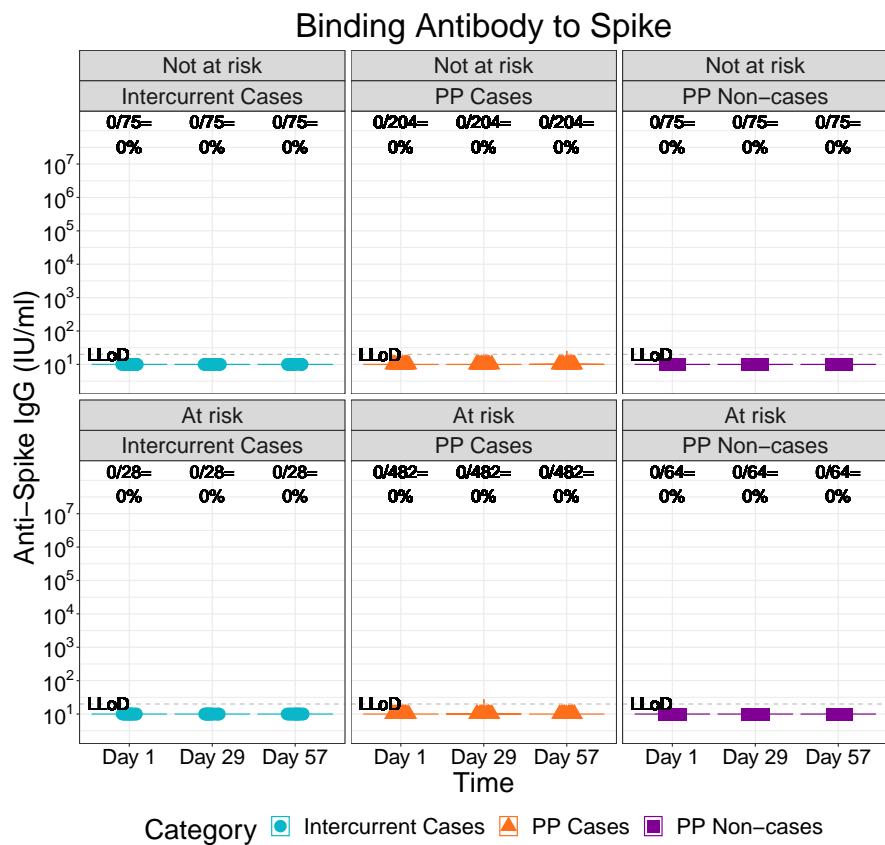


Figure 1.115: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints)

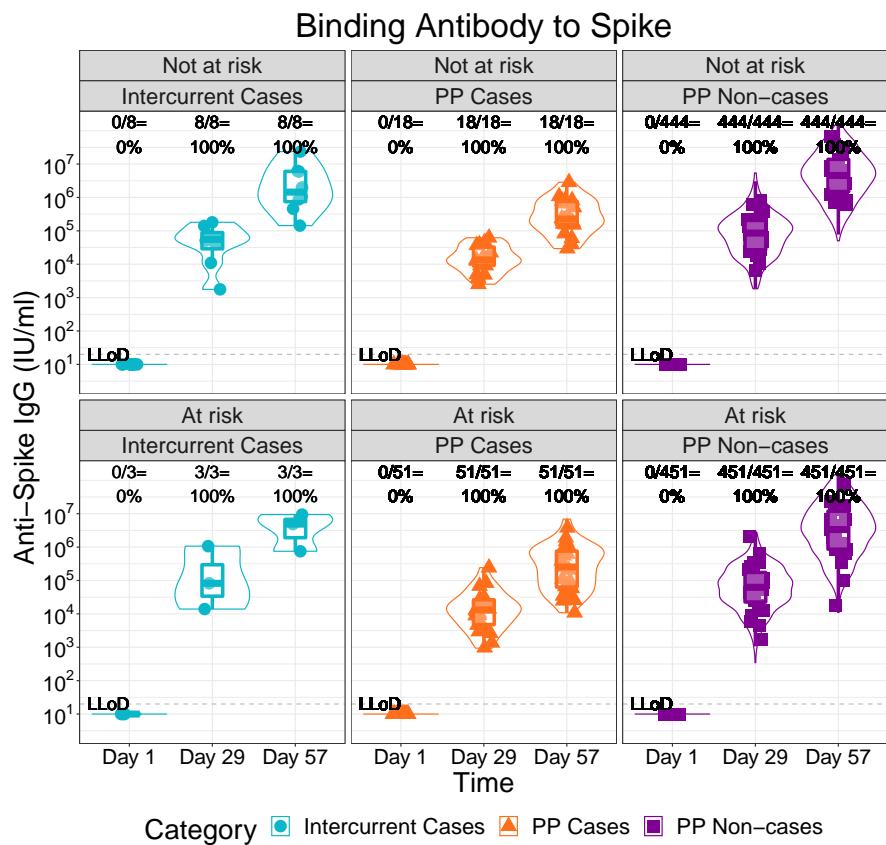


Figure 1.116: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints)

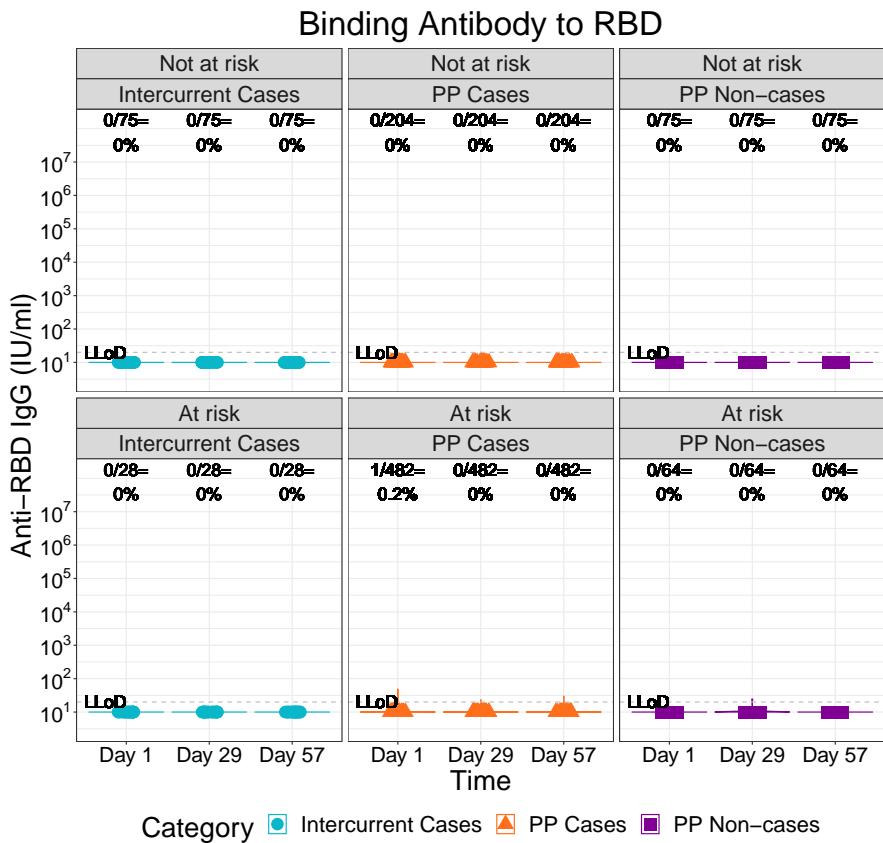


Figure 1.117: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints)

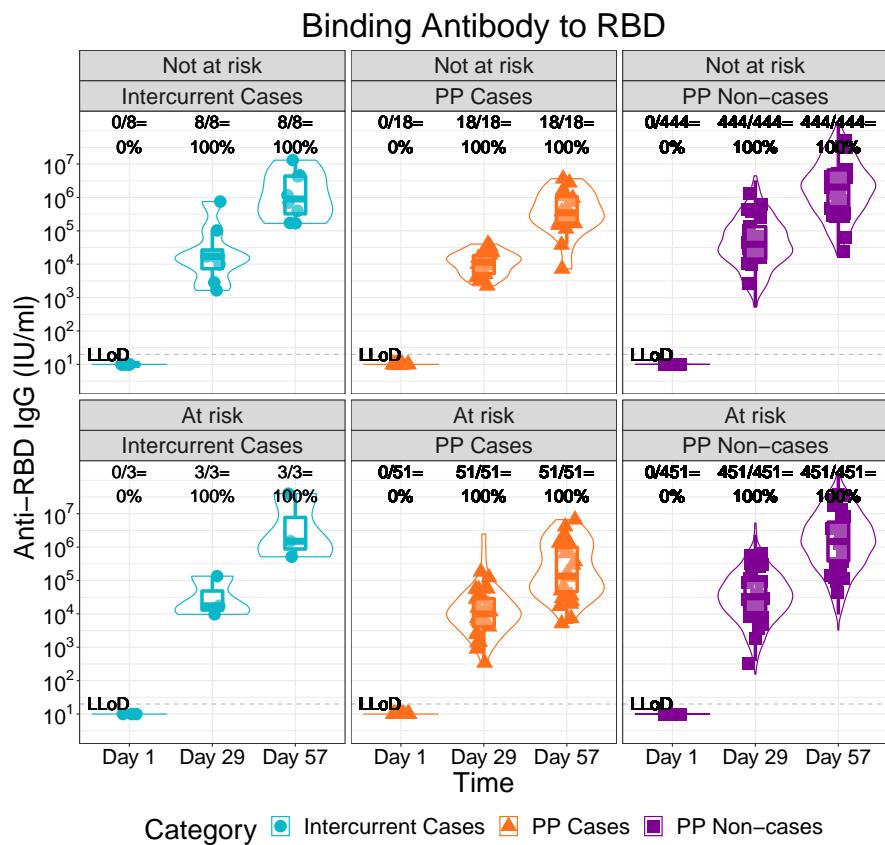


Figure 1.118: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints)

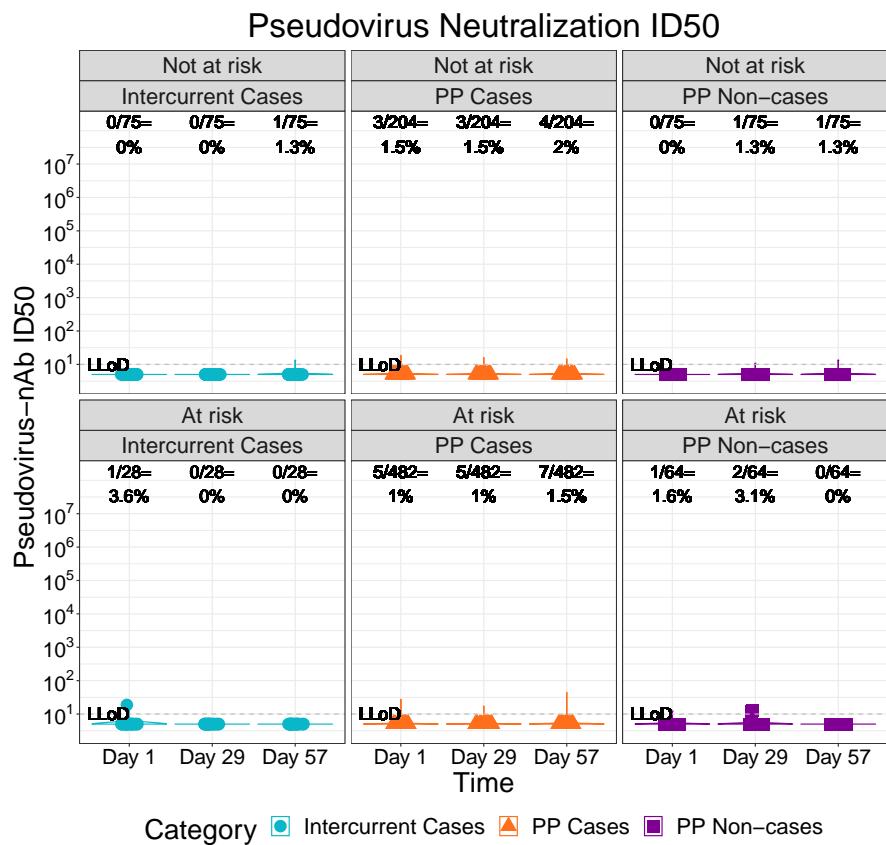


Figure 1.119: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints)

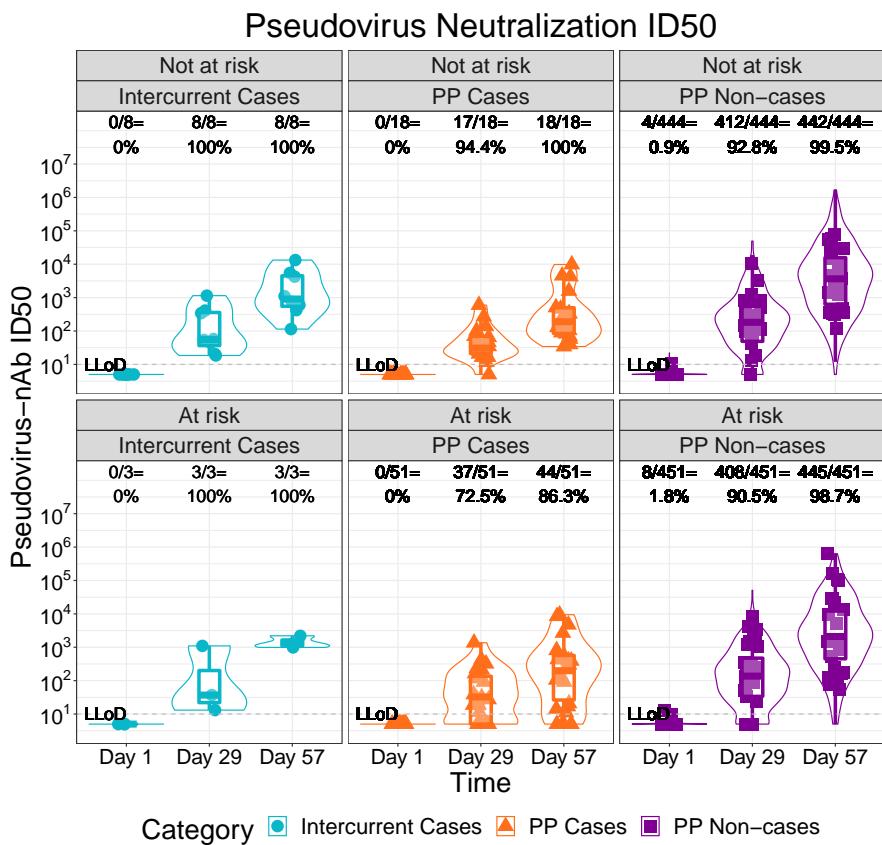


Figure 1.120: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints)

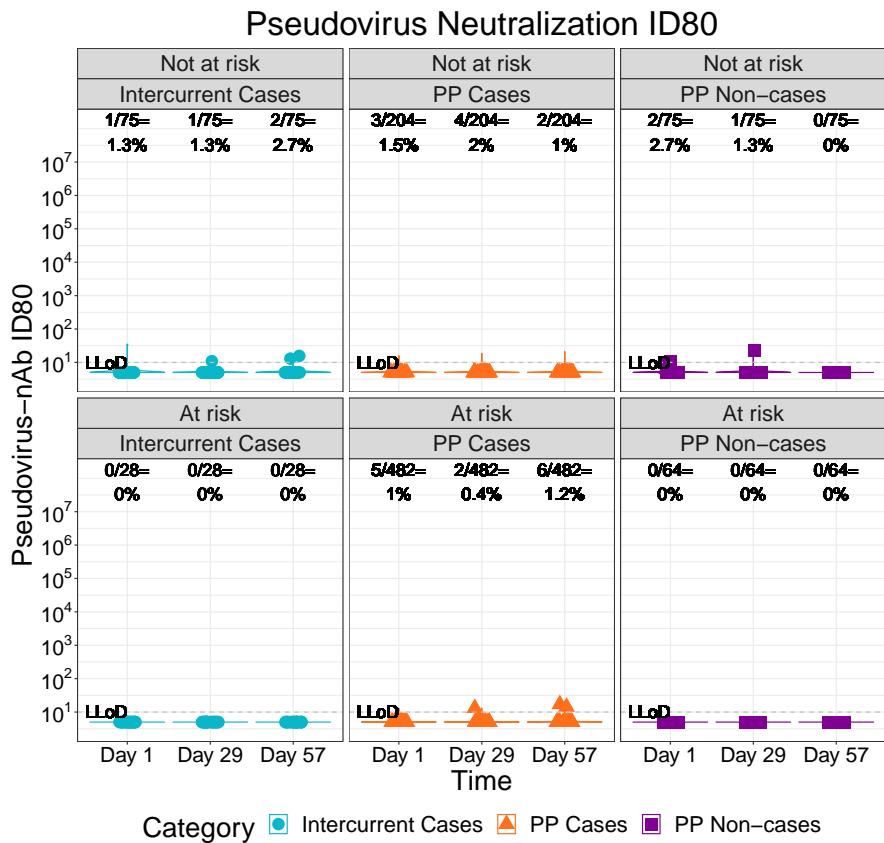


Figure 1.121: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints)

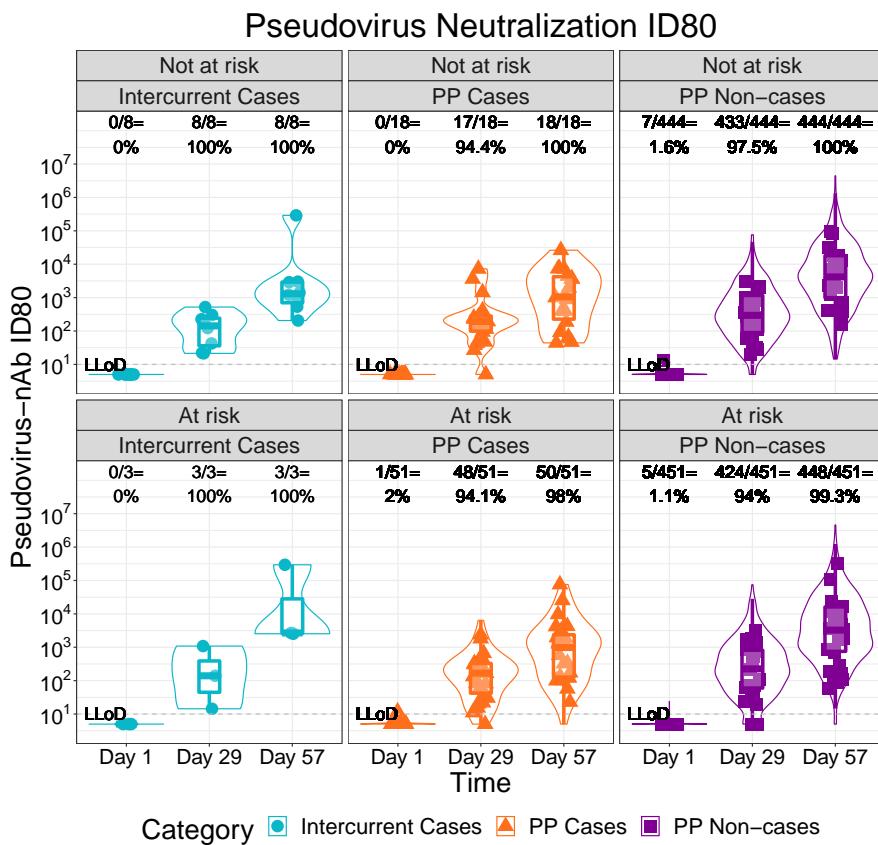


Figure 1.122: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints)

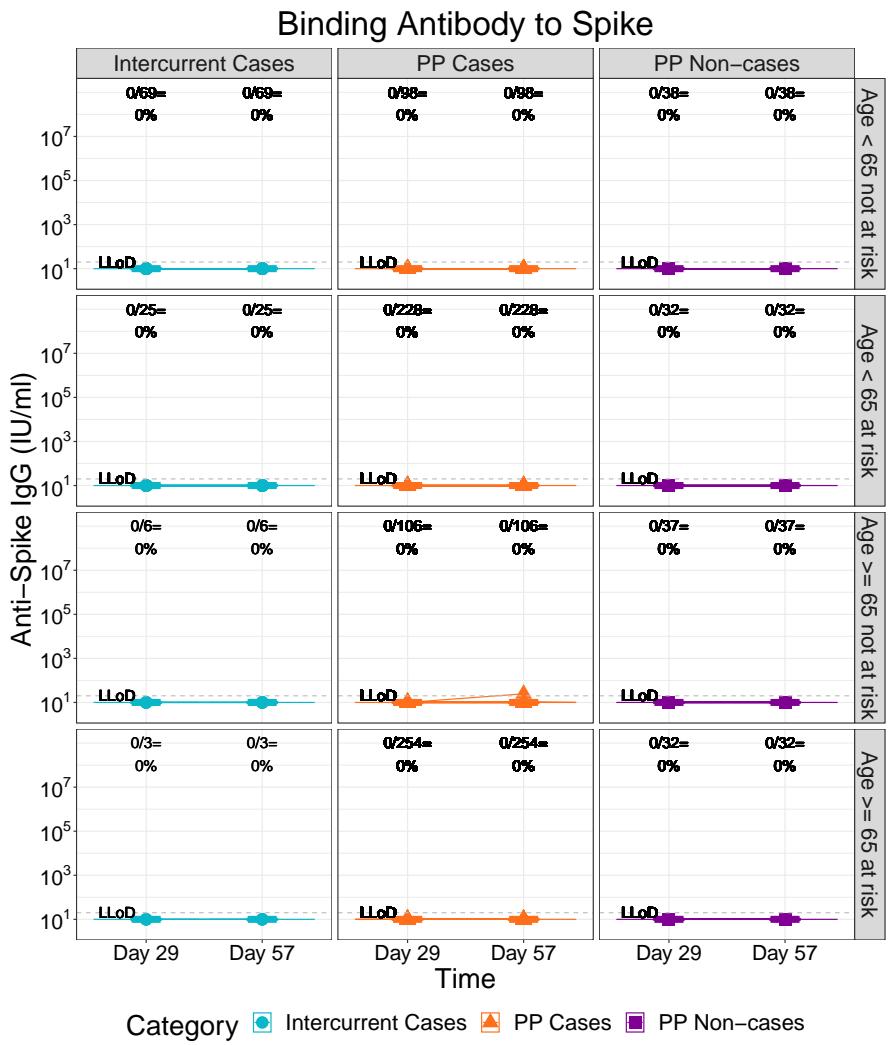


Figure 1.123: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints)

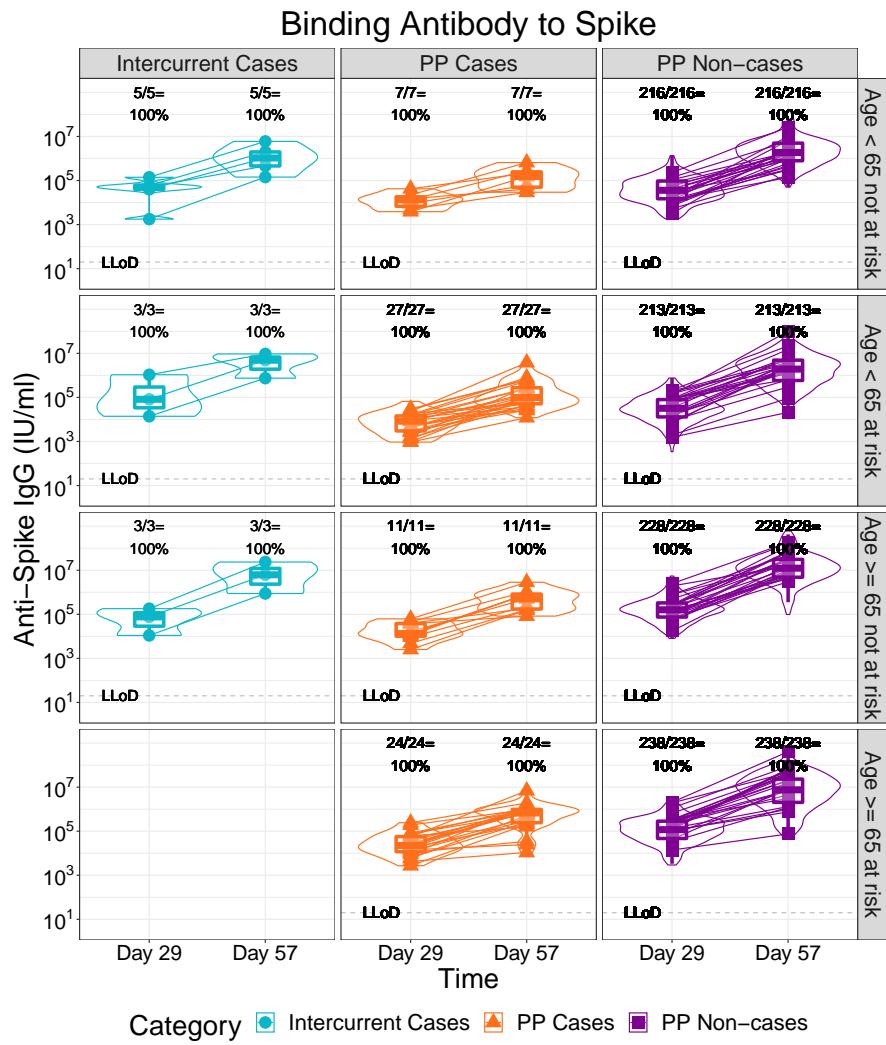


Figure 1.124: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints)

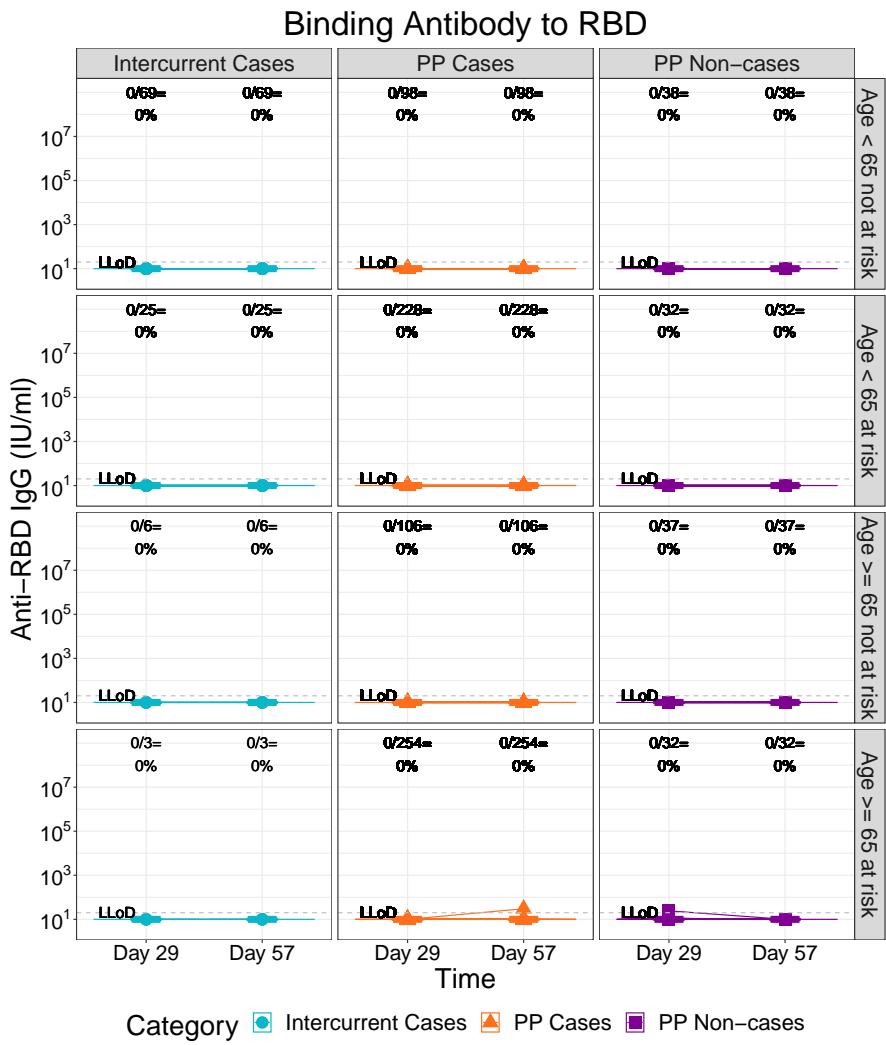


Figure 1.125: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints)

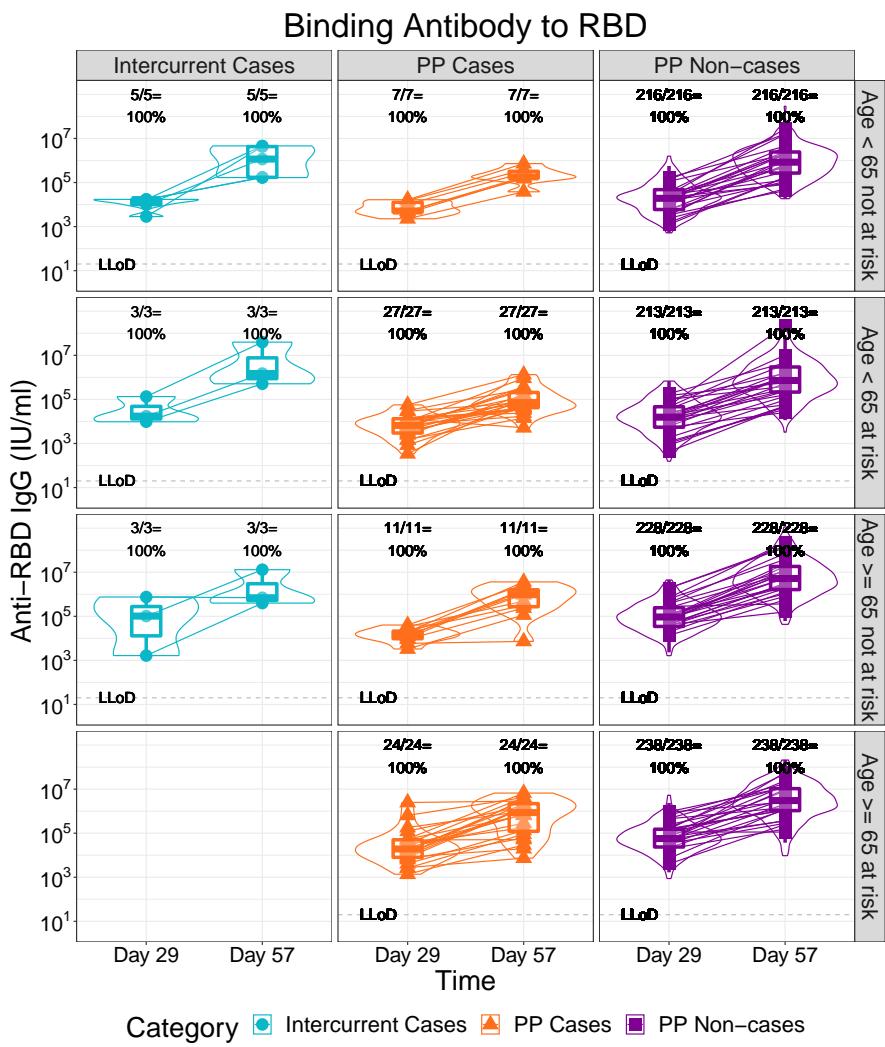


Figure 1.126: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints)

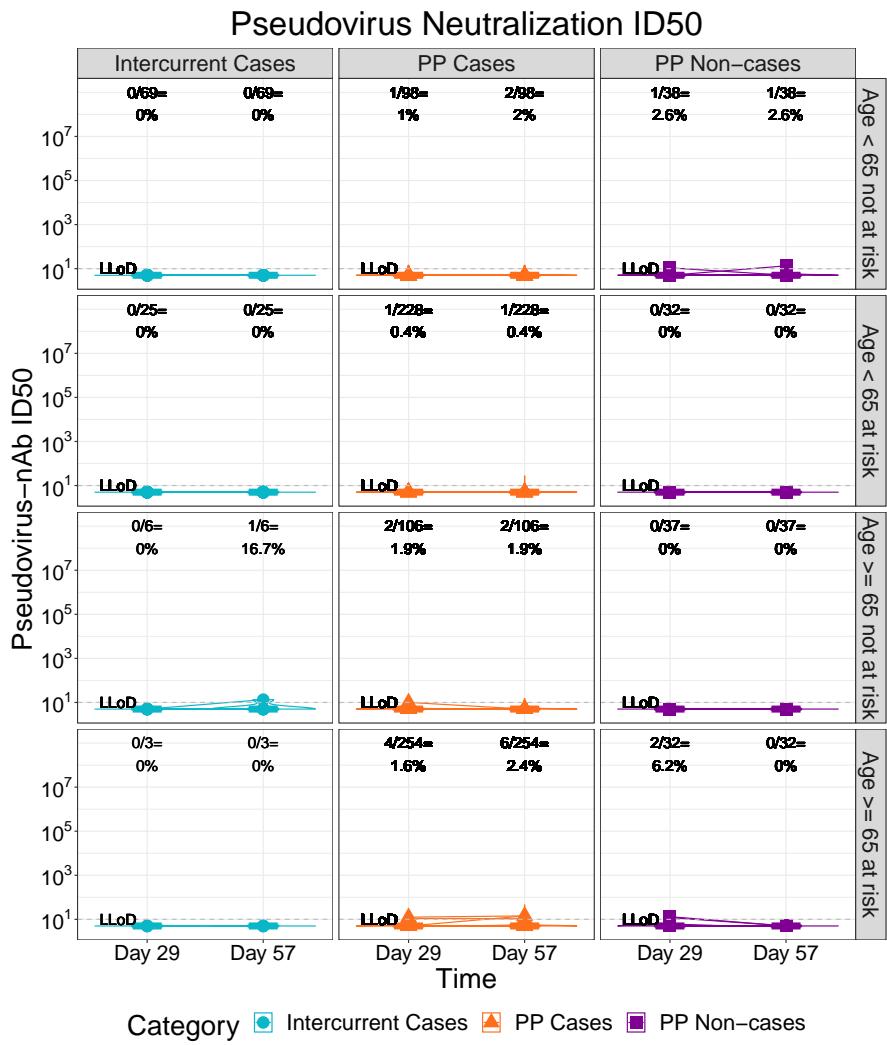


Figure 1.127: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints)

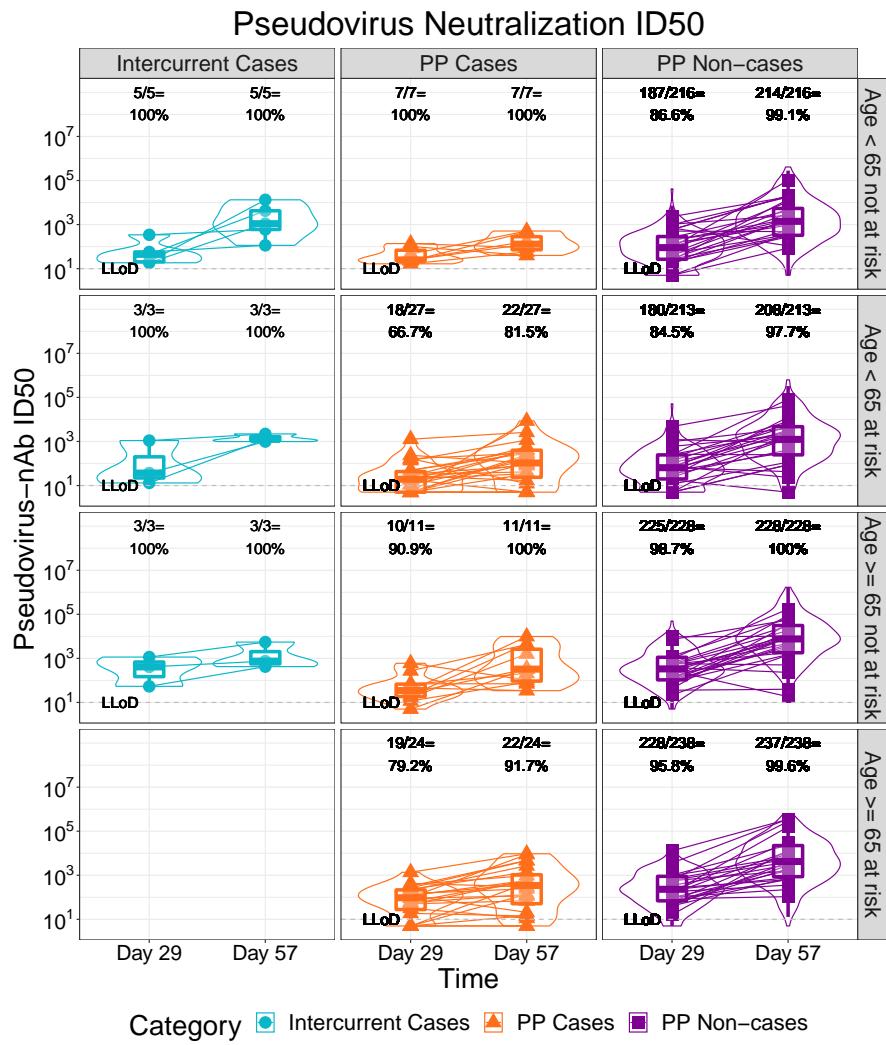


Figure 1.128: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints)

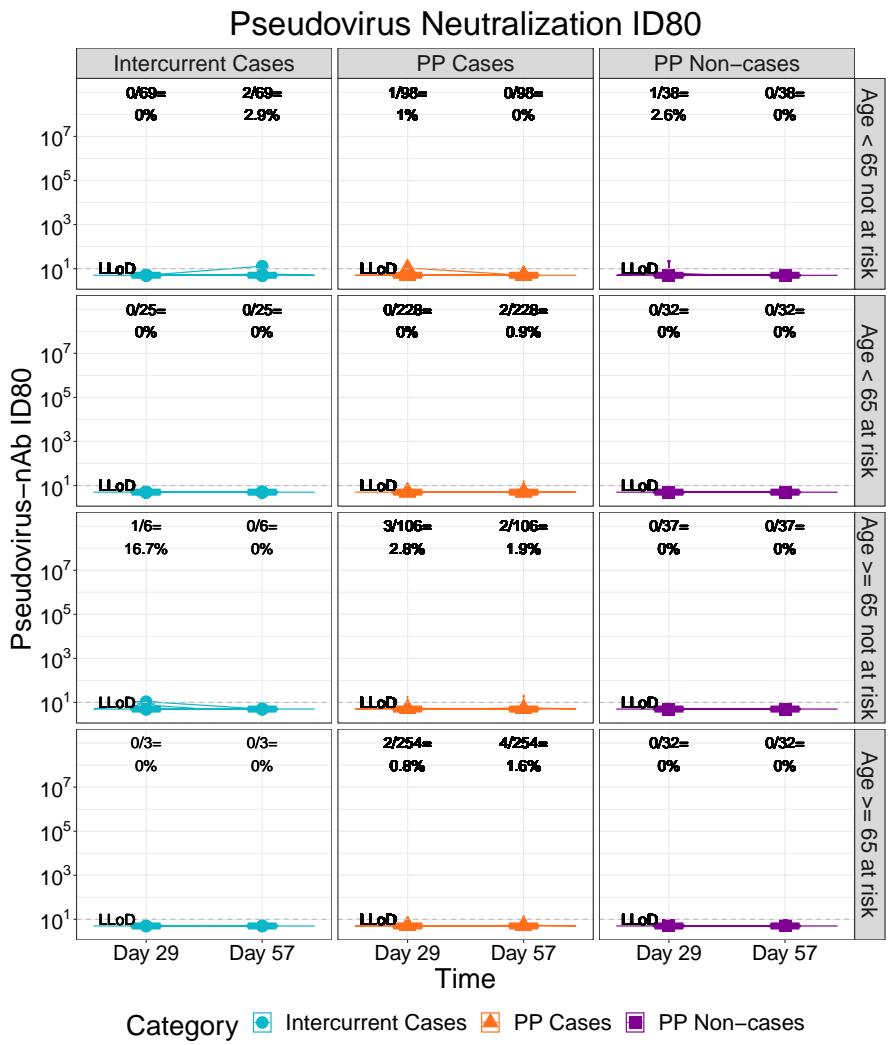


Figure 1.129: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints)

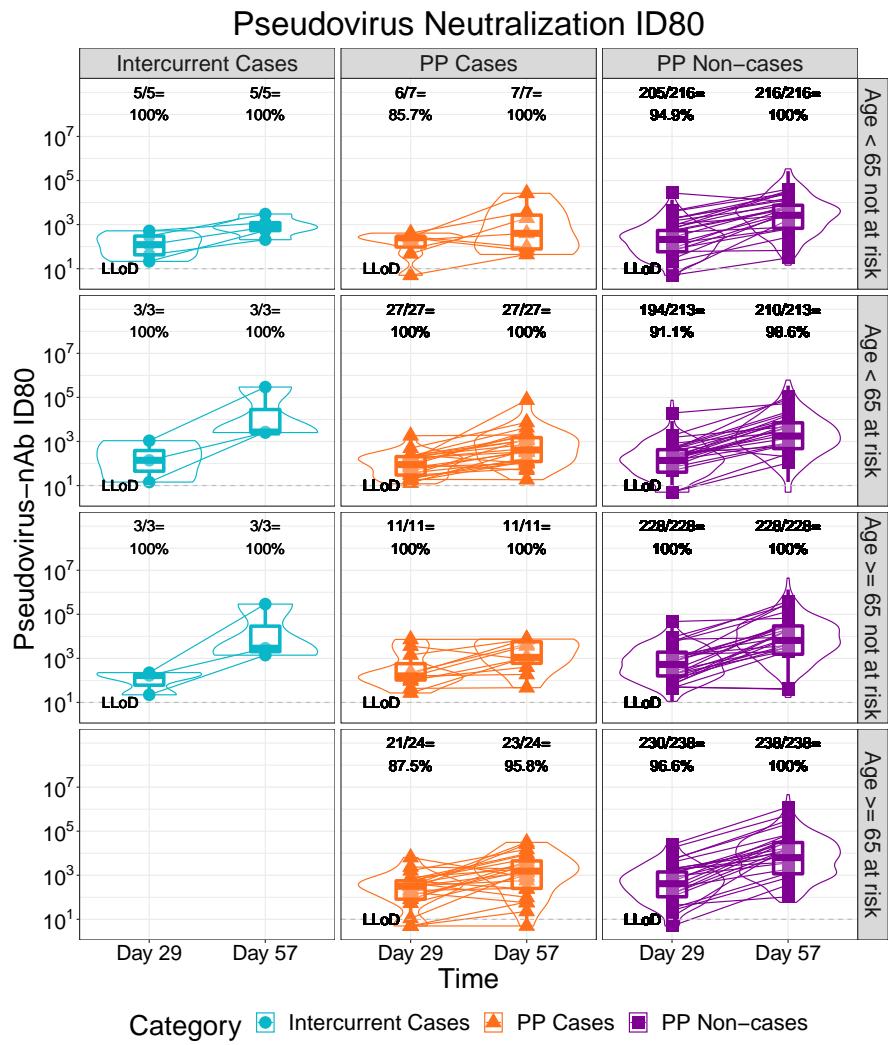


Figure 1.130: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints)

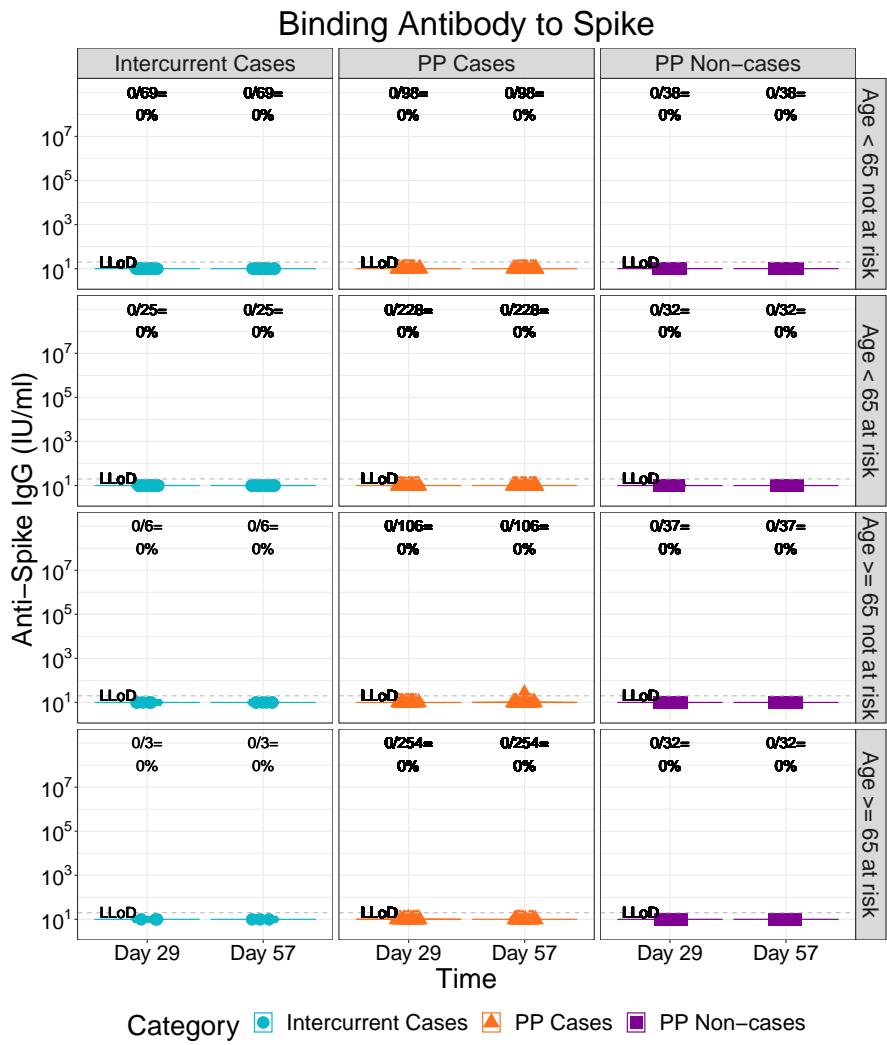


Figure 1.131: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints)

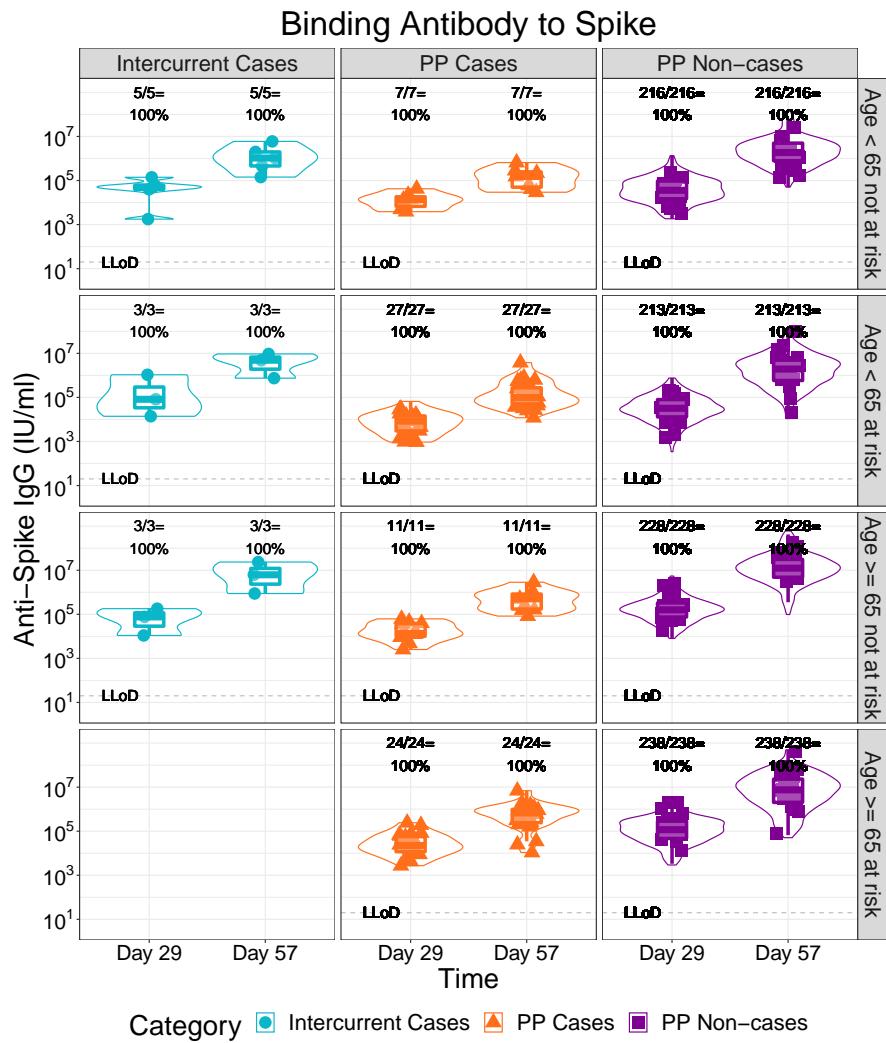


Figure 1.132: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints)

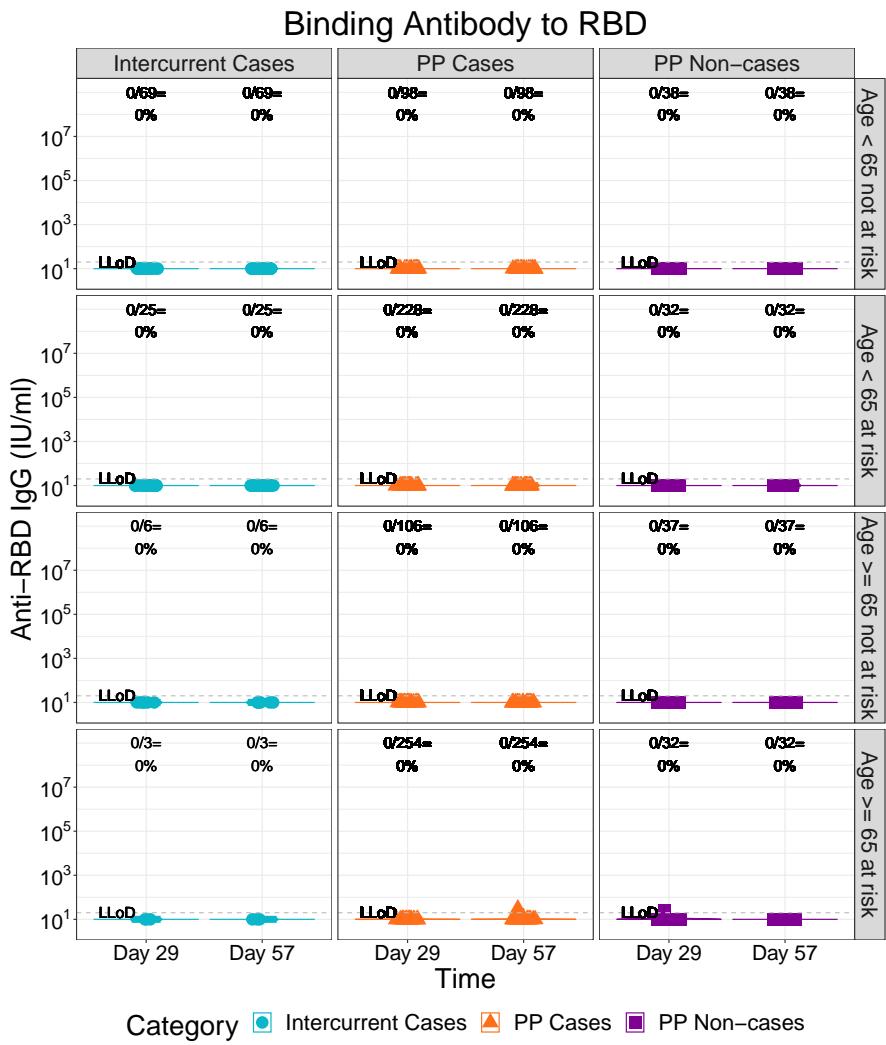


Figure 1.133: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints)

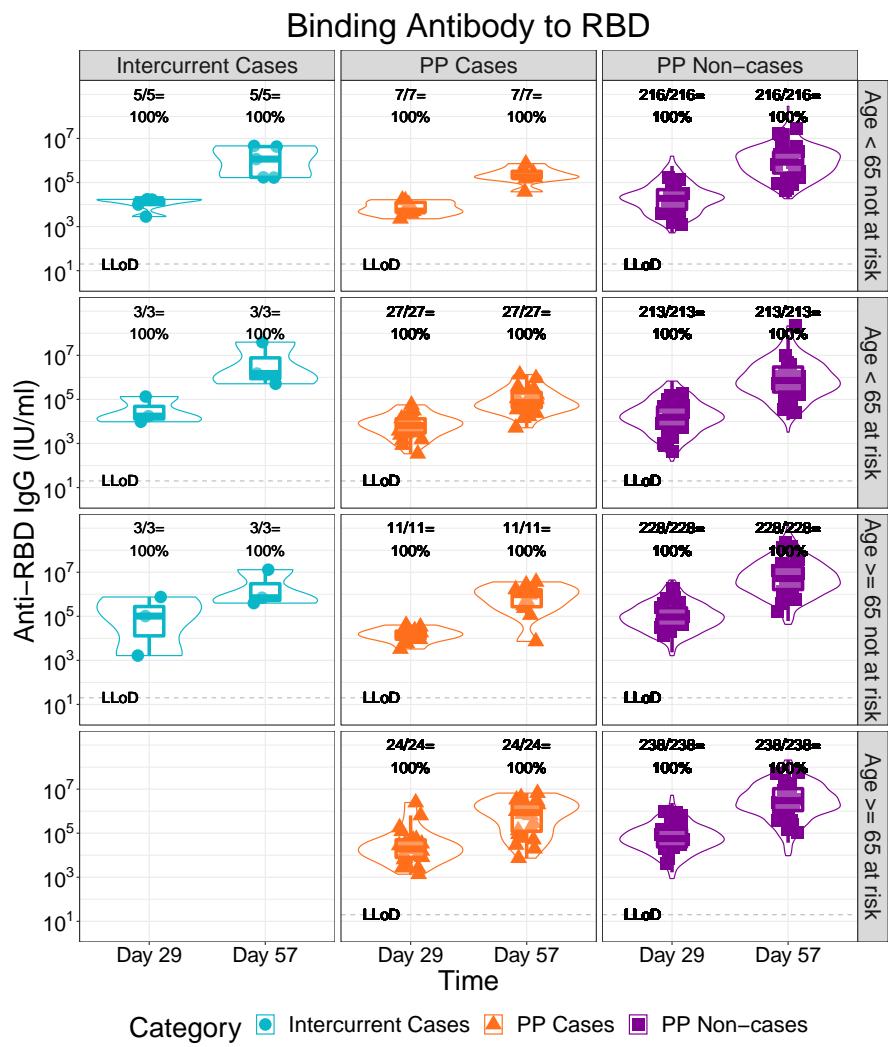


Figure 1.134: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints)

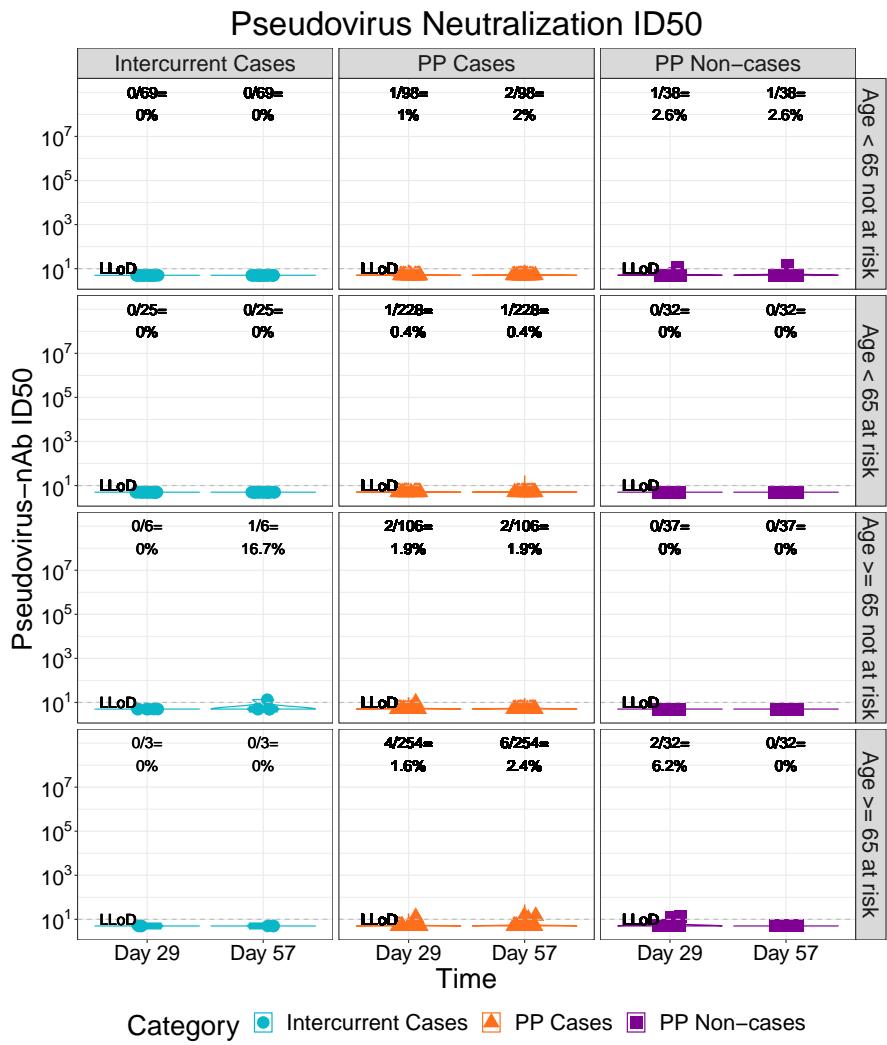


Figure 1.135: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints)

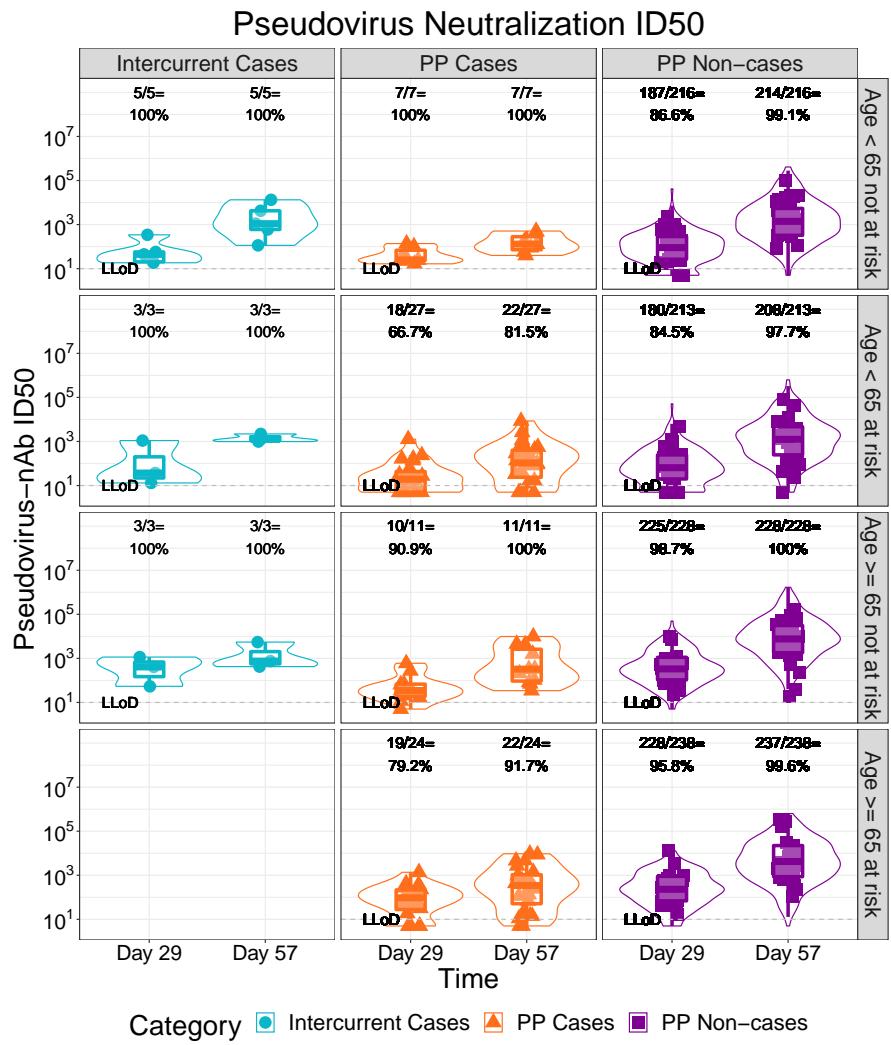


Figure 1.136: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints)

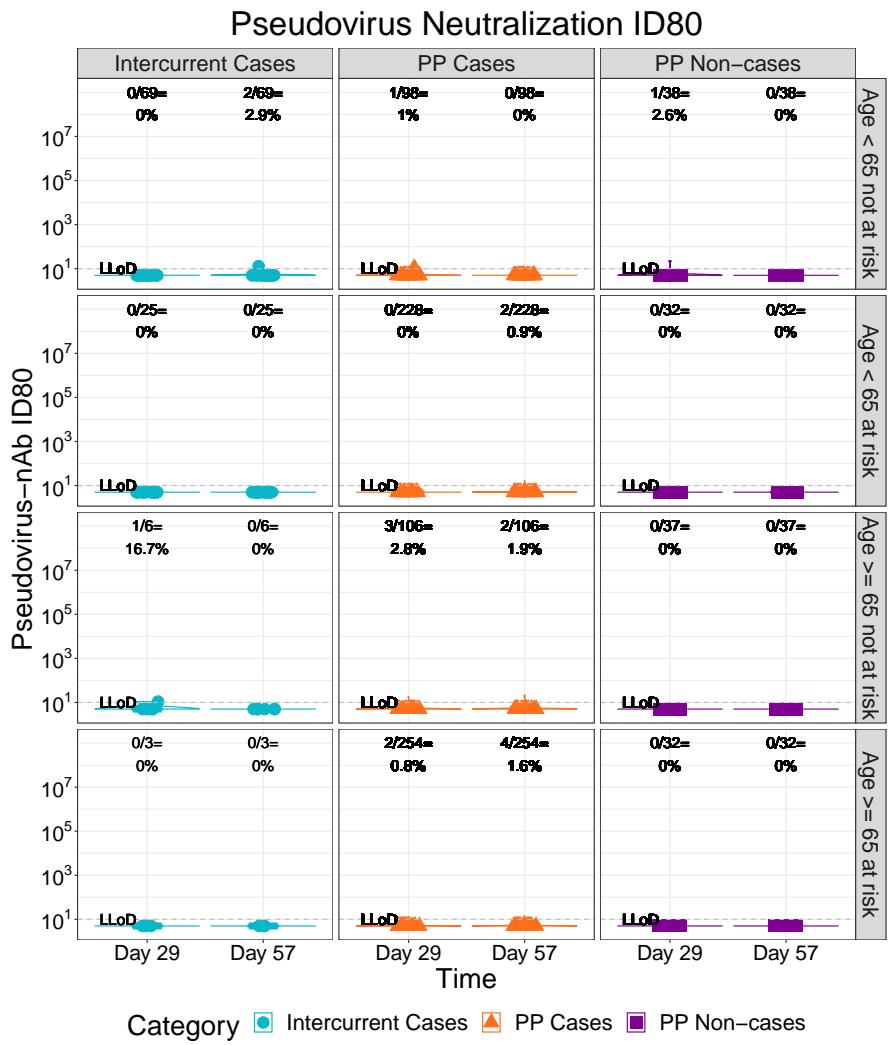


Figure 1.137: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints)

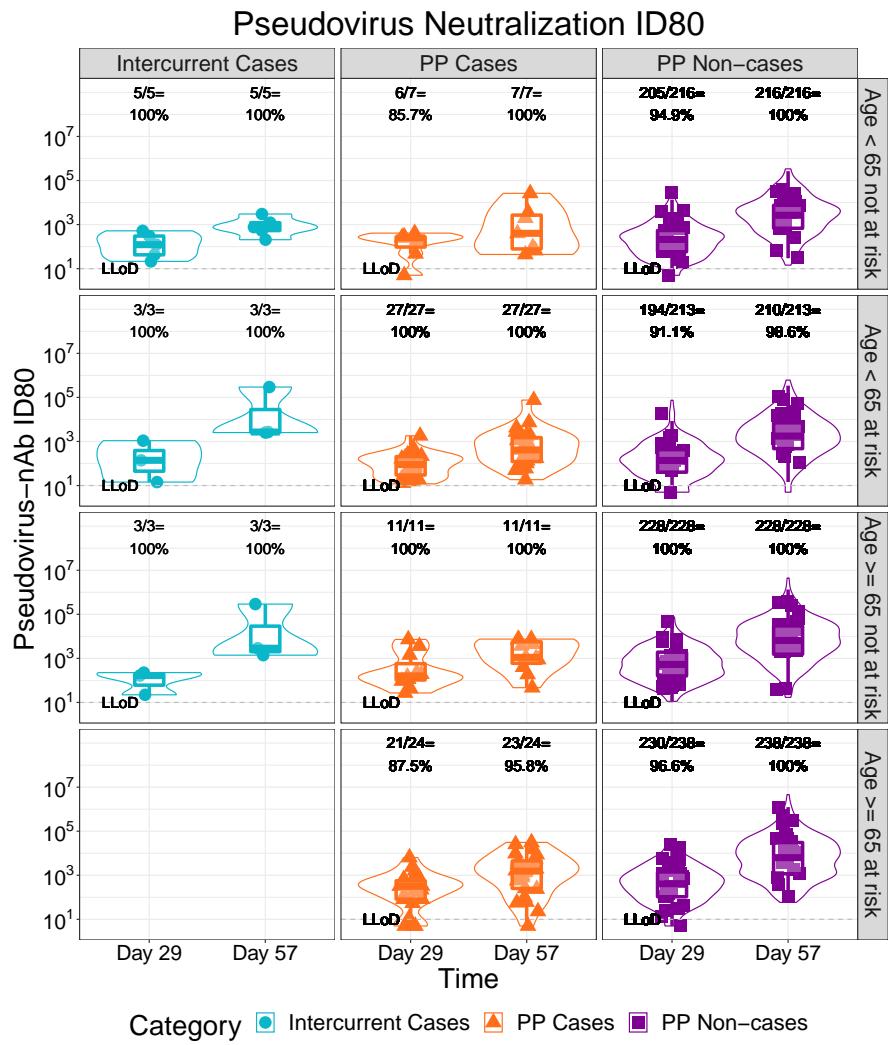


Figure 1.138: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints)

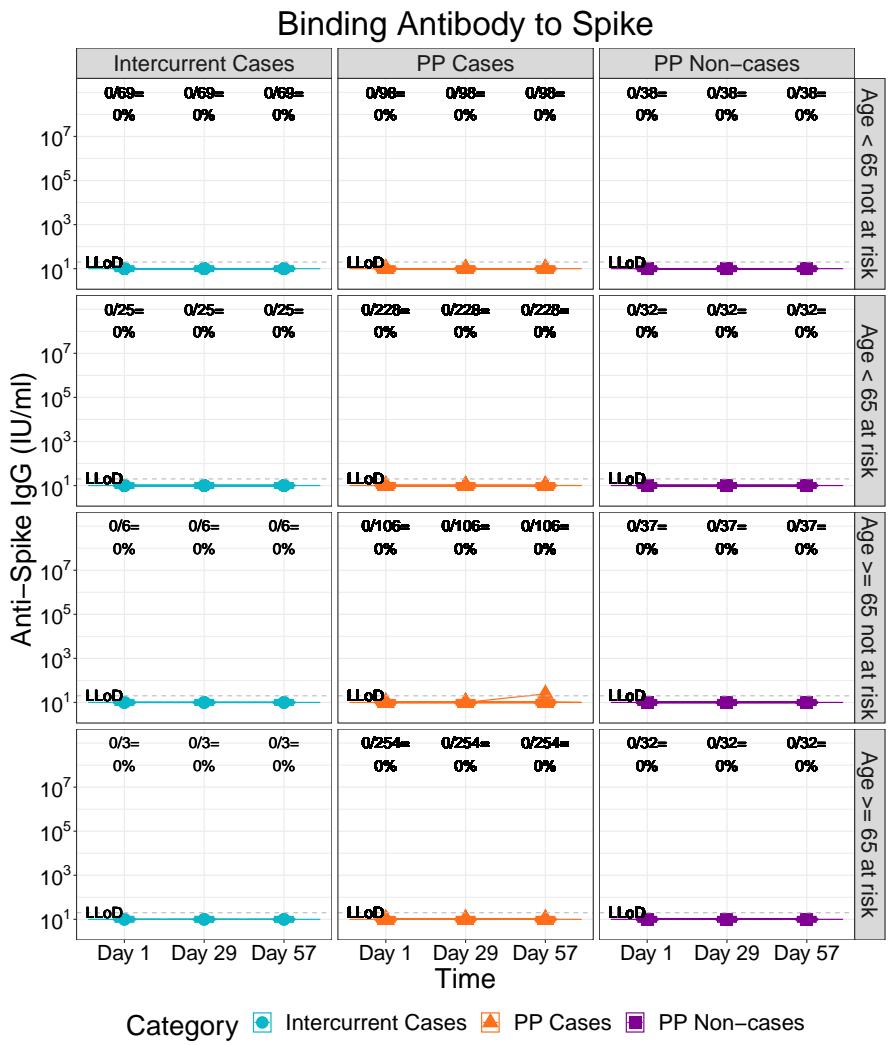


Figure 1.139: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints)

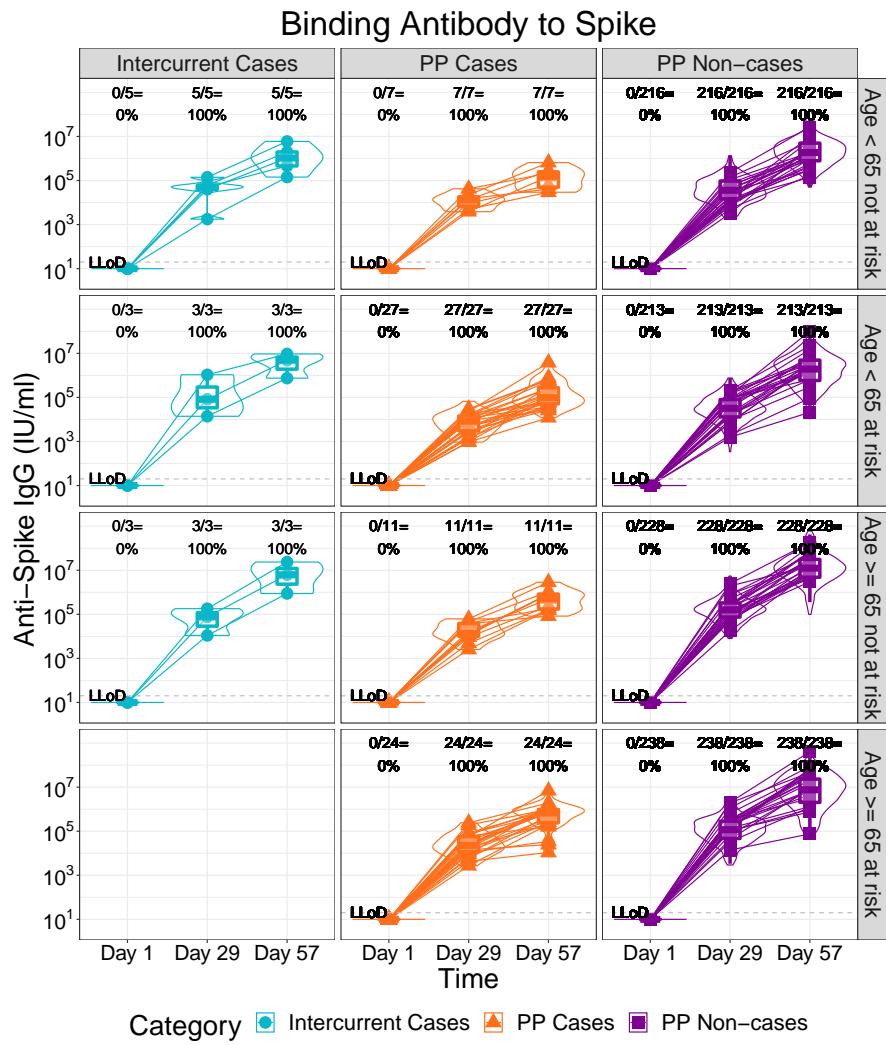


Figure 1.140: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints)

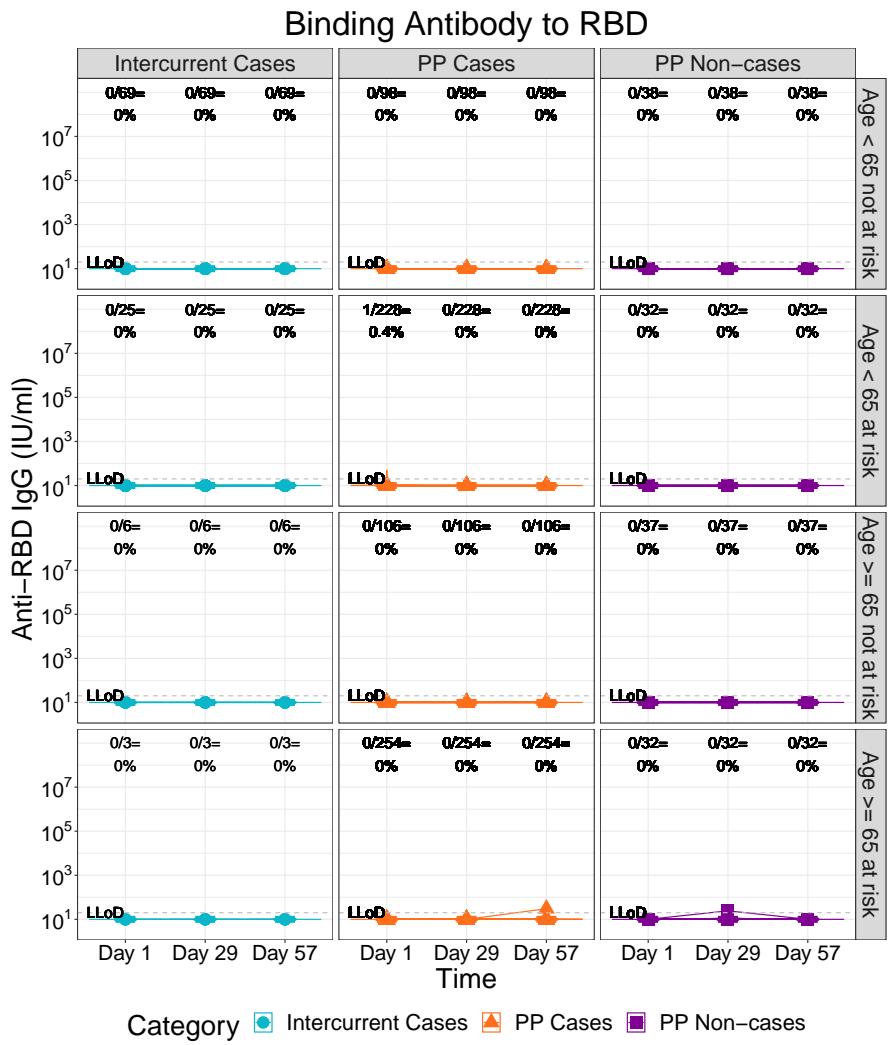


Figure 1.141: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints)

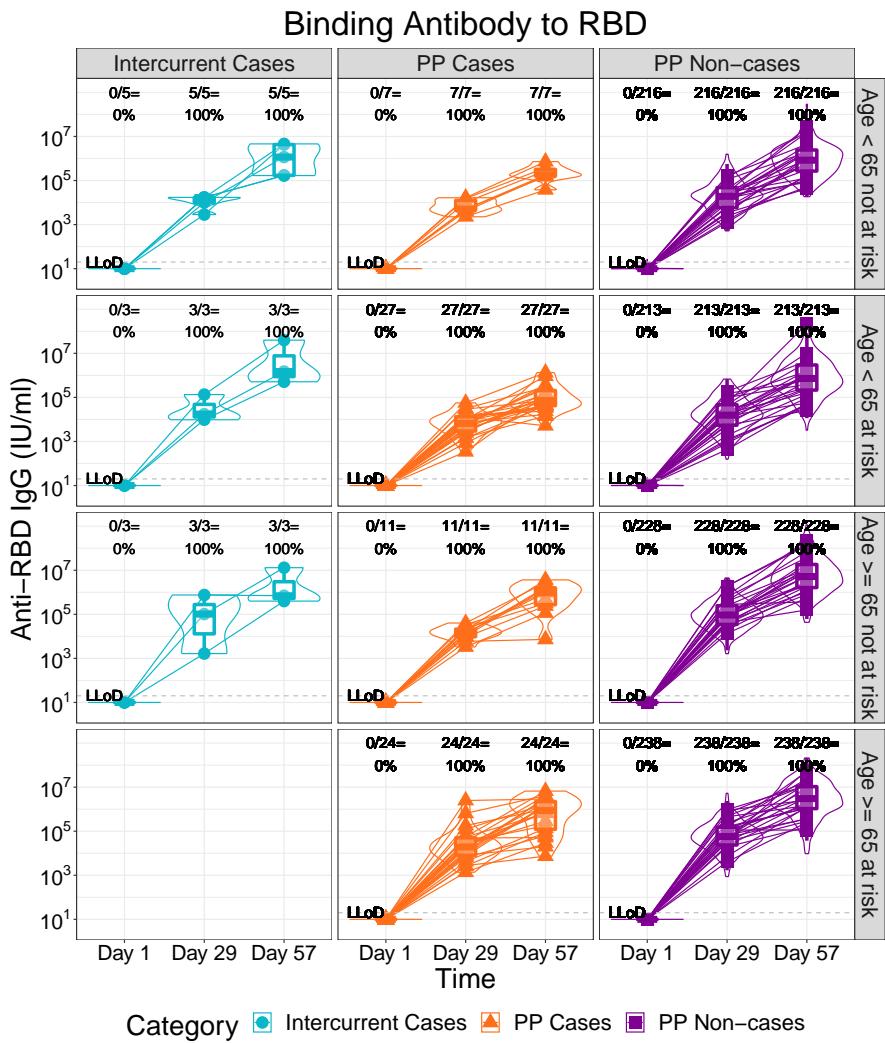


Figure 1.142: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints)

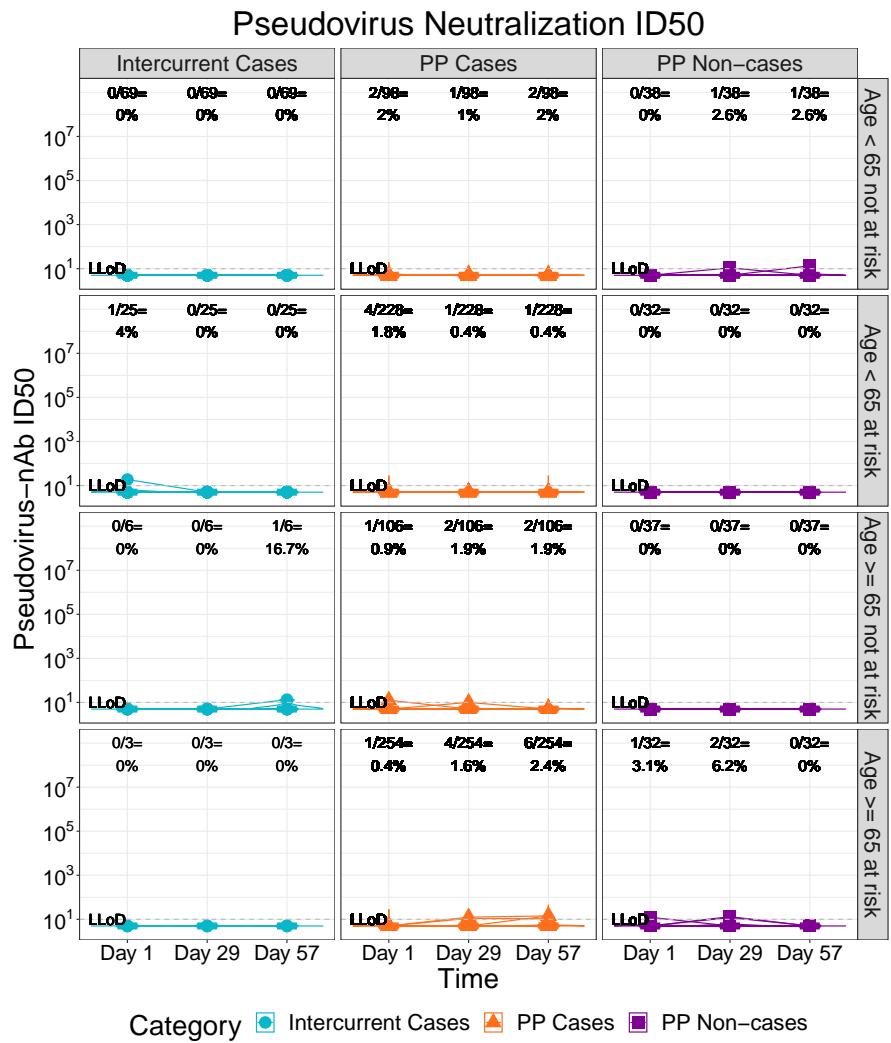


Figure 1.143: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints)

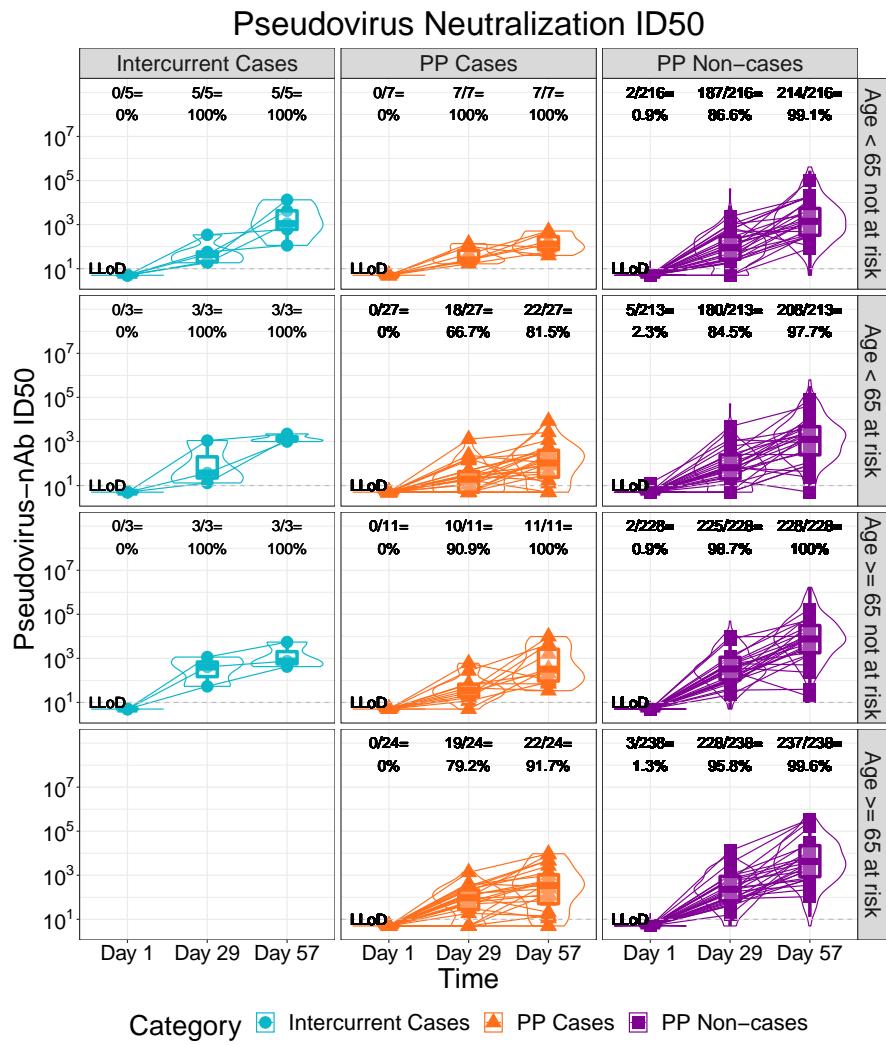


Figure 1.144: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints)

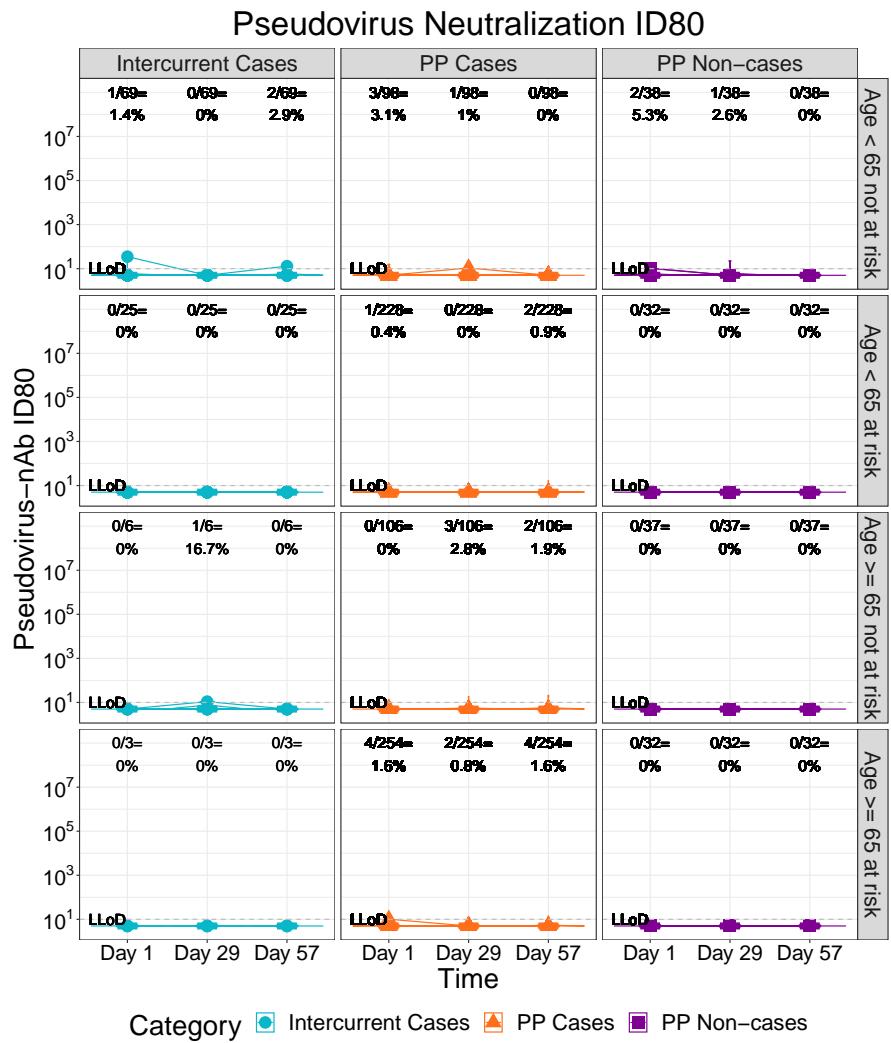


Figure 1.145: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints)

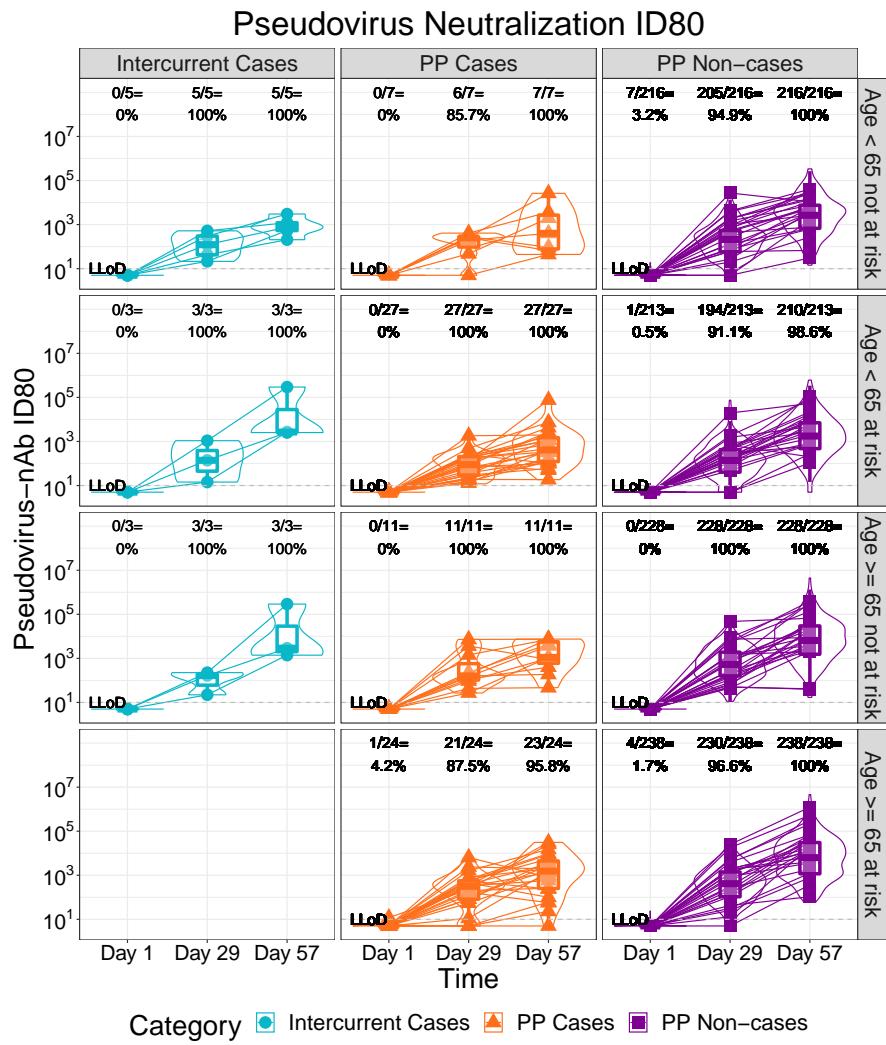


Figure 1.146: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints)

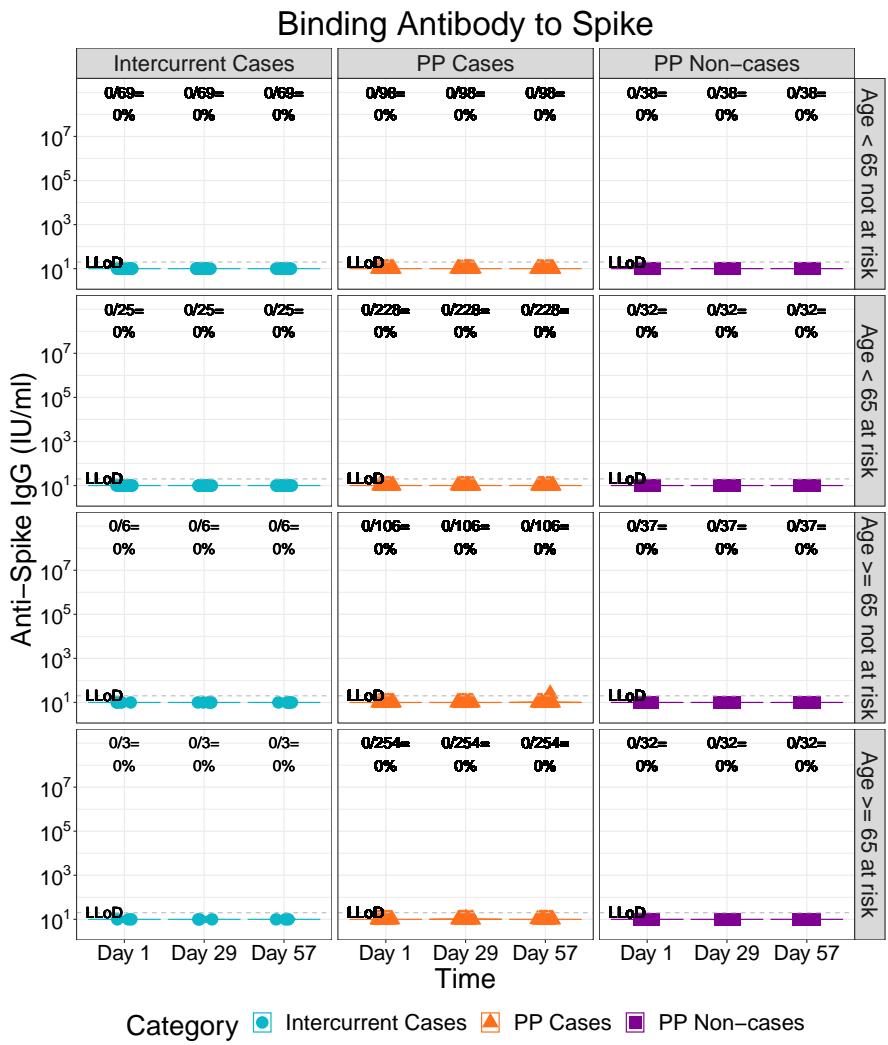


Figure 1.147: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints)

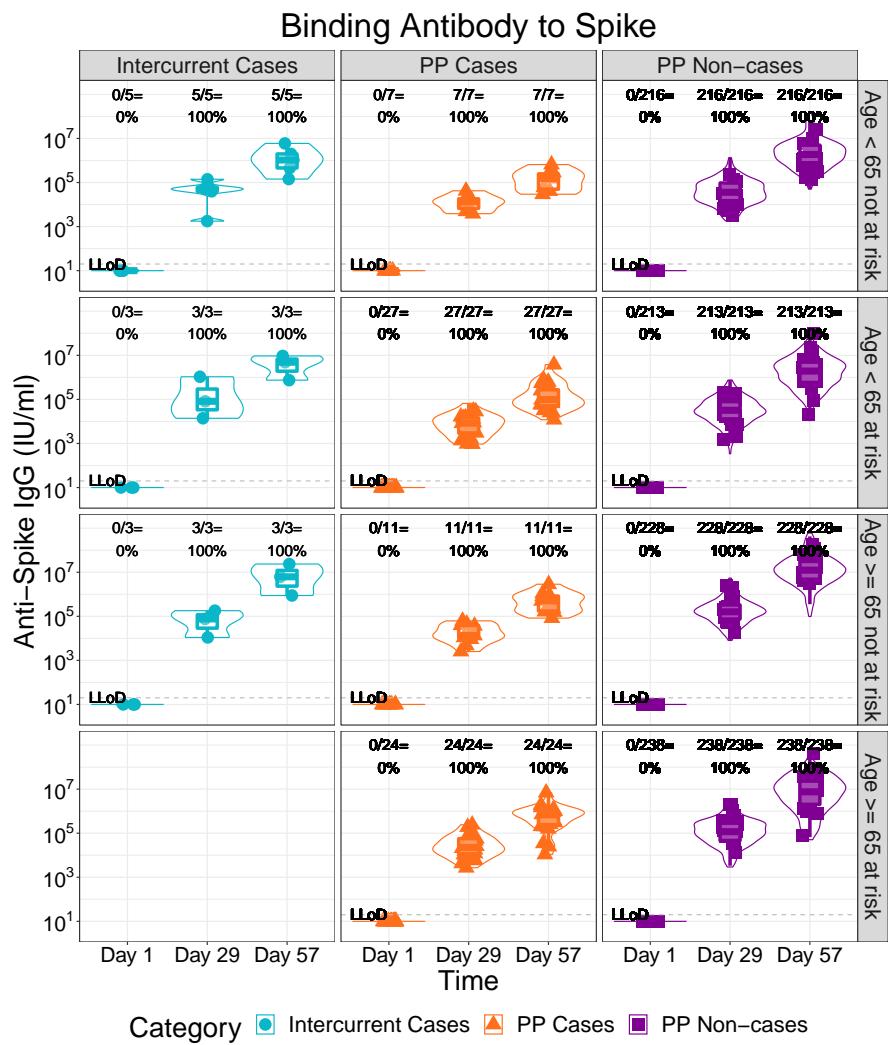


Figure 1.148: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints)

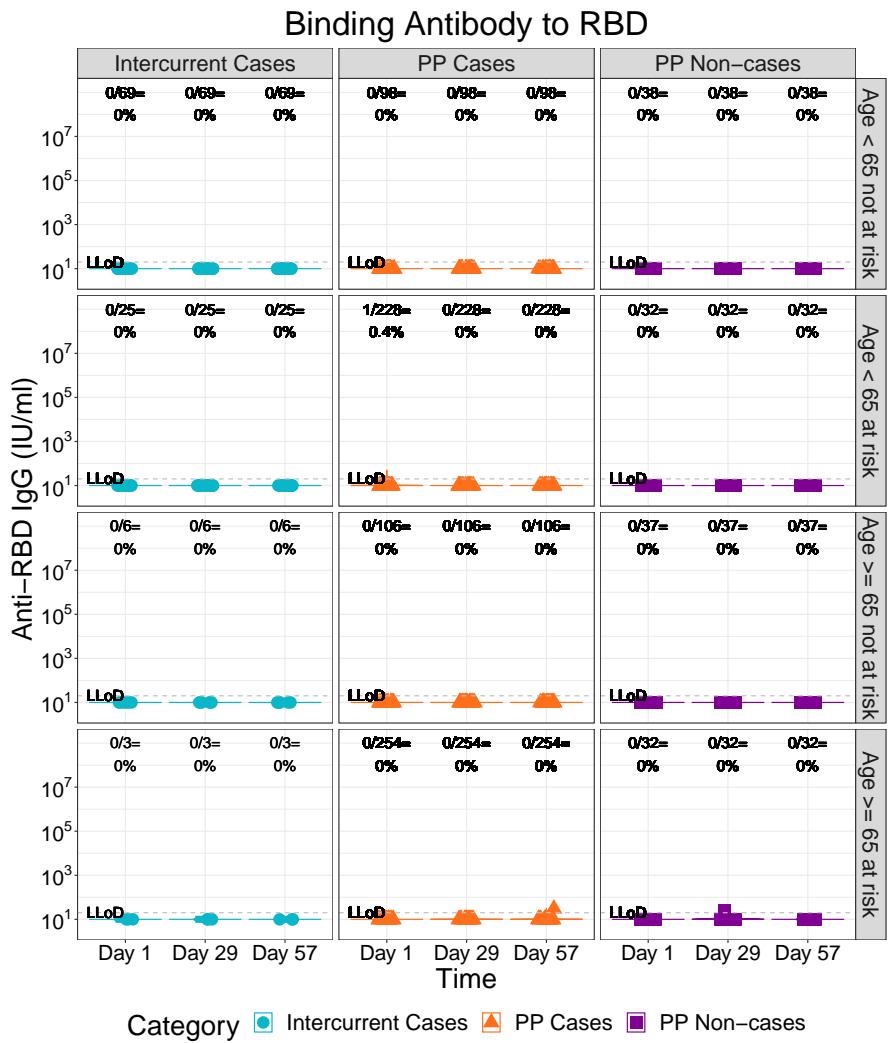


Figure 1.149: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints)

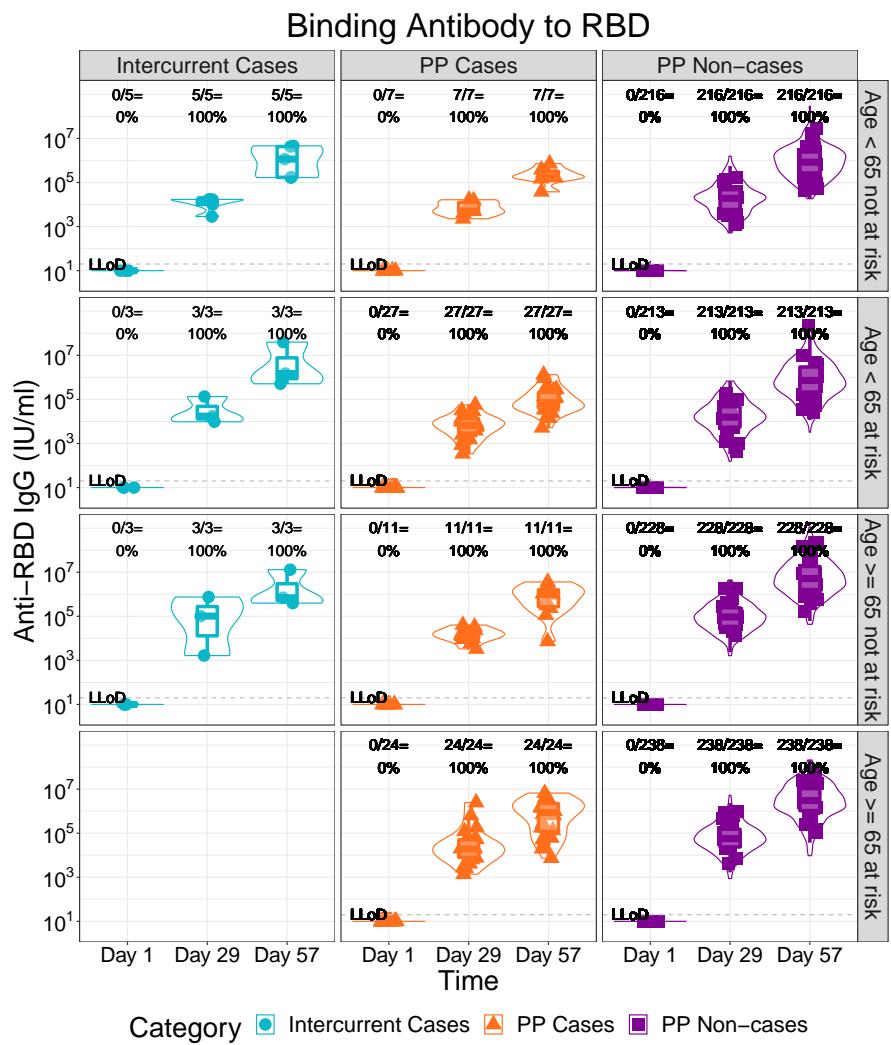


Figure 1.150: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints)

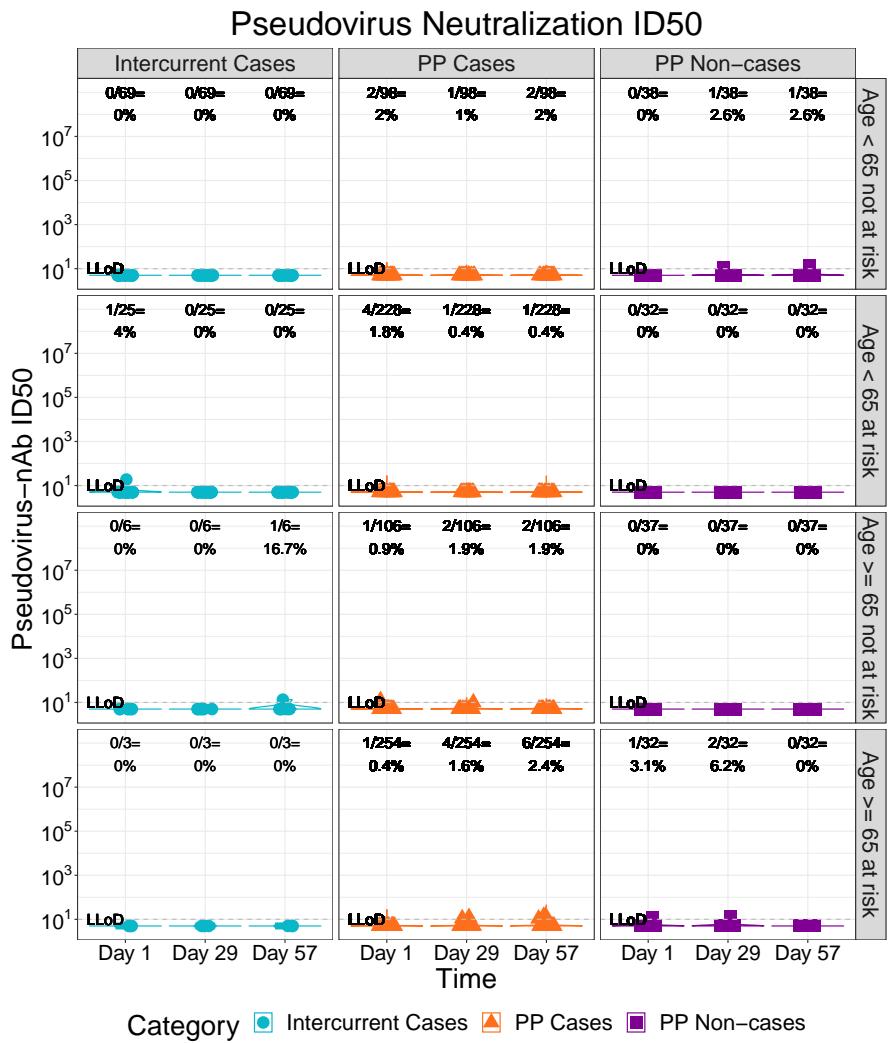


Figure 1.151: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints)

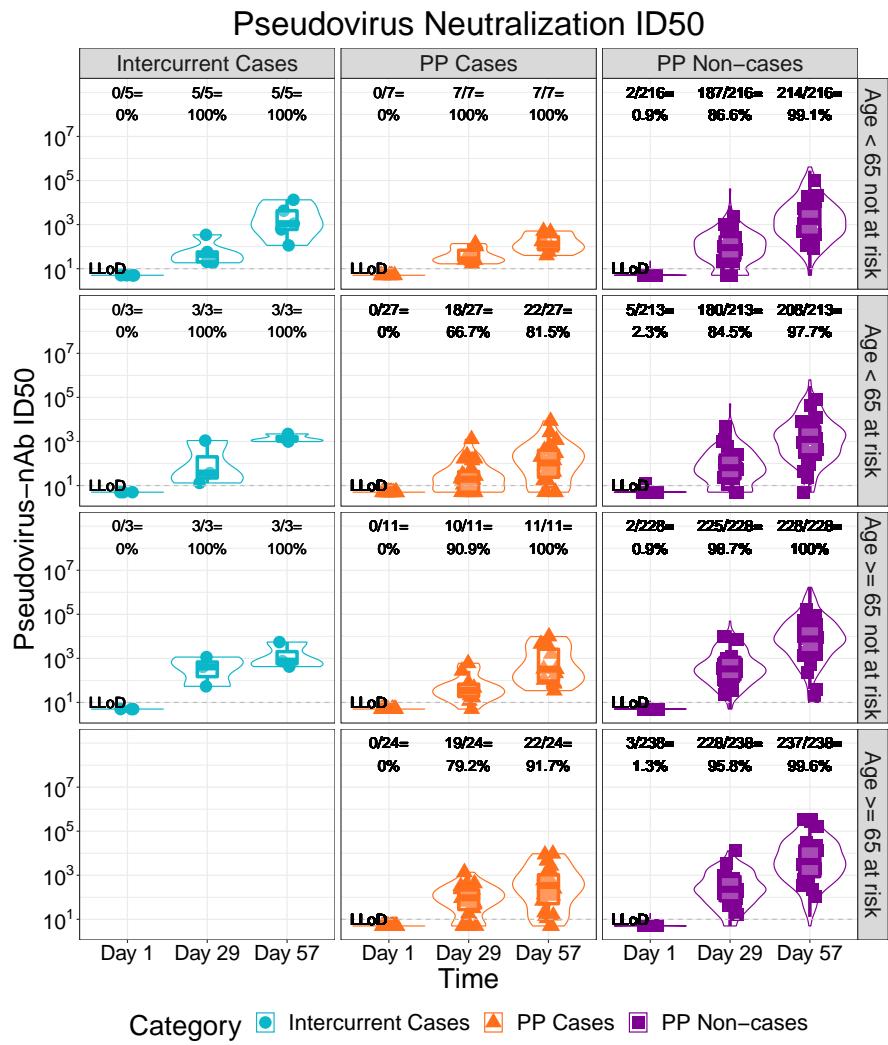


Figure 1.152: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints)

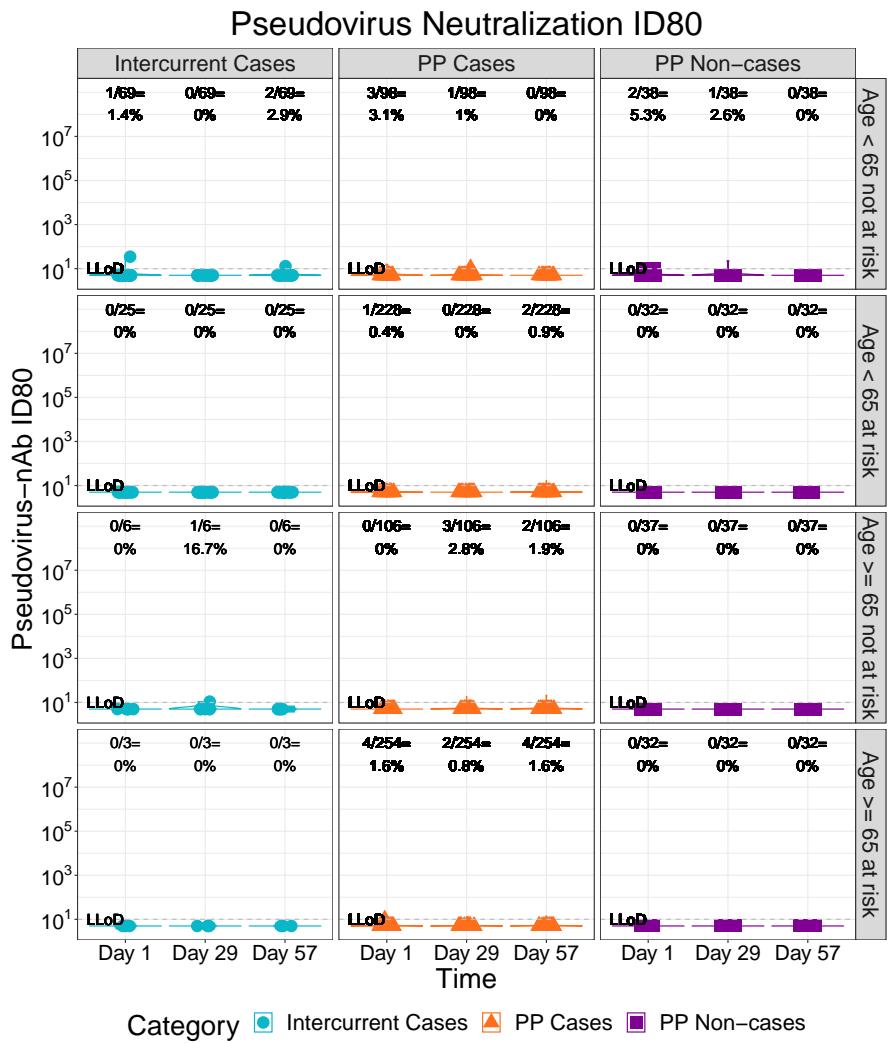


Figure 1.153: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints)

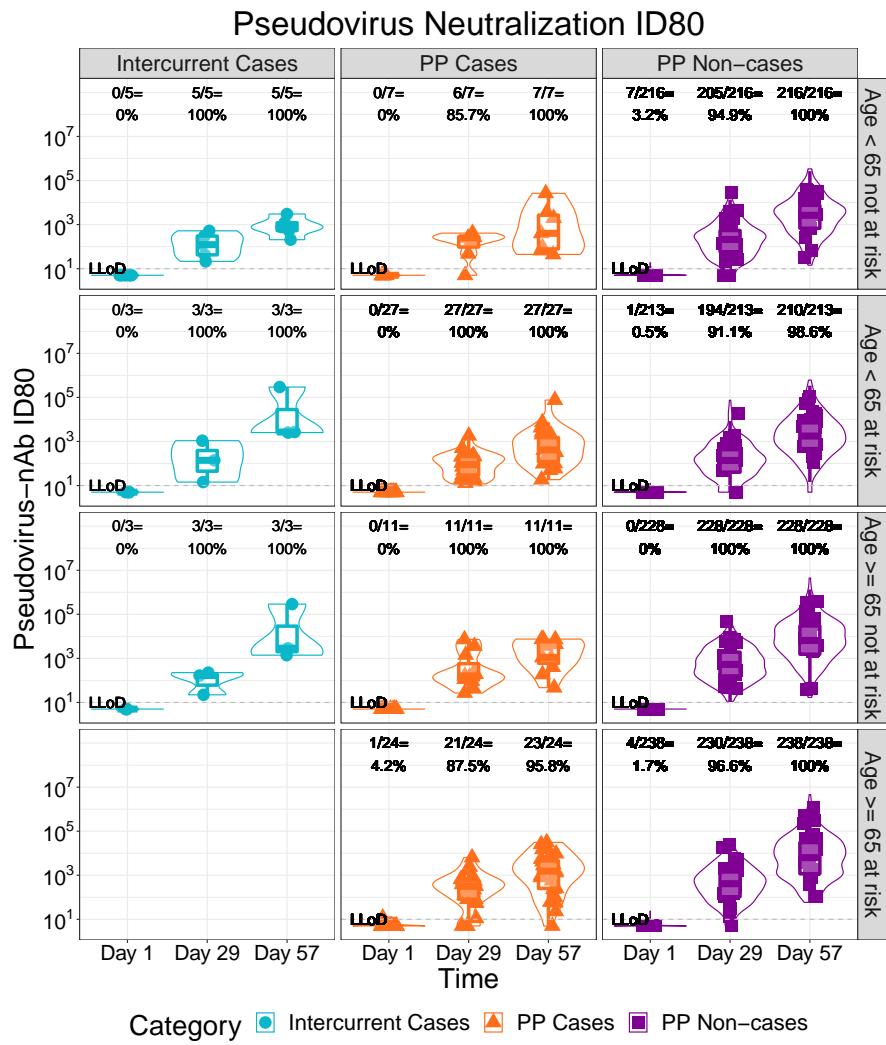


Figure 1.154: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints)

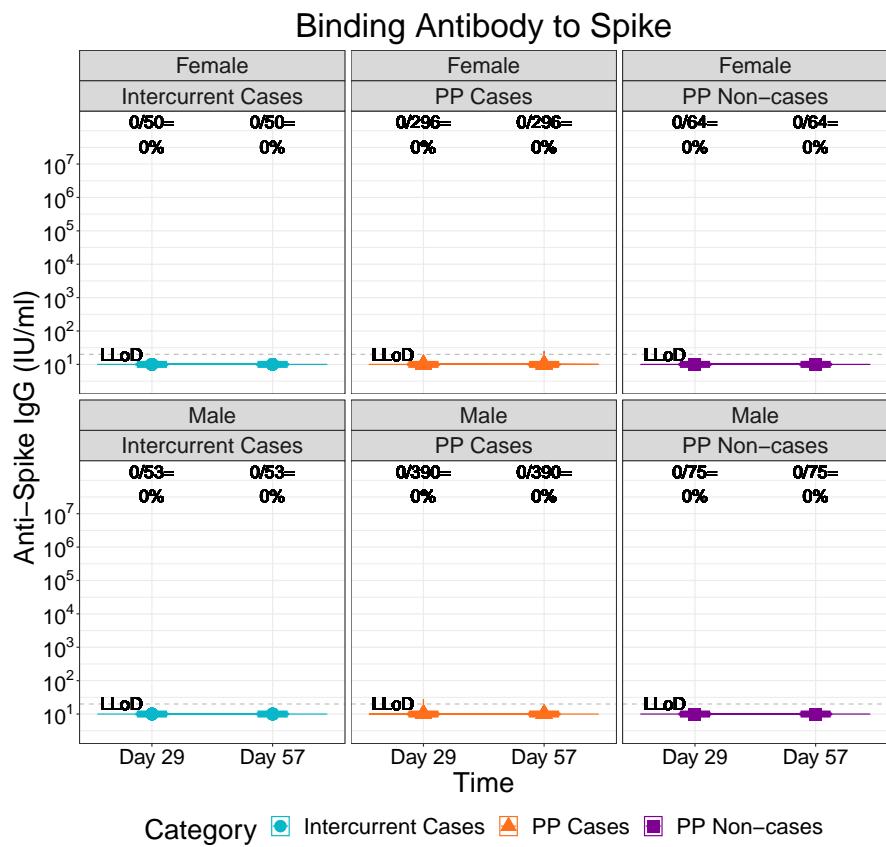


Figure 1.155: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints)

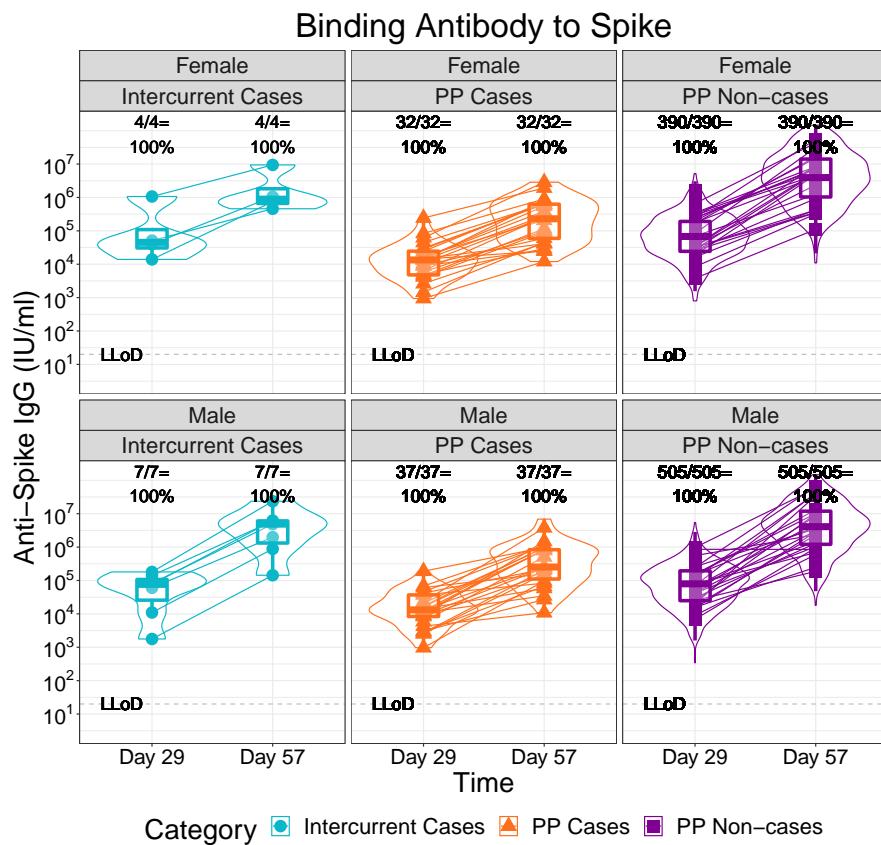


Figure 1.156: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

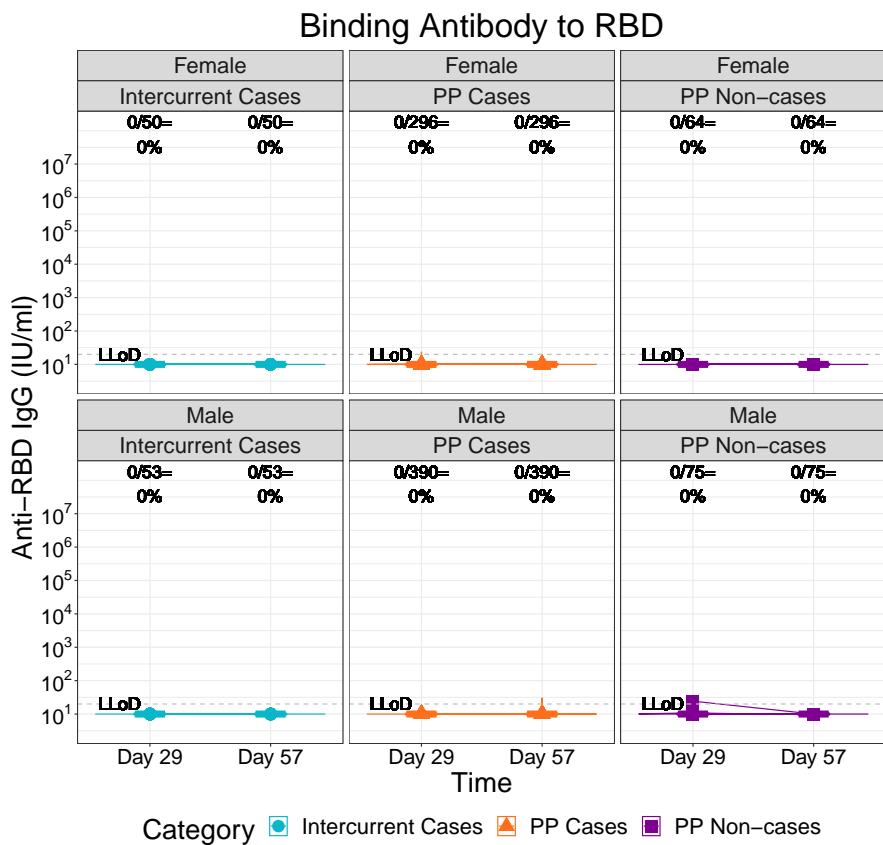


Figure 1.157: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints)

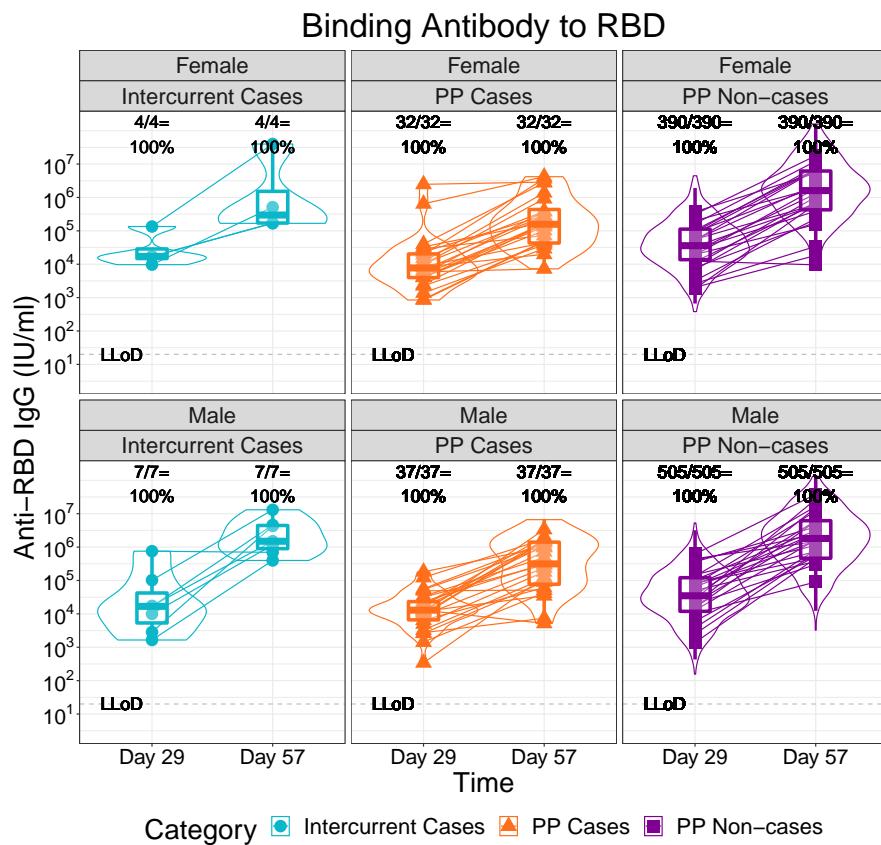


Figure 1.158: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

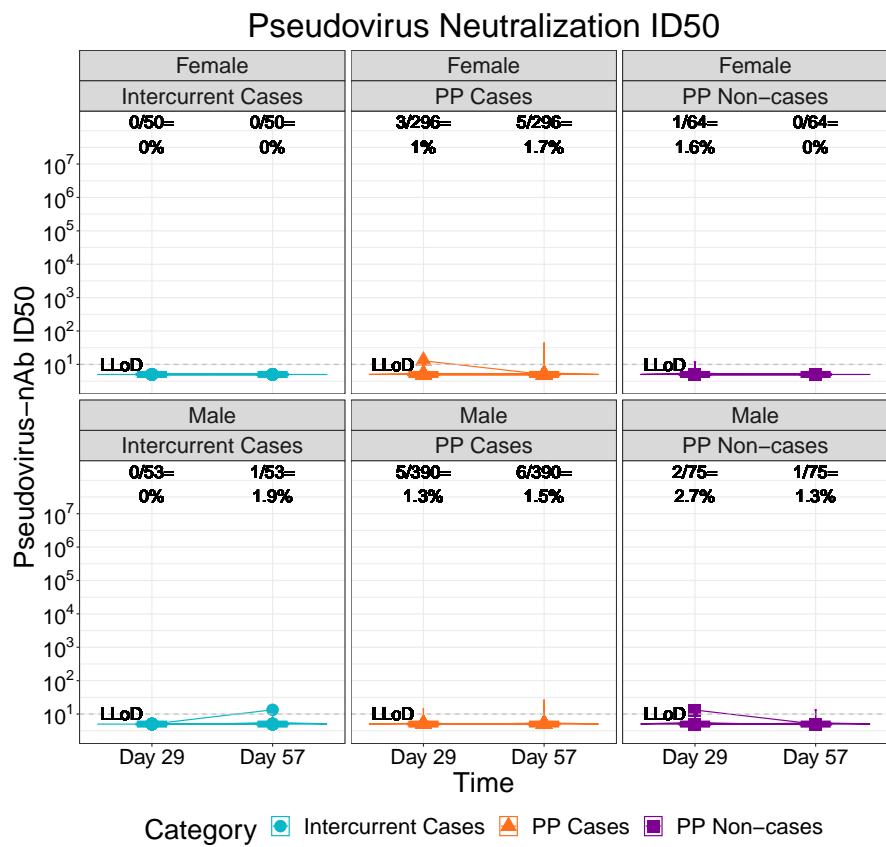


Figure 1.159: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints)

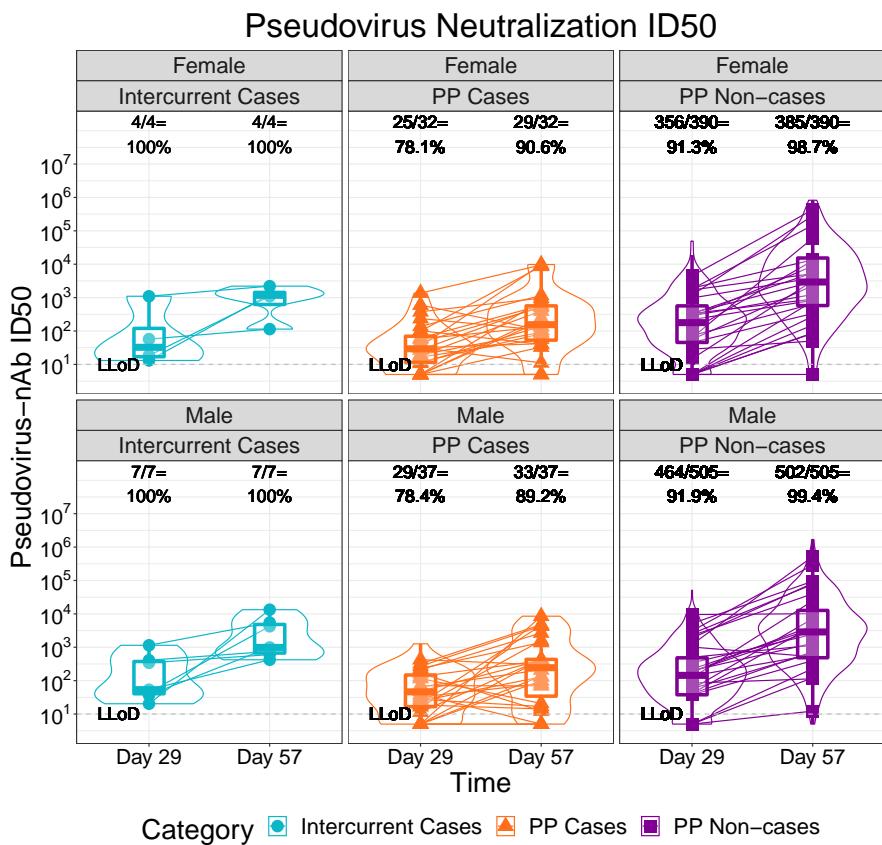


Figure 1.160: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

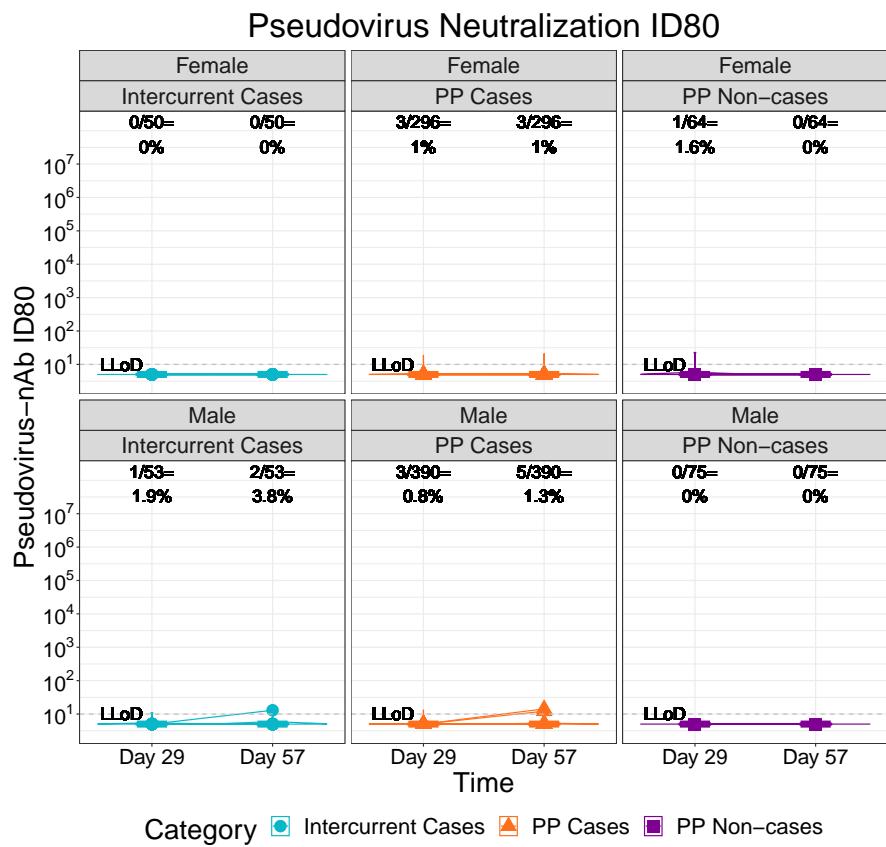


Figure 1.161: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints)

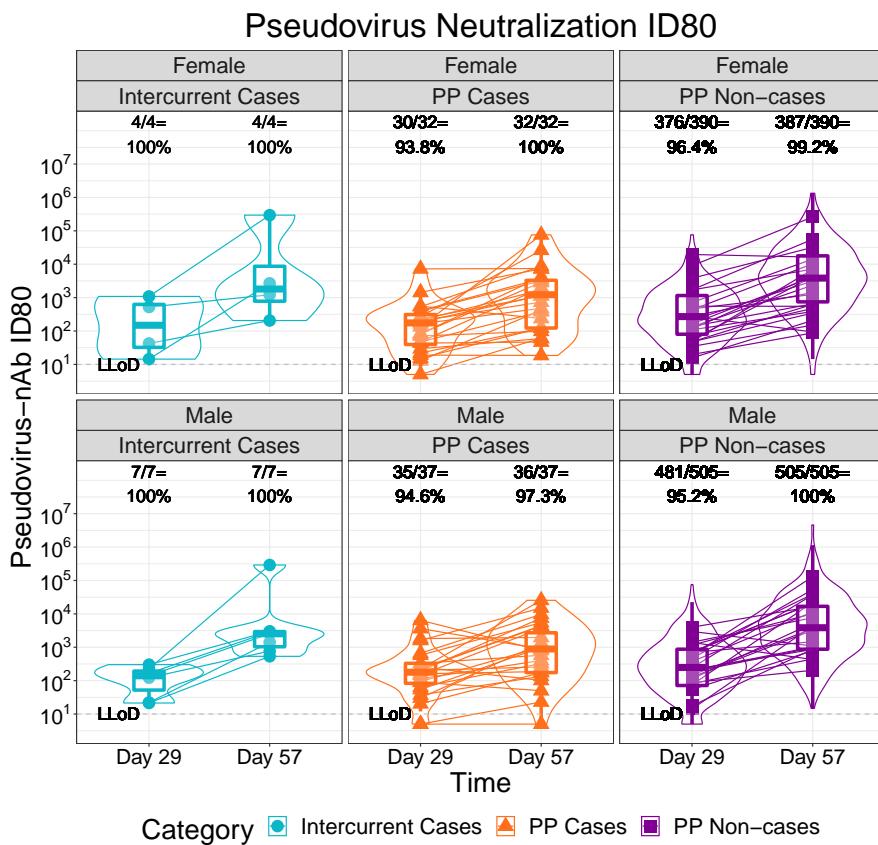


Figure 1.162: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

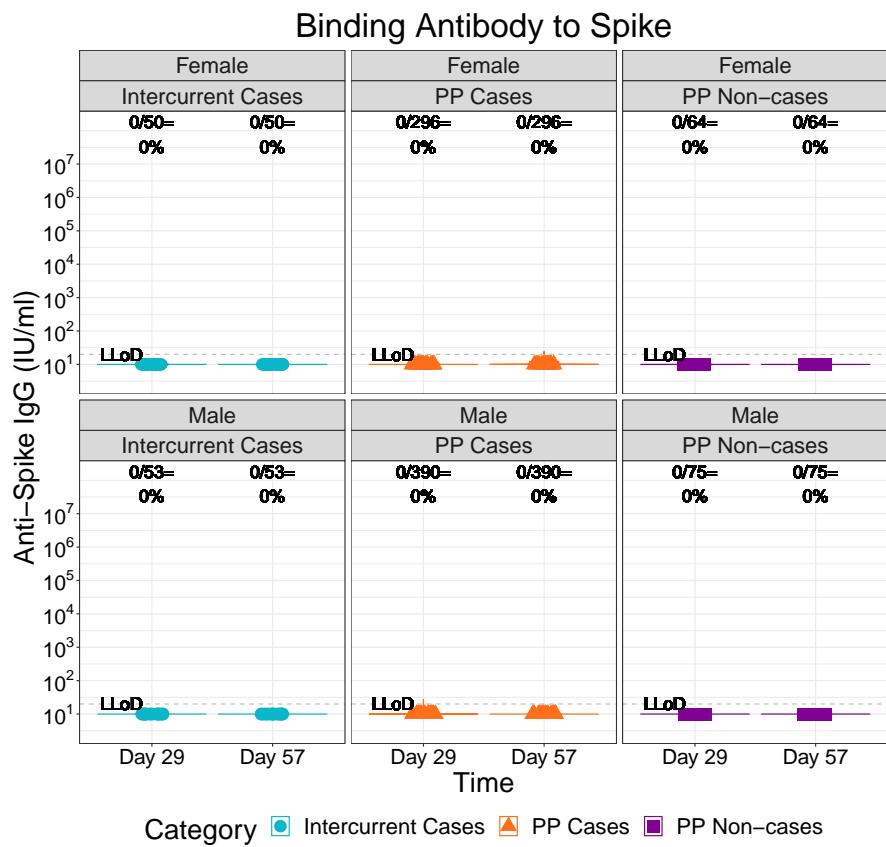


Figure 1.163: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints)

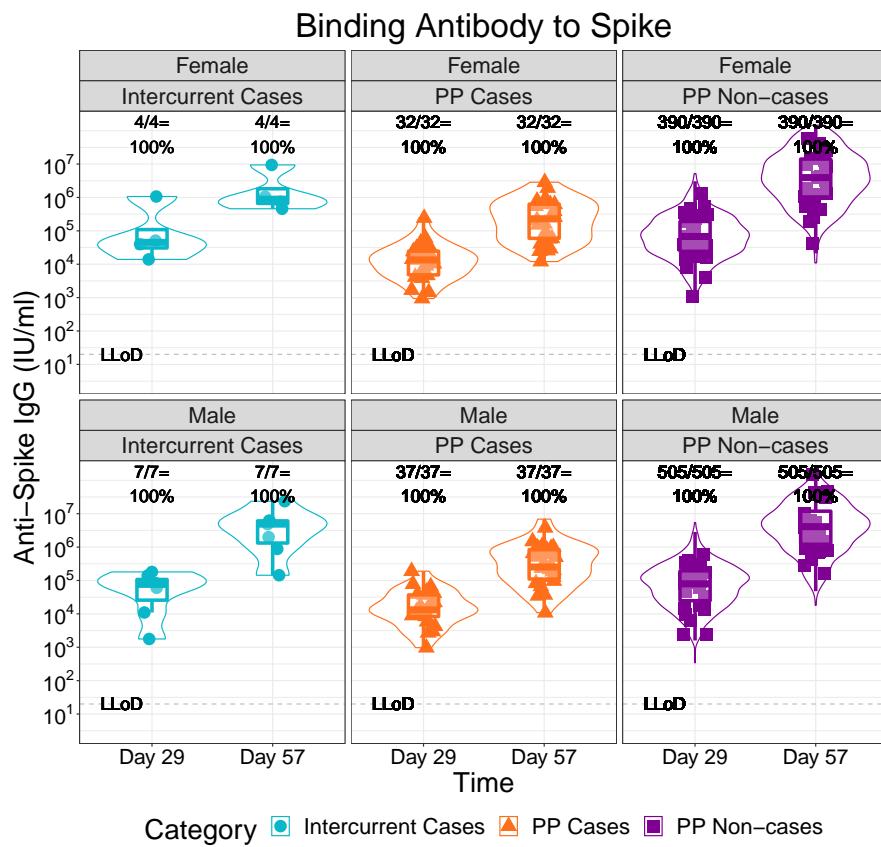


Figure 1.164: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

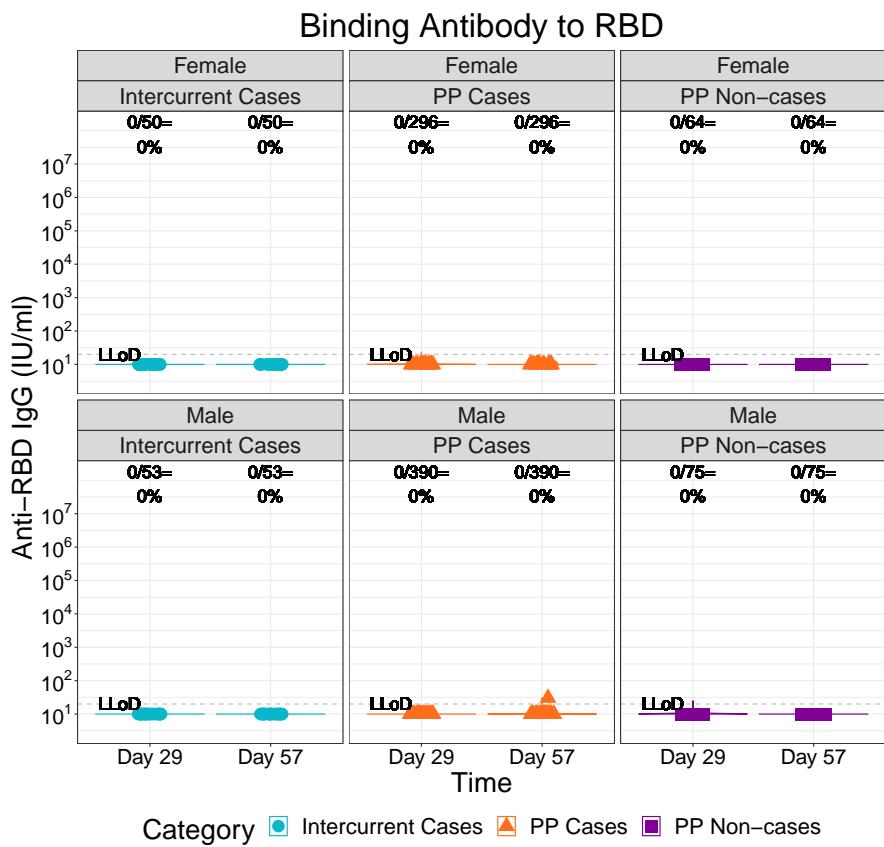


Figure 1.165: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints)

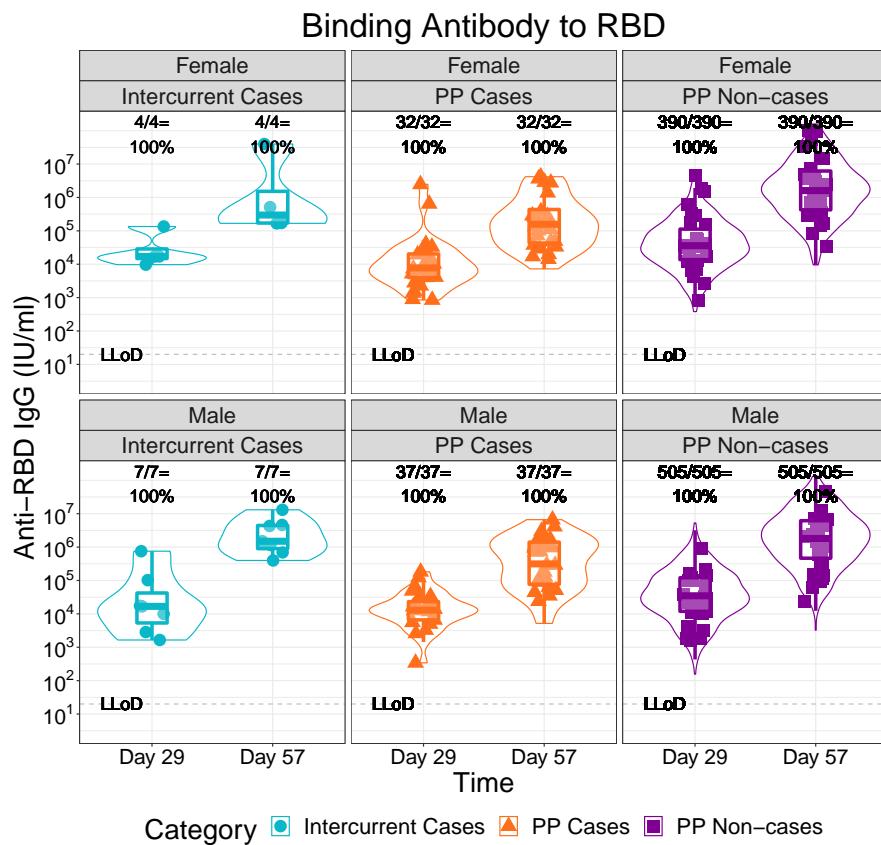


Figure 1.166: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

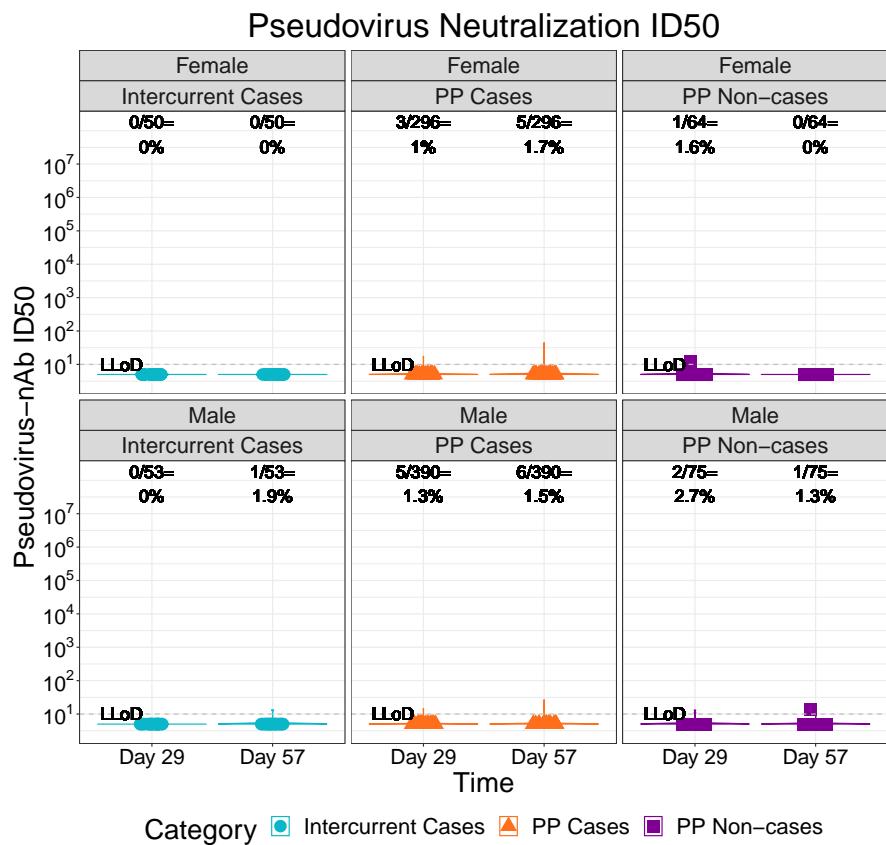


Figure 1.167: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints)

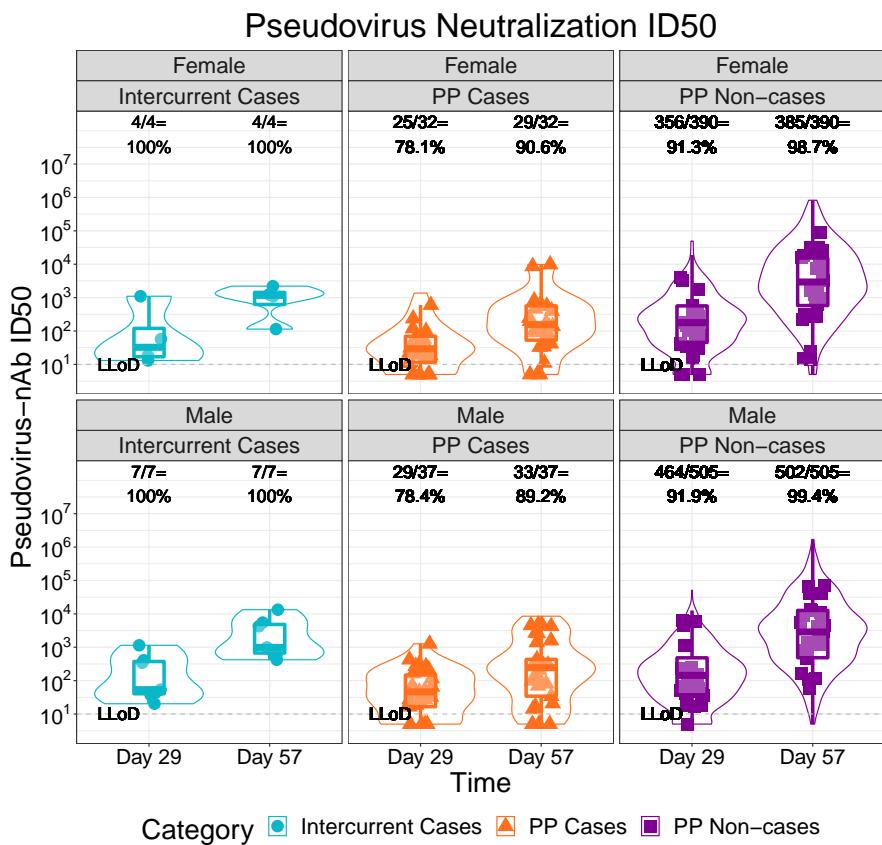


Figure 1.168: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

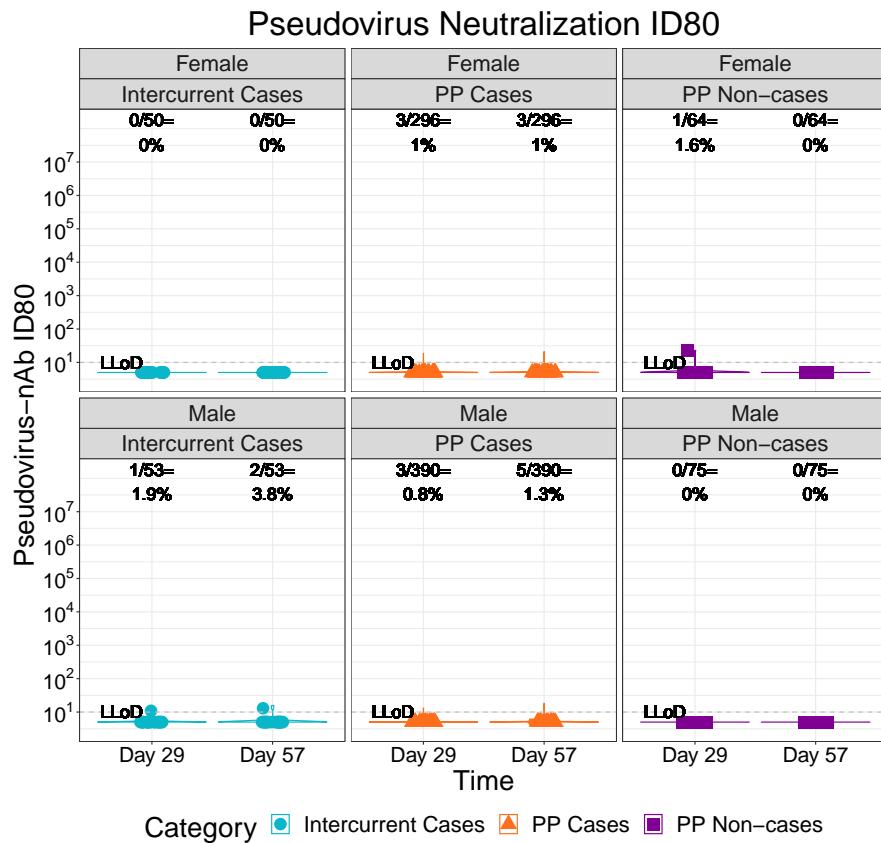


Figure 1.169: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints)

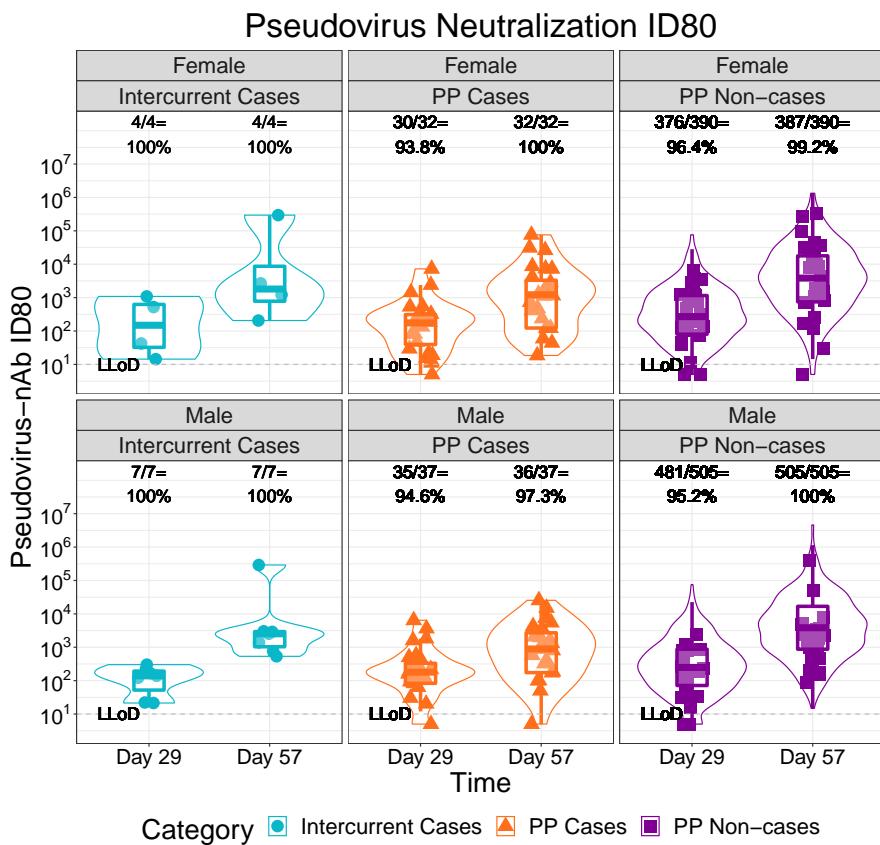


Figure 1.170: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

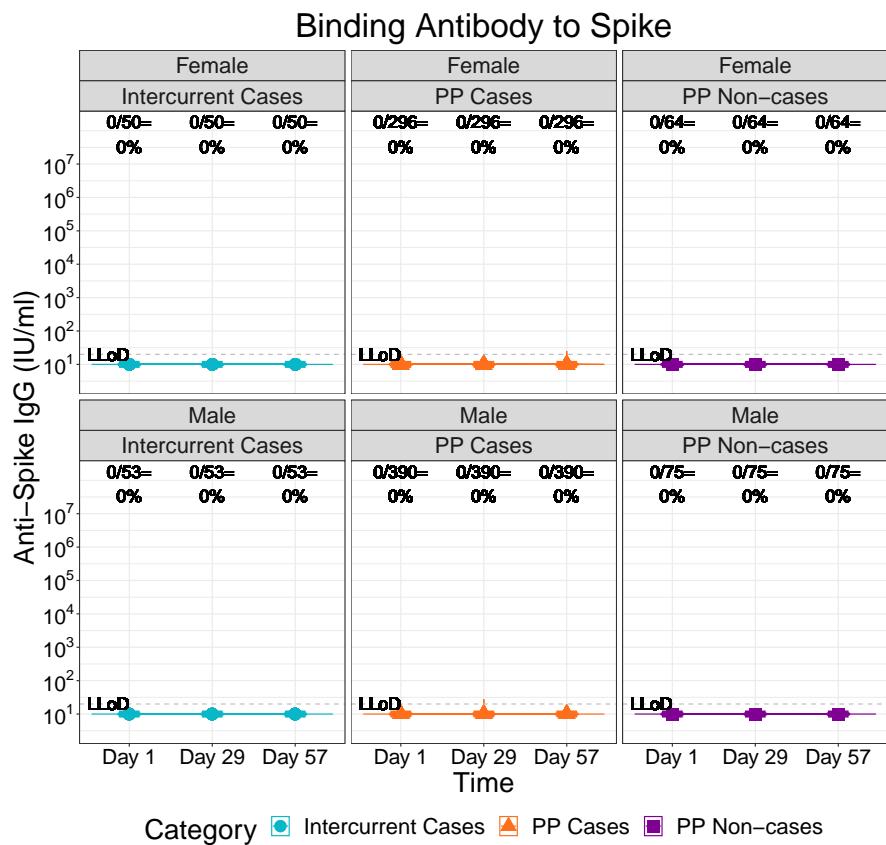


Figure 1.171: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints)

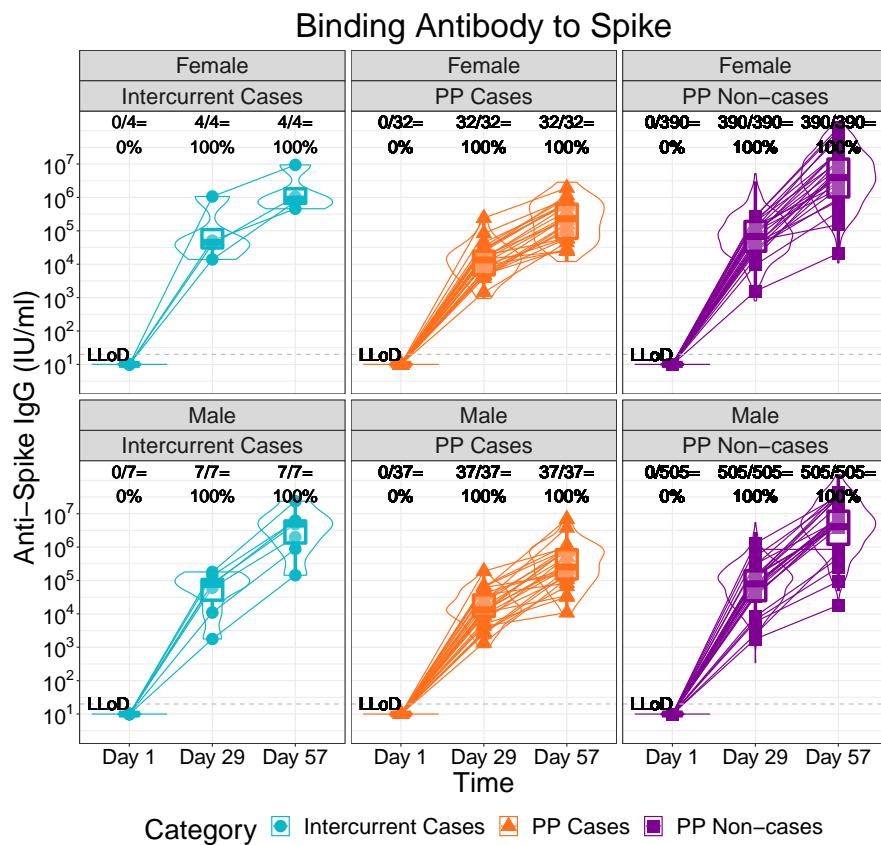


Figure 1.172: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

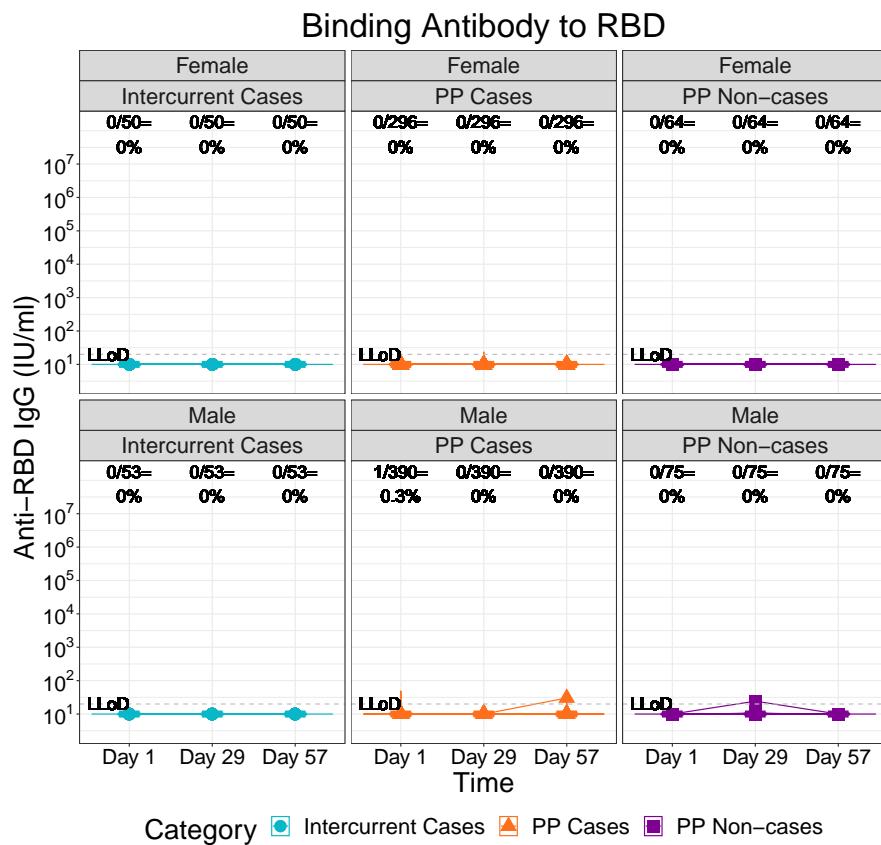


Figure 1.173: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints)

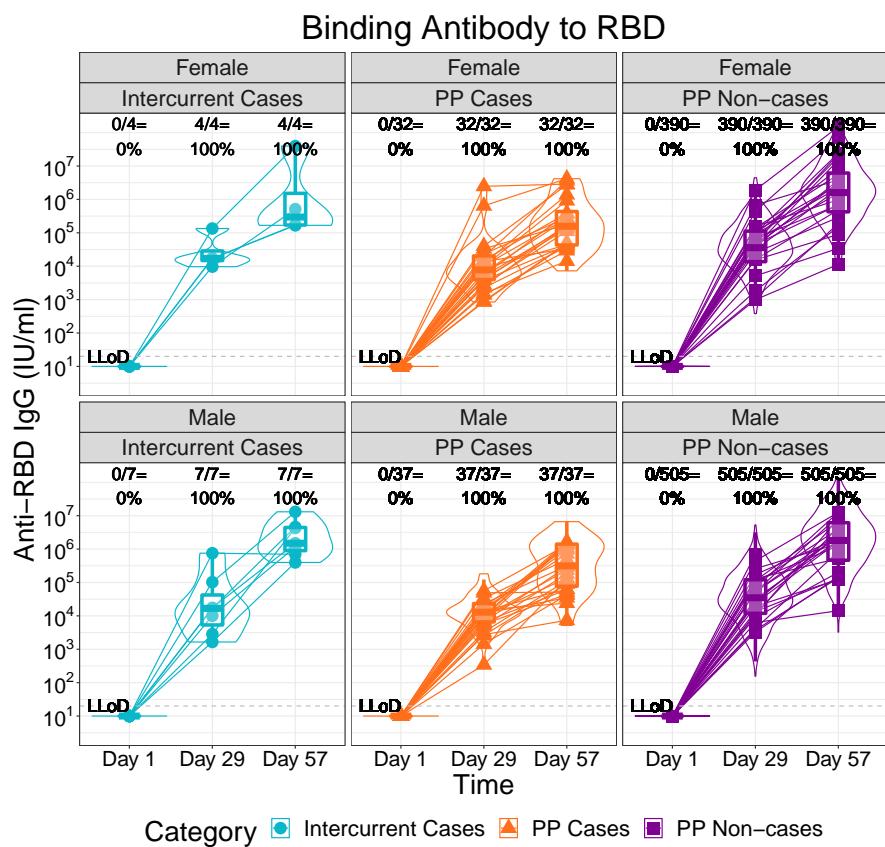


Figure 1.174: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

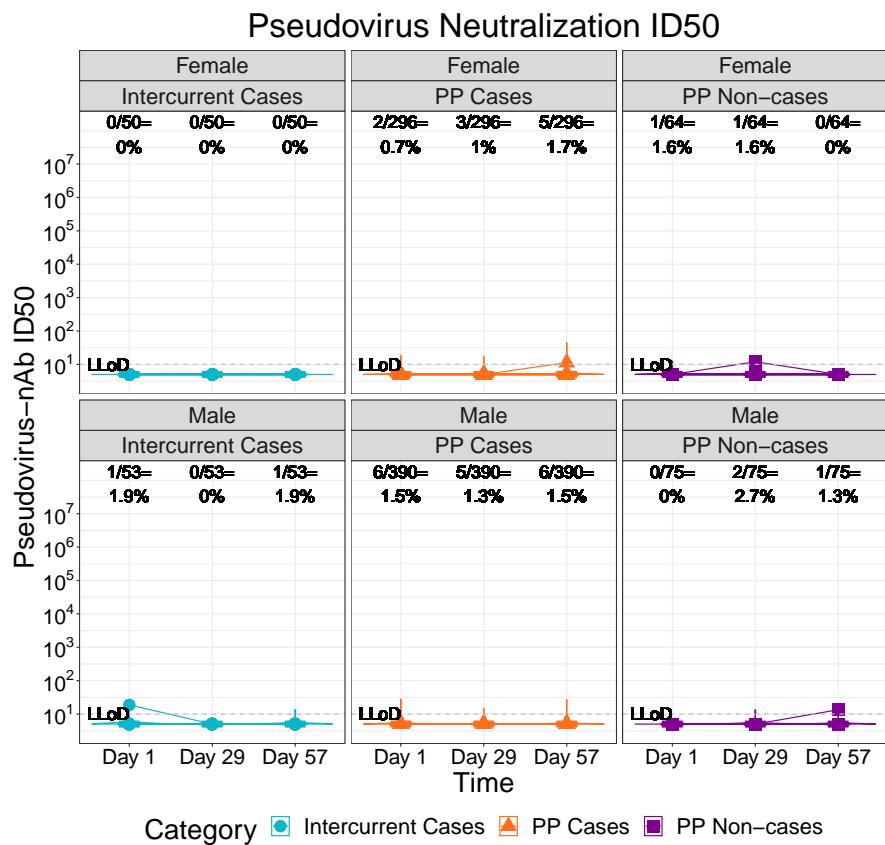


Figure 1.175: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints)

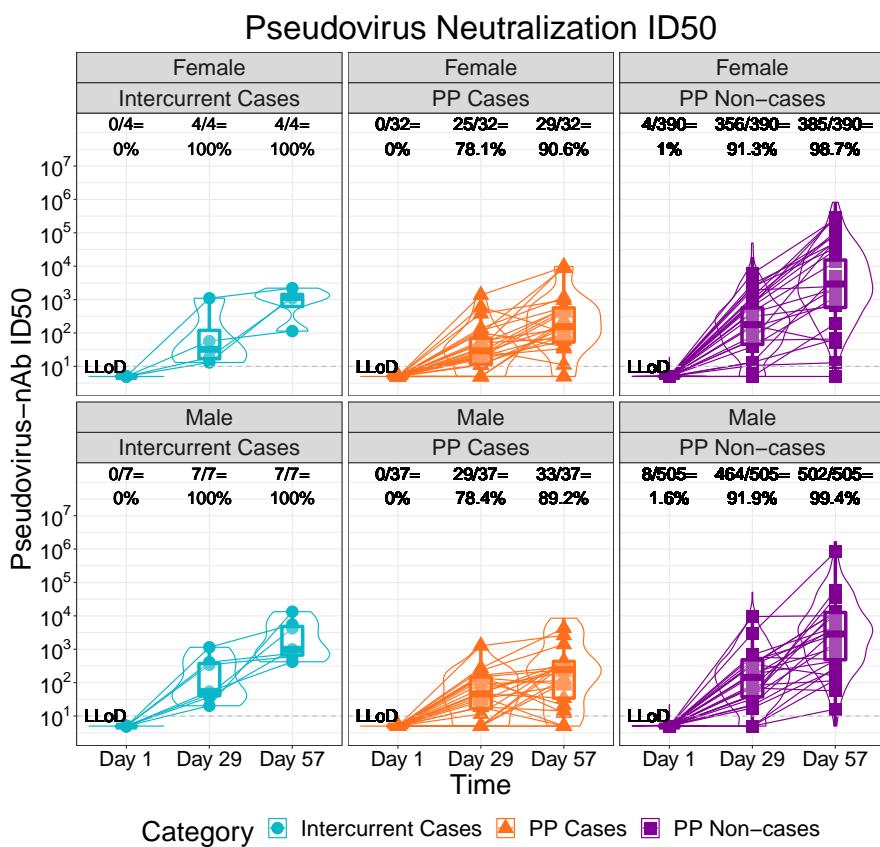


Figure 1.176: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

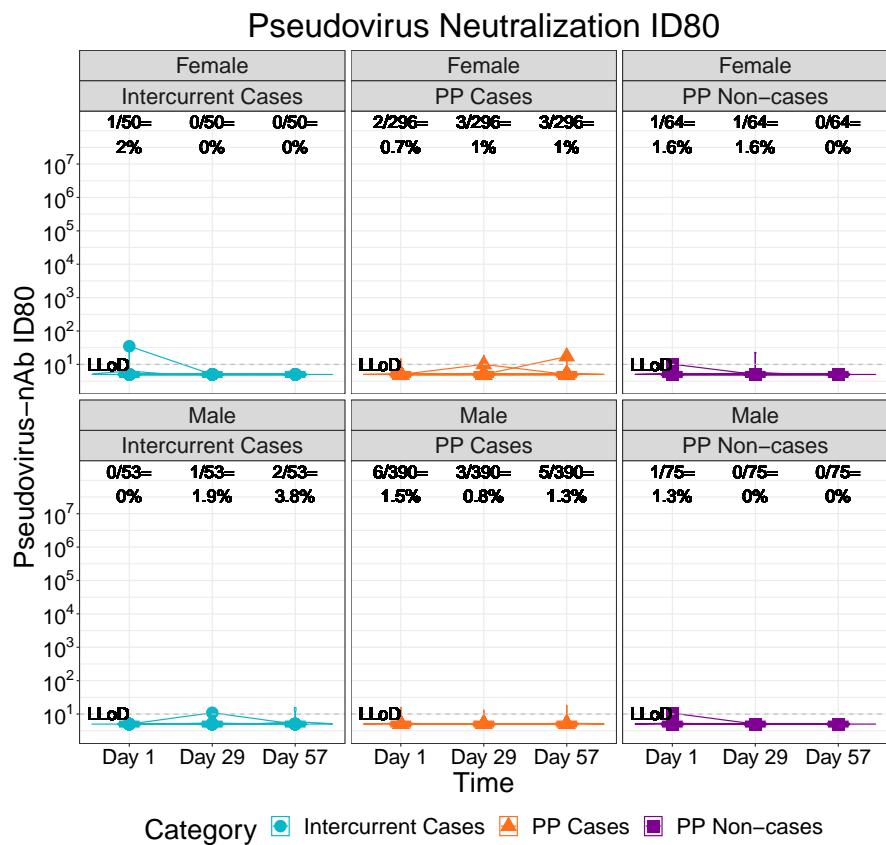


Figure 1.177: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints)

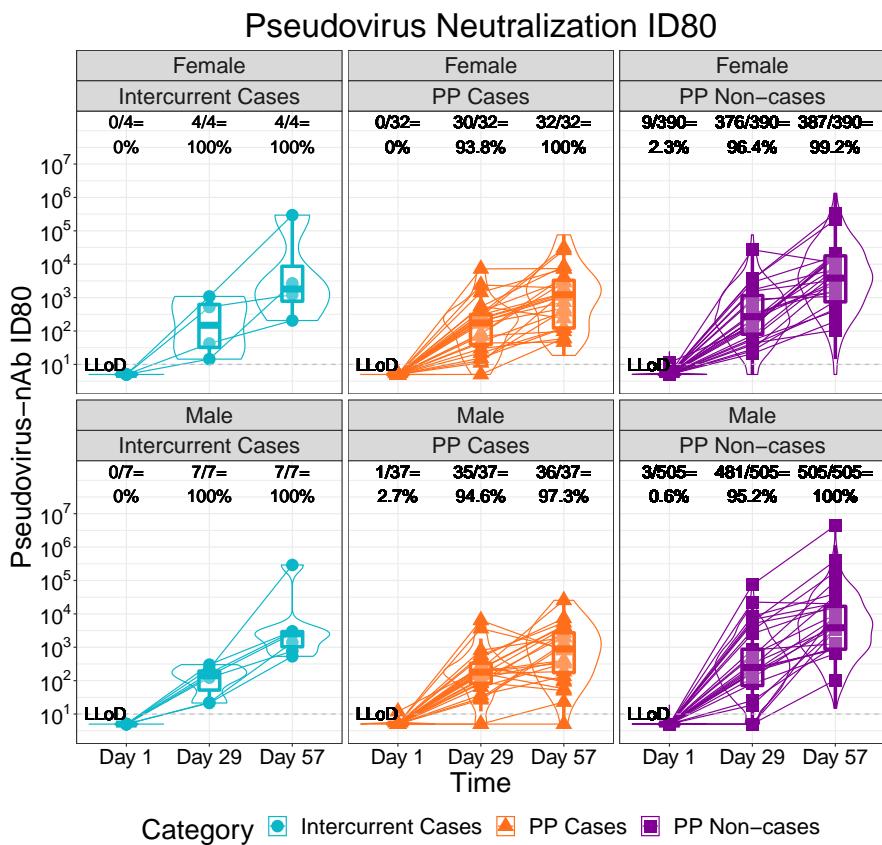


Figure 1.178: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

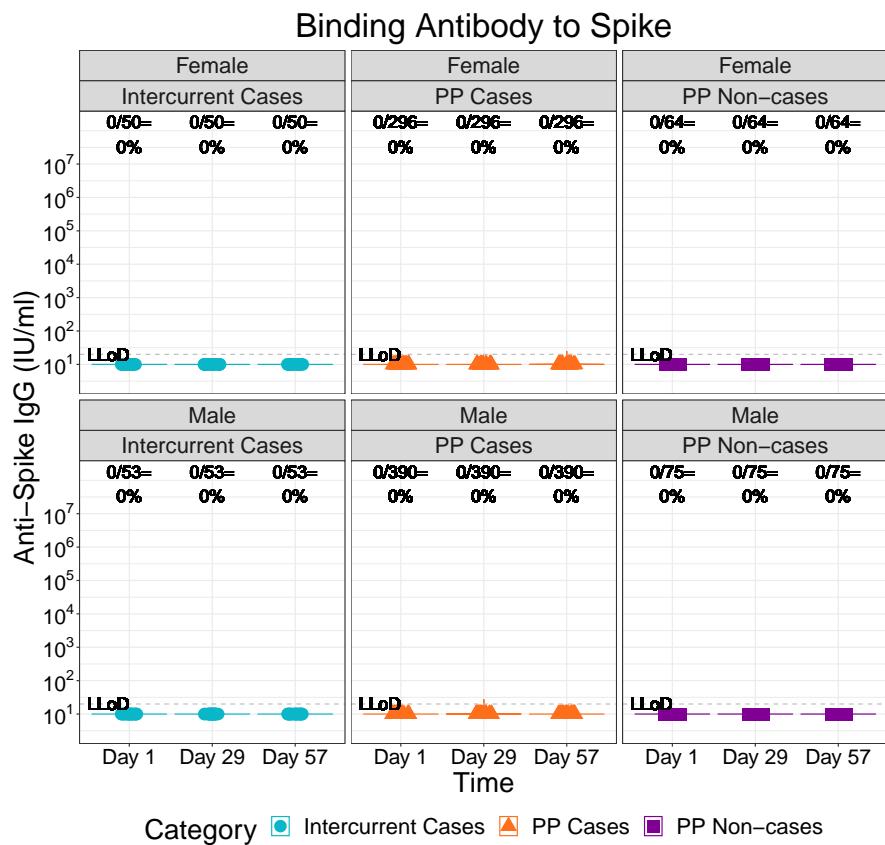


Figure 1.179: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints)

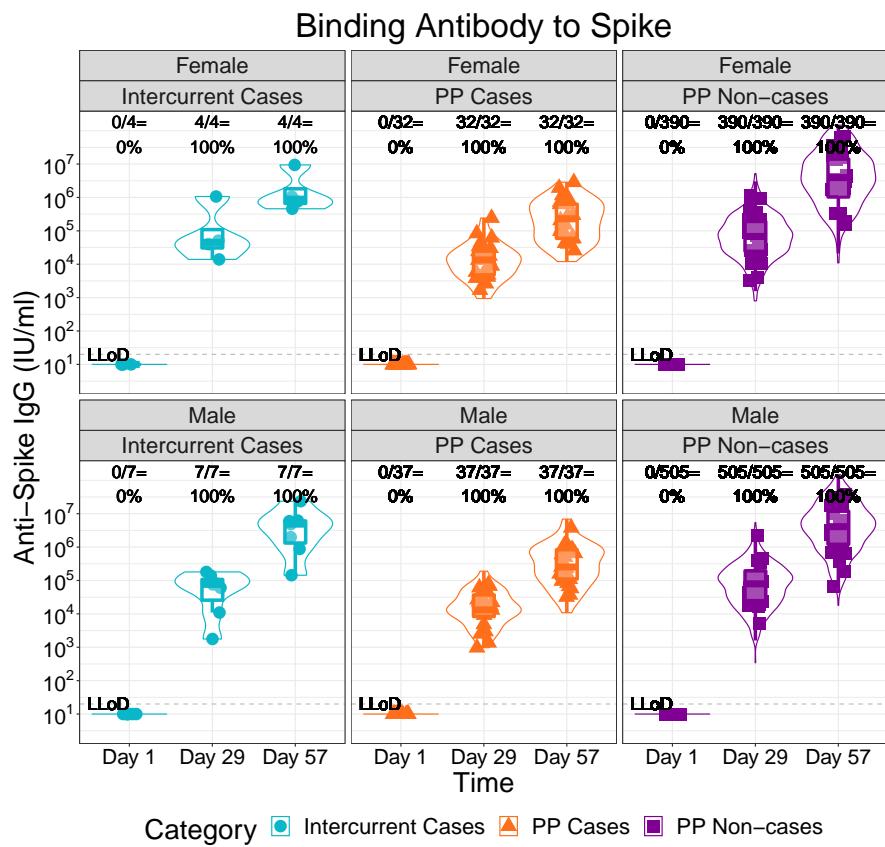


Figure 1.180: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

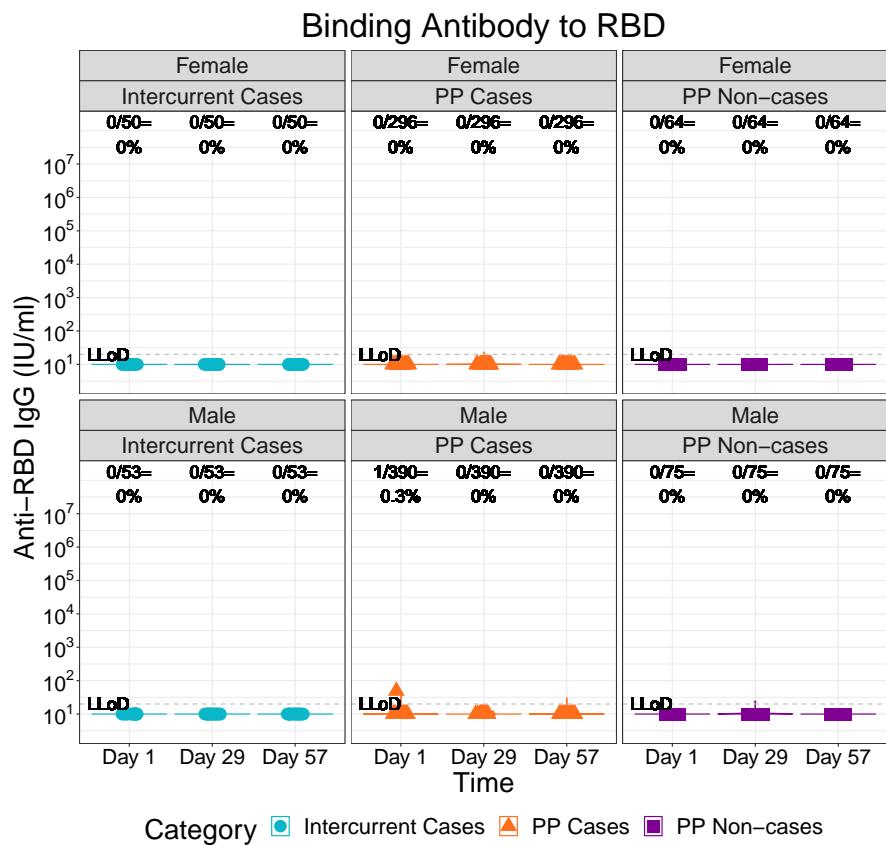


Figure 1.181: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints)

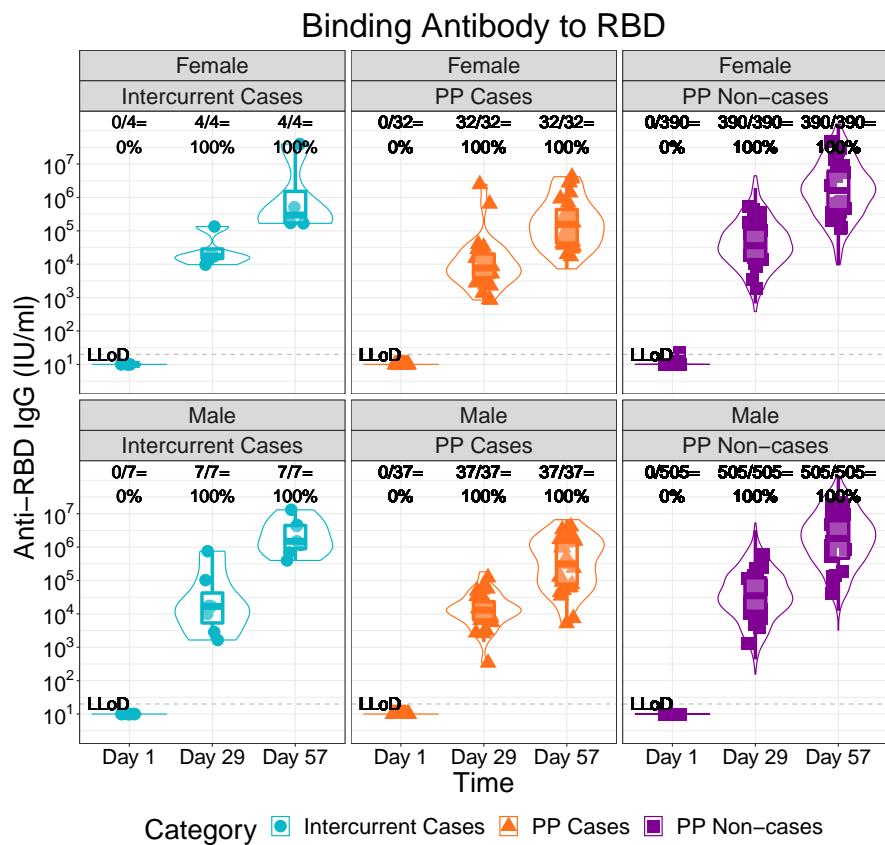


Figure 1.182: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

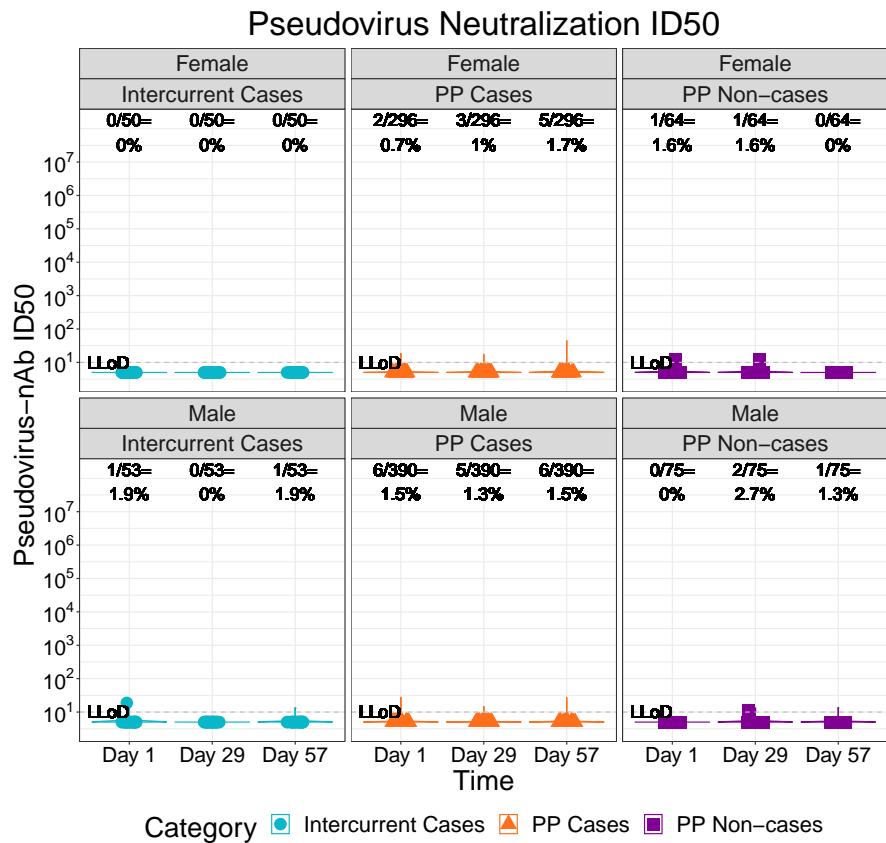


Figure 1.183: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints)

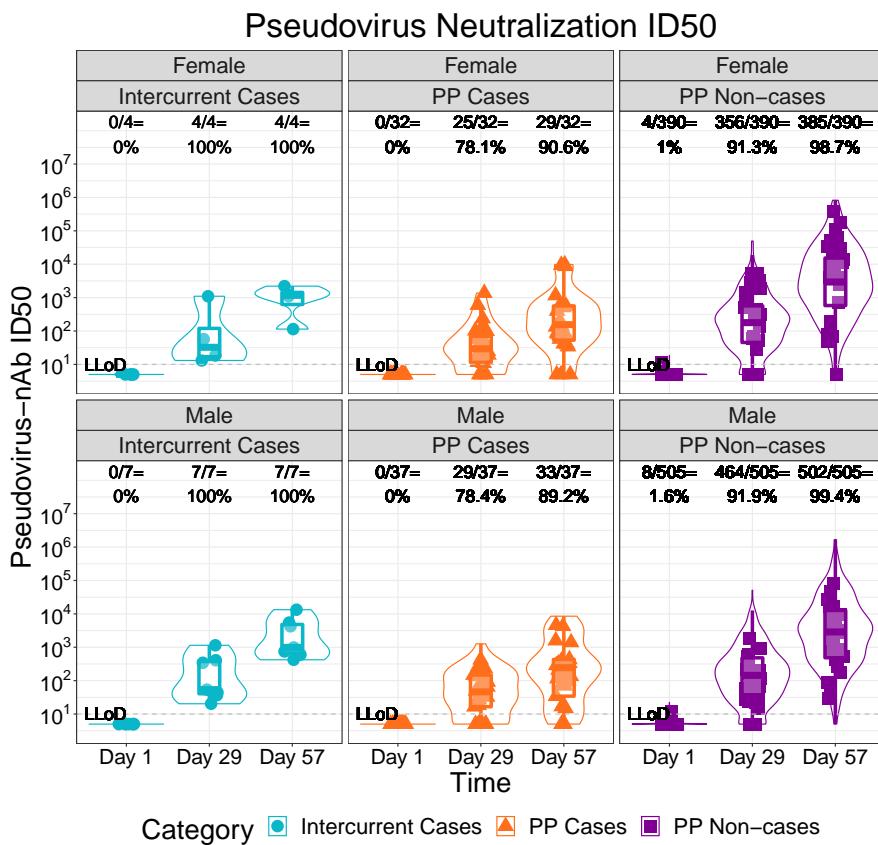


Figure 1.184: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

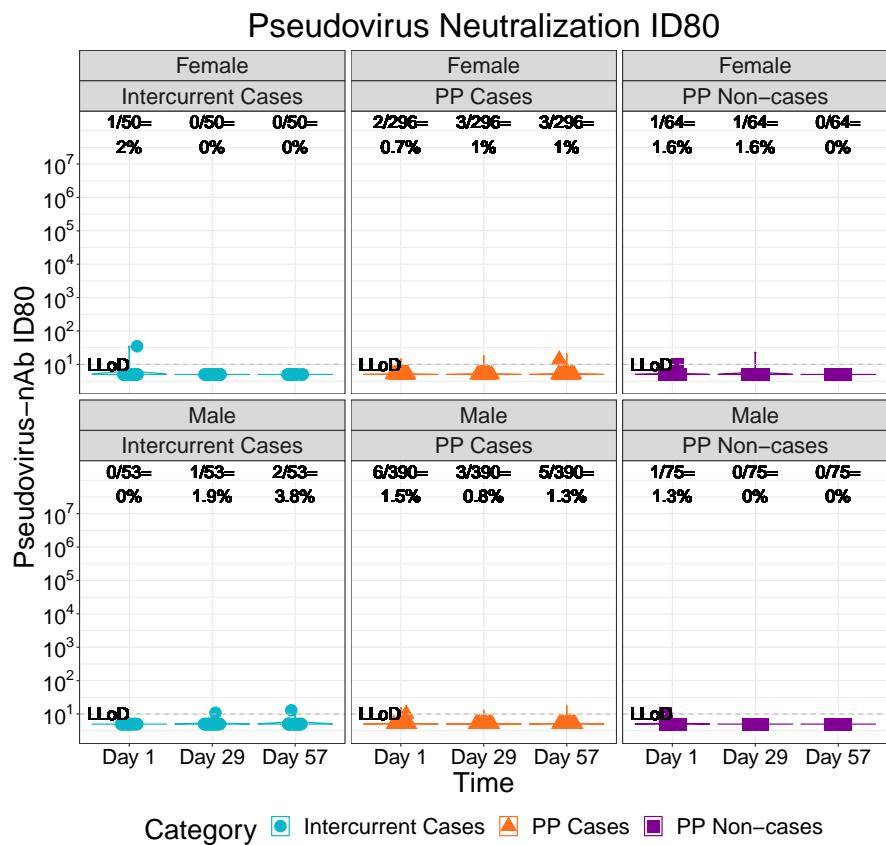


Figure 1.185: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints)

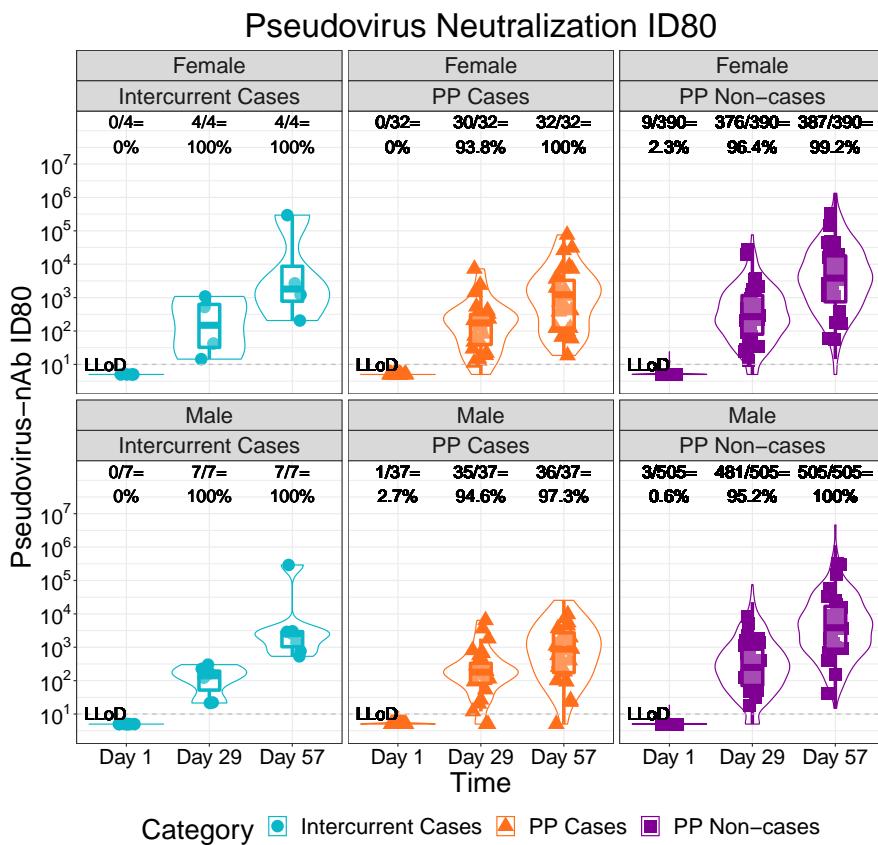


Figure 1.186: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

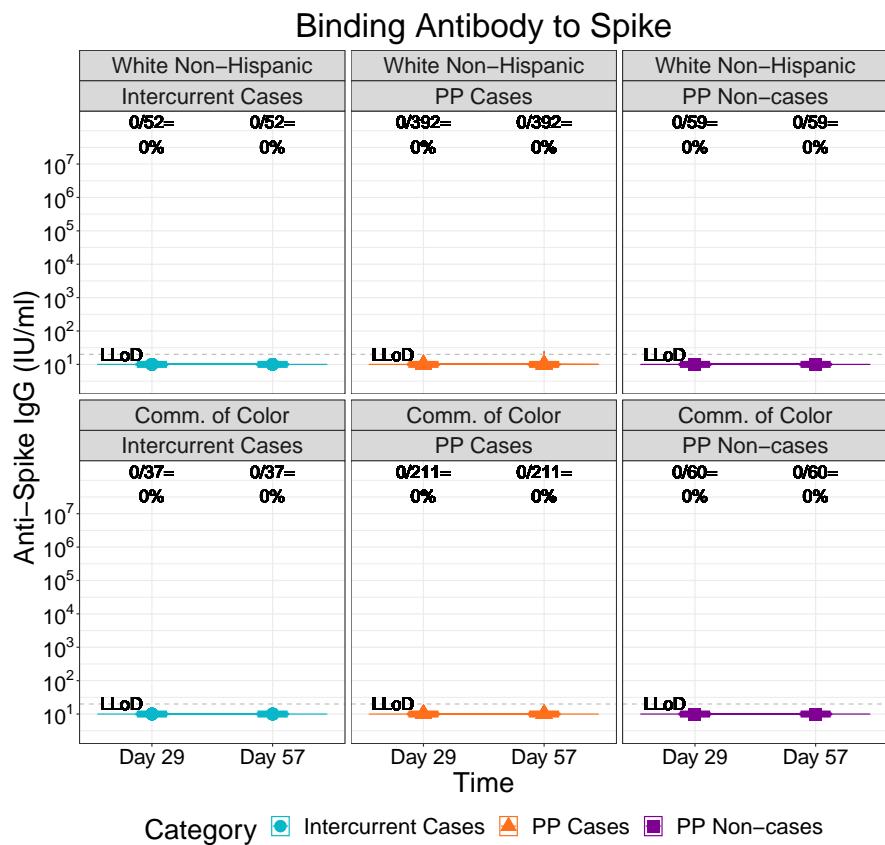


Figure 1.187: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints)

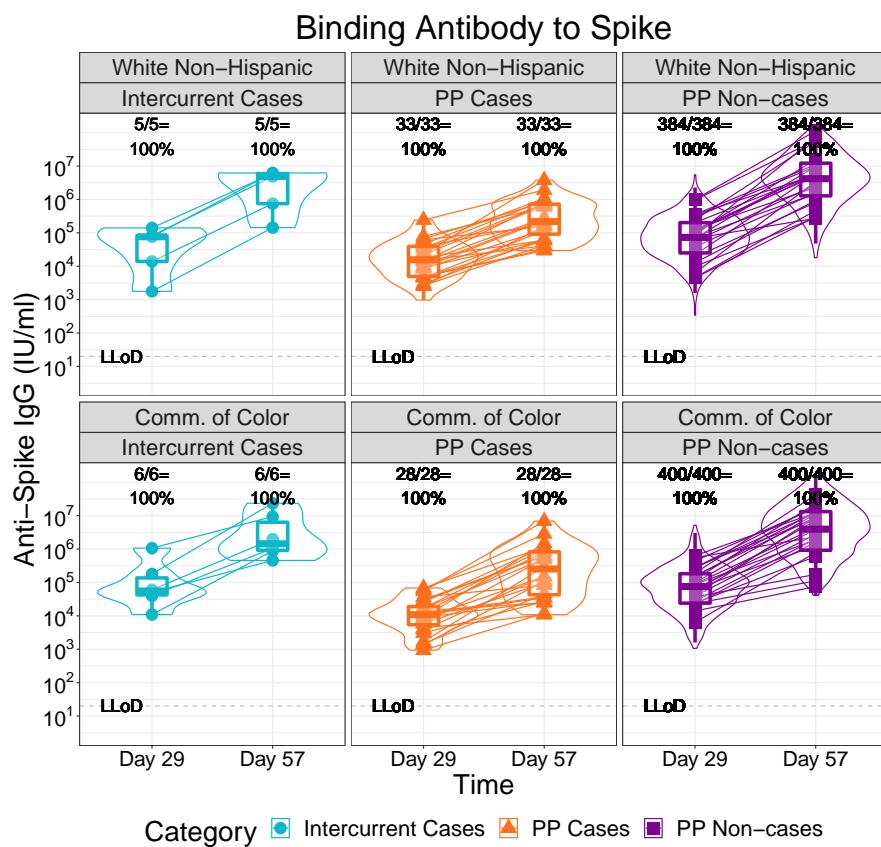


Figure 1.188: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints)

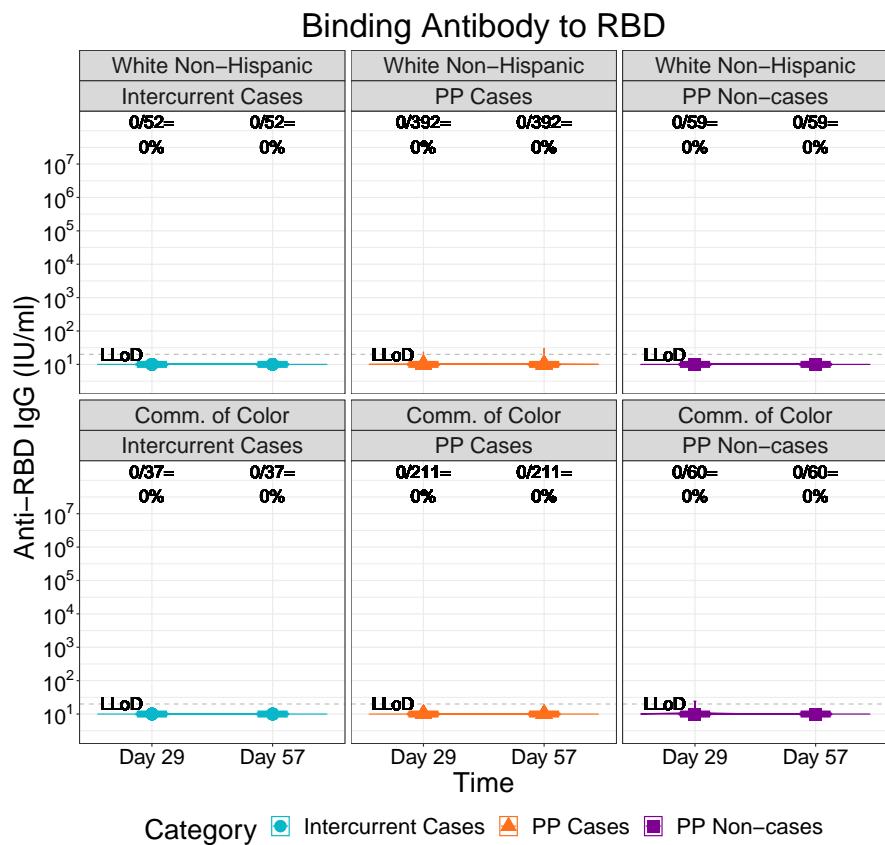


Figure 1.189: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints)

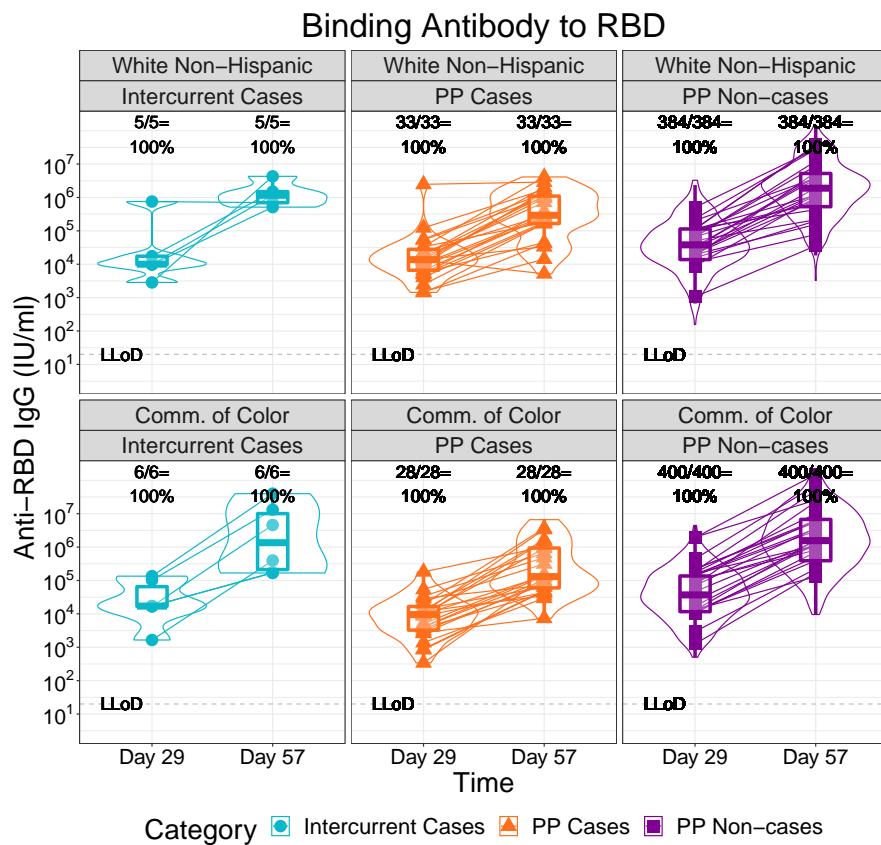


Figure 1.190: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints)

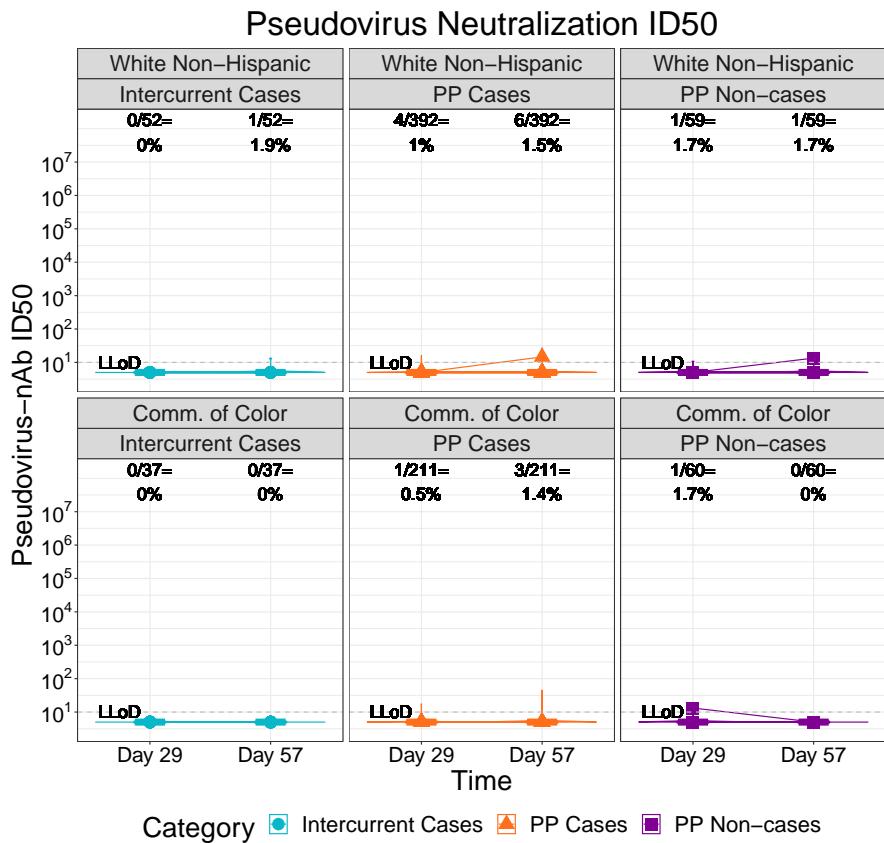


Figure 1.191: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints)

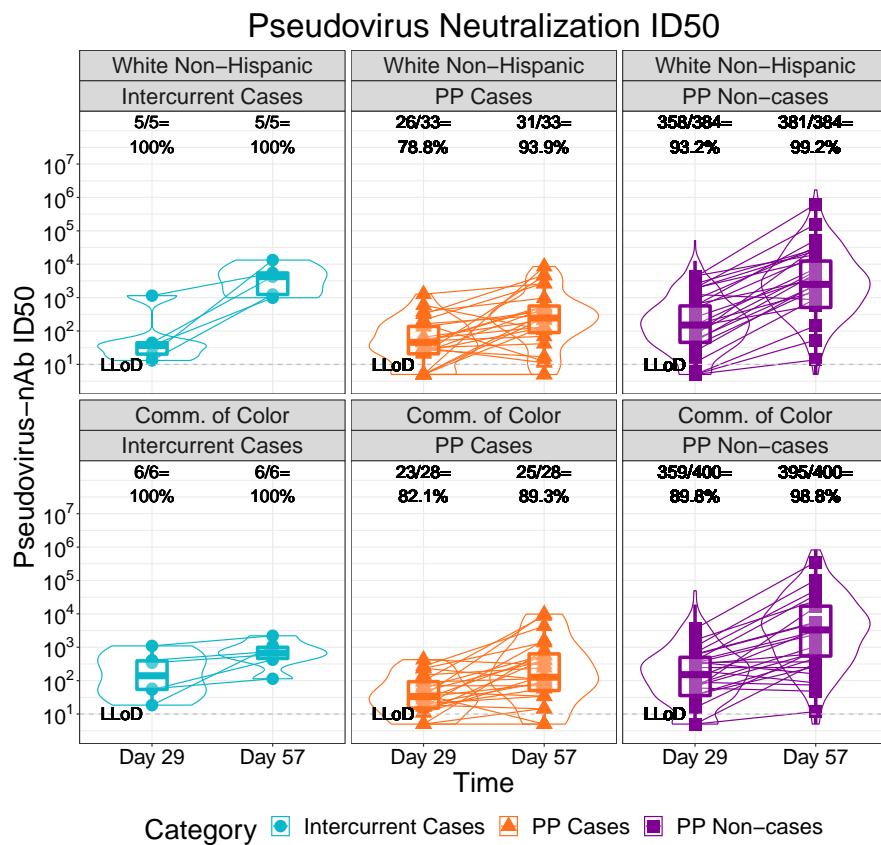


Figure 1.192: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints)

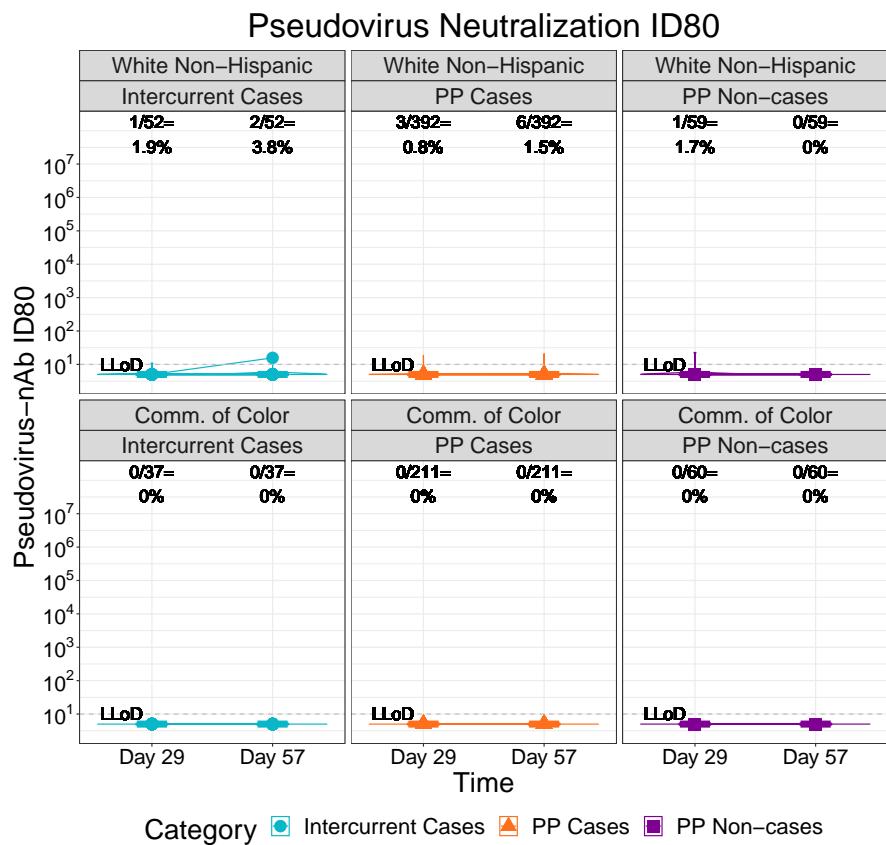


Figure 1.193: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints)

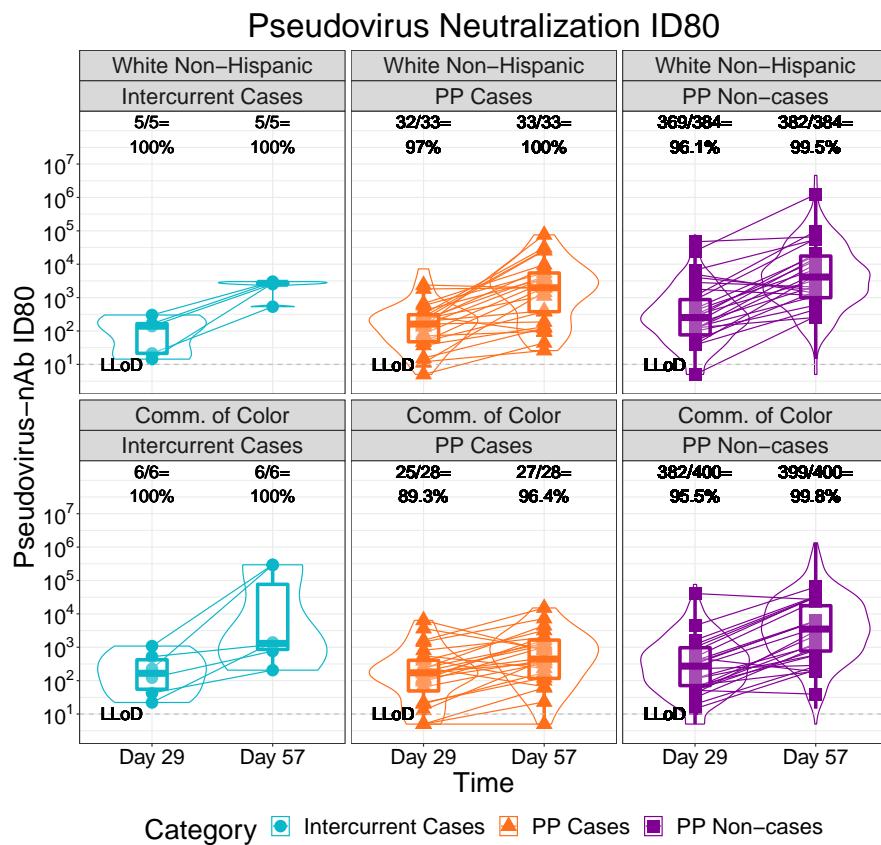


Figure 1.194: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints)

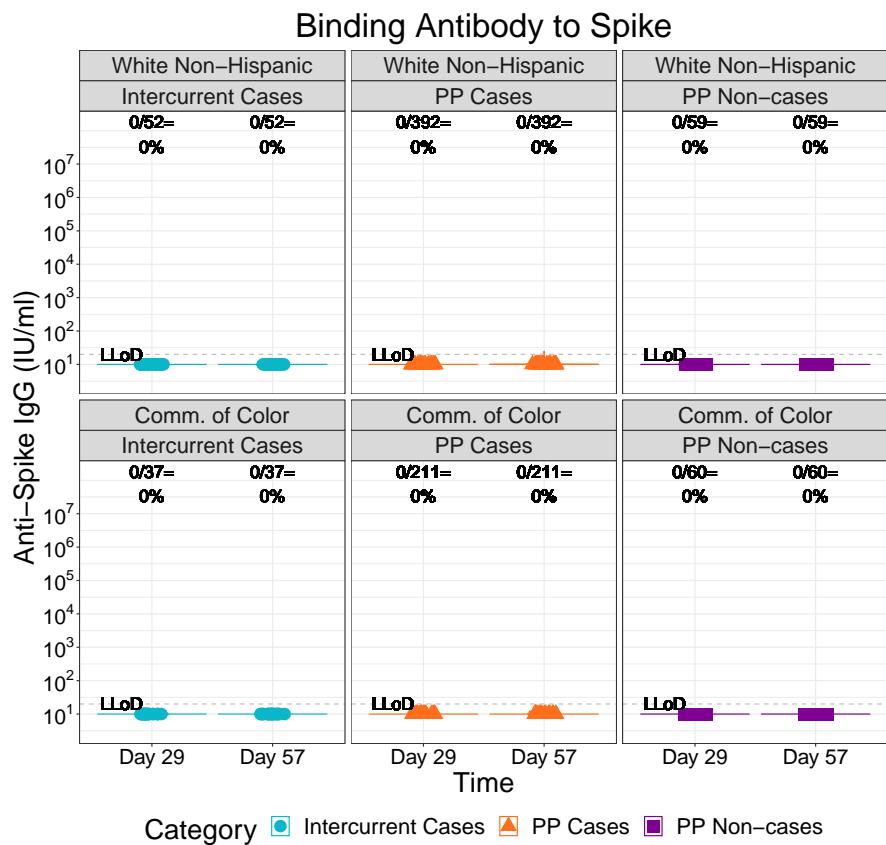


Figure 1.195: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints)

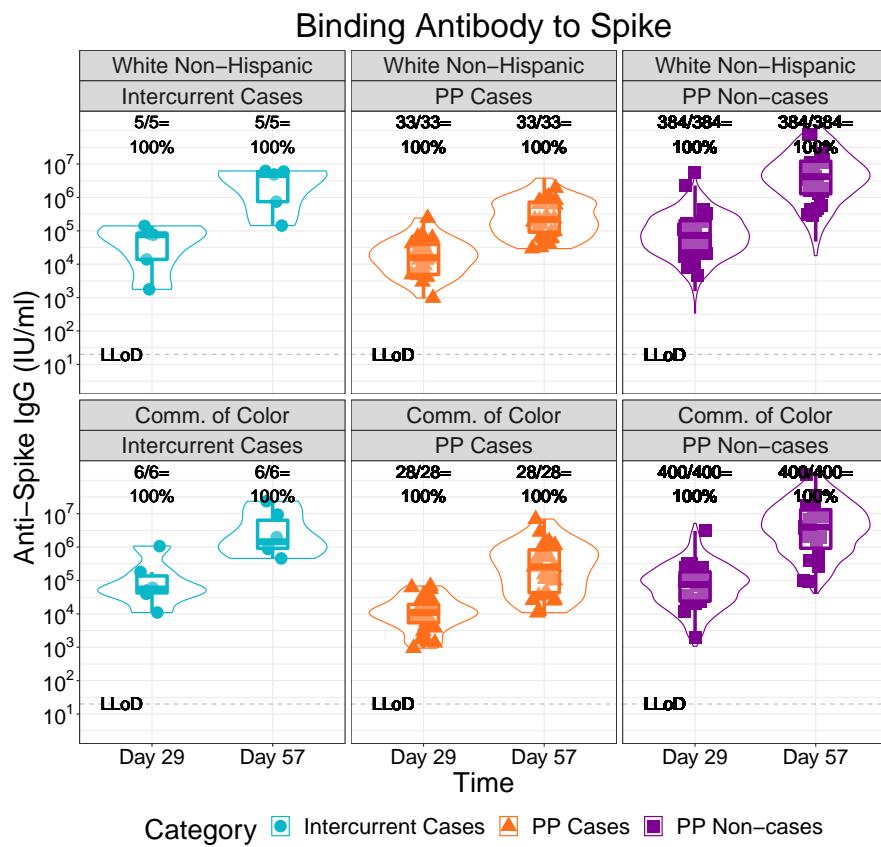


Figure 1.196: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints)

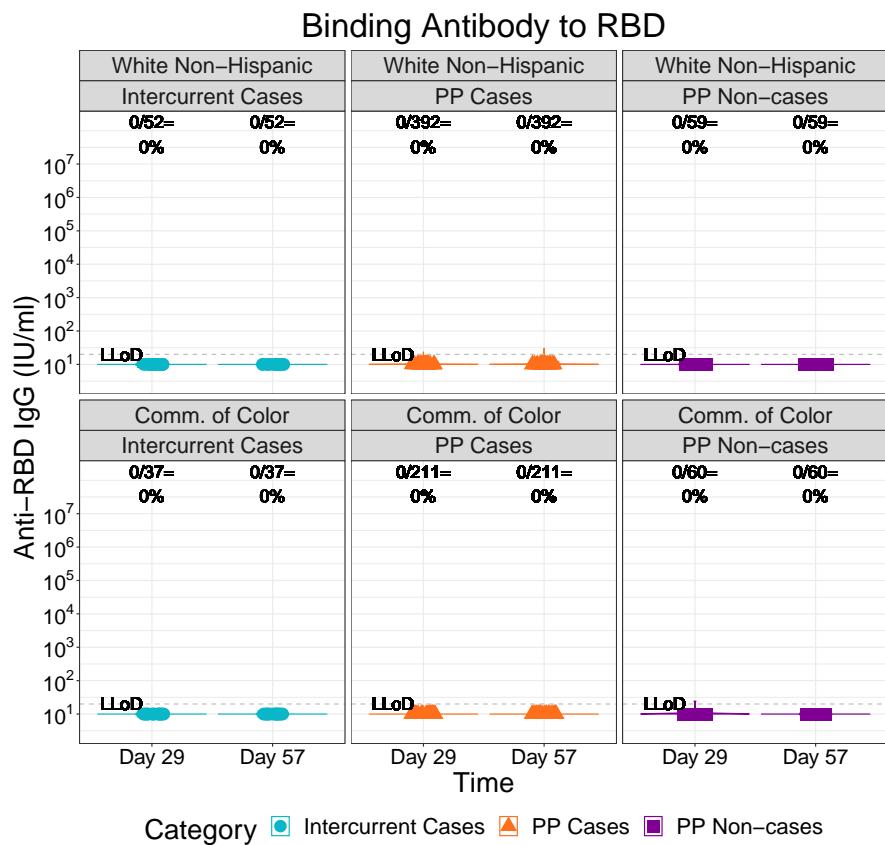


Figure 1.197: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints)

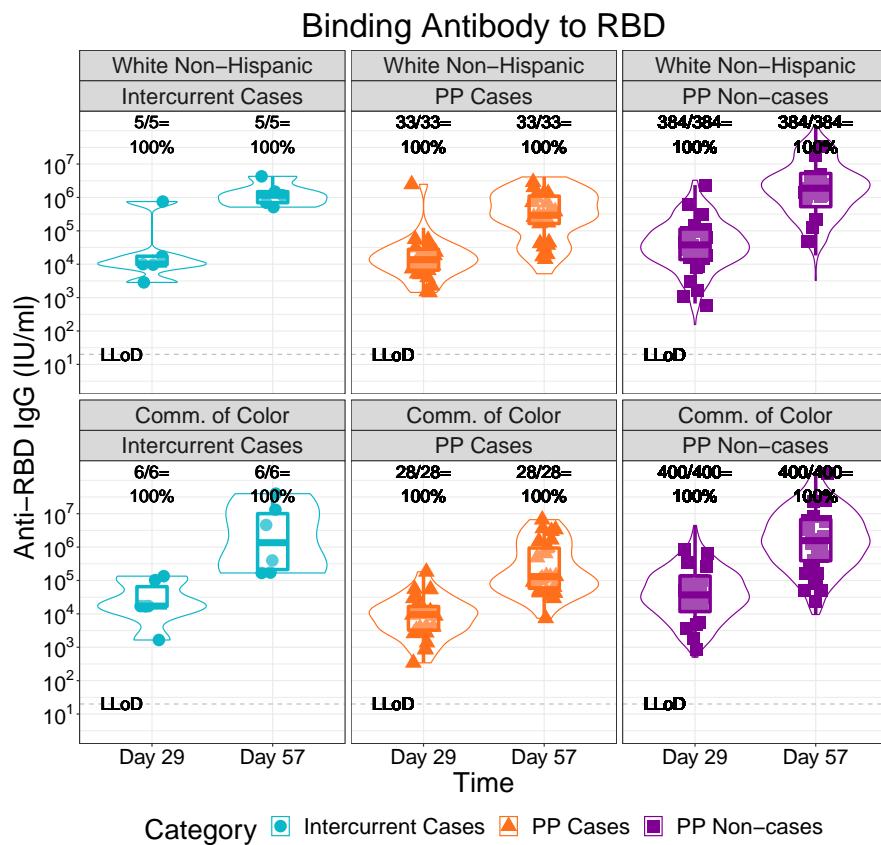


Figure 1.198: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints)

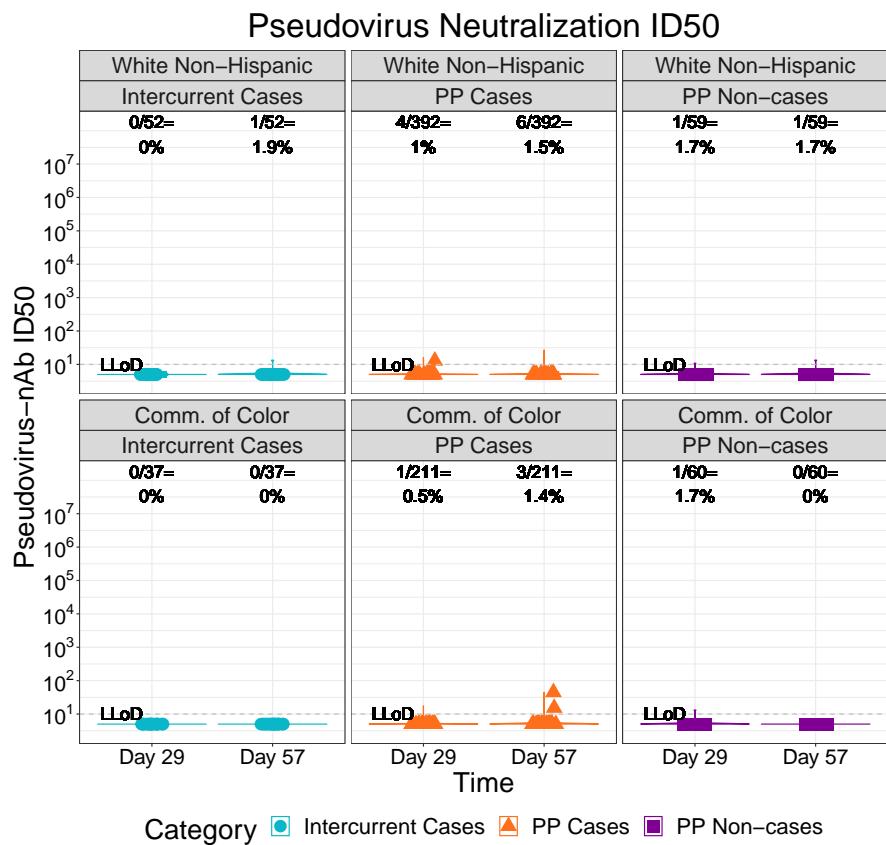


Figure 1.199: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints)

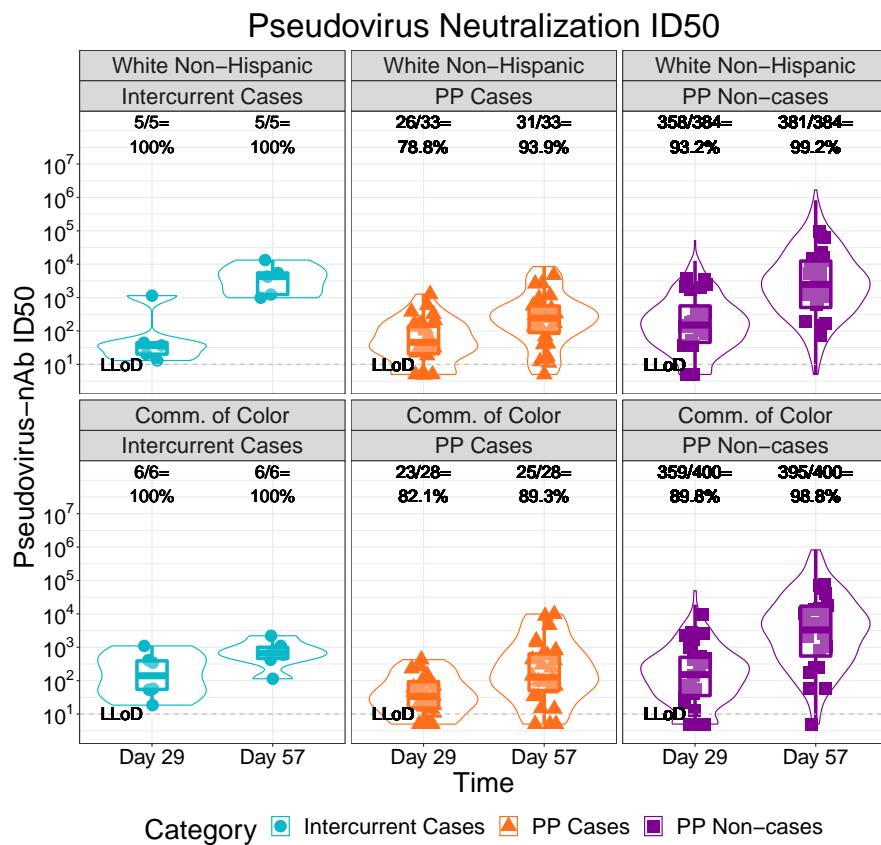


Figure 1.200: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints)

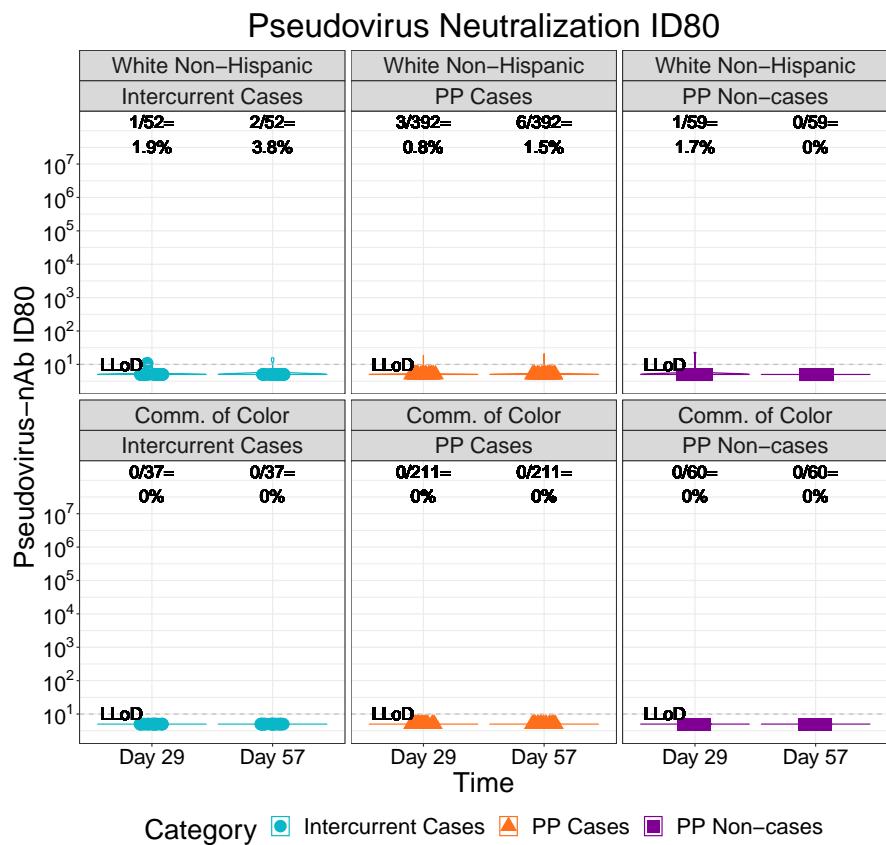


Figure 1.201: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints)

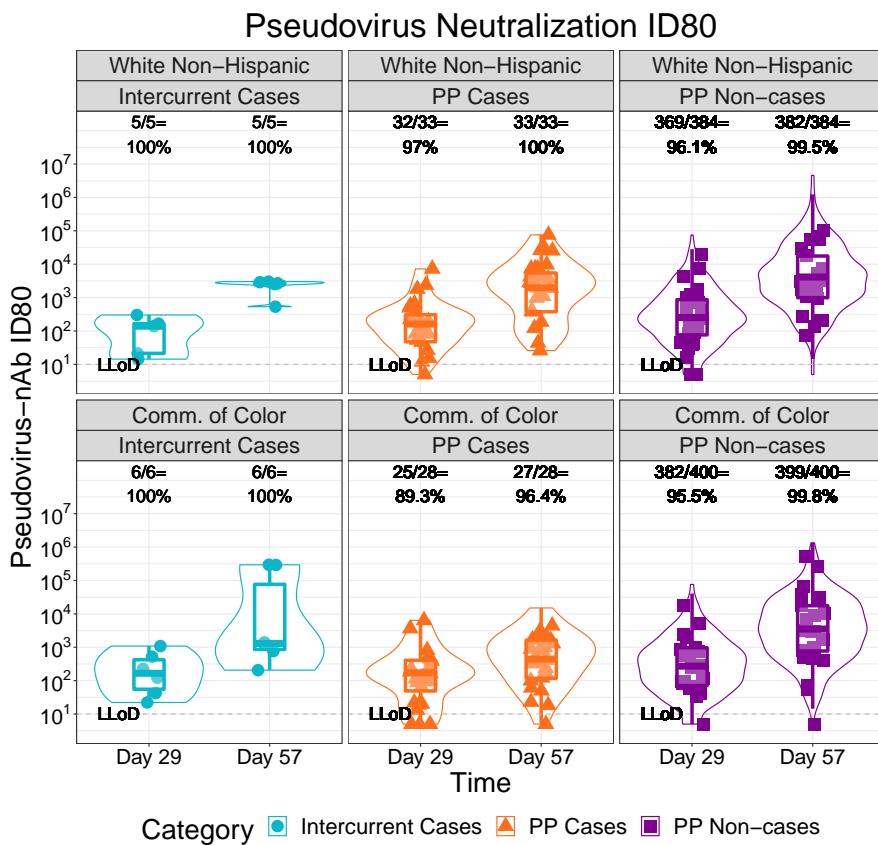


Figure 1.202: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints)

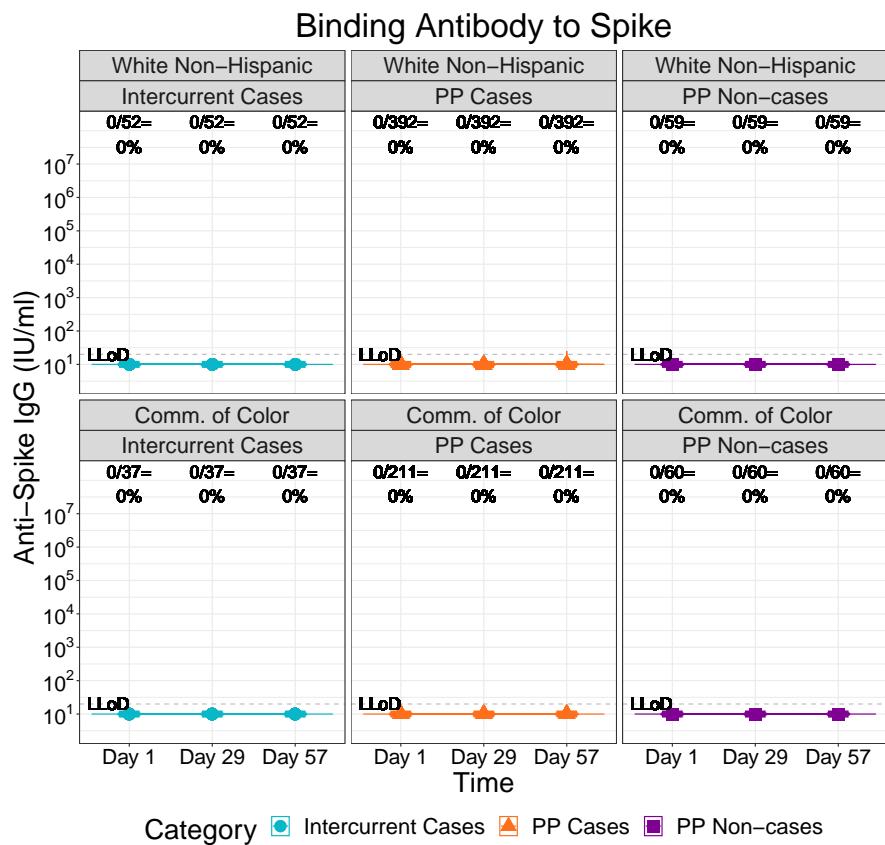


Figure 1.203: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints)

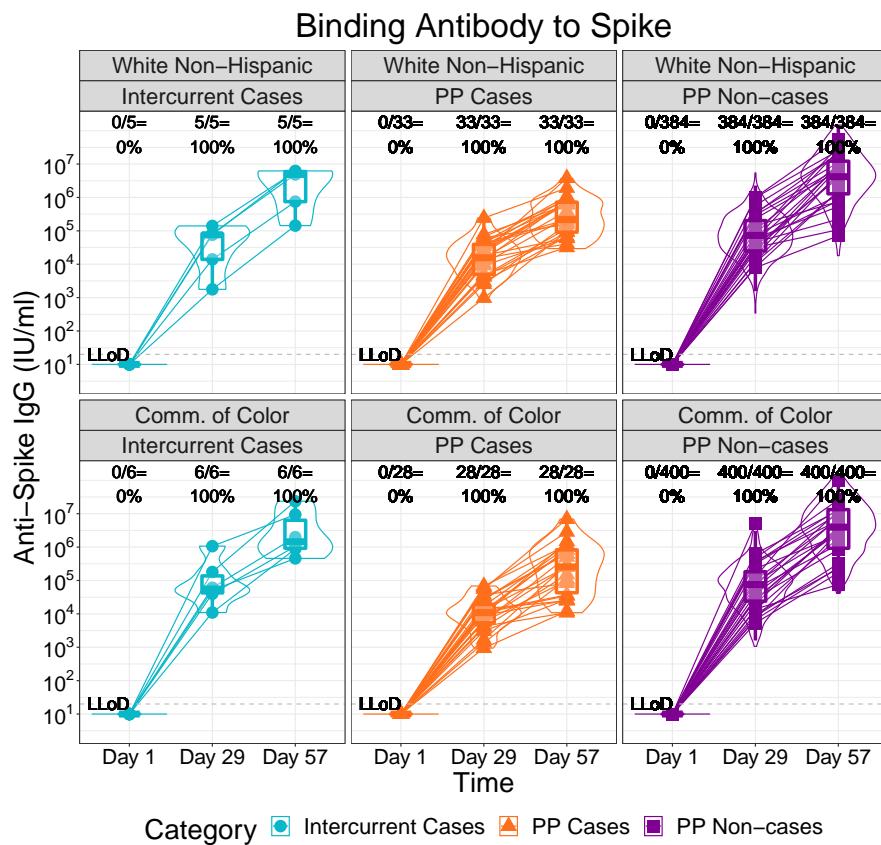


Figure 1.204: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints)

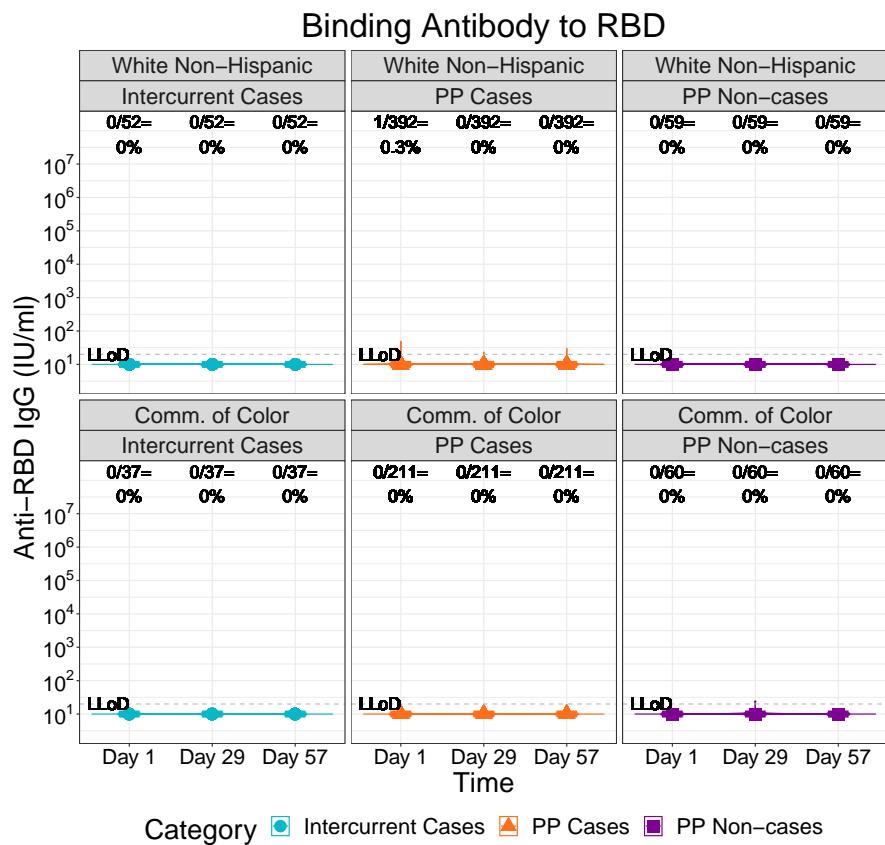


Figure 1.205: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints)

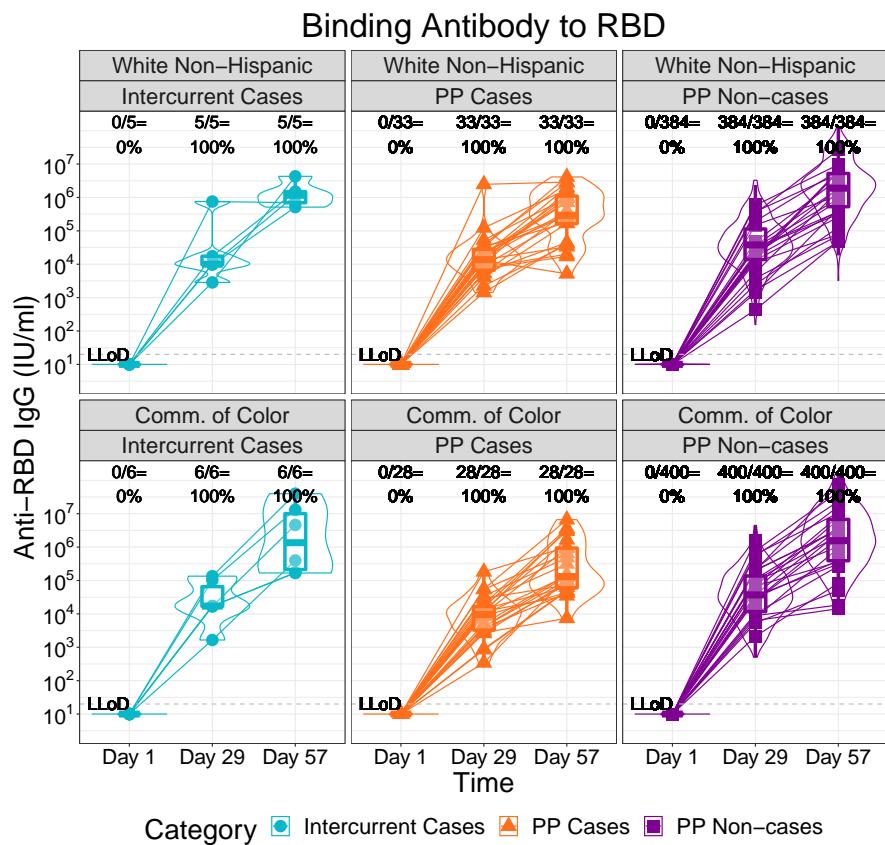


Figure 1.206: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints)

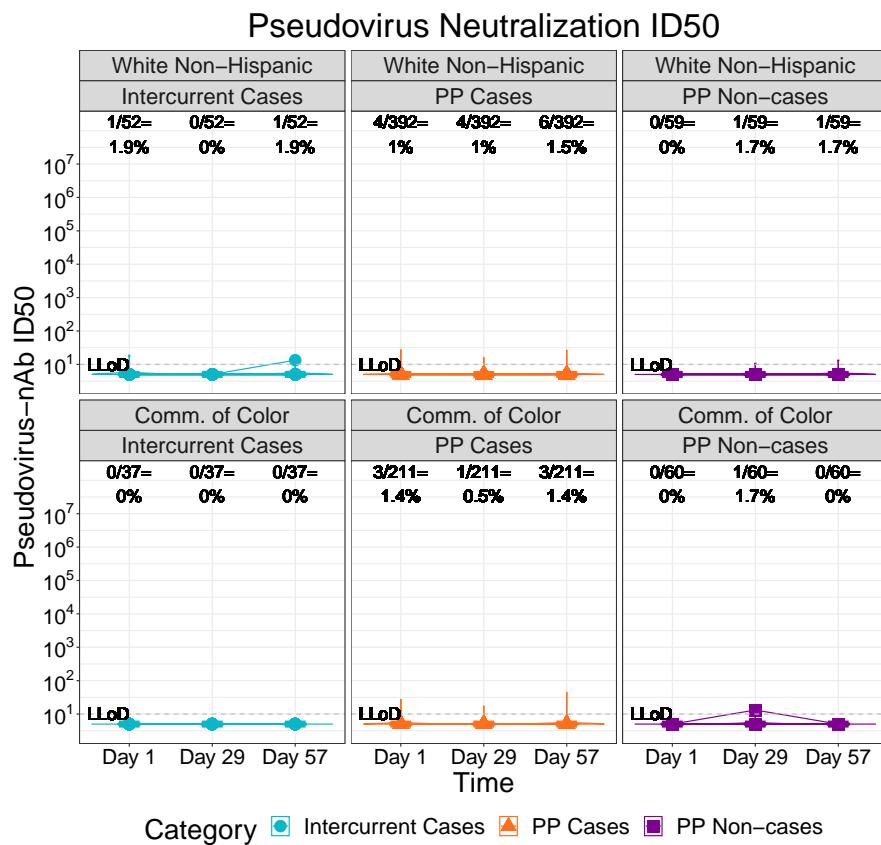


Figure 1.207: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints)

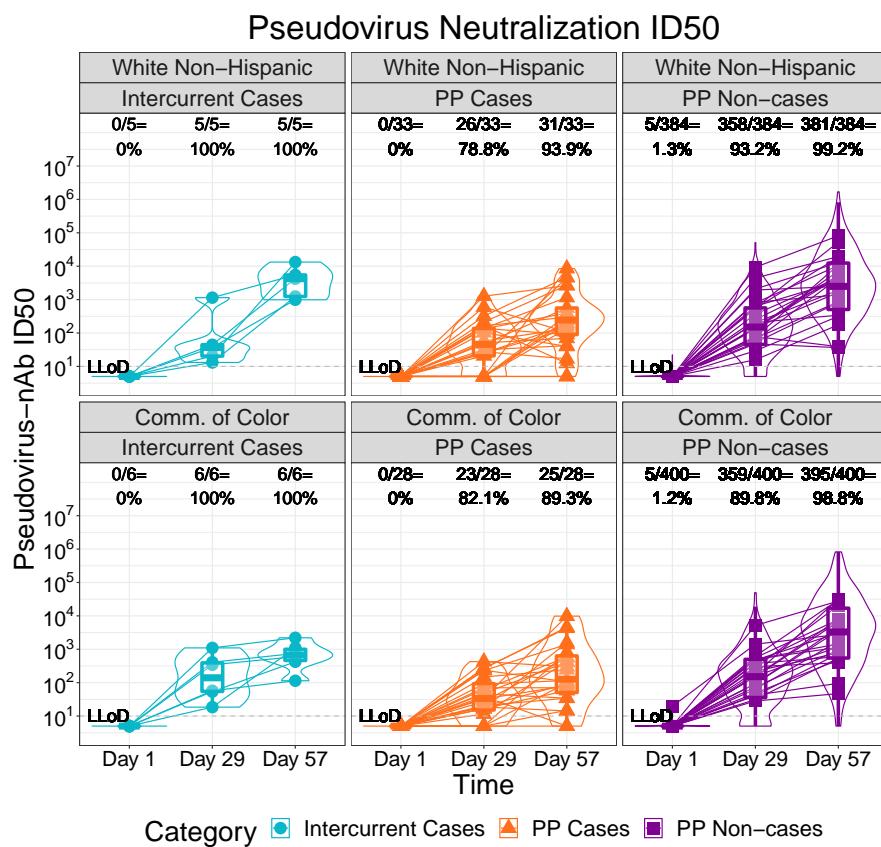


Figure 1.208: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints)

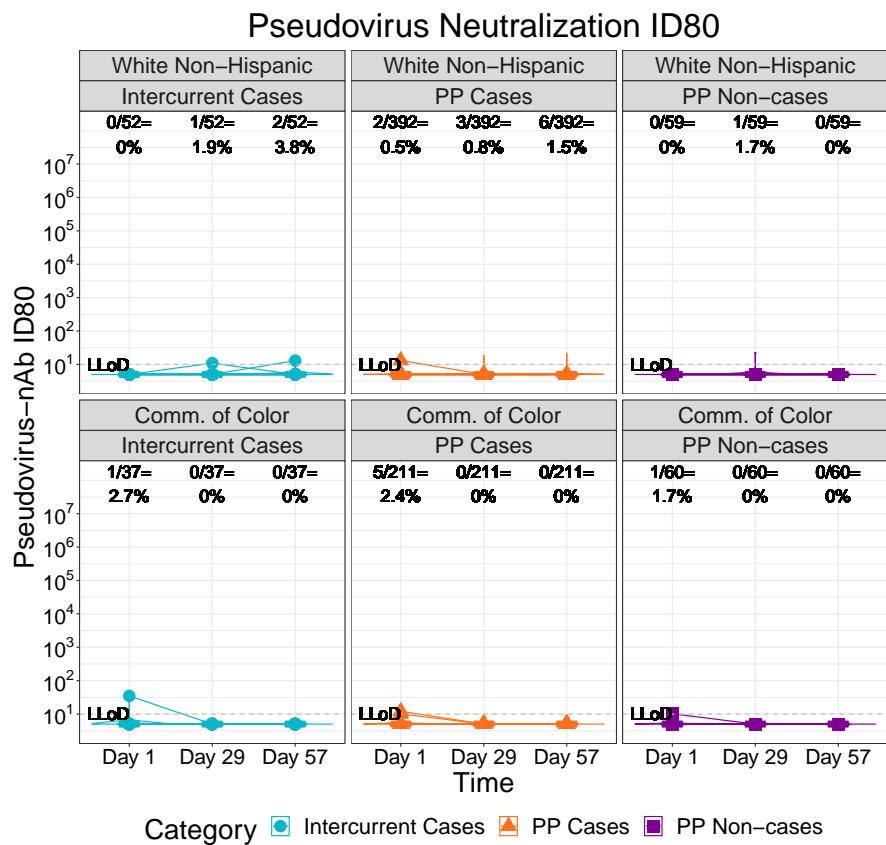


Figure 1.209: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints)

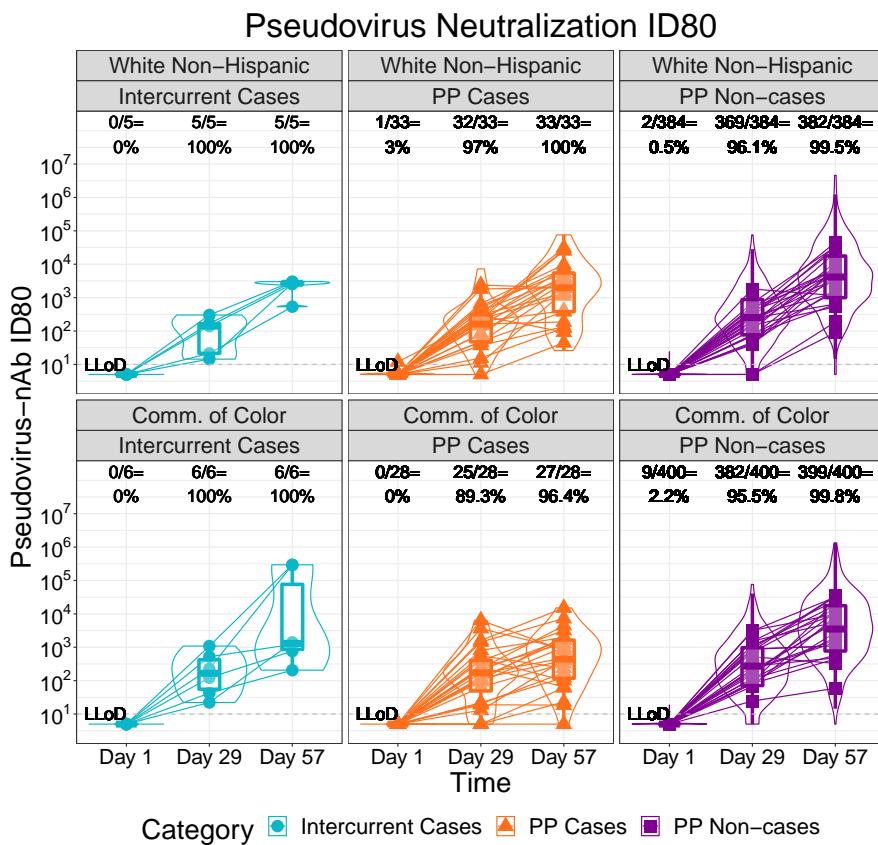


Figure 1.210: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints)

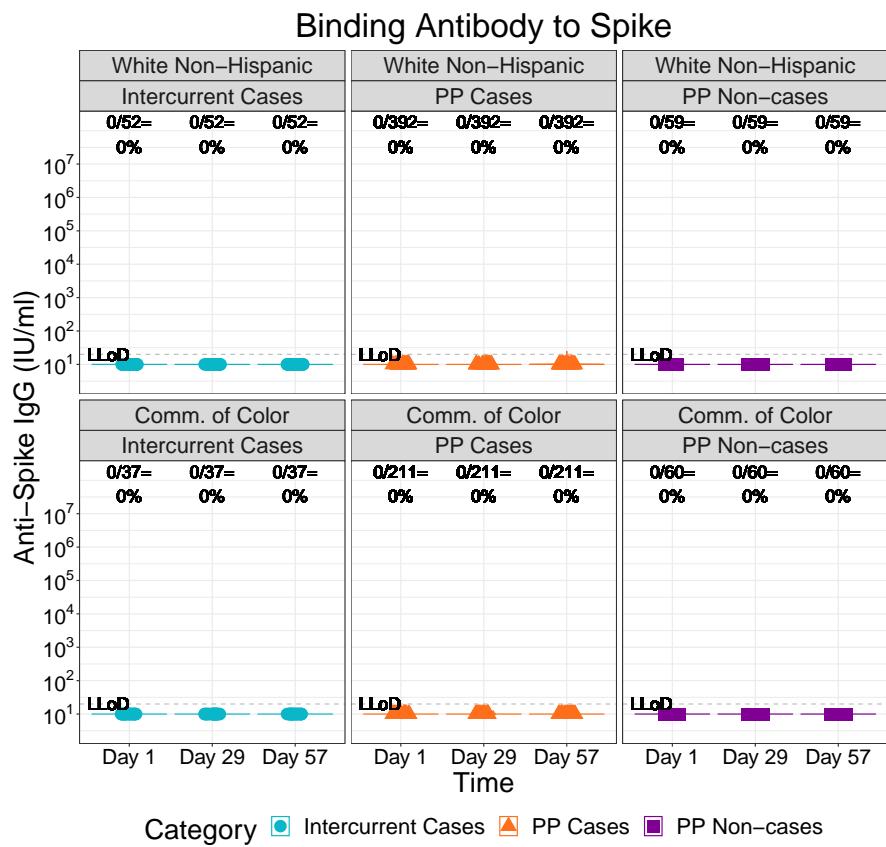


Figure 1.211: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints)

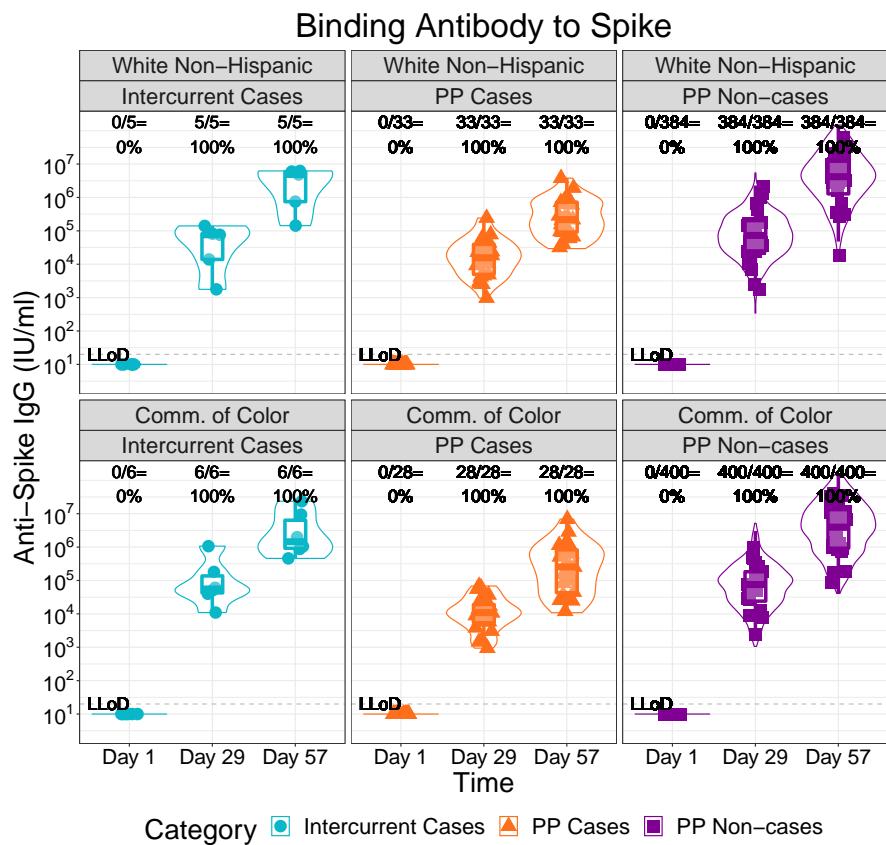


Figure 1.212: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints)

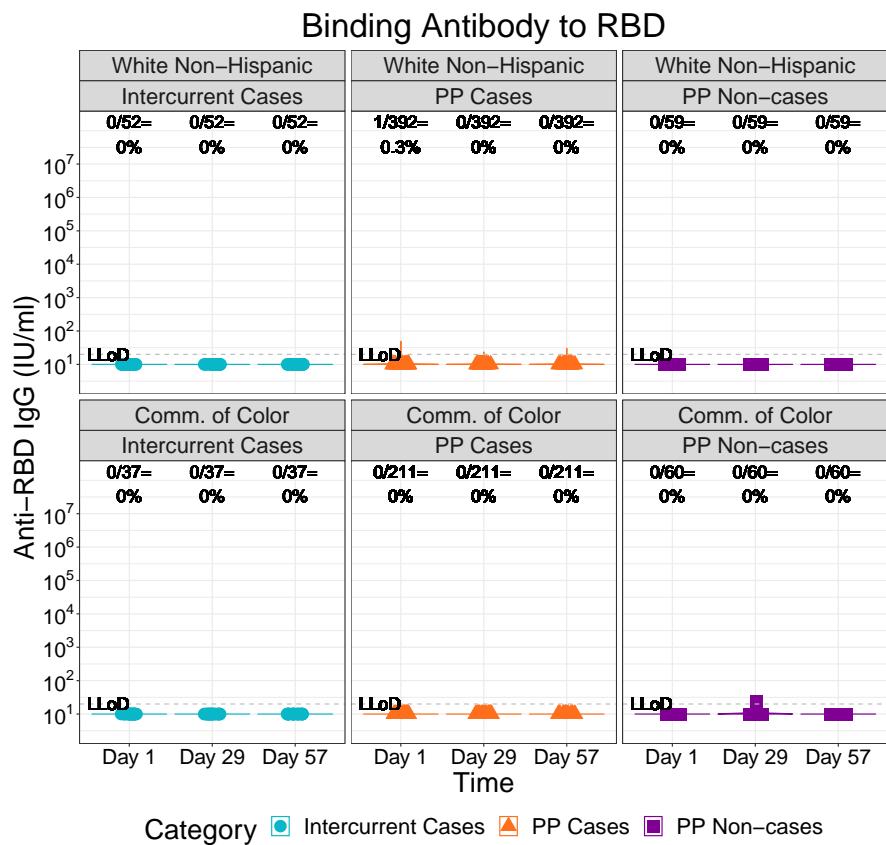


Figure 1.213: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints)

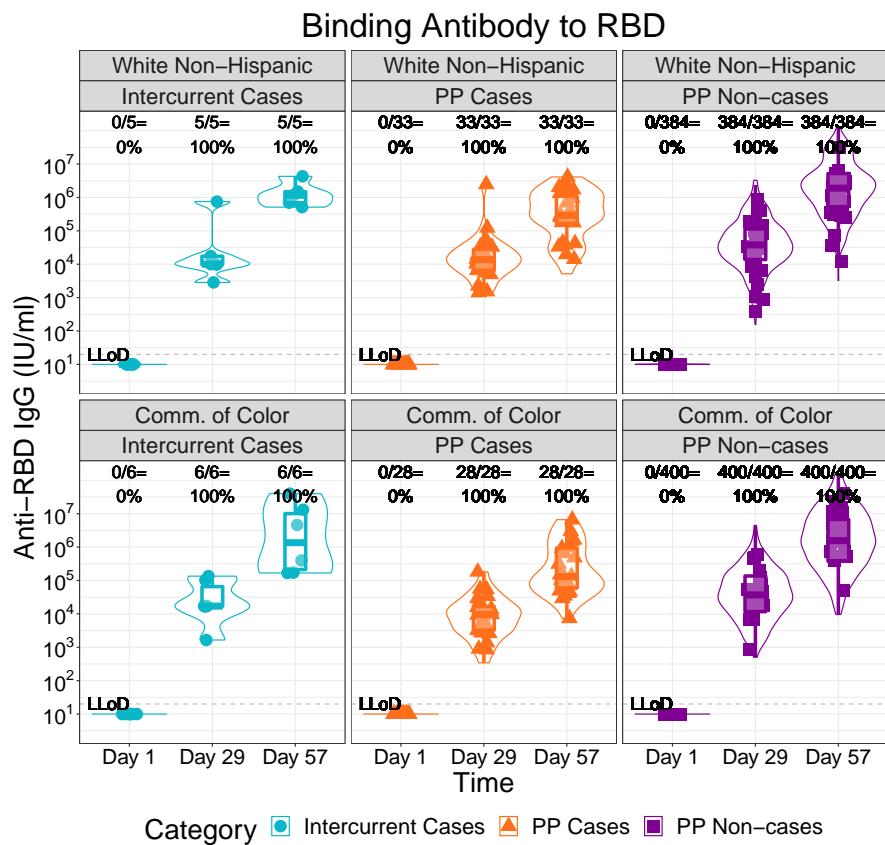


Figure 1.214: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints)

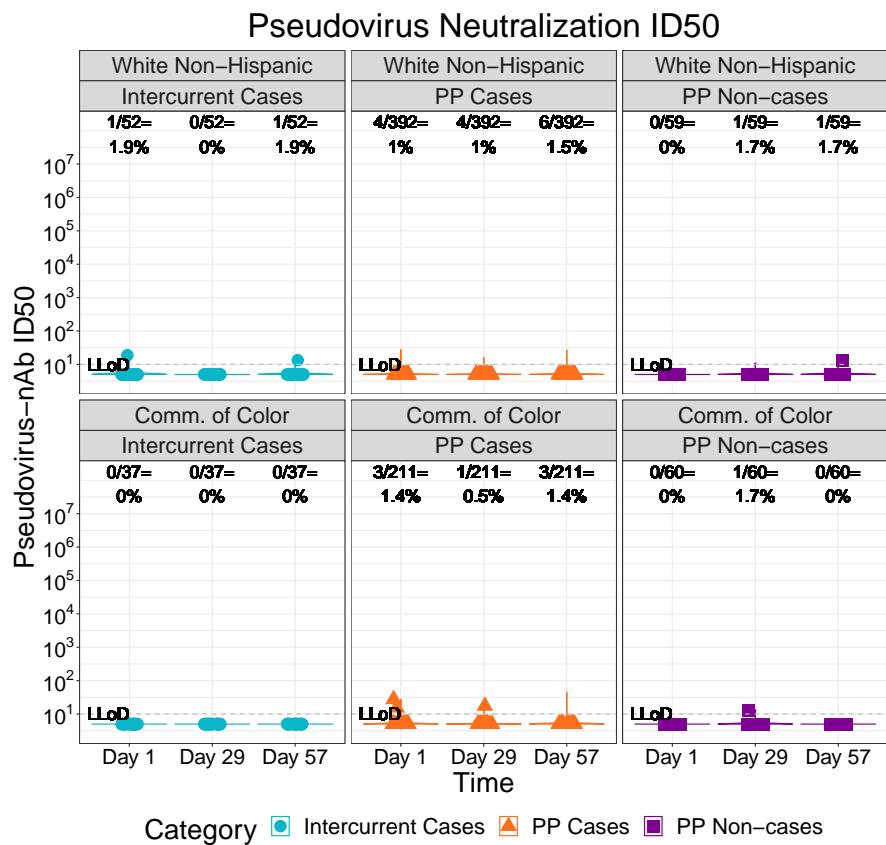


Figure 1.215: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints)

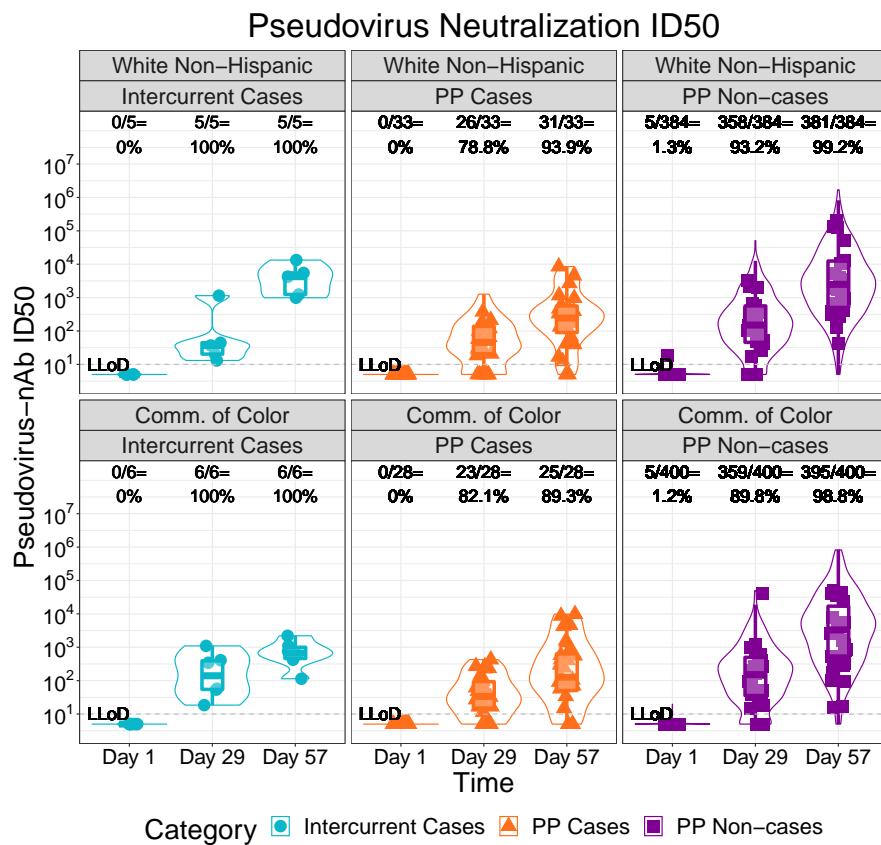


Figure 1.216: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints)

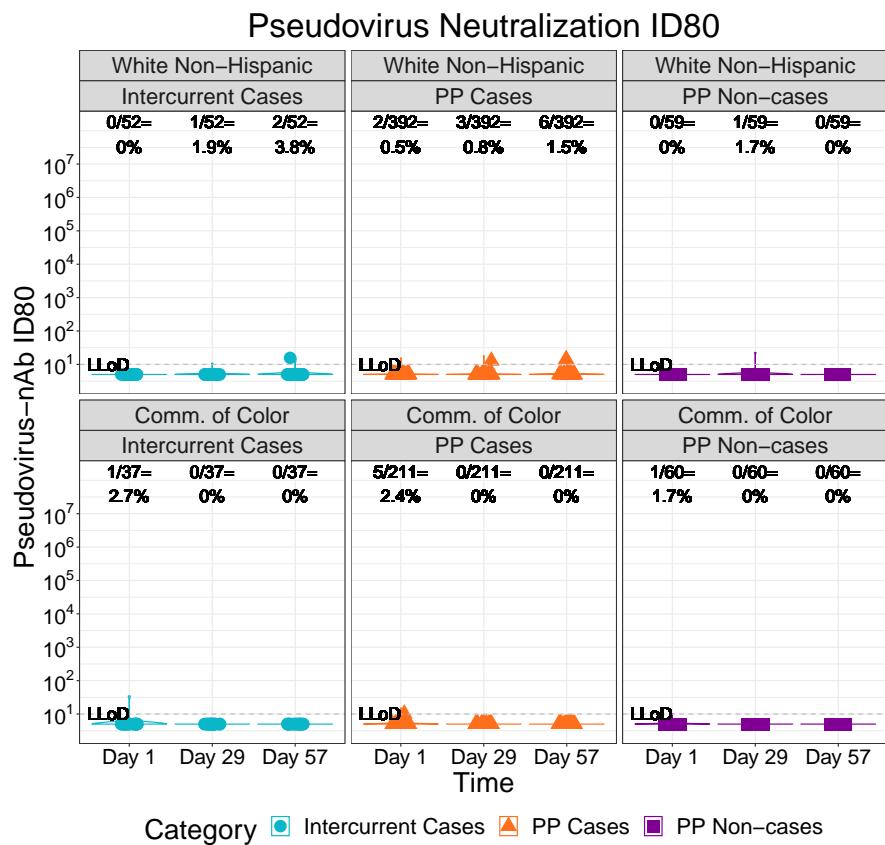


Figure 1.217: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints)

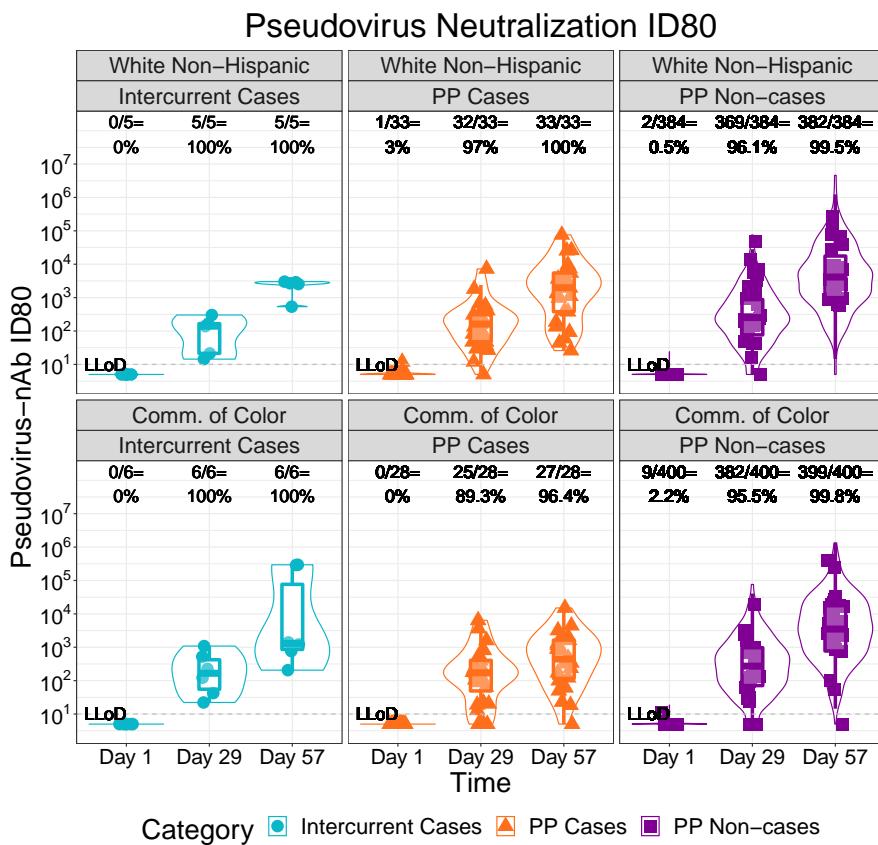


Figure 1.218: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints)

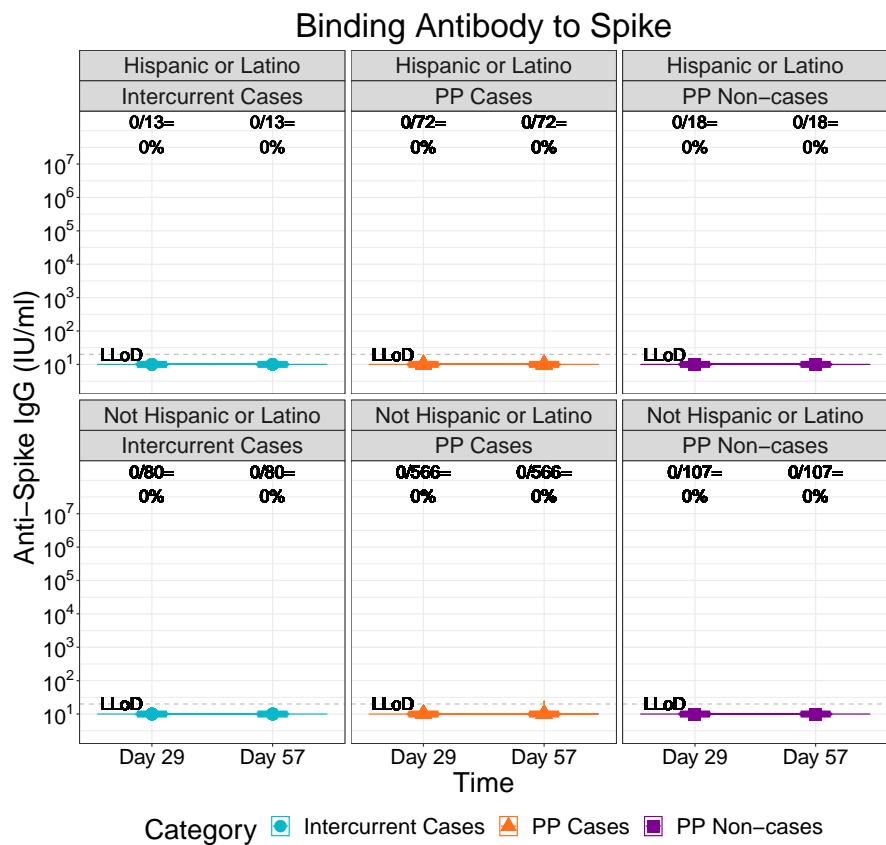


Figure 1.219: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

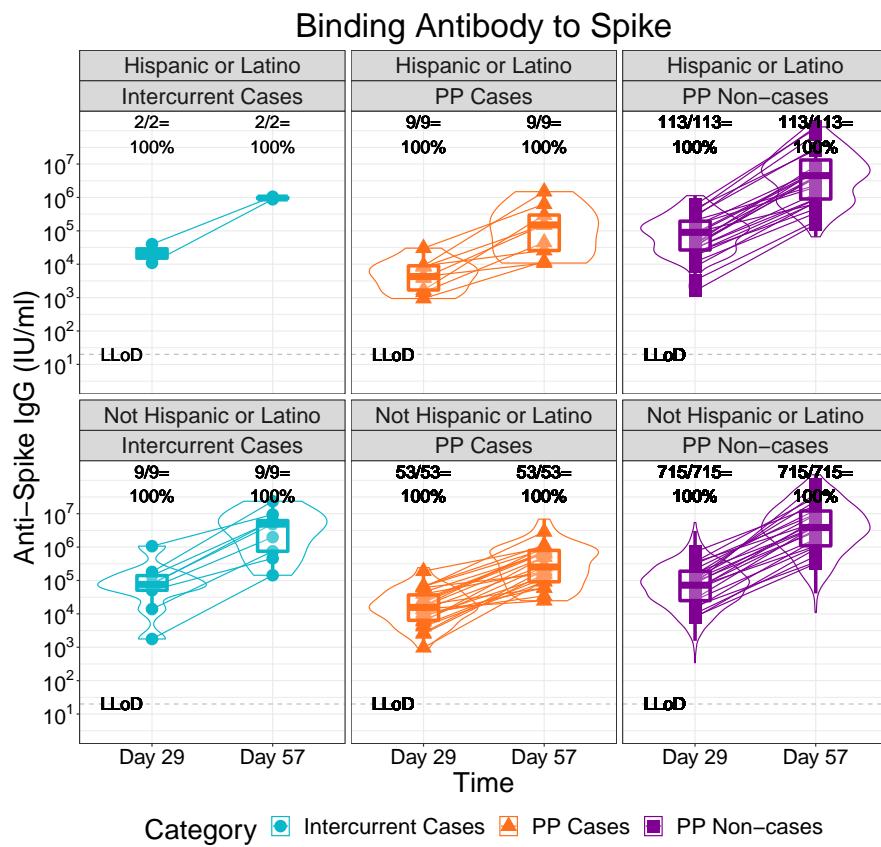


Figure 1.220: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

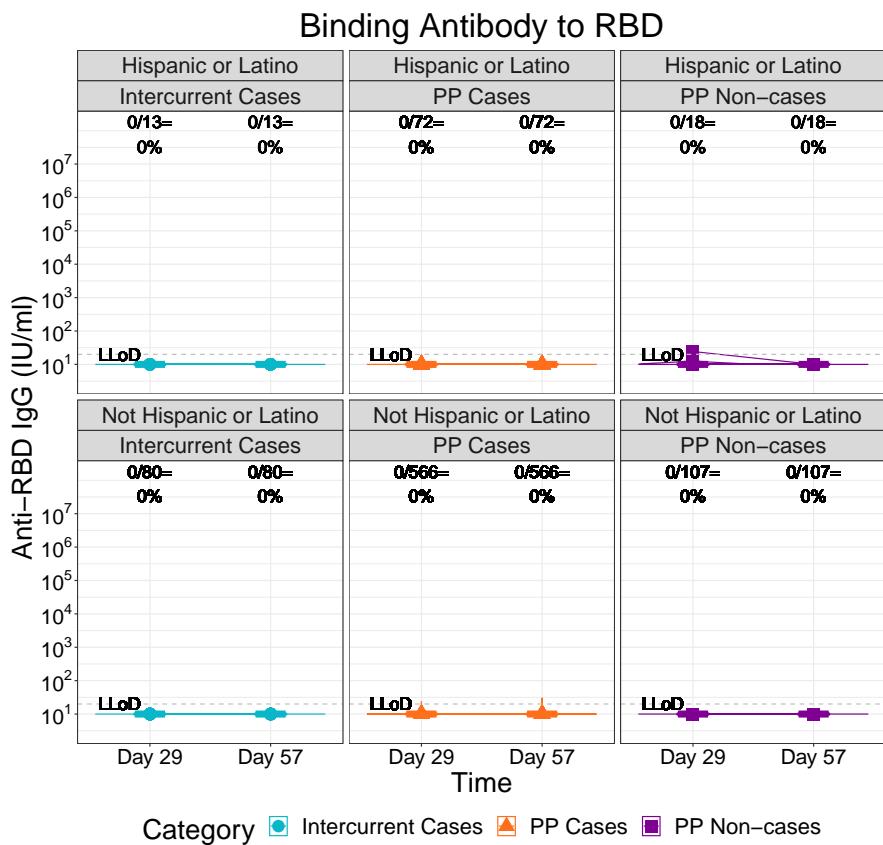


Figure 1.221: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

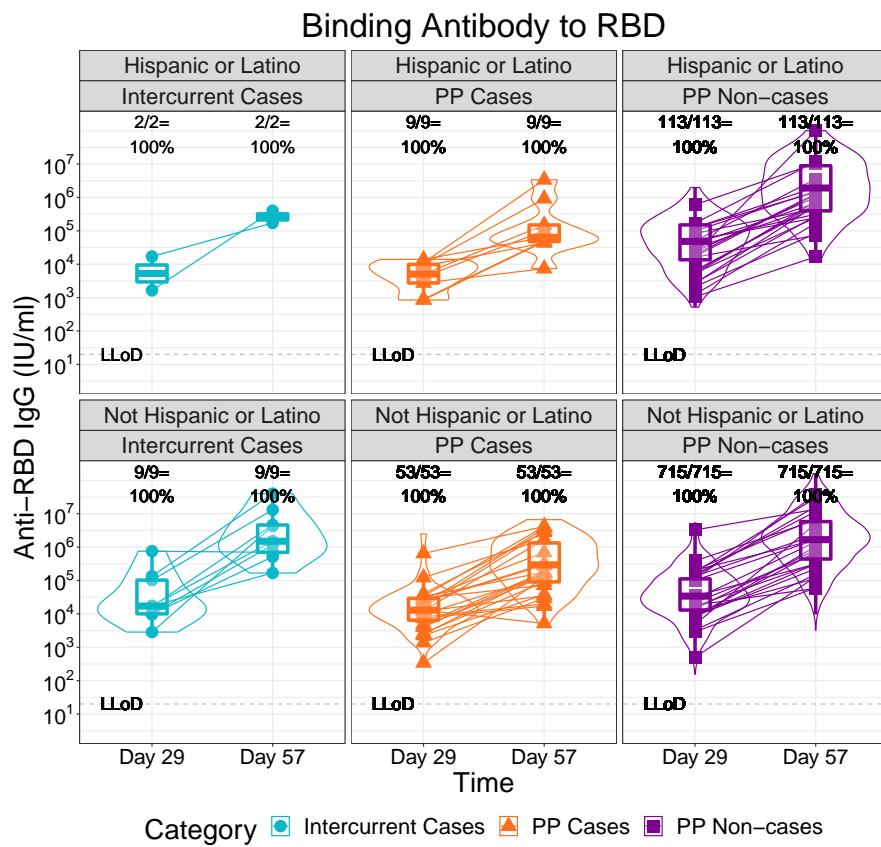


Figure 1.222: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

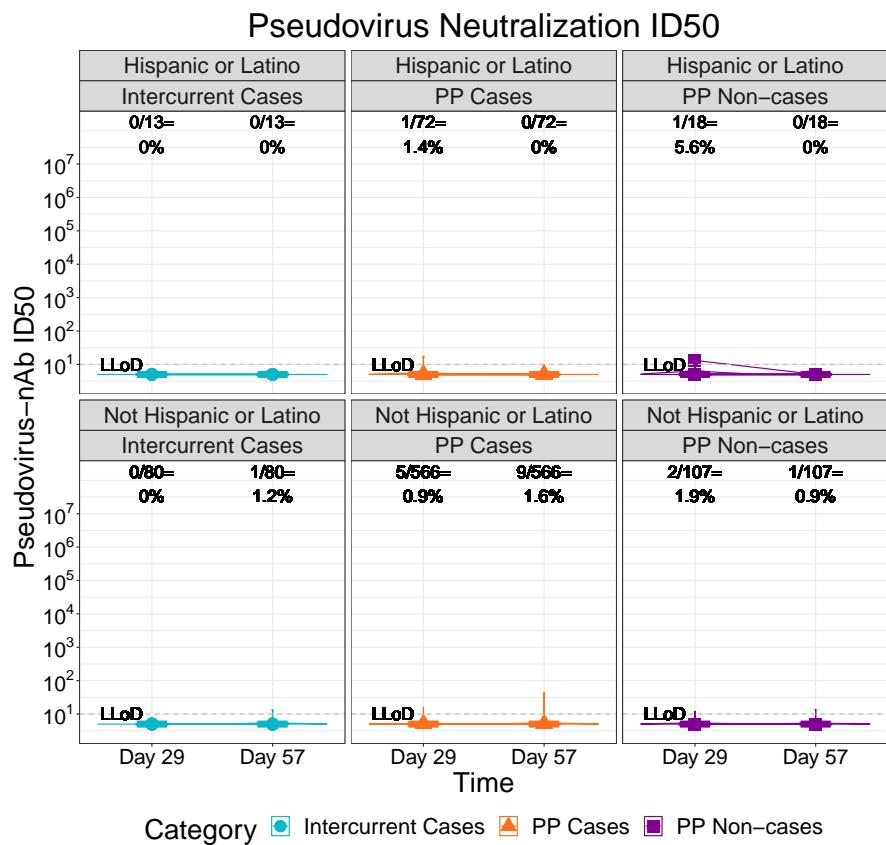


Figure 1.223: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

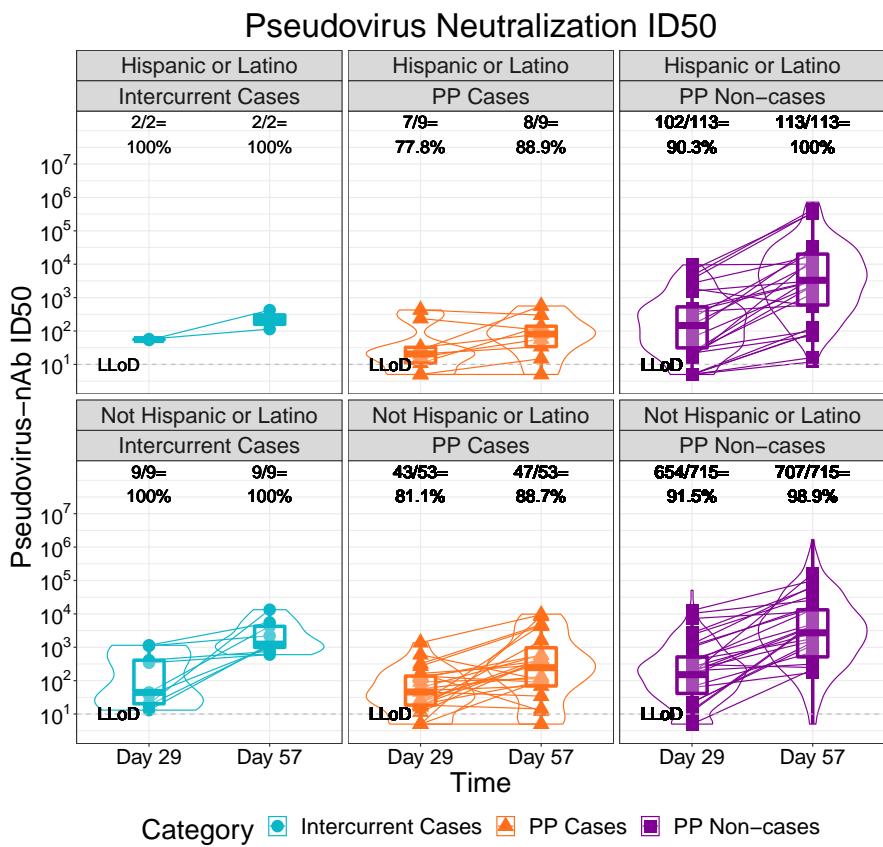


Figure 1.224: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

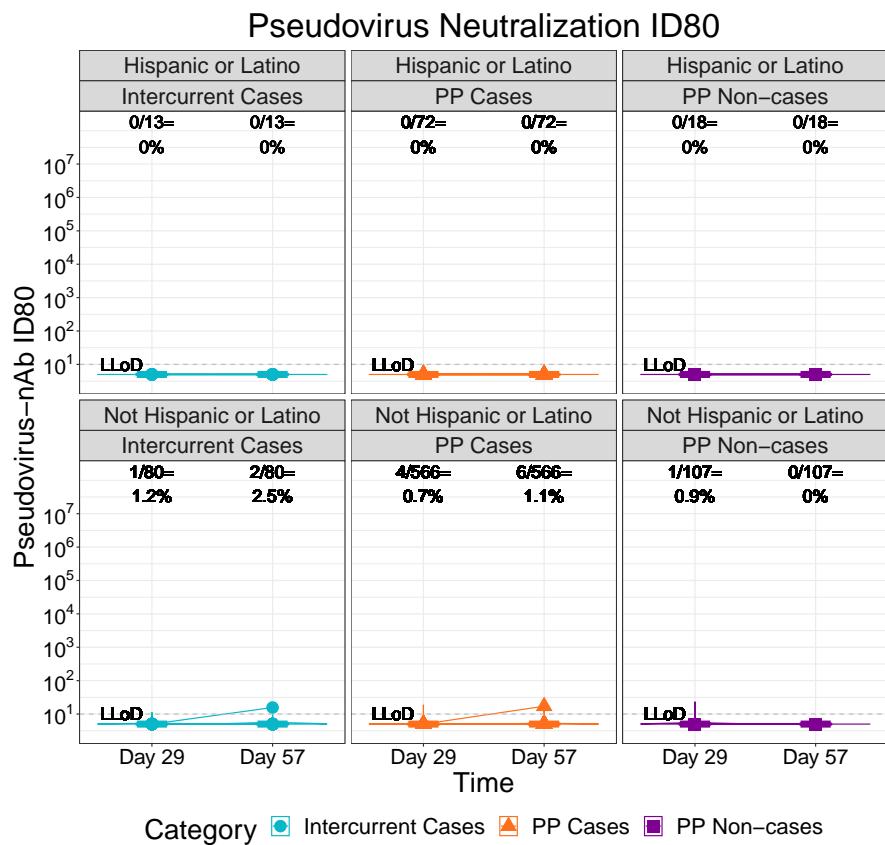


Figure 1.225: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

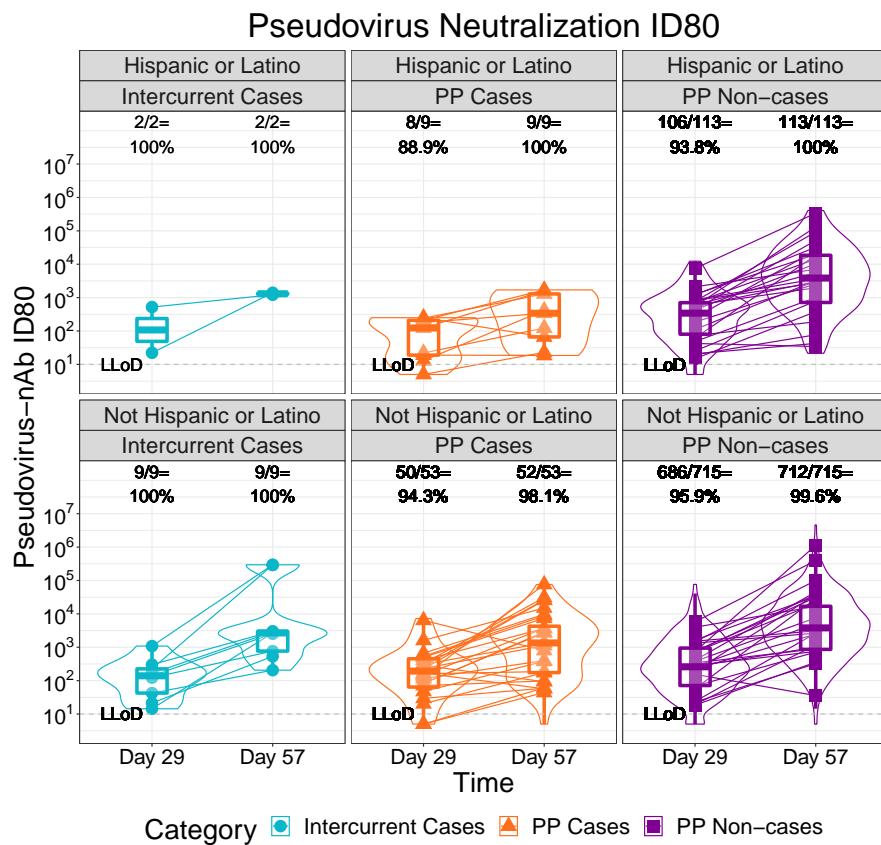


Figure 1.226: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

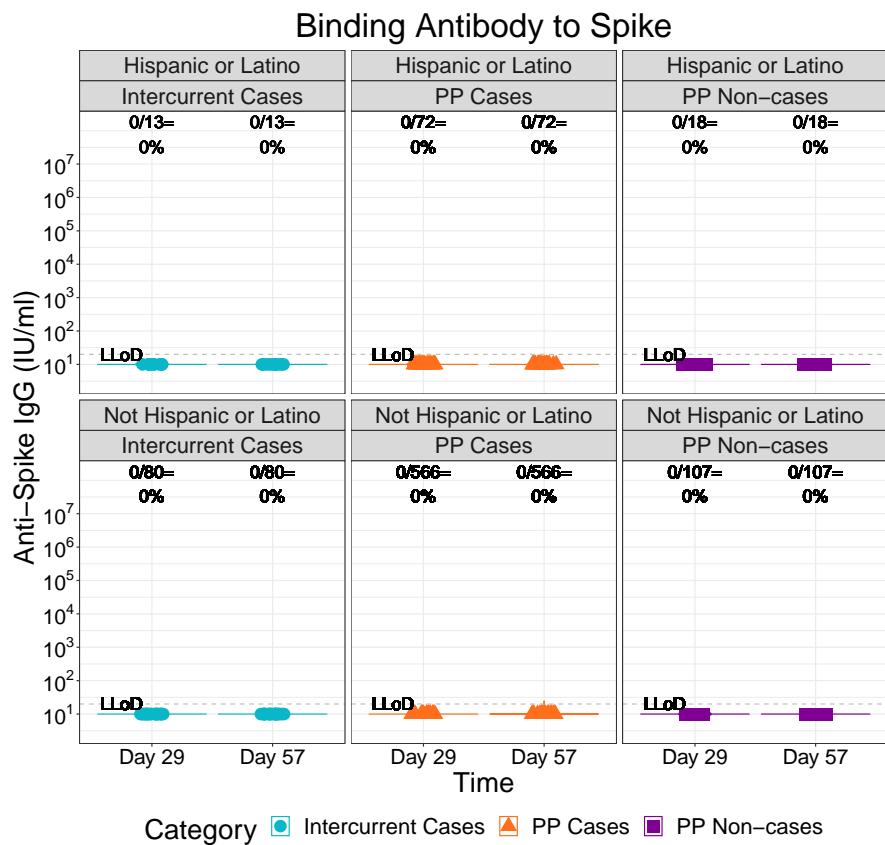


Figure 1.227: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

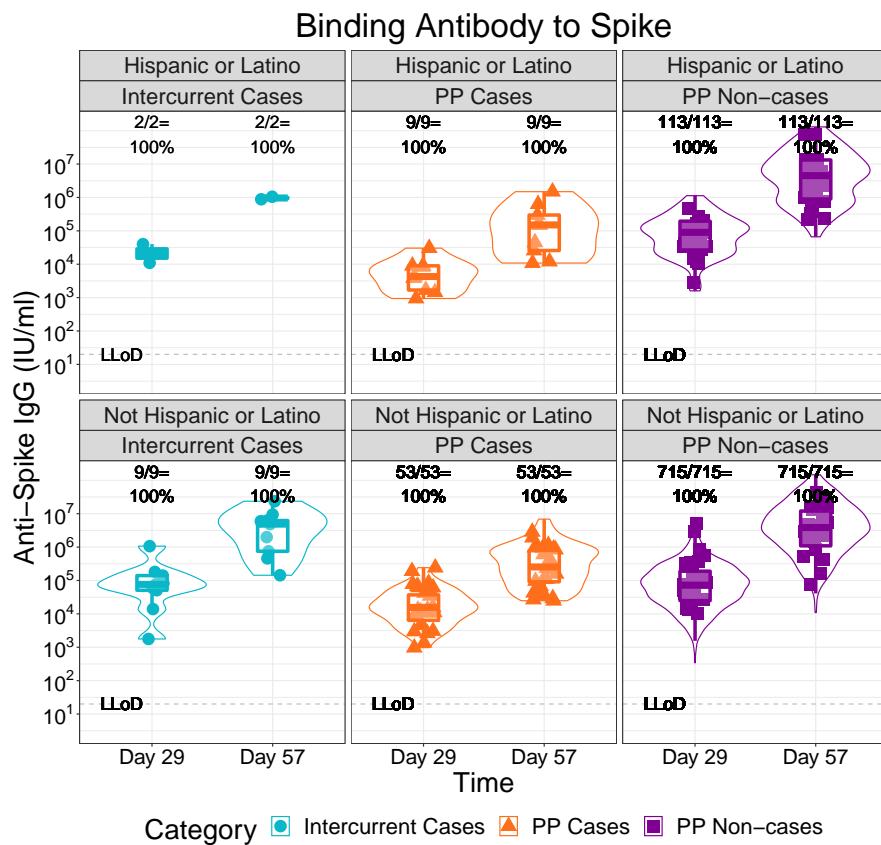


Figure 1.228: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

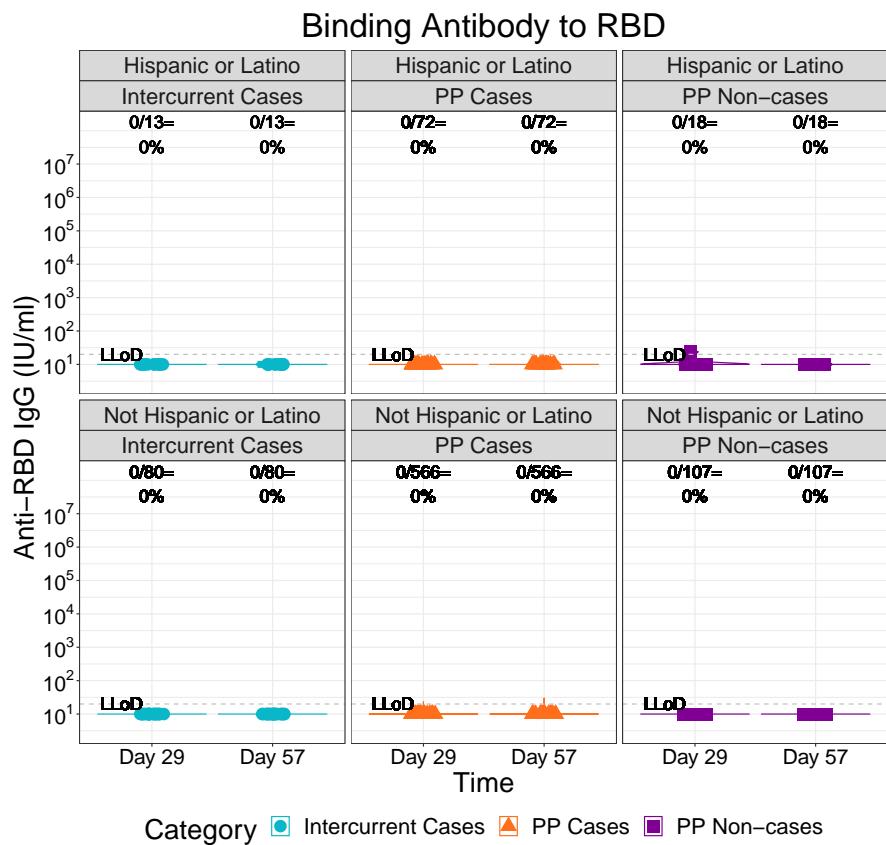


Figure 1.229: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

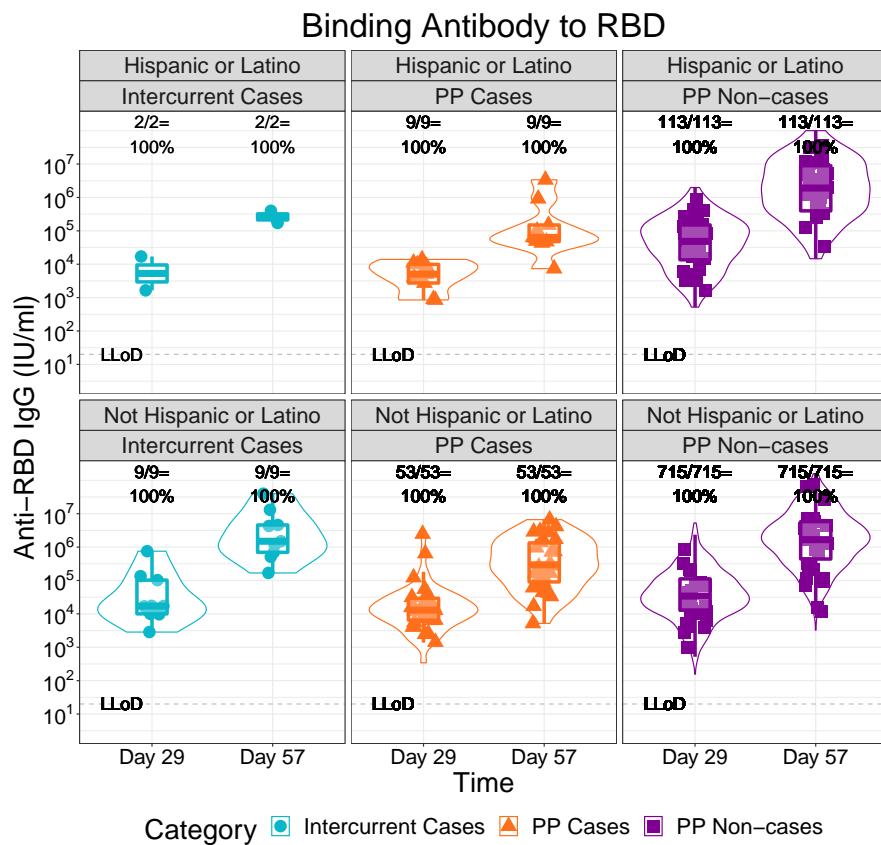


Figure 1.230: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

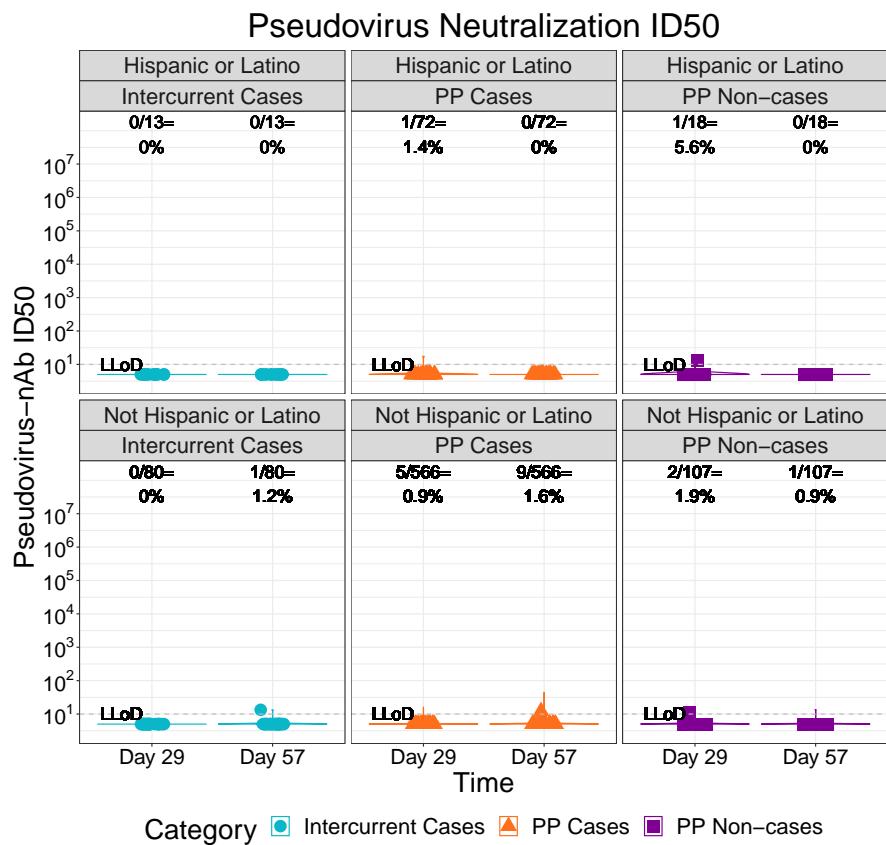


Figure 1.231: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

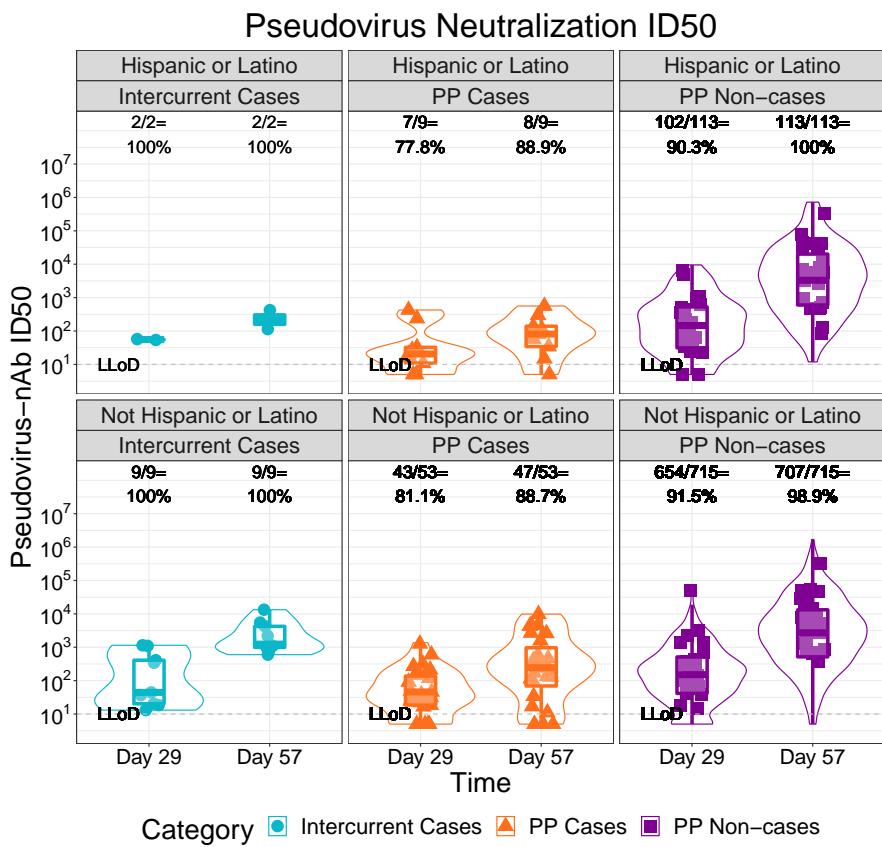


Figure 1.232: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

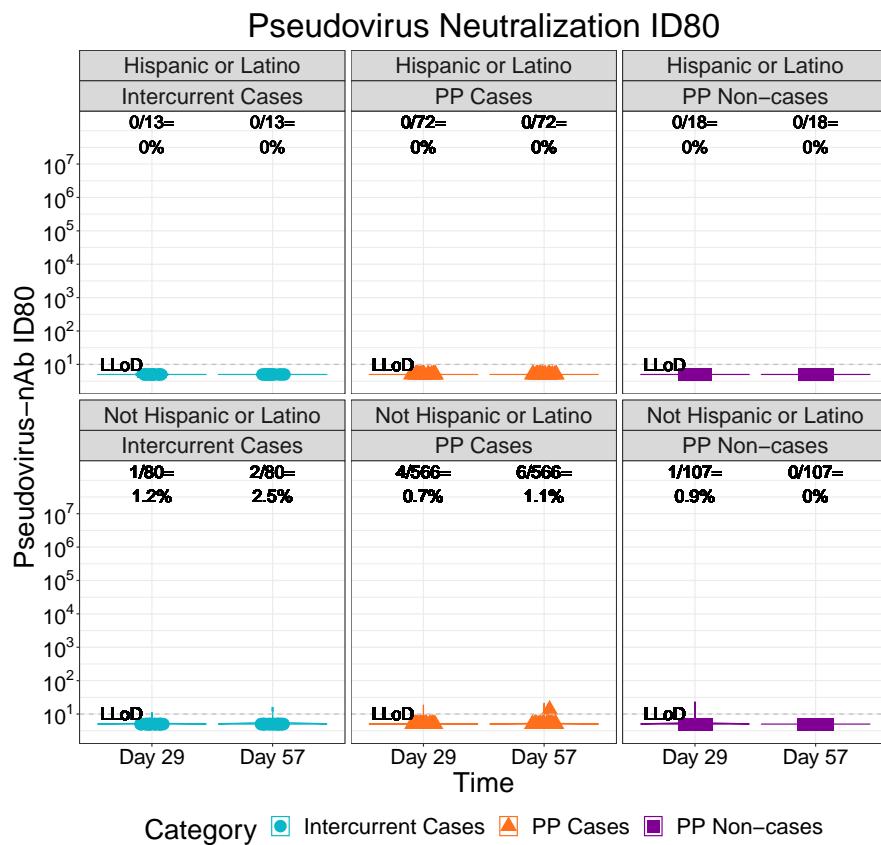


Figure 1.233: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

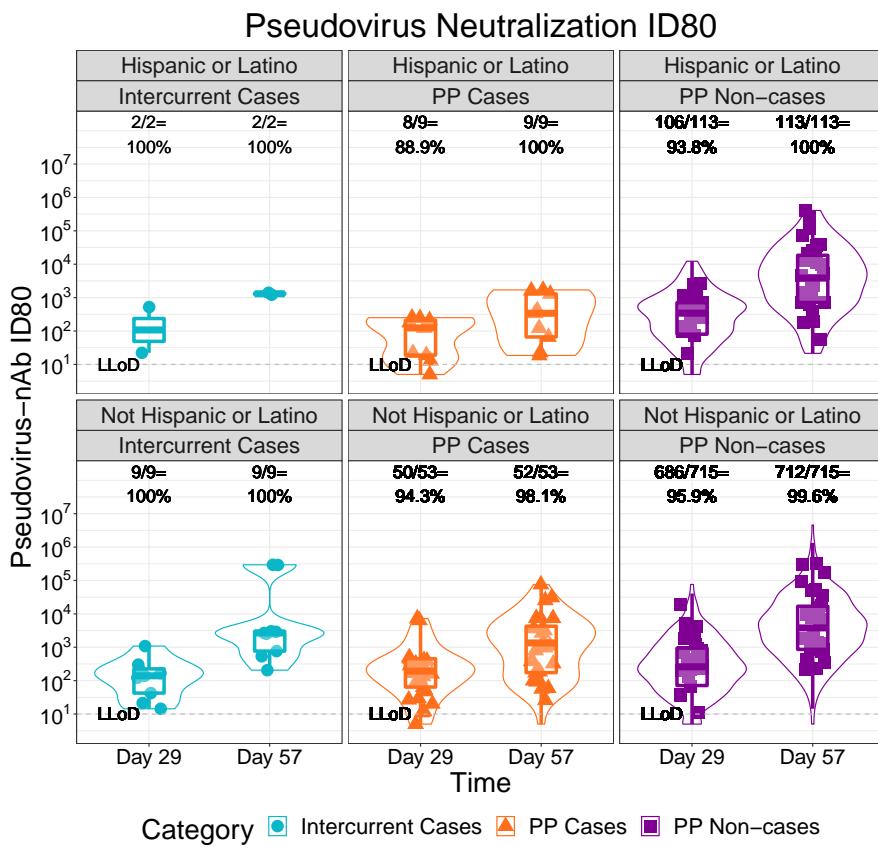


Figure 1.234: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

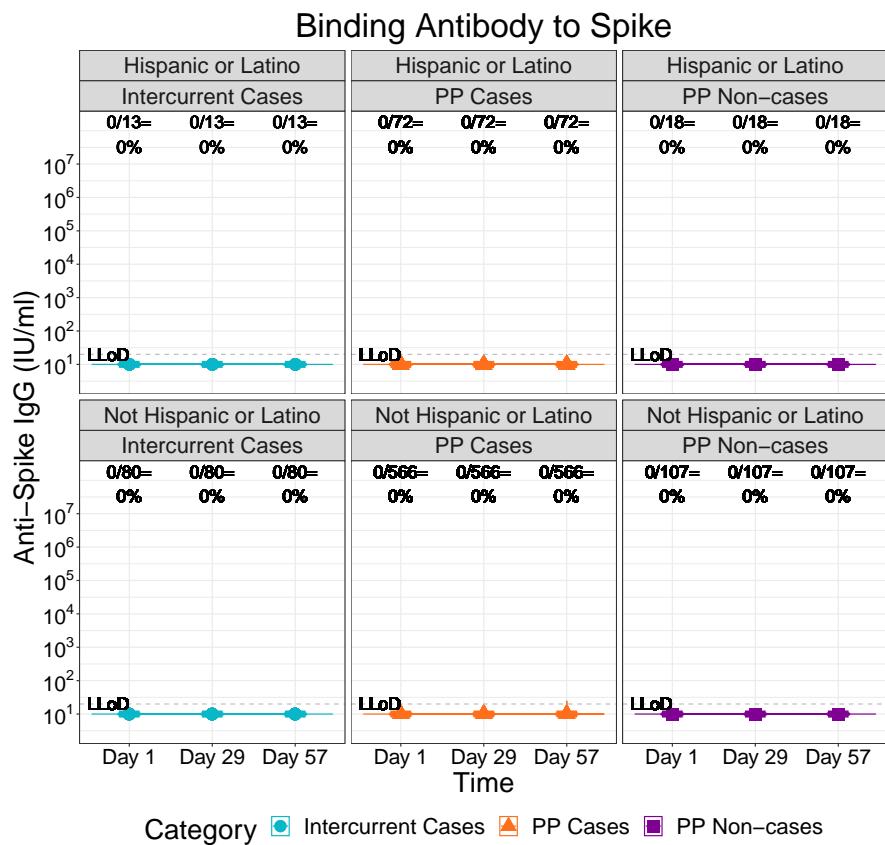


Figure 1.235: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

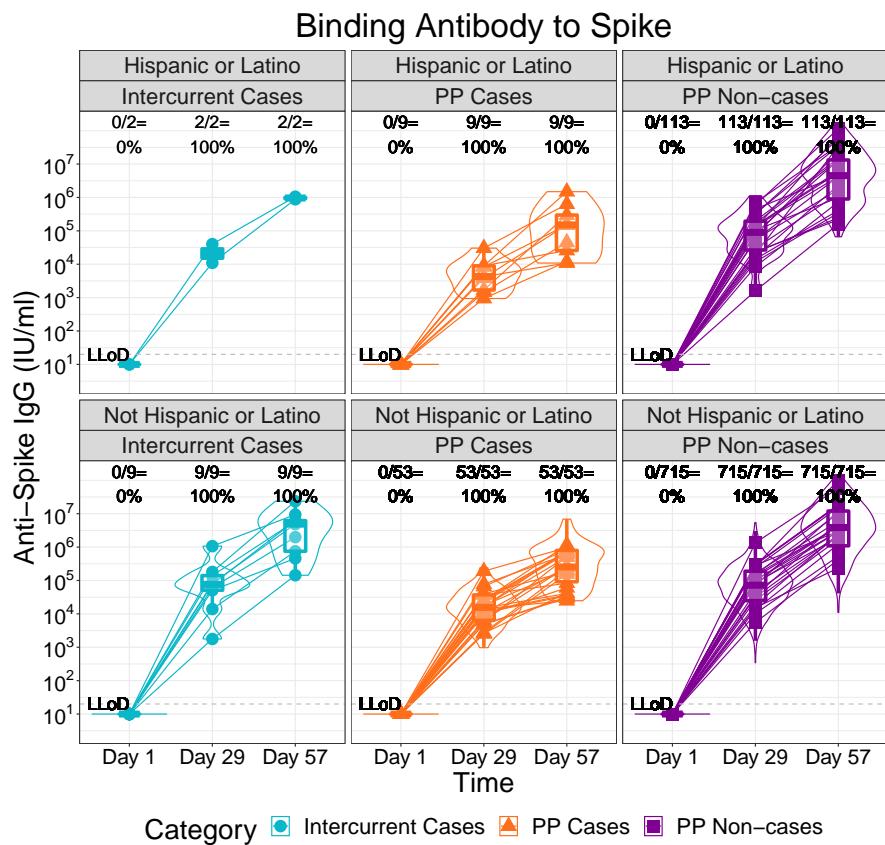


Figure 1.236: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

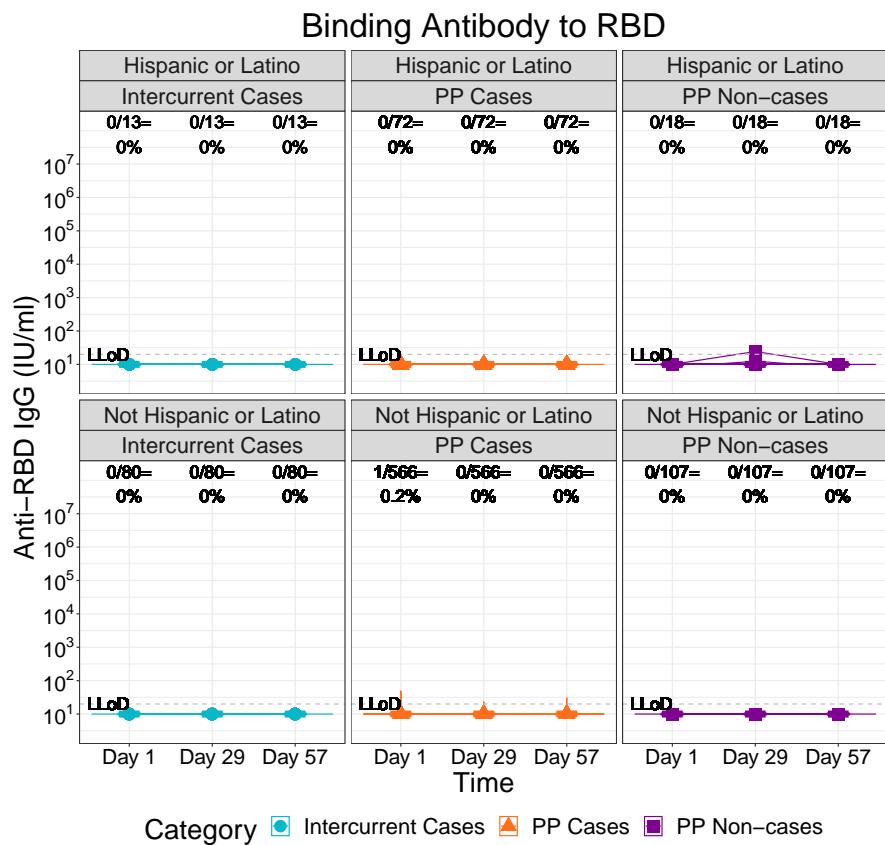


Figure 1.237: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

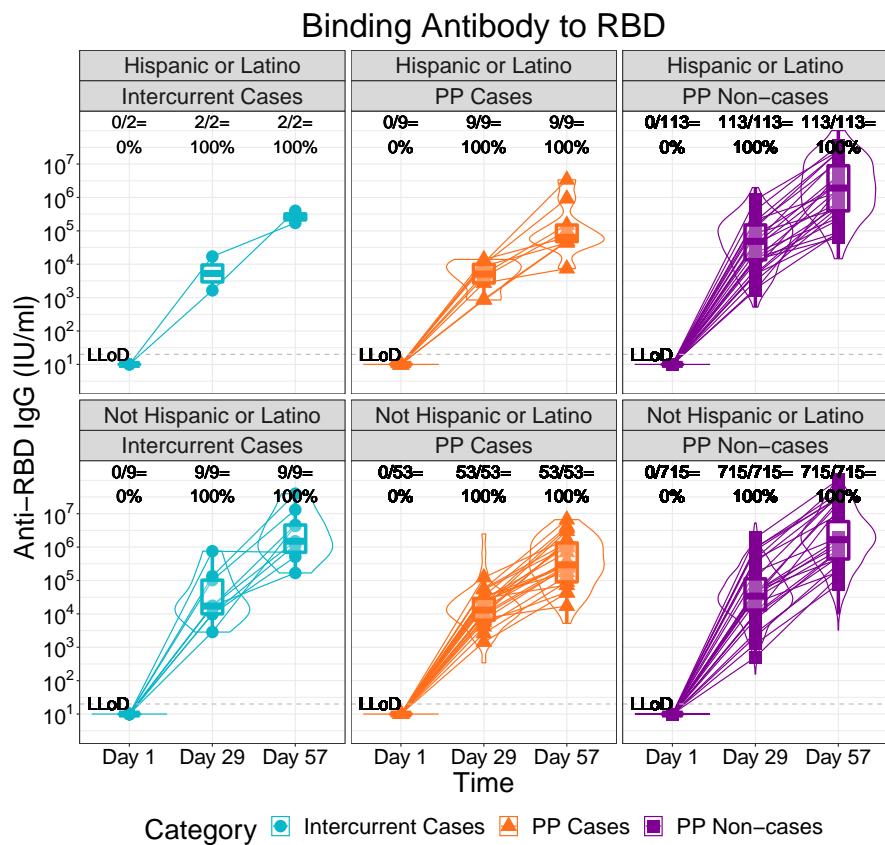


Figure 1.238: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

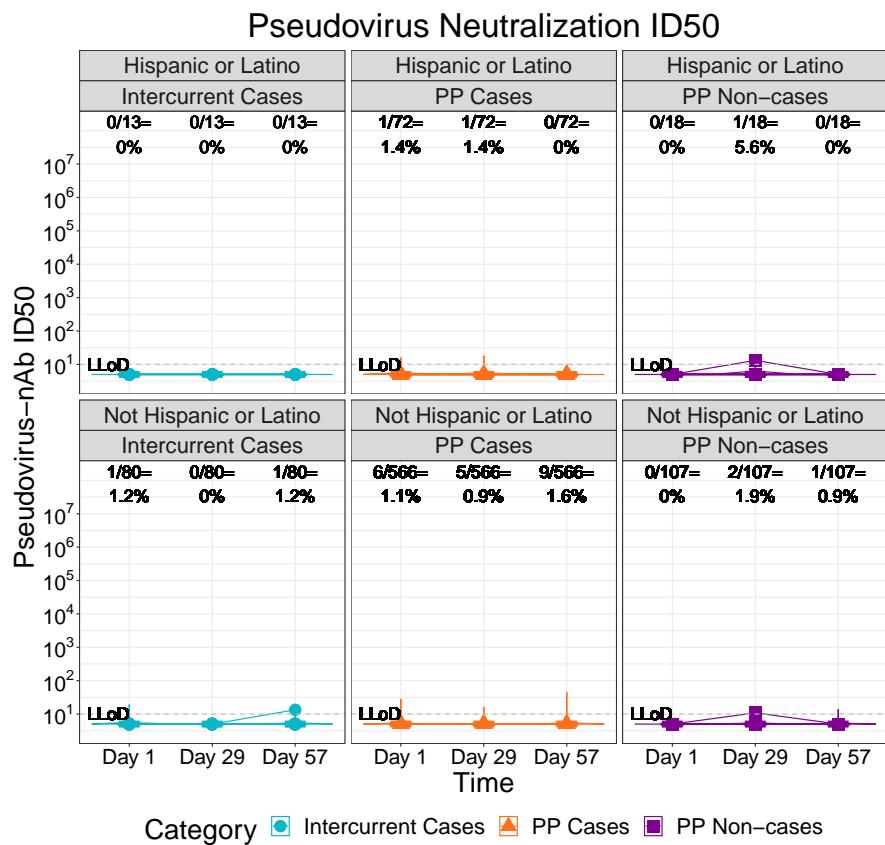


Figure 1.239: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

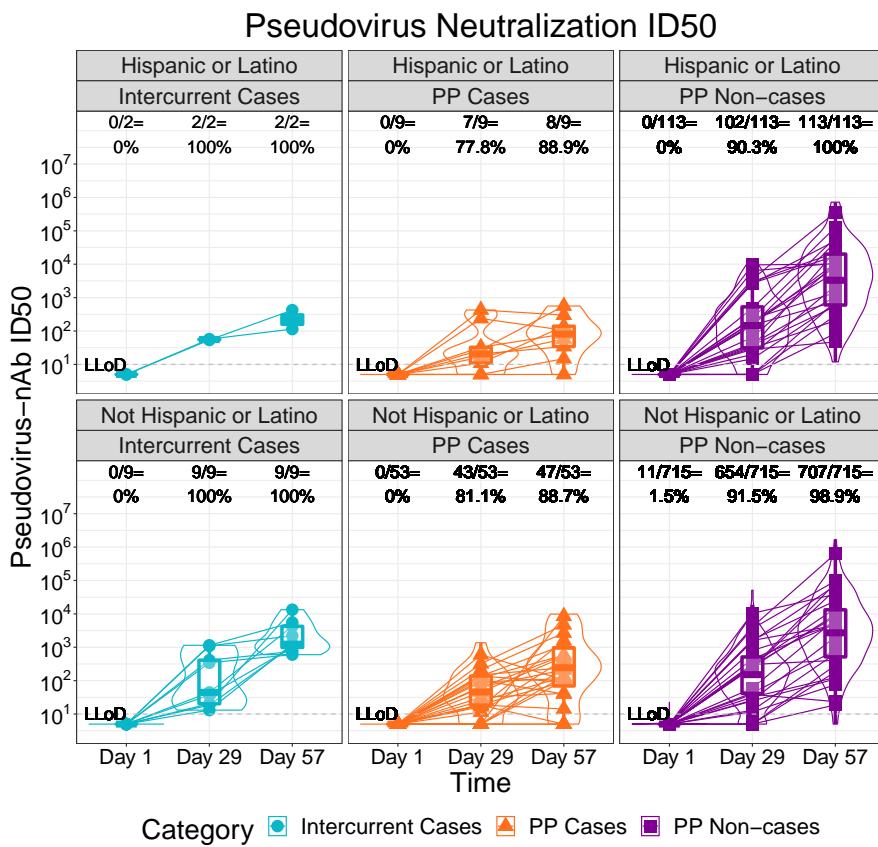


Figure 1.240: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

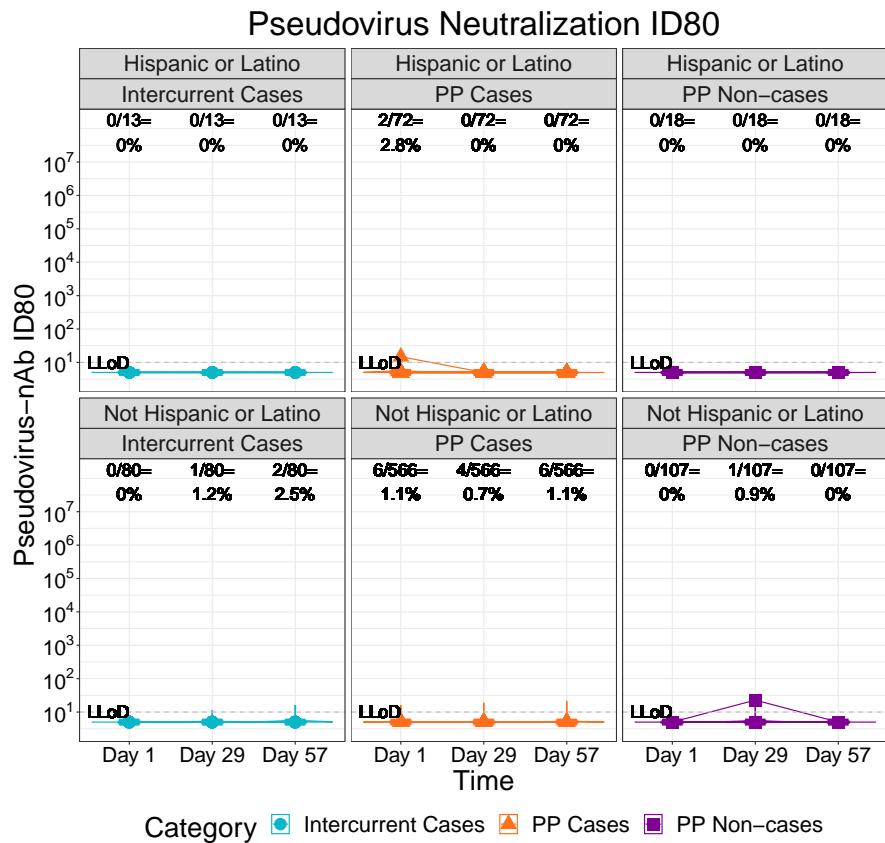


Figure 1.241: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

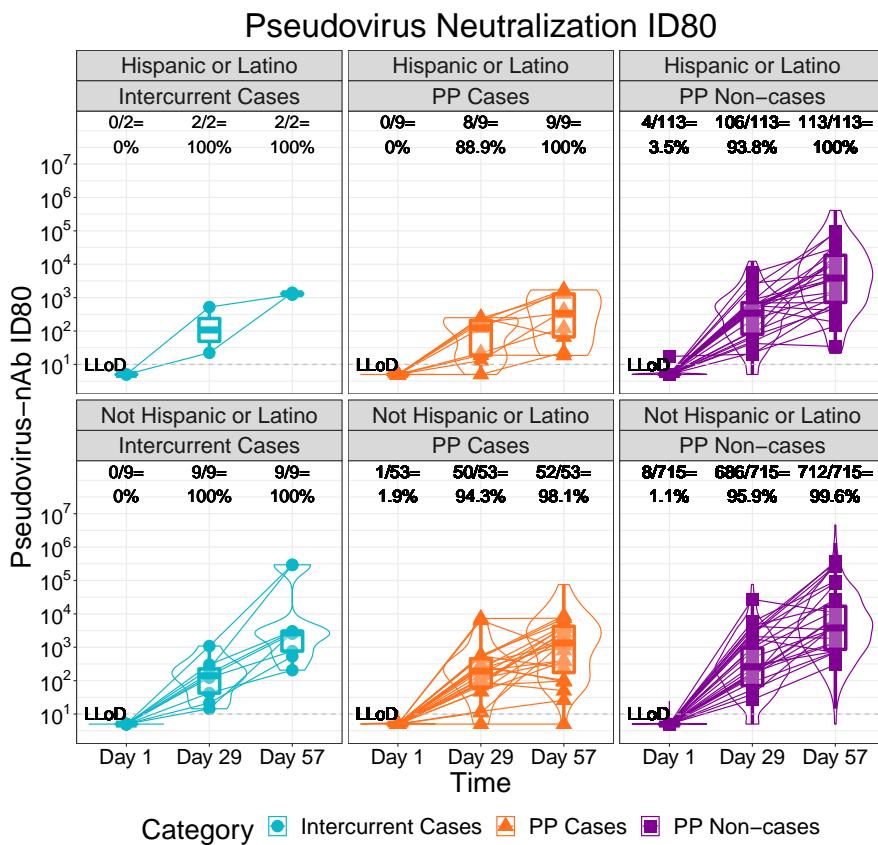


Figure 1.242: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

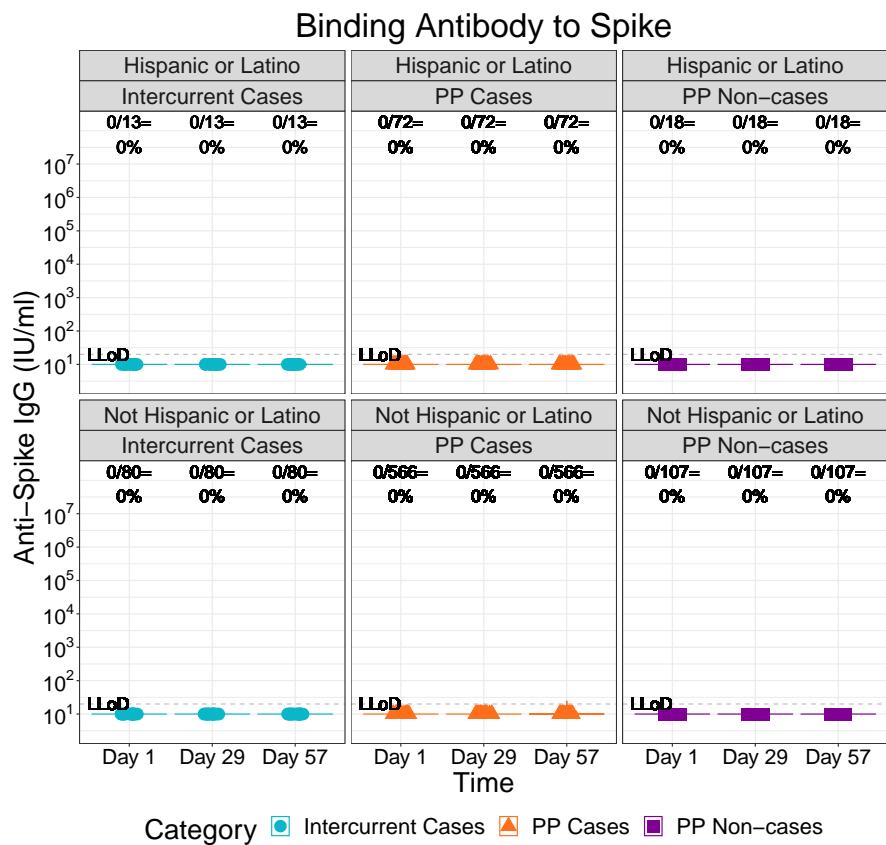


Figure 1.243: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

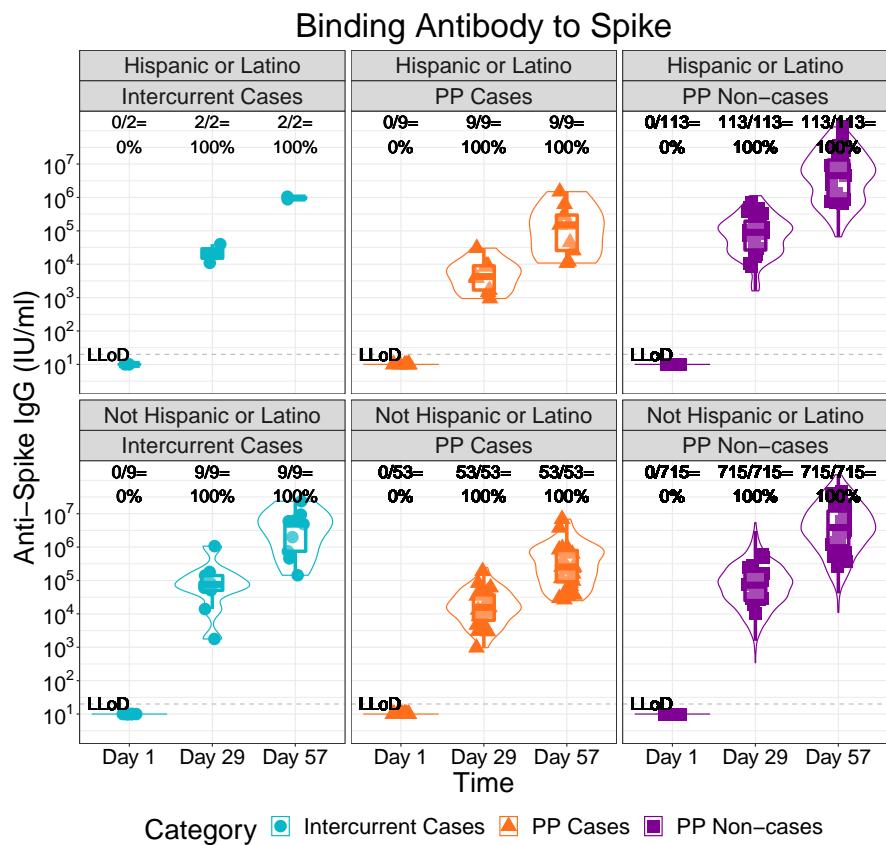


Figure 1.244: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

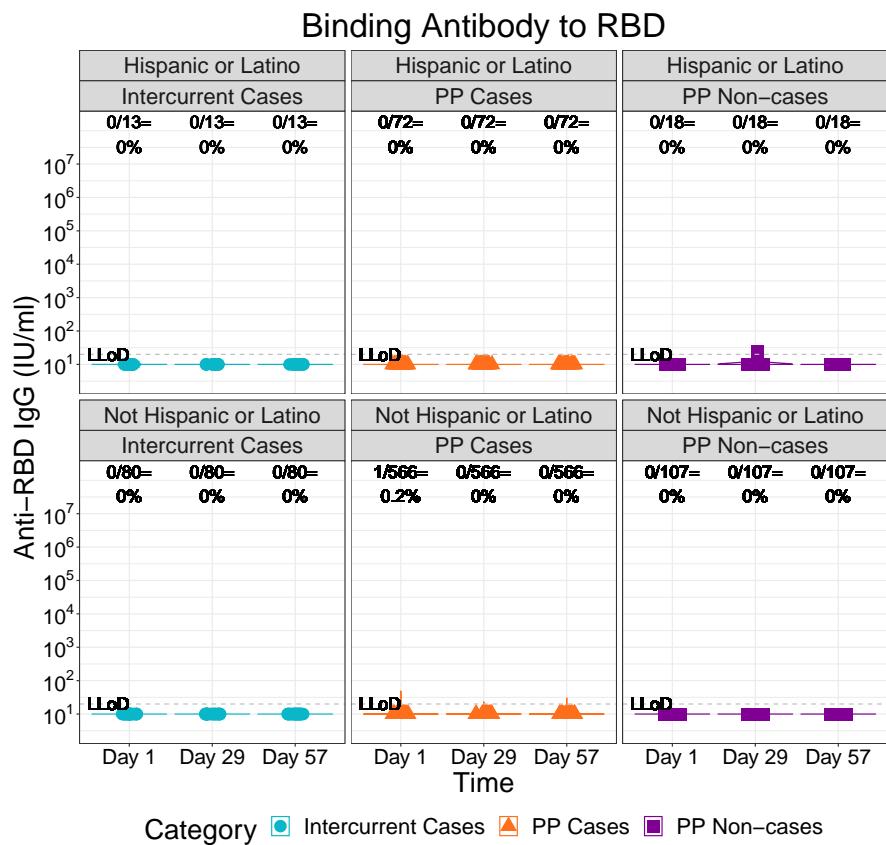


Figure 1.245: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

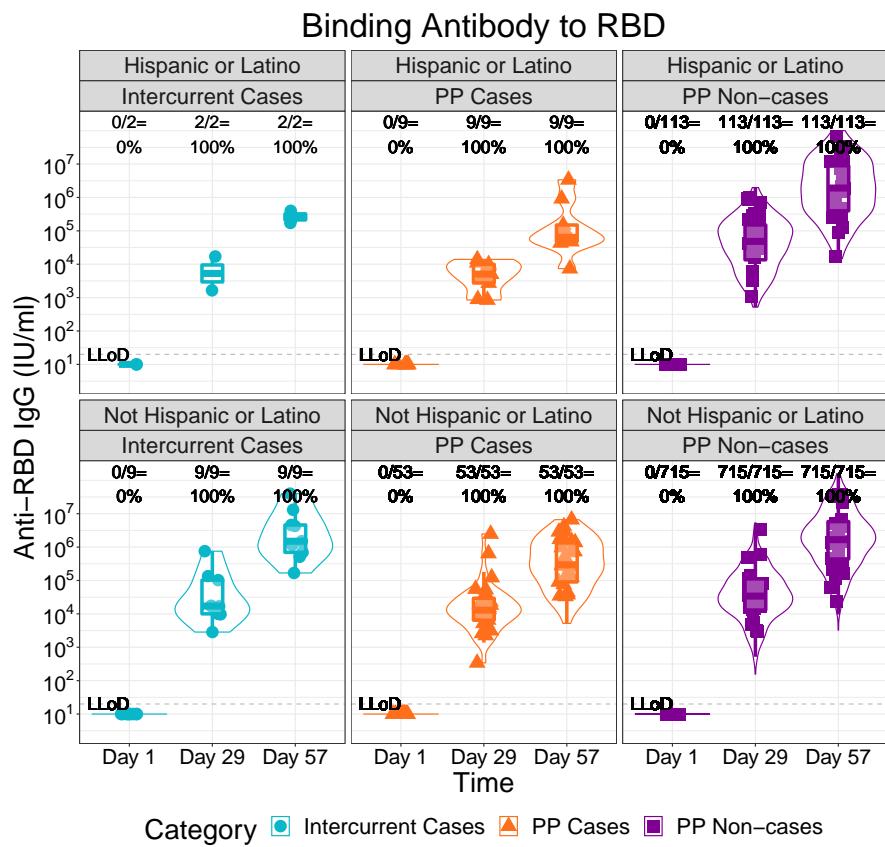


Figure 1.246: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

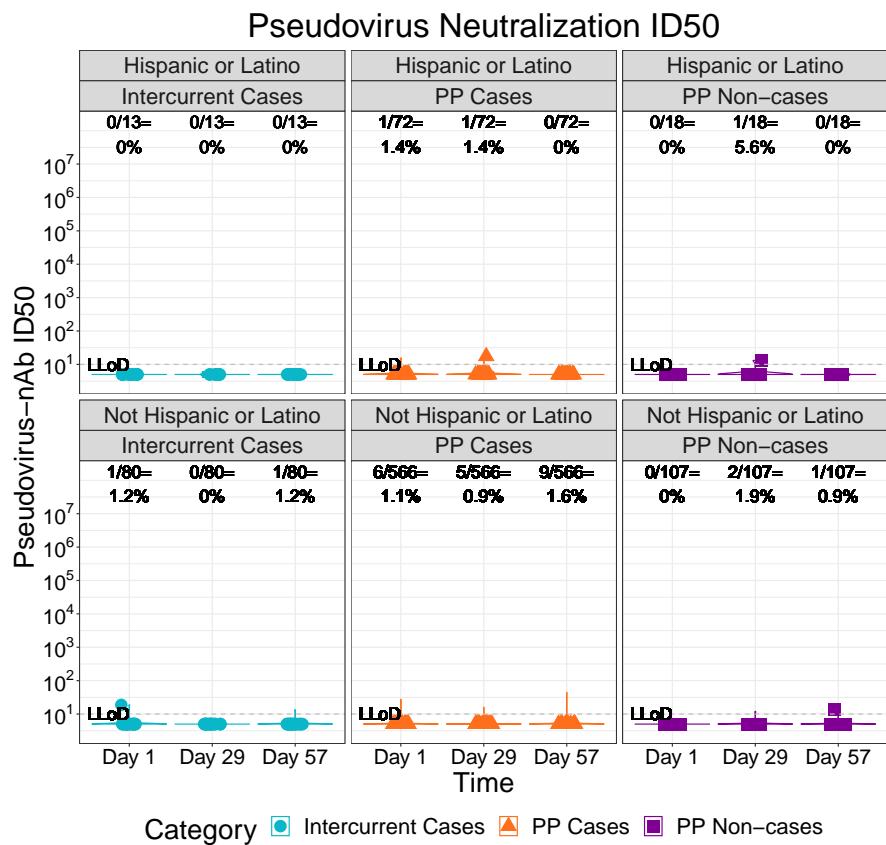


Figure 1.247: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

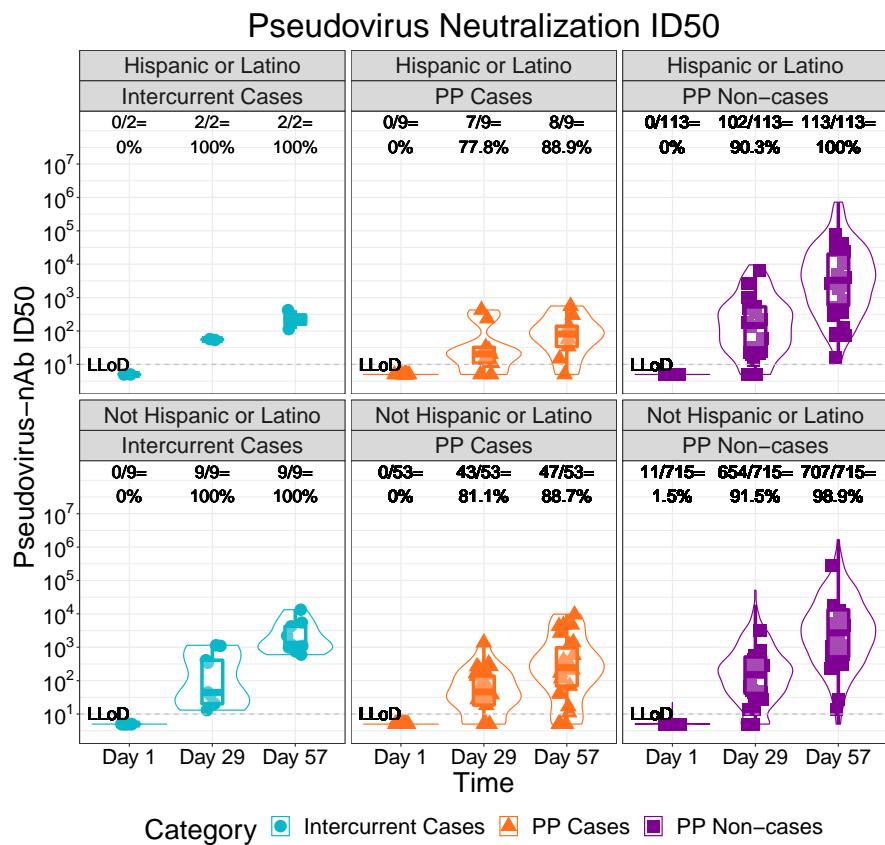


Figure 1.248: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

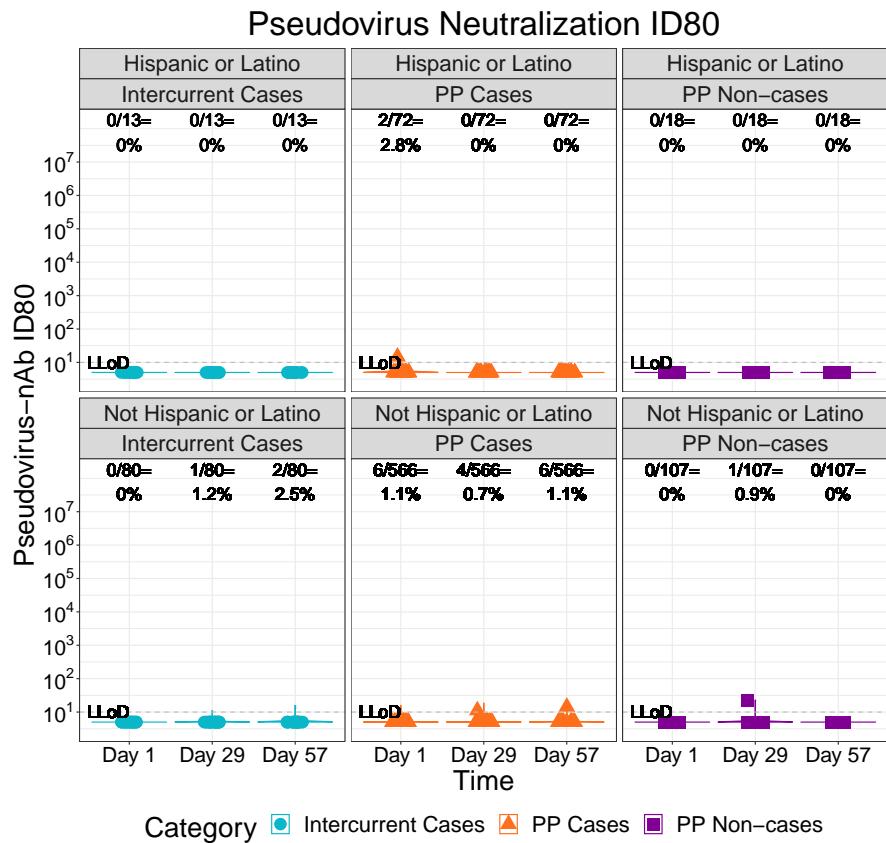


Figure 1.249: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

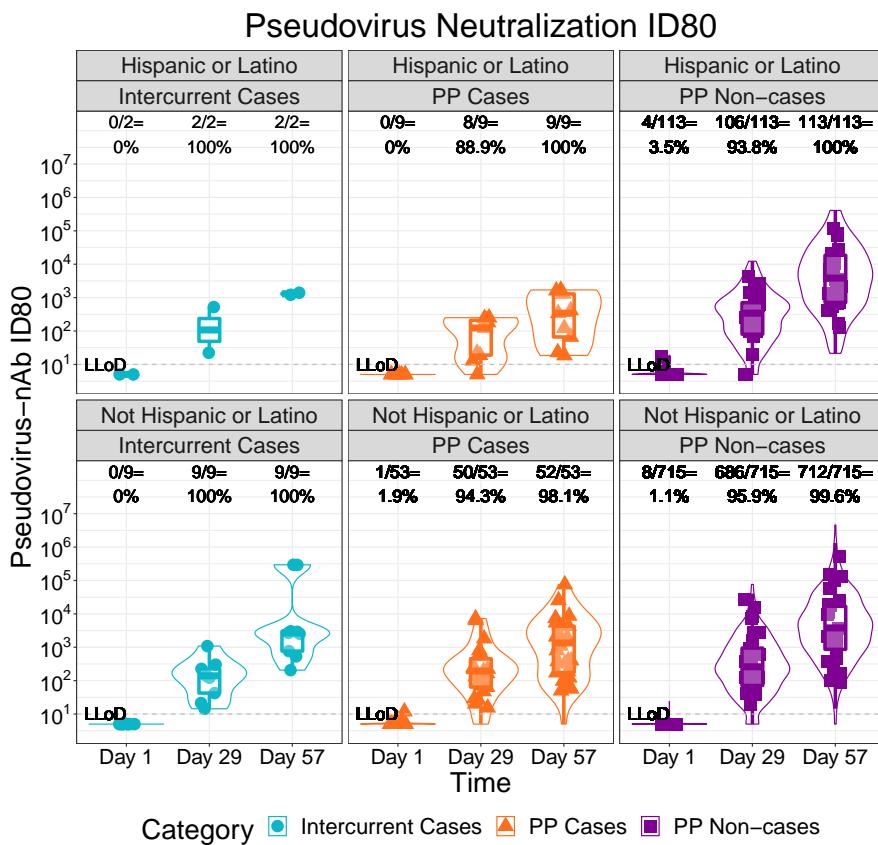


Figure 1.250: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

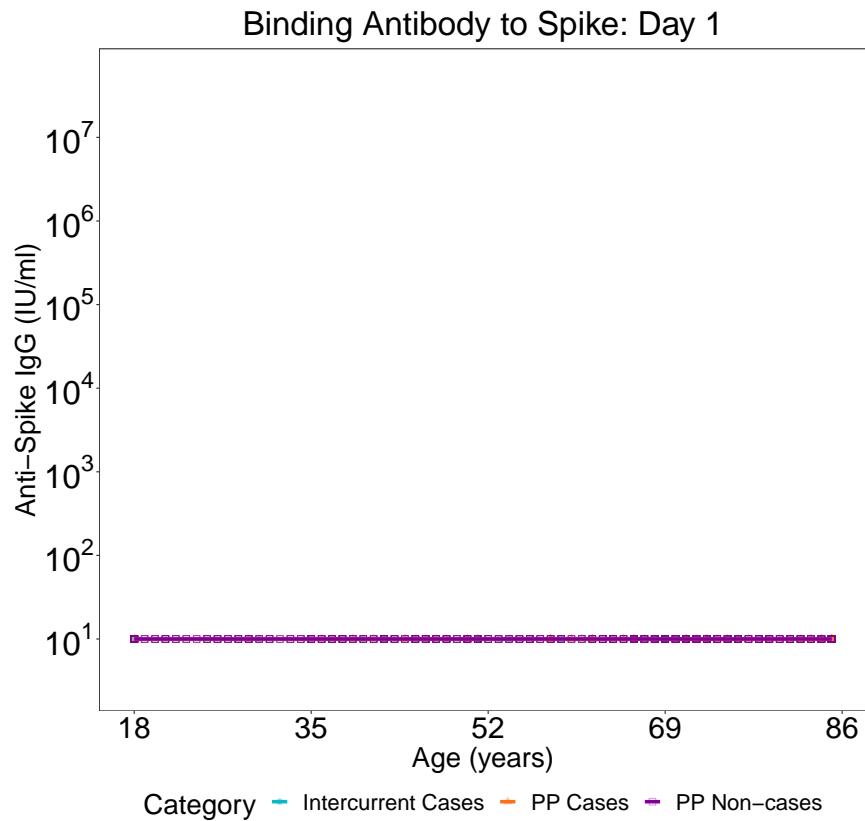


Figure 1.251: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1

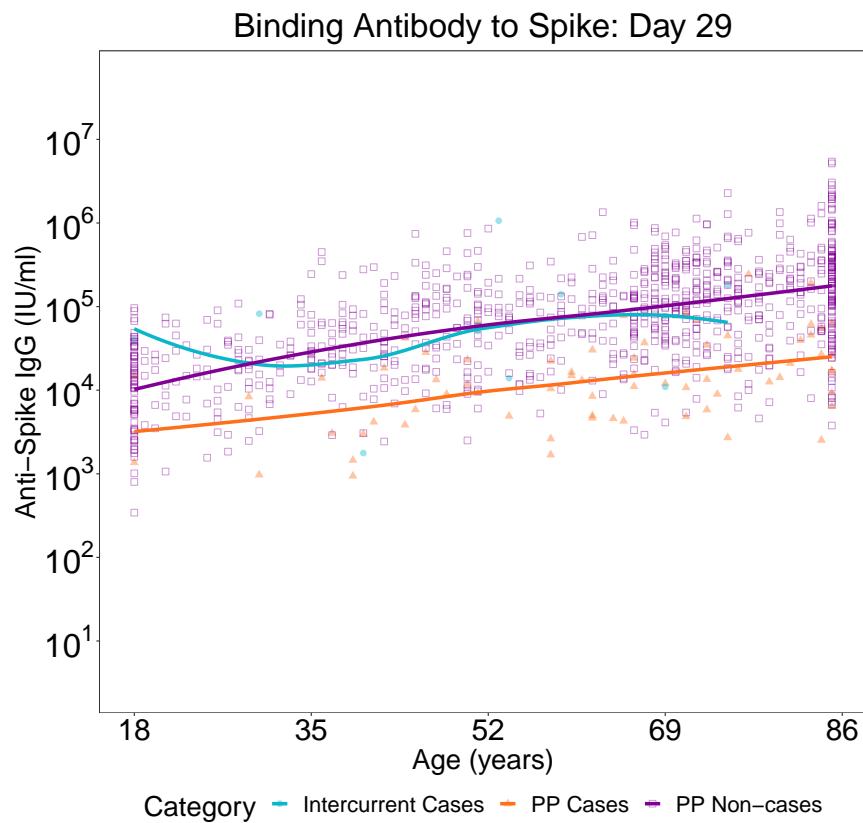


Figure 1.252: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29

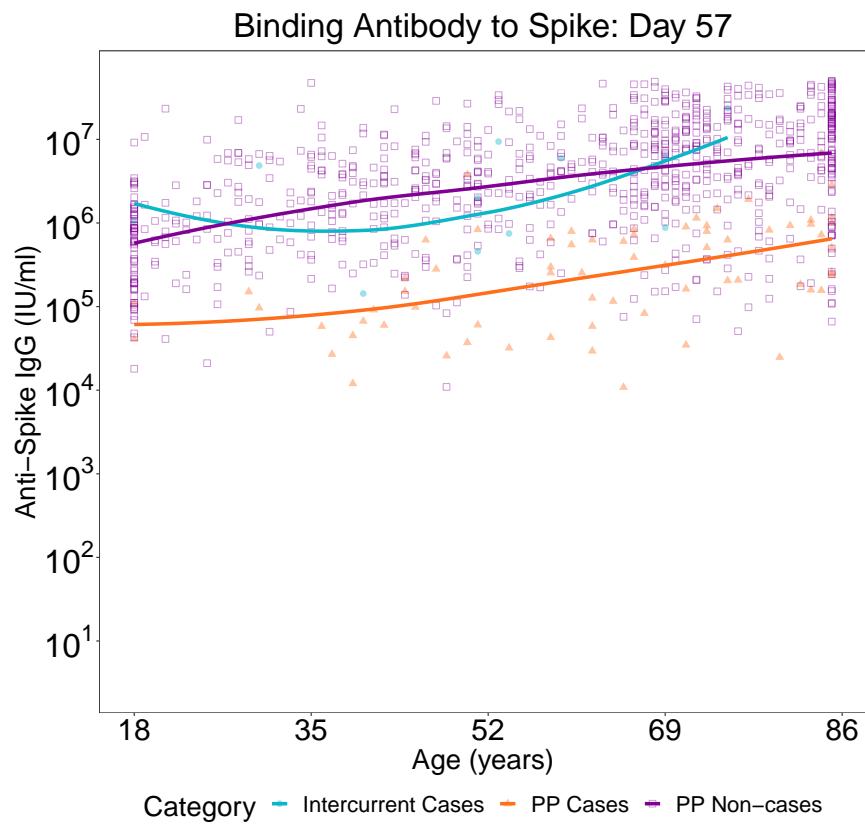


Figure 1.253: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57

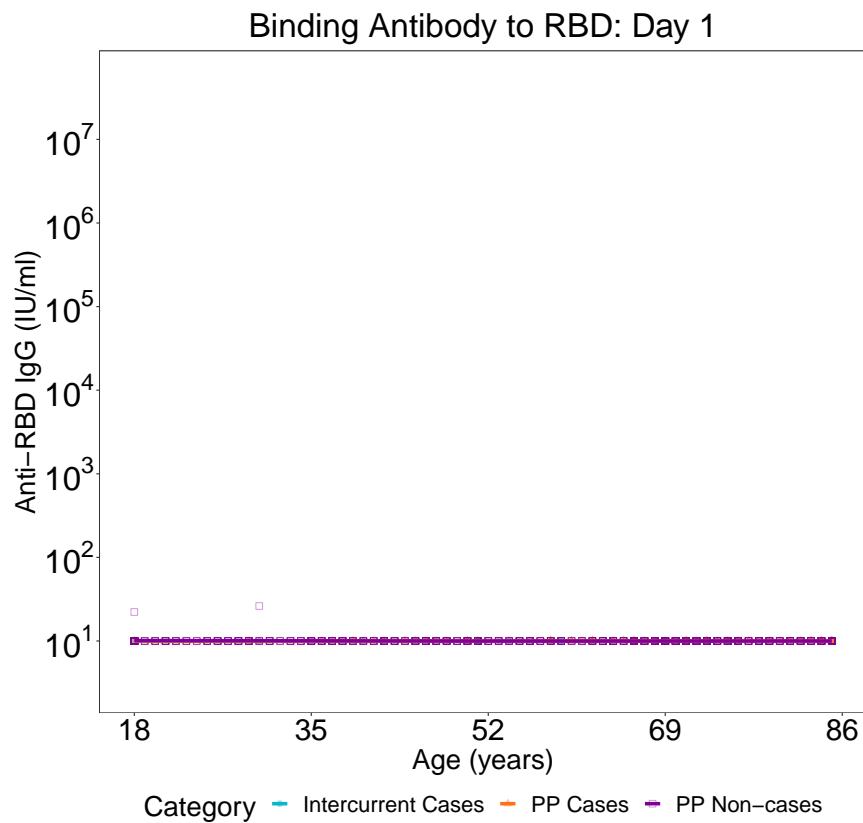


Figure 1.254: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1

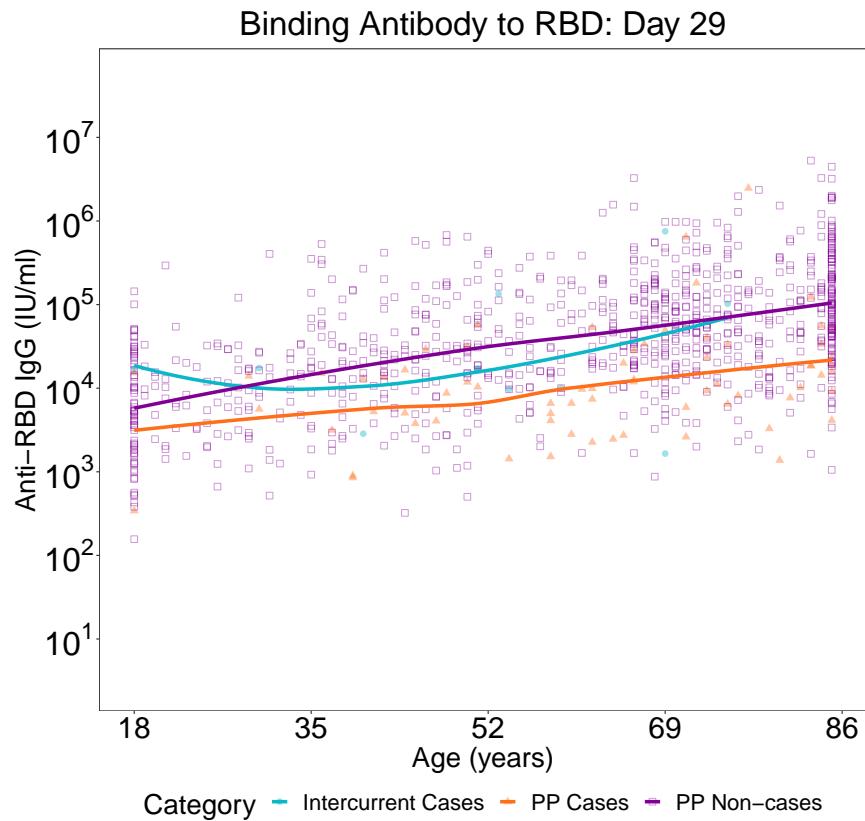


Figure 1.255: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29

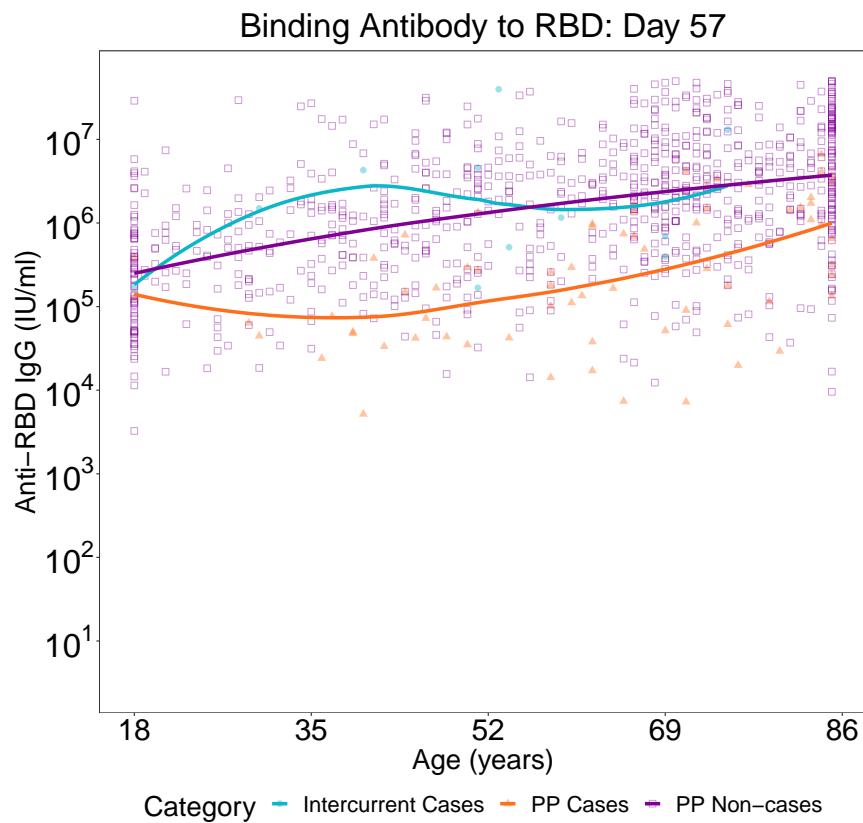


Figure 1.256: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57

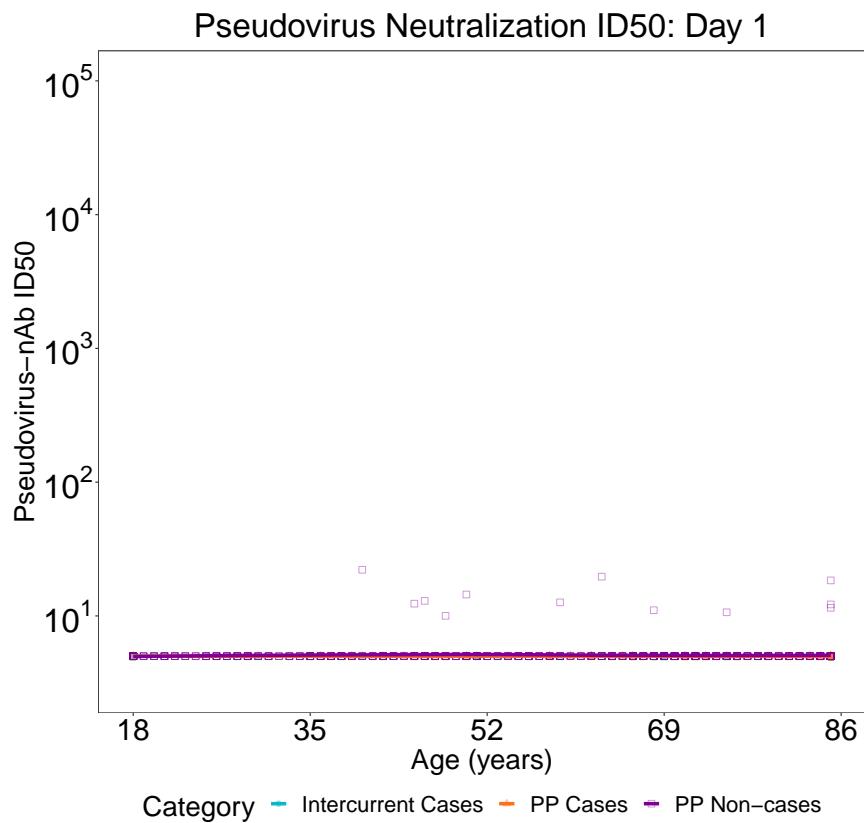


Figure 1.257: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1

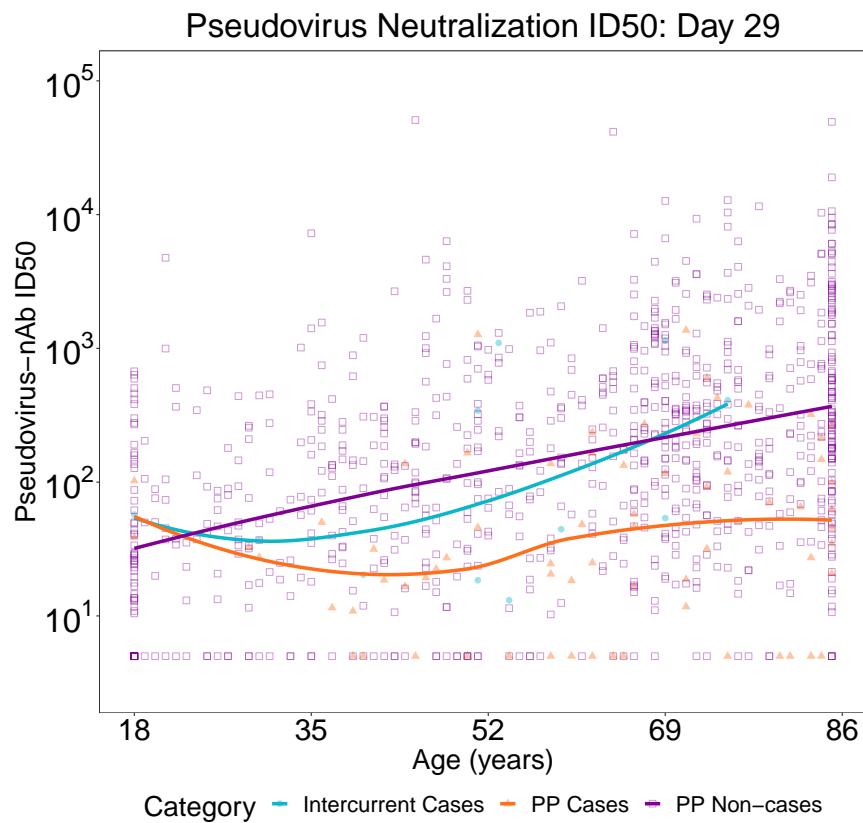


Figure 1.258: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29

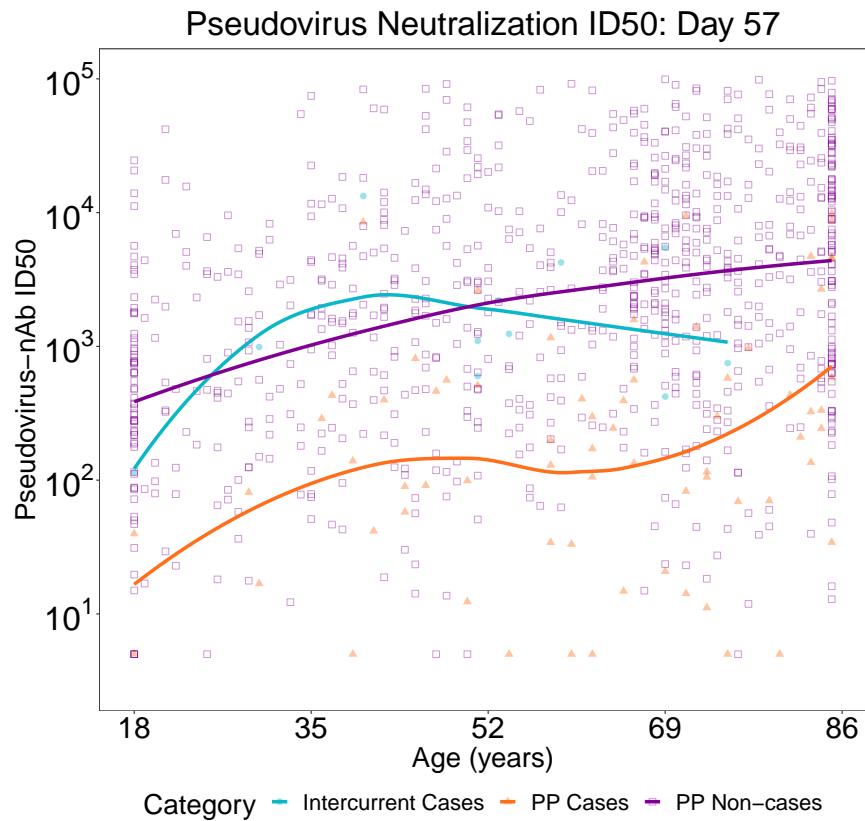


Figure 1.259: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 57

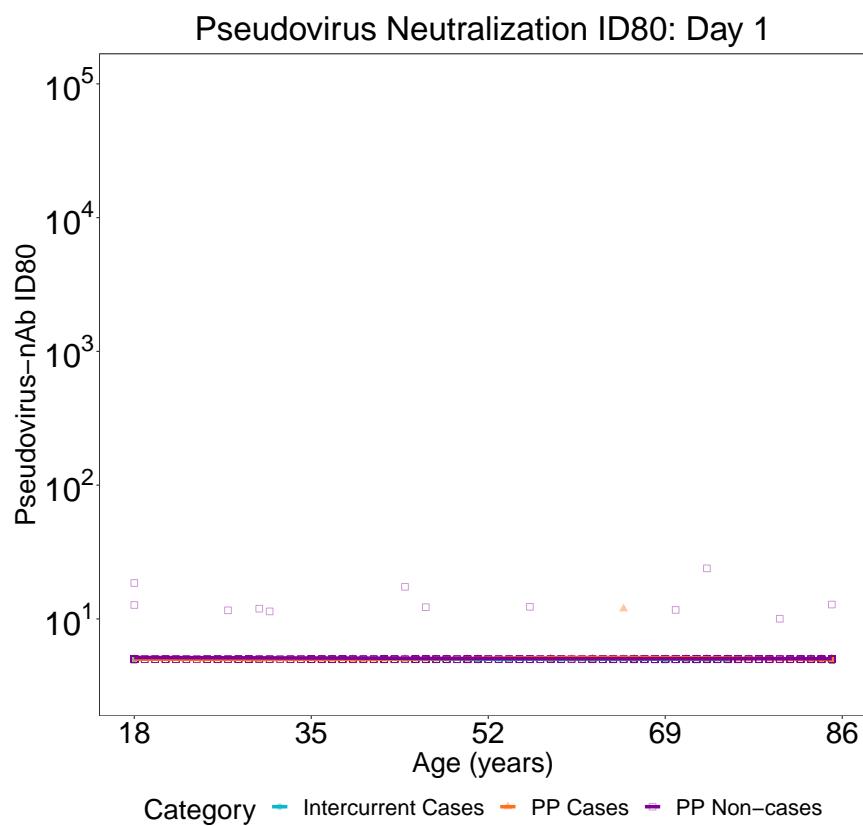


Figure 1.260: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1

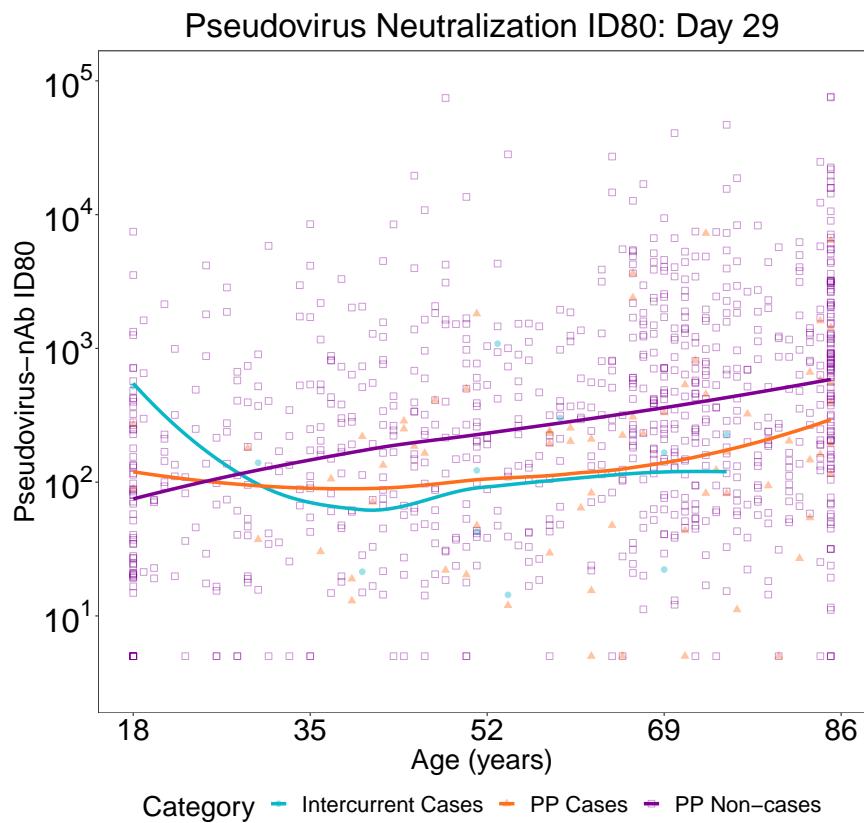


Figure 1.261: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29

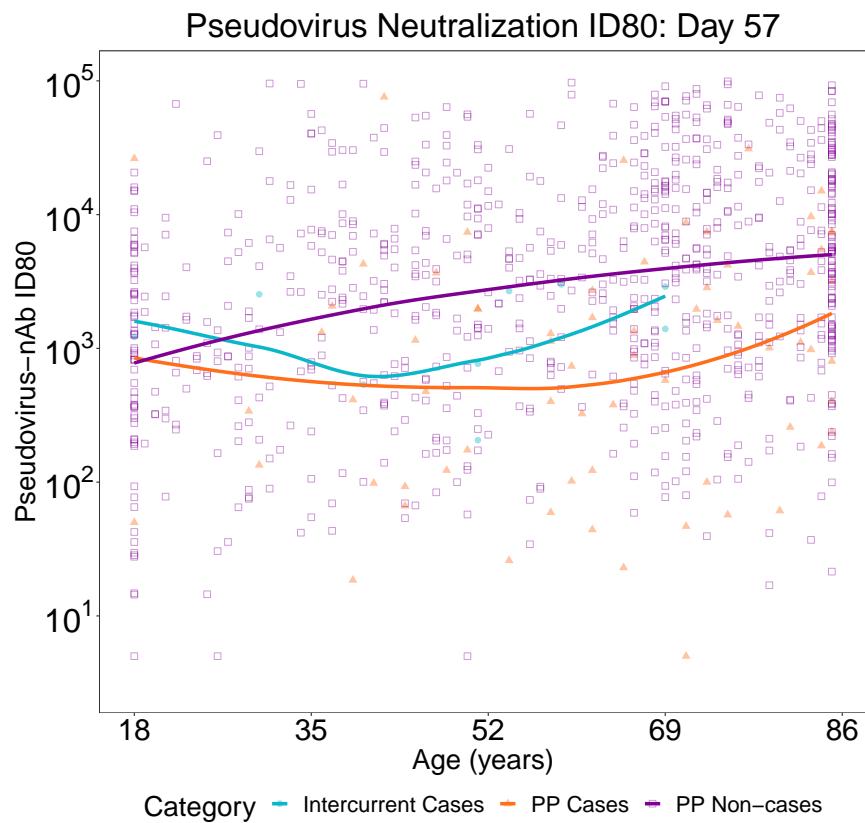


Figure 1.262: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57

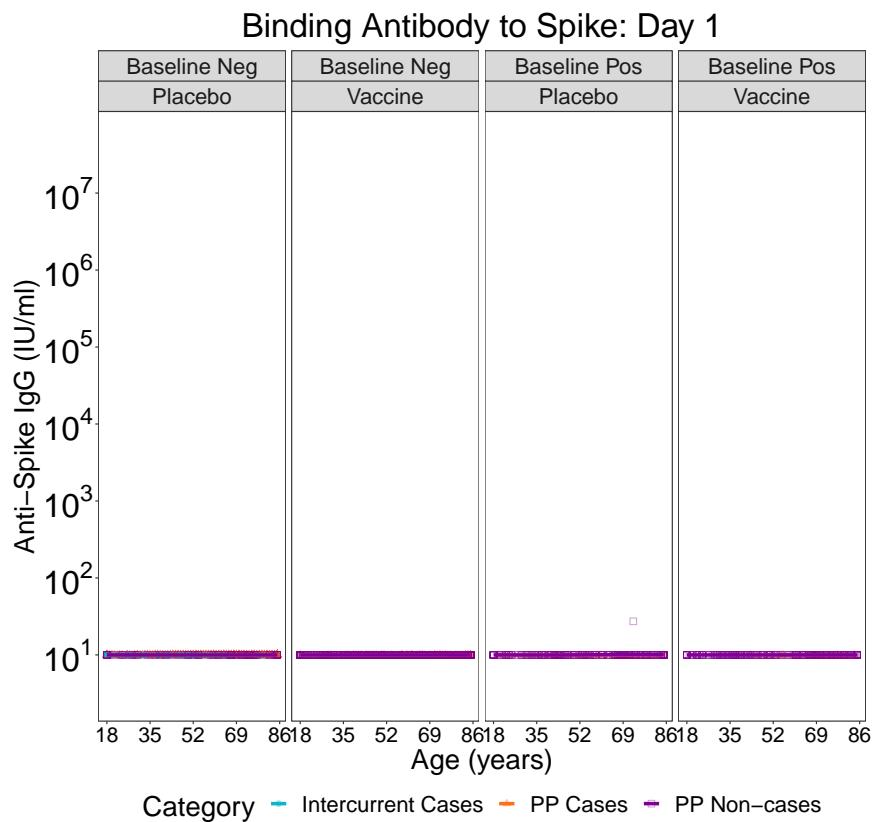


Figure 1.263: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 1

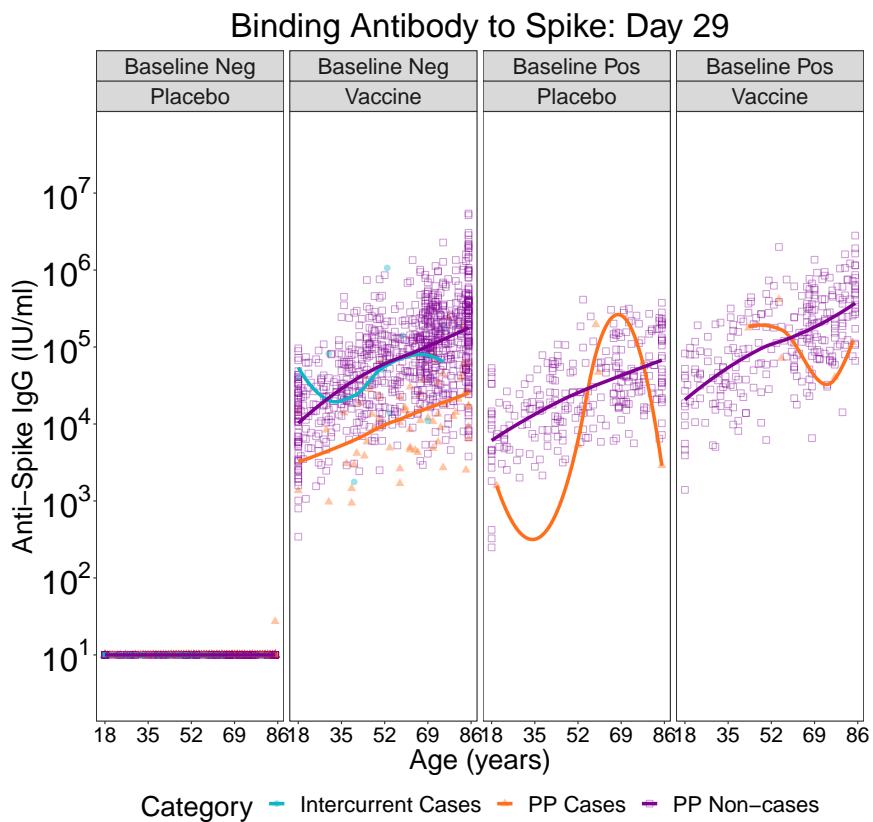


Figure 1.264: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 29

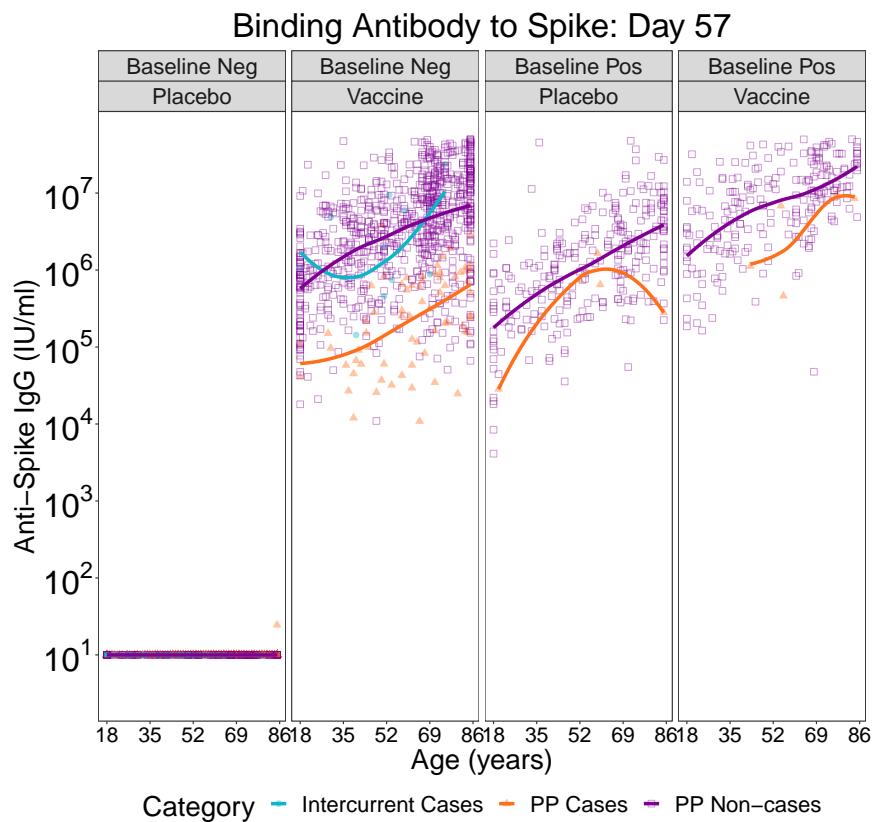


Figure 1.265: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 57

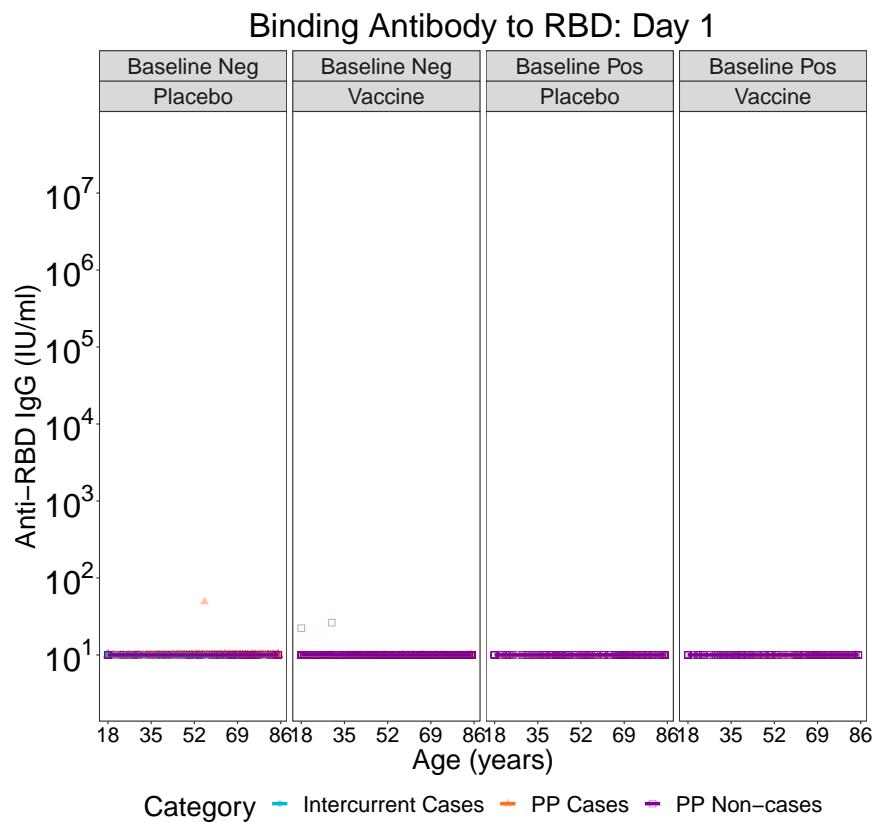


Figure 1.266: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 1

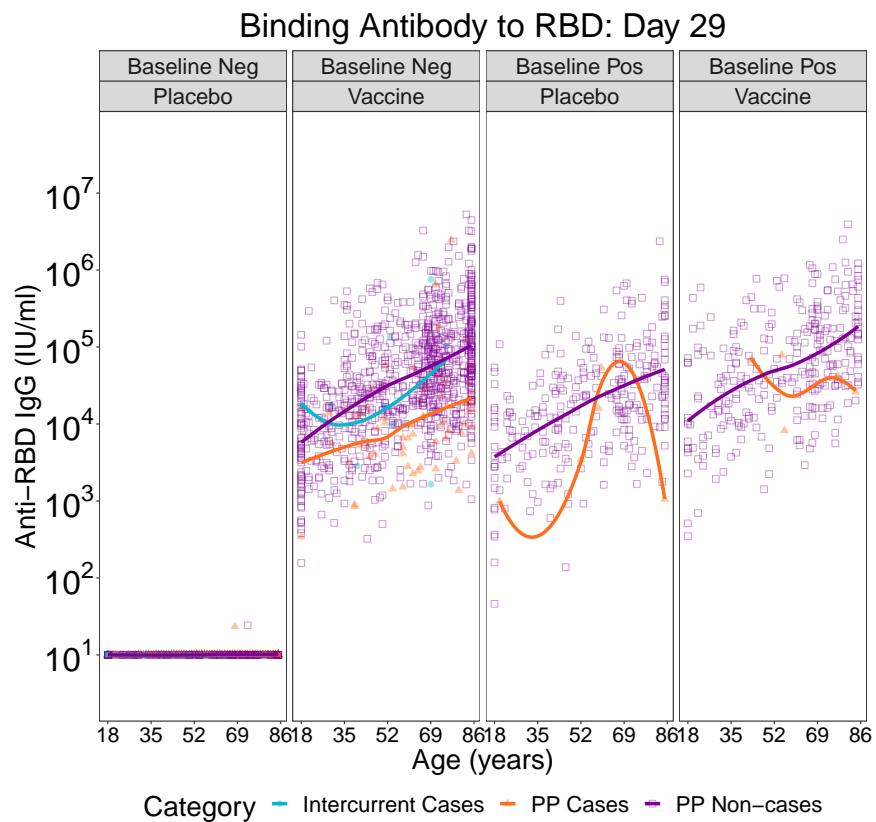


Figure 1.267: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 29

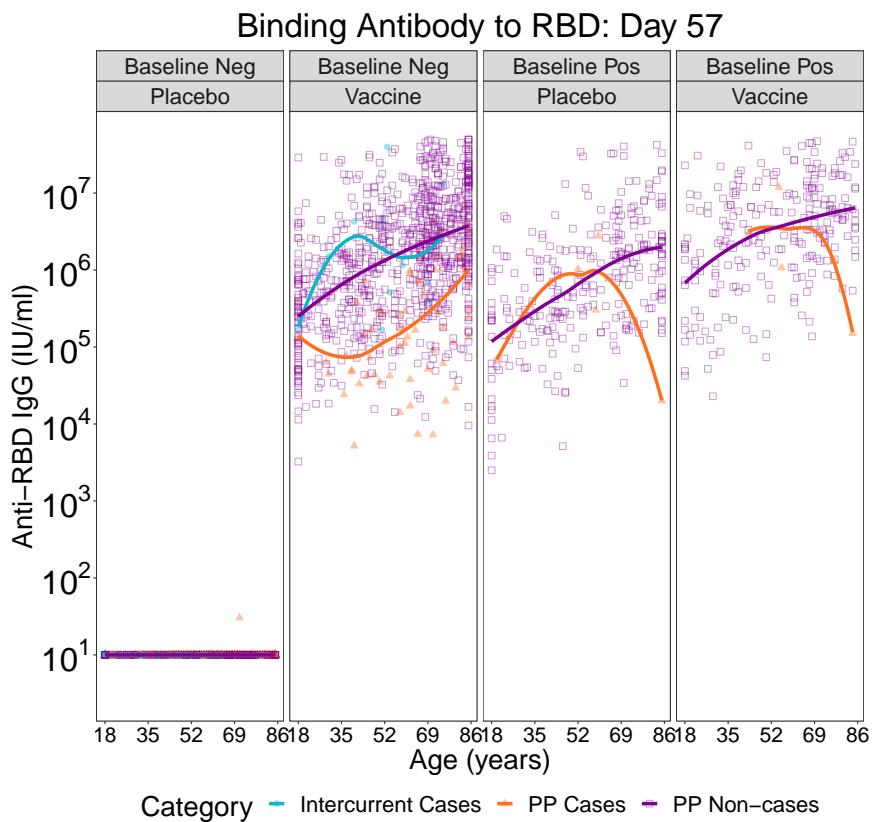


Figure 1.268: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 57

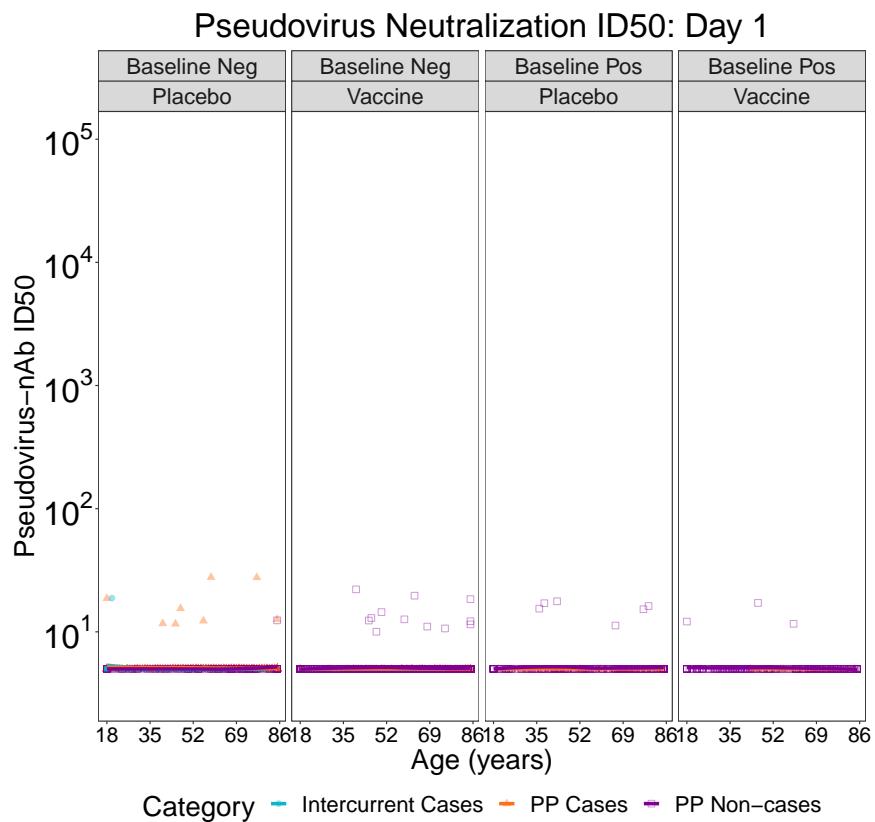


Figure 1.269: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 1

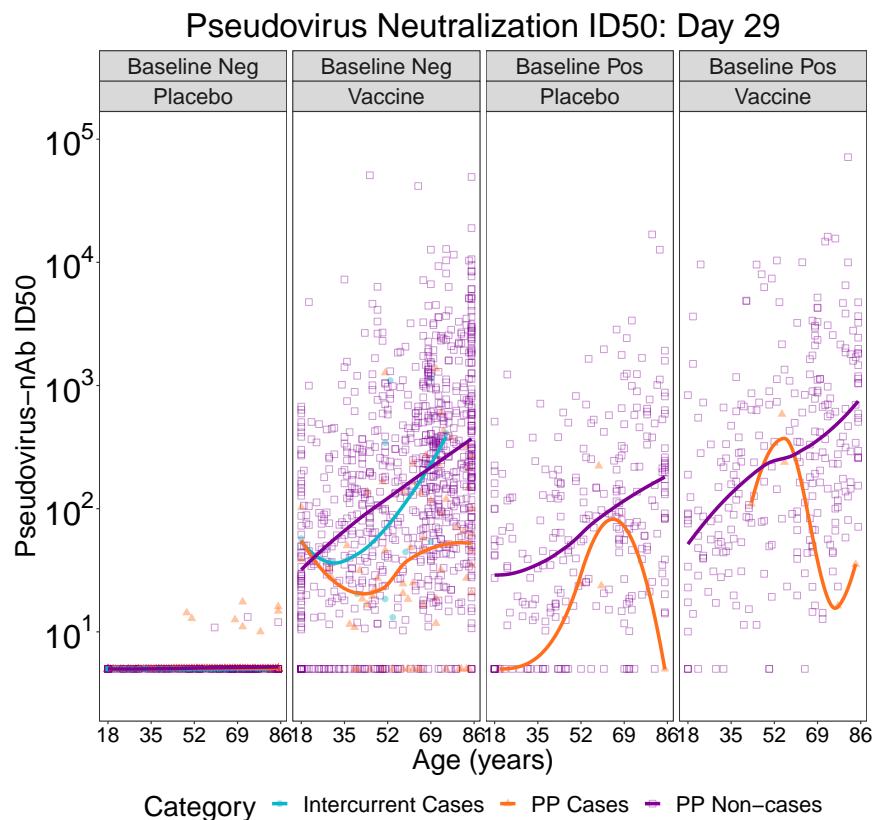


Figure 1.270: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 29

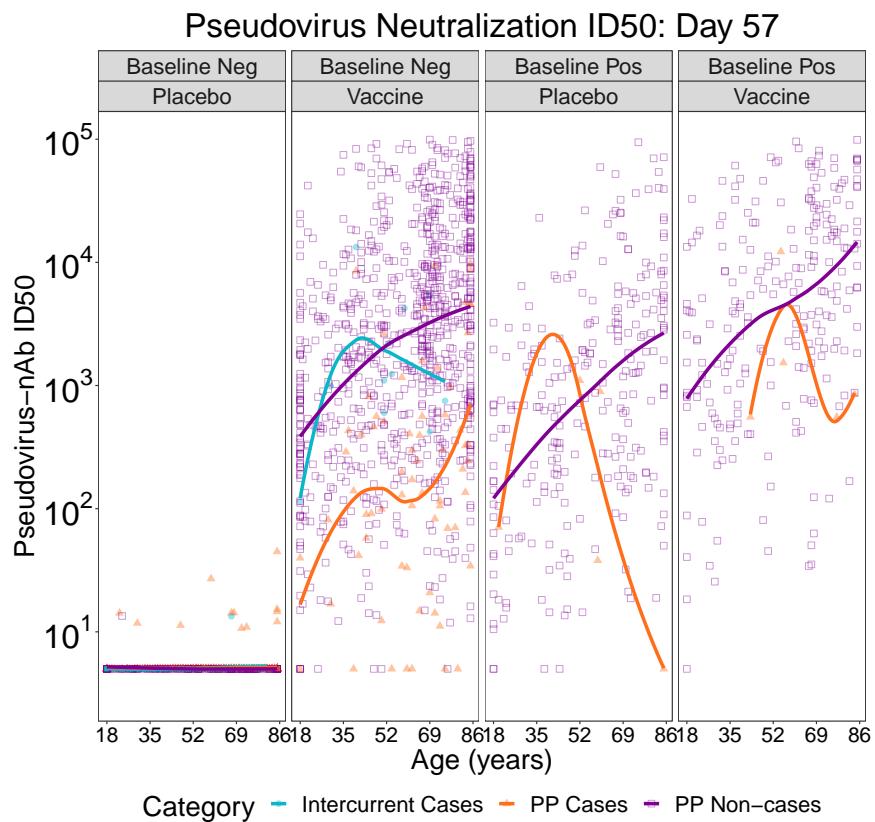


Figure 1.271: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 57

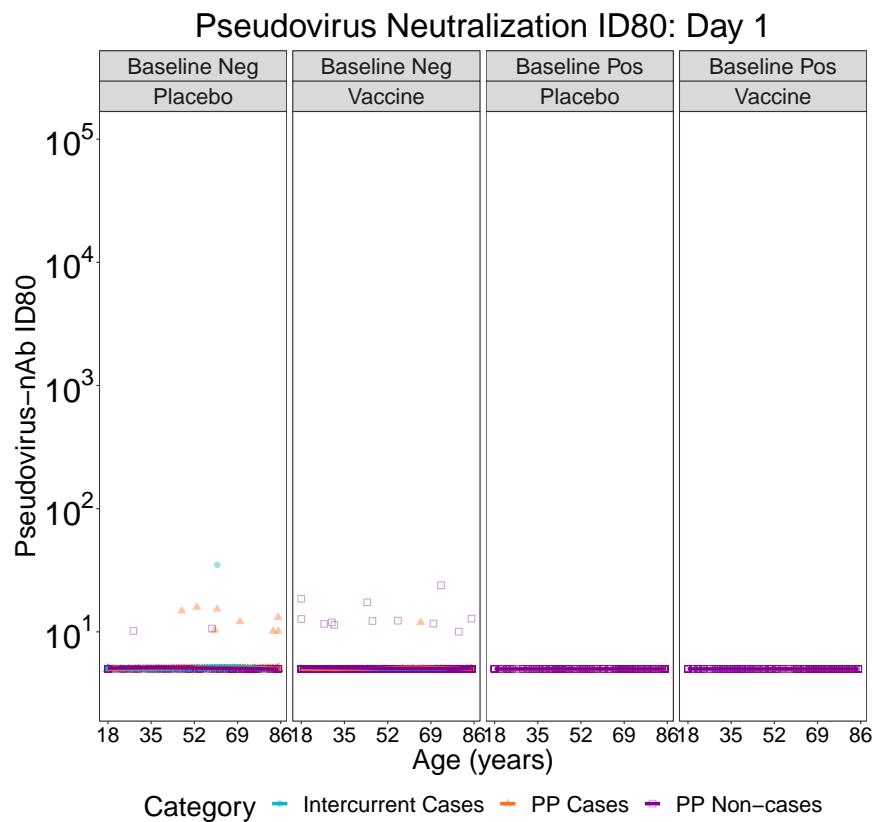


Figure 1.272: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 1

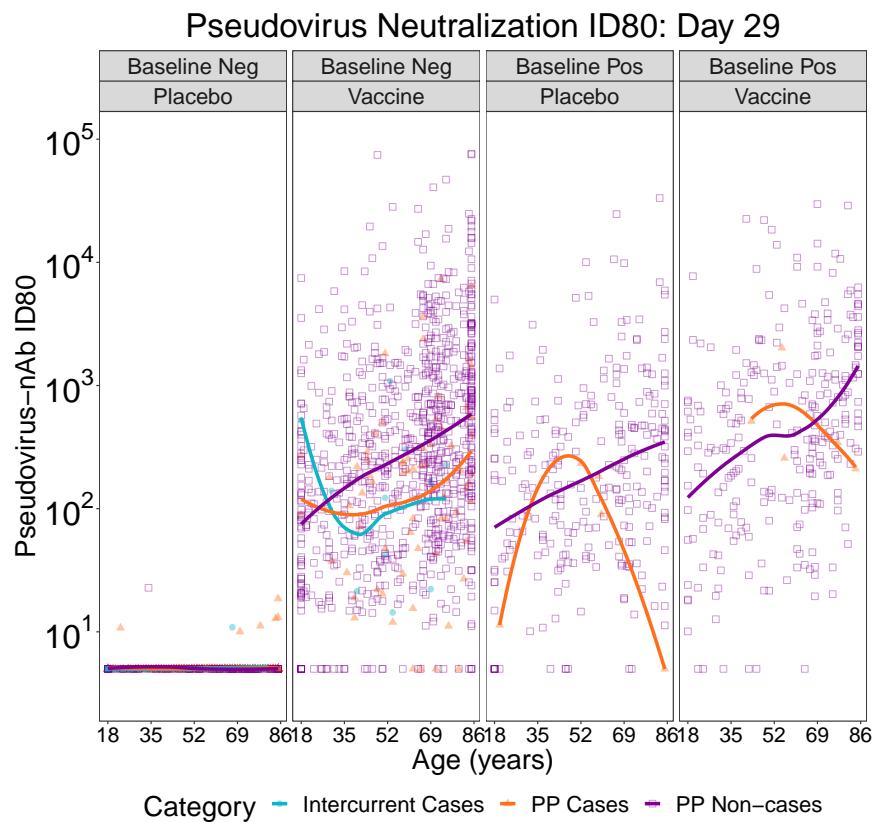


Figure 1.273: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 29

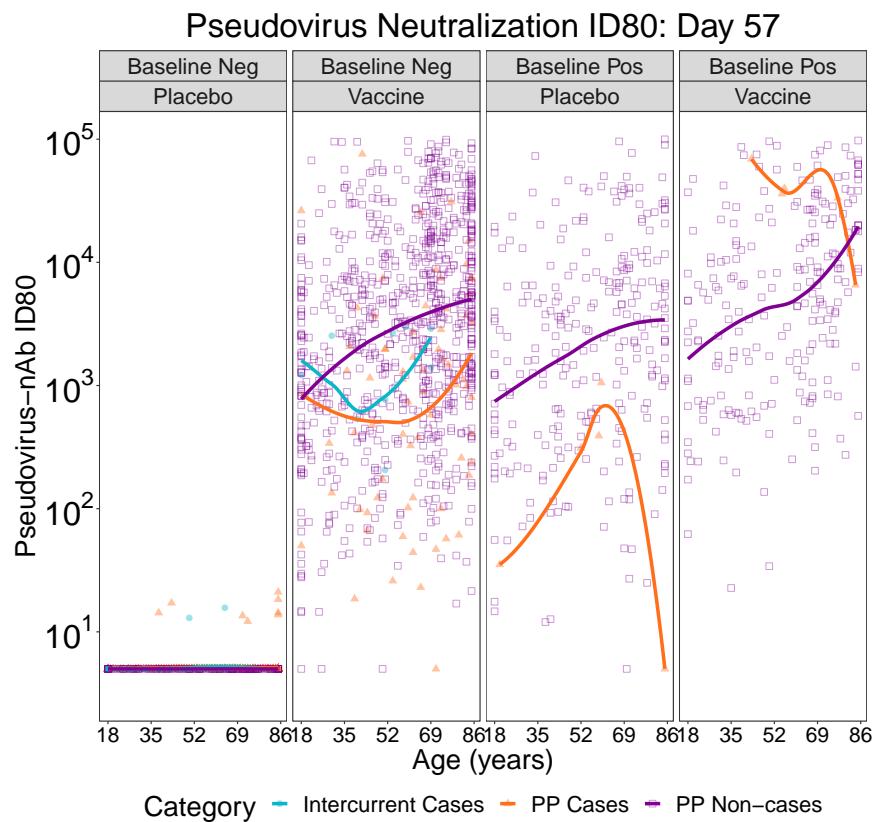


Figure 1.274: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 57



## Chapter 2

# 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.

### 2.1 Hazard ratios

Table 2.1: 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\*

Mock Immunologic Marker	No. cases / No. at-risk**	HR per 10-fold incr. Pt. Est.	95% CI	P-value (2-sided)	q-value	FWER
Spike IgG (IU/ml)	72/13,254	0.08	(0.05-0.12)	<0.001	<0.001	<0.001
RBD IgG (IU/ml)	72/13,254	0.17	(0.12-0.25)	<0.001	<0.001	<0.001
PsV-nAb ID50	72/13,254	0.24	(0.18-0.31)	<0.001	<0.001	<0.001
PsV-nAb ID80	72/13,254	0.38	(0.28-0.51)	<0.001	<0.001	<0.001

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not \*\*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.

Table 2.2: 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\*

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
Spike IgG (IU/ml)	Lower	67/4,425	0.0151	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	4/4,403	0.0009	0.04	(0.01-0.11)	<0.001			
	Upper	1/4,426	0.0002	0.00	(0.00-0.03)	<0.001			
RBD IgG (IU/ml)	Lower	45/4,437	0.0101	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	19/4,398	0.0043	0.24	(0.13-0.43)	<0.001			
	Upper	8/4,420	0.0018	0.05	(0.02-0.12)	<0.001			
PsV-nAb ID50	Lower	56/4,443	0.0126	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	9/4,382	0.0021	0.10	(0.05-0.22)	<0.001			
	Upper	6/4,429	0.0014	0.05	(0.02-0.11)	<0.001			
PsV-nAb ID80	Lower	40/4,434	0.0090	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	21/4,400	0.0048	0.43	(0.24-0.79)	0.006			
	Upper	11/4,420	0.0025	0.17	(0.08-0.34)	<0.001			
Placebo		713/13,271	0.0537						

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not . Average follow-up time 172 days, maximum follow-up time 185 days. Cutpoints: Spike IgG (IU/ml) [6.09, 6.7), RBD IgG (IU/ml) [5.68, 6.38), PsV-nAb ID50 [2.8, 3.66), PsV-nAb ID80 [3.08, 3.82) \*\*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.

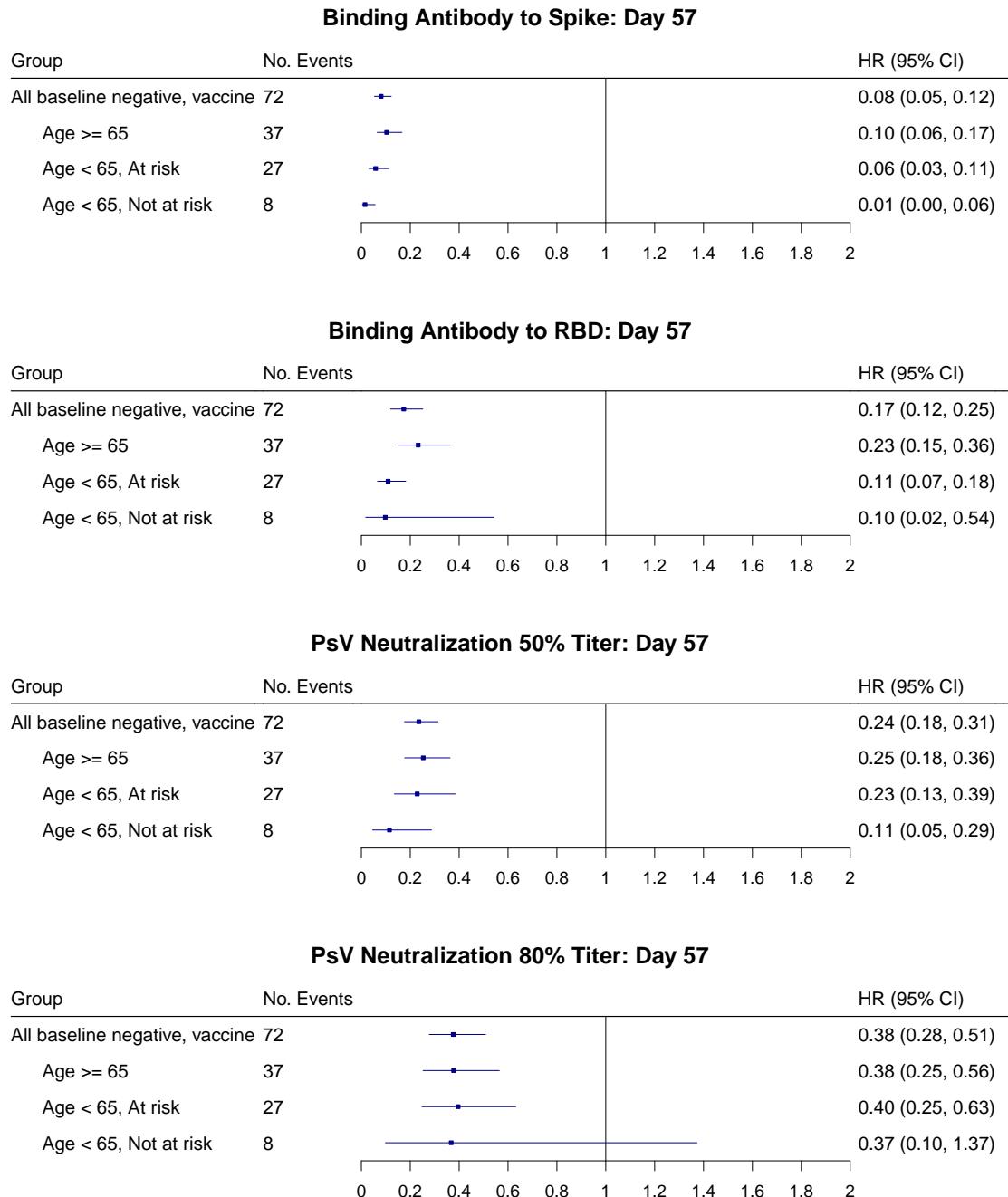


Figure 2.1: Forest plots of hazard ratios among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

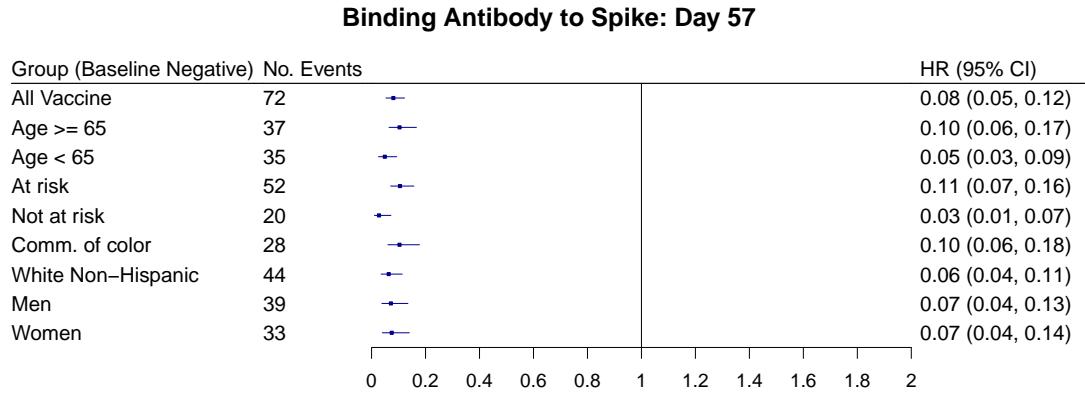


Figure 2.2: Forest plots of hazard ratios of Day 57 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

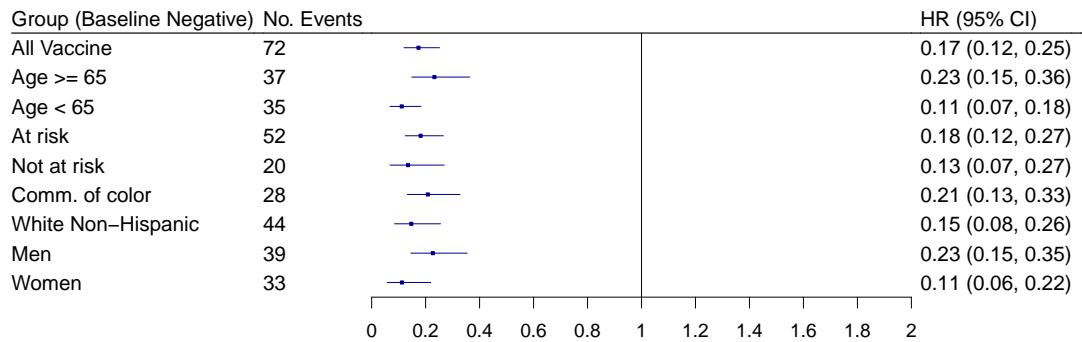
**Binding Antibody to RBD: Day 57**

Figure 2.3: Forest plots of hazard ratios of 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.

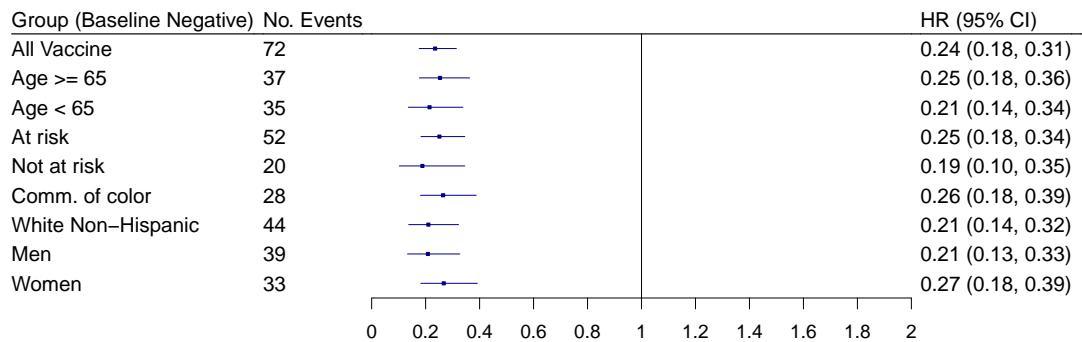
**PsV Neutralization 50% Titer: Day 57**

Figure 2.4: Forest plots of hazard ratios of 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.

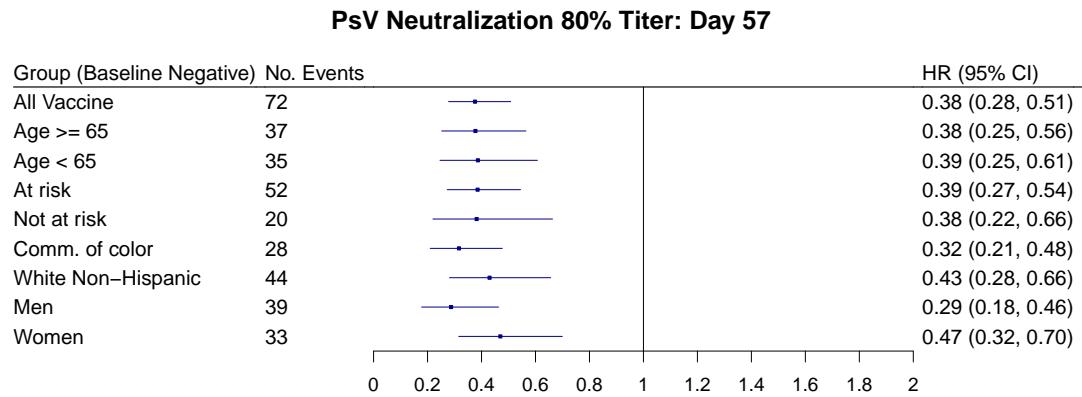


Figure 2.5: Forest plots of hazard ratios of Day 57 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

## 2.2 Marginalized risk and controlled vaccine efficacy plots

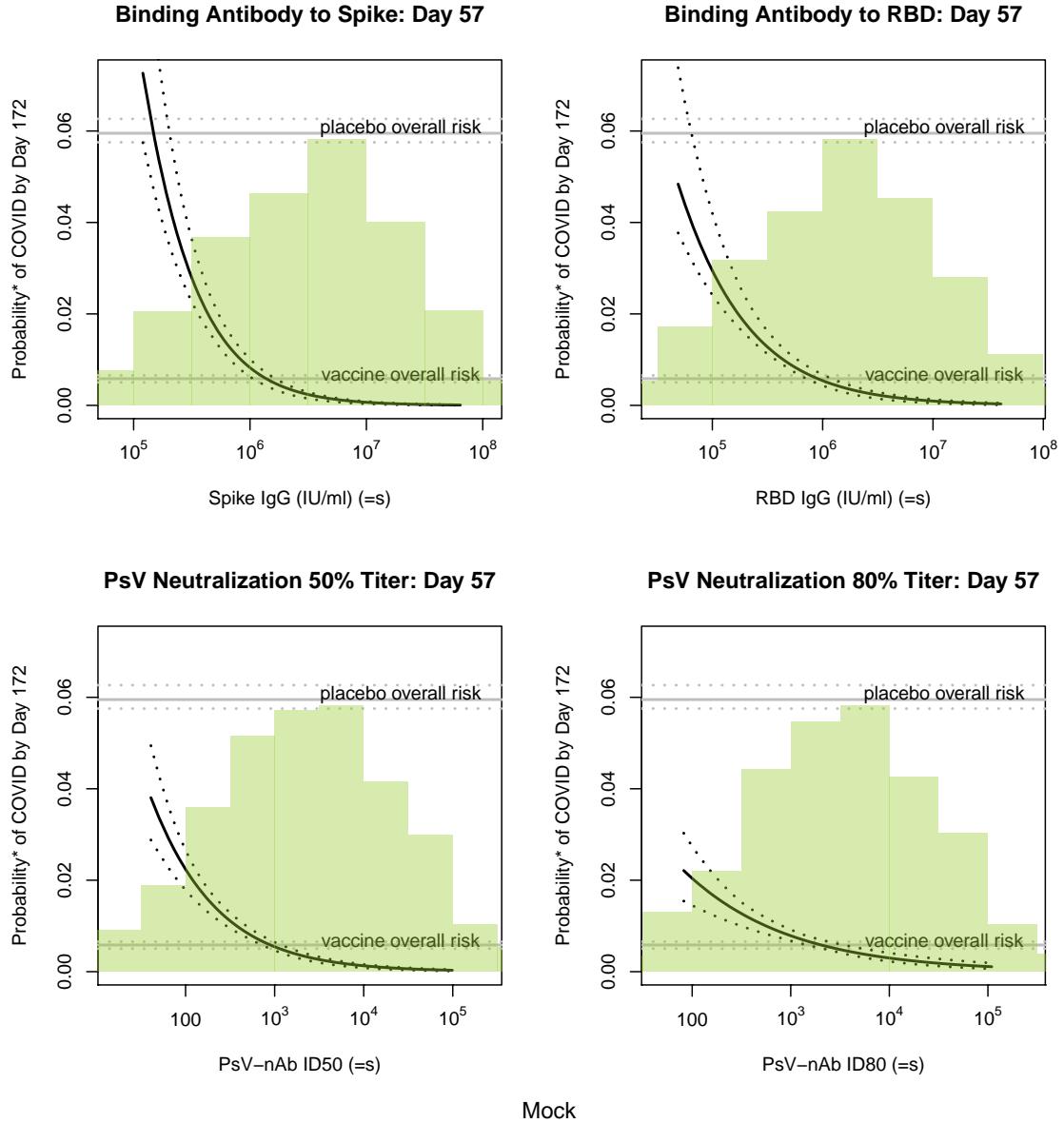


Figure 2.6: Marginalized cumulative risk by Day 172 as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 172 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

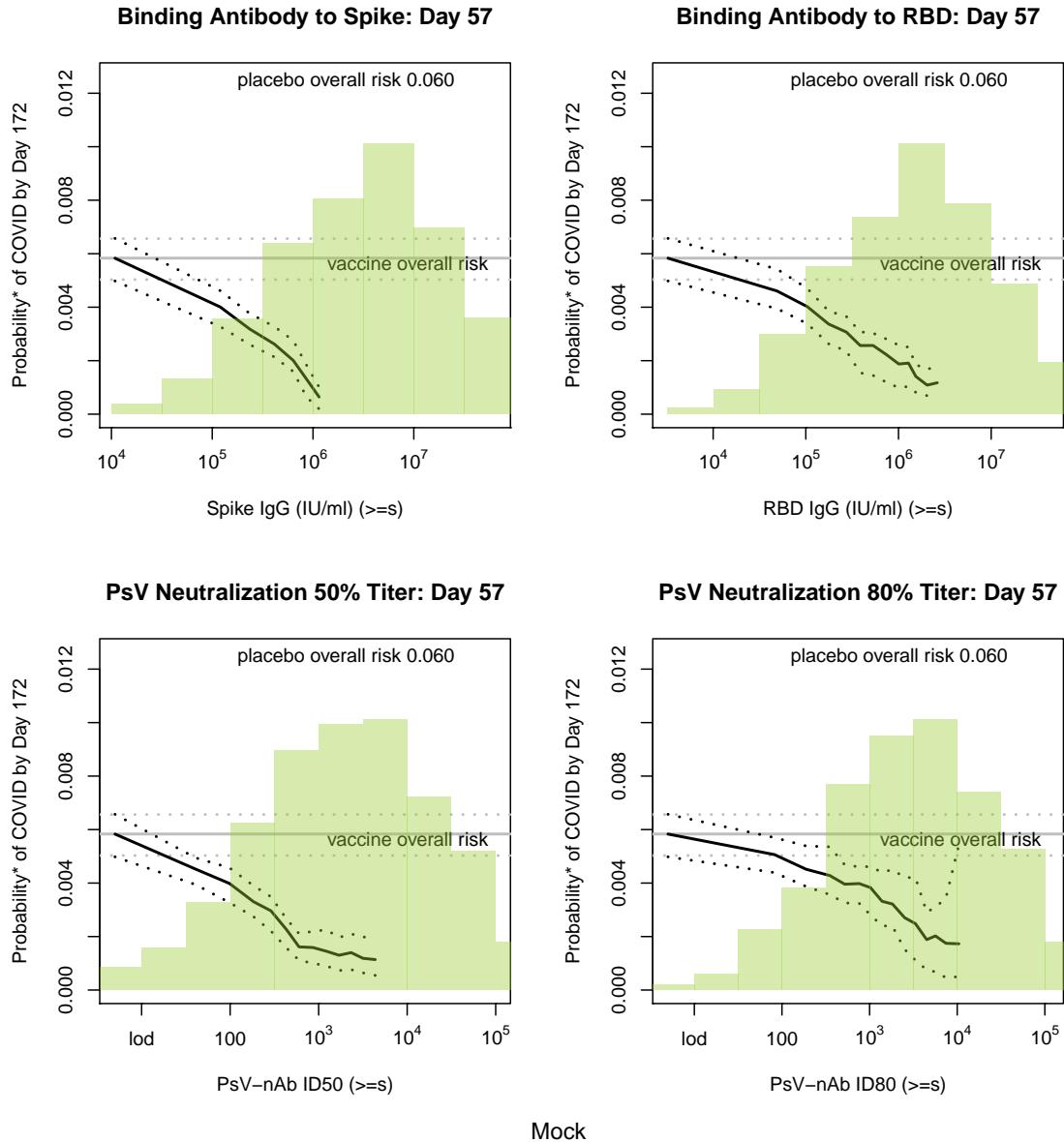


Figure 2.7: Marginalized cumulative risk by Day 57 as functions of Day 57 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 172 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

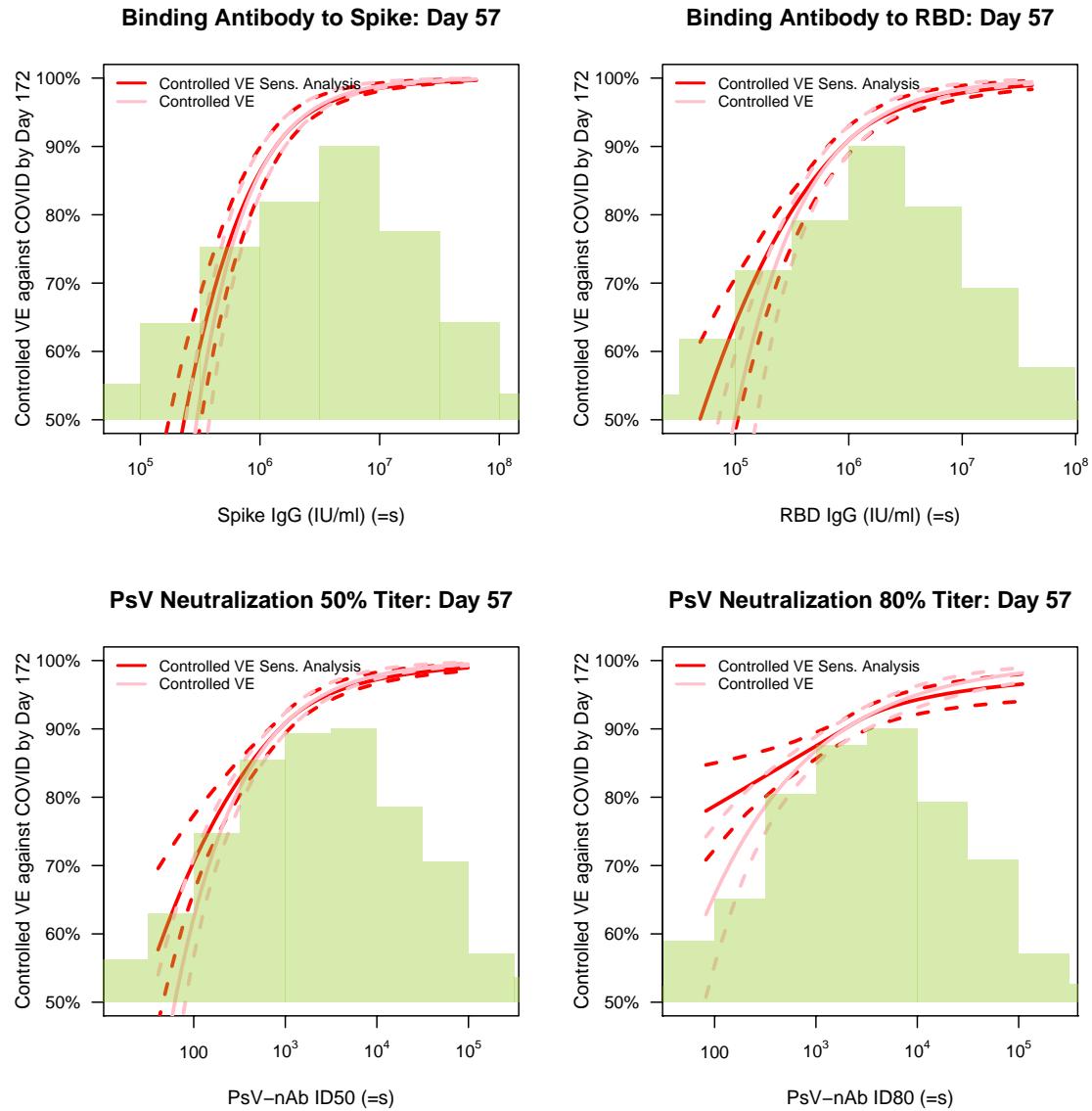


Figure 2.8: Controlled VE with sensitivity analysis as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

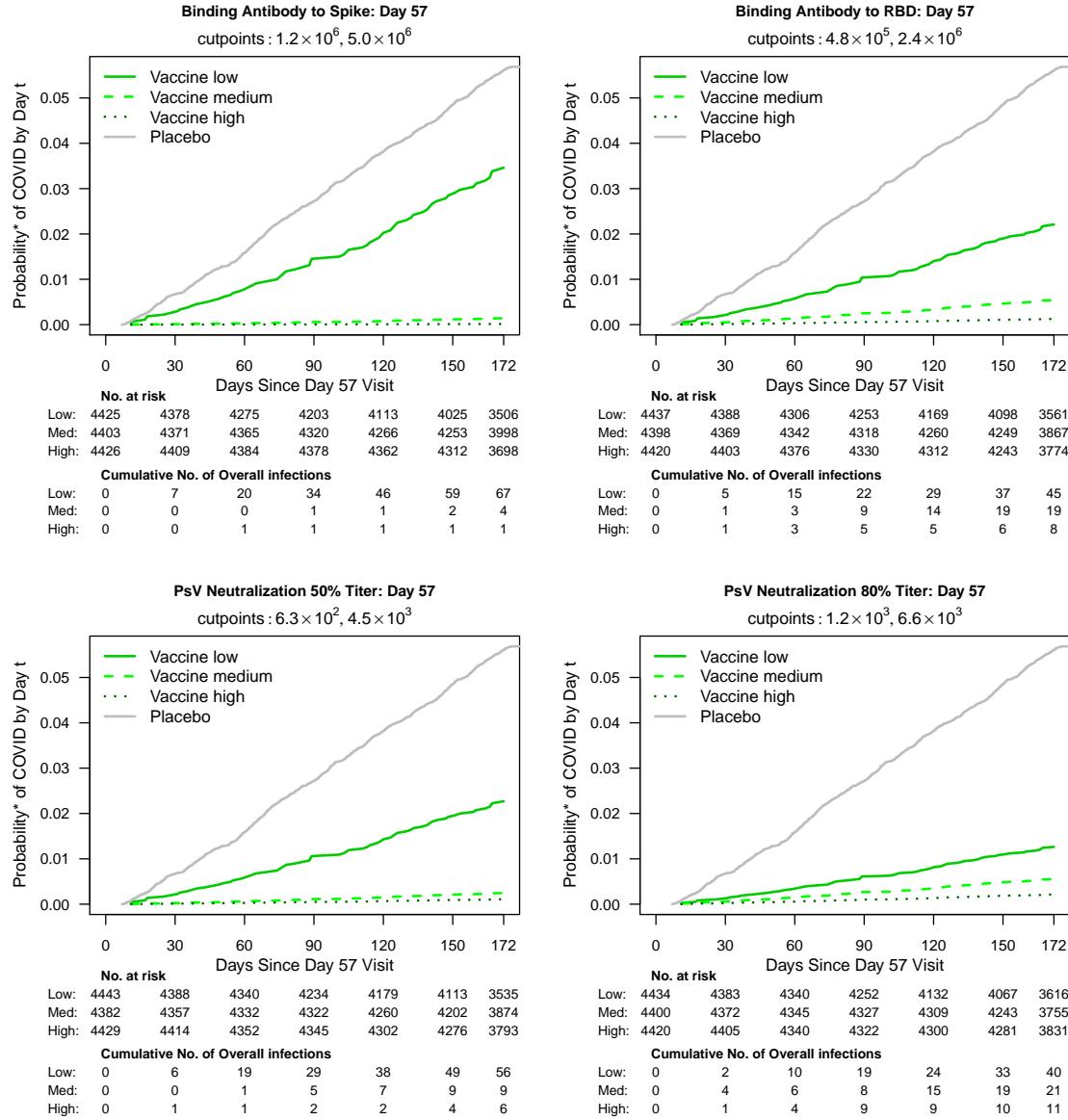


Figure 2.9: Marginalized cumulative incidence rate curves for trichotomized Day 57 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.



## Chapter 3

# 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.

### 3.1 Hazard ratios

Table 3.1: 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\*

Mock Immunologic Marker	No. cases / No. at-risk**	HR per 10-fold incr. Pt. Est.	95% CI	P-value (2-sided)	q-value	FWER
Spike IgG (IU/ml)	83/13,271	0.09	(0.05-0.16)	<0.001	<0.001	<0.001
RBD IgG (IU/ml)	83/13,271	0.25	(0.16-0.38)	<0.001	<0.001	<0.001
PsV-nAb ID50	83/13,271	0.32	(0.23-0.46)	<0.001	<0.001	<0.001
PsV-nAb ID80	83/13,271	0.57	(0.43-0.75)	<0.001	<0.001	<0.001

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not \*\*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.

Table 3.2: 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\*

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
Spike IgG (IU/ml)	Lower	54/4,422	0.0122	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	24/4,423	0.0054	0.20	(0.11-0.37)	<0.001			
	Upper	5/4,427	0.0011	0.02	(0.01-0.06)	<0.001			
RBD IgG (IU/ml)	Lower	46/4,419	0.0104	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	25/4,428	0.0056	0.30	(0.17-0.55)	<0.001			
	Upper	12/4,424	0.0027	0.08	(0.04-0.17)	<0.001			
PsV-nAb ID50	Lower	47/4,403	0.0107	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	24/4,420	0.0054	0.33	(0.19-0.59)	<0.001			
	Upper	12/4,448	0.0027	0.12	(0.06-0.25)	<0.001			
PsV-nAb ID80	Lower	30/4,416	0.0068	1	N/A	N/A	0.001	<0.001	<0.001
	Middle	36/4,429	0.0081	0.94	(0.55-1.62)	0.834			
	Upper	17/4,426	0.0038	0.33	(0.17-0.64)	0.001			
Placebo		821/13,299	0.0617						

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not . Average follow-up time 200 days, maximum follow-up time 213 days. Cutpoints: Spike IgG (IU/ml) [4.38, 4.94], RBD IgG (IU/ml) [4.11, 4.66], PsV-nAb ID50 [1.67, 2.38], PsV-nAb ID80 [1.97, 2.64] \*\*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.

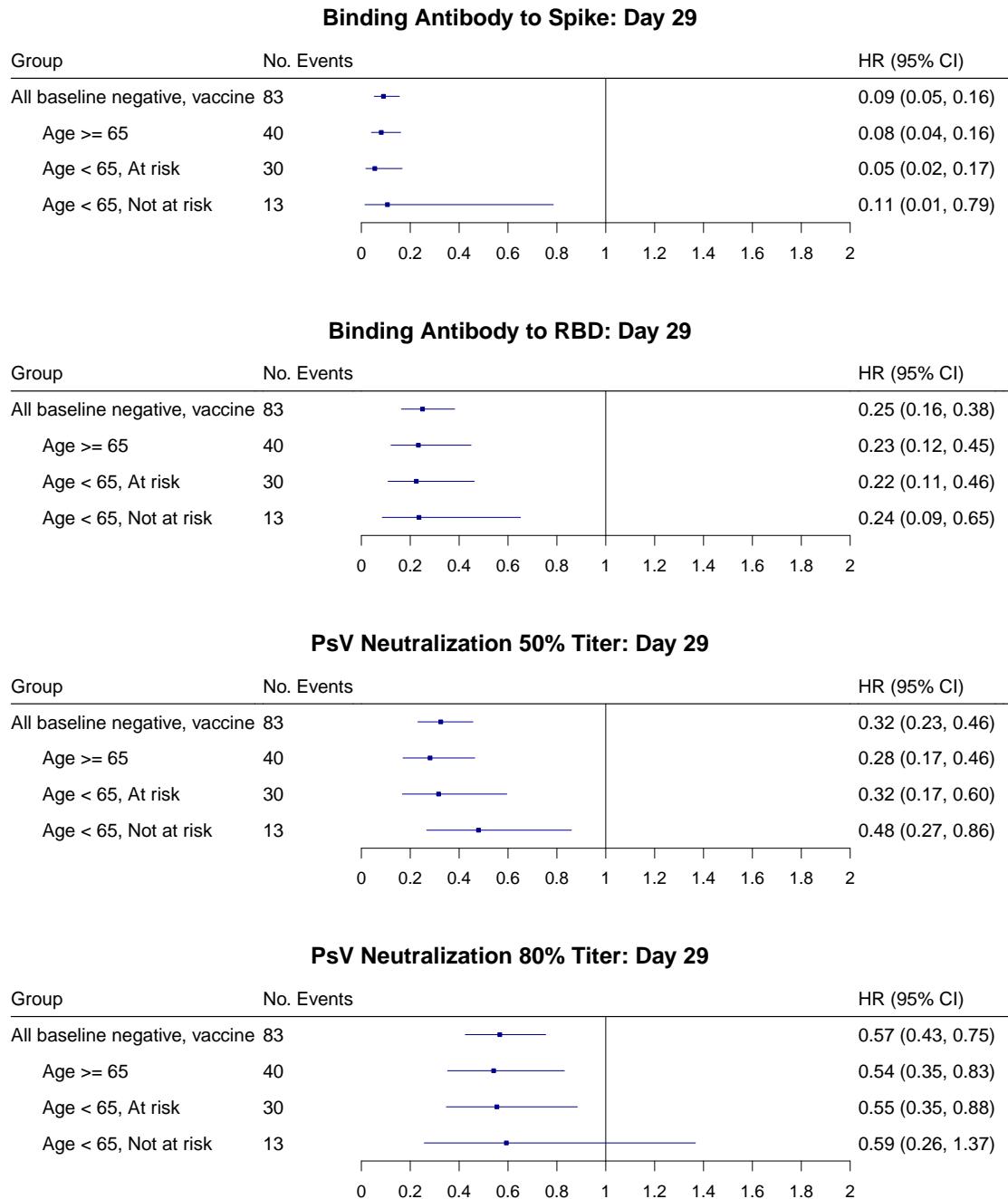


Figure 3.1: Forest plots of hazard ratios among baseline seronegative vaccine recipients and sub-groups with 95% point-wise confidence intervals.

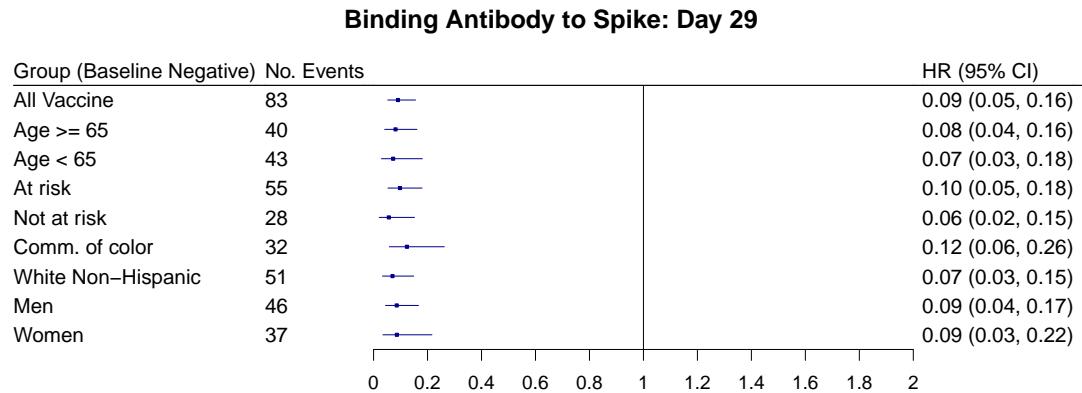


Figure 3.2: Forest plots of hazard ratios of Day 29 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

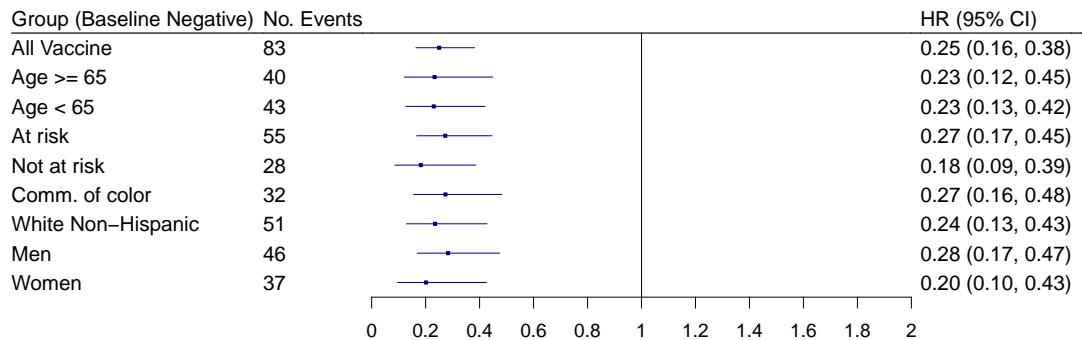
**Binding Antibody to RBD: Day 29**

Figure 3.3: Forest plots of hazard ratios of 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.

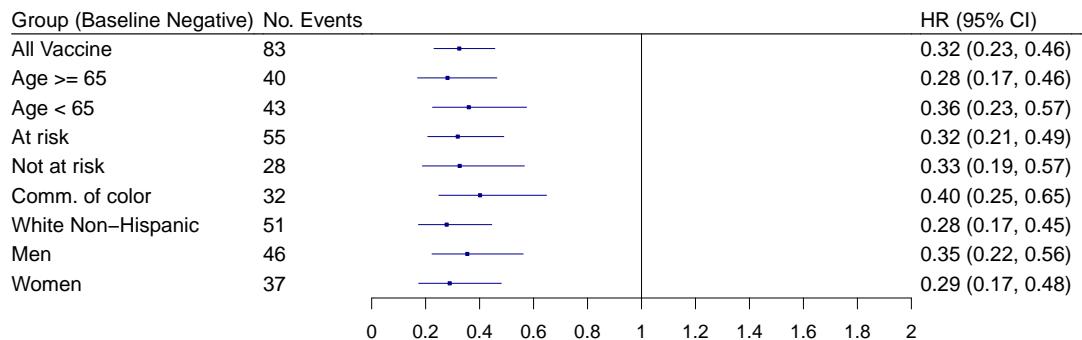
**PsV Neutralization 50% Titer: Day 29**

Figure 3.4: Forest plots of hazard ratios of 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.

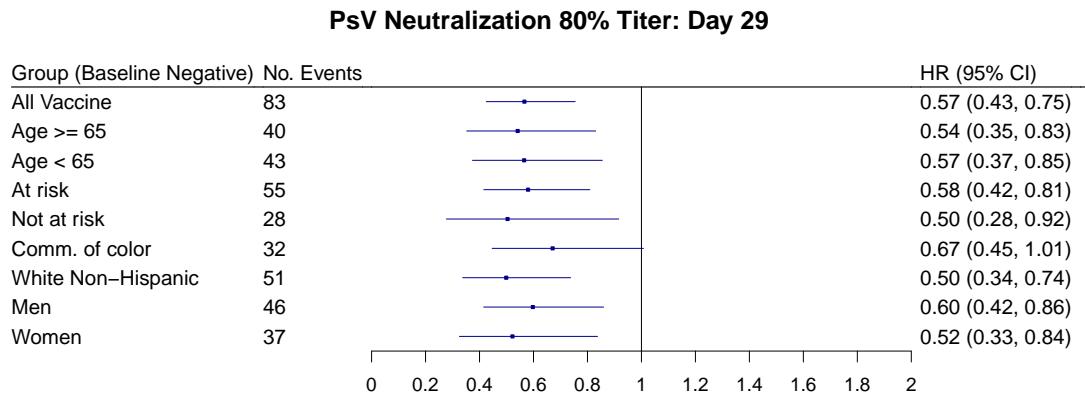


Figure 3.5: Forest plots of hazard ratios of Day 29 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### 3.2 Marginalized risk and controlled vaccine efficacy plots

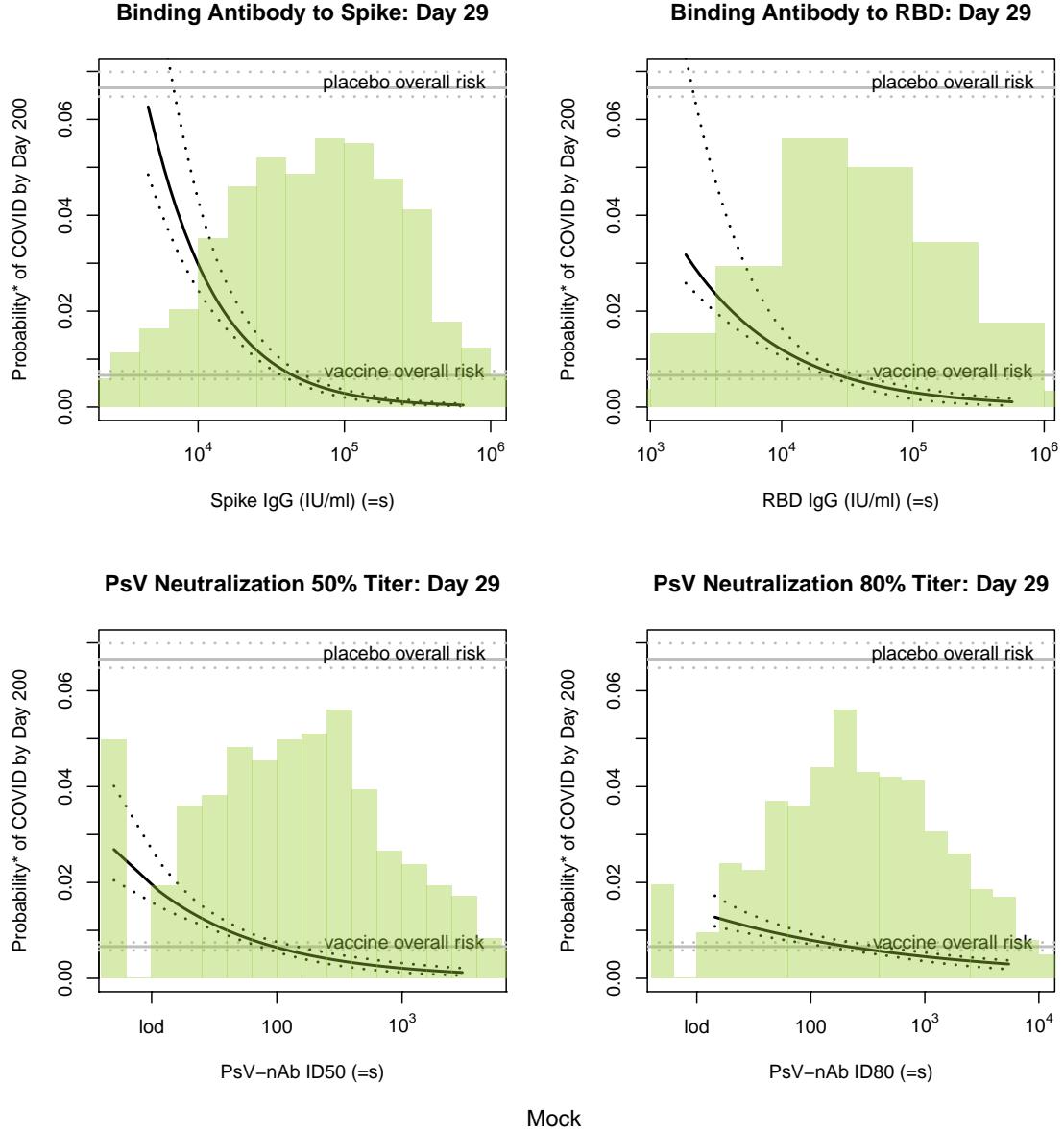


Figure 3.6: Marginalized cumulative risk by Day 200 as functions of Day 29 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 200 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

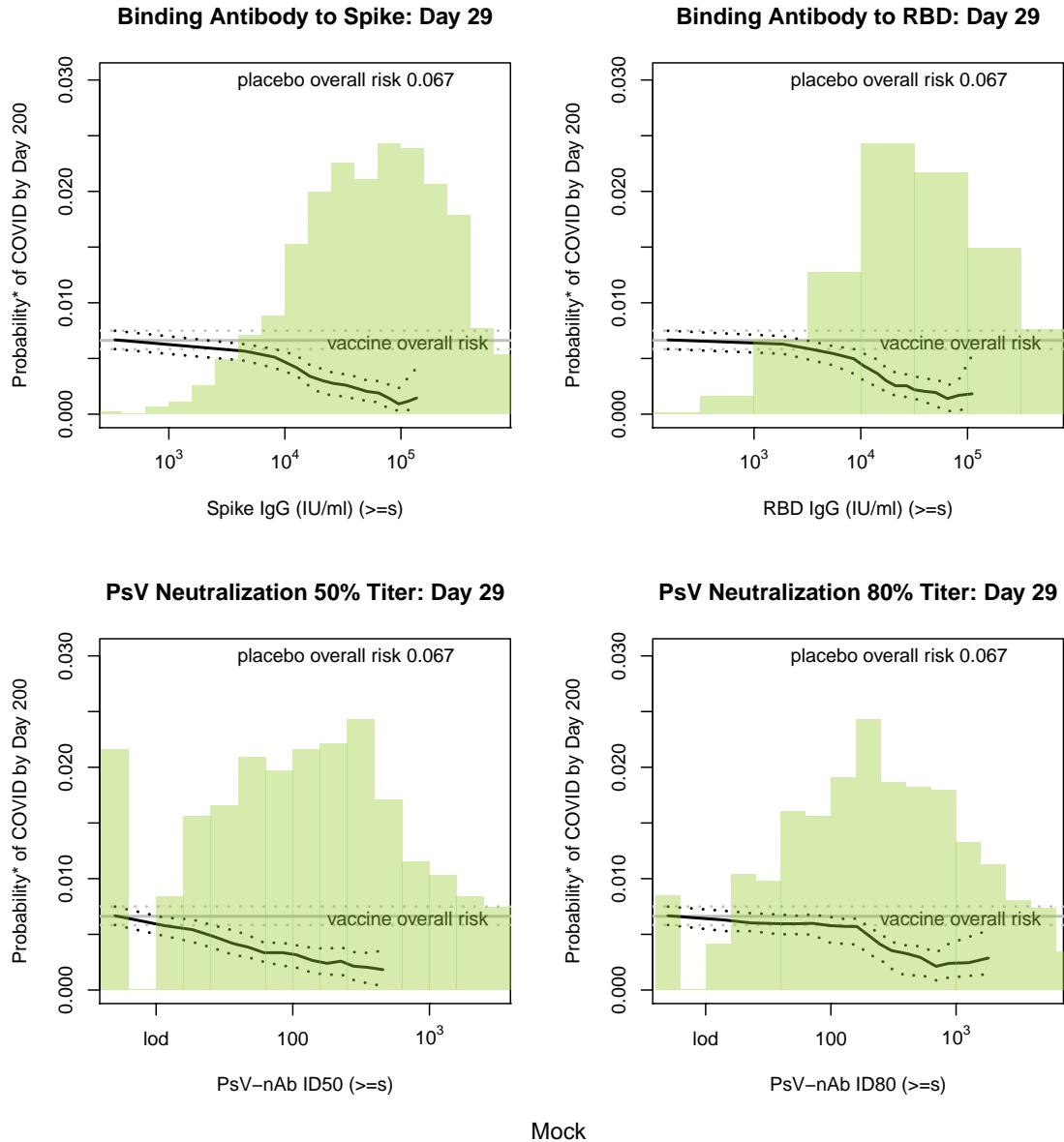


Figure 3.7: Marginalized cumulative risk by Day 29 as functions of Day 29 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 200 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

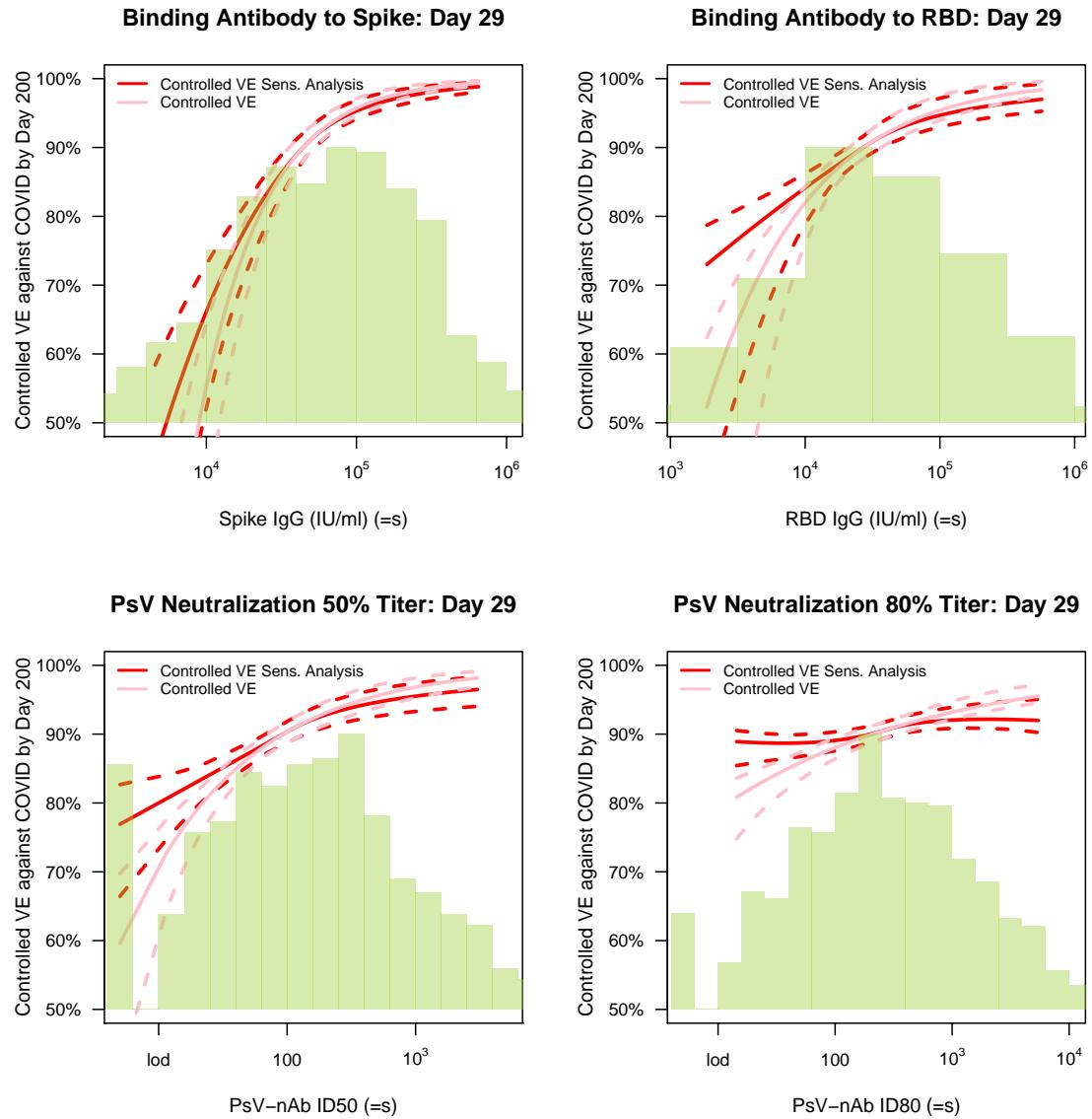


Figure 3.8: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

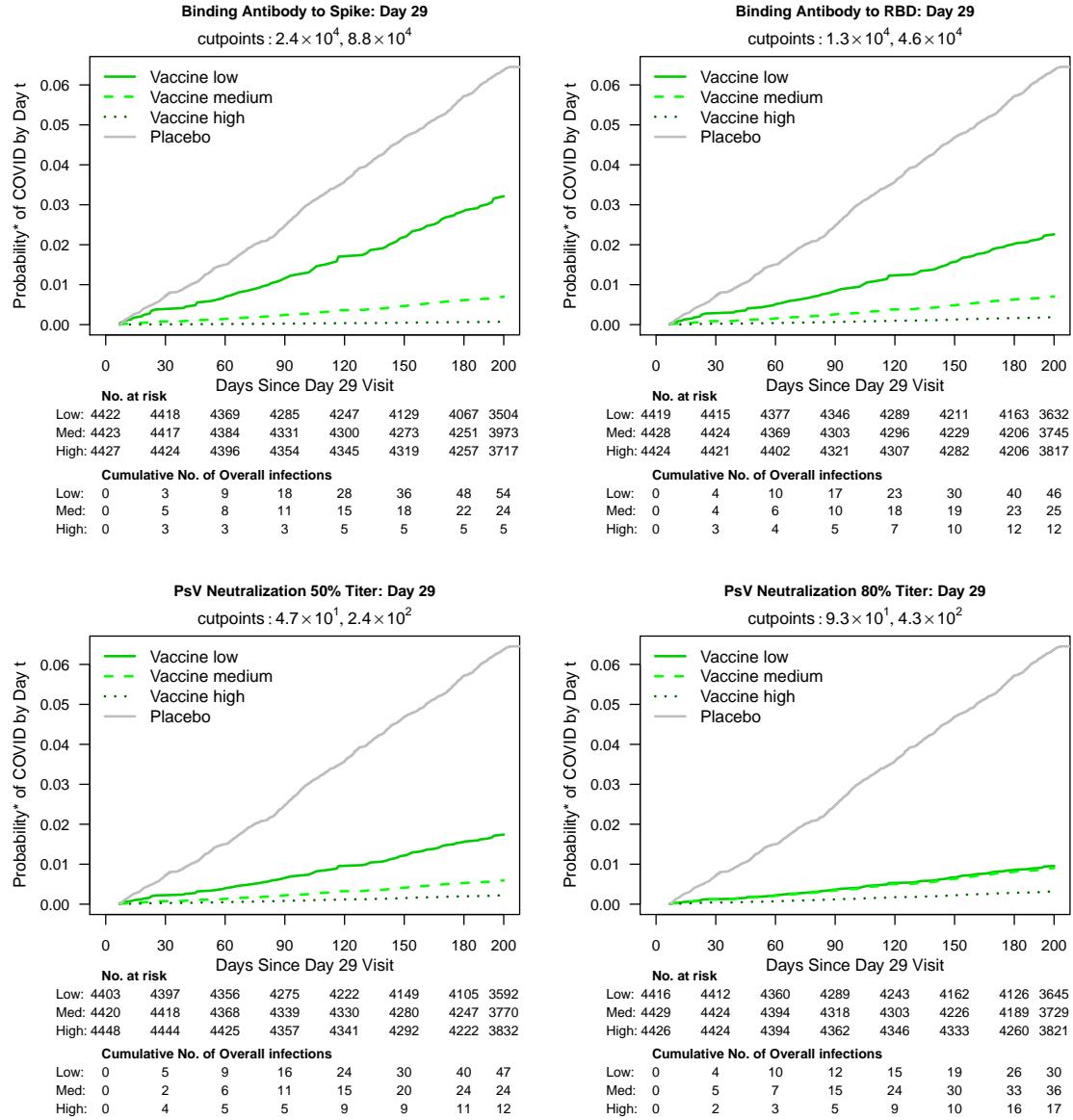


Figure 3.9: Marginalized cumulative incidence rate curves for trichotomized Day 29 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.



## Chapter 4

# Univariate CoR: Nonparametric Threshold Modeling

An extension of the unadjusted nonparametric threshold-searching approach developed in (??), the covariate-adjusted TMLE-based approach developed by van der Laan, Zhang, Gilbert (in progress) 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 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: age, 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 for the threshold-response at a grid of thresholds. 2. A plot and table with risk estimates and simultaneous 95% confidence bands for the threshold-response at a grid of thresholds.

A histogram 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.

#### 4.0.1 Day 57 Spike protein antibody

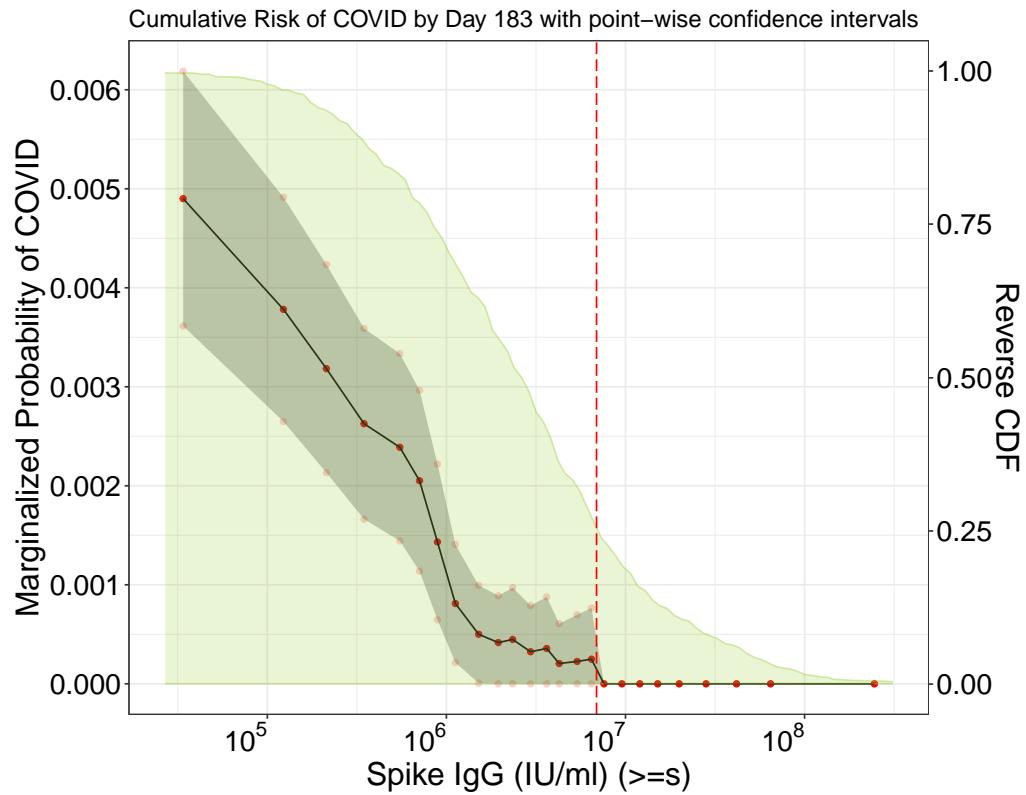


Figure 4.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.1: Table of risk estimates for range of thresholds of Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
4.530	$3.39 * 10^4$	0.00490	0.00361	0.00619
5.540	$3.47 * 10^5$	0.00263	0.00166	0.00359
5.853	$7.13 * 10^5$	0.00205	0.00114	0.00296
6.182	$1.52 * 10^6$	0.00050	0.00001	0.00099
6.472	$2.96 * 10^6$	0.00032	0.00000	0.00079
6.628	$4.25 * 10^6$	0.00020	0.00000	0.00061
6.880	$7.59 * 10^6$	0.00000	0.00000	NA
7.184	$1.53 * 10^7$	0.00000	0.00000	NA
7.449	$2.81 * 10^7$	0.00000	0.00000	NA
8.391	$2.46 * 10^8$	0.00000	0.00000	NA

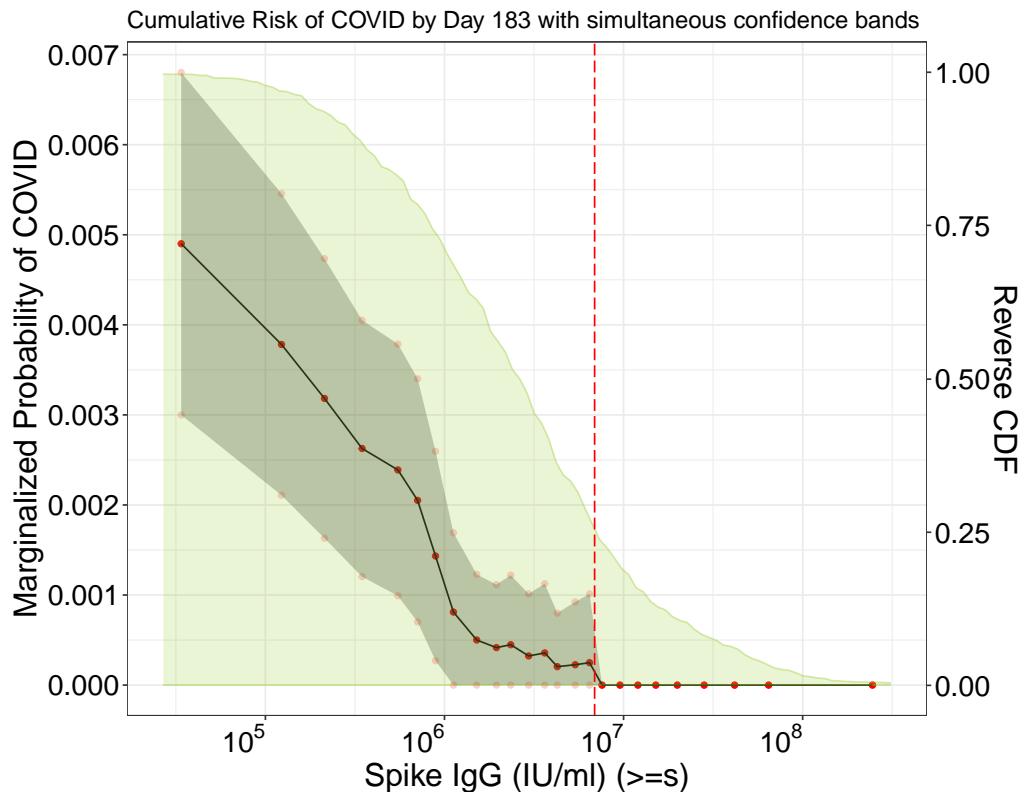


Figure 4.2: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.2: Table of risk estimates for range of thresholds of Day 57 Spike protein antibody activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
4.530	$3.39 * 10^4$	0.00490	0.00361	0.00619
5.540	$3.47 * 10^5$	0.00263	0.00166	0.00359
5.853	$7.13 * 10^5$	0.00205	0.00114	0.00296
6.182	$1.52 * 10^6$	0.00050	0.00001	0.00099
6.472	$2.96 * 10^6$	0.00032	0.00000	0.00079
6.628	$4.25 * 10^6$	0.00020	0.00000	0.00061
6.880	$7.59 * 10^6$	0.00000	0.00000	NA
7.184	$1.53 * 10^7$	0.00000	0.00000	NA
7.449	$2.81 * 10^7$	0.00000	0.00000	NA
8.391	$2.46 * 10^8$	0.00000	0.00000	NA

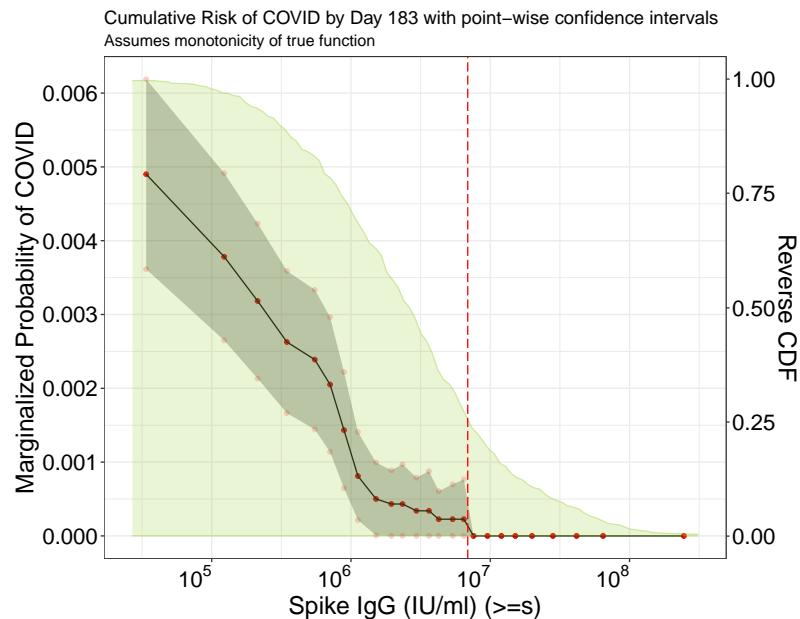


Figure 4.3: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

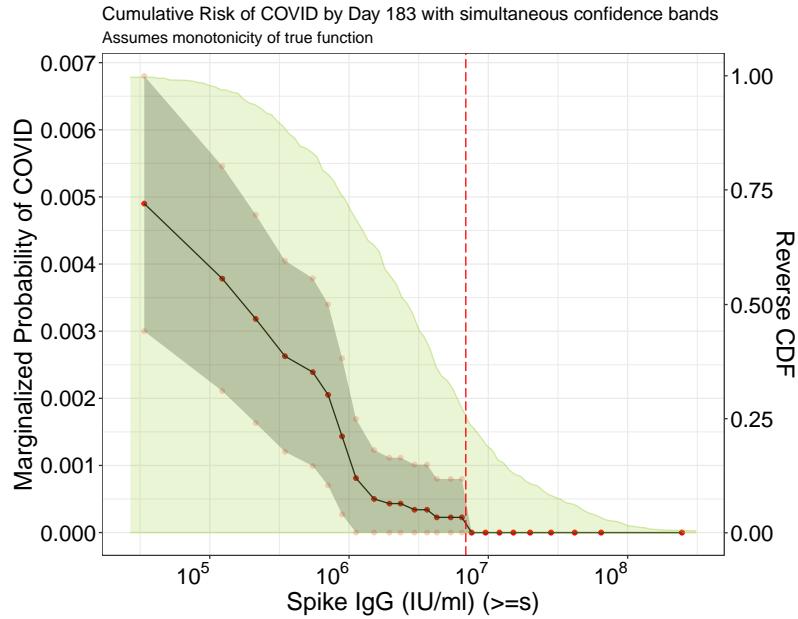


Figure 4.4: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

#### 4.0.2 Day 57 RBD binding antibody

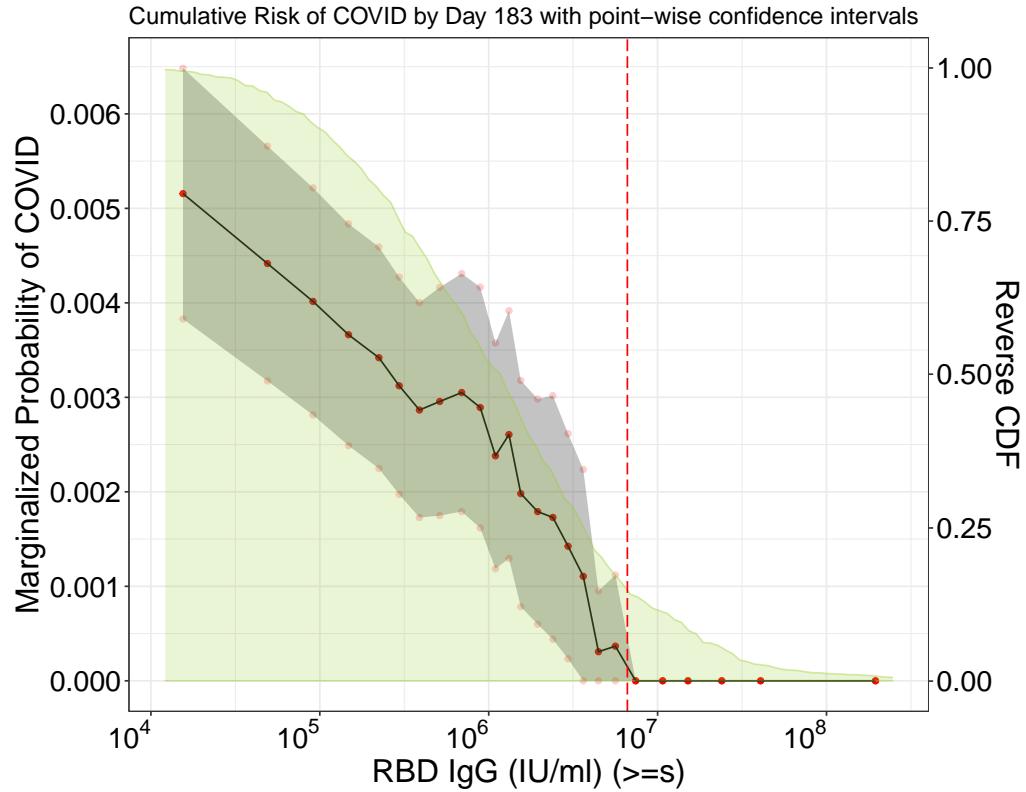


Figure 4.5: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.3: Table of risk estimates for range of thresholds of Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
4.185	$1.53 * 10^4$	0.00516	0.00383	0.00648
5.172	$1.49 * 10^5$	0.00366	0.00249	0.00484
5.469	$2.94 * 10^5$	0.00312	0.00197	0.00427
5.841	$6.93 * 10^5$	0.00305	0.00179	0.00431
6.125	$1.33 * 10^6$	0.00261	0.00129	0.00392
6.286	$1.93 * 10^6$	0.00179	0.00060	0.00298
6.559	$3.62 * 10^6$	0.00111	0.00000	0.00224
6.868	$7.38 * 10^6$	0.00000	0.00000	NA
7.178	$1.51 * 10^7$	0.00000	0.00000	NA
8.291	$1.95 * 10^8$	0.00000	0.00000	NA

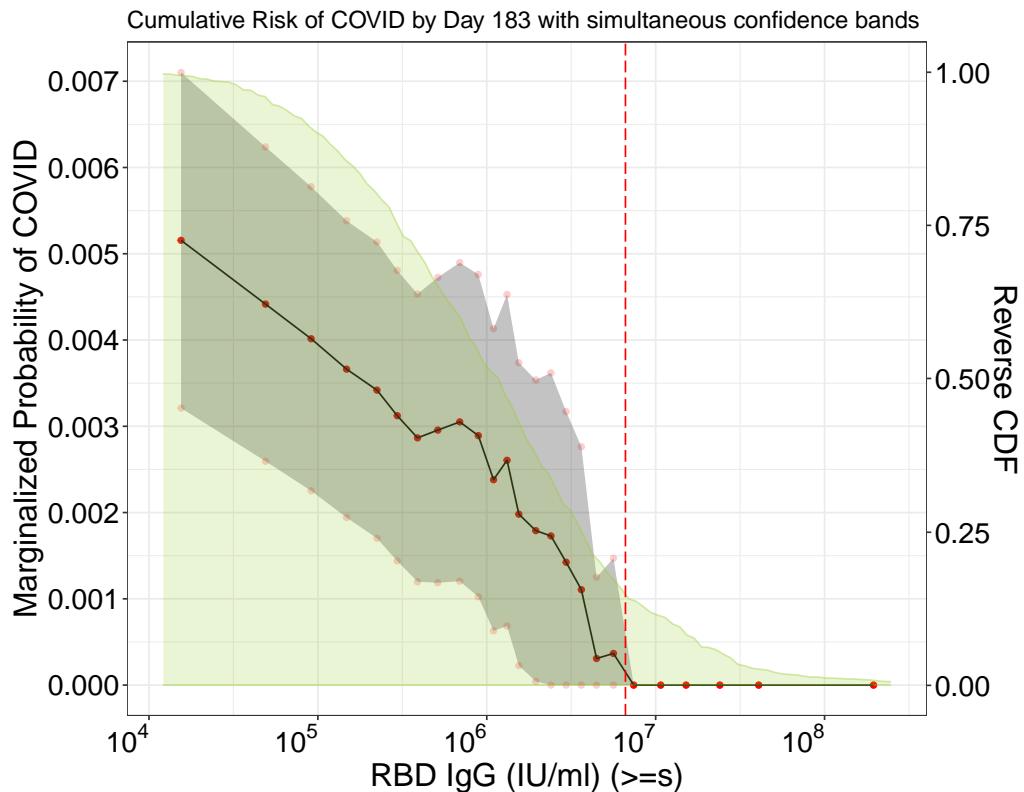


Figure 4.6: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.4: Table of risk estimates for range of thresholds of Day 57 RBD binding antibody activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
4.185	$1.53 * 10^4$	0.00516	0.00383	0.00648
5.172	$1.49 * 10^5$	0.00366	0.00249	0.00484
5.469	$2.94 * 10^5$	0.00312	0.00197	0.00427
5.841	$6.93 * 10^5$	0.00305	0.00179	0.00431
6.125	$1.33 * 10^6$	0.00261	0.00129	0.00392
6.286	$1.93 * 10^6$	0.00179	0.00060	0.00298
6.559	$3.62 * 10^6$	0.00111	0.00000	0.00224
6.868	$7.38 * 10^6$	0.00000	0.00000	NA
7.178	$1.51 * 10^7$	0.00000	0.00000	NA
8.291	$1.95 * 10^8$	0.00000	0.00000	NA

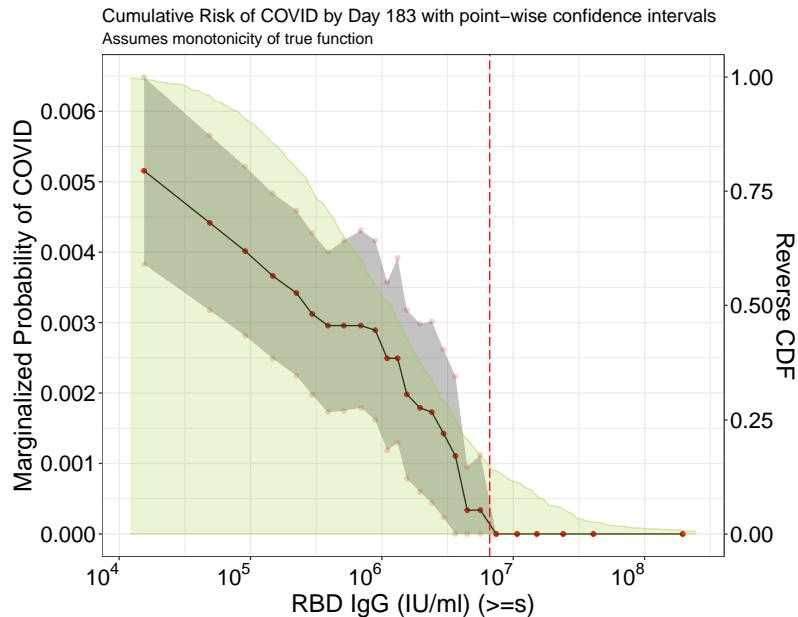


Figure 4.7: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

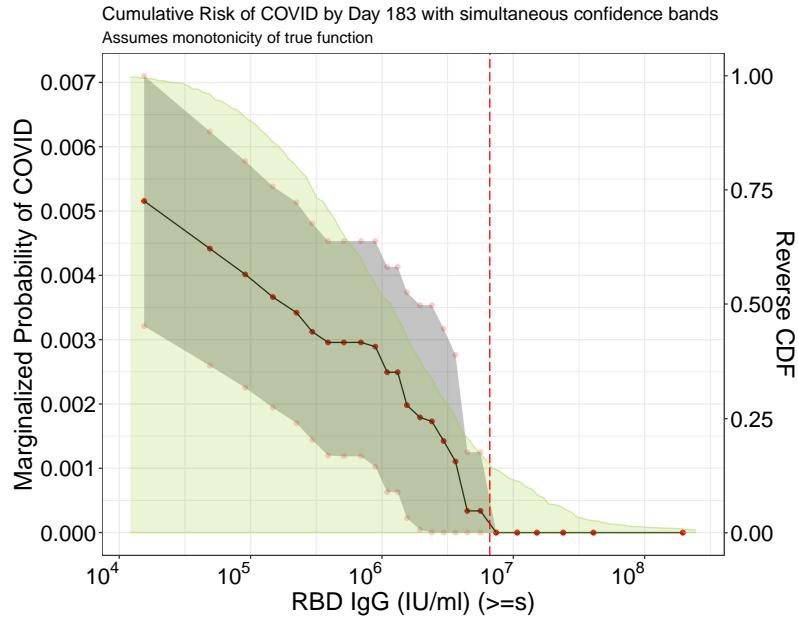


Figure 4.8: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

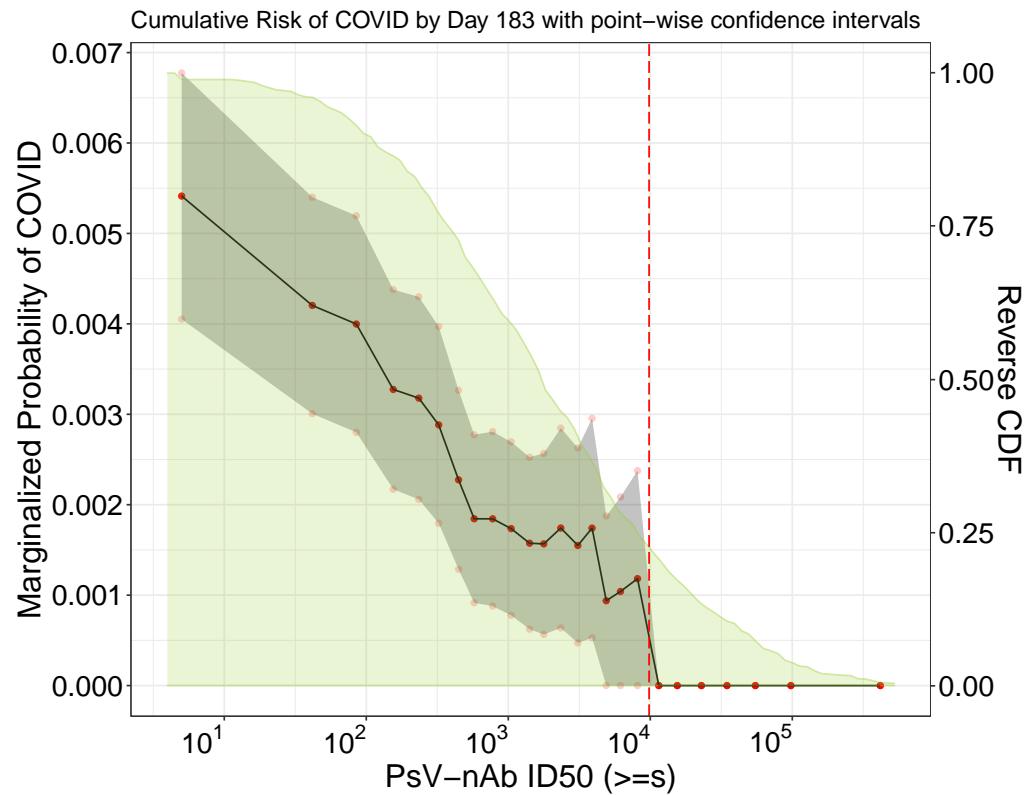


Figure 4.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.5: Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	5.00 * 10 <sup>0</sup>	0.00541	0.00405	0.00677
2.187	1.54 * 10 <sup>2</sup>	0.00327	0.00217	0.00438
2.510	3.24 * 10 <sup>2</sup>	0.00288	0.00180	0.00397
2.891	7.78 * 10 <sup>2</sup>	0.00184	0.00088	0.00281
3.248	1.77 * 10 <sup>3</sup>	0.00157	0.00057	0.00257
3.489	3.08 * 10 <sup>3</sup>	0.00155	0.00047	0.00263
3.787	6.12 * 10 <sup>3</sup>	0.00104	0.00000	0.00209
4.187	1.54 * 10 <sup>4</sup>	0.00000	0.00000	NA
4.543	3.49 * 10 <sup>4</sup>	0.00000	0.00000	NA
5.620	4.17 * 10 <sup>5</sup>	0.00000	0.00000	NA

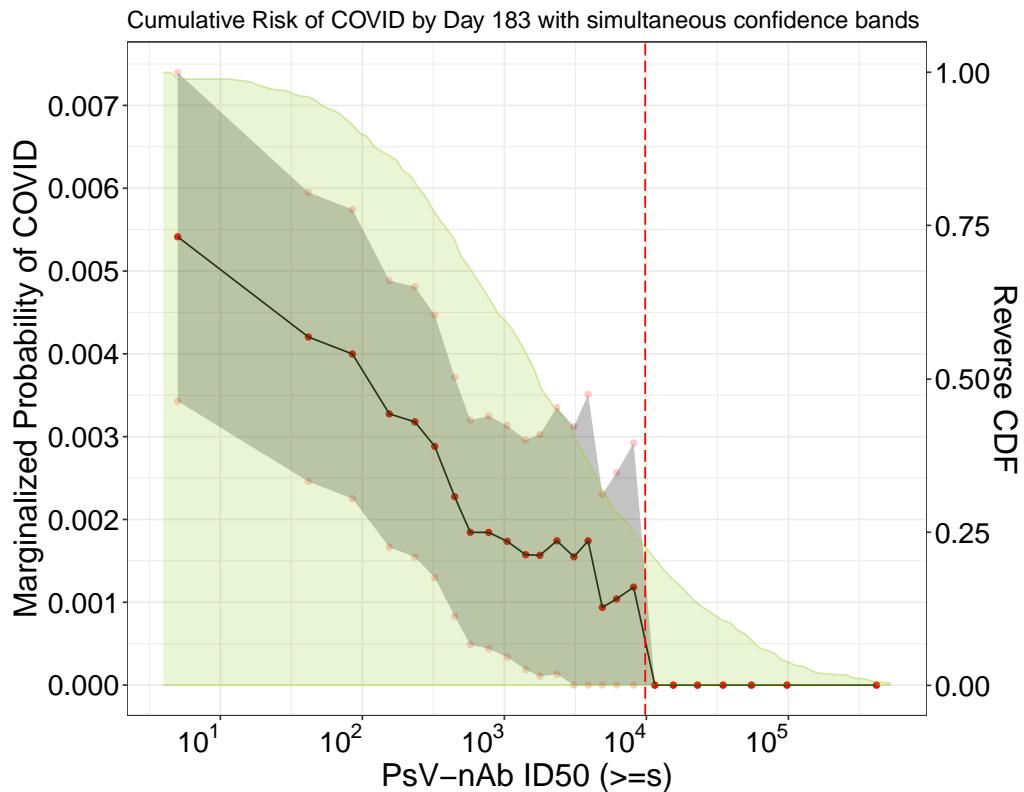


Figure 4.10: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.6: Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00541	0.00405	0.00677
2.187	$1.54 * 10^2$	0.00327	0.00217	0.00438
2.510	$3.24 * 10^2$	0.00288	0.00180	0.00397
2.891	$7.78 * 10^2$	0.00184	0.00088	0.00281
3.248	$1.77 * 10^3$	0.00157	0.00057	0.00257
3.489	$3.08 * 10^3$	0.00155	0.00047	0.00263
3.787	$6.12 * 10^3$	0.00104	0.00000	0.00209
4.187	$1.54 * 10^4$	0.00000	0.00000	NA
4.543	$3.49 * 10^4$	0.00000	0.00000	NA
5.620	$4.17 * 10^5$	0.00000	0.00000	NA

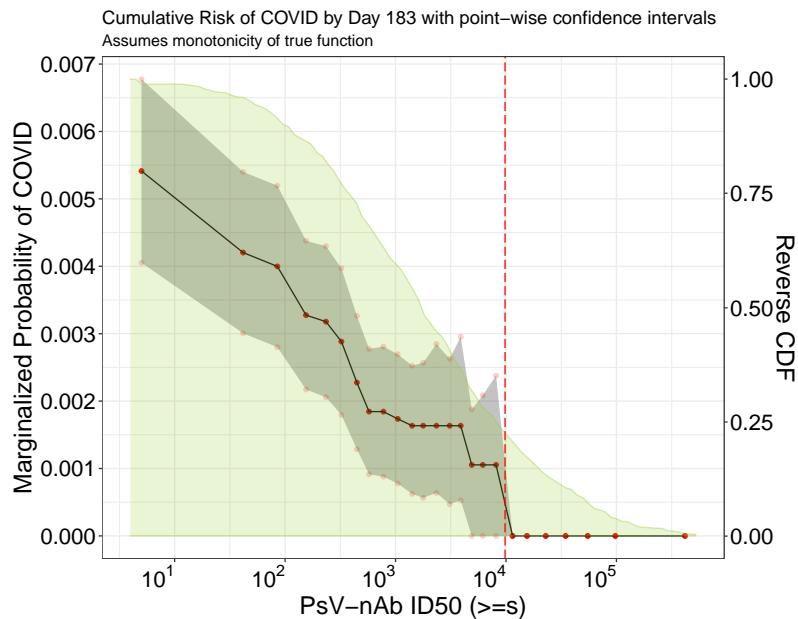


Figure 4.11: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

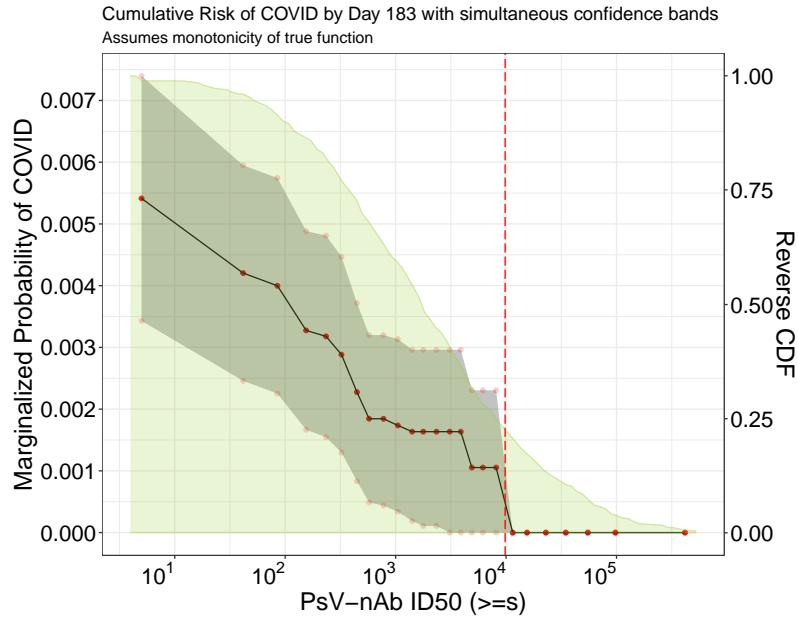


Figure 4.12: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

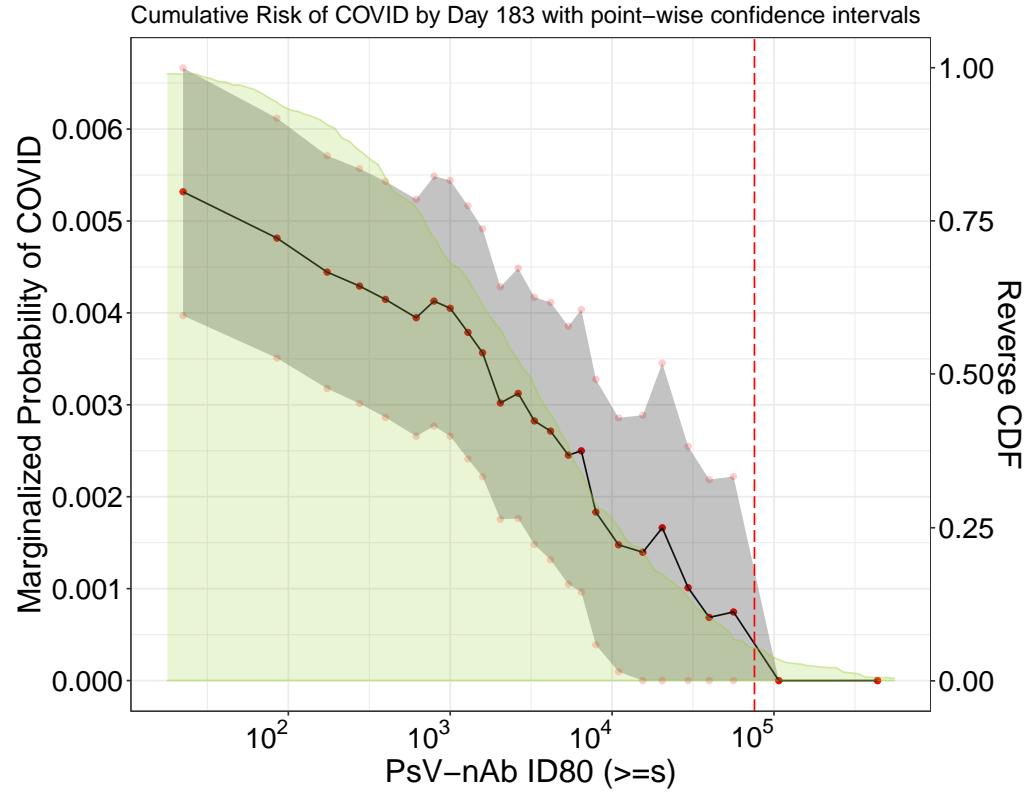


Figure 4.13: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.7: Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.352	$2.25 * 10^1$	0.00532	0.00397	0.00666
2.441	$2.76 * 10^2$	0.00429	0.00301	0.00557
2.789	$6.15 * 10^2$	0.00395	0.00266	0.00524
3.111	$1.29 * 10^3$	0.00379	0.00241	0.00517
3.421	$2.64 * 10^3$	0.00312	0.00176	0.00449
3.623	$4.20 * 10^3$	0.00271	0.00131	0.00411
3.900	$7.94 * 10^3$	0.00183	0.00039	0.00328
4.309	$2.04 * 10^4$	0.00166	0.00000	0.00345
4.598	$3.96 * 10^4$	0.00069	0.00000	0.00219
5.644	$4.41 * 10^5$	0.00000	0.00000	NA

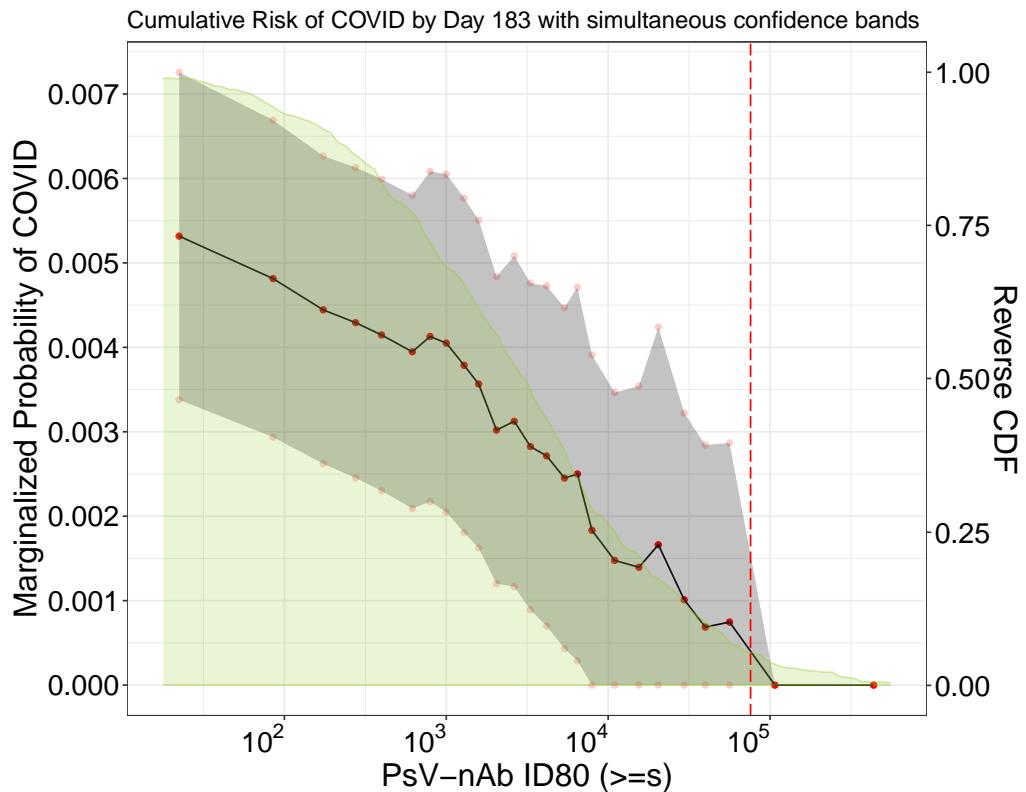


Figure 4.14: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.8: Table of risk estimates for range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
1.352	$2.25 * 10^1$	0.00532	0.00397	0.00666
2.441	$2.76 * 10^2$	0.00429	0.00301	0.00557
2.789	$6.15 * 10^2$	0.00395	0.00266	0.00524
3.111	$1.29 * 10^3$	0.00379	0.00241	0.00517
3.421	$2.64 * 10^3$	0.00312	0.00176	0.00449
3.623	$4.20 * 10^3$	0.00271	0.00131	0.00411
3.900	$7.94 * 10^3$	0.00183	0.00039	0.00328
4.309	$2.04 * 10^4$	0.00166	0.00000	0.00345
4.598	$3.96 * 10^4$	0.00069	0.00000	0.00219
5.644	$4.41 * 10^5$	0.00000	0.00000	NA

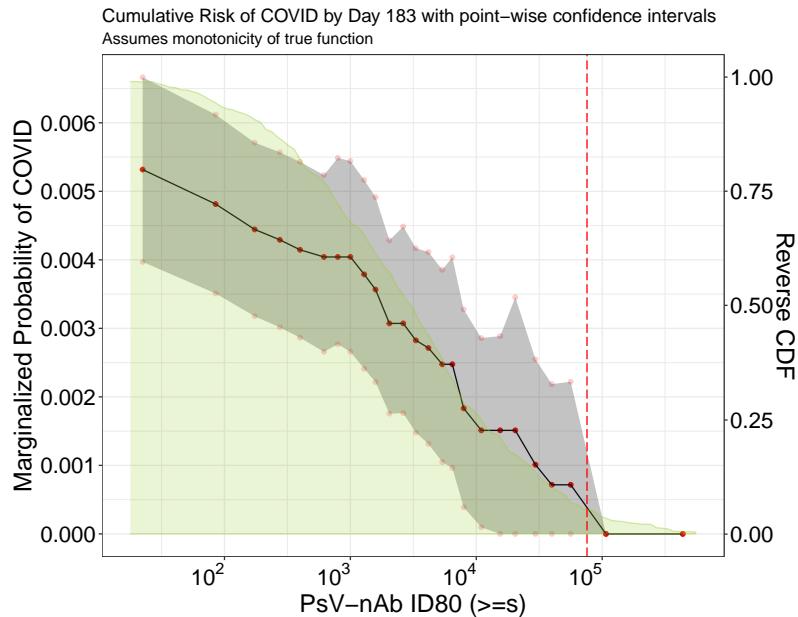


Figure 4.15: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

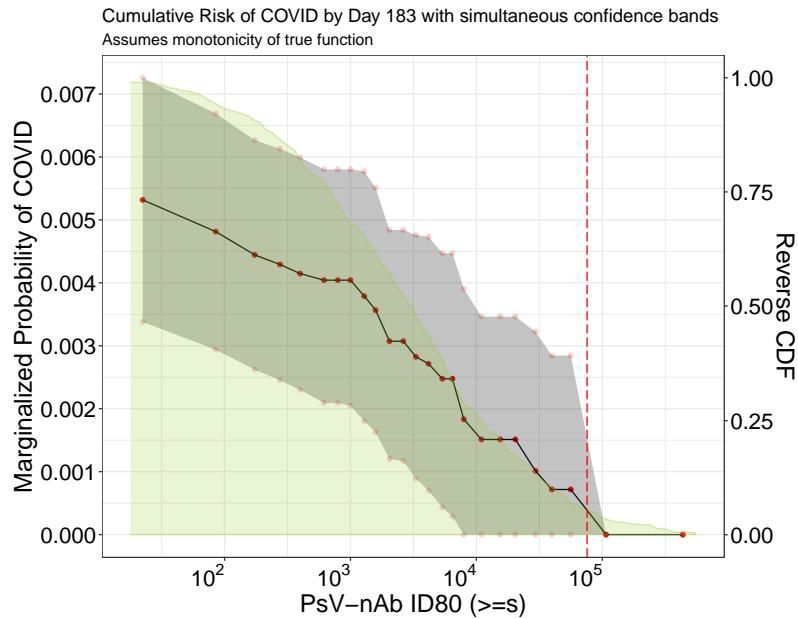


Figure 4.16: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

#### 4.0.5 Day 29 Spike protein antibody

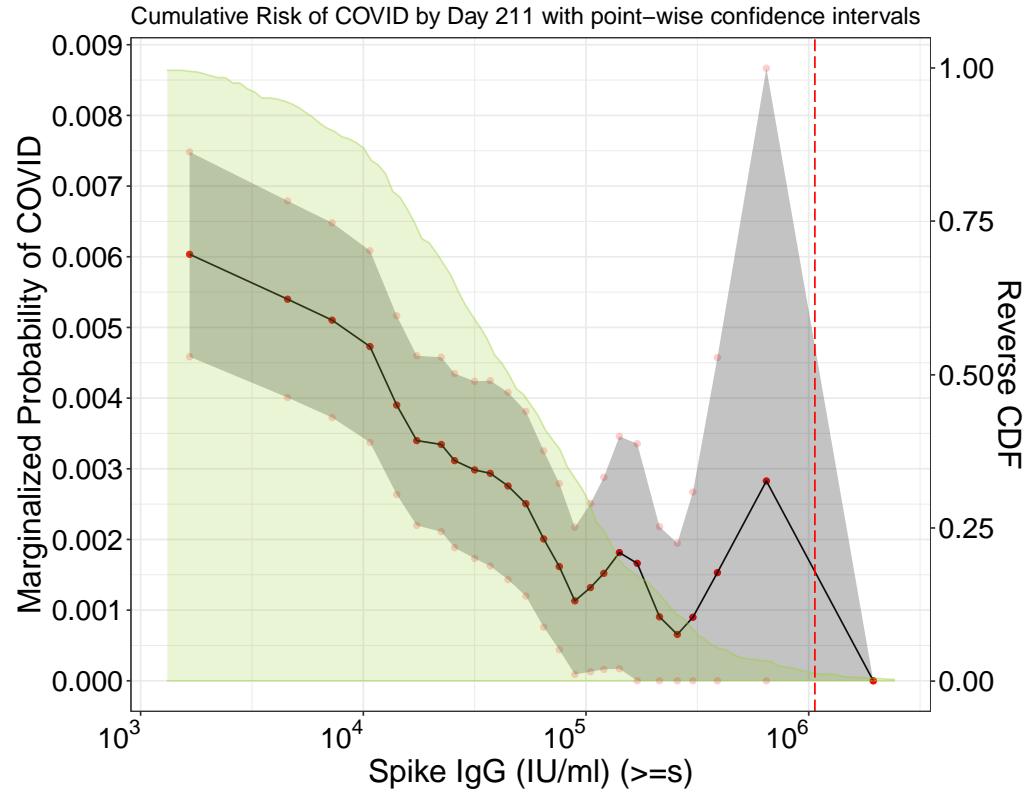


Figure 4.17: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.9: Table of risk estimates for range of thresholds of Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
3.220	1.66 * 10 <sup>3</sup>	0.00603	0.00459	0.00748
4.030	1.07 * 10 <sup>4</sup>	0.00473	0.00337	0.00609
4.244	1.75 * 10 <sup>4</sup>	0.00340	0.00220	0.00460
4.503	3.18 * 10 <sup>4</sup>	0.00298	0.00173	0.00424
4.729	5.36 * 10 <sup>4</sup>	0.00251	0.00120	0.00381
4.884	7.66 * 10 <sup>4</sup>	0.00162	0.00044	0.00279
5.082	1.21 * 10 <sup>5</sup>	0.00152	0.00016	0.00288
5.326	2.12 * 10 <sup>5</sup>	0.00091	0.00000	0.00218
5.484	3.05 * 10 <sup>5</sup>	0.00090	0.00000	0.00267
6.285	1.93 * 10 <sup>6</sup>	0.00000	0.00000	NA

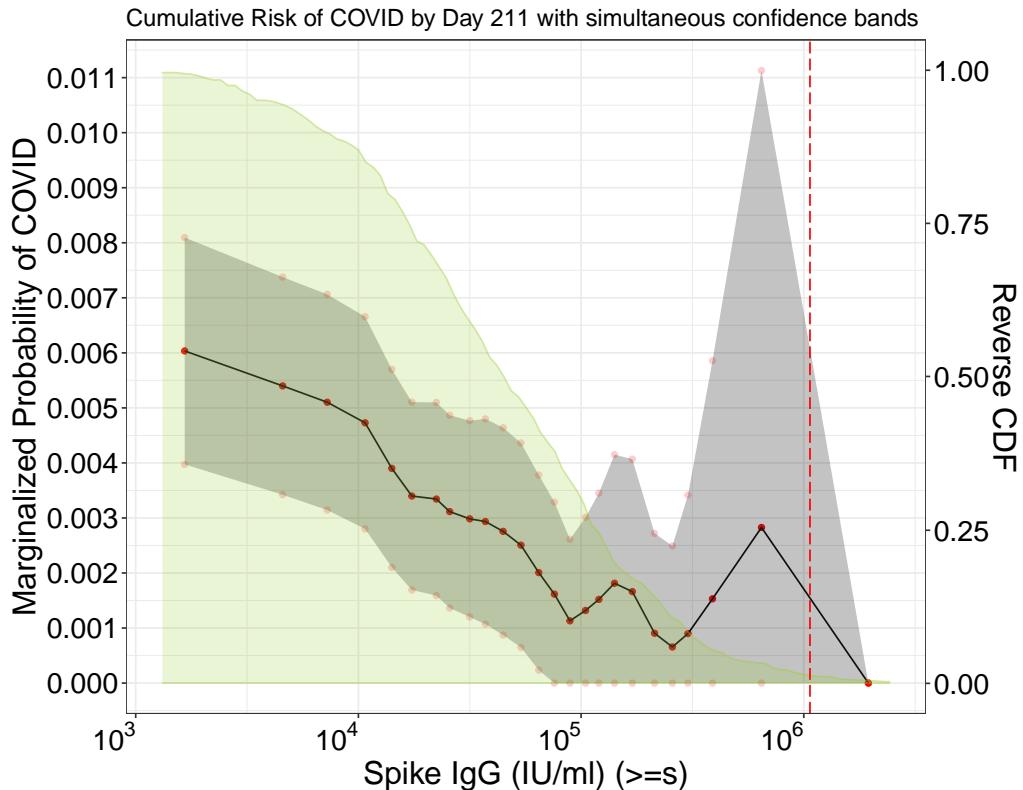


Figure 4.18: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.10: Table of risk estimates for range of thresholds of Day 29 Spike protein antibody activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
3.220	$1.66 * 10^3$	0.00603	0.00459	0.00748
4.030	$1.07 * 10^4$	0.00473	0.00337	0.00609
4.244	$1.75 * 10^4$	0.00340	0.00220	0.00460
4.503	$3.18 * 10^4$	0.00298	0.00173	0.00424
4.729	$5.36 * 10^4$	0.00251	0.00120	0.00381
4.884	$7.66 * 10^4$	0.00162	0.00044	0.00279
5.082	$1.21 * 10^5$	0.00152	0.00016	0.00288
5.326	$2.12 * 10^5$	0.00091	0.00000	0.00218
5.484	$3.05 * 10^5$	0.00090	0.00000	0.00267
6.285	$1.93 * 10^6$	0.00000	0.00000	NA

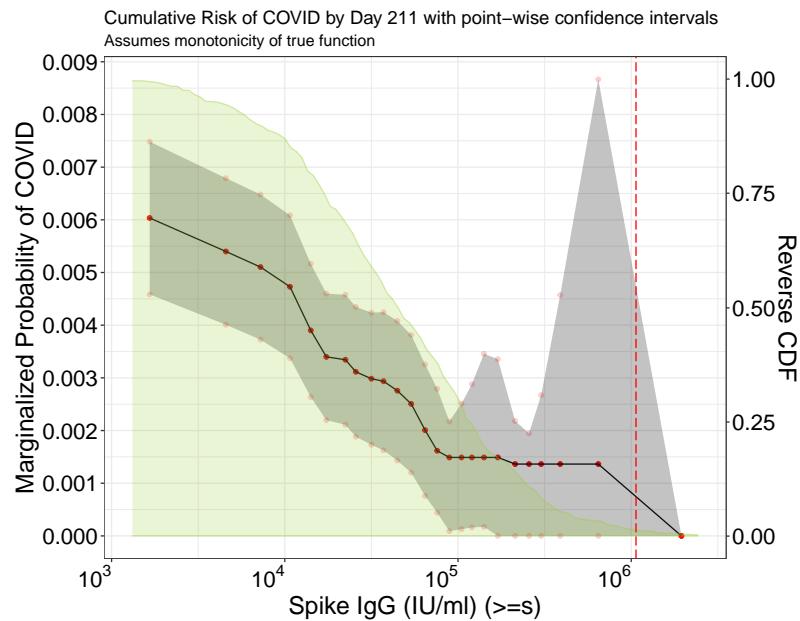


Figure 4.19: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

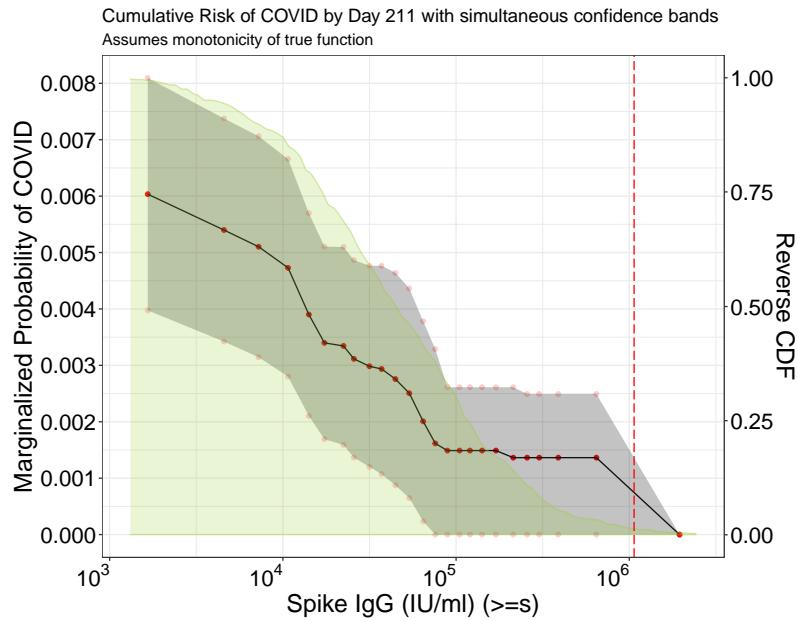


Figure 4.20: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

#### 4.0.6 Day 29 RBD binding antibody

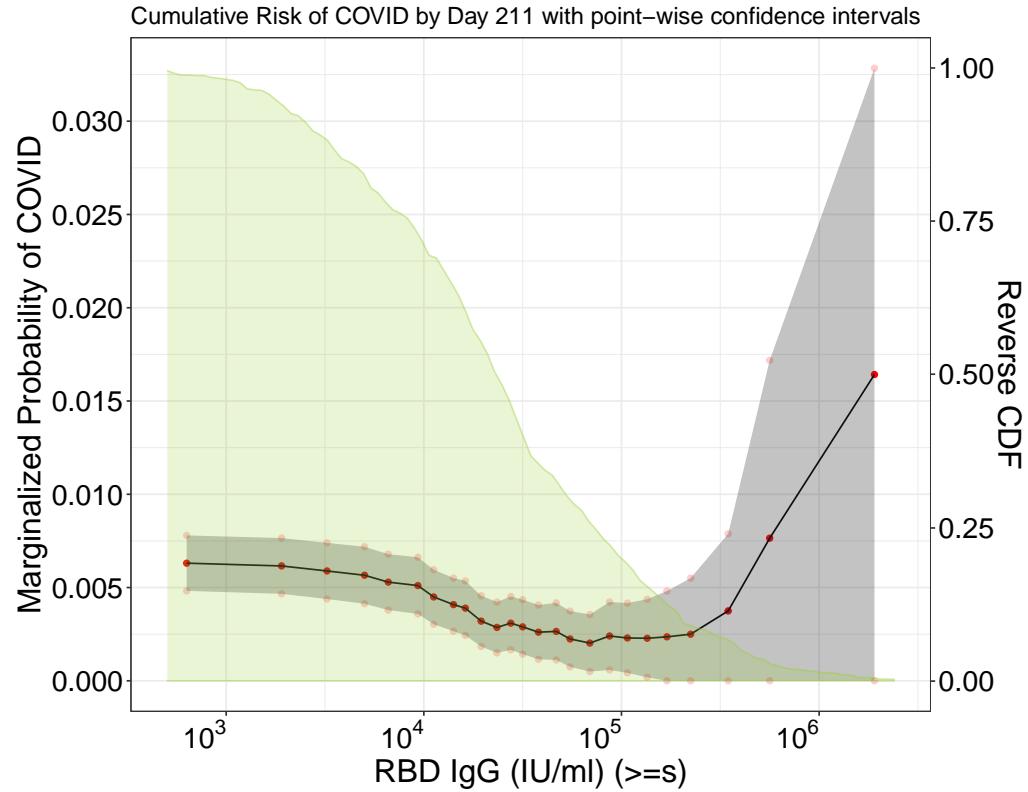


Figure 4.21: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.11: Table of risk estimates for range of thresholds of Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals.

log <sub>10</sub> -Threshold	Threshold	Risk estimate	CI left	CI right
2.802	$6.34 * 10^2$	0.00631	0.00482	0.00779
3.701	$5.02 * 10^3$	0.00566	0.00413	0.00719
3.970	$9.33 * 10^3$	0.00511	0.00359	0.00662
4.215	$1.64 * 10^4$	0.00390	0.00244	0.00535
4.443	$2.77 * 10^4$	0.00309	0.00166	0.00452
4.579	$3.79 * 10^4$	0.00261	0.00115	0.00406
4.835	$6.84 * 10^4$	0.00202	0.00050	0.00355
5.127	$1.34 * 10^5$	0.00228	0.00019	0.00437
5.351	$2.24 * 10^5$	0.00250	0.00000	0.00551
6.281	$1.91 * 10^6$	0.01642	0.00000	0.04845

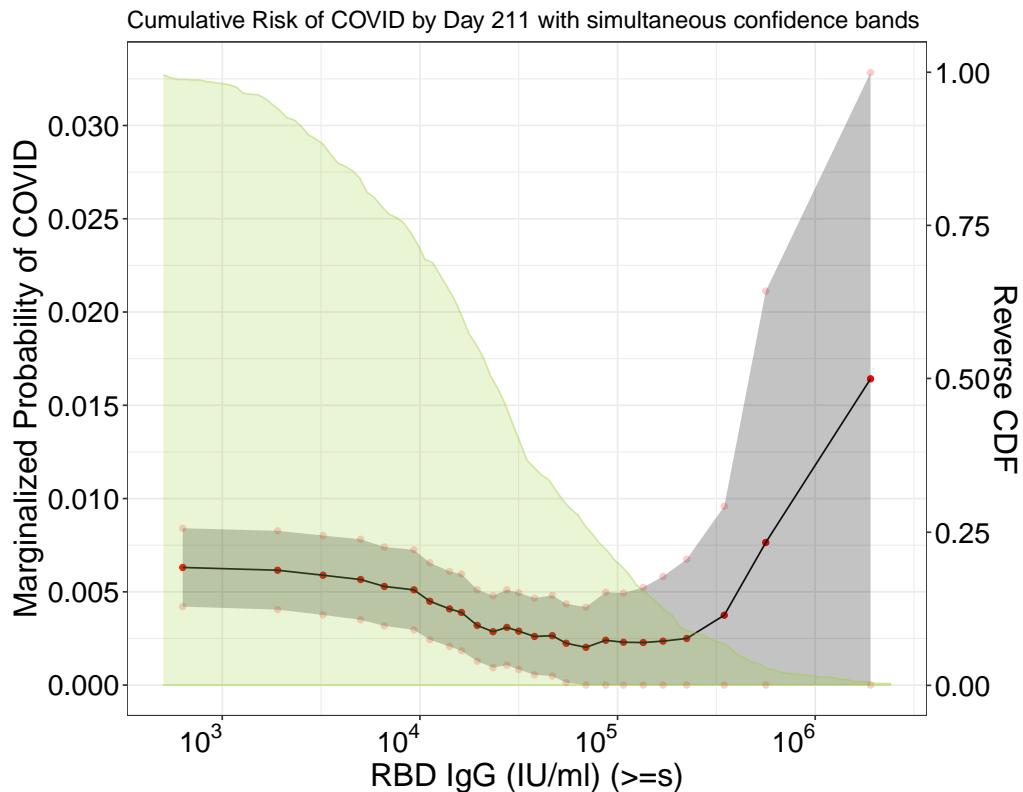


Figure 4.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.12: Table of risk estimates for range of thresholds of Day 29 RBD binding antibody activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
2.802	$6.34 * 10^2$	0.00631	0.00482	0.00779
3.701	$5.02 * 10^3$	0.00566	0.00413	0.00719
3.970	$9.33 * 10^3$	0.00511	0.00359	0.00662
4.215	$1.64 * 10^4$	0.00390	0.00244	0.00535
4.443	$2.77 * 10^4$	0.00309	0.00166	0.00452
4.579	$3.79 * 10^4$	0.00261	0.00115	0.00406
4.835	$6.84 * 10^4$	0.00202	0.00050	0.00355
5.127	$1.34 * 10^5$	0.00228	0.00019	0.00437
5.351	$2.24 * 10^5$	0.00250	0.00000	0.00551
6.281	$1.91 * 10^6$	0.01642	0.00000	0.04845

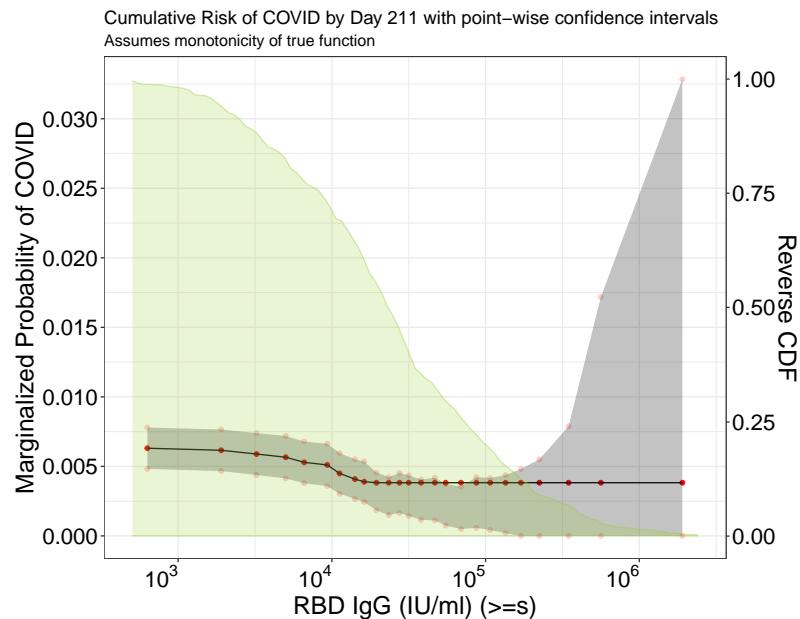


Figure 4.23: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

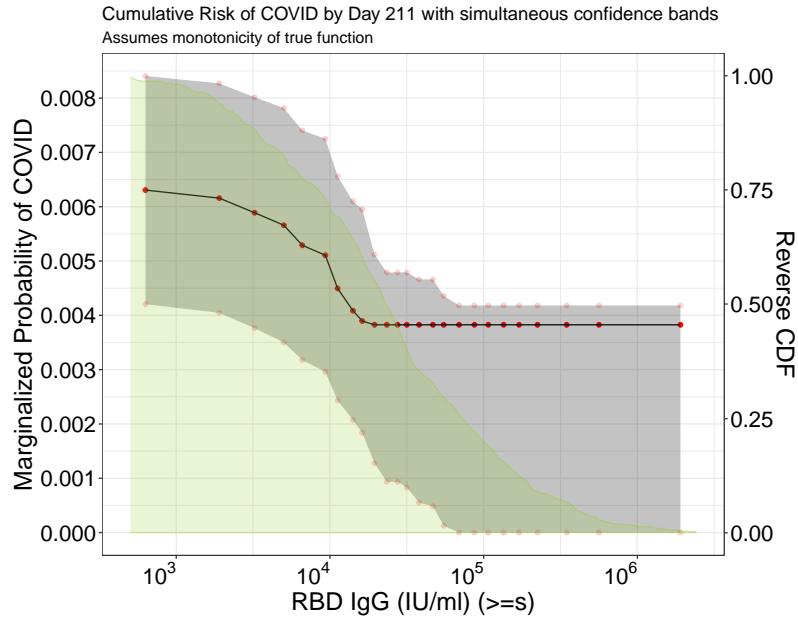


Figure 4.24: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

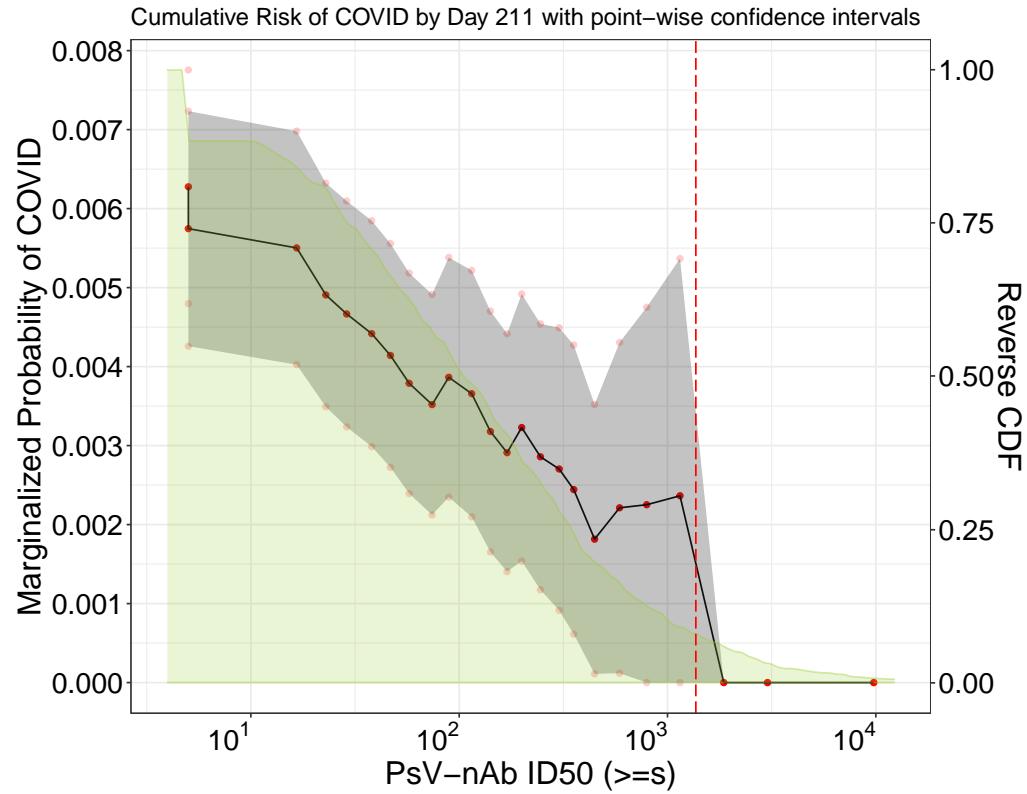


Figure 4.25: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.13: Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00628	0.00480	0.00775
1.356	$2.27 * 10^1$	0.00491	0.00349	0.00632
1.575	$3.76 * 10^1$	0.00442	0.00299	0.00585
1.868	$7.38 * 10^1$	0.00352	0.00212	0.00492
2.055	$1.14 * 10^2$	0.00366	0.00210	0.00522
2.303	$2.01 * 10^2$	0.00323	0.00154	0.00492
2.481	$3.03 * 10^2$	0.00270	0.00091	0.00449
2.770	$5.89 * 10^2$	0.00221	0.00012	0.00431
3.056	$1.14 * 10^3$	0.00236	0.00000	0.00537
3.989	$9.75 * 10^3$	0.00000	0.00000	NA

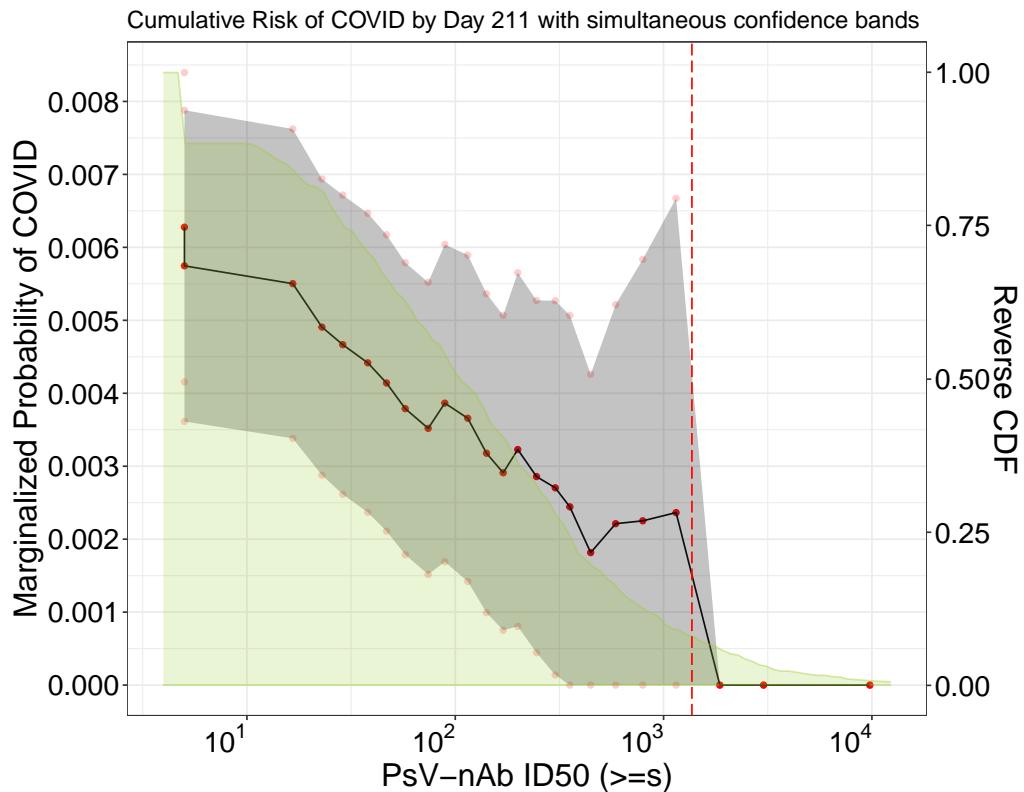


Figure 4.26: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.14: Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00628	0.00480	0.00775
1.356	$2.27 * 10^1$	0.00491	0.00349	0.00632
1.575	$3.76 * 10^1$	0.00442	0.00299	0.00585
1.868	$7.38 * 10^1$	0.00352	0.00212	0.00492
2.055	$1.14 * 10^2$	0.00366	0.00210	0.00522
2.303	$2.01 * 10^2$	0.00323	0.00154	0.00492
2.481	$3.03 * 10^2$	0.00270	0.00091	0.00449
2.770	$5.89 * 10^2$	0.00221	0.00012	0.00431
3.056	$1.14 * 10^3$	0.00236	0.00000	0.00537
3.989	$9.75 * 10^3$	0.00000	0.00000	NA

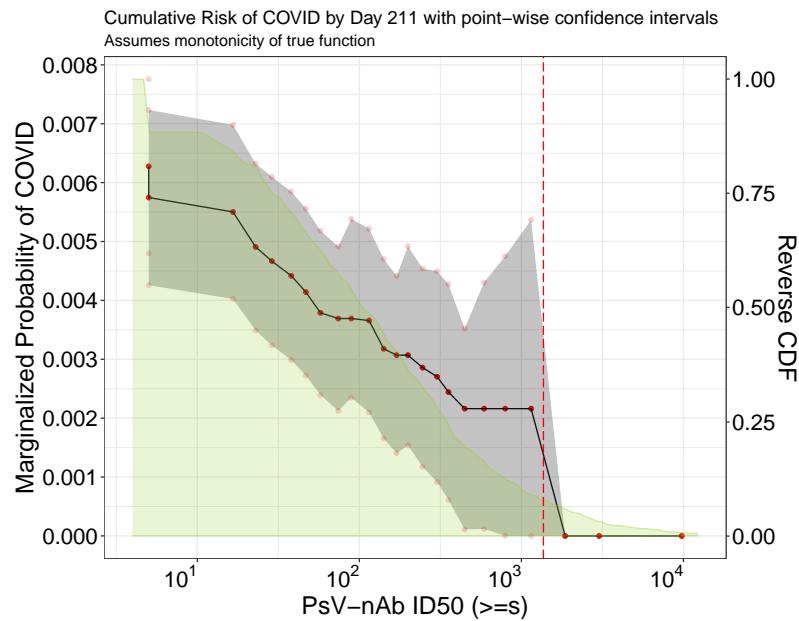


Figure 4.27: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

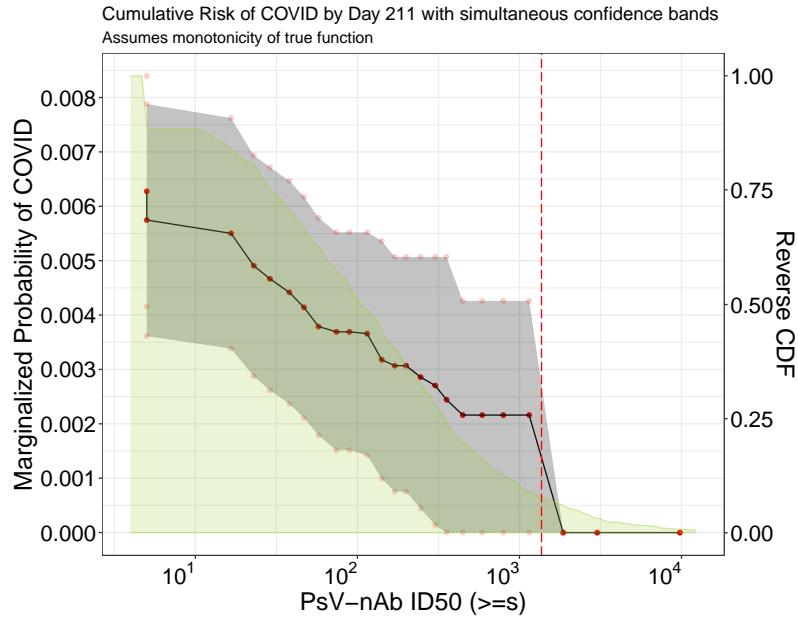


Figure 4.28: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

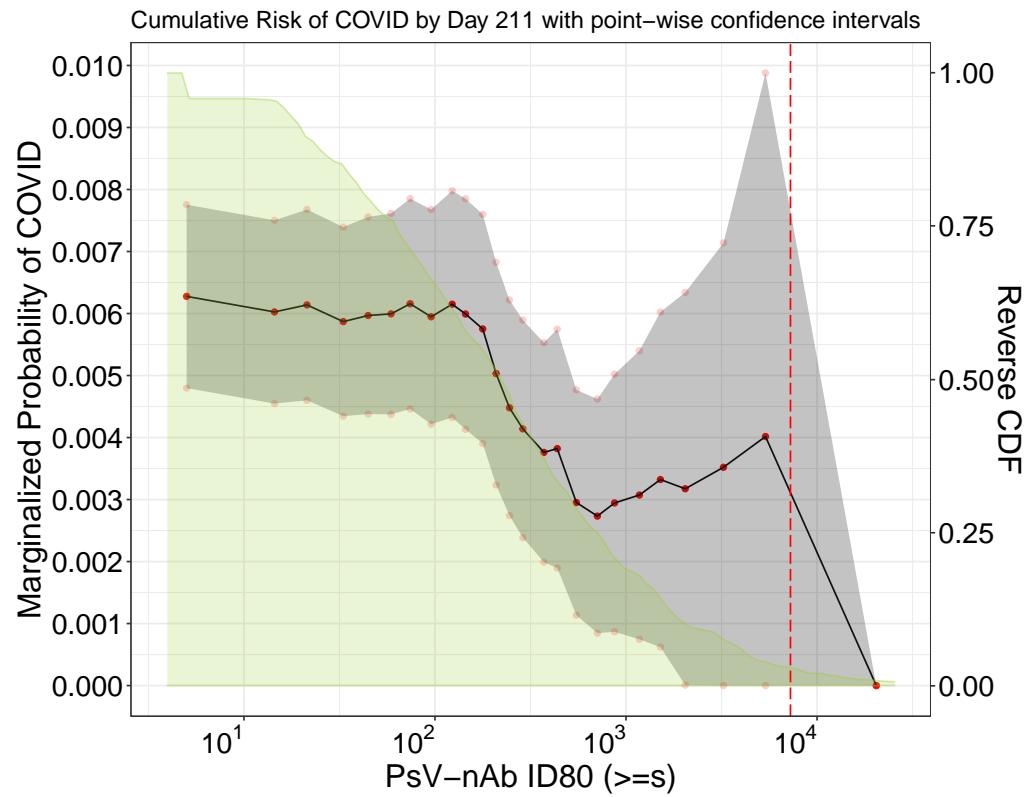


Figure 4.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.15: Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00628	0.00480	0.00775
1.515	$3.27 * 10^1$	0.00587	0.00435	0.00739
1.765	$5.82 * 10^1$	0.00599	0.00437	0.00761
2.088	$1.22 * 10^2$	0.00615	0.00432	0.00798
2.324	$2.11 * 10^2$	0.00503	0.00324	0.00683
2.462	$2.90 * 10^2$	0.00414	0.00239	0.00589
2.744	$5.55 * 10^2$	0.00295	0.00114	0.00477
3.070	$1.17 * 10^3$	0.00307	0.00075	0.00540
3.314	$2.06 * 10^3$	0.00317	0.00001	0.00634
4.305	$2.02 * 10^4$	0.00000	0.00000	NA

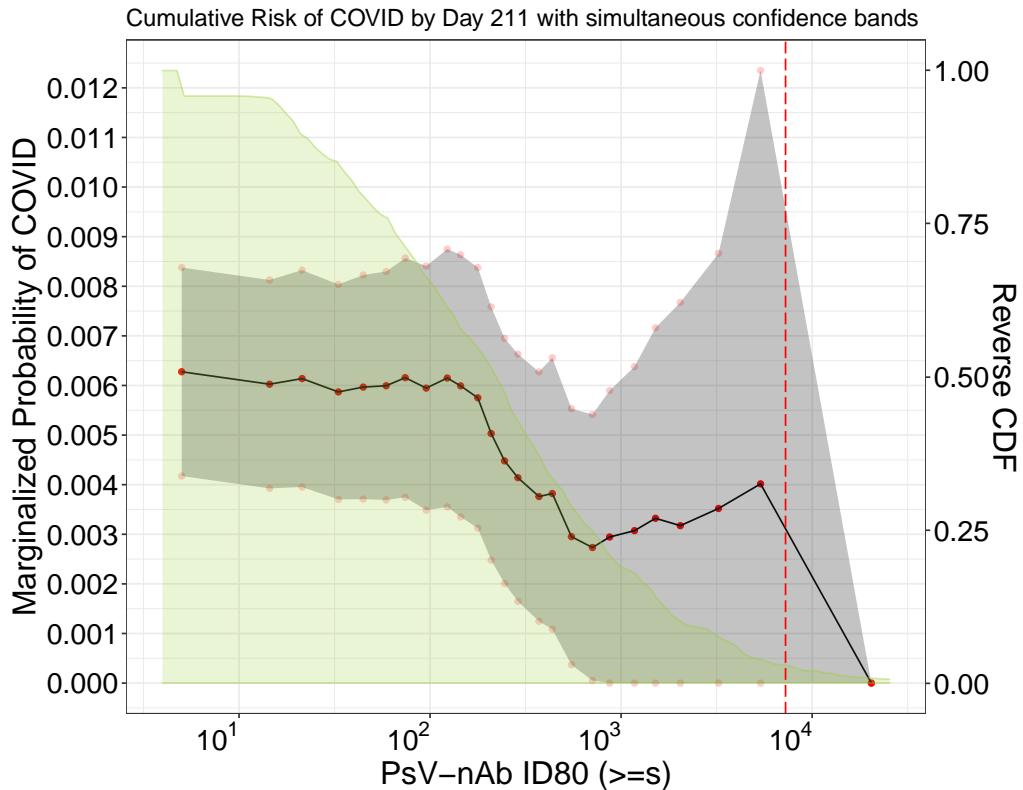


Figure 4.30: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

Table 4.16: Table of risk estimates for range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% simultaneous confidence intervals.

$\log_{10}$ -Threshold	Threshold	Risk estimate	CI left	CI right
0.699	$5.00 * 10^0$	0.00628	0.00480	0.00775
1.515	$3.27 * 10^1$	0.00587	0.00435	0.00739
1.765	$5.82 * 10^1$	0.00599	0.00437	0.00761
2.088	$1.22 * 10^2$	0.00615	0.00432	0.00798
2.324	$2.11 * 10^2$	0.00503	0.00324	0.00683
2.462	$2.90 * 10^2$	0.00414	0.00239	0.00589
2.744	$5.55 * 10^2$	0.00295	0.00114	0.00477
3.070	$1.17 * 10^3$	0.00307	0.00075	0.00540
3.314	$2.06 * 10^3$	0.00317	0.00001	0.00634
4.305	$2.02 * 10^4$	0.00000	0.00000	NA

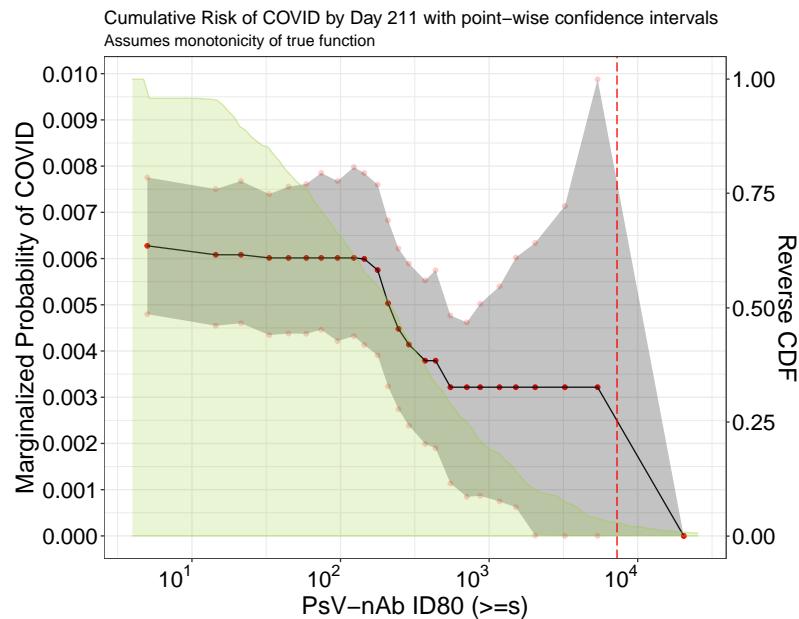


Figure 4.31: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

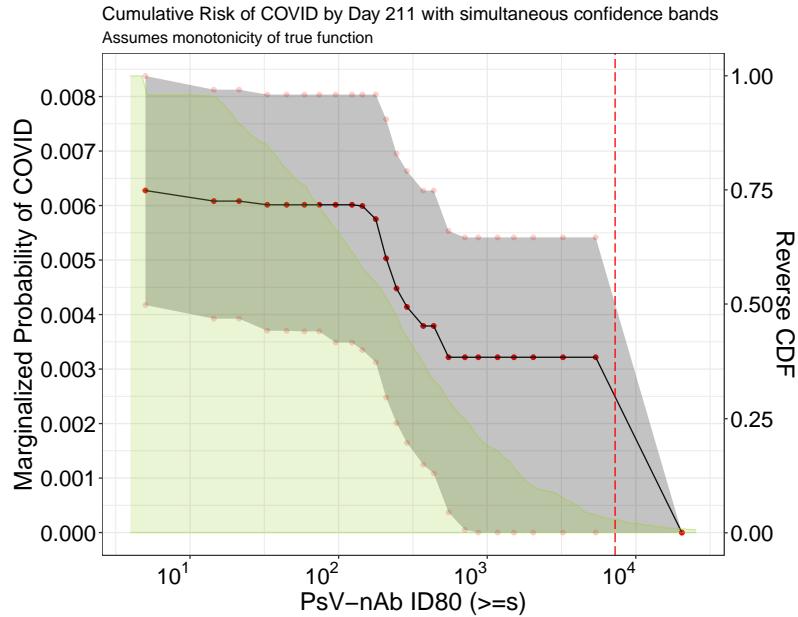


Figure 4.32: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.