

COVID-19 Correlates of Risk Analysis Report
MockCOVE Study

USG COVID-19 Response Biostatistics Team

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Chapter 1

Disclaimers

- The data presented in the analysis originated from the Moderna Sponsored mRNA-1273-P301 clinical study and are provided to NIAID in accordance with Clinical Trial Agreement between the parties. The study was funded in part by BARDA under Government Contract No. 75A50120C00034
- The preliminary immunogenicity data presented here do not reflect the Sponsors statistical analysis plan and therefore should not be interpreted as a protocol defined read-out of the clinical study.
- These data are not to be disclosed without written permission of Moderna.

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Chapter 2

Summary Tables

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

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

| Characteristics | Vaccine (N = 747) | Placebo (N = 138) | Total (N = 885) |
|---|----------------------|----------------------|--------------------|
| Age | | | |
| Age < 65 | 357 (47.8%) | 72 (52.2%) | 429 (48.5%) |
| Age ≥ 65 | 390 (52.2%) | 66 (47.8%) | 456 (51.5%) |
| Mean (Range) | 58.5 (18.0, 85.0) | 58.3 (18.0, 85.0) | 58.5 (18.0, 85.0) |
| BMI | | | |
| Mean ± SD | 29.7 ± 6.6 | 31.4 ± 6.3 | 30.0 ± 6.6 |
| Risk for Severe Covid-19 | | | |
| At-risk | 381 (51.0%) | 71 (51.4%) | 452 (51.1%) |
| Not at-risk | 366 (49.0%) | 67 (48.6%) | 433 (48.9%) |
| Age, Risk for Severe Covid-19 | | | |
| Age < 65 At-risk | 185 (24.8%) | 36 (26.1%) | 221 (25.0%) |
| Age < 65 Not at-risk | 172 (23.0%) | 36 (26.1%) | 208 (23.5%) |
| Age ≥ 65 | 390 (52.2%) | 66 (47.8%) | 456 (51.5%) |
| Sex | | | |
| Female | 427 (57.2%) | 75 (54.3%) | 502 (56.7%) |
| Male | 320 (42.8%) | 63 (45.7%) | 383 (43.3%) |
| Hispanic or Latino ethnicity | | | |
| Hispanic or Latino | 99 (13.3%) | 20 (14.5%) | 119 (13.4%) |
| Not Hispanic or Latino | 623 (83.4%) | 113 (81.9%) | 736 (83.2%) |
| Not reported and unknown | 25 (3.3%) | 5 (3.6%) | 30 (3.4%) |
| Race | | | |
| White | 397 (53.1%) | 74 (53.6%) | 471 (53.2%) |
| Black or African American | 184 (24.6%) | 40 (29.0%) | 224 (25.3%) |
| Asian | 56 (7.5%) | 10 (7.2%) | 66 (7.5%) |
| American Indian or Alaska Native | 16 (2.1%) | 2 (1.4%) | 18 (2.0%) |
| Native Hawaiian or Other Pacific Islander | 17 (2.3%) | 2 (1.4%) | 19 (2.1%) |

(continued)

| Characteristics | Vaccine (N = 747) | Placebo (N = 138) | Total (N = 885) |
|--------------------------|----------------------|----------------------|--------------------|
| Multiracial | 57 (7.6%) | 8 (5.8%) | 65 (7.3%) |
| Other | 16 (2.1%) | 1 (0.7%) | 17 (1.9%) |
| Not reported and unknown | 4 (0.5%) | 1 (0.7%) | 5 (0.6%) |
| White Non-Hispanic | 370 (49.5%) | 63 (45.7%) | 433 (48.9%) |
| Communities of Color | 377 (50.5%) | 75 (54.3%) | 452 (51.1%) |

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

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

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

| Characteristics | Vaccine (N = 234) | Placebo (N = 241) | Total (N = 475) |
|---|----------------------|----------------------|--------------------|
| Age | | | |
| Age < 65 | 114 (48.7%) | 120 (49.8%) | 234 (49.3%) |
| Age ≥ 65 | 120 (51.3%) | 121 (50.2%) | 241 (50.7%) |
| Mean (Range) | 58.3 (18.0, 85.0) | 56.3 (18.0, 85.0) | 57.3 (18.0, 85.0) |
| BMI | | | |
| Mean ± SD | 29.7 ± 7.5 | 30.0 ± 6.6 | 29.9 ± 7.0 |
| Risk for Severe Covid-19 | | | |
| At-risk | 111 (47.4%) | 117 (48.5%) | 228 (48.0%) |
| Not at-risk | 123 (52.6%) | 124 (51.5%) | 247 (52.0%) |
| Age, Risk for Severe Covid-19 | | | |
| Age < 65 At-risk | 56 (23.9%) | 59 (24.5%) | 115 (24.2%) |
| Age < 65 Not at-risk | 58 (24.8%) | 61 (25.3%) | 119 (25.1%) |
| Age ≥ 65 | 120 (51.3%) | 121 (50.2%) | 241 (50.7%) |
| Sex | | | |
| Female | 139 (59.4%) | 133 (55.2%) | 272 (57.3%) |
| Male | 95 (40.6%) | 108 (44.8%) | 203 (42.7%) |
| Hispanic or Latino ethnicity | | | |
| Hispanic or Latino | 31 (13.2%) | 34 (14.1%) | 65 (13.7%) |
| Not Hispanic or Latino | 194 (82.9%) | 201 (83.4%) | 395 (83.2%) |
| Not reported and unknown | 9 (3.8%) | 6 (2.5%) | 15 (3.2%) |
| Race | | | |
| White | 126 (53.8%) | 129 (53.5%) | 255 (53.7%) |
| Black or African American | 58 (24.8%) | 45 (18.7%) | 103 (21.7%) |
| Asian | 19 (8.1%) | 27 (11.2%) | 46 (9.7%) |
| American Indian or Alaska Native | 10 (4.3%) | 7 (2.9%) | 17 (3.6%) |
| Native Hawaiian or Other Pacific Islander | 4 (1.7%) | 2 (0.8%) | 6 (1.3%) |
| Multiracial | 10 (4.3%) | 16 (6.6%) | 26 (5.5%) |
| Other | 7 (3.0%) | 13 (5.4%) | 20 (4.2%) |
| Not reported and unknown | | 2 (0.8%) | 2 (0.4%) |
| White Non-Hispanic | 118 (50.4%) | 121 (50.2%) | 239 (50.3%) |
| Communities of Color | 116 (49.6%) | 120 (49.8%) | 236 (49.7%) |

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

2.3 Sample Sizes of Baseline Strata for Correlates of Risk Analysis

Table 3. Sample Sizes of Baseline Strata for Correlates of Risk Analysis

| Per-protocol Cases and Non-Cases (Moderna Trial) | | | | | | | | | | | | | | | | | | |
|--|------------------------------|-----|----|----|-----|----|----|-----|----|------------------------------|----|----|----|----|----|----|----|----|
| | Baseline SARS-CoV-2 Negative | | | | | | | | | Baseline SARS-CoV-2 Positive | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Vaccine | | | | | | | | | | | | | | | | | | |
| Day 29 Cases | 8 | 18 | 6 | 2 | 7 | 0 | 3 | 12 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| Day 57 Cases | 8 | 18 | 4 | 2 | 7 | 0 | 1 | 9 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| Non-Cases | 153 | 235 | 69 | 78 | 106 | 35 | 67 | 105 | 39 | 48 | 72 | 26 | 24 | 32 | 12 | 23 | 35 | 11 |
| Placebo | | | | | | | | | | | | | | | | | | |
| Day 29 Cases | 141 | 329 | 77 | 48 | 109 | 31 | 87 | 243 | 55 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| Day 57 Cases | 132 | 306 | 72 | 37 | 93 | 27 | 61 | 198 | 42 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| Non-Cases | 21 | 34 | 9 | 16 | 16 | 2 | 16 | 18 | 3 | 43 | 77 | 32 | 19 | 39 | 16 | 22 | 38 | 9 |

Demographic covariate strata:

- | | |
|----------------------------------|--------------------------------------|
| 1. Age \geq 65 Minority | 6. Age < 65 At-risk Unknown |
| 2. Age \geq 65 Non-Minority | 7. Age < 65 Not At-risk Minority |
| 3. Age \geq 65 Unknown | 8. Age < 65 Not At-risk Non-Minority |
| 4. Age < 65 At-risk Minority | 9. Age < 65 Not At-risk Unknown |
| 5. Age < 65 At-risk Non-Minority | |

Minority includes Blacks or African Americans, Hispanics or Latinos, American Indians or Alaska Natives, Native Hawaiians, and other Pacific Islanders.

Non-Minority includes all other races with observed race (Asian, Multiracial, White, Other) and observed ethnicity Not Hispanic or Latino.

Unknown includes unknown, unreported race or ethnicity.

Cases for Day 29 marker correlates analyses are per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 29 study visit. Cases for Day 57 marker correlates analyses are per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases are per-protocol participants sampled into the random subcohort with no COVID primary endpoint up to the time of data cut and no evidence of SARS-CoV-2 infection up to six days post Day 57 visit.

The table shows the numbers of cases sampled into the subcohort within baseline covariate strata.

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

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

| Visit | Marker | Baseline SARS-CoV-2 Negative Vaccine Recipients | | | | | | Comparison | |
|--------|------------------------|---|------------------------------------|-------------------------------|-----|--|-------------------------------|-----------------------|----------------------|
| | | Cases* | | Non-Cases/Control | | Resp Rate Difference | GMTR/GMCR | | |
| N | Resp rate | N | Resp rate | GMT/GMC | | | | | |
| Day 29 | Pseudovirus-nAb ID80 | 59 | 35.6/60 = 59.3% (46.2%, 71.3%) | 21.18 (17.33, 25.87) | 744 | 6530.6/11070 = 59.0% (54.4%, 63.4%) | 25.97 (23.98, 28.13) | 0 (-0.14, 0.13) | 0.82 (0.66, 1.01) |
| Day 29 | Pseudovirus-nAb ID50 | 59 | 53.9/60 = 89.8% (78.9%, 95.4%) | 16.19 (12.51, 20.95) | 744 | 9932/11070 = 89.7% (86.2%, 92.4%) | 17.35 (15.85, 18.99) | 0 (-0.11, 0.07) | 0.93 (0.71, 1.23) |
| Day 29 | Anti RBD IgG (IU/ml) | 59 | 60/60 = 100.0% (100.0%, 100.0%) | 456.66 (292.67, 712.53) | 744 | 10896.8/11070 = 98.4% (96.6%, 99.3%) | 473.53 (412.98, 542.96) | 0.02 (0.01, 0.03) | 0.96 (0.61, 1.54) |
| Day 29 | Anti Spike IgG (IU/ml) | 59 | 60/60 = 100.0% (100.0%, 100.0%) | 236.57 (169.47, 330.25) | 744 | 10981.5/11070 = 99.2% (97.7%, 99.7%) | 266.03 (238.38, 296.89) | 0.01 (0, 0.02) | 0.89 (0.63, 1.26) |
| Day 29 | Anti N IgG (IU/ml) | 59 | 35.6/60 = 59.3% (46.2%, 71.3%) | 39.18 (24.94, 61.55) | 744 | 6848.9/11070 = 61.9% (57.3%, 66.2%) | 36.77 (31.08, 43.49) | -0.03 (-0.16, 0.1) | 1.07 (0.66, 1.73) |
| Day 57 | Pseudovirus-nAb ID80 | 52 | 52/52 = 100.0% (100.0%, 100.0%) | 408.70 (310.06, 538.71) | 744 | 11065/11065 = 100.0% (100.0%, 100.0%) | 564.67 (511.70, 623.12) | 0 (0, 0) | 0.72 (0.54, 0.97) |
| Day 57 | Pseudovirus-nAb ID50 | 52 | 52/52 = 100.0% (100.0%, 100.0%) | 320.14 (230.41, 444.83) | 744 | 11065/11065 = 100.0% (100.0%, 100.0%) | 427.25 (383.62, 475.84) | 0 (0, 0) | 0.75 (0.53, 1.06) |
| Day 57 | Anti RBD IgG (IU/ml) | 52 | 52/52 = 100.0% (100.0%, 100.0%) | 3325.76 (2232.06, 4955.38) | 744 | 11045.2/11065 = 99.8% (98.7%, 100.0%) | 3599.25 (3171.86, 4084.22) | 0 (0, 0.01) | 0.92 (0.61, 1.40) |
| Day 57 | Anti Spike IgG (IU/ml) | 52 | 52/52 = 100.0% (100.0%, 100.0%) | 1847.33 (1337.98, 2550.57) | 744 | 11065/11065 = 100.0% (100.0%, 100.0%) | 2668.40 (2364.64, 3011.17) | 0 (0, 0) | 0.69 (0.49, 0.98) |

| | | | | | | | | | |
|-----|--------------------|----|------------------------------------|--------------------------|-----|---|---------------------------|-----------------------|----------------------|
| Day | Anti N IgG (IU/ml) | 52 | $37/52 = 71.2\%$ (57.2%, 82.0%) | 71.78 (43.87, 117.44) | 744 | $8998.4/11065 = 81.3\%$ (77.3%, 84.8%) | 110.30 (94.07, 129.33) | -0.1 (-0.25, 0.01) | 0.65 (0.39, 1.09) |
|-----|--------------------|----|------------------------------------|--------------------------|-----|---|---------------------------|-----------------------|----------------------|

Cases for Day 29 marker correlates analyses are baseline negative per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 29 study visit. Cases for Day 57 marker correlates analyses are baseline negative per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit.

N is the number of cases sampled into the subcohort within baseline covariate strata.

The denominator in Resp Rate is the number of participants in the whole per-protocol cohort within baseline covariate strata, calculated using inverse probability weighting.



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

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

| Visit | Marker | Baseline SARS-CoV-2 Positive Vaccine Recipients | | | | | | Comparison | |
|--------|------------------------|---|----------------------------------|----------------------------------|-----|---|--------------------------------|------------------------|----------------------|
| | | Cases* | | Non-Cases/Control | | | | Resp Rate Difference | GMTR/GMCR |
| | | N | Resp rate | GMT/GMC | N | Resp rate | GMT/GMC | | |
| Day 29 | Pseudovirus-nAb ID80 | 3 | 3.3/5 = 66.7% (0.6%, 99.8%) | 28.17 (20.25, 39.20) | 234 | 904.7/1218.1 = 74.3% (66.3%, 80.9%) | 51.20 (44.64, 58.73) | -0.08 (-0.74, 0.27) | 0.55 (0.38, 0.79) |
| Day 29 | Pseudovirus-nAb ID50 | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 37.31 (35.33, 39.40) | 234 | 1159.7/1218.1 = 95.2% (89.2%, 97.9%) | 32.70 (28.11, 38.04) | 0.05 (0.02, 0.11) | 1.14 (0.97, 1.34) |
| Day 29 | Anti RBD IgG (IU/ml) | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 622.59 (124.89, 3103.56) | 234 | 1213.5/1218.1 = 99.6% (97.3%, 99.9%) | 823.96 (640.00, 1060.79) | 0 (0, 0.03) | 0.76 (0.15, 3.84) |
| Day 29 | Anti Spike IgG (IU/ml) | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 180.93 (156.70, 208.91) | 234 | 1209.6/1218.1 = 99.3% (95.1%, 99.9%) | 474.27 (397.60, 565.71) | 0.01 (0, 0.05) | 0.38 (0.30, 0.48) |
| Day 29 | Anti N IgG (IU/ml) | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 220.52 (99.97, 486.42) | 234 | 928.1/1218.1 = 76.2% (68.6%, 82.4%) | 70.68 (55.09, 90.70) | 0.24 (0.18, 0.31) | 3.12 (1.36, 7.15) |
| Day 57 | Pseudovirus-nAb ID80 | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 1156.48 (486.62, 2748.44) | 233 | 1229/1229 = 100.0% (100.0%, 100.0%) | 1559.92 (1333.89, 1824.26) | 0 (0, 0) | 0.74 (0.31, 1.79) |
| Day 57 | Pseudovirus-nAb ID50 | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 493.08 (319.26, 761.53) | 233 | 1229/1229 = 100.0% (100.0%, 100.0%) | 1227.59 (1000.73, 1505.88) | 0 (0, 0) | 0.40 (0.25, 0.65) |
| Day 57 | Anti RBD IgG (IU/ml) | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 15558.50 (14386.64, 16825.81) | 233 | 1229/1229 = 100.0% (100.0%, 100.0%) | 8619.19 (7266.78, 10223.28) | 0 (0, 0) | 1.81 (1.50, 2.18) |
| Day 57 | Anti Spike IgG (IU/ml) | 3 | 5/5 = 100.0% (100.0%, 100.0%) | 4871.27 (3719.87, 6379.06) | 233 | 1229/1229 = 100.0% (100.0%, 100.0%) | 5665.25 (4956.22, 6475.72) | 0 (0, 0) | 0.86 (0.64, 1.16) |

| | | | | | | | | | |
|-----------|--------------------|---|-------------------------------------|----------------------------|-----|--|----------------------------|----------------------|----------------------|
| Day 57 | Anti N IgG (IU/ml) | 3 | $5/5 = 100.0\%$ (100.0%, 100.0%) | 293.21 (150.76, 570.25) | 233 | $1182.5/1229 = 96.2\%$ (90.6%, 98.5%) | 248.12 (202.53, 303.97) | 0.04 (0.01, 0.09) | 1.18 (0.59, 2.37) |
|-----------|--------------------|---|-------------------------------------|----------------------------|-----|--|----------------------------|----------------------|----------------------|

The SAP does not specify correlates analyses in baseline positive vaccine recipients. This table summarizes descriptively the same information for baseline positive vaccine recipients that was summarized for baseline negative vaccine recipients. Cases for Day 29 markers are baseline positive per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 29 study visit. Cases for Day 57 markers are baseline positive per-protocol vaccine recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases/Controls are baseline positive per-protocol vaccine recipients sampled into the random subcohort with no COVID-19 endpoint diagnosis by the time of data-cut.

N is the number of cases sampled into the subcohort within baseline covariate strata.

The denominator in Resp Rate is the number of participants in the whole per-protocol cohort within baseline covariate strata, calculated using inverse probability weighting.



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

Table 6. Antibody levels in the baseline SARS-CoV-2 positive per-protocol cohort (placebo recipients)

| Visit | Marker | Baseline SARS-CoV-2 Positive Placebo Recipients | | | | | | Comparison | |
|--------|------------------------|---|-------------------------------|-----------|--|-------------------------------|------------------------|-----------------------|-----------|
| | | Cases* | | | Non-Cases/Control | | | Resp Rate Difference | GMTR/GMCR |
| N | Resp rate | GMT/GMC | N | Resp rate | GMT/GMC | | | | |
| Day 29 | Pseudovirus-nAb ID80 | 5 3/5 = 60.0% (10.6%, 95.0%) | 19.58 (9.63, 39.79) | 238 | 442.9/1121 = 39.5% (32.4%, 47.1%) | 20.38 (17.86, 23.27) | 0.2 (-0.29, 0.56) | 0.96 (0.47, 1.98) | |
| Day 29 | Pseudovirus-nAb ID50 | 5 2/5 = 40.0% (5.0%, 89.4%) | 4.46 (1.50, 13.28) | 238 | 896.5/1121 = 80.0% (72.4%, 85.9%) | 11.68 (9.90, 13.77) | -0.4 (-0.75, 0.1) | 0.38 (0.13, 1.15) | |
| Day 29 | Anti RBD IgG (IU/ml) | 5 5/5 = 100.0% (100.0%, 100.0%) | 498.48 (77.45, 3208.22) | 238 | 1060/1121 = 94.6% (88.4%, 97.5%) | 306.92 (232.82, 404.62) | 0.05 (0.02, 0.12) | 1.62 (0.25, 10.67) | |
| Day 29 | Anti Spike IgG (IU/ml) | 5 5/5 = 100.0% (100.0%, 100.0%) | 266.06 (74.76, 946.84) | 238 | 1085.9/1121 = 96.9% (91.9%, 98.8%) | 170.13 (136.41, 212.19) | 0.03 (0.01, 0.08) | 1.56 (0.43, 5.67) | |
| Day 29 | Anti N IgG (IU/ml) | 5 3/5 = 60.0% (10.6%, 95.0%) | 11.78 (2.03, 68.41) | 238 | 603/1121 = 53.8% (45.9%, 61.5%) | 26.96 (20.32, 35.77) | 0.06 (-0.44, 0.42) | 0.44 (0.07, 2.60) | |
| Day 57 | Pseudovirus-nAb ID80 | 5 5/5 = 100.0% (100.0%, 100.0%) | 288.29 (114.87, 723.51) | 238 | 1119/1119 = 100.0% (100.0%, 100.0%) | 462.73 (395.43, 541.48) | 0 (0, 0) | 0.62 (0.24, 1.58) | |
| Day 57 | Pseudovirus-nAb ID50 | 5 5/5 = 100.0% (100.0%, 100.0%) | 629.06 (128.64, 3076.16) | 238 | 1119/1119 = 100.0% (100.0%, 100.0%) | 313.97 (258.96, 380.65) | 0 (0, 0) | 2.00 (0.40, 9.91) | |
| Day 57 | Anti RBD IgG (IU/ml) | 5 5/5 = 100.0% (100.0%, 100.0%) | 1704.47 (253.44, 11462.91) | 238 | 1119/1119 = 100.0% (100.0%, 100.0%) | 2656.74 (2066.29, 3415.92) | 0 (0, 0) | 0.64 (0.09, 4.39) | |
| Day 57 | Anti Spike IgG (IU/ml) | 5 5/5 = 100.0% (100.0%, 100.0%) | 1648.06 (332.52, 8168.38) | 238 | 1119/1119 = 100.0% (100.0%, 100.0%) | 1953.05 (1538.23, 2479.73) | 0 (0, 0) | 0.84 (0.17, 4.26) | |
| Day 57 | Anti N IgG (IU/ml) | 5 3/5 = 60.0% (10.6%, 95.0%) | 49.66 (3.50, 703.93) | 238 | 865.3/1119 = 77.3% (69.5%, 83.6%) | 94.81 (70.11, 128.23) | -0.17 (-0.67, 0.19) | 0.52 (0.04, 7.55) | |

(continued)

| Visit | Marker | N | Resp rate | GMT/GMC | N | Resp rate | GMT/GMC | Resp Rate Difference | GMTR/GMCR |
|-------|--------|---|-----------|---------|---|-----------|---------|----------------------|-----------|
|-------|--------|---|-----------|---------|---|-----------|---------|----------------------|-----------|

The SAP does not specify correlates analyses in baseline positive placebo recipients. This table summarizes descriptively the same information for baseline positive placebo recipients that was summarized for baseline negative and positive vaccine recipients. Cases for Day 29 markers are baseline positive per-protocol placebo recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 29 study visit. Cases for Day 57 markers are baseline positive per-protocol placebo recipients with the symptomatic infection COVID-19 primary endpoint diagnosed starting 7 days after the Day 57 study visit. Non-cases/Controls are baseline positive per-protocol placebo recipients sampled into the random subcohort with no COVID-19 endpoint diagnosis by the time of data-cut.

N is the number of cases sampled into the subcohort within baseline covariate strata.

The denominator in Resp Rate is the number of participants in the whole per-protocol cohort within baseline covariate strata, calculated using inverse probability weighting.

MOCK

Chapter 3

Graphical Descriptions of Antibody Marker Data

3.1 Boxplots

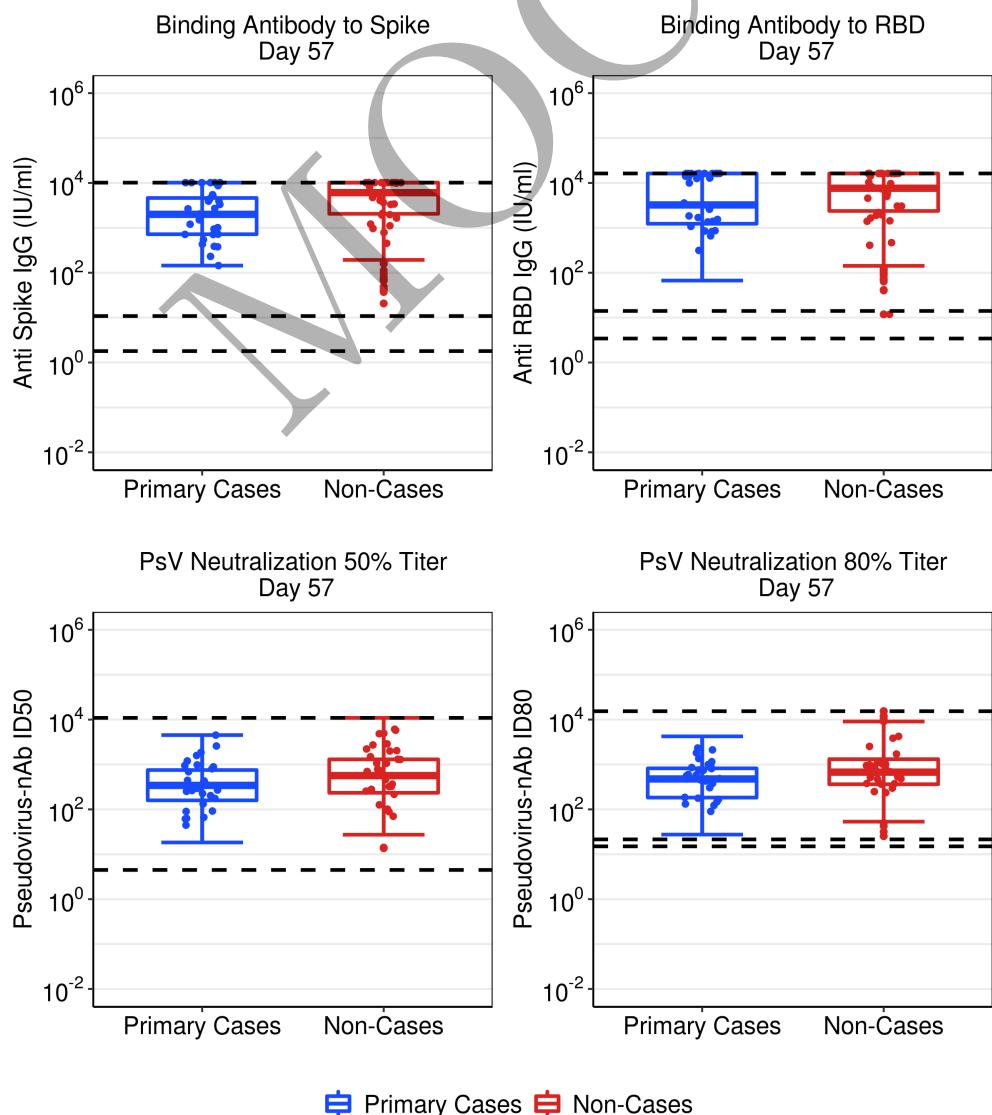


Figure 3.1: Boxplots of D57 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

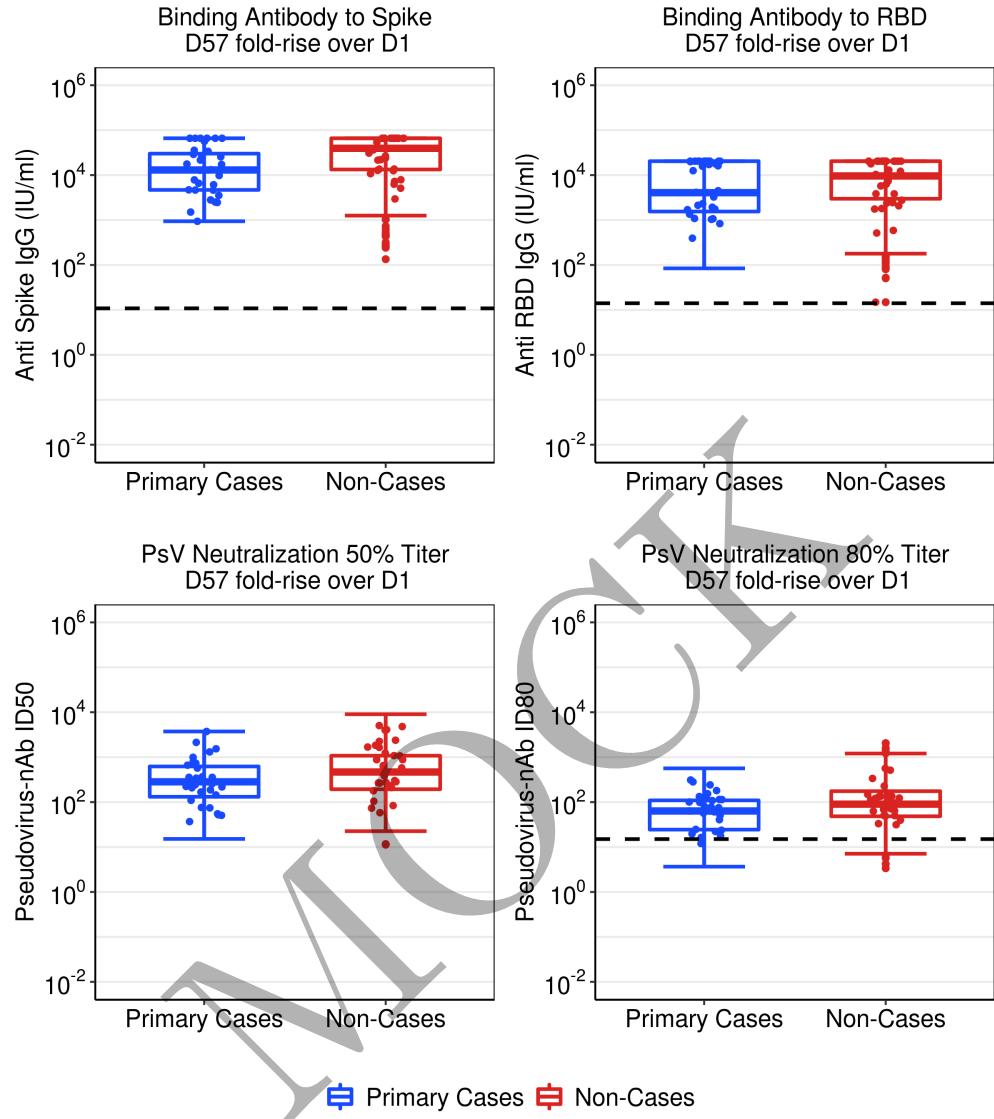


Figure 3.2: Boxplots of D57 fold-rise over D1 Ab markers: vaccine arm.

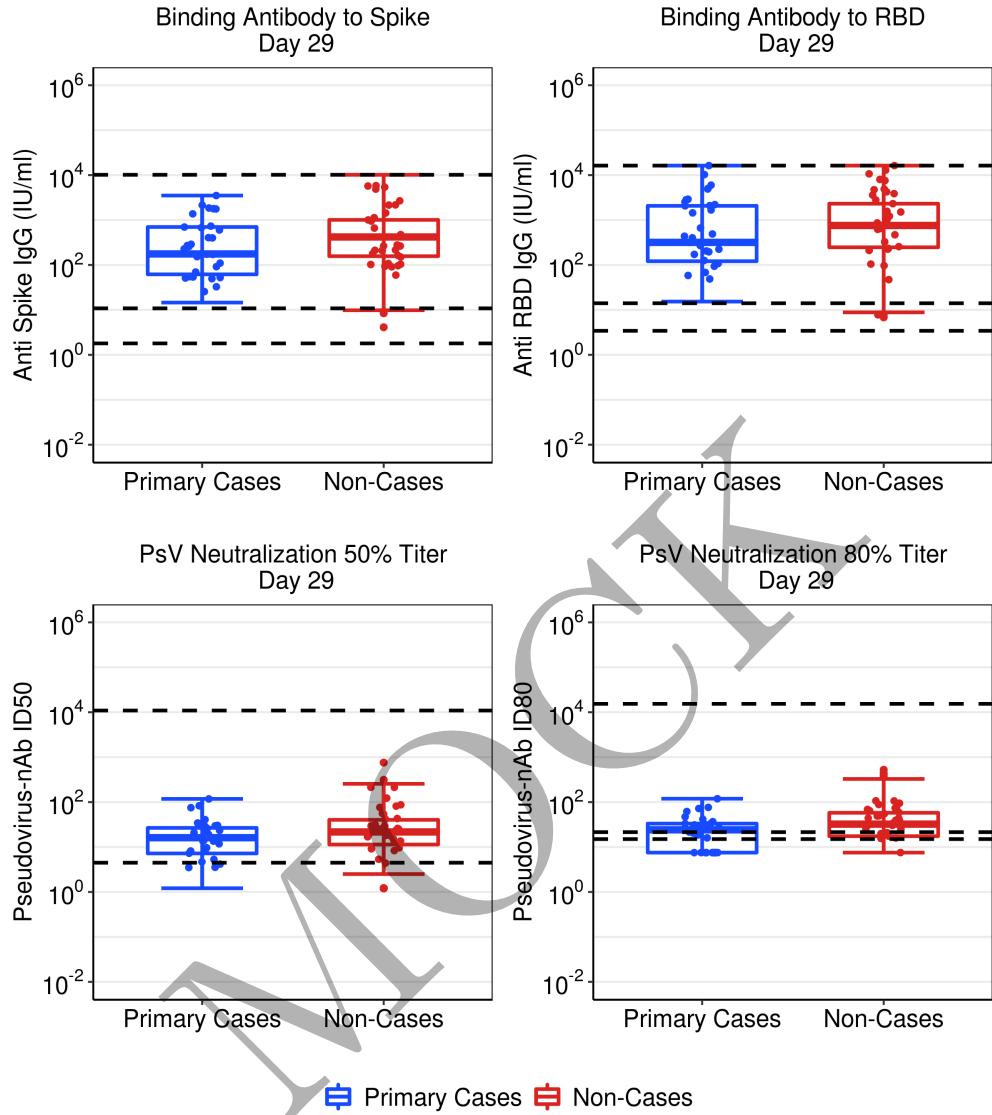


Figure 3.3: Boxplots of D29 Ab markers: vaccine arm. The three dashed lines in each figure are ULOQ, LLOQ, and LLOD, from top to bottom respectively.

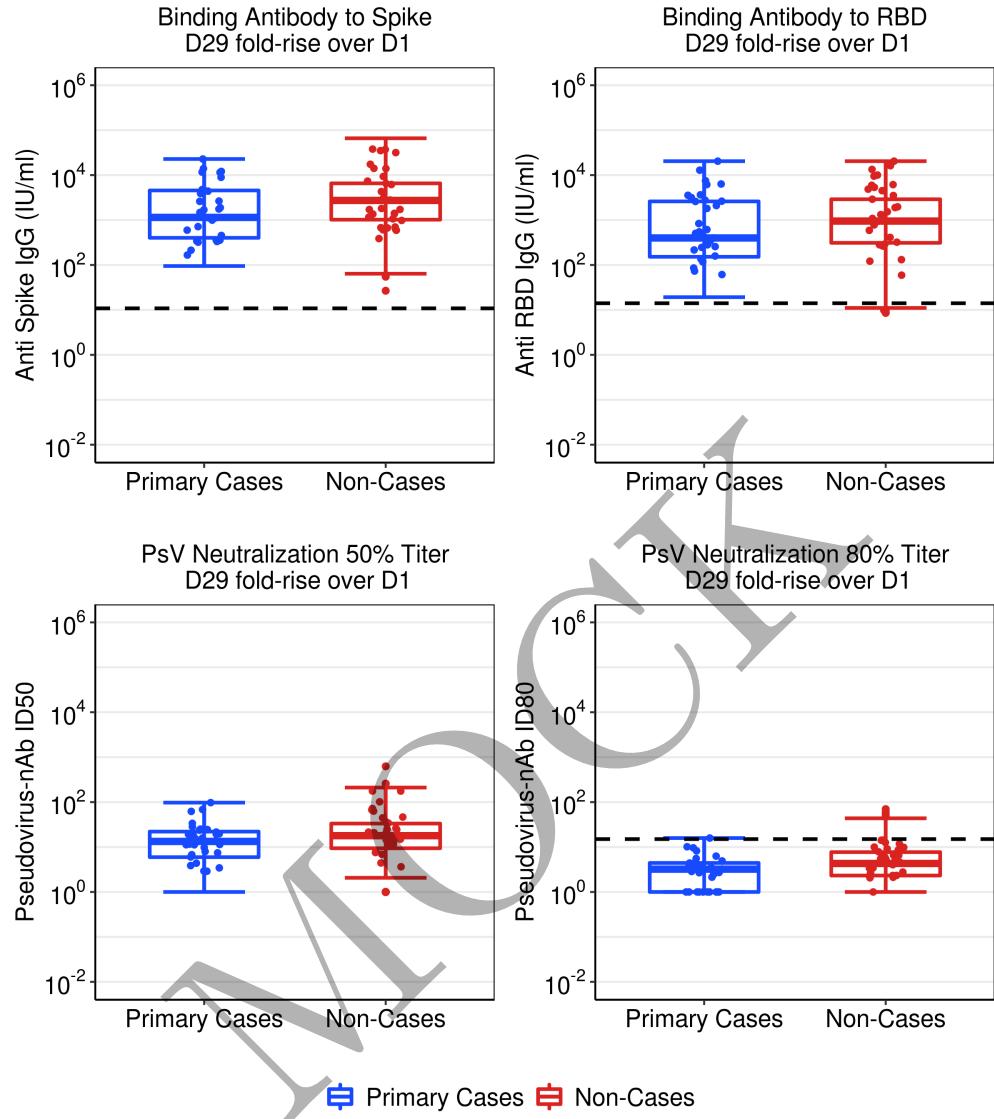


Figure 3.4: Boxplots of D29 fold-rise over D1 Ab markers: vaccine arm.

3.2 Weighted RCDF plots

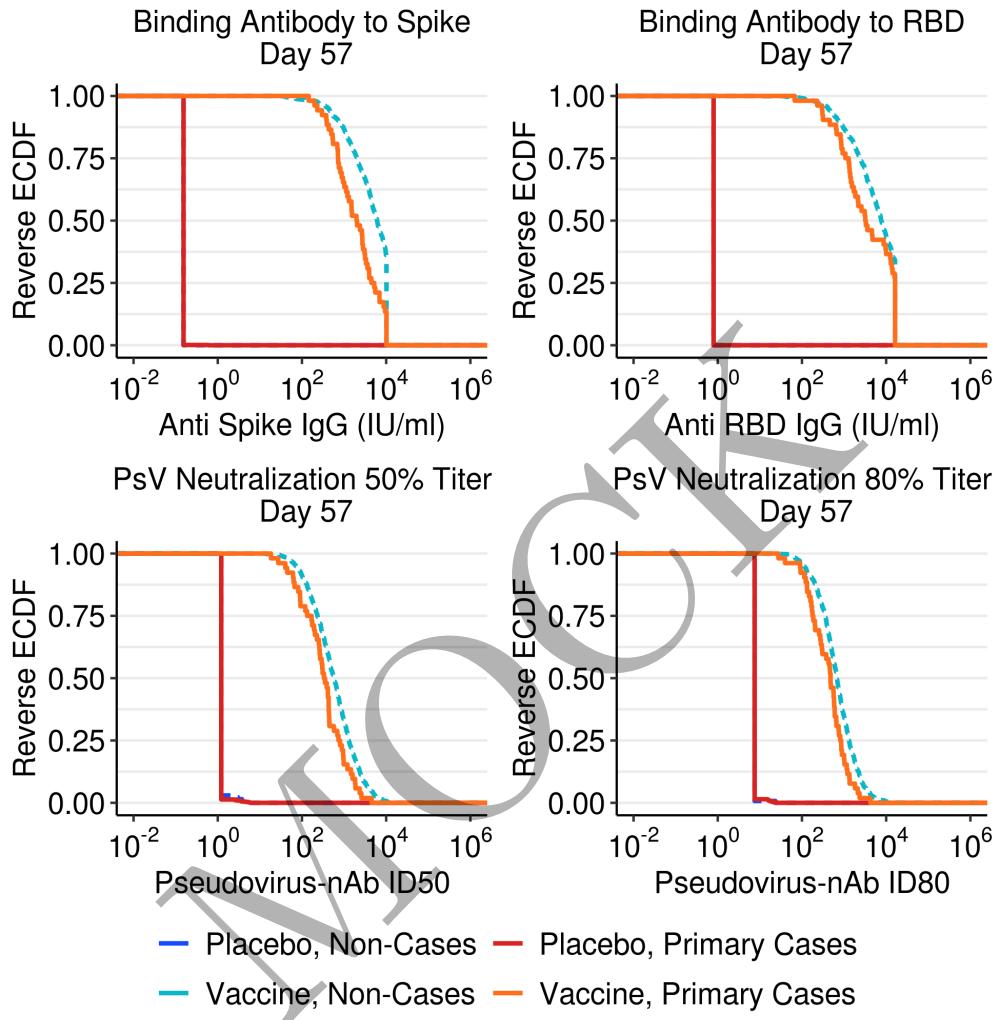


Figure 3.5: RCDF plots for D57 Ab markers by treatment arm.

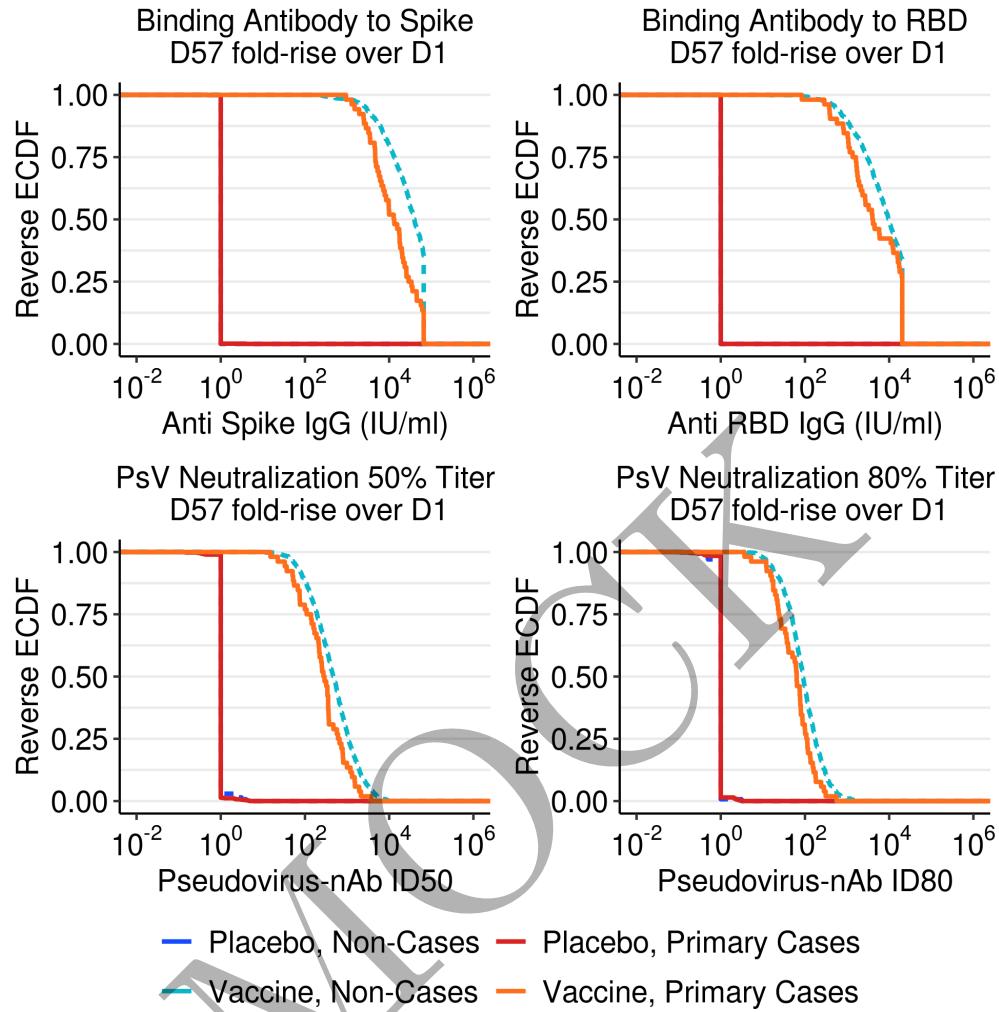


Figure 3.6: RCDF plots for D57 fold-rise over D1 Ab markers by treatment arm.

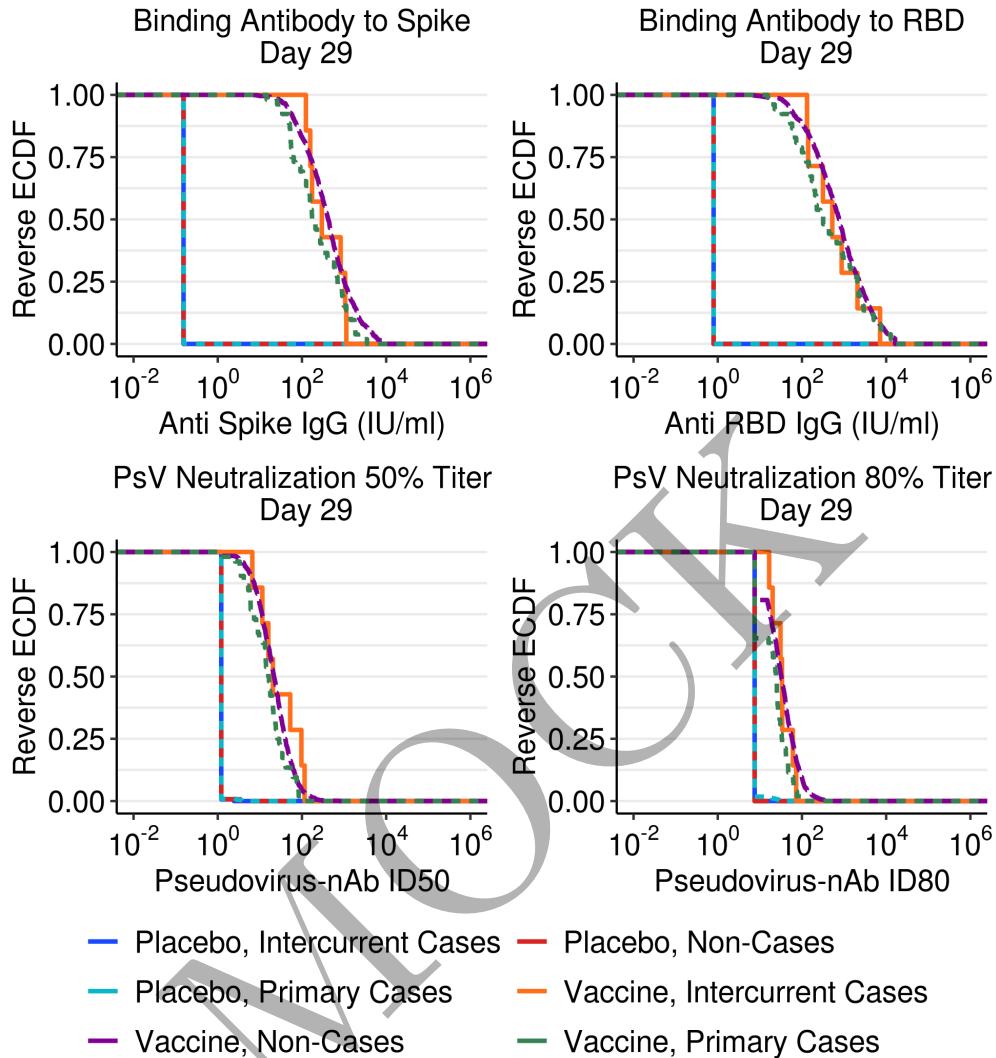


Figure 3.7: RCDF plots for D29 Ab markers by treatment arm.

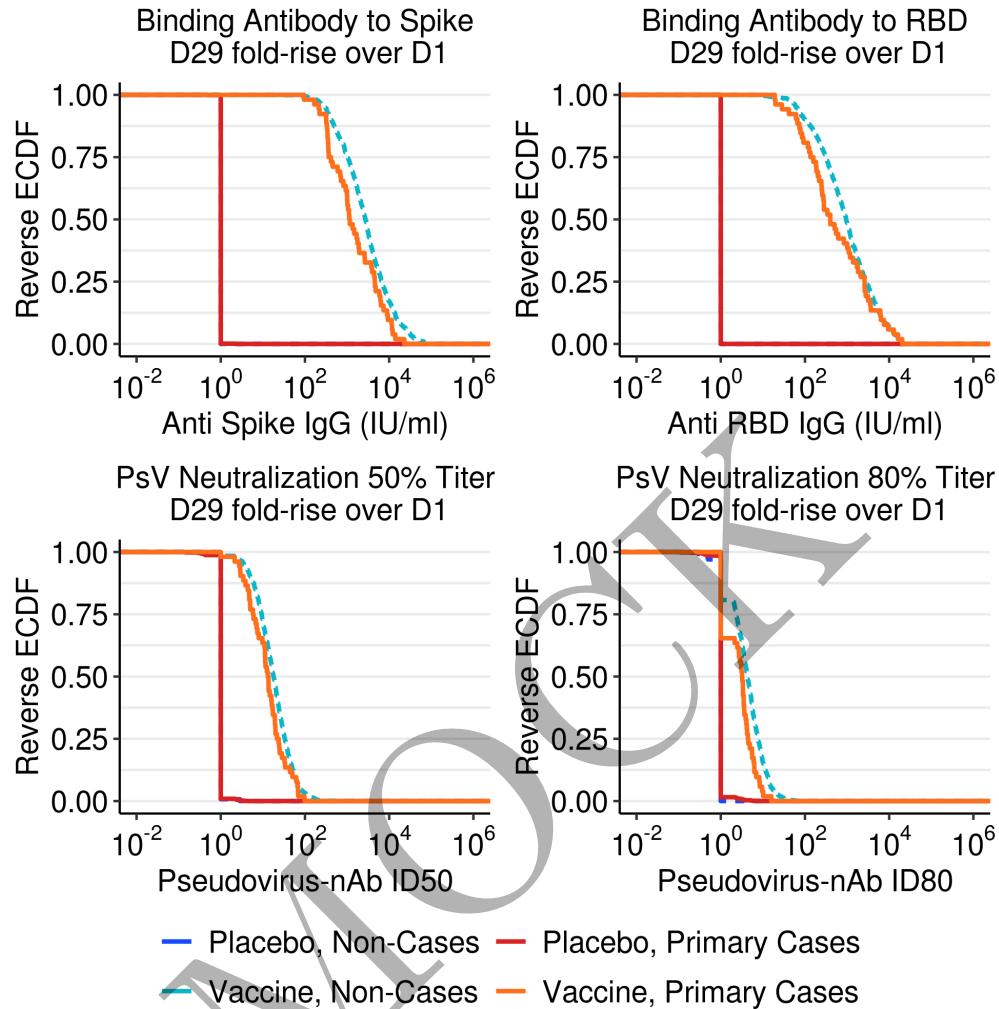


Figure 3.8: RCDF plots for D29 fold-rise over D1 Ab markers by treatment arm.

3.3 Weighted RCDF plots of threshold correlate concentration for vaccine efficacy



Figure 3.9: Marker RCDF of D57 anti-Spike binding Ab: vaccine arm

3.3. WEIGHTED RCDF PLOTS OF THRESHOLD CORRELATE CONCENTRATION FOR VACCINE EFFICACY53



Figure 3.10: Marker RCDF of D57 anti-RBD binding Ab: vaccine arm



Figure 3.11: Marker RCDF of D57 PsV-nAb ID50: vaccine arm

3.3. WEIGHTED RCDF PLOTS OF THRESHOLD CORRELATE CONCENTRATION FOR VACCINE EFFICACY55



Figure 3.12: Marker RCDF of D57 PsV-nAb ID80: vaccine arm

3.4 Spaghetti plots

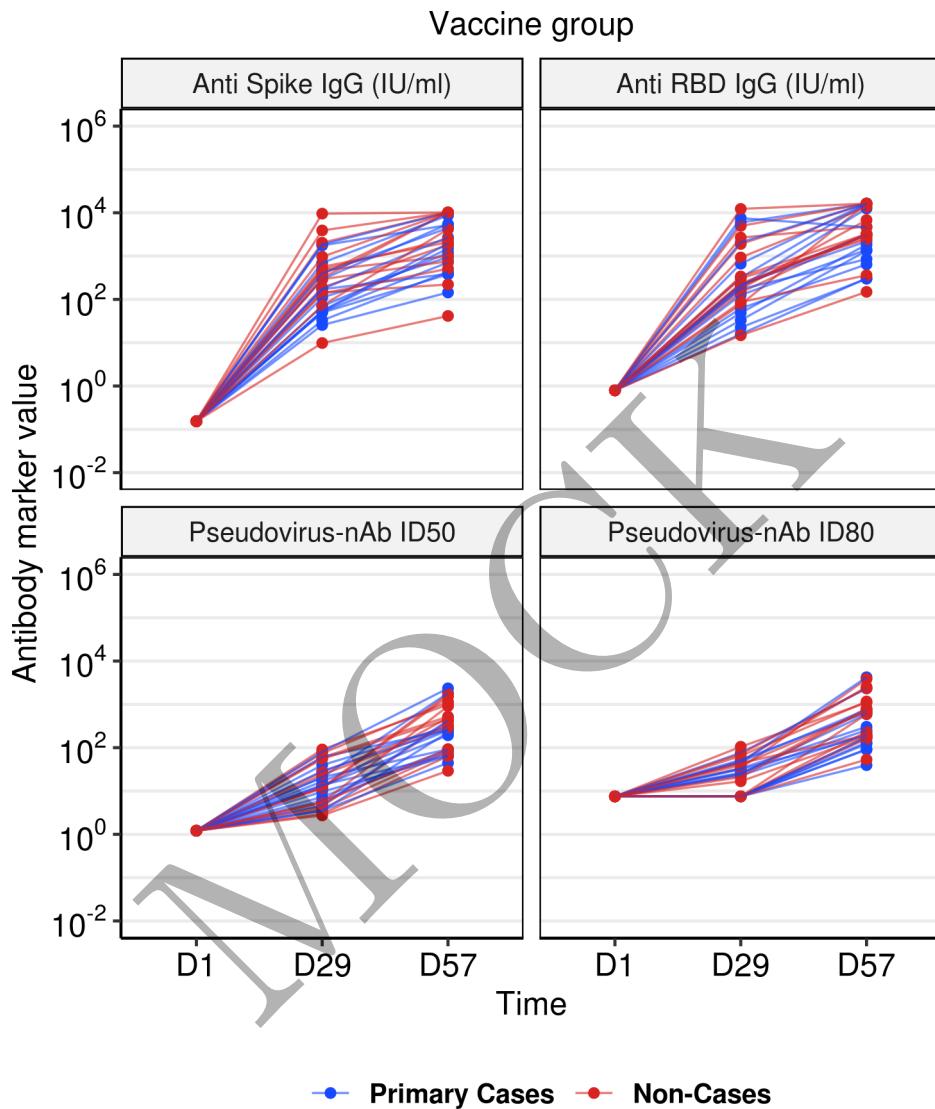


Figure 3.13: Spaghetti Plots of Marker Trajectory: vaccine arm

3.5 Violin and line plots

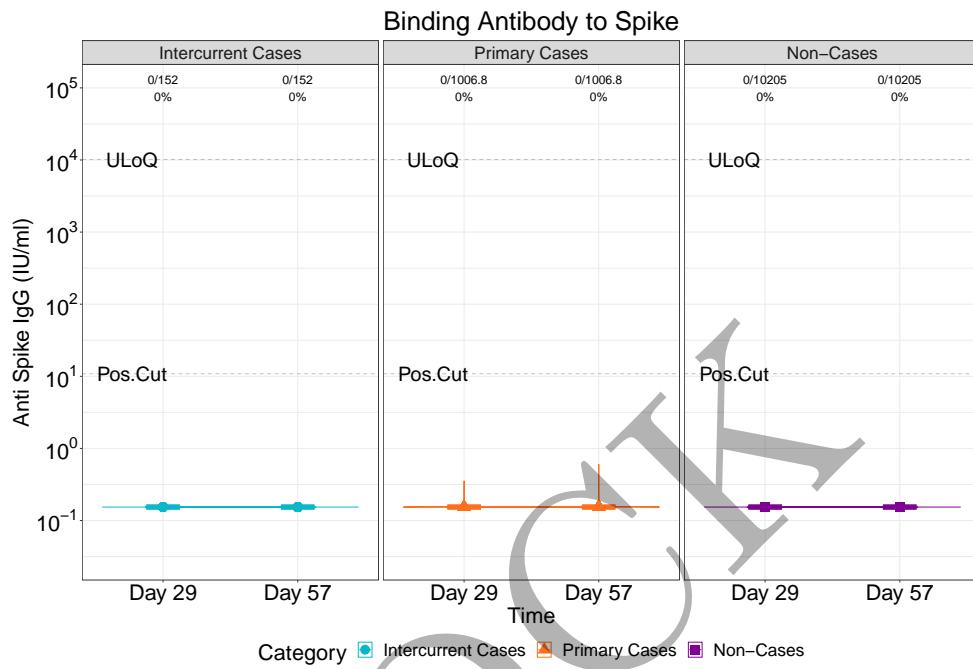


Figure 3.14: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

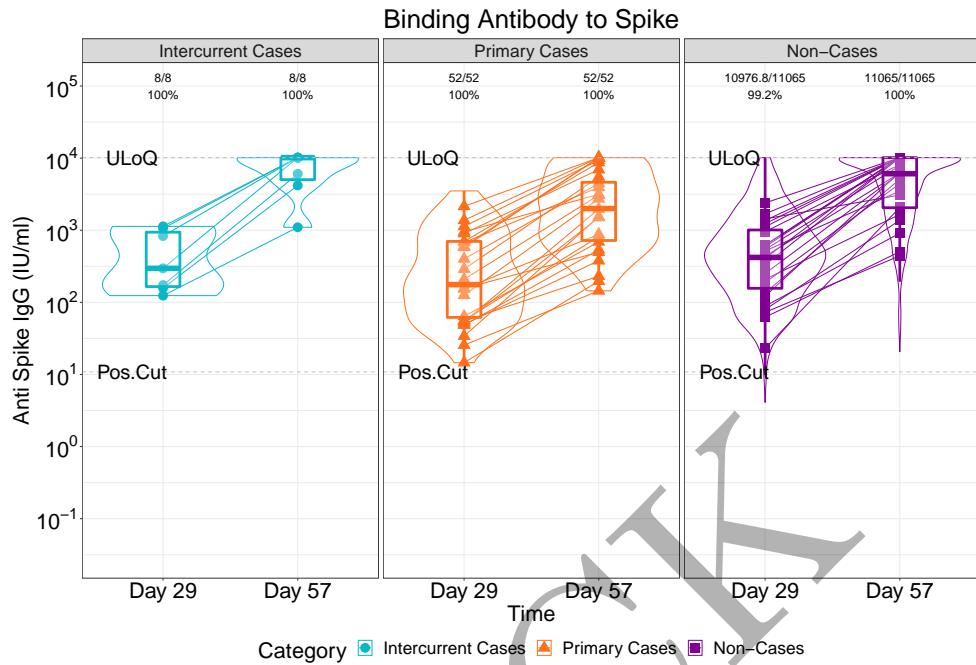


Figure 3.15: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

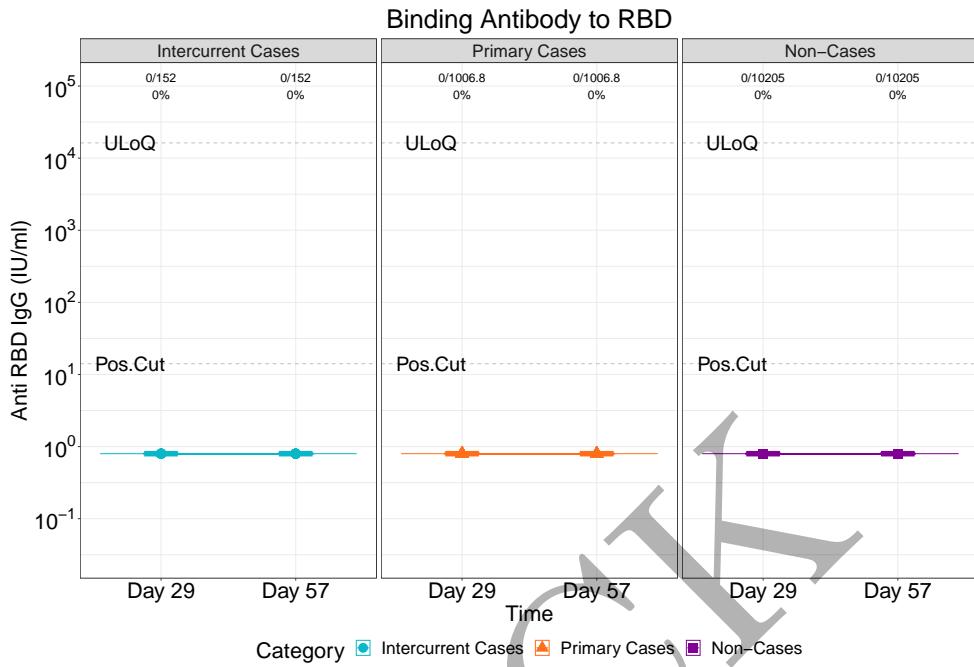


Figure 3.16: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

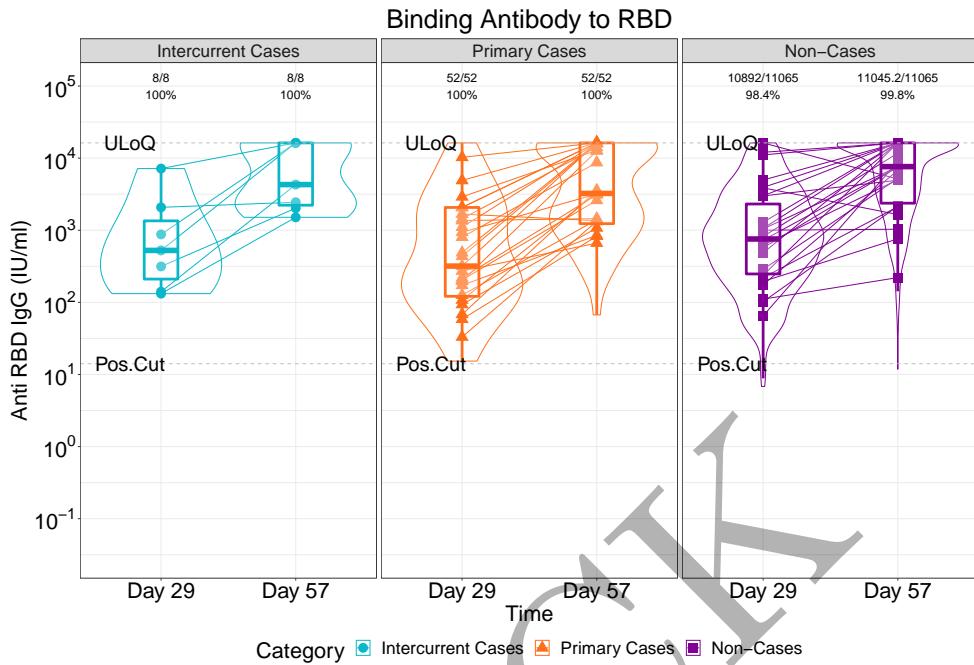


Figure 3.17: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

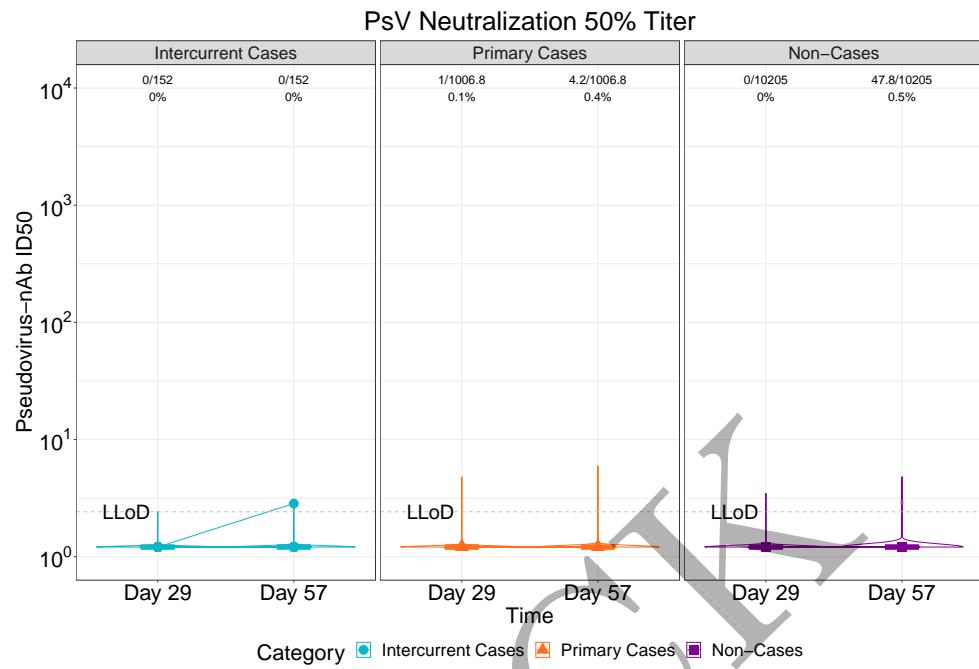


Figure 3.18: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

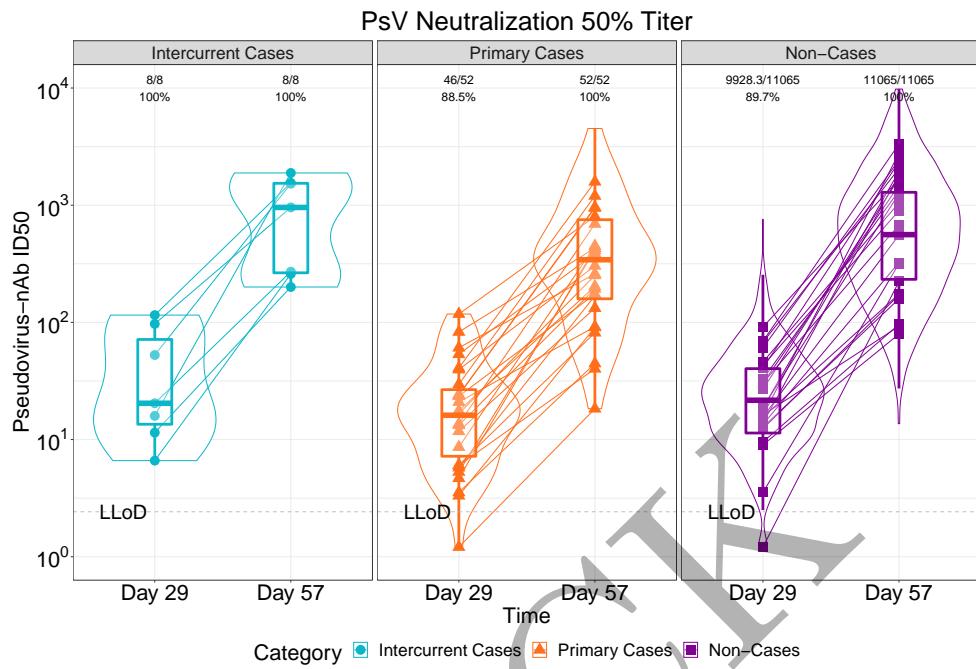


Figure 3.19: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

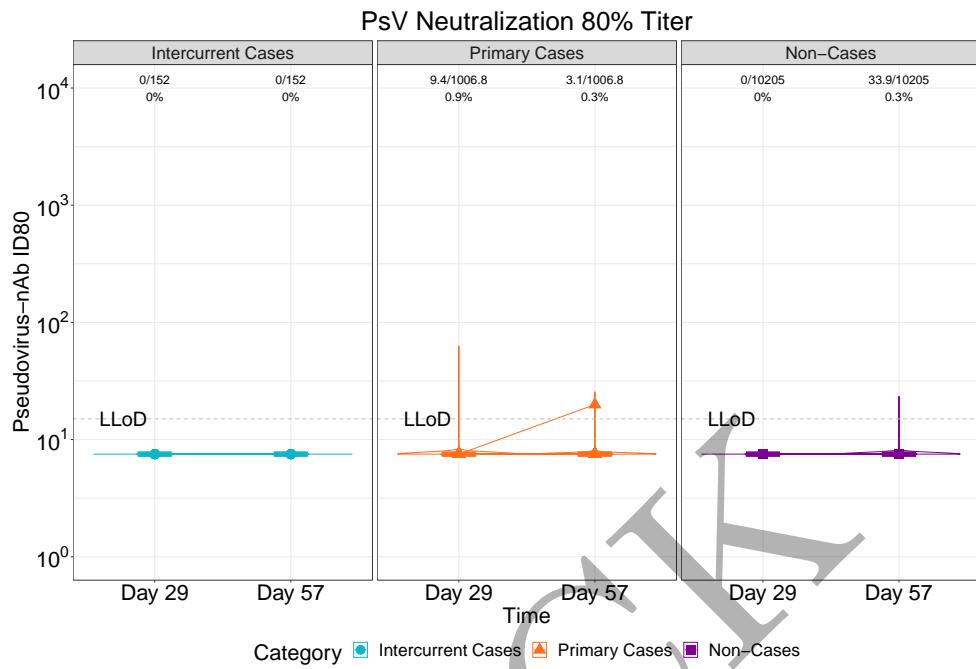


Figure 3.20: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

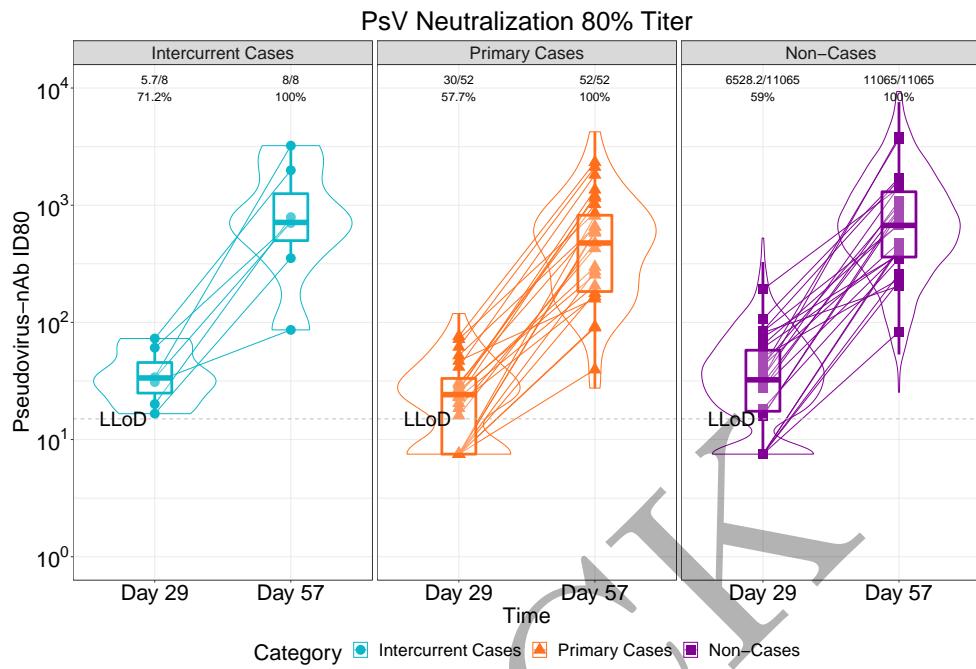


Figure 3.21: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

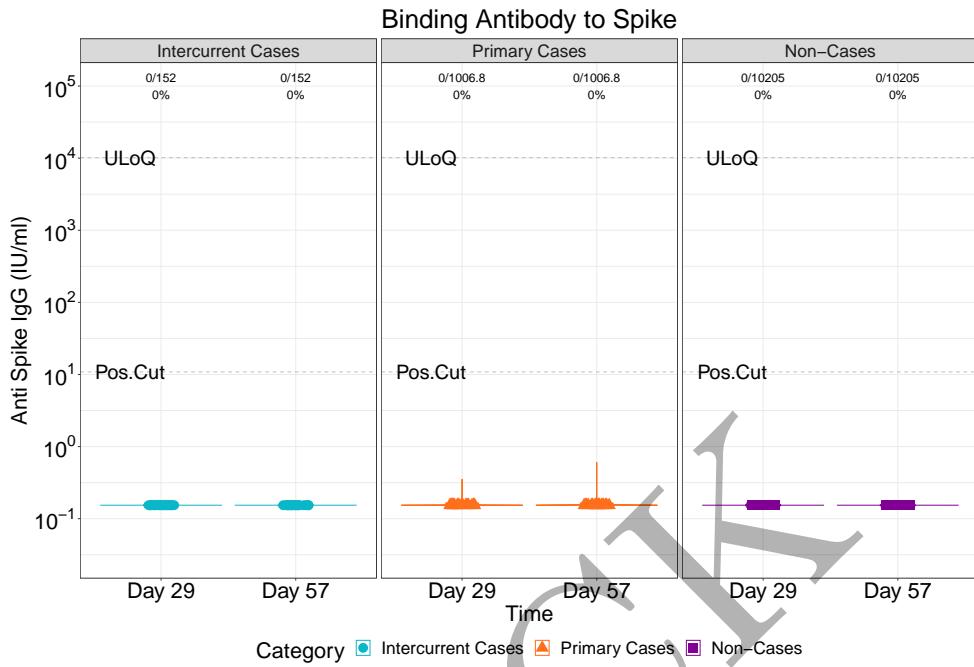


Figure 3.22: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 1)

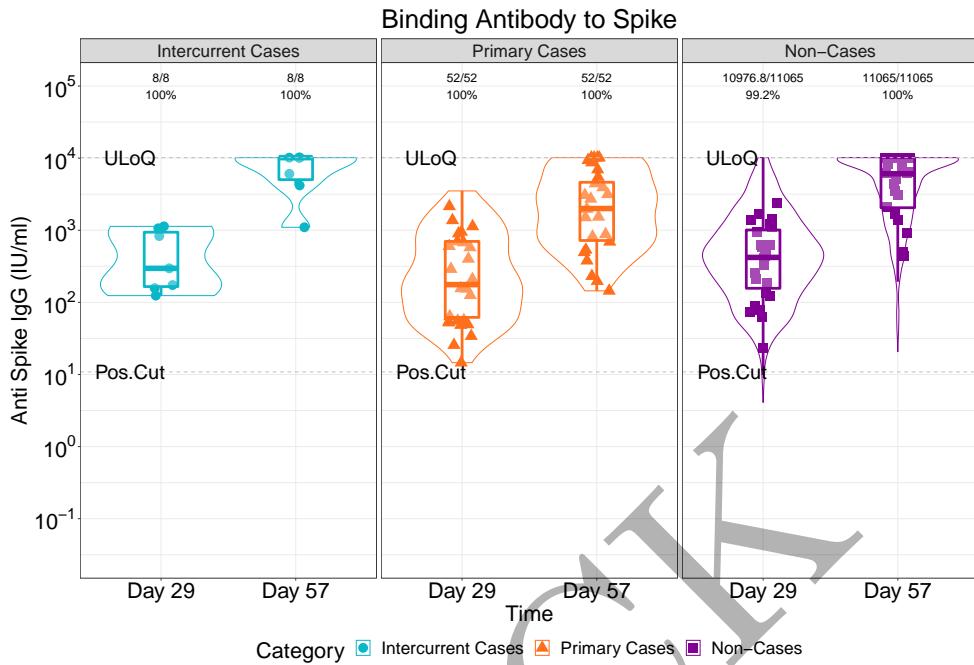


Figure 3.23: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 1)

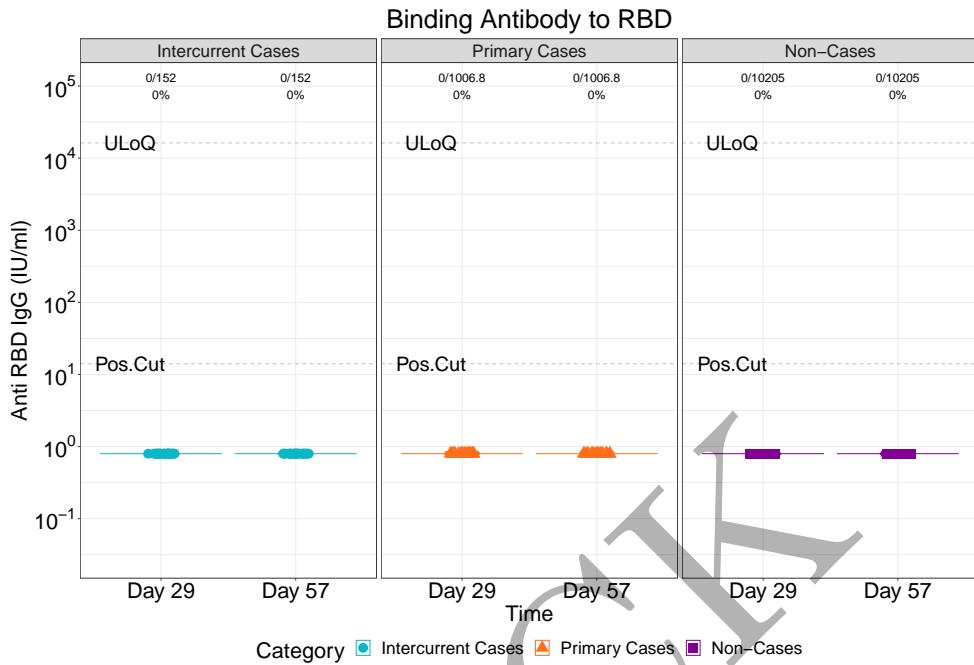


Figure 3.24: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 1)

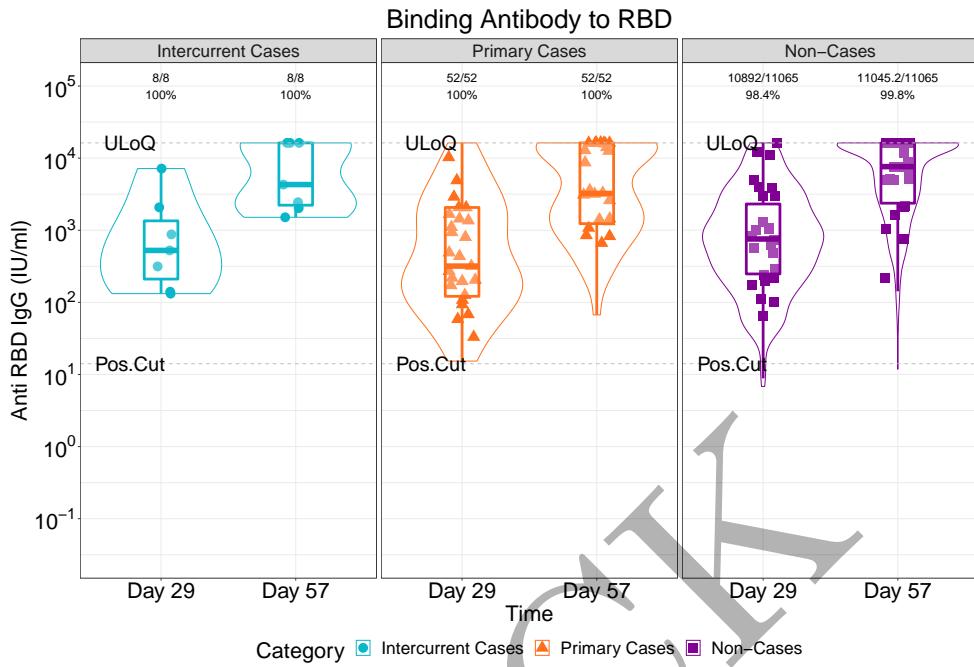


Figure 3.25: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 1)

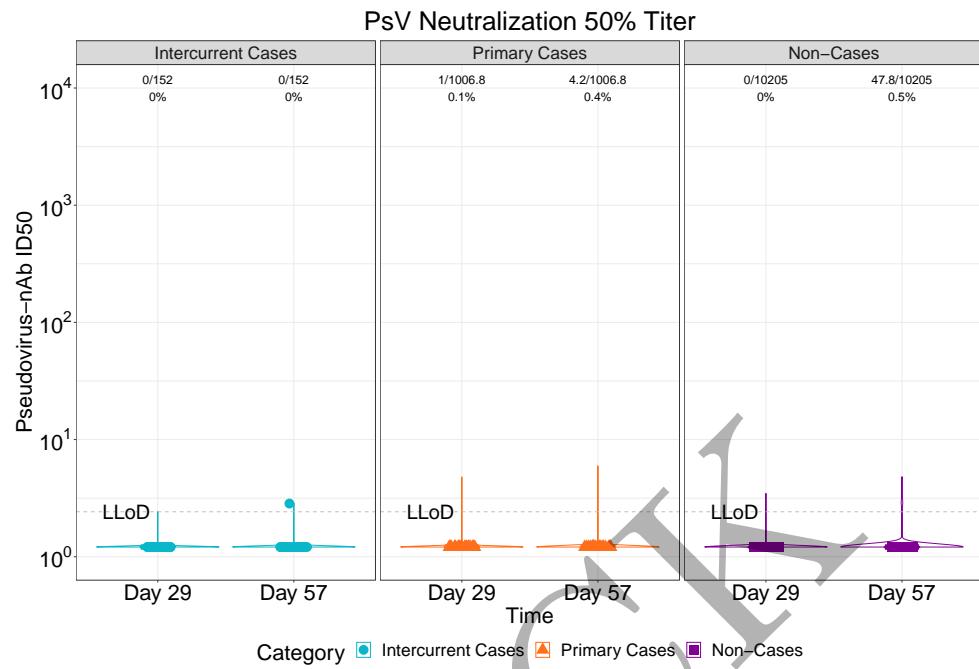


Figure 3.26: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 1)

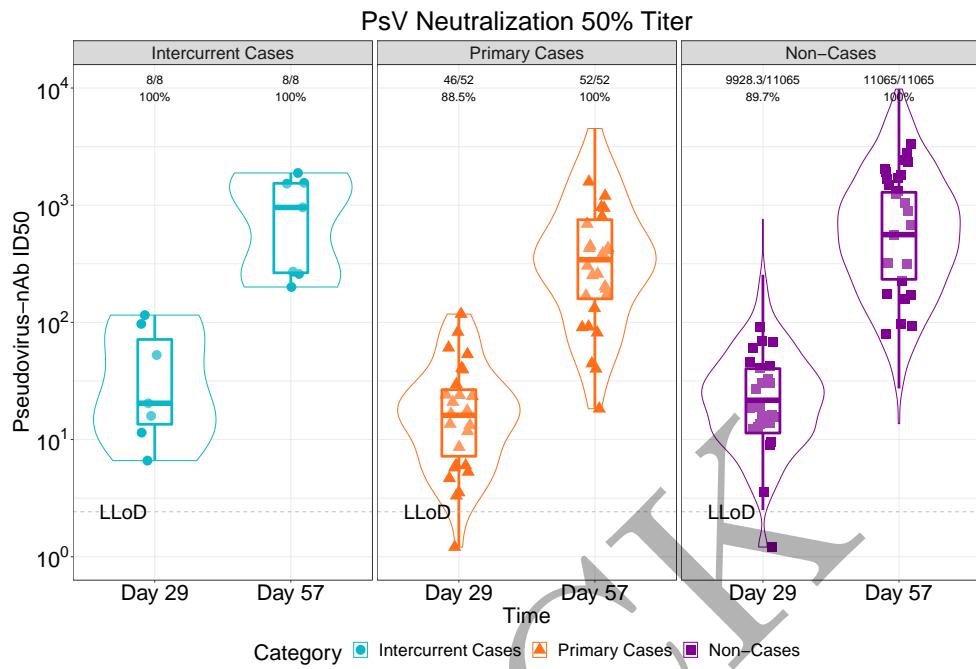


Figure 3.27: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 1)

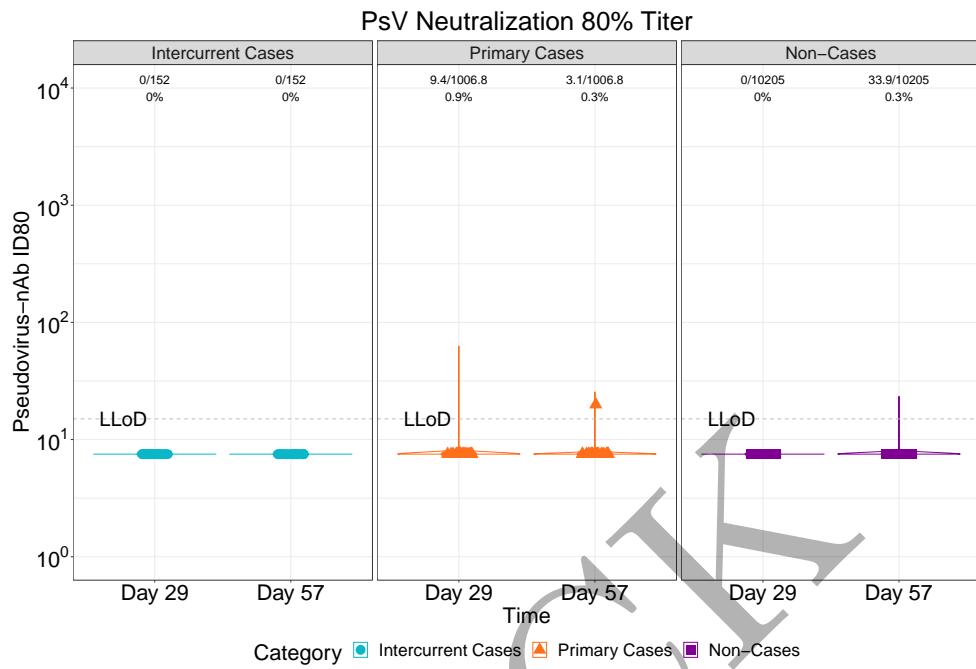


Figure 3.28: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 1)

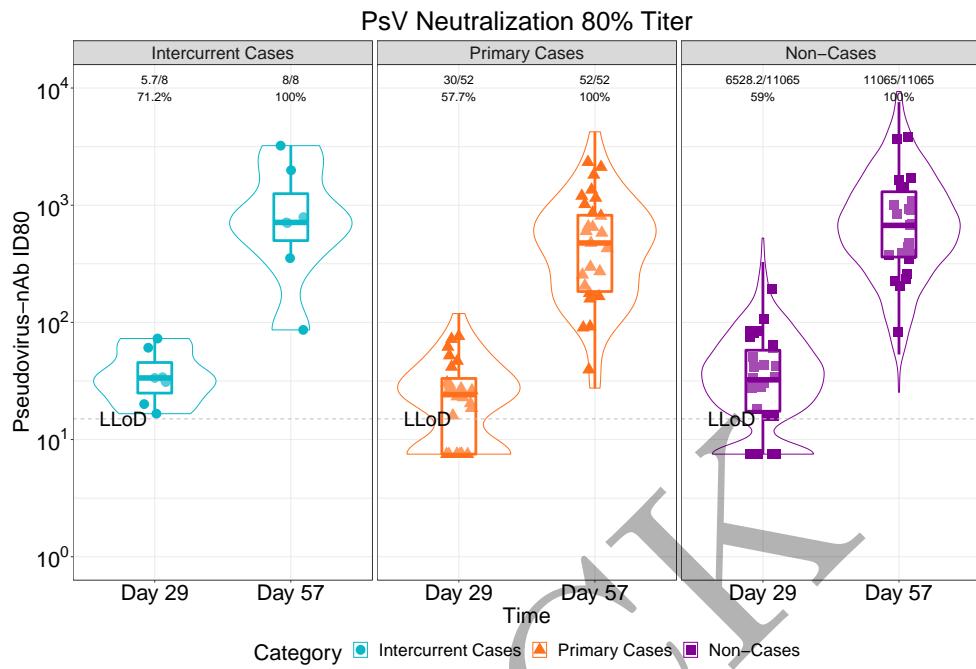


Figure 3.29: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 1)

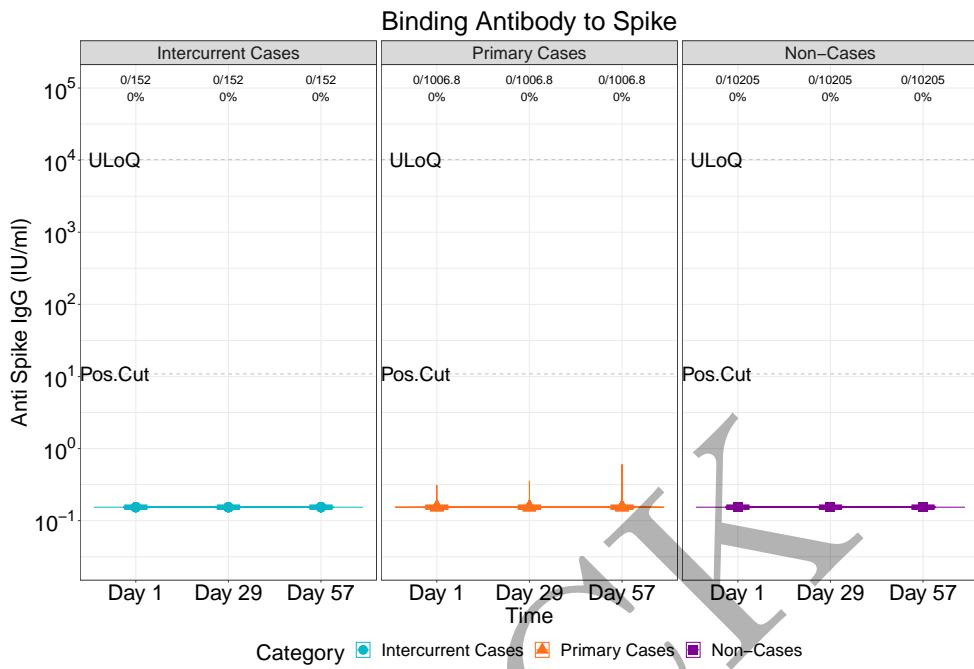


Figure 3.30: lineplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

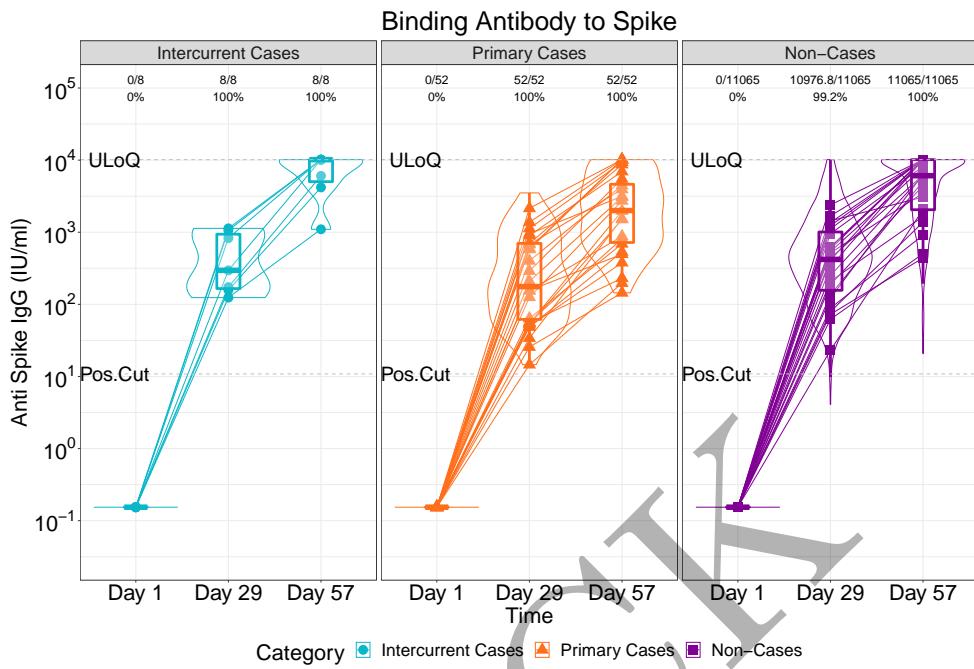


Figure 3.31: lineplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

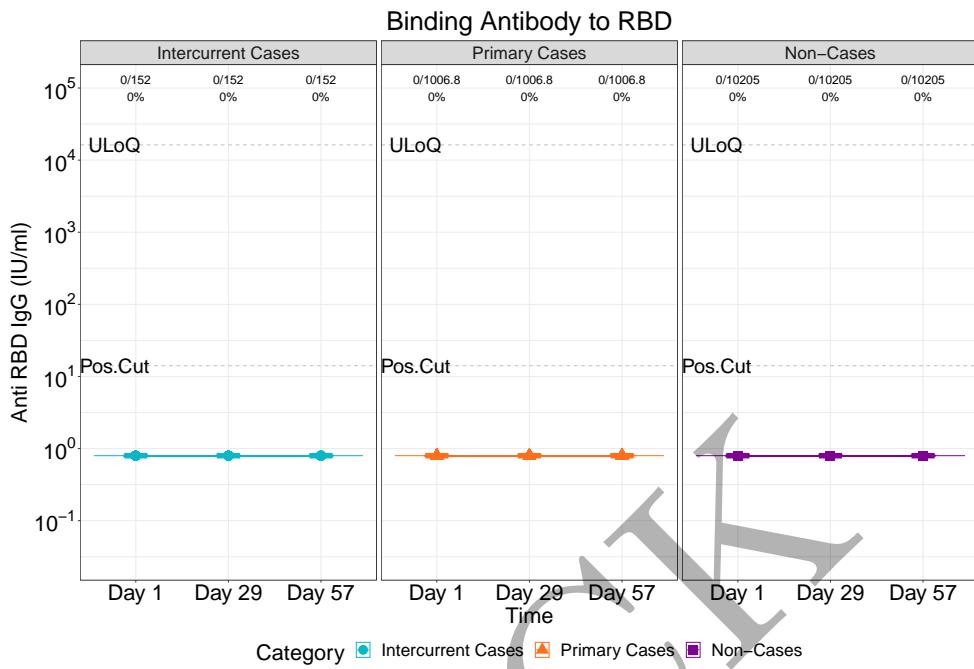


Figure 3.32: lineplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

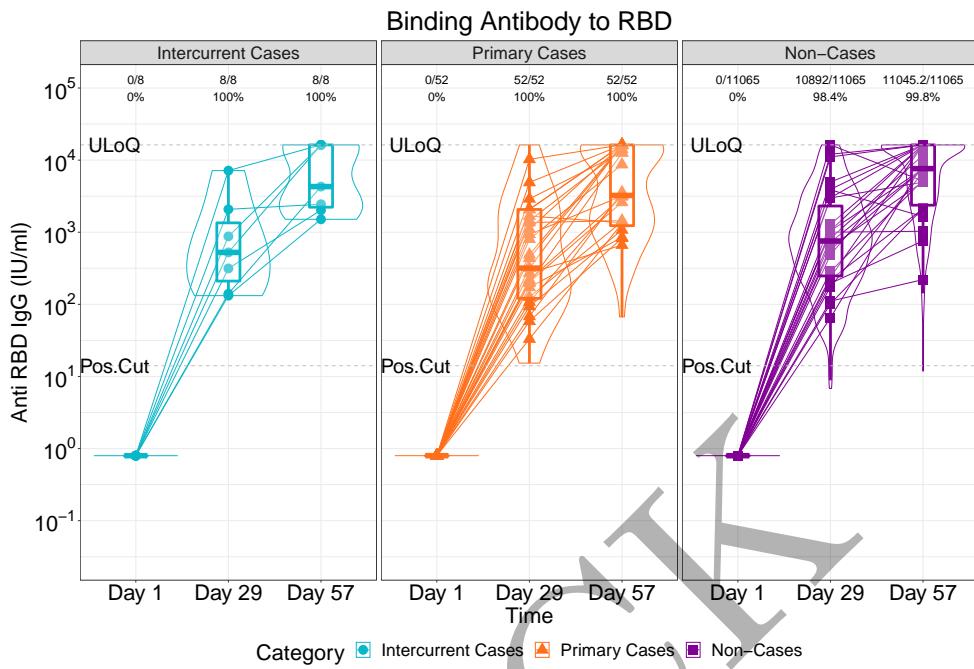


Figure 3.33: lineplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

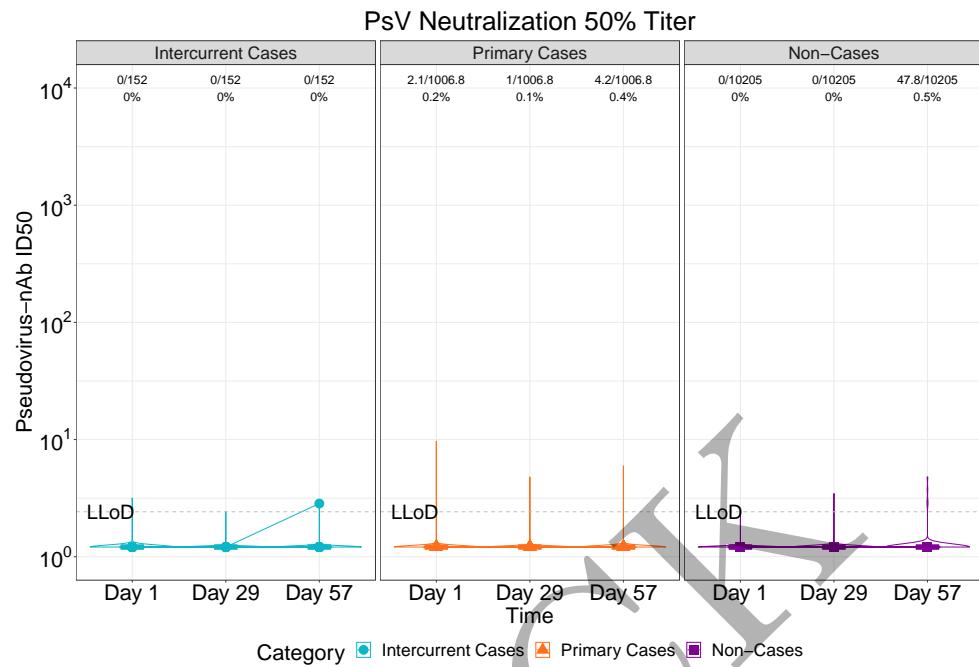


Figure 3.34: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

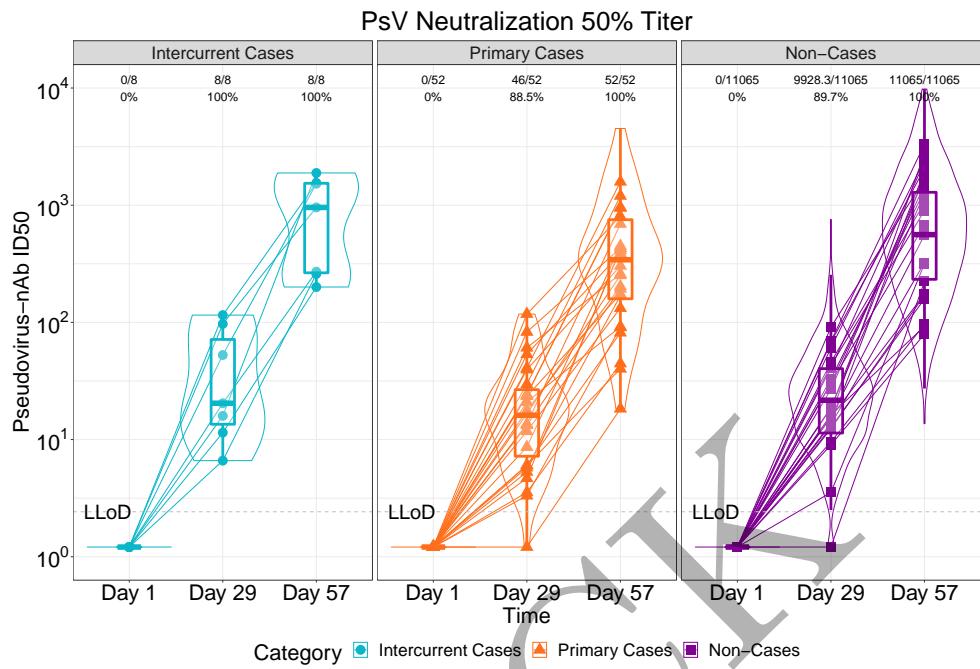


Figure 3.35: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

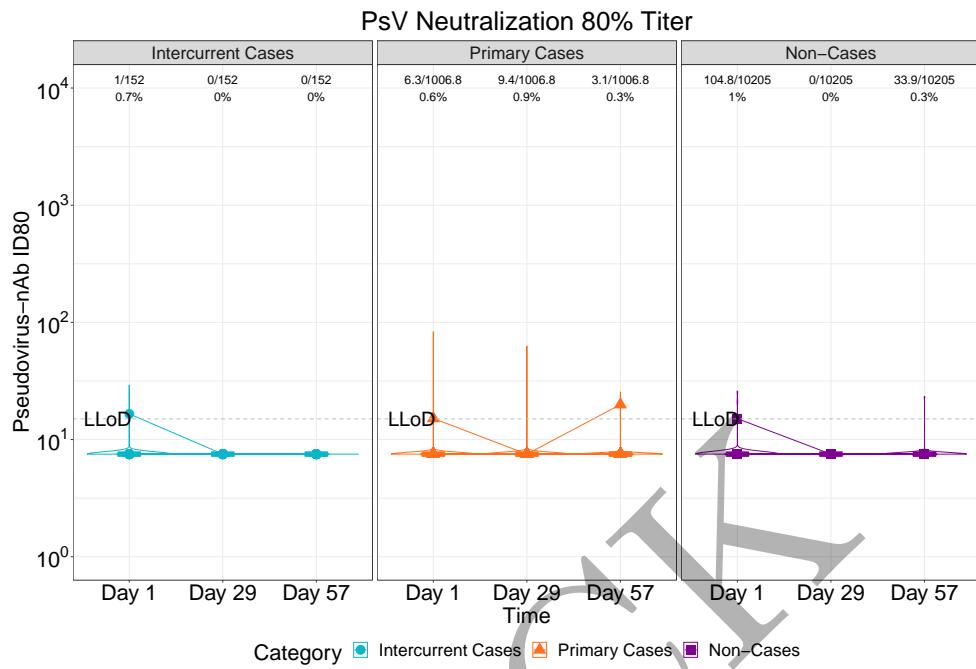


Figure 3.36: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

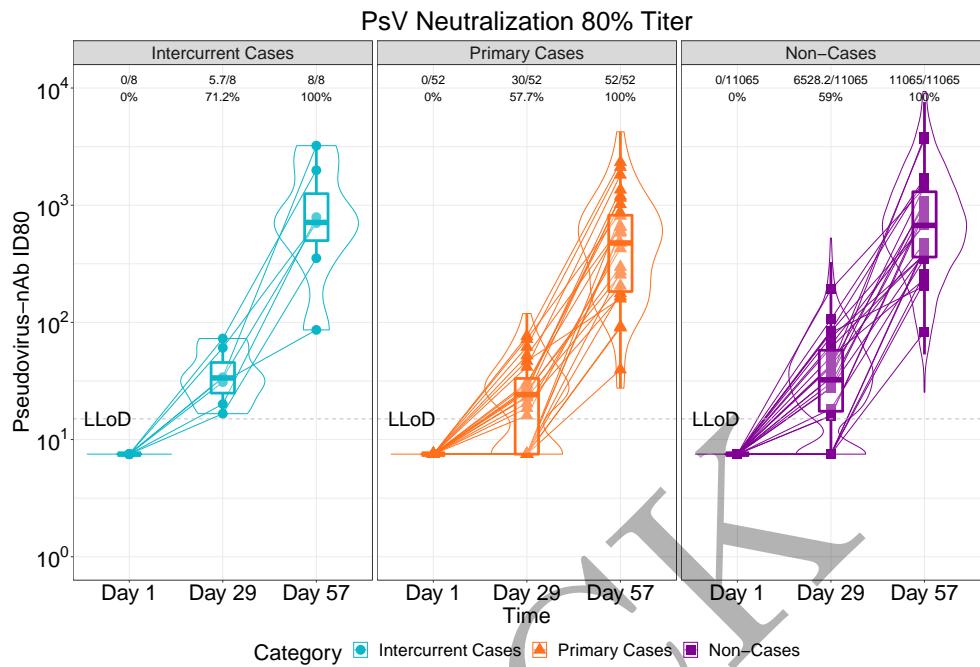


Figure 3.37: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

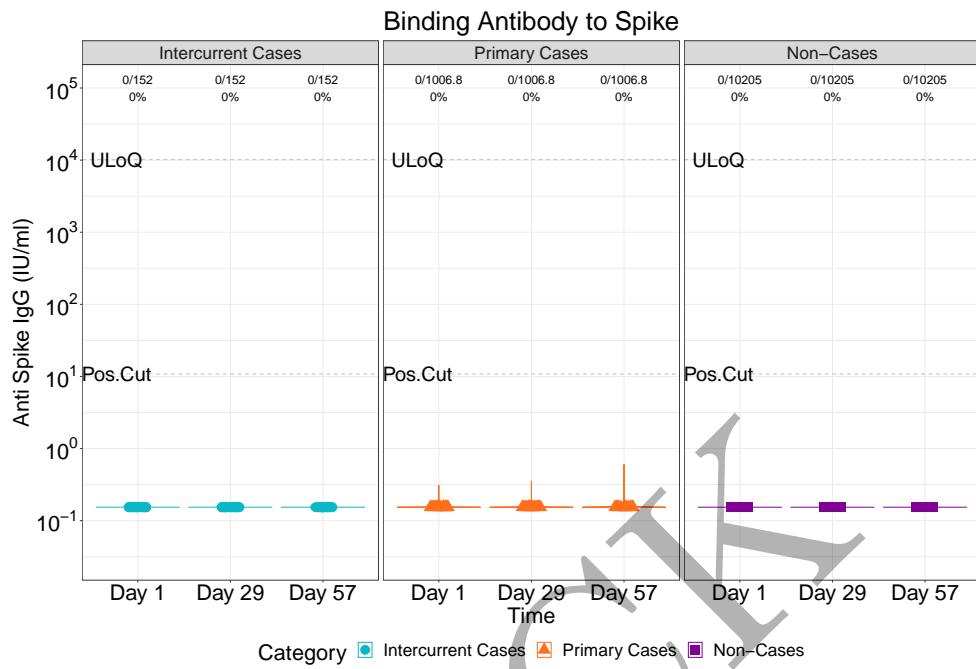


Figure 3.38: violinplots of Binding Antibody to Spike: baseline negative placebo arm (version 2)

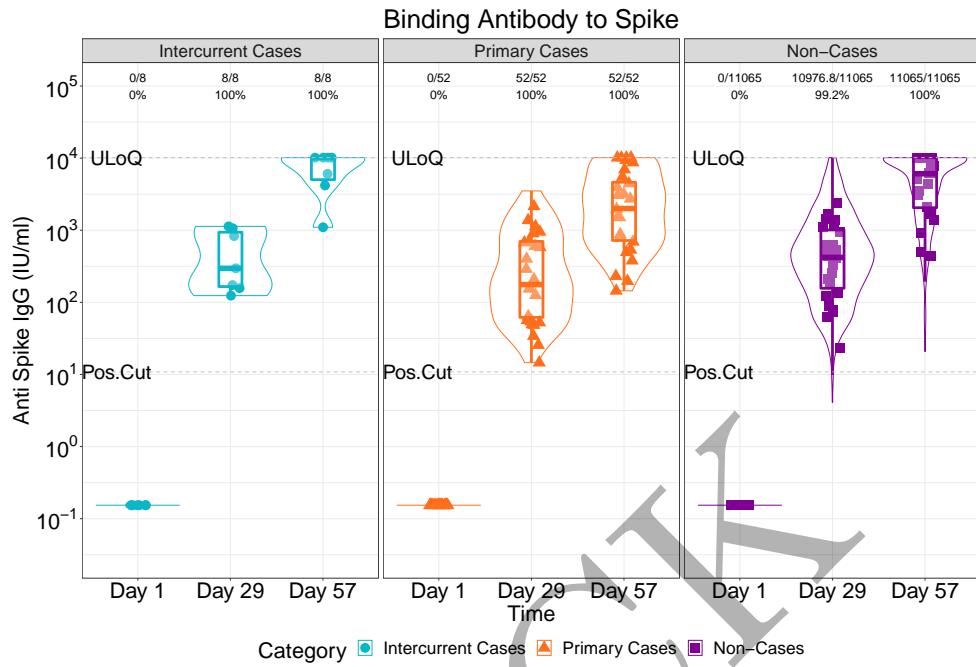


Figure 3.39: violinplots of Binding Antibody to Spike: baseline negative vaccine arm (version 2)

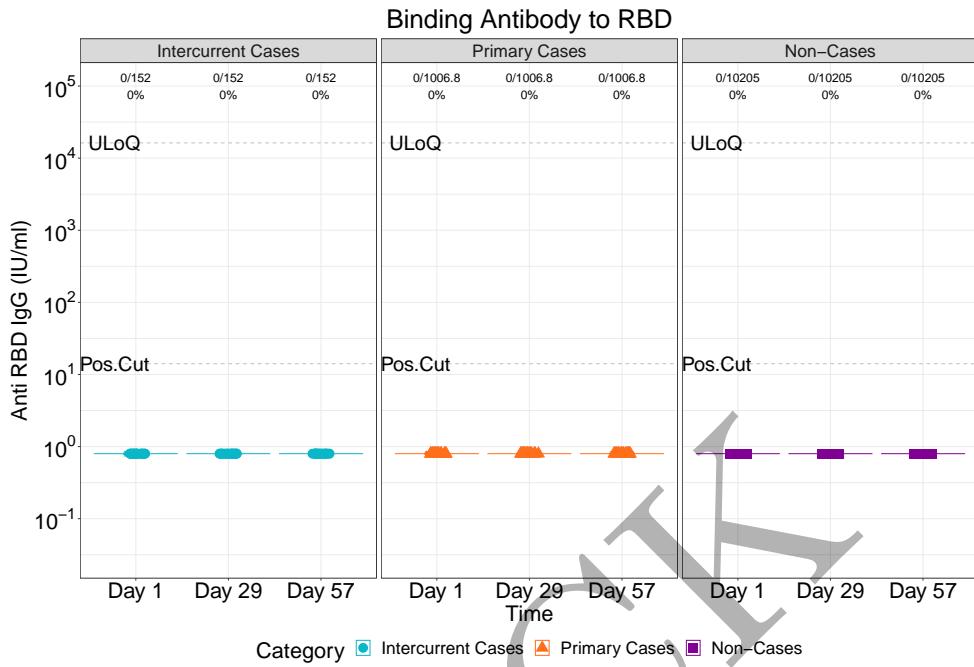


Figure 3.40: violinplots of Binding Antibody to RBD: baseline negative placebo arm (version 2)

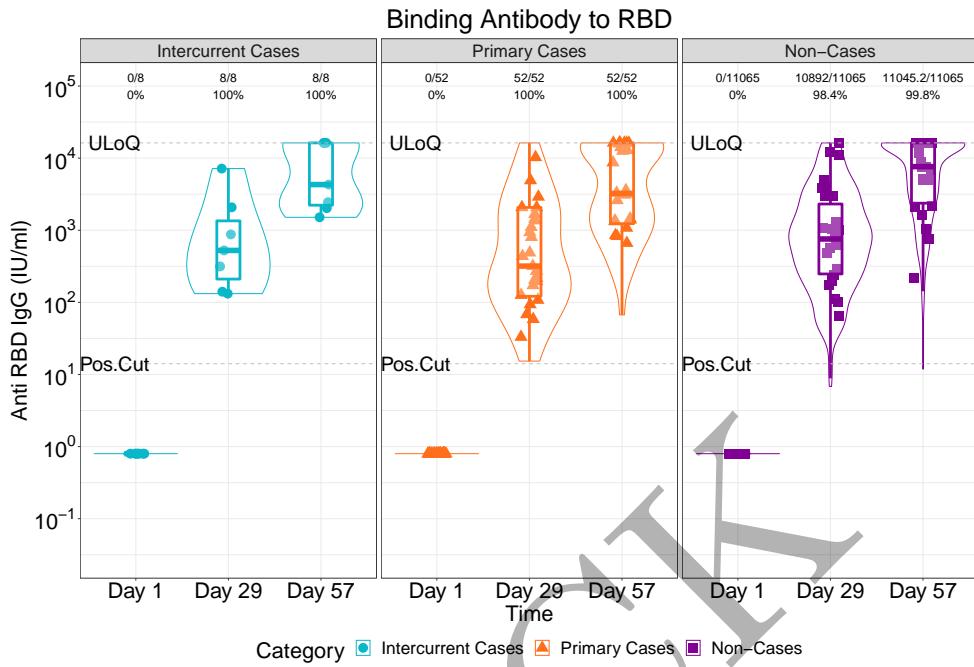


Figure 3.41: violinplots of Binding Antibody to RBD: baseline negative vaccine arm (version 2)

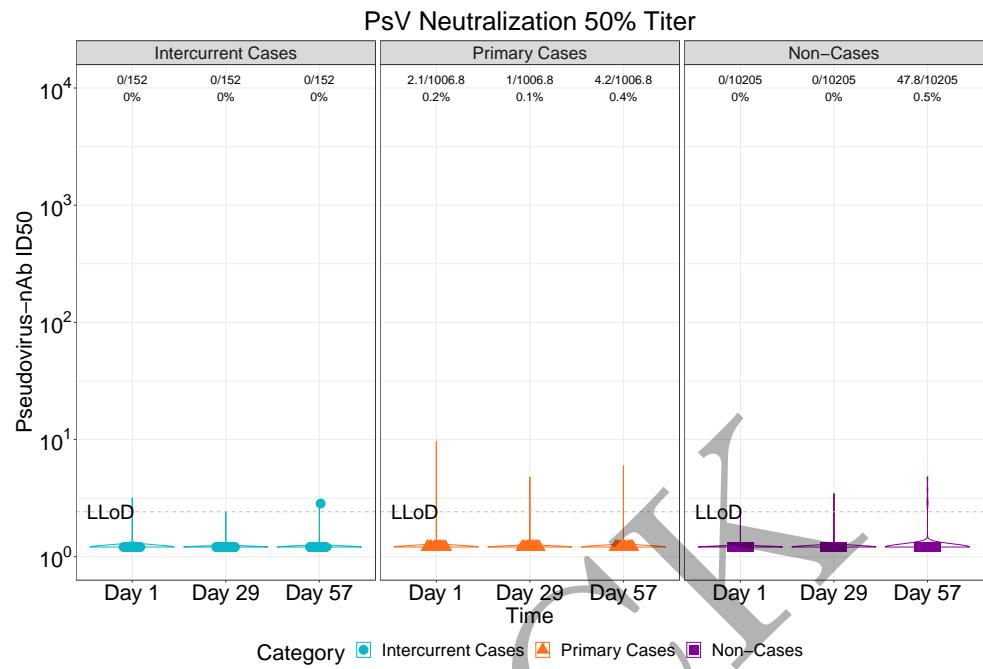


Figure 3.42: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (version 2)

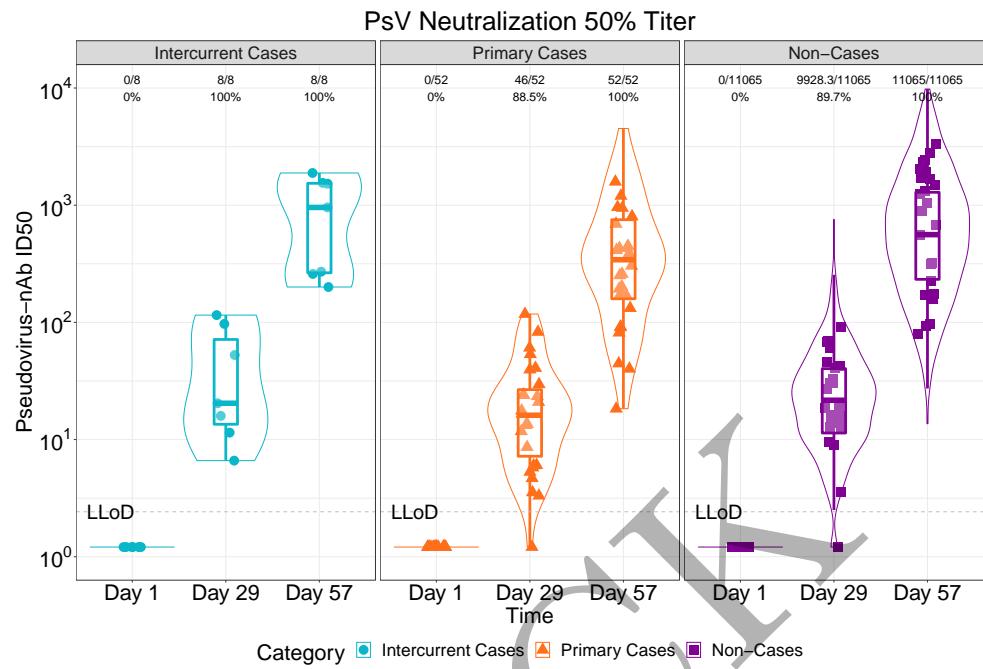


Figure 3.43: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (version 2)

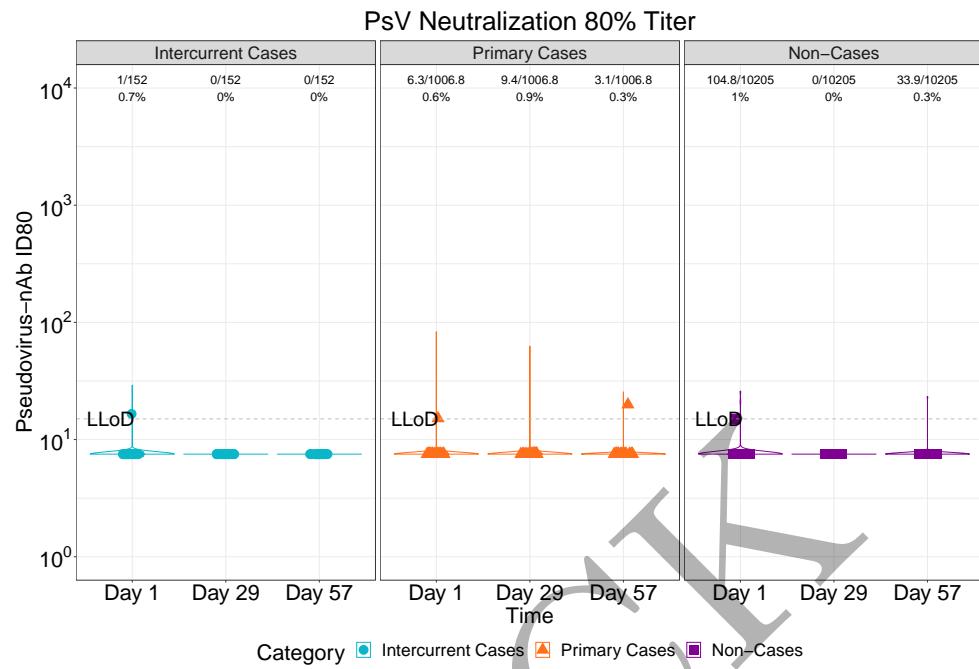


Figure 3.44: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (version 2)

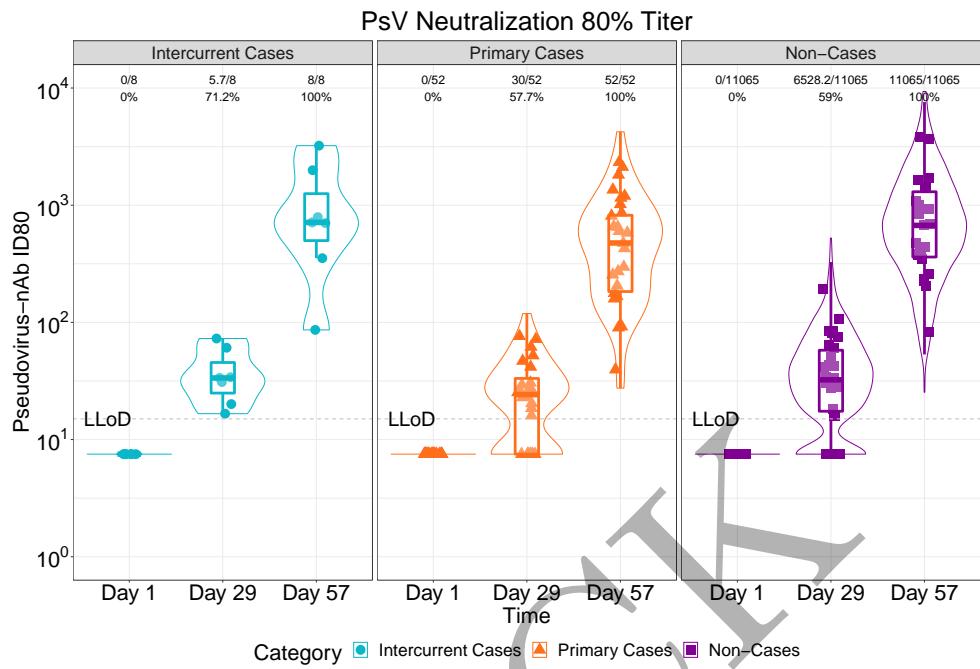


Figure 3.45: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (version 2)

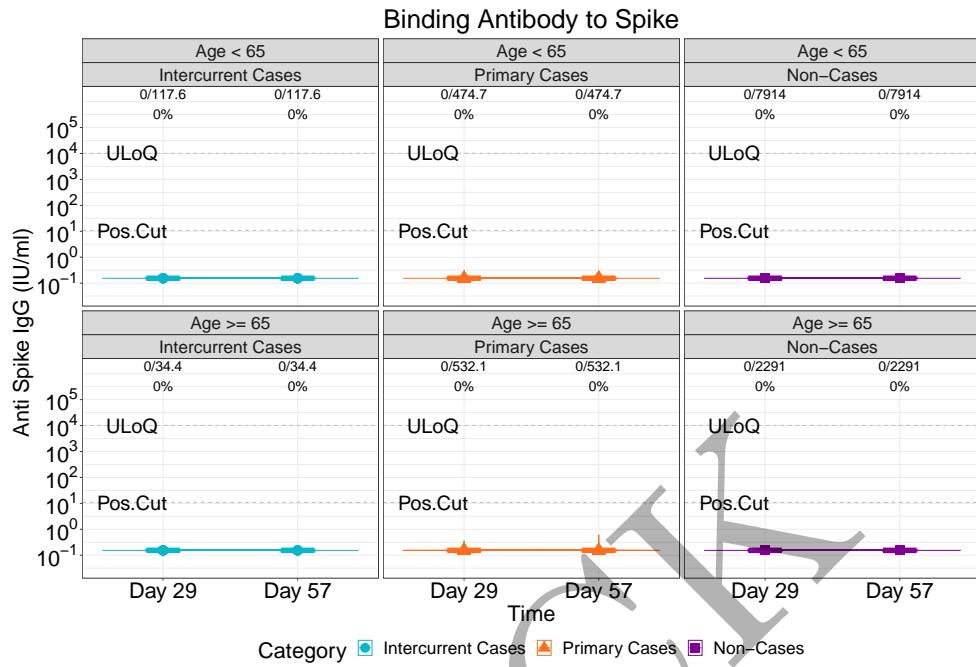


Figure 3.46: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

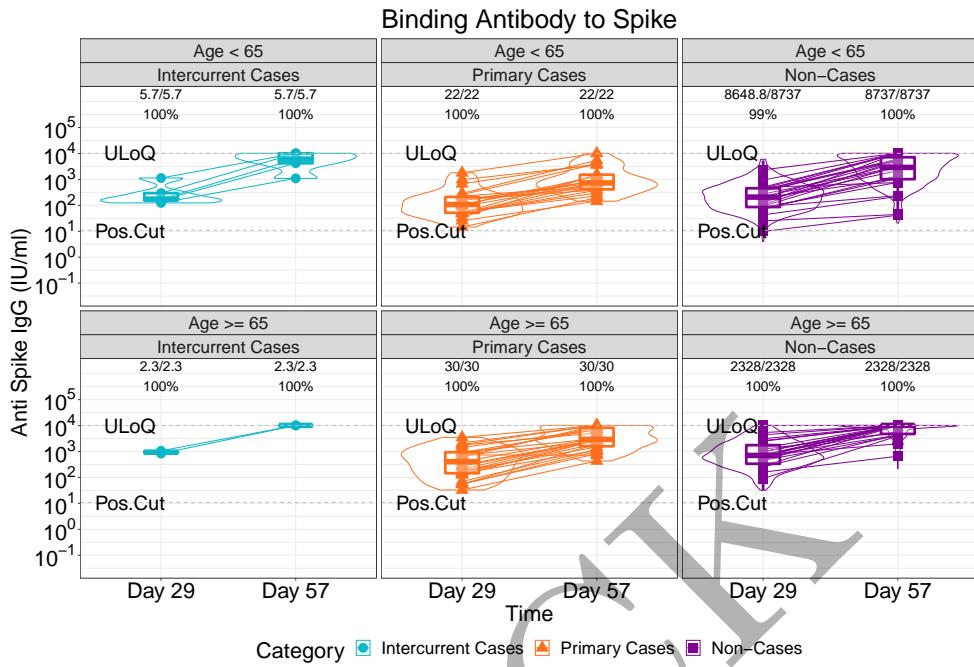


Figure 3.47: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

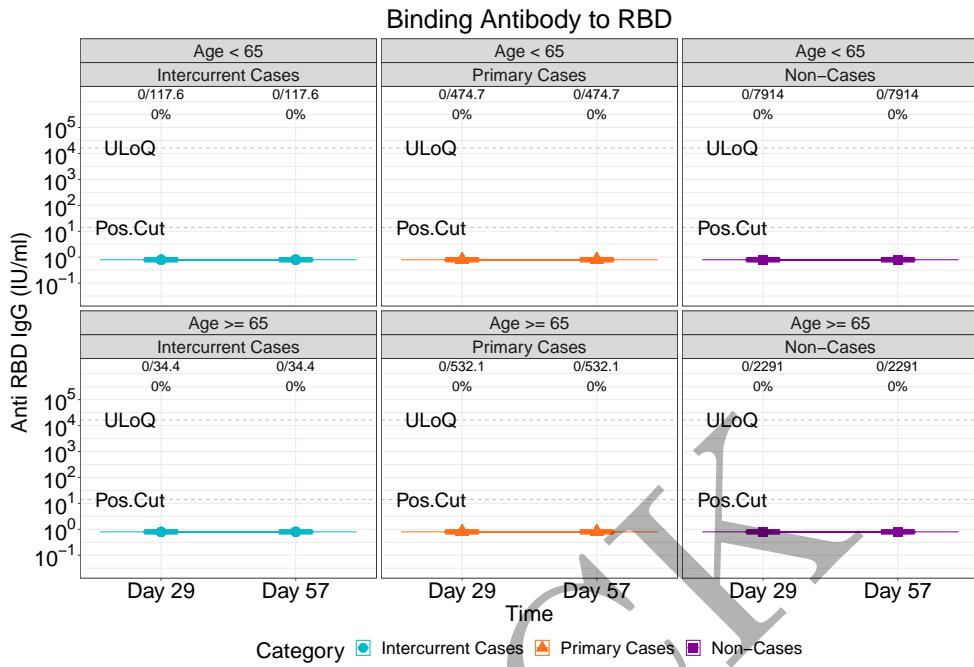


Figure 3.48: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

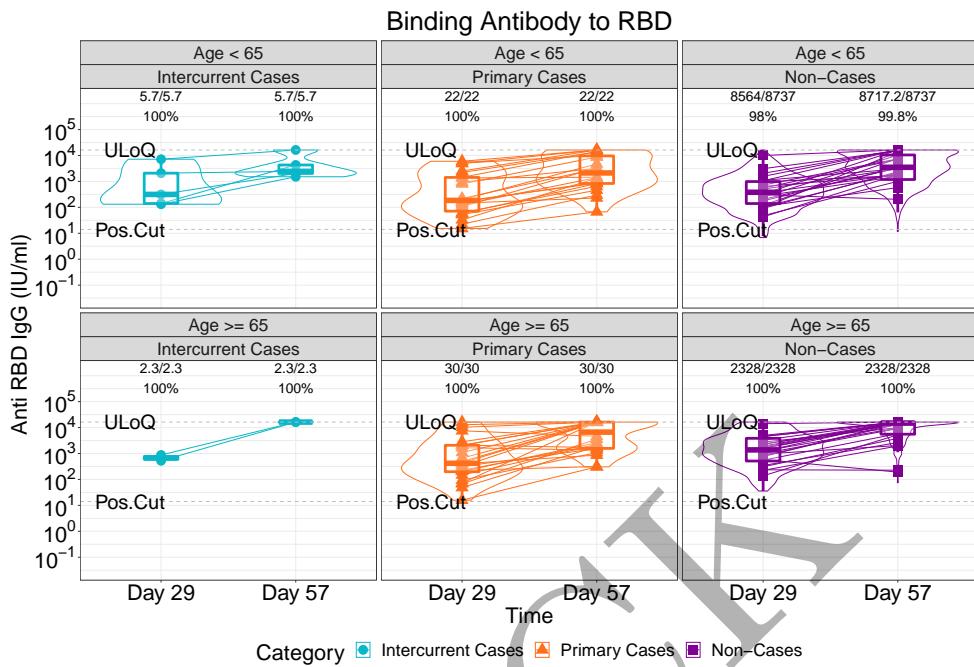


Figure 3.49: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

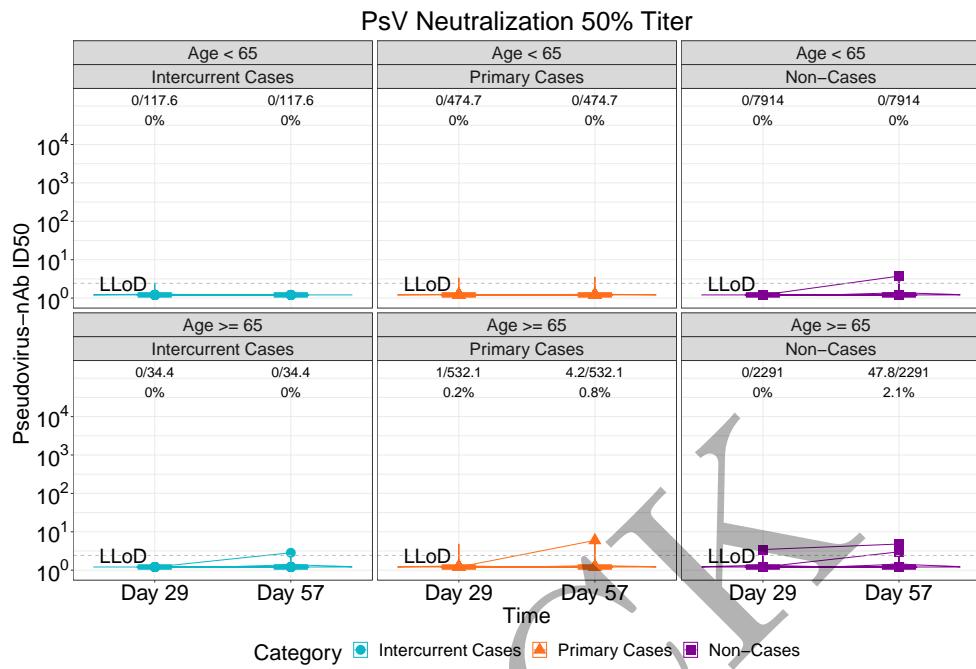


Figure 3.50: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

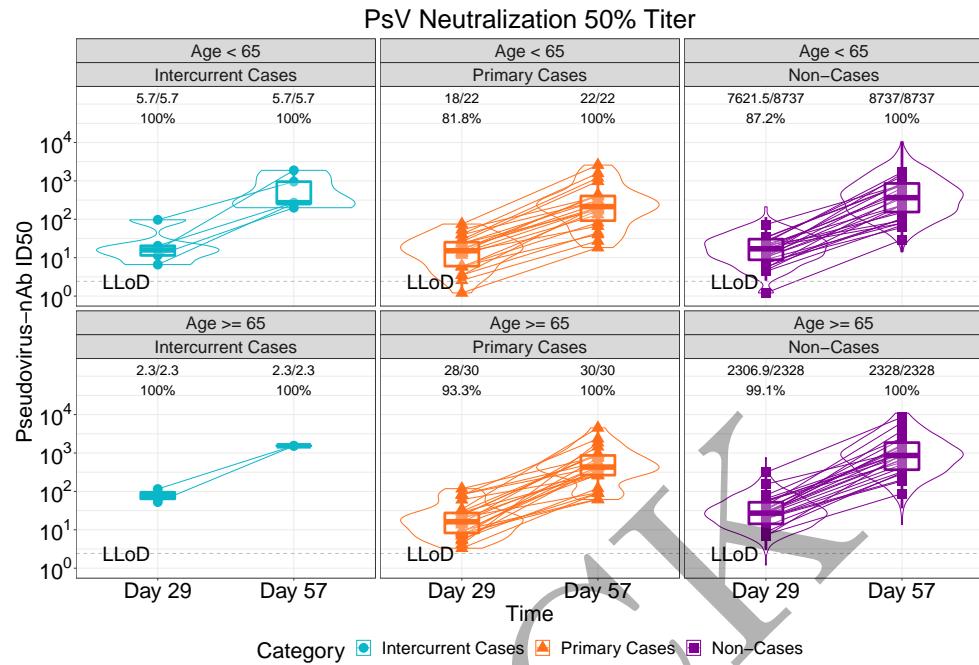


Figure 3.51: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

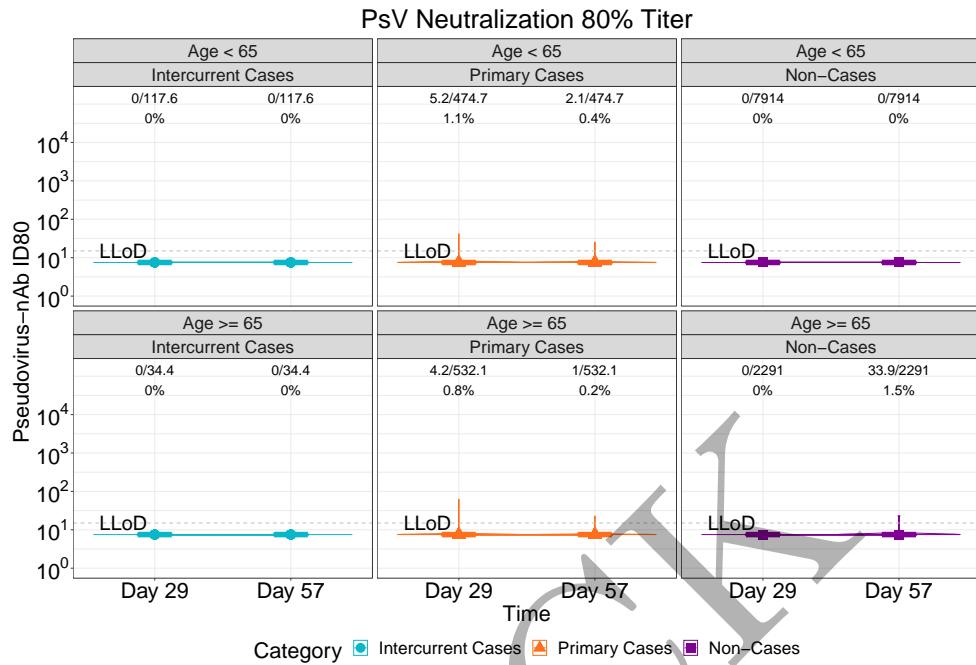


Figure 3.52: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

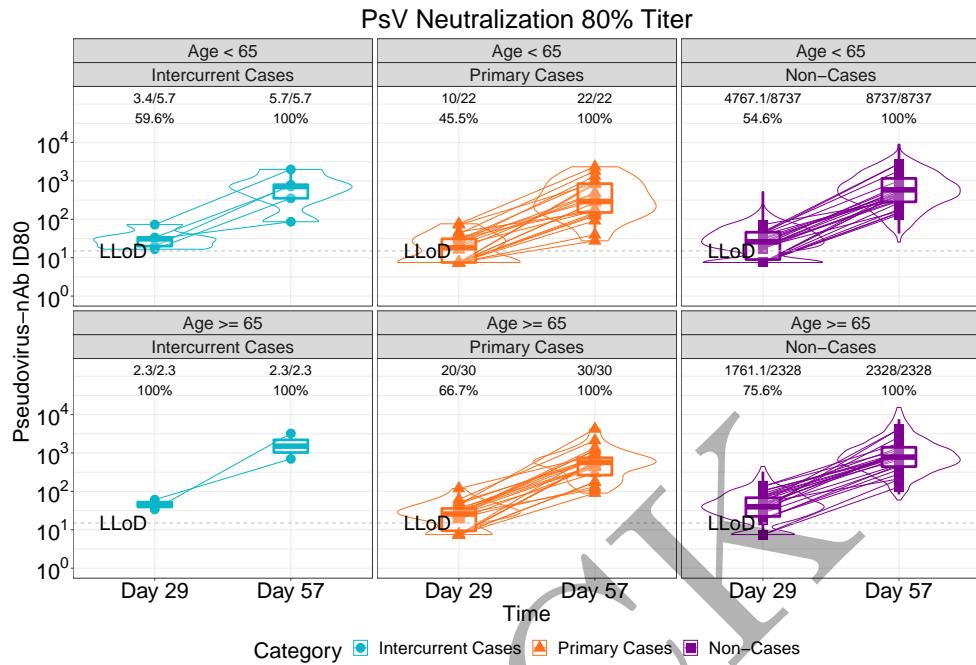


Figure 3.53: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

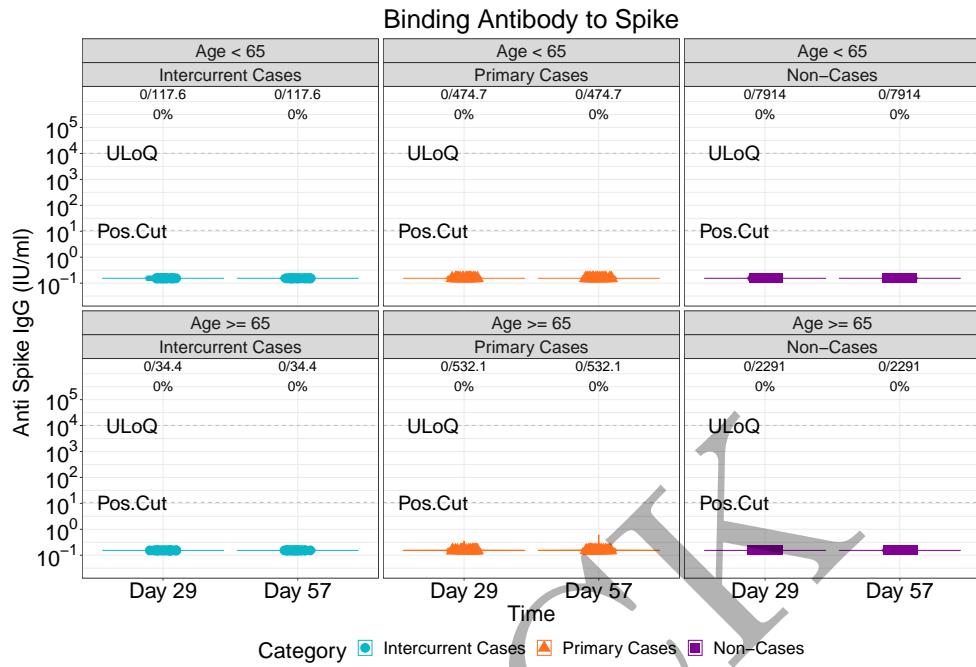


Figure 3.54: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 1)

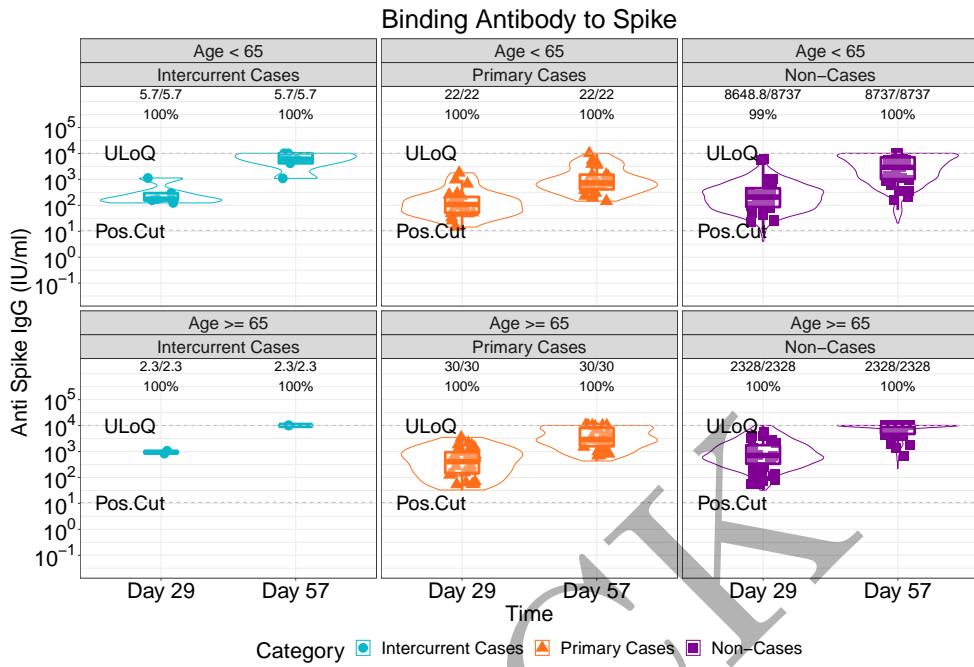


Figure 3.55: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 1)

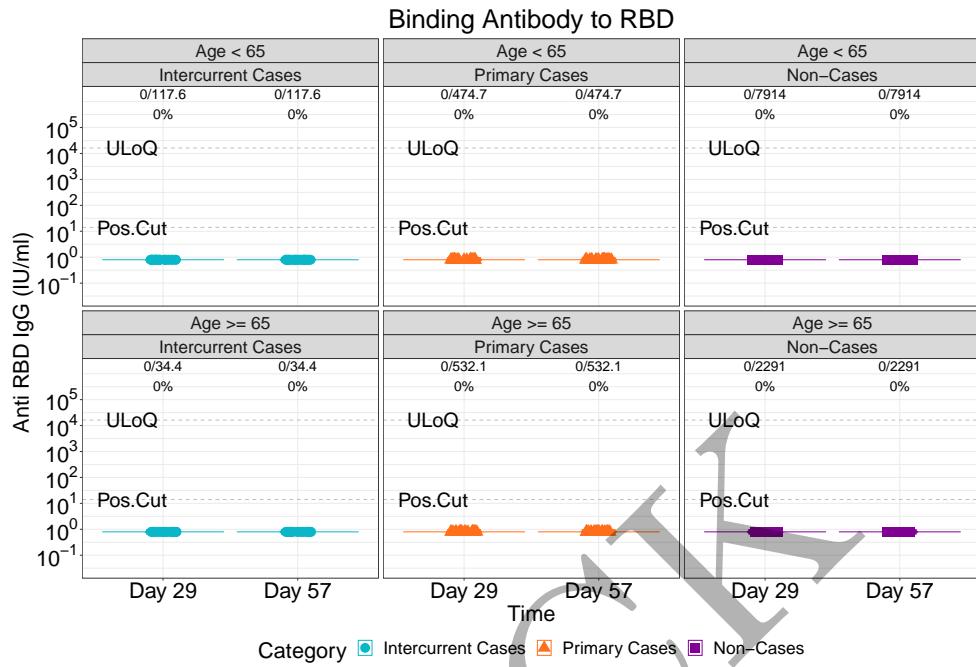


Figure 3.56: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 1)

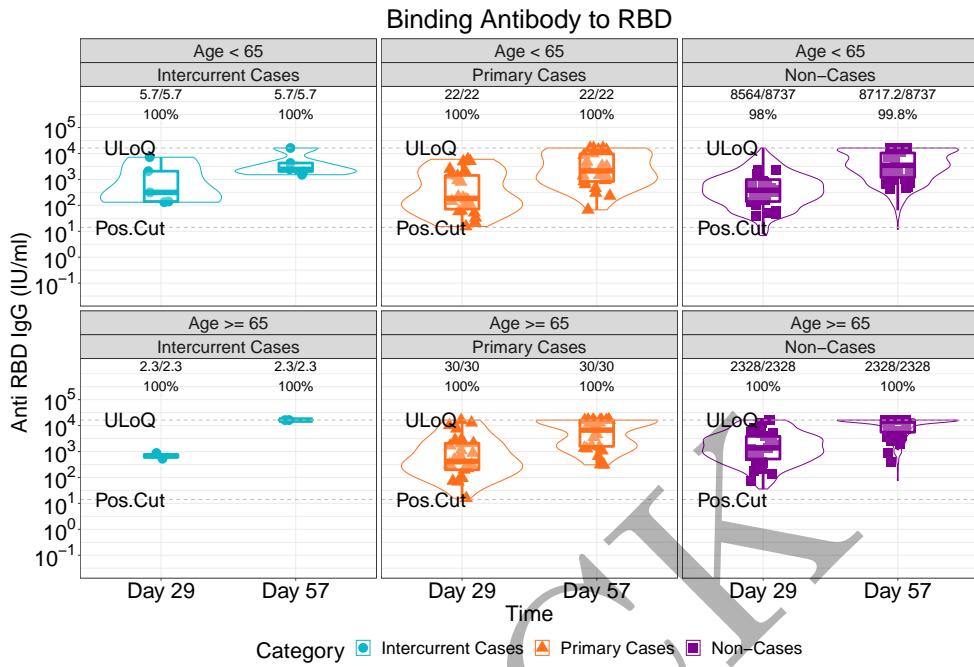


Figure 3.57: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 1)

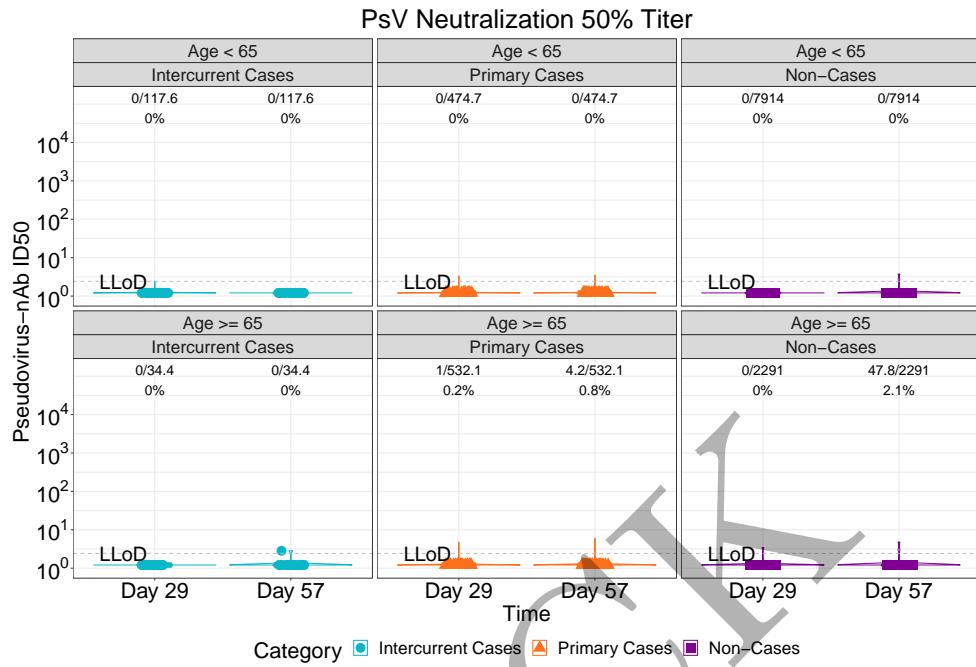


Figure 3.58: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 1)

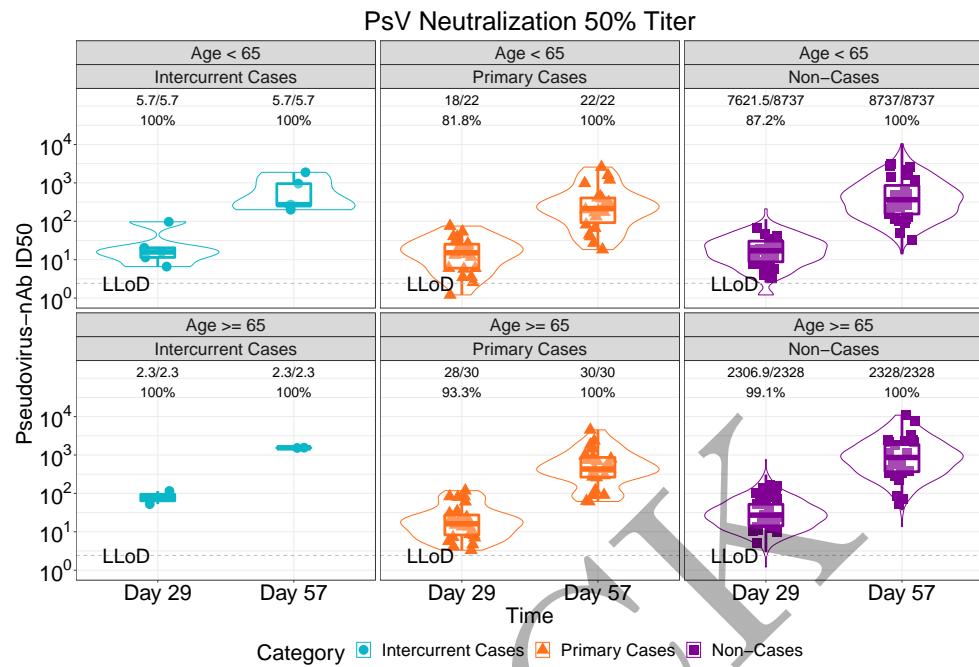


Figure 3.59: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 1)

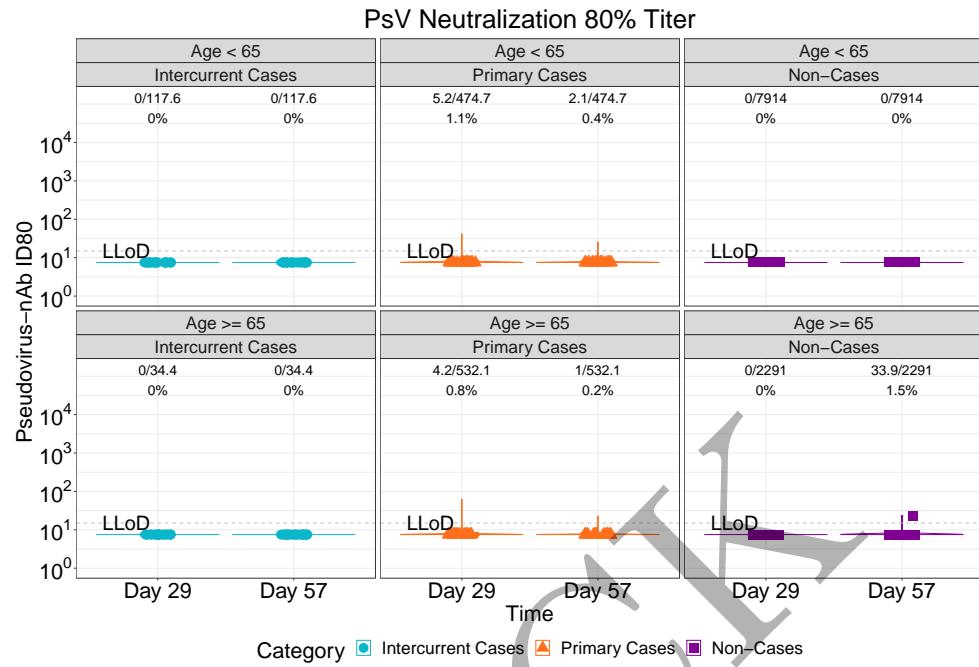


Figure 3.60: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 1)

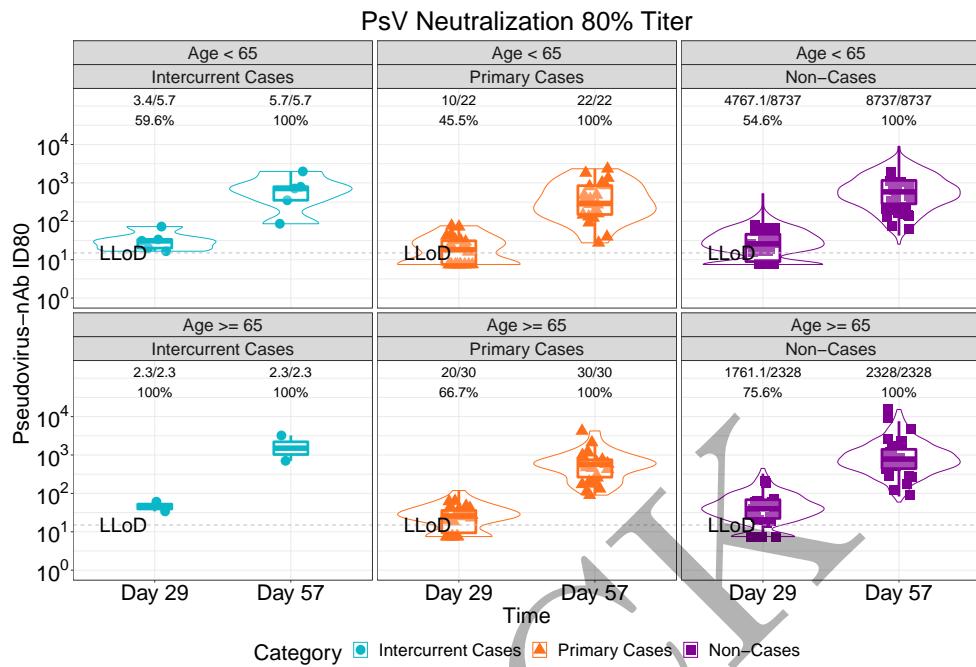


Figure 3.61: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 1)

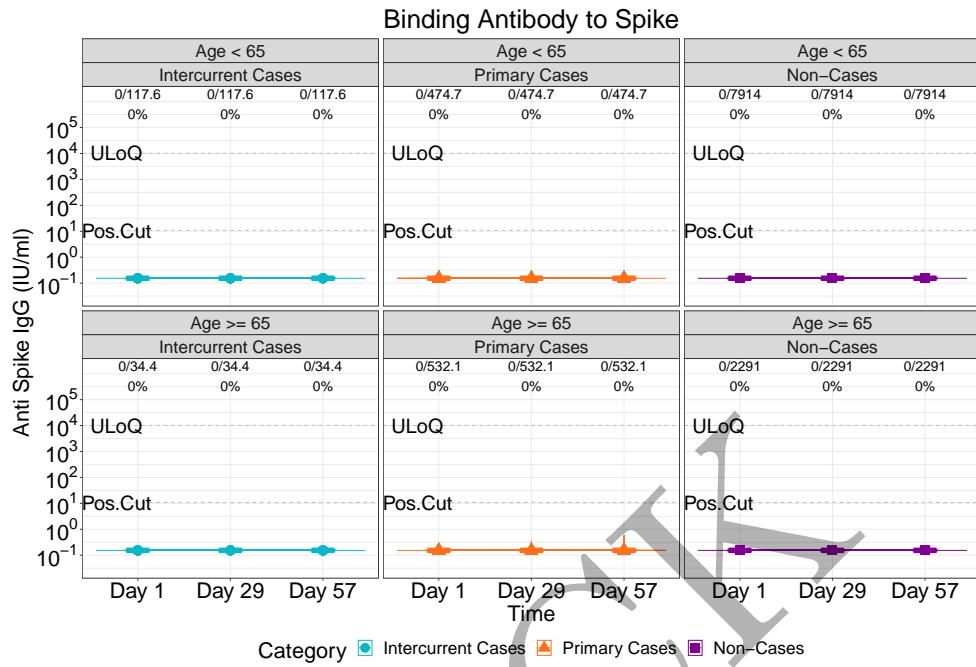


Figure 3.62: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

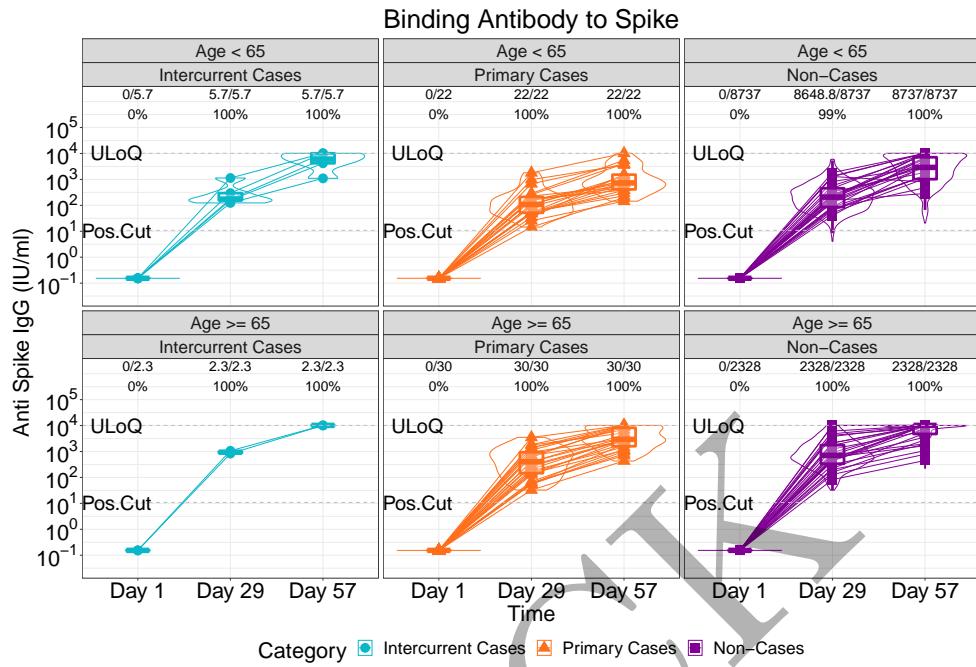


Figure 3.63: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

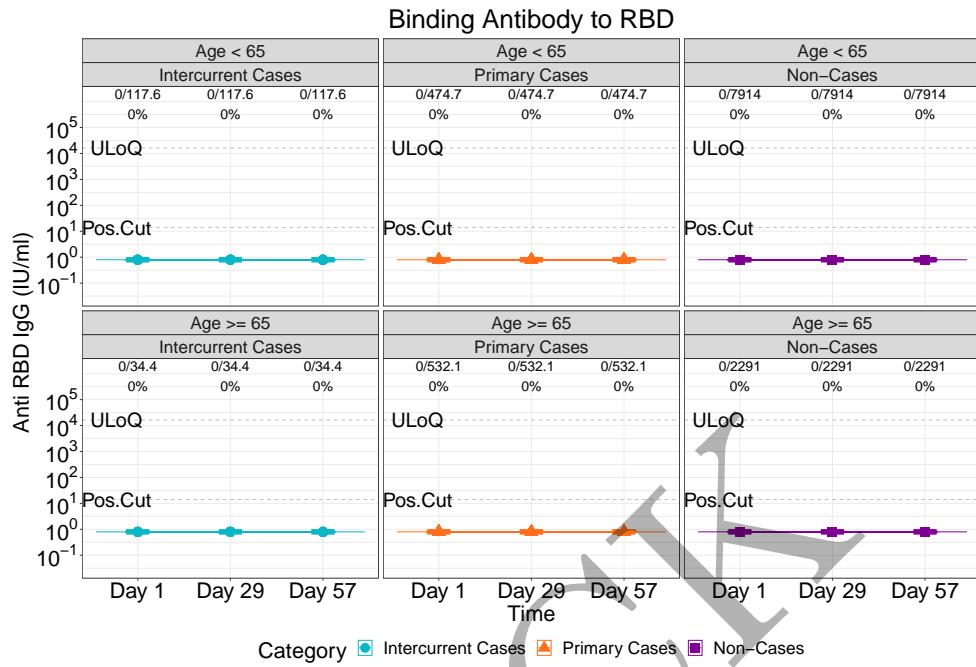


Figure 3.64: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

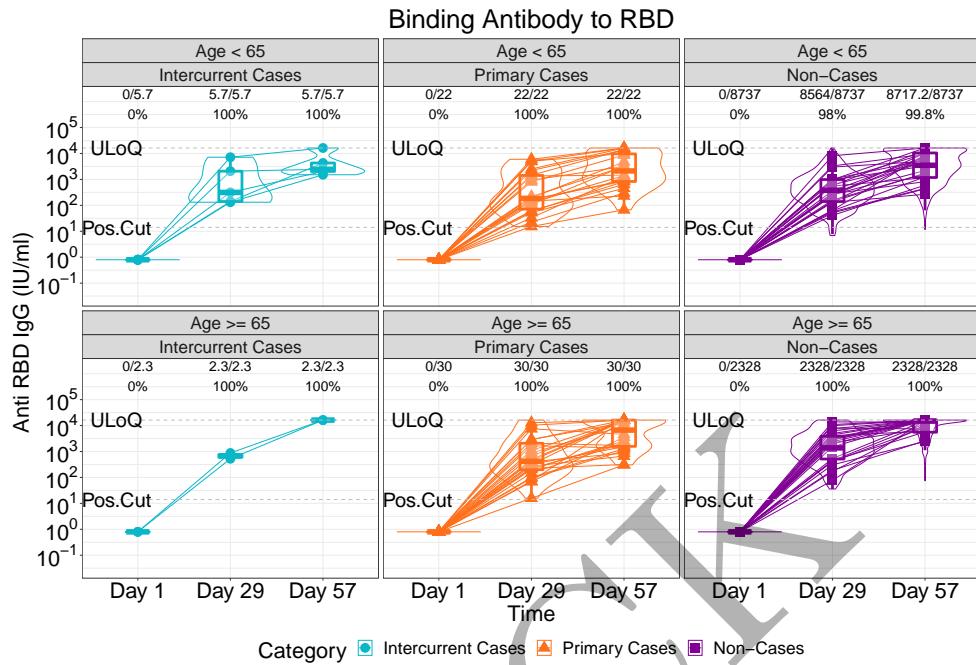


Figure 3.65: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

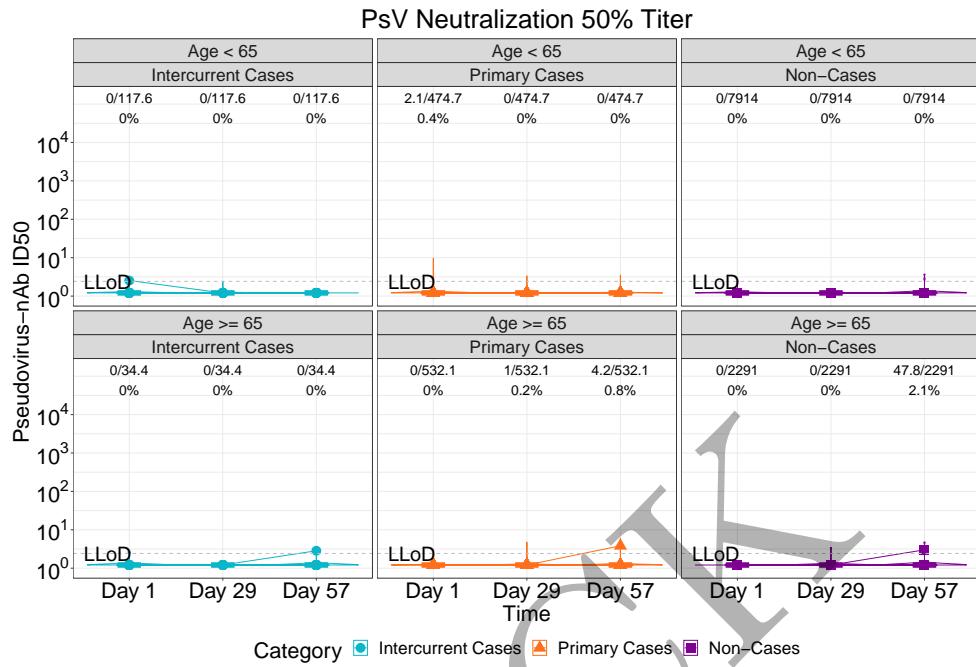


Figure 3.66: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

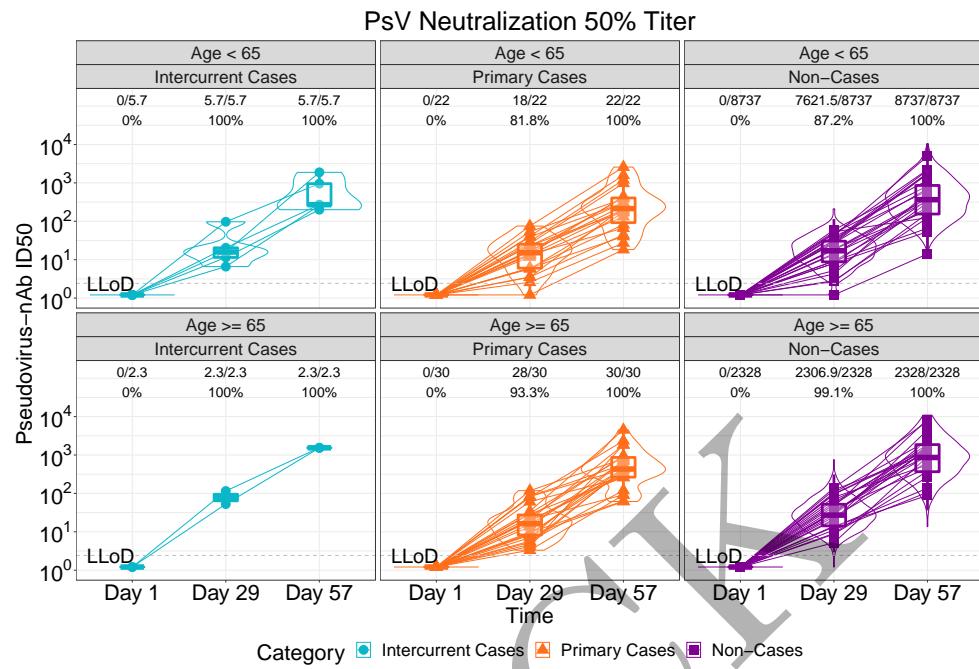


Figure 3.67: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

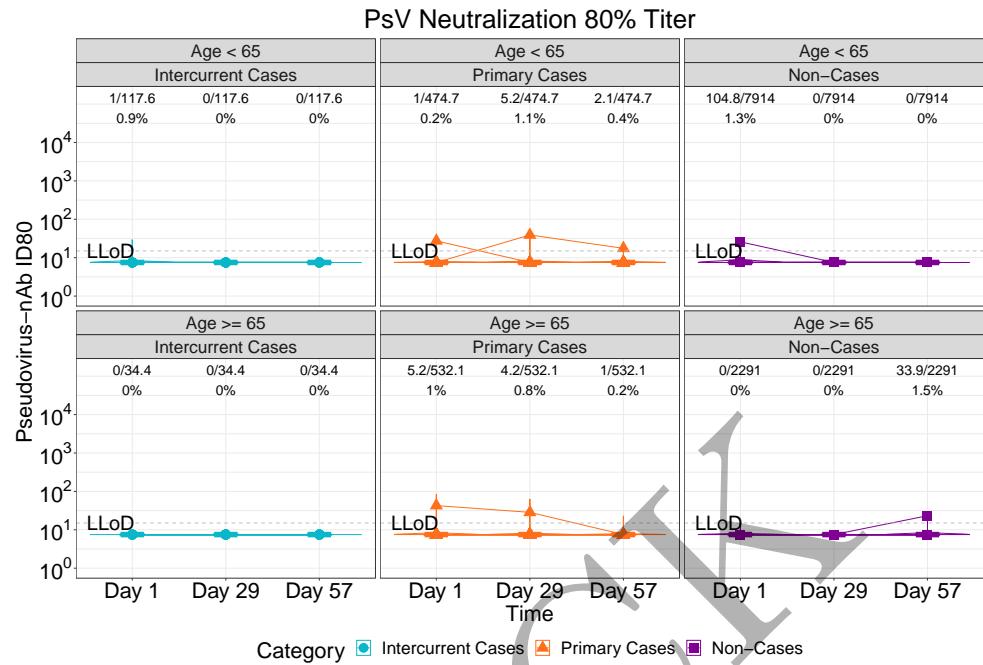


Figure 3.68: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

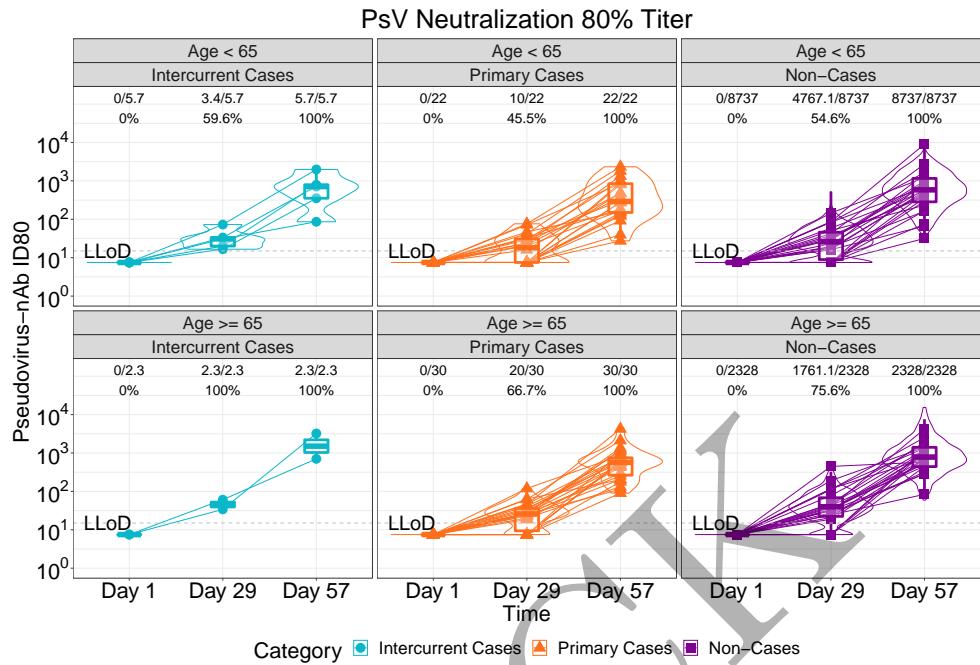


Figure 3.69: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

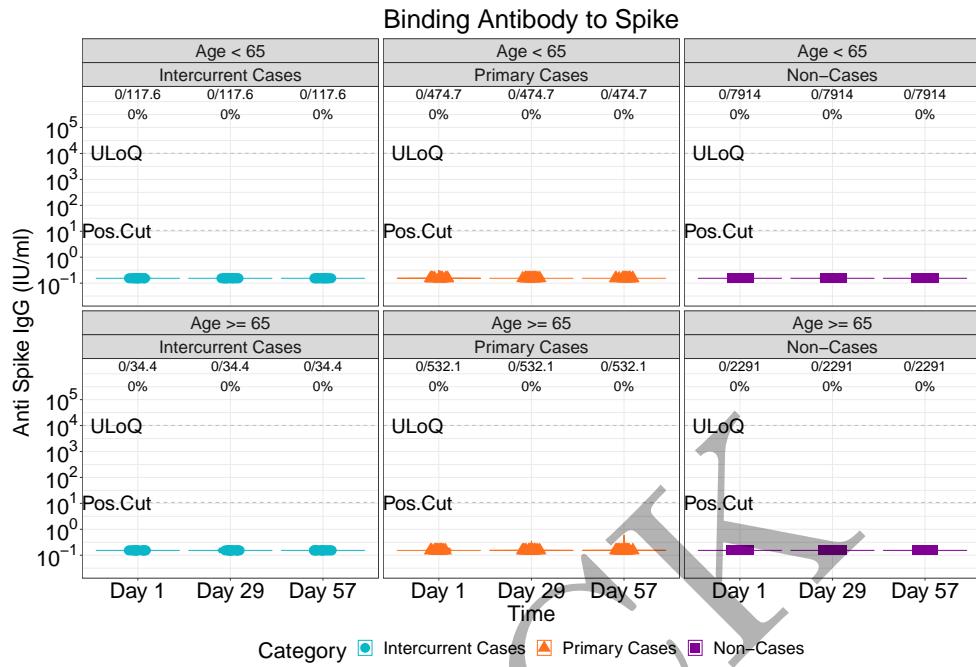


Figure 3.70: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (version 2)

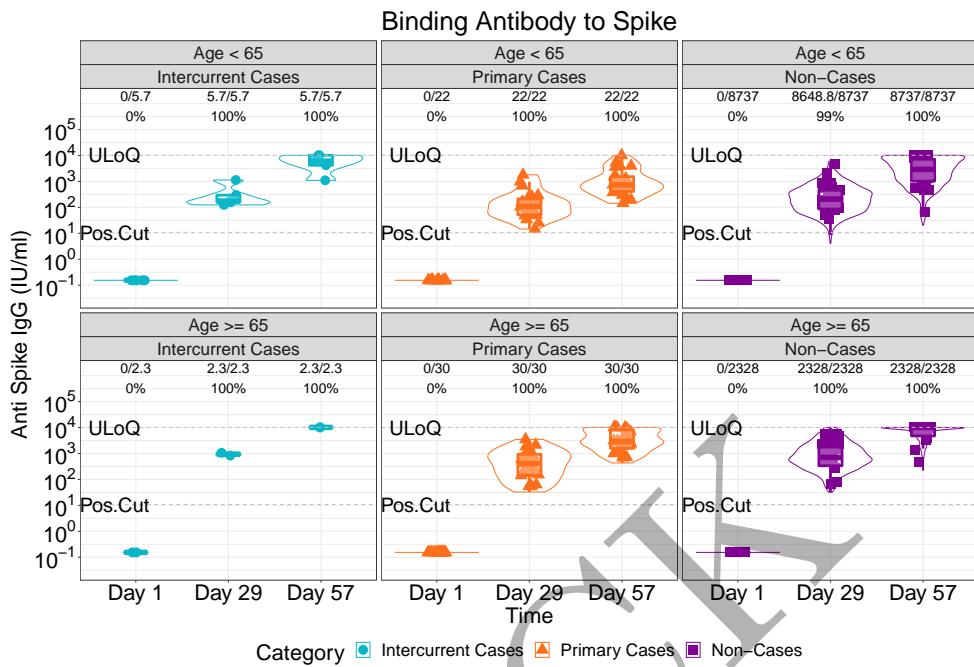


Figure 3.71: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (version 2)

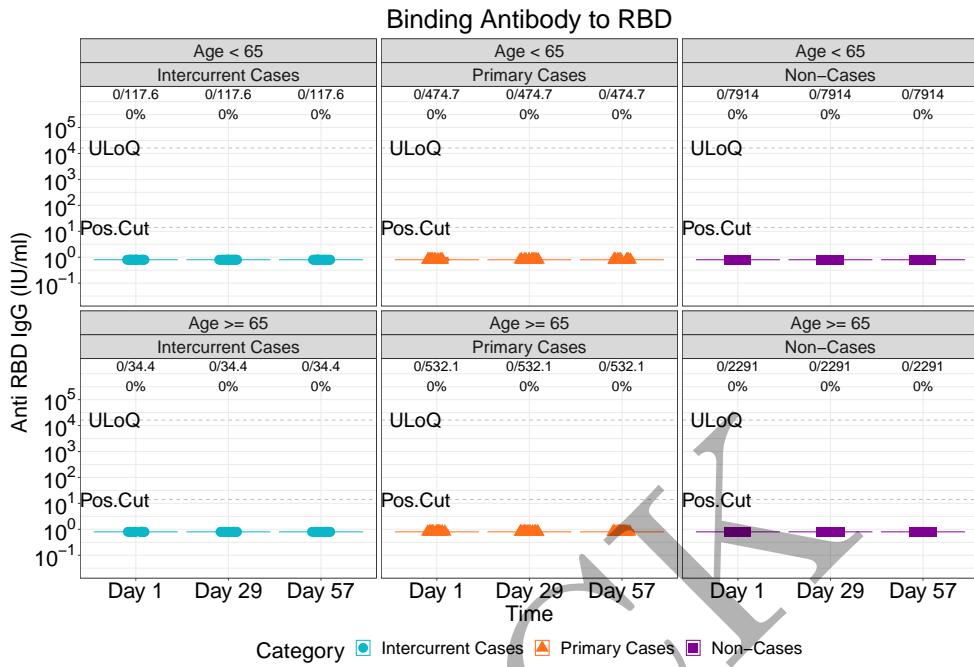


Figure 3.72: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (version 2)

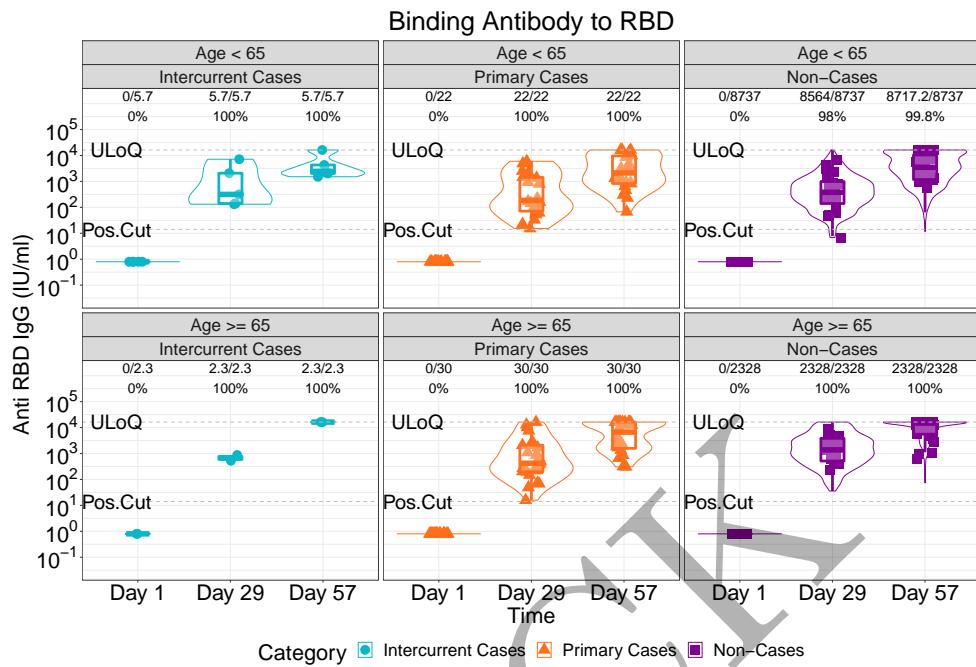


Figure 3.73: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (version 2)

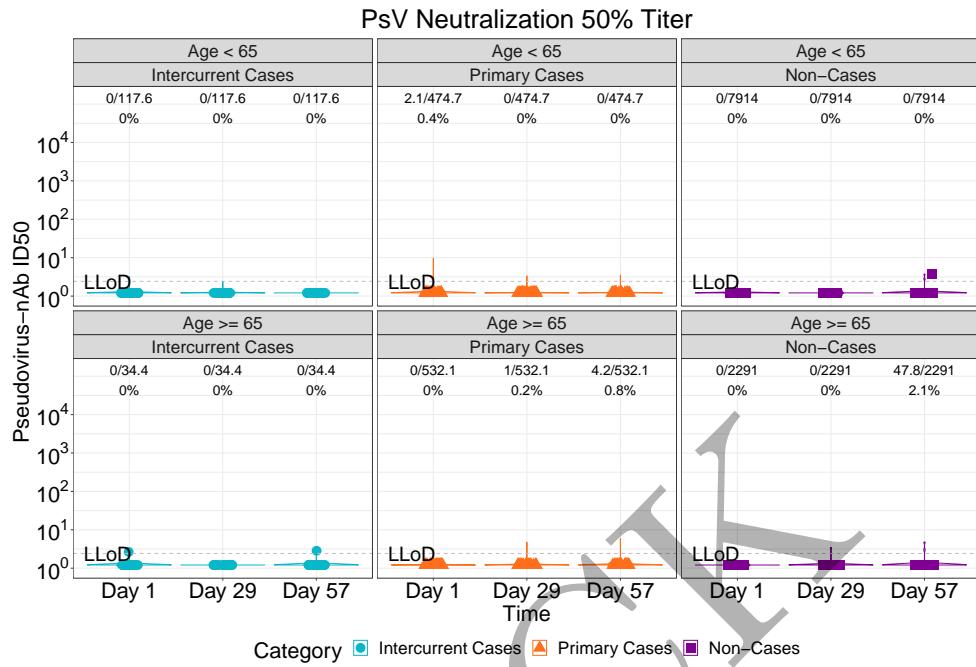


Figure 3.74: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (version 2)

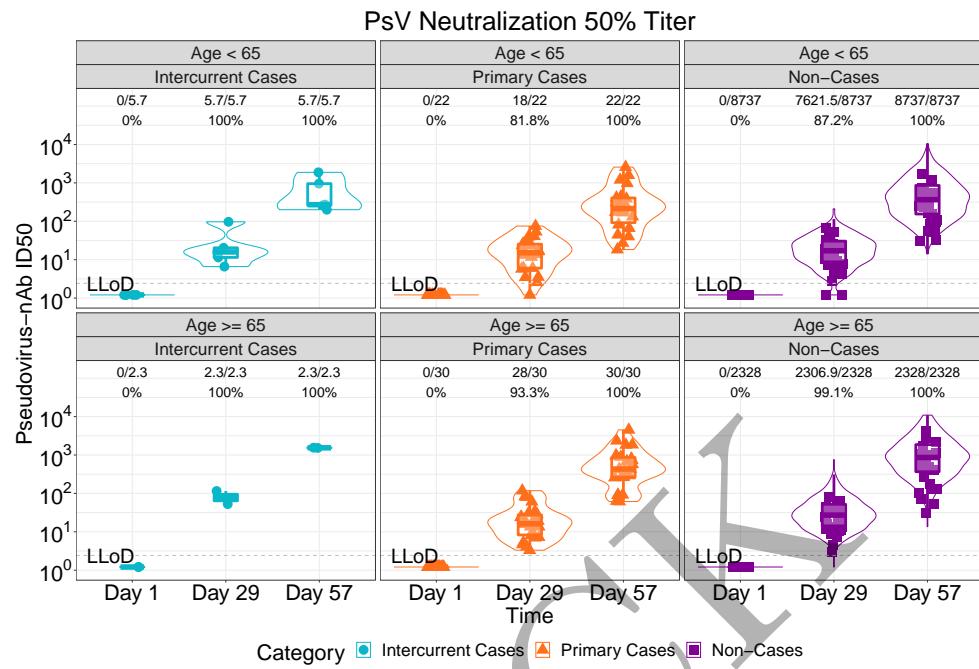


Figure 3.75: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (version 2)

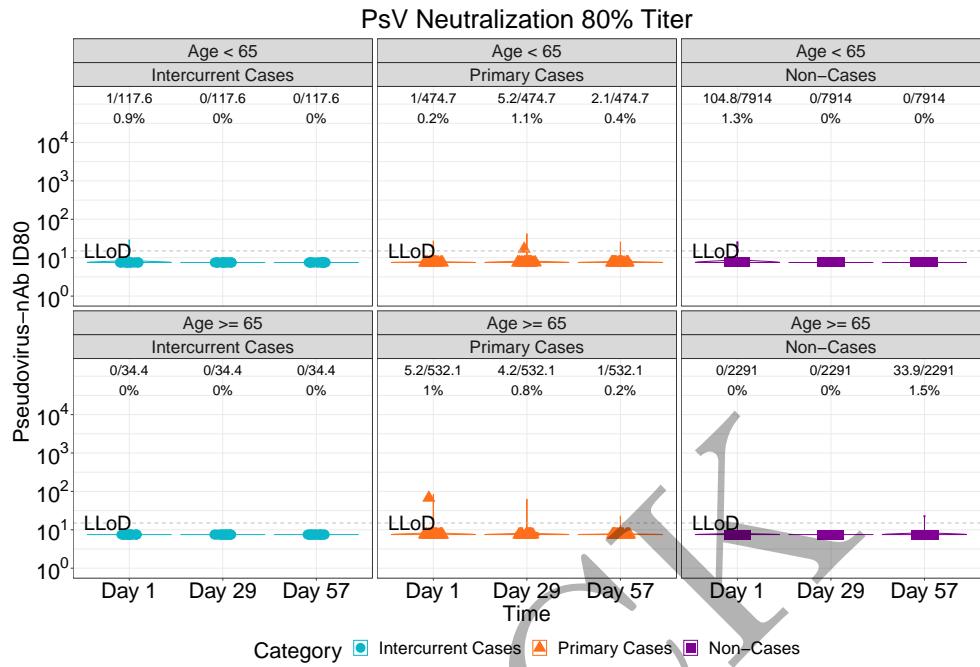


Figure 3.76: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (version 2)

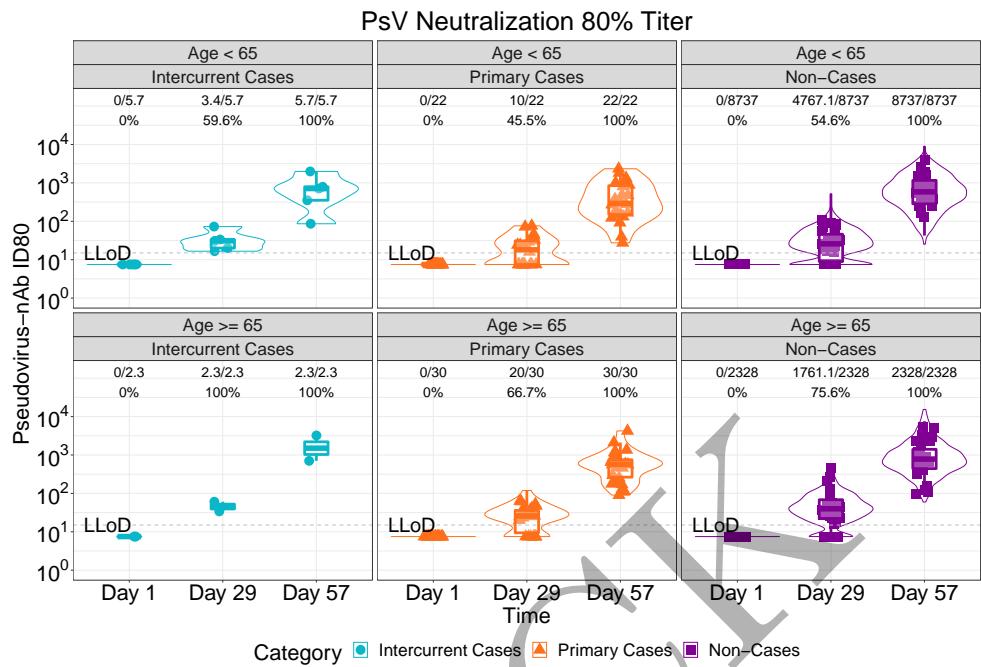


Figure 3.77: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (version 2)

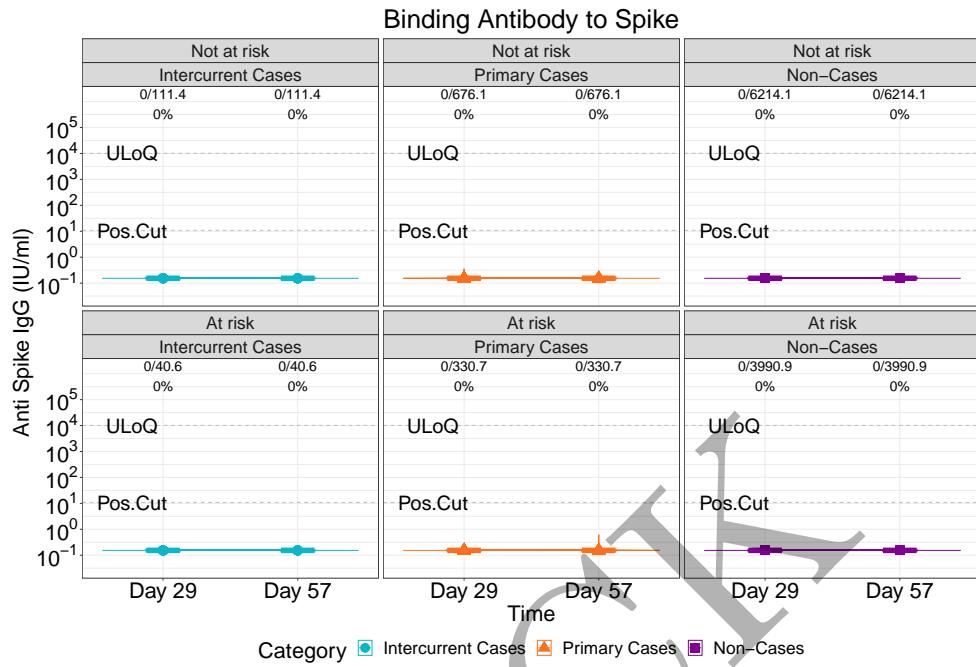


Figure 3.78: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

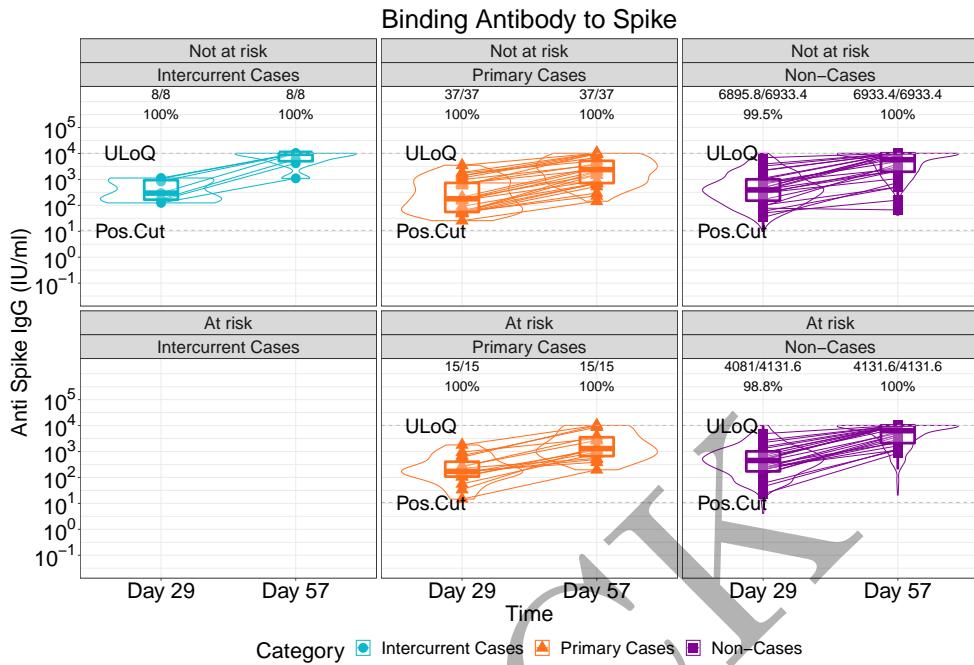


Figure 3.79: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

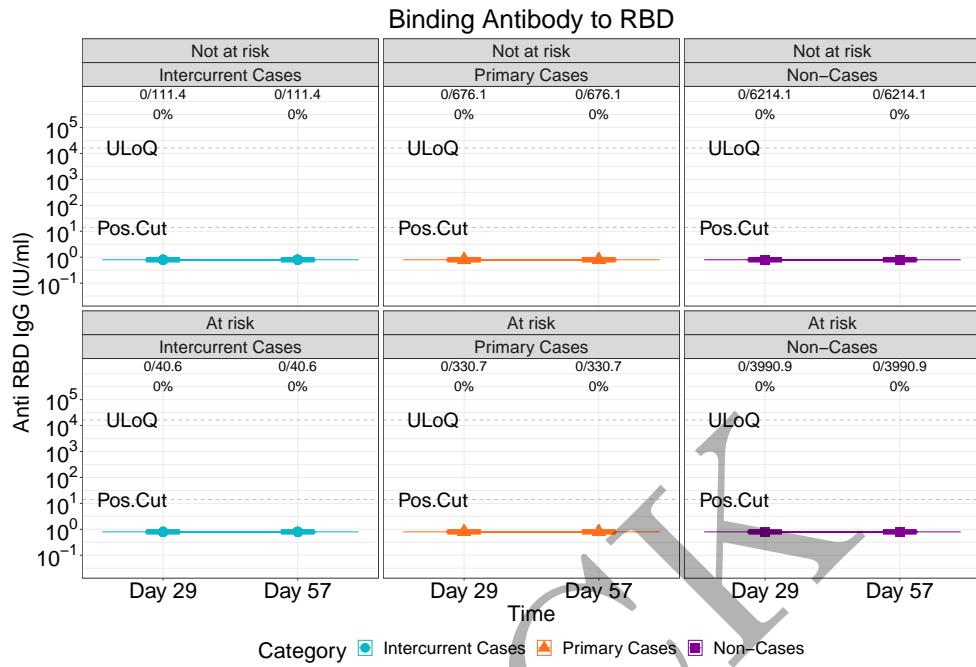


Figure 3.80: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

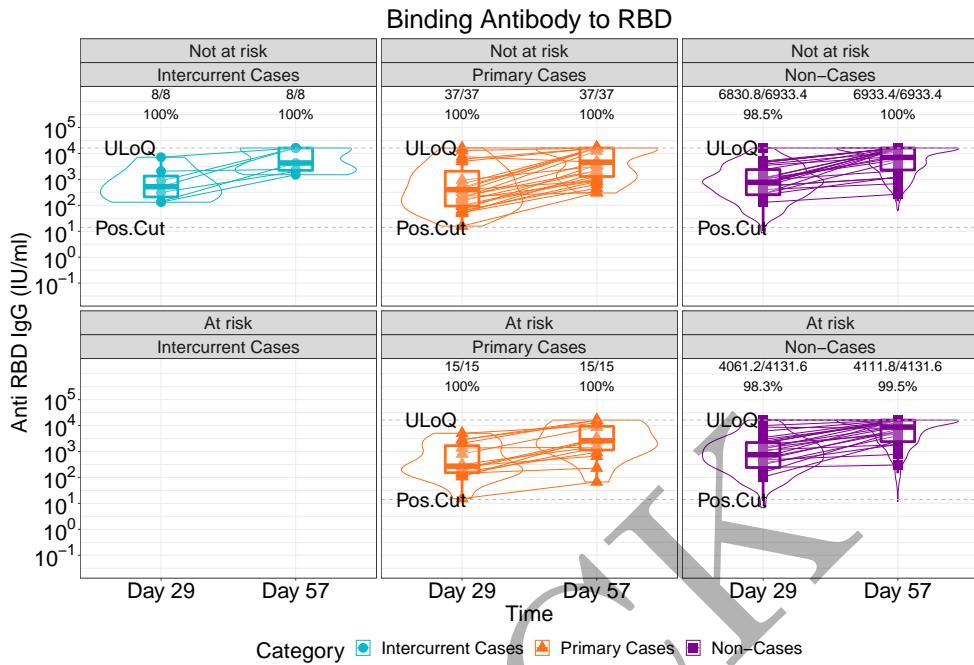


Figure 3.81: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

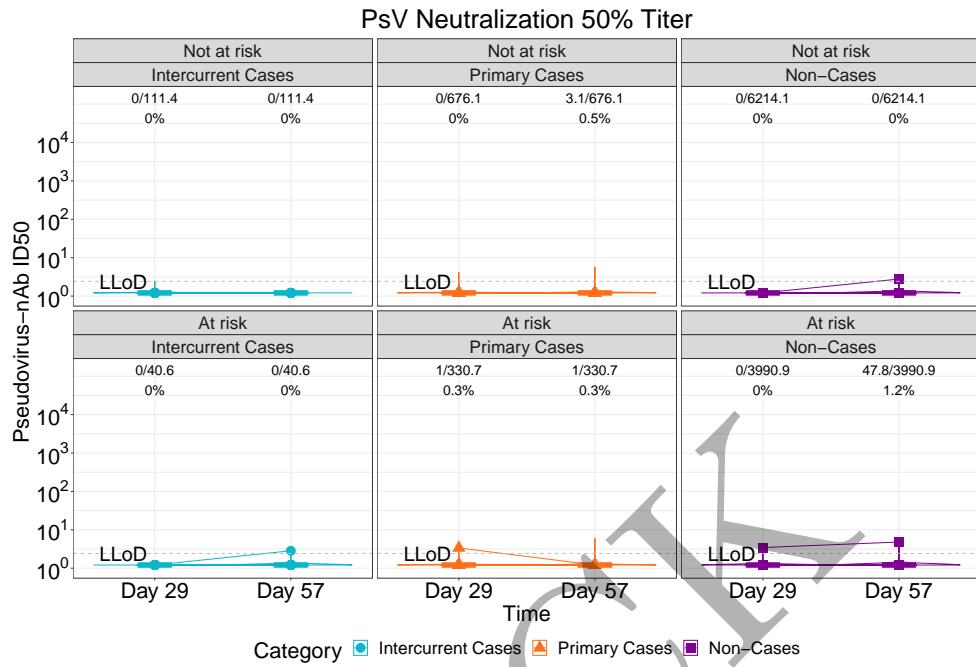


Figure 3.82: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

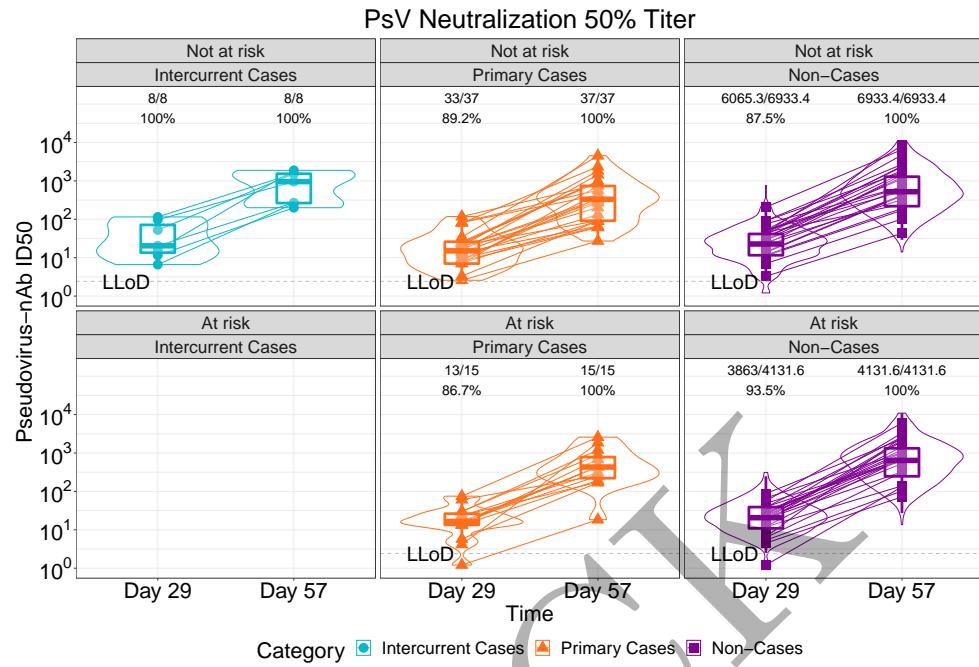


Figure 3.83: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

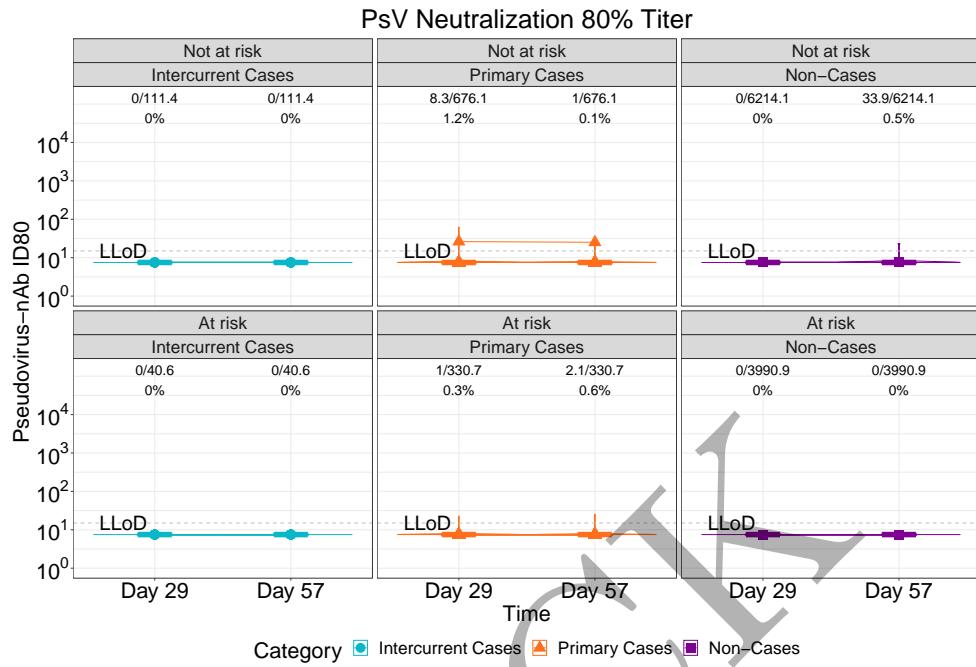


Figure 3.84: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

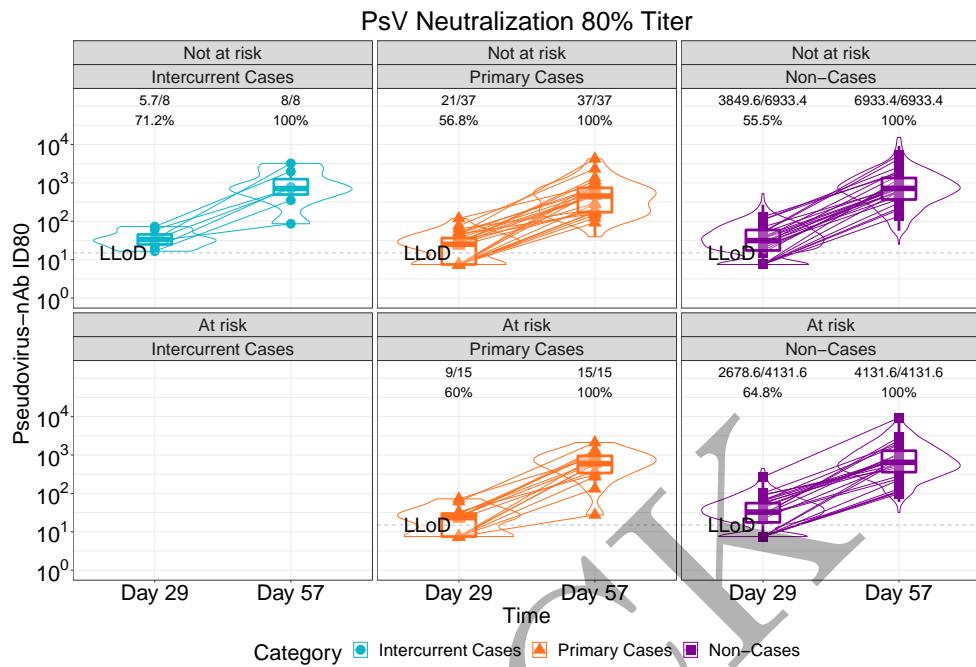


Figure 3.85: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

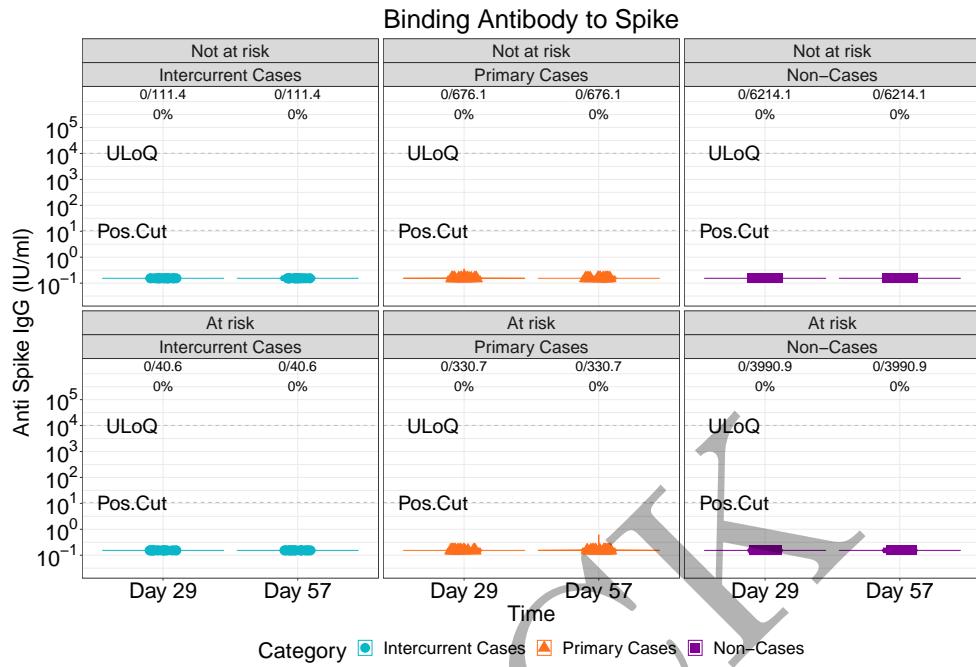


Figure 3.86: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 1)

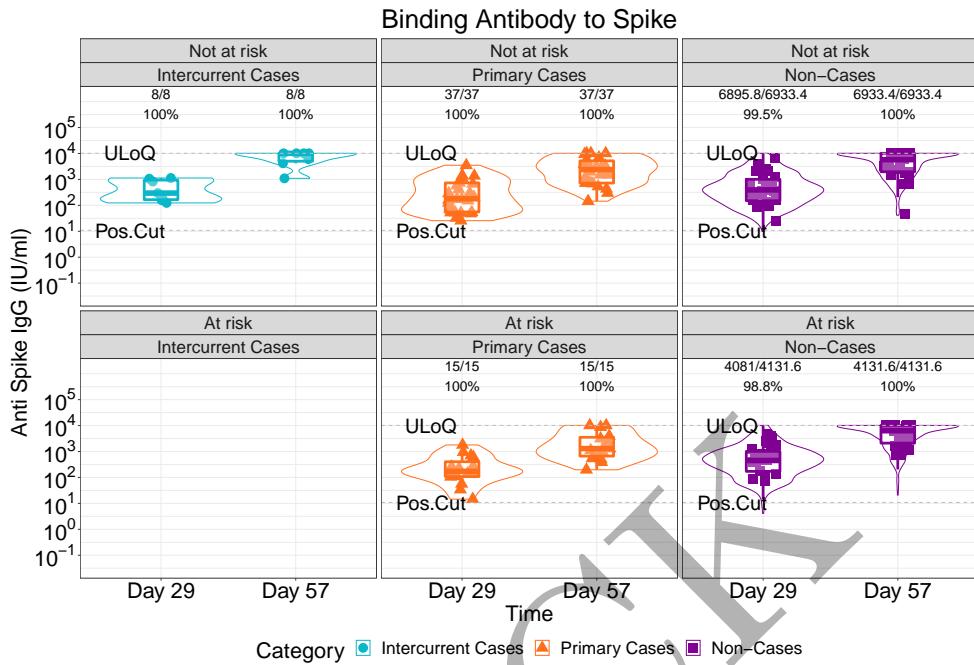


Figure 3.87: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 1)

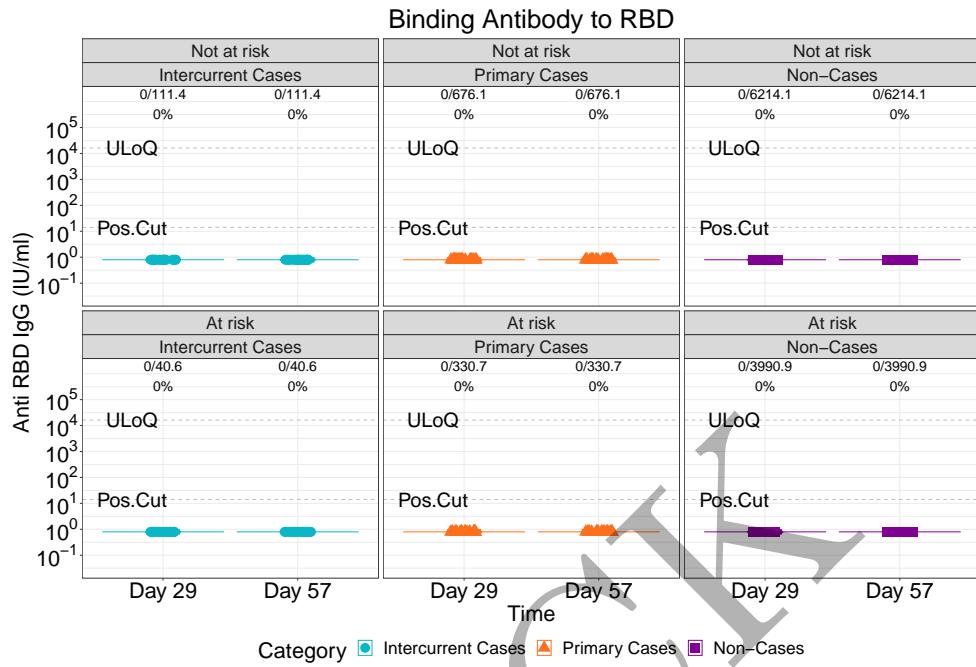


Figure 3.88: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 1)

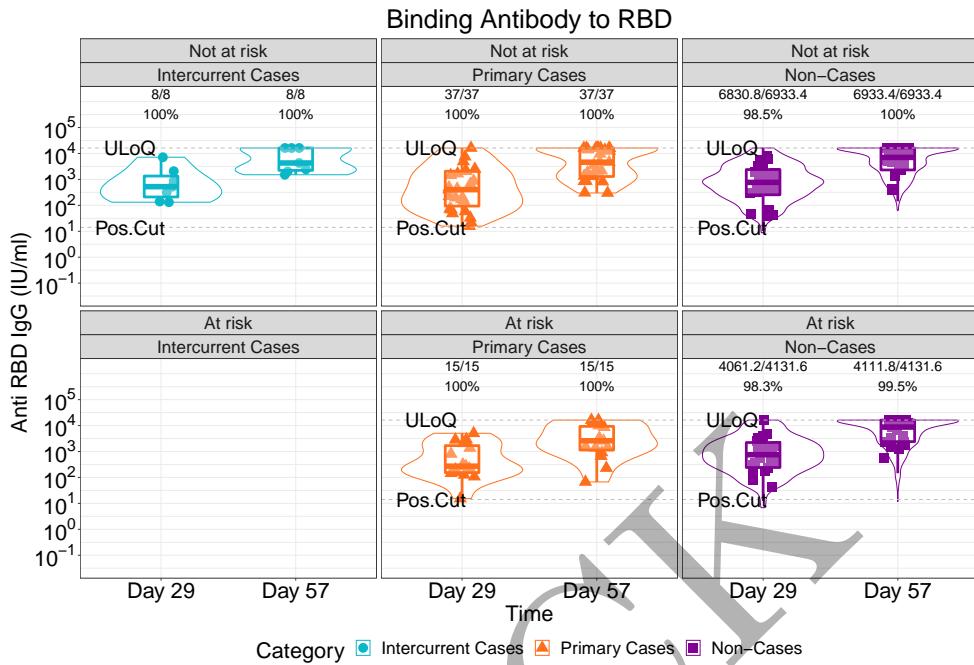


Figure 3.89: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 1)

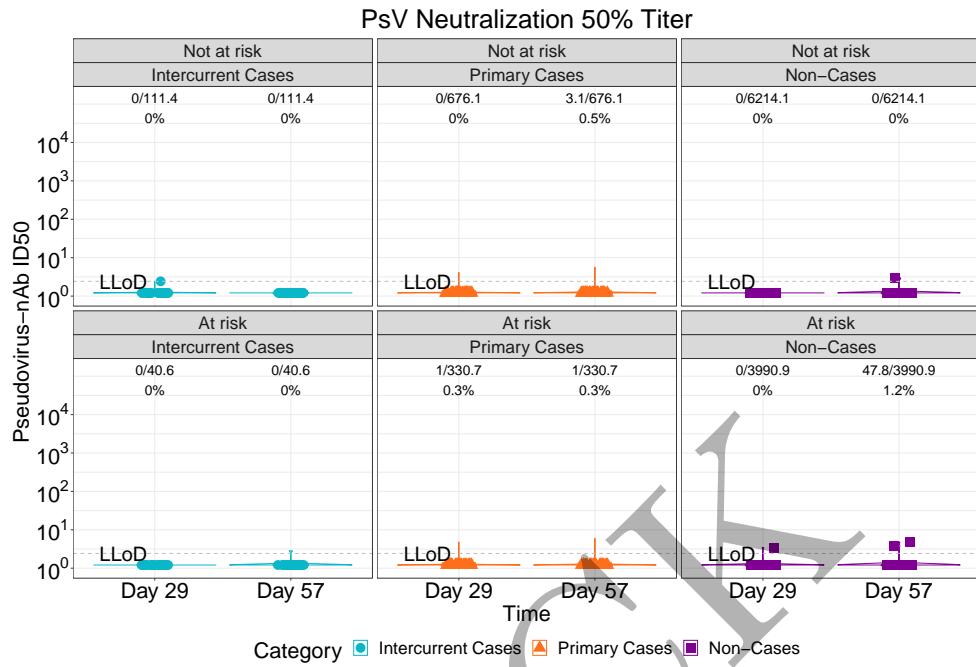


Figure 3.90: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 1)

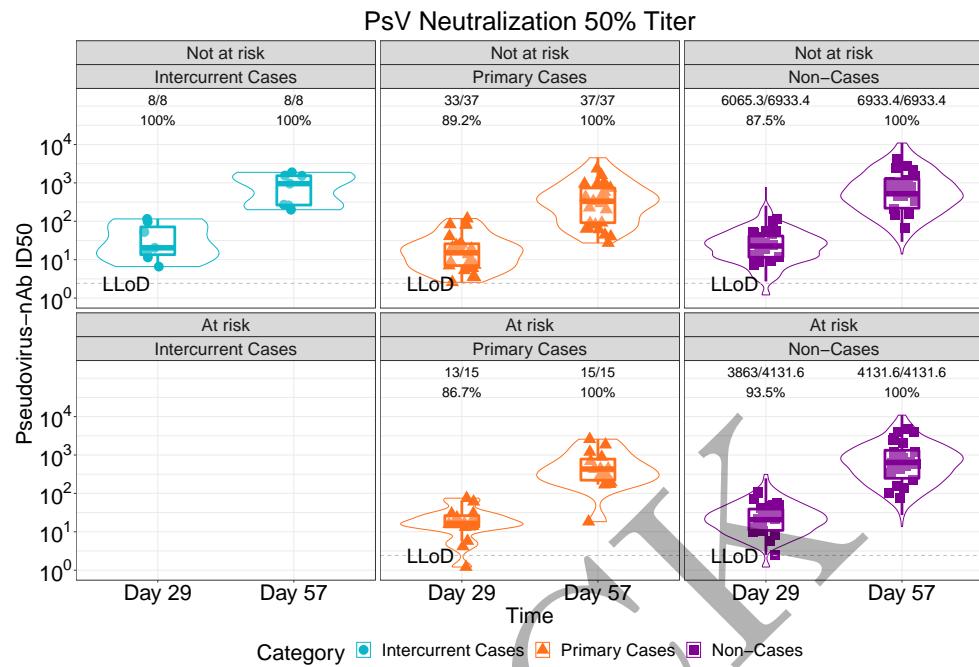


Figure 3.91: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 1)

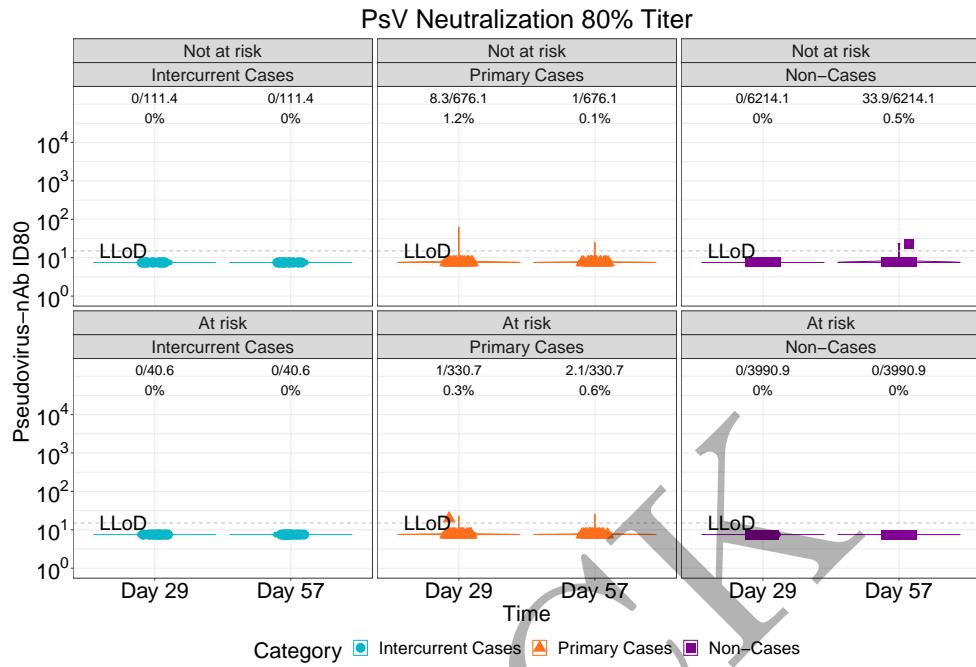


Figure 3.92: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 1)

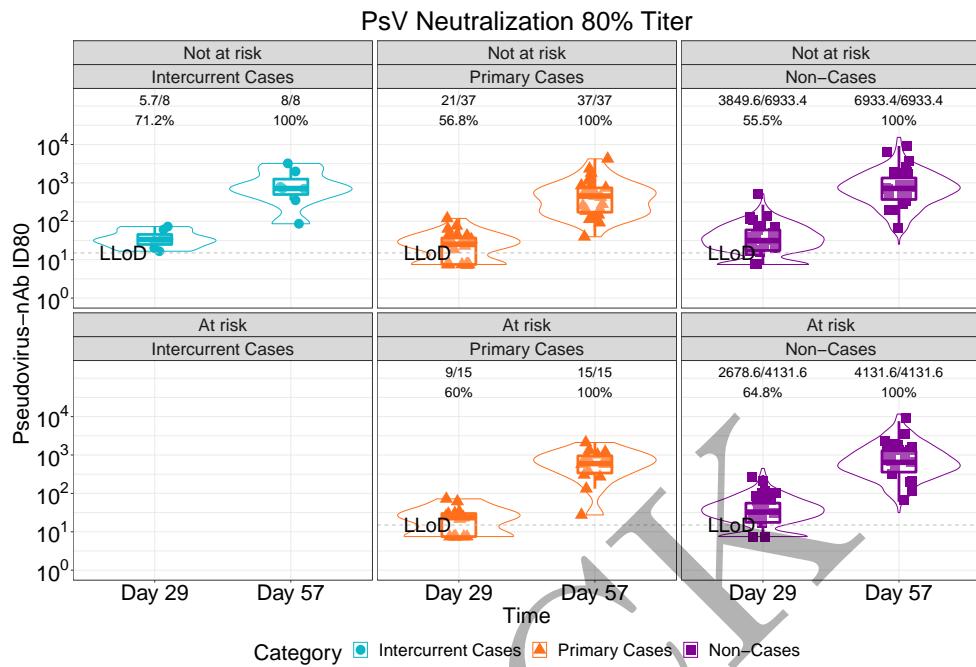


Figure 3.93: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 1)

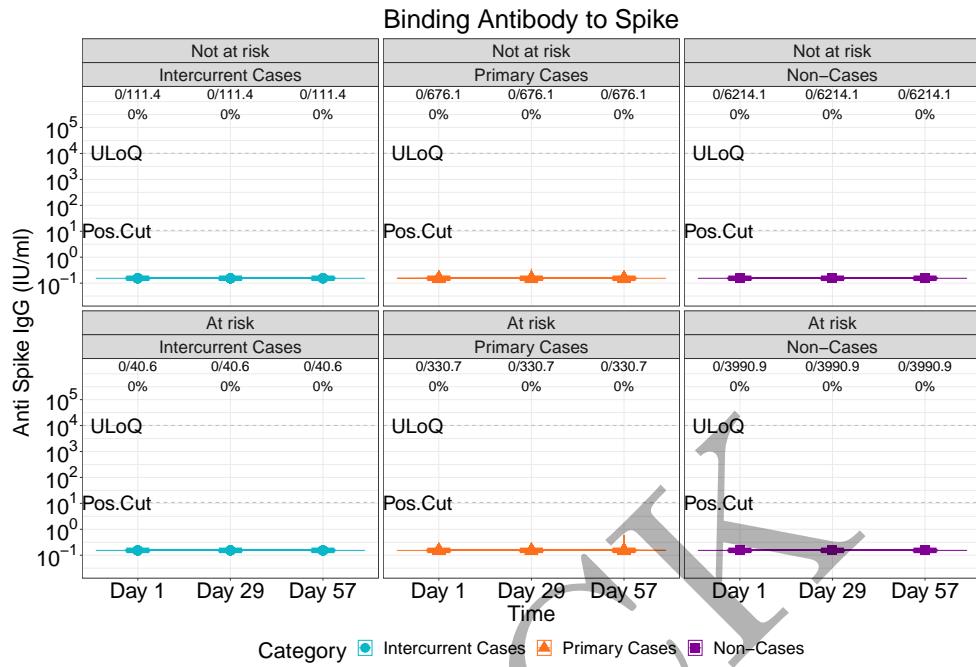


Figure 3.94: lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

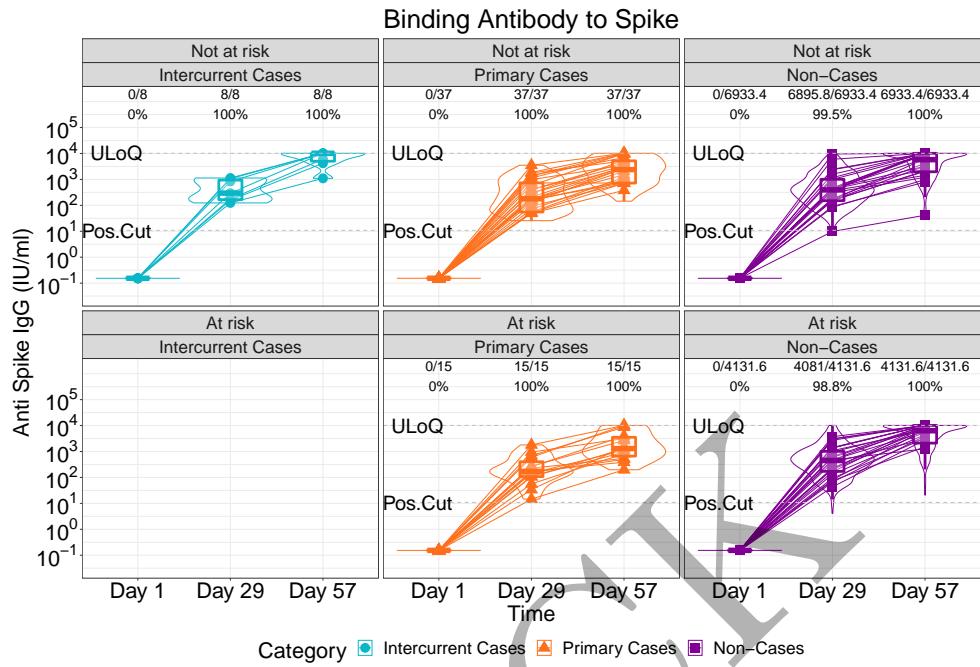


Figure 3.95: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

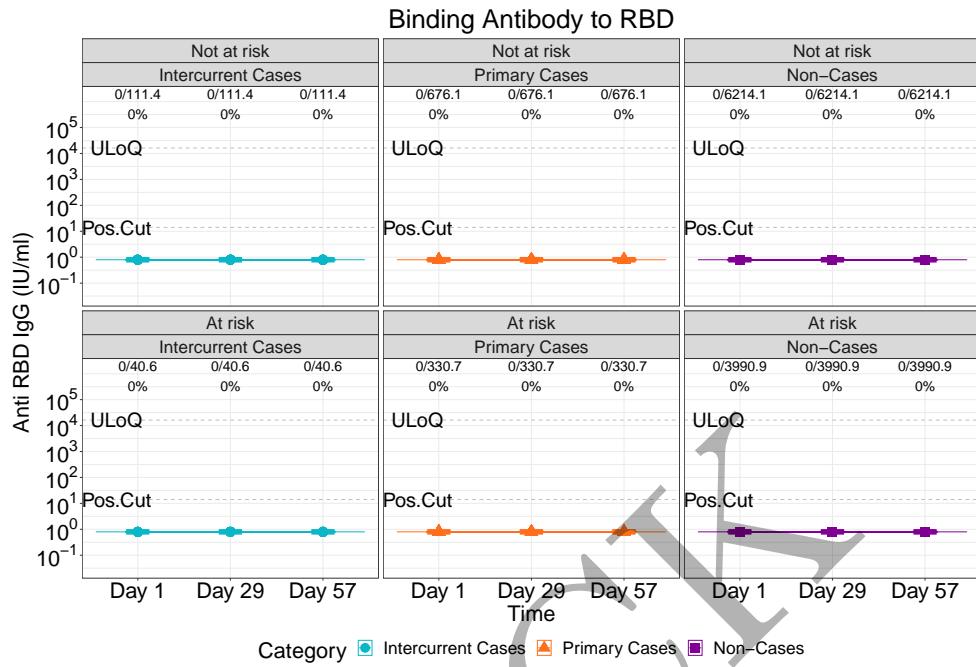


Figure 3.96: lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

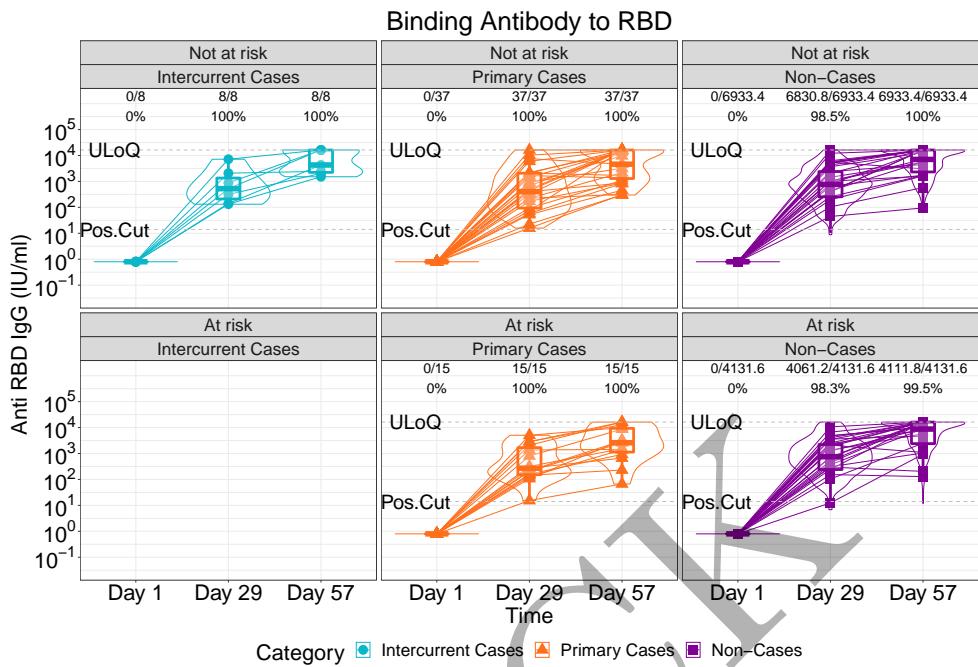


Figure 3.97: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

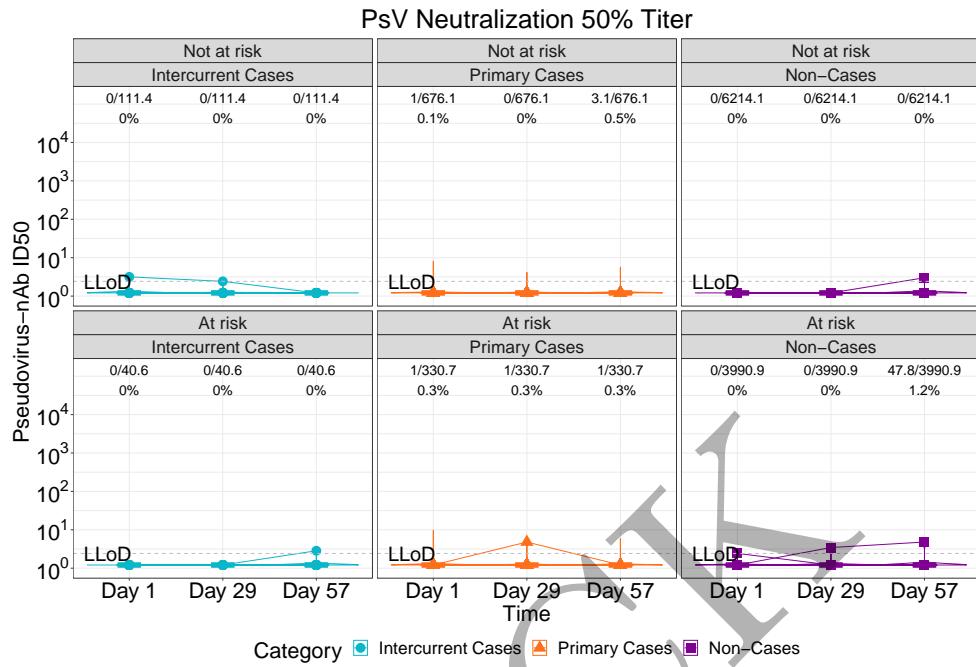


Figure 3.98: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

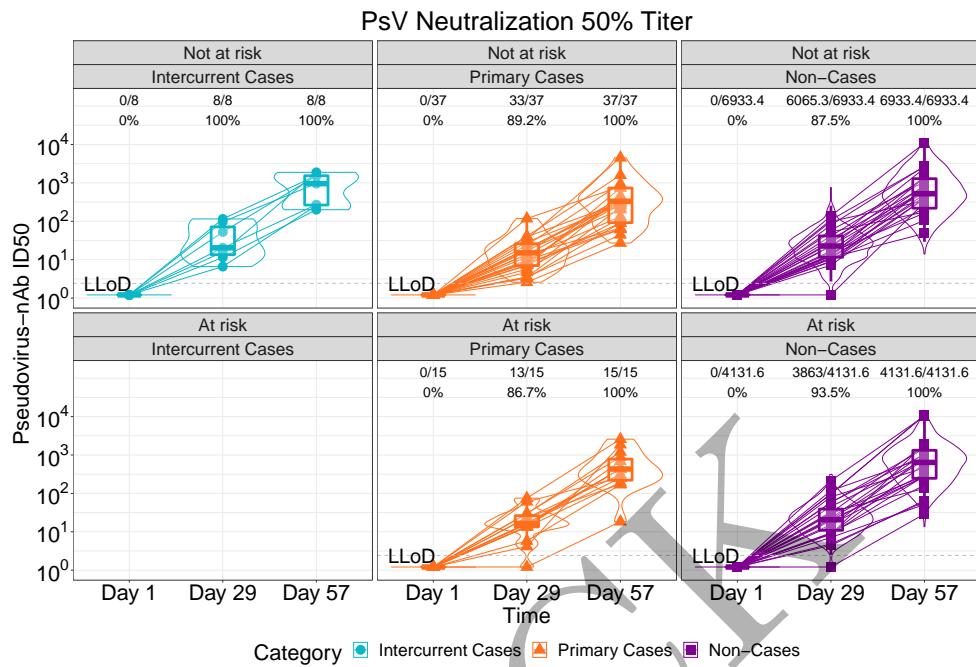


Figure 3.99: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

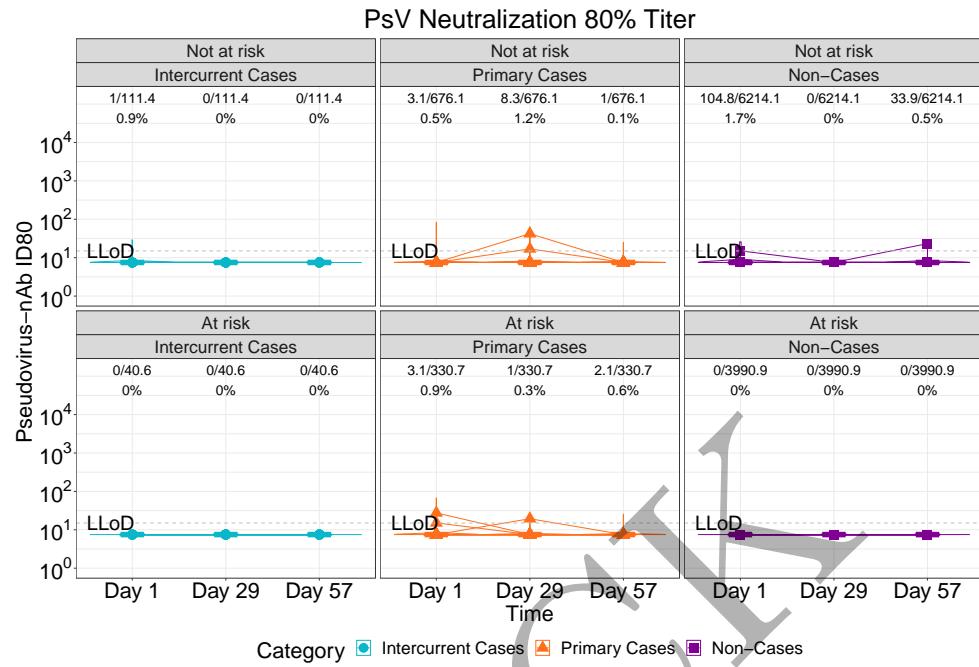


Figure 3.100: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

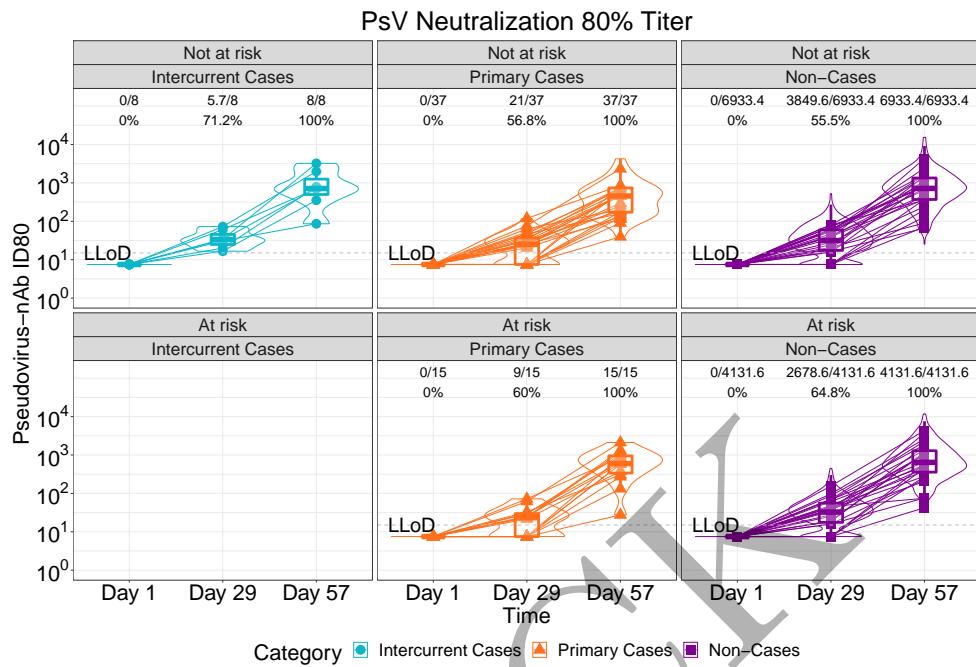


Figure 3.101: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

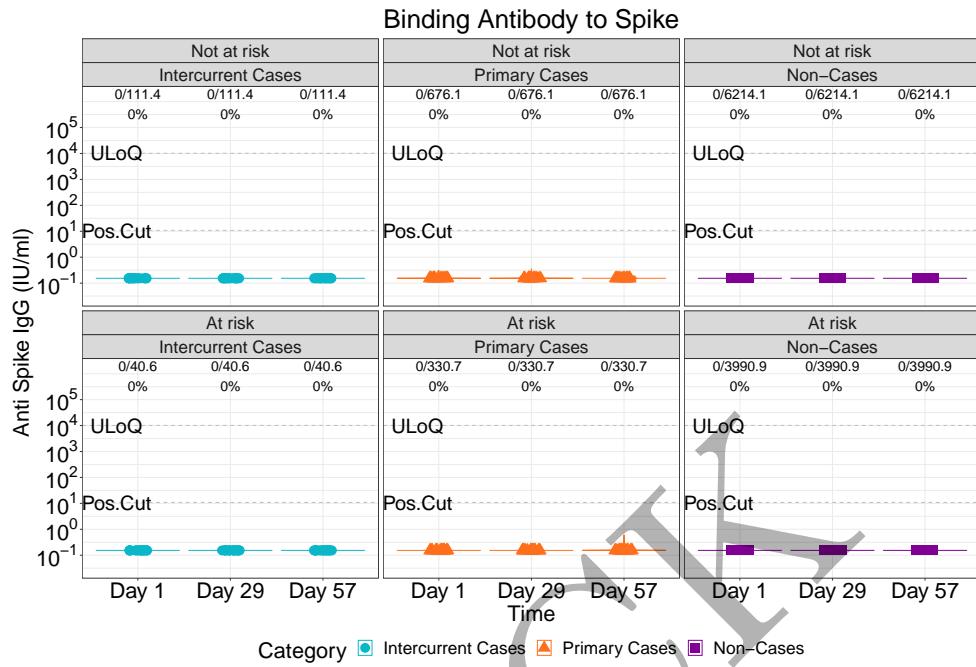


Figure 3.102: violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (version 2)

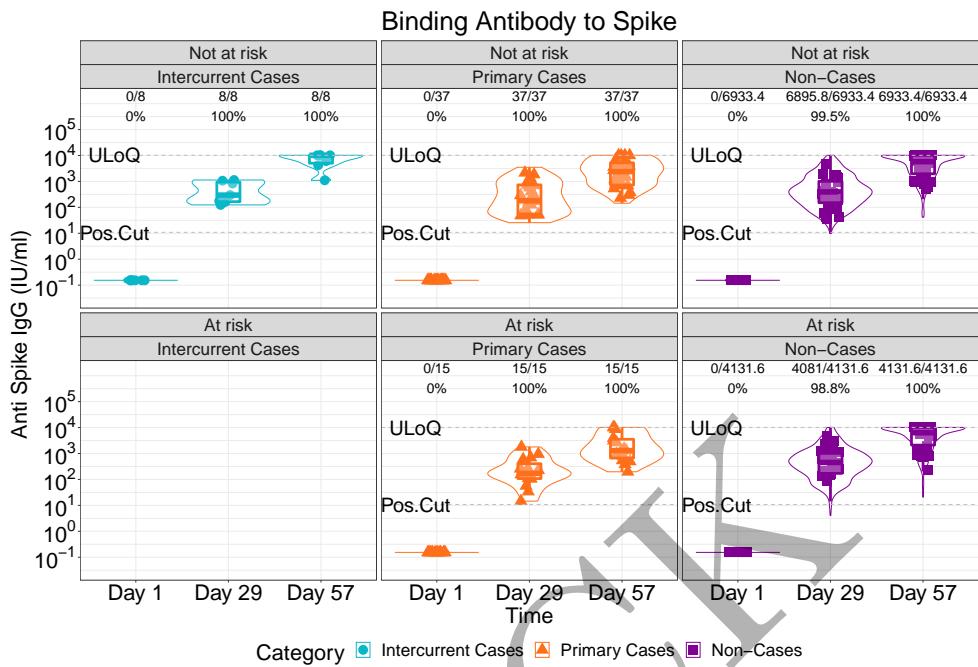


Figure 3.103: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (version 2)

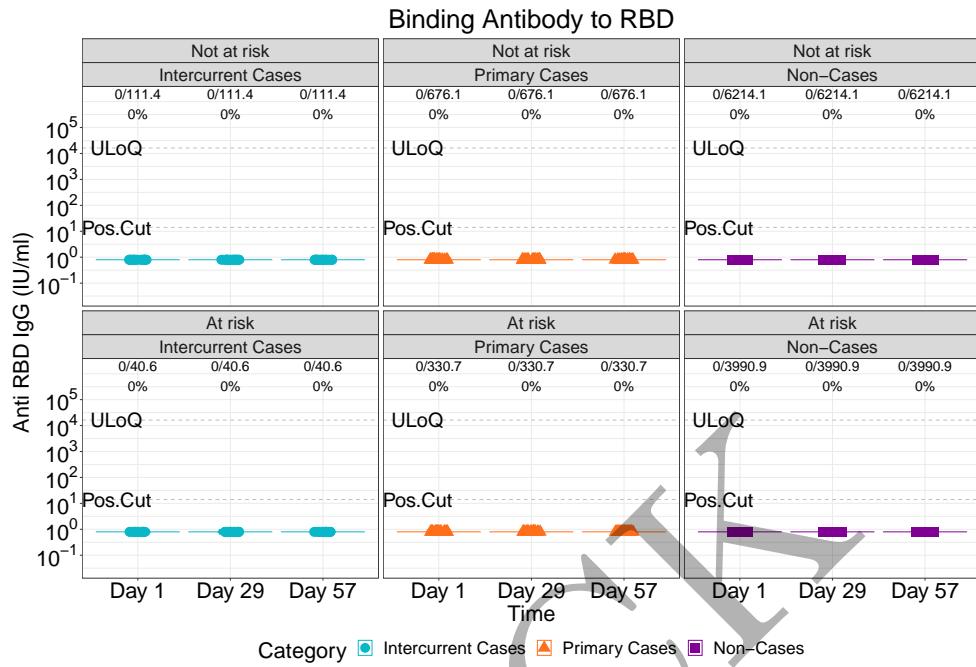


Figure 3.104: violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (version 2)

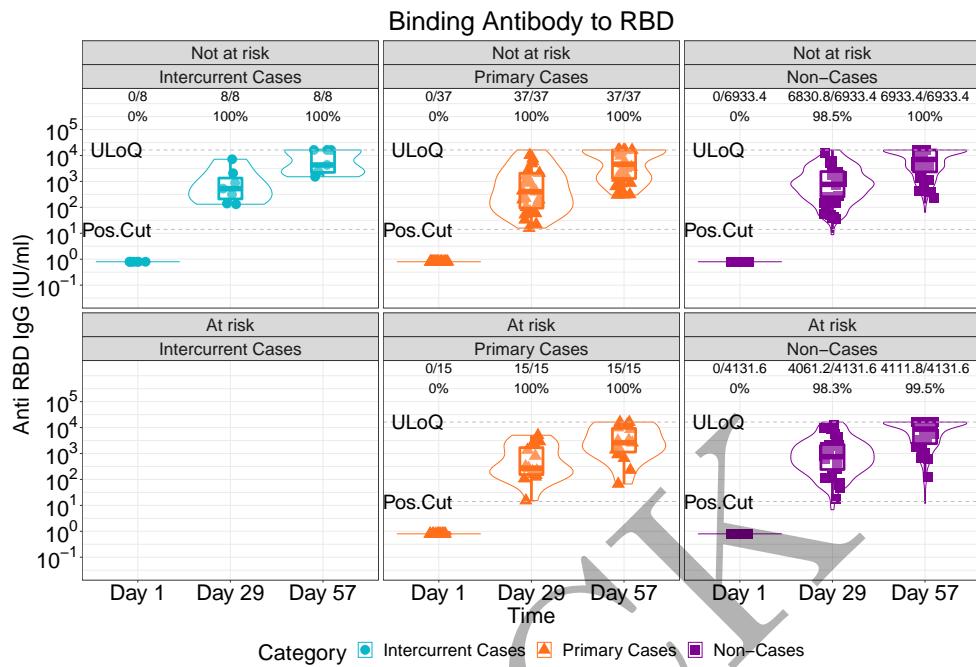


Figure 3.105: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (version 2)

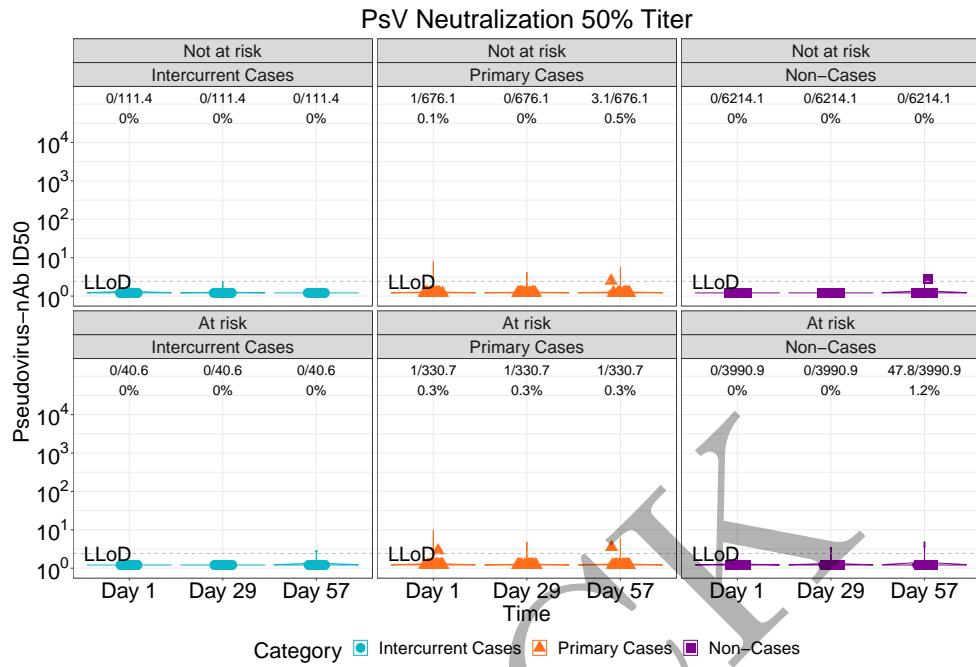


Figure 3.106: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (version 2)

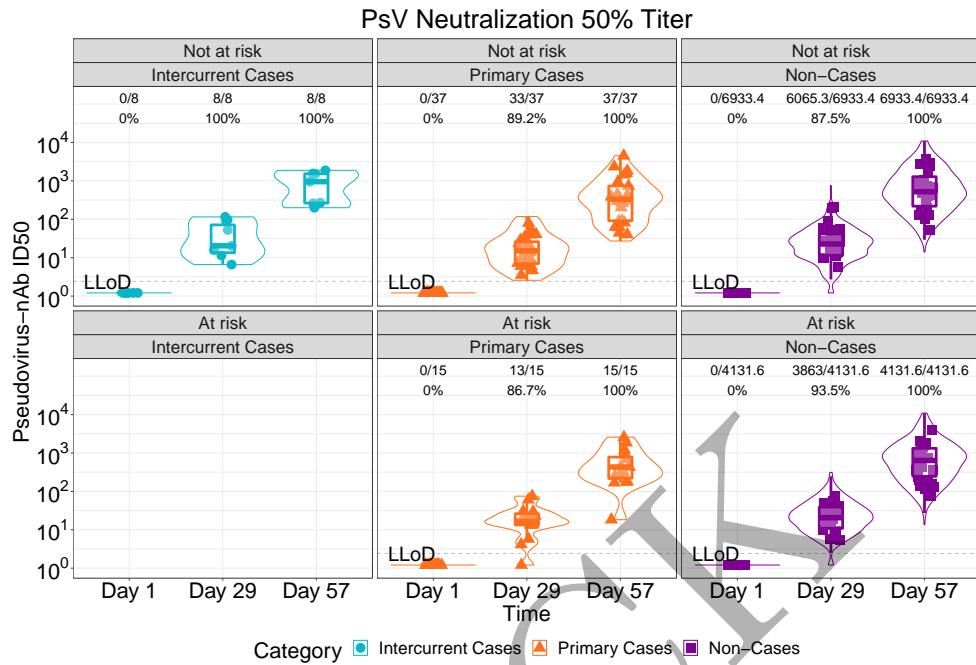


Figure 3.107: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (version 2)

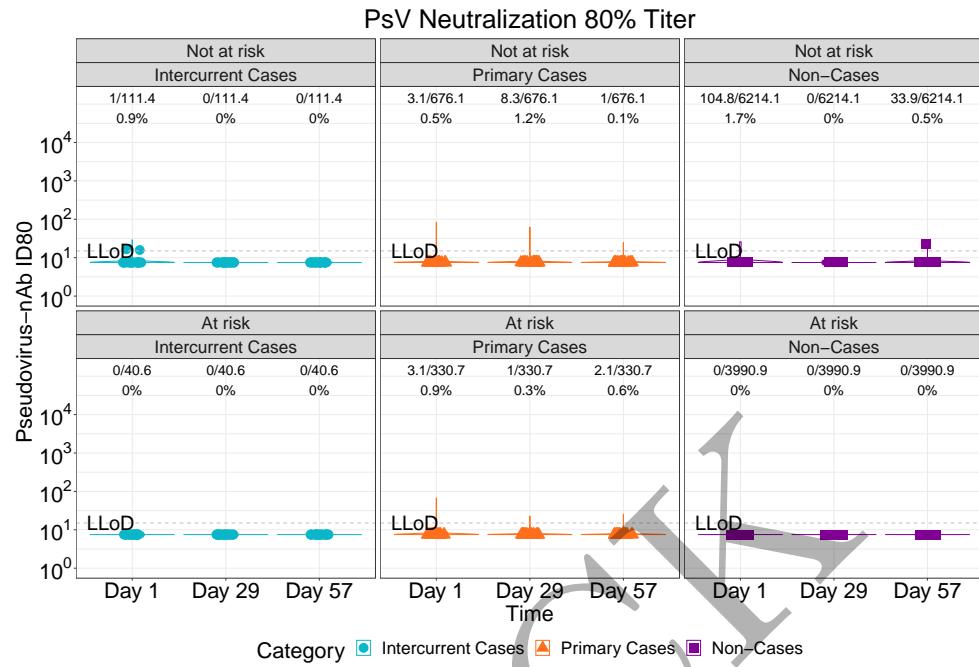


Figure 3.108: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (version 2)

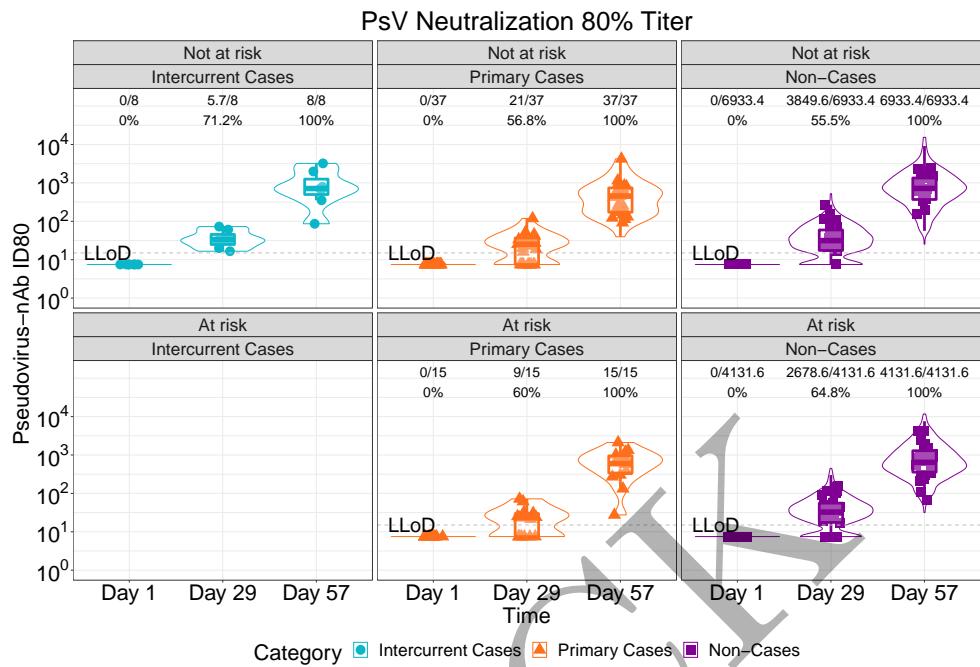


Figure 3.109: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (version 2)

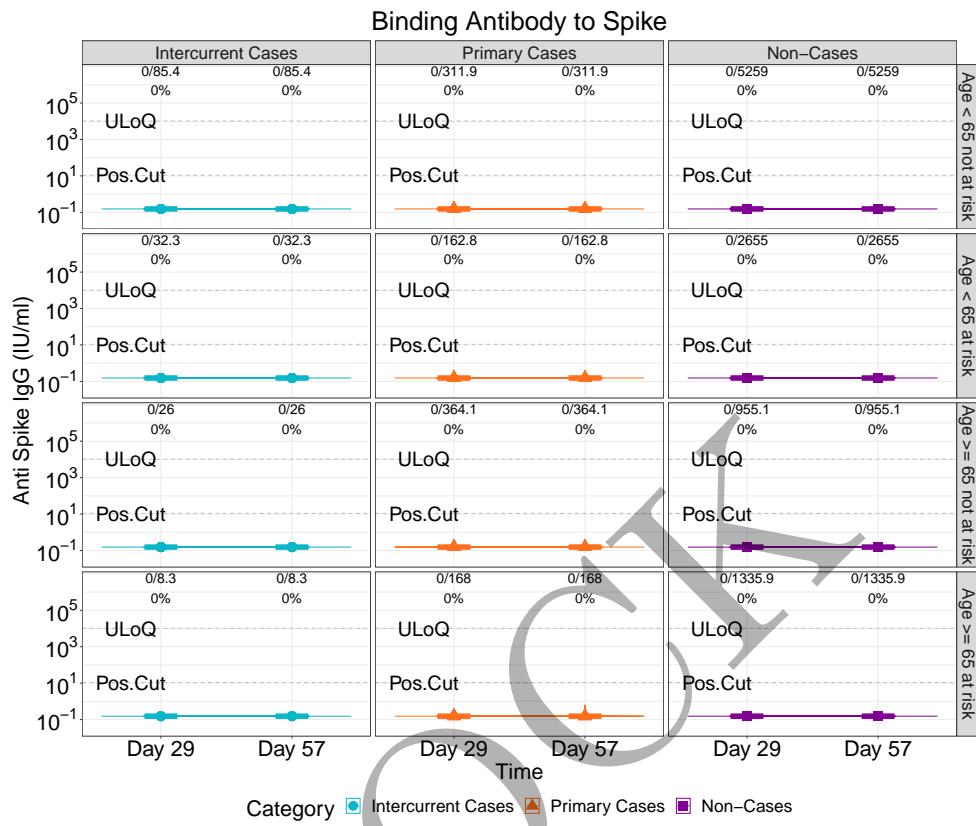


Figure 3.110: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

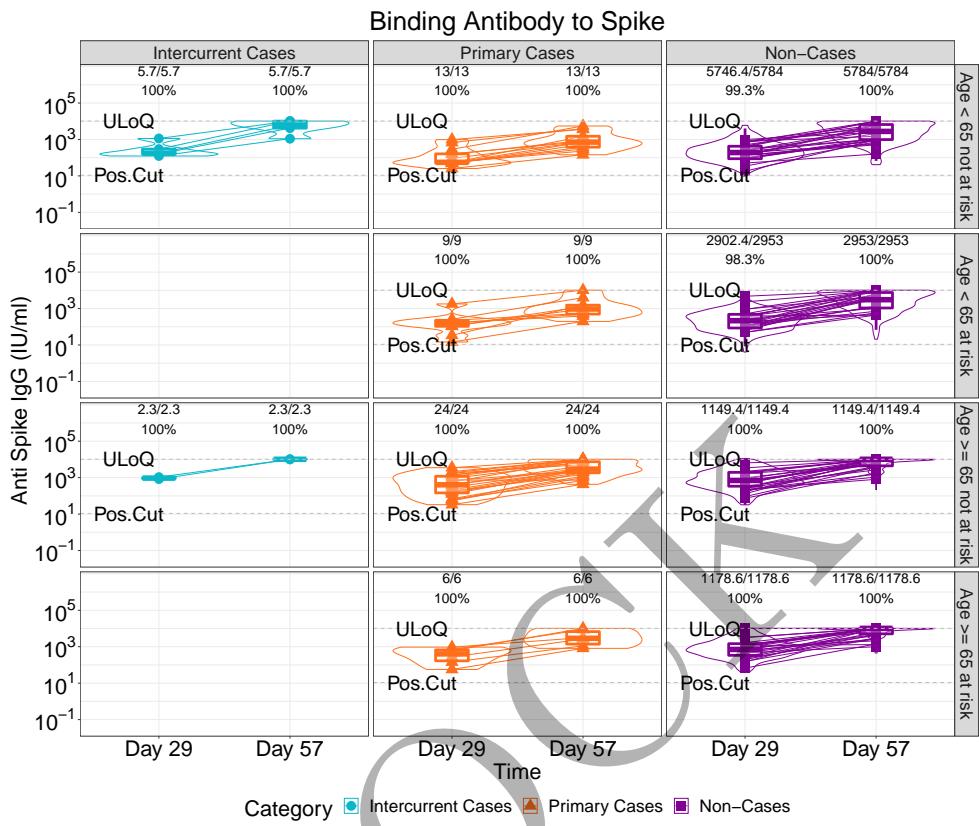


Figure 3.111: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

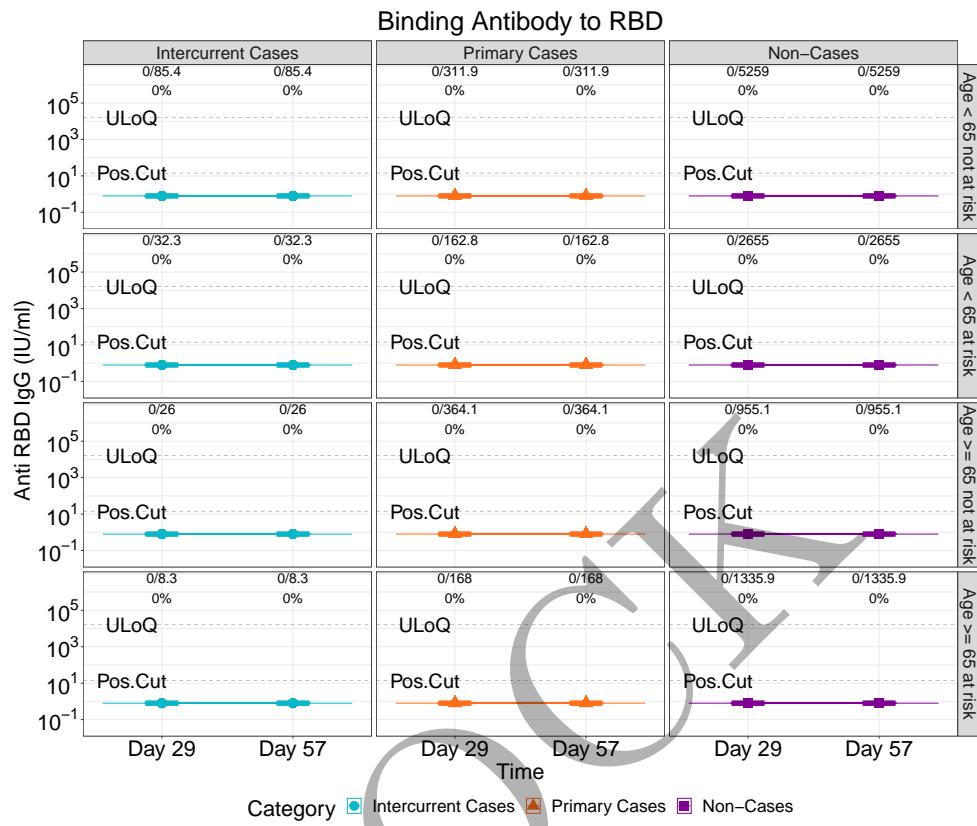


Figure 3.112: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

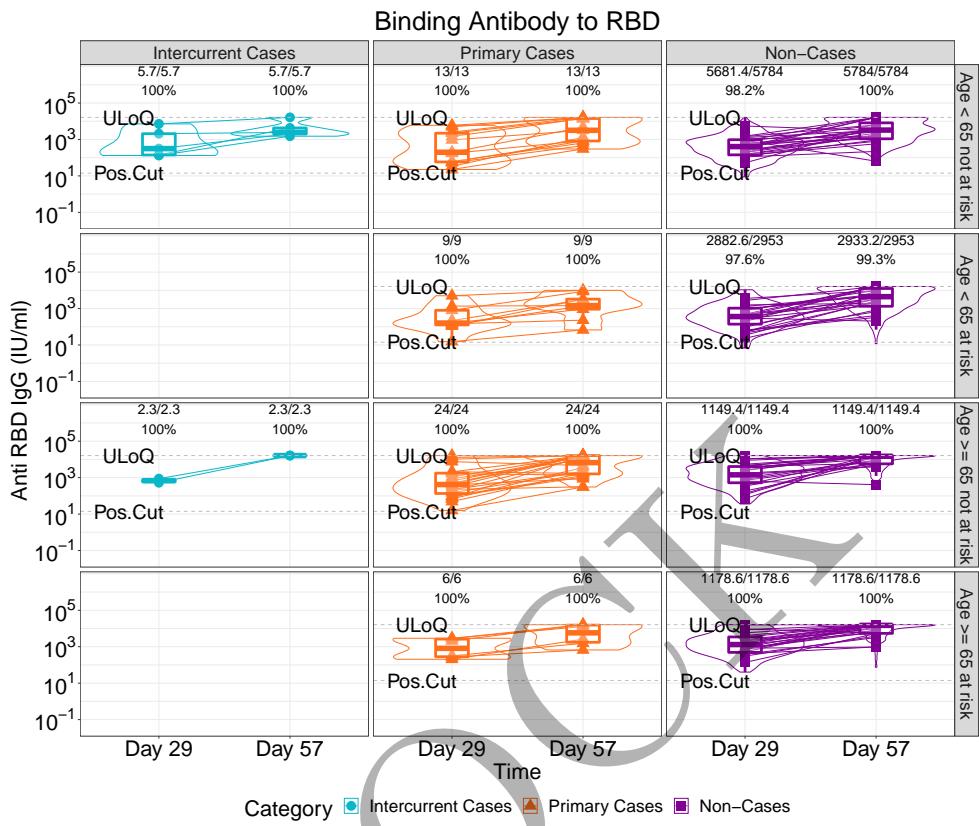


Figure 3.113: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

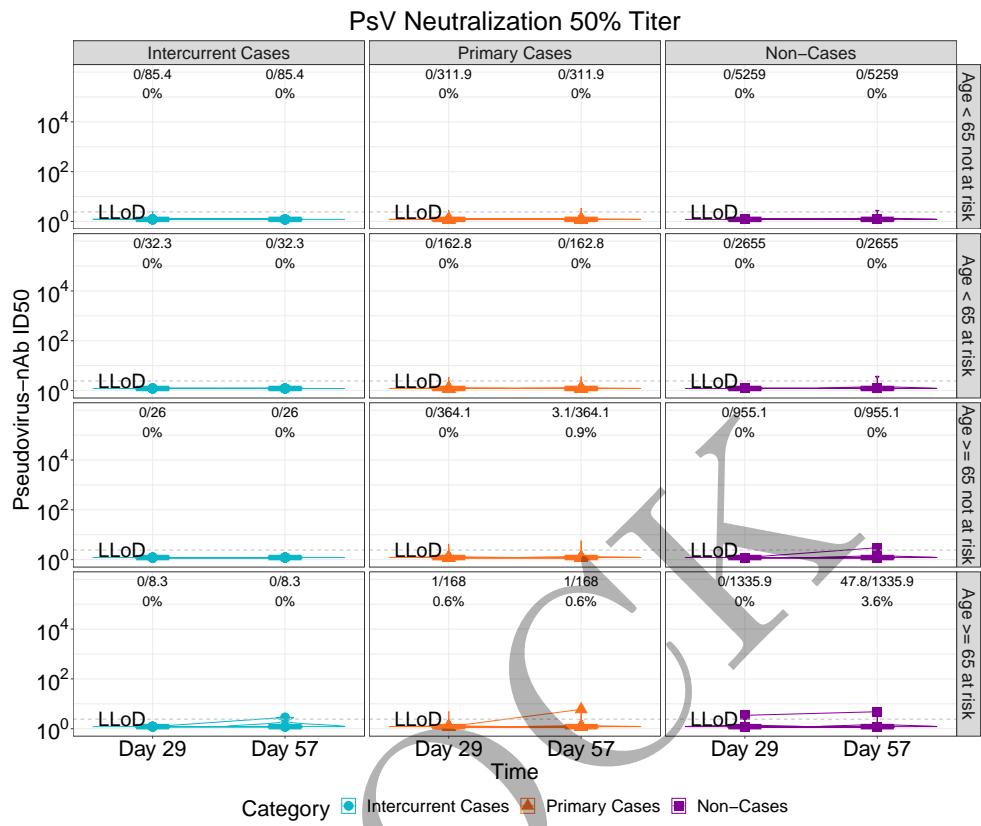


Figure 3.114: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 1)

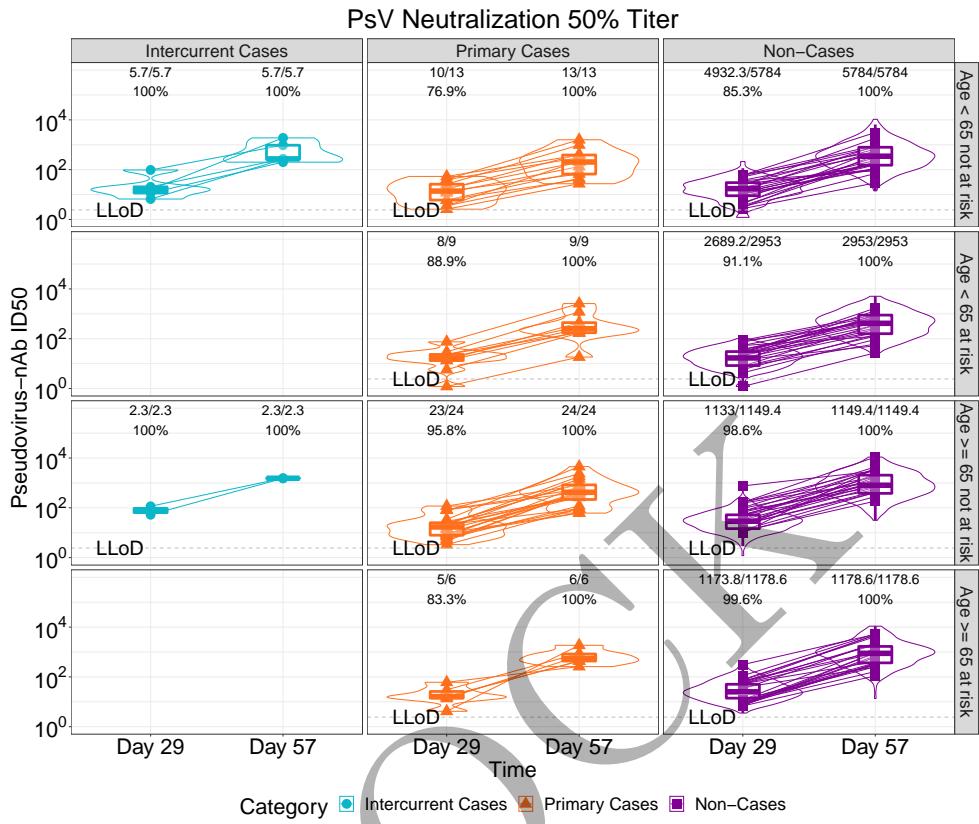


Figure 3.115: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1)

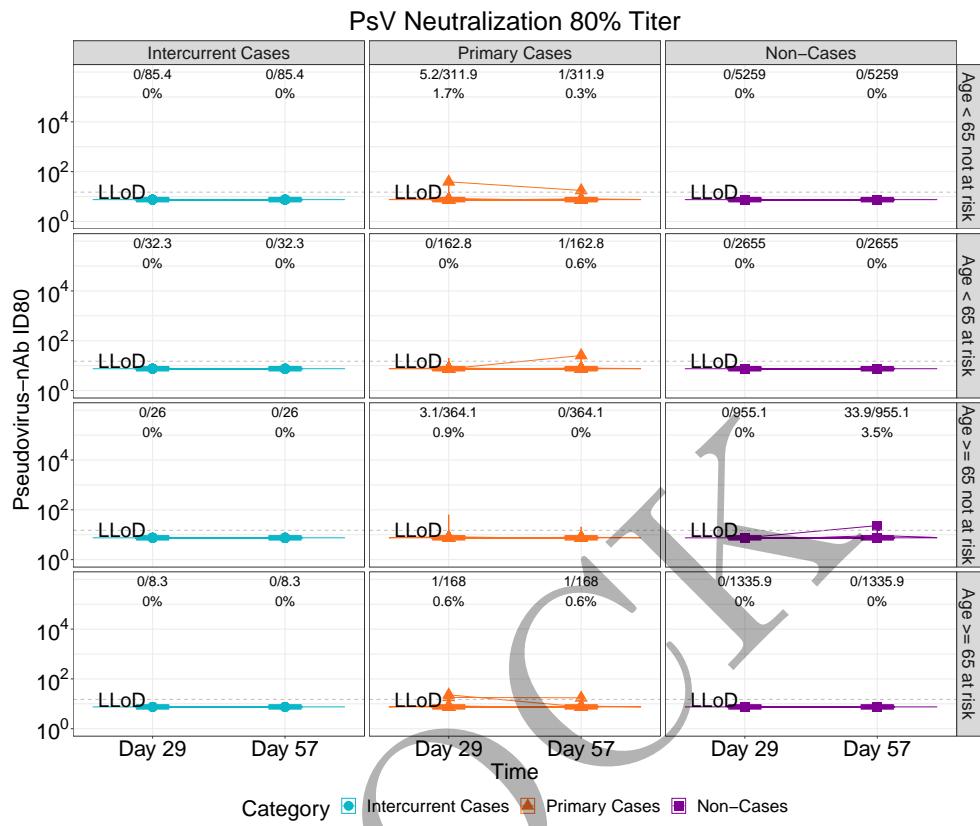


Figure 3.116: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

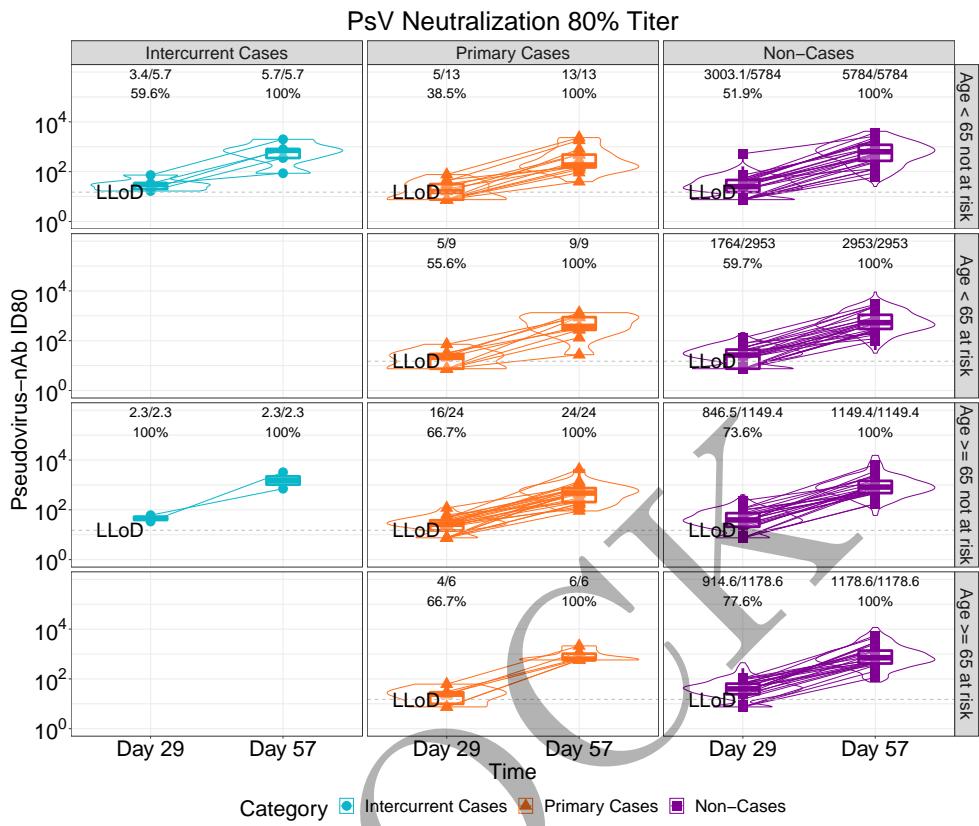


Figure 3.117: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

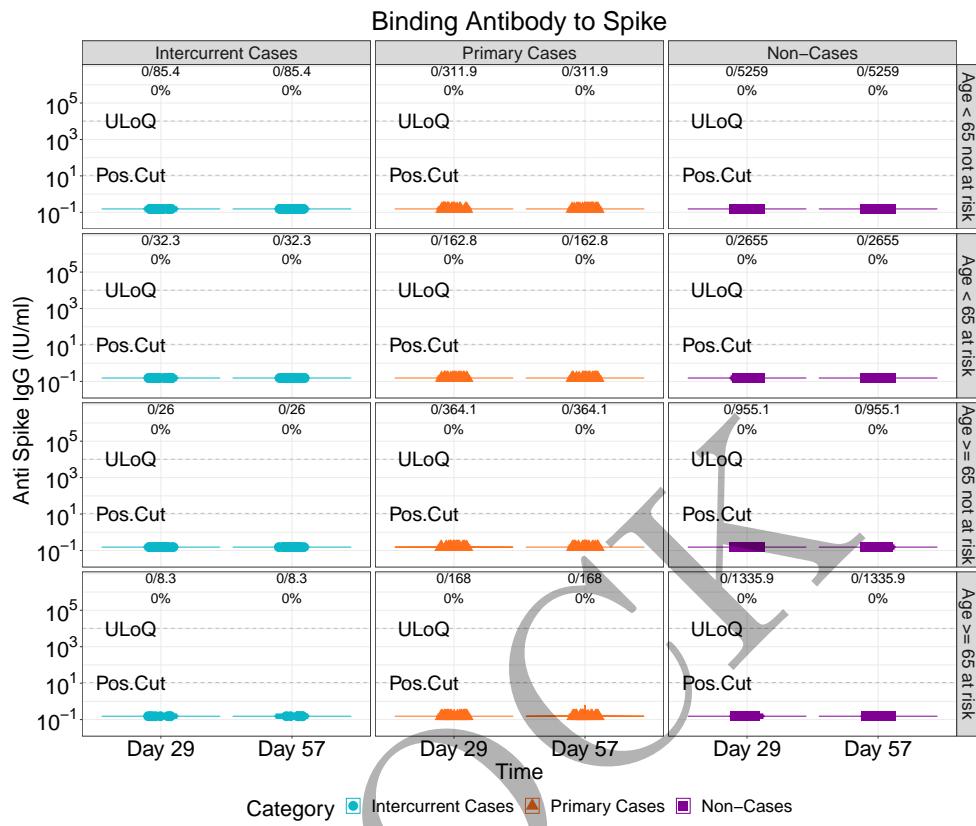


Figure 3.118: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 1)

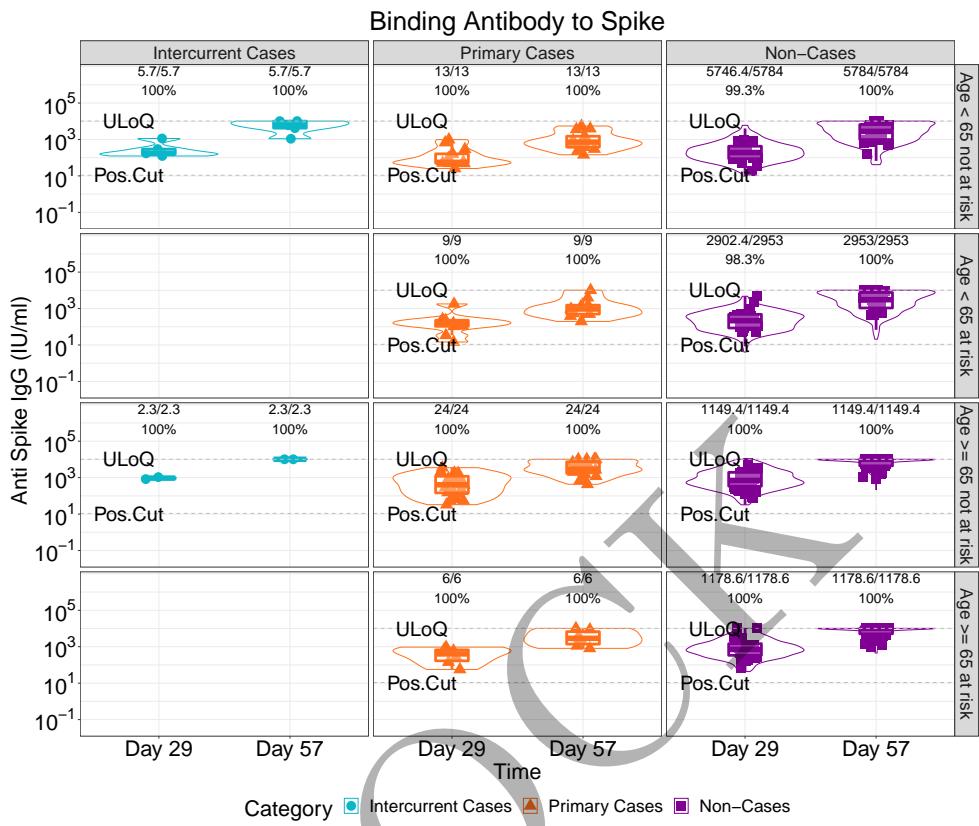


Figure 3.119: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 1)

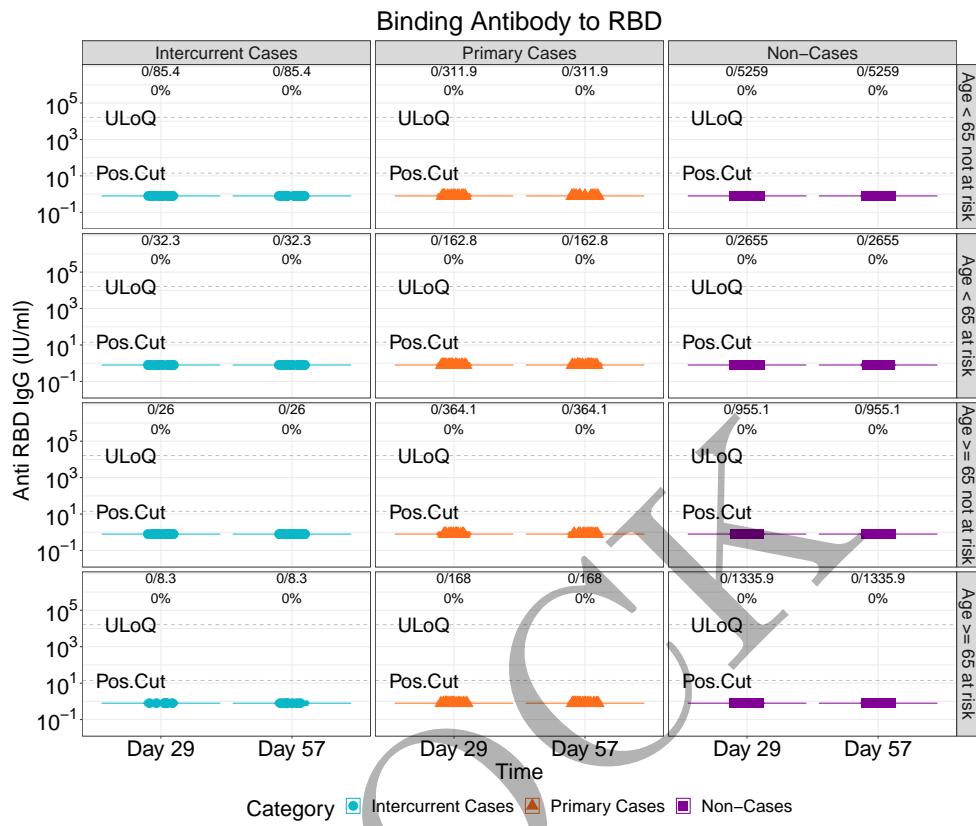


Figure 3.120: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 1)

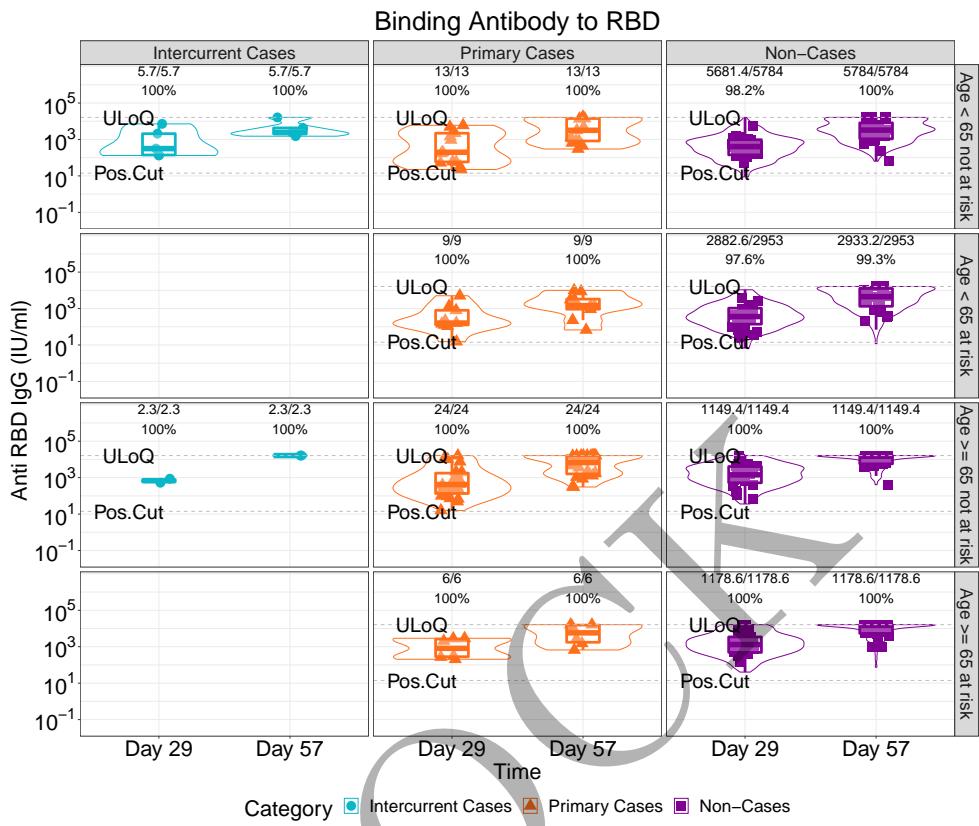


Figure 3.121: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 1)

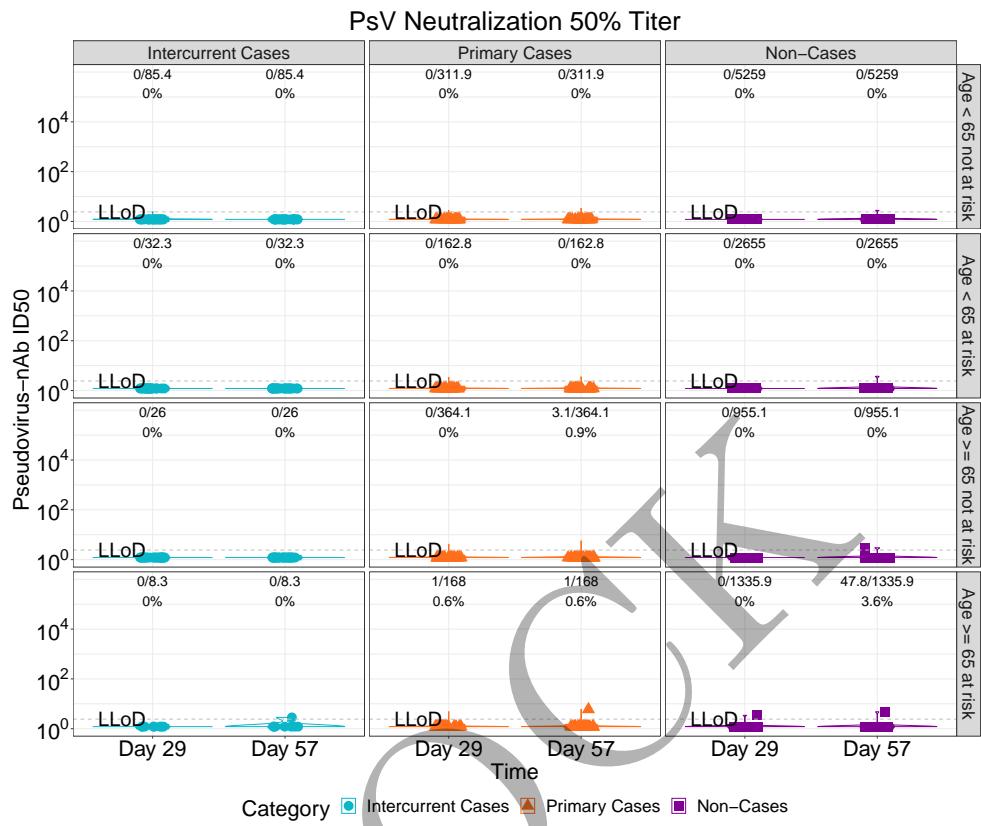


Figure 3.122: violinplots of Pseudovirus Neutralization ID₅₀: baseline negative placebo arm by age and risk condition (version 1)

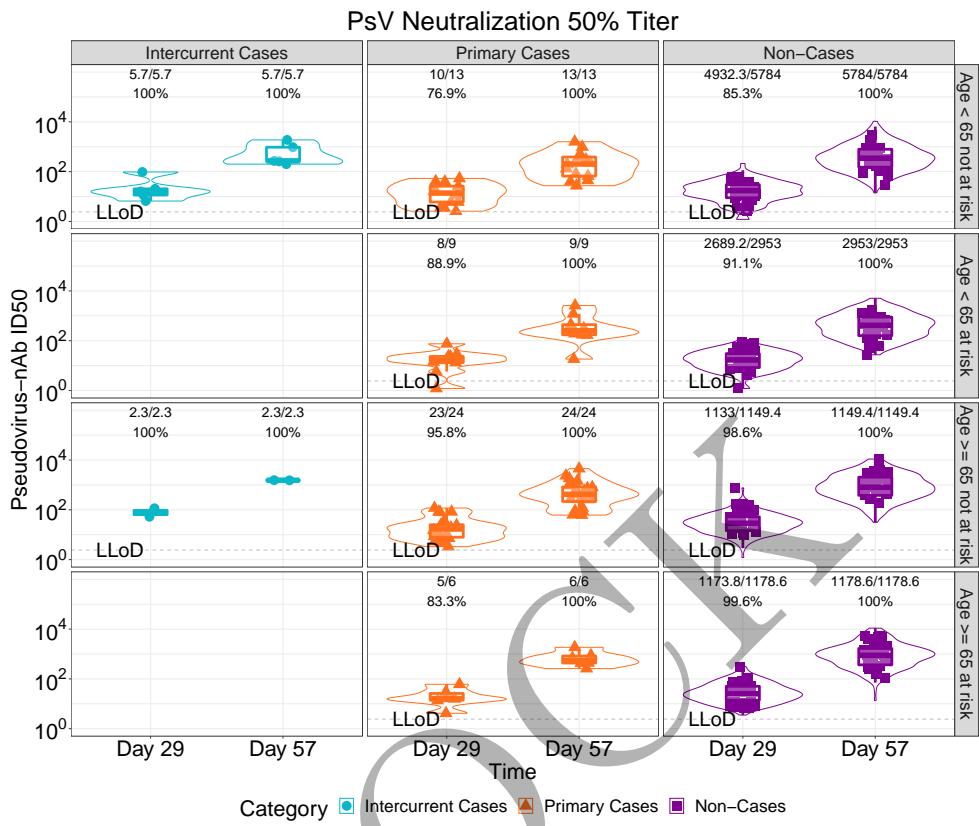


Figure 3.123: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 1)

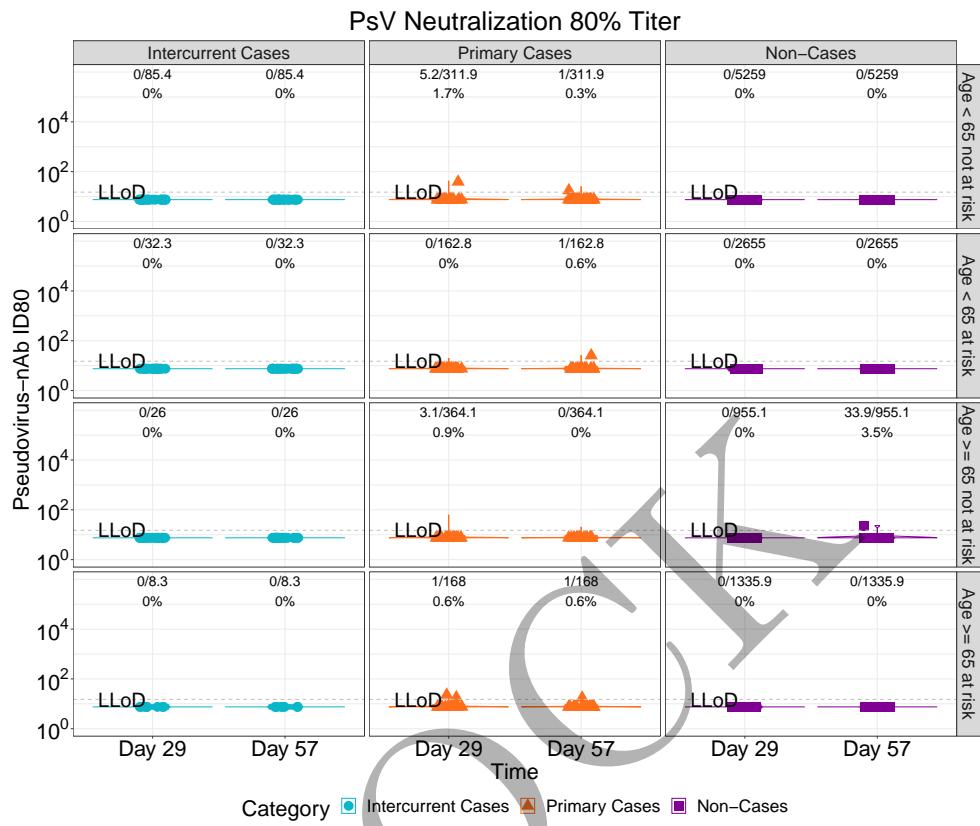


Figure 3.124: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 1)

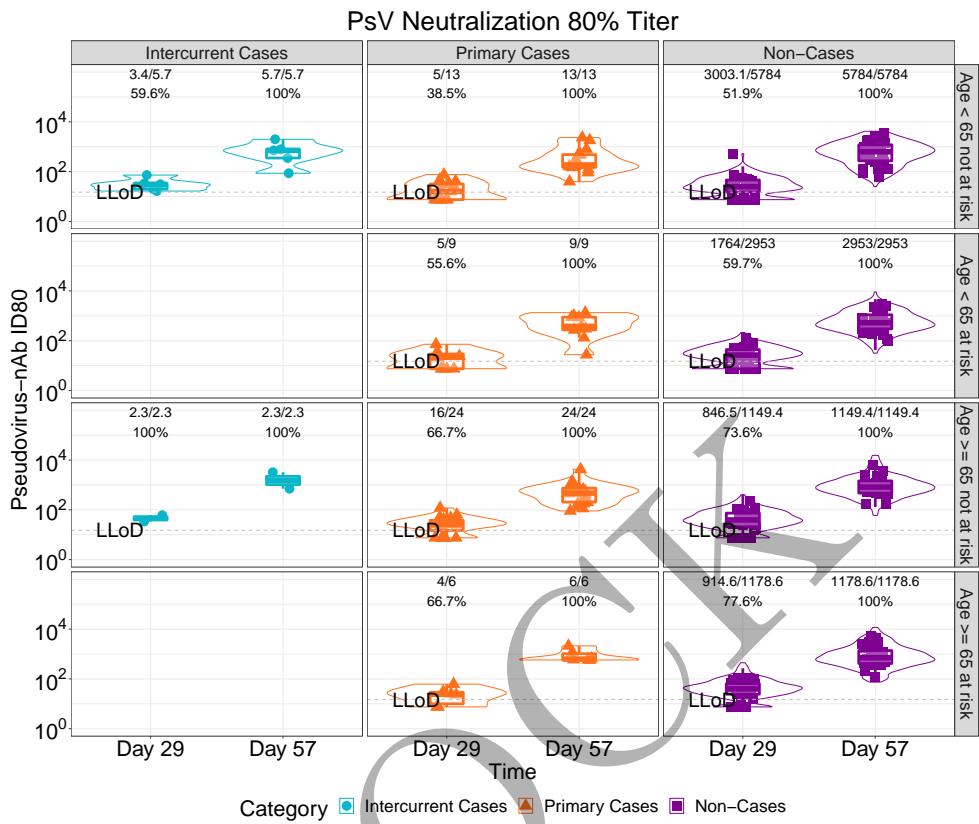


Figure 3.125: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 1)

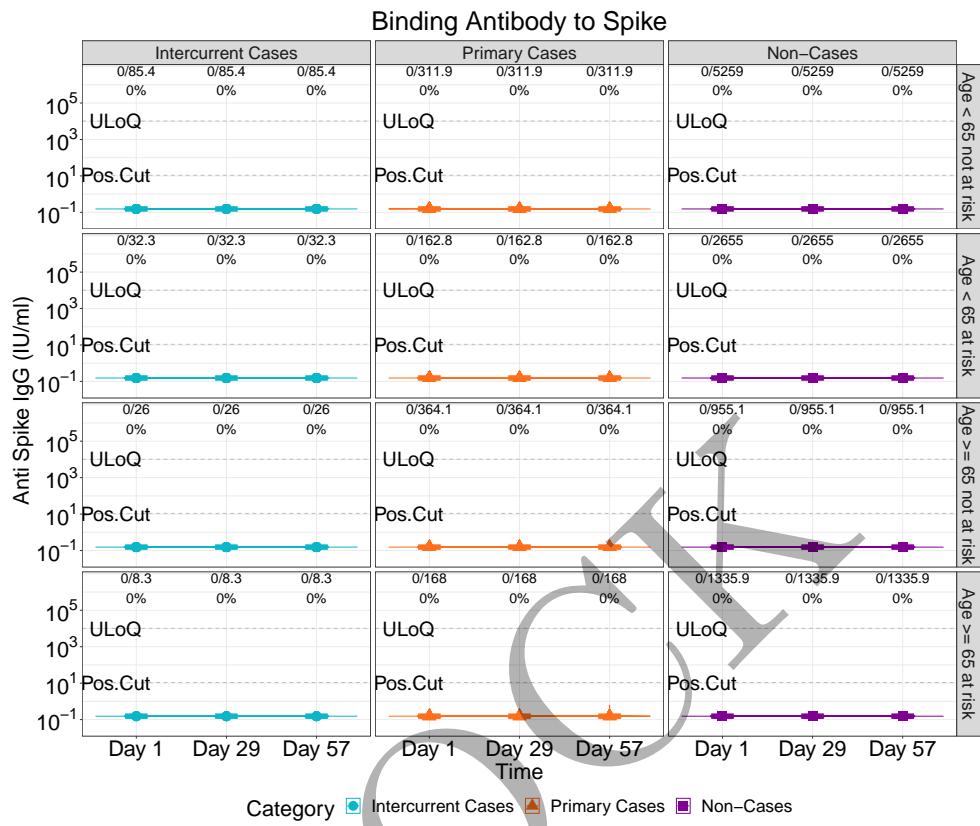


Figure 3.126: lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

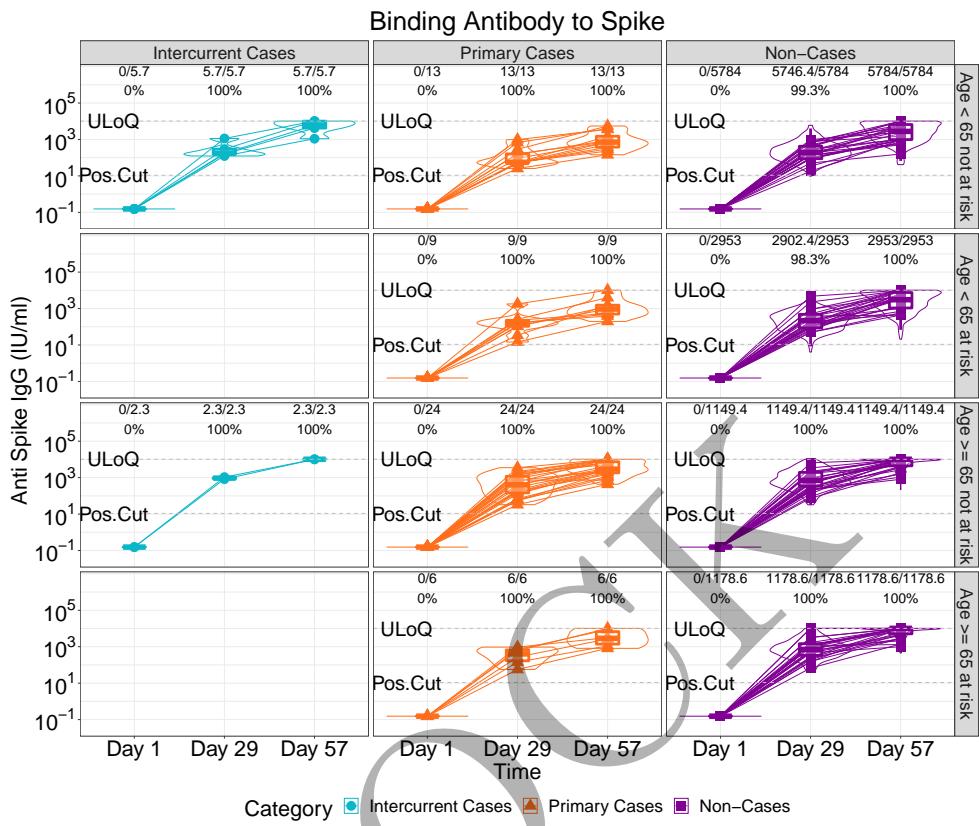


Figure 3.127: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

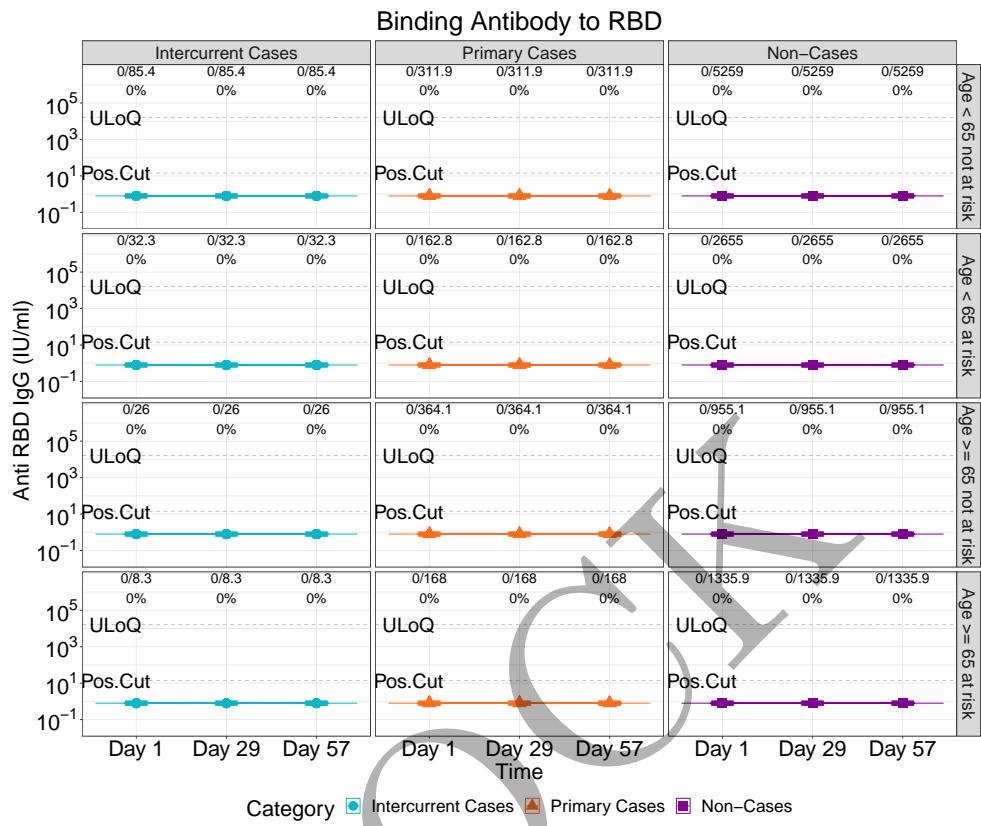


Figure 3.128: lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

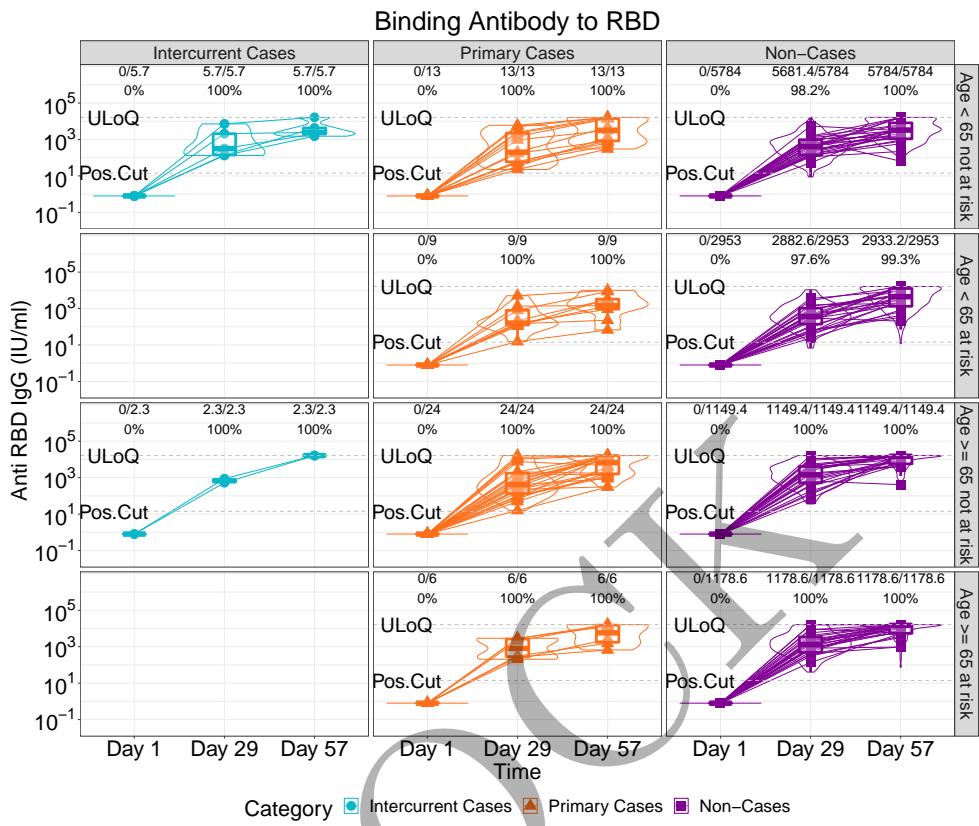


Figure 3.129: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

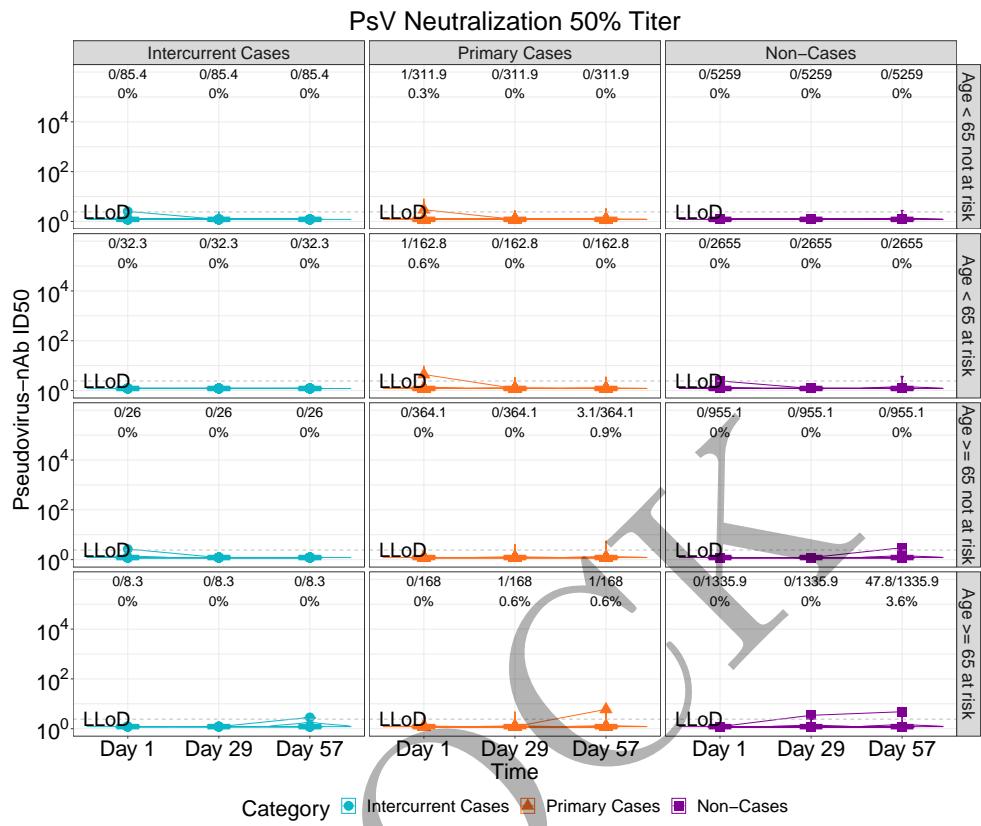


Figure 3.130: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

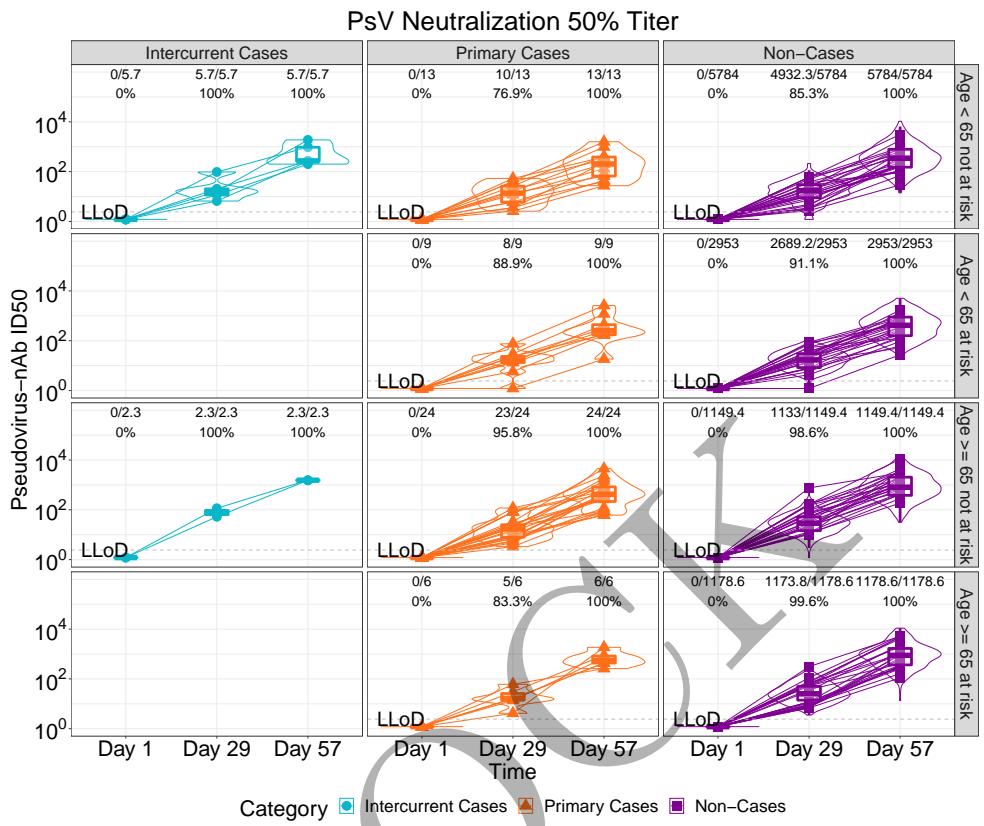


Figure 3.131: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (version 2)

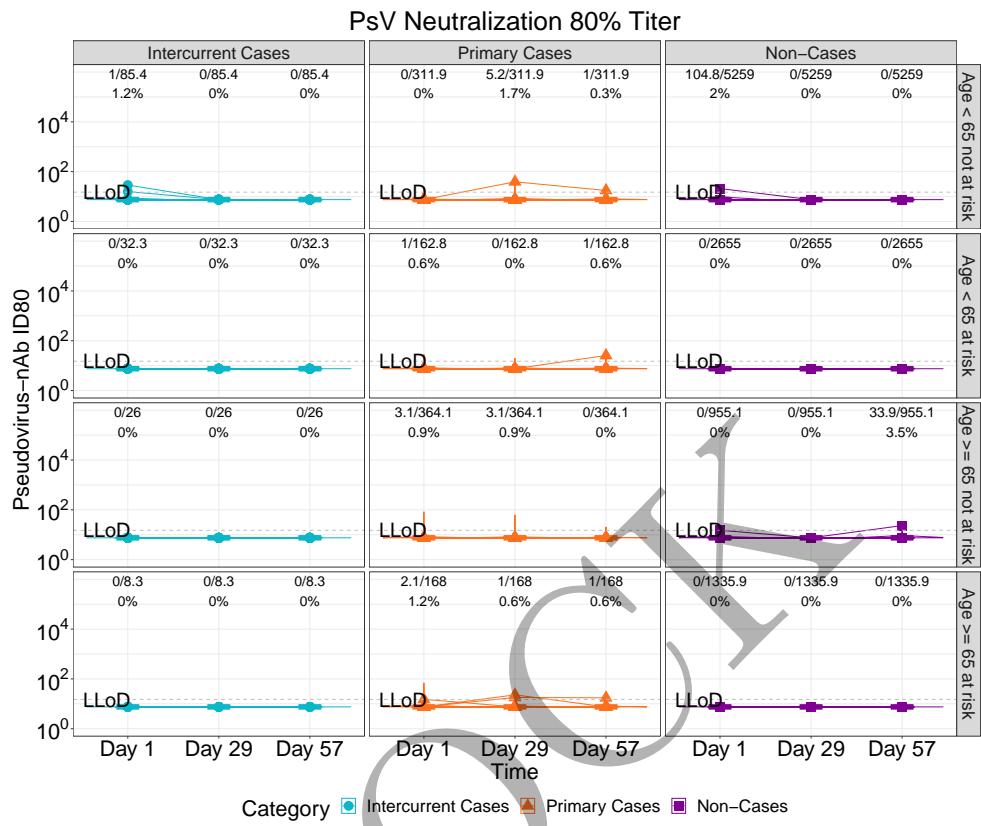


Figure 3.132: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

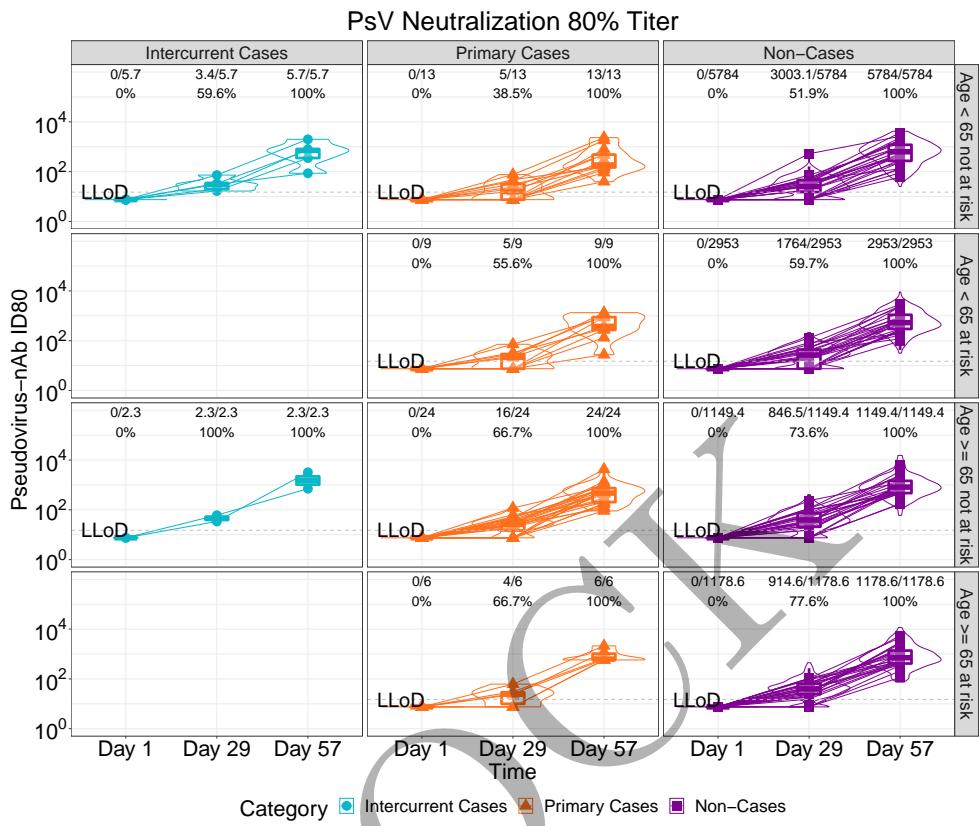


Figure 3.133: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

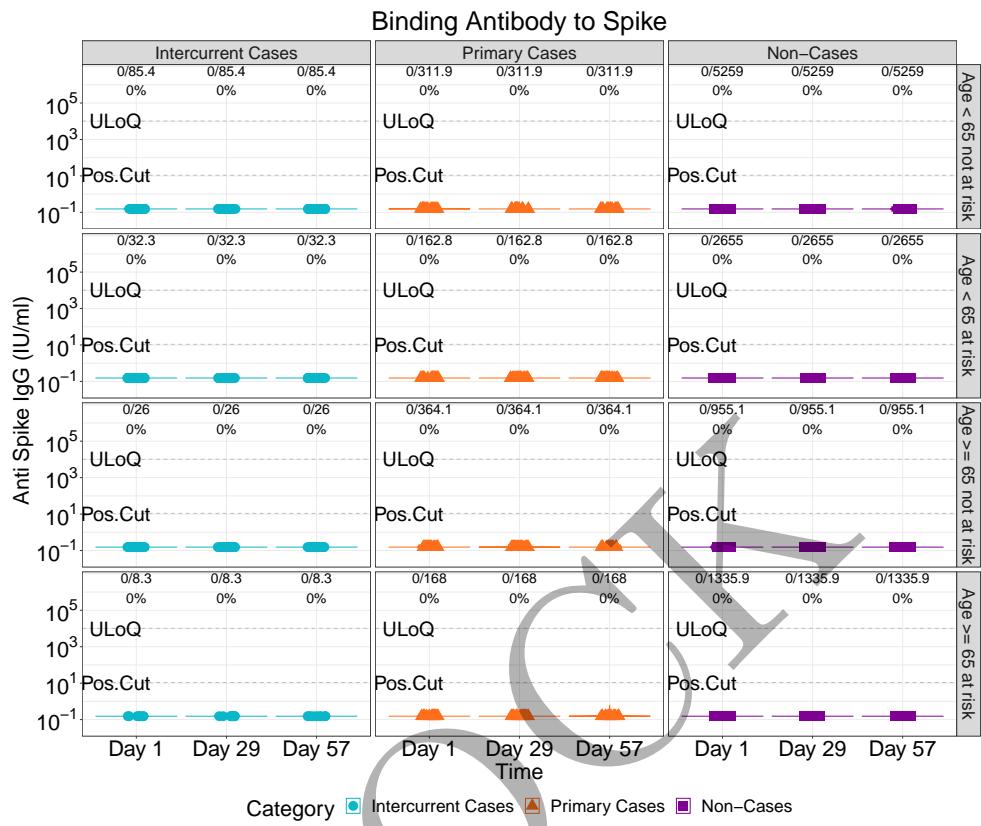


Figure 3.134: violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (version 2)

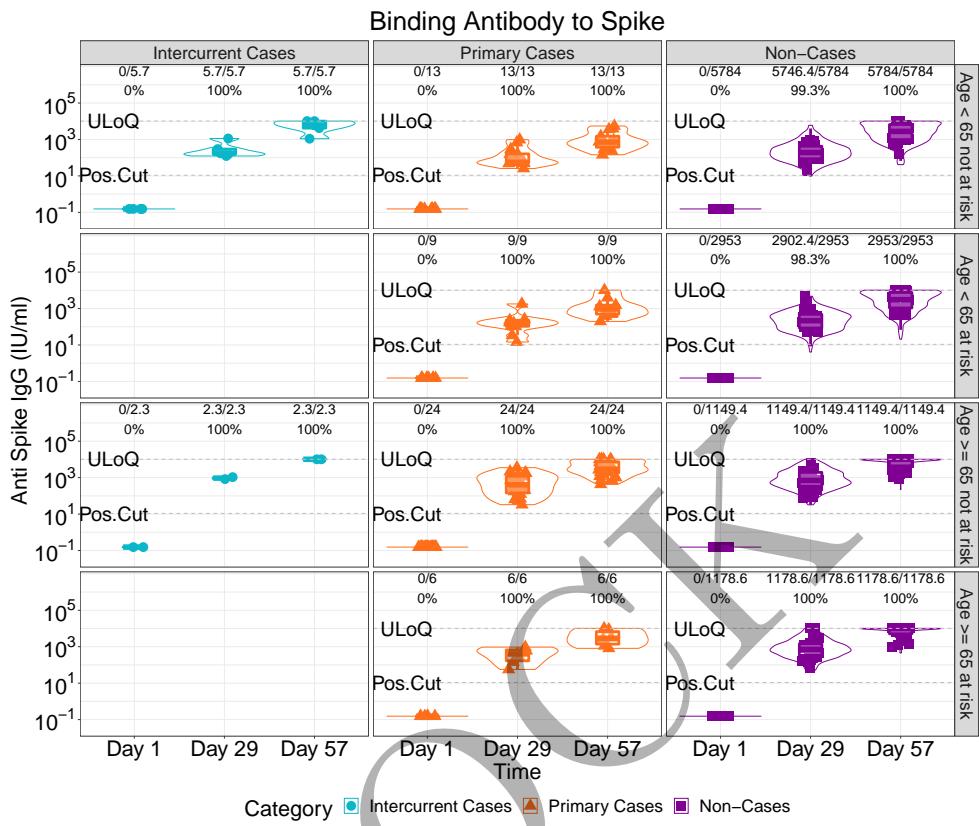


Figure 3.135: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (version 2)

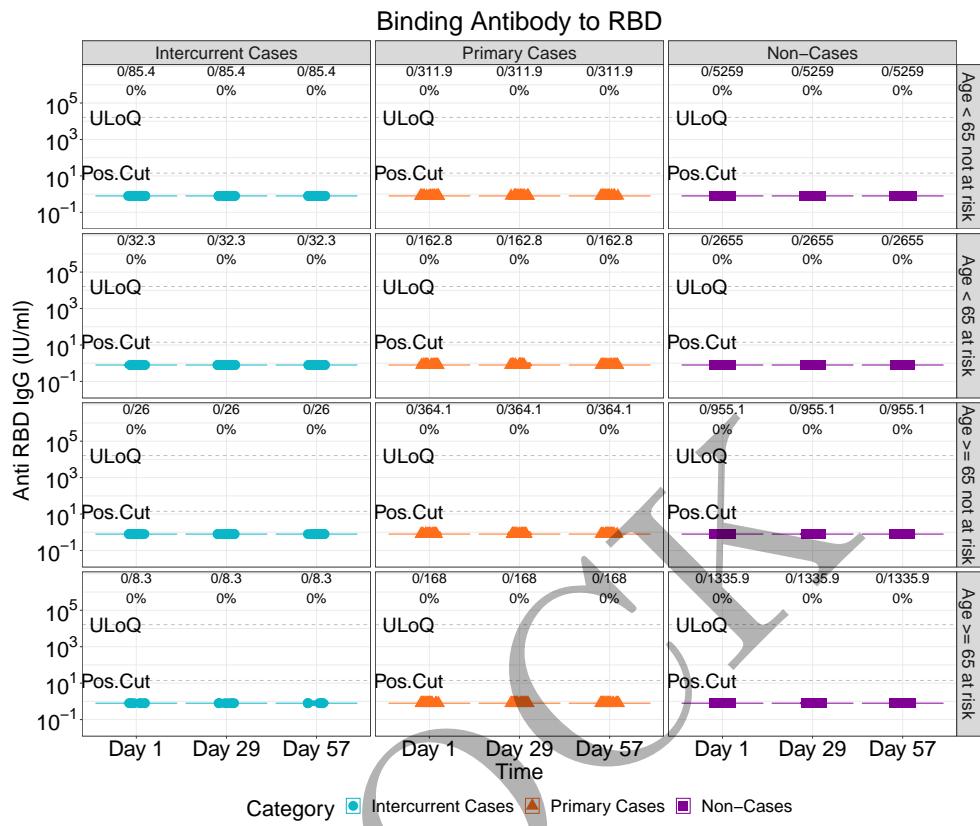


Figure 3.136: violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (version 2)

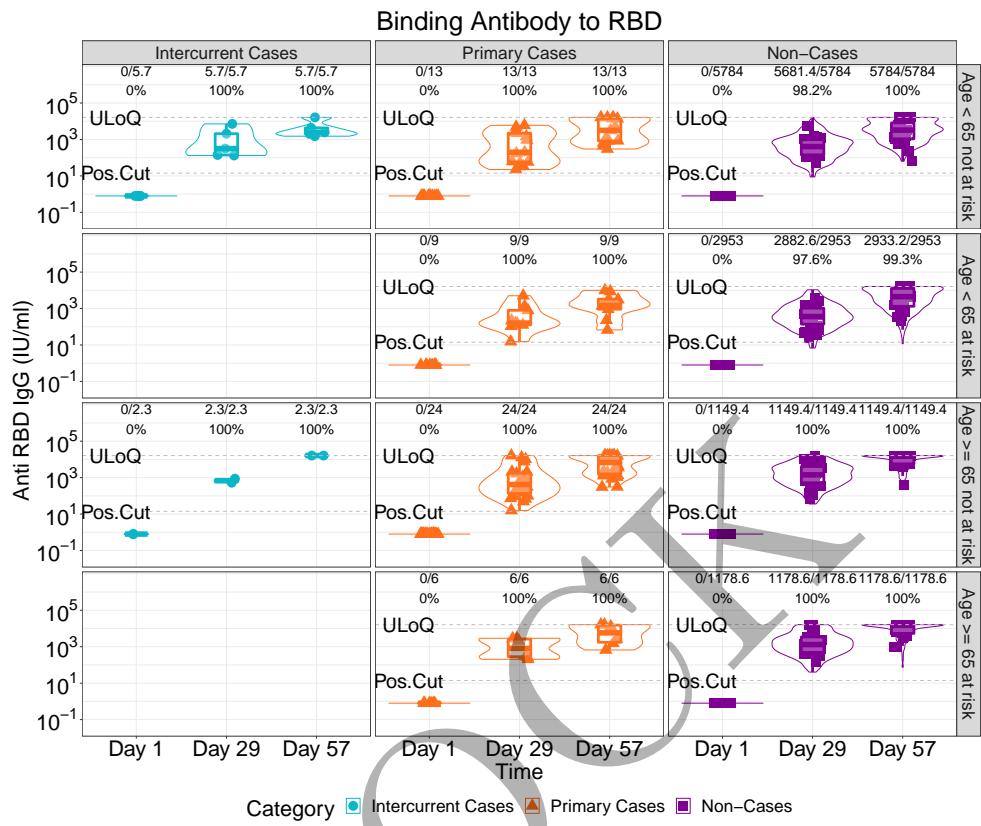


Figure 3.137: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (version 2)

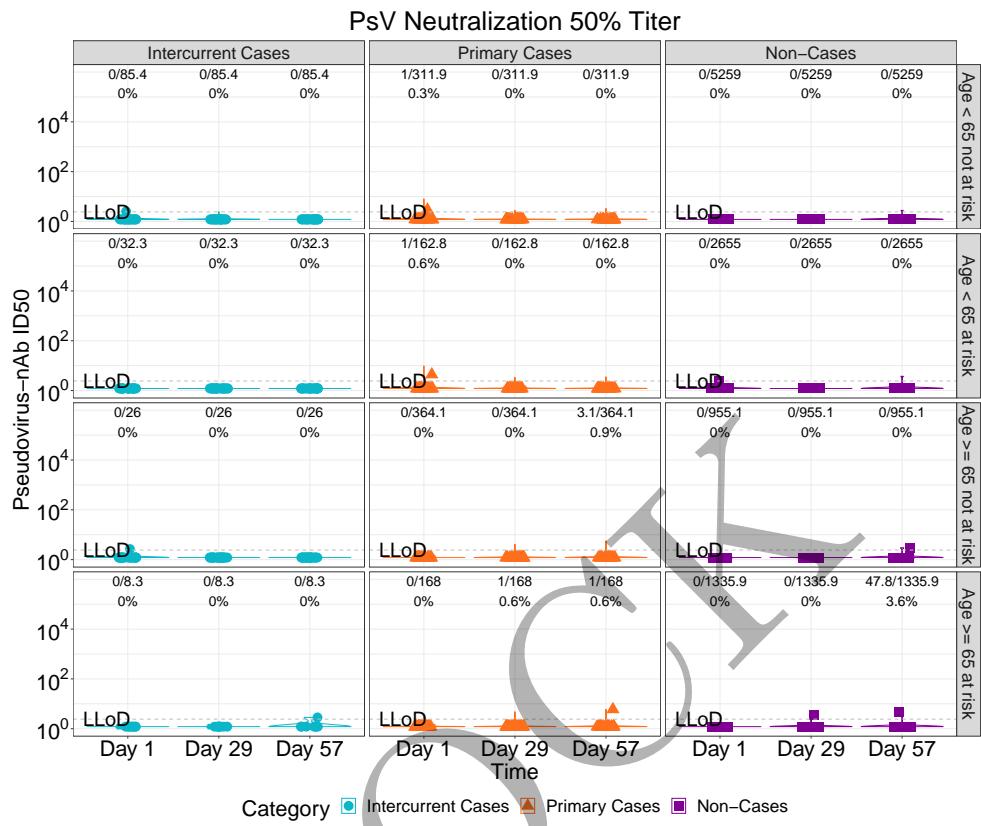


Figure 3.138: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (version 2)

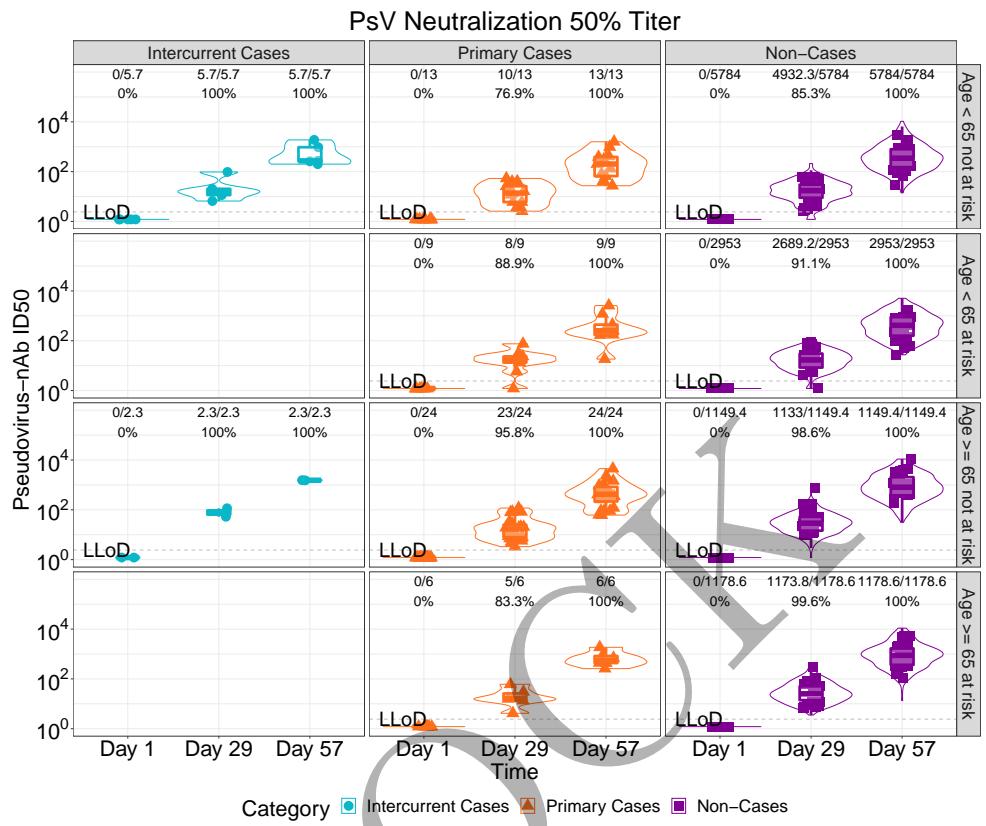


Figure 3.139: violinplots of Pseudovirus Neutralization ID₅₀: baseline negative vaccine arm by age and risk condition (version 2)

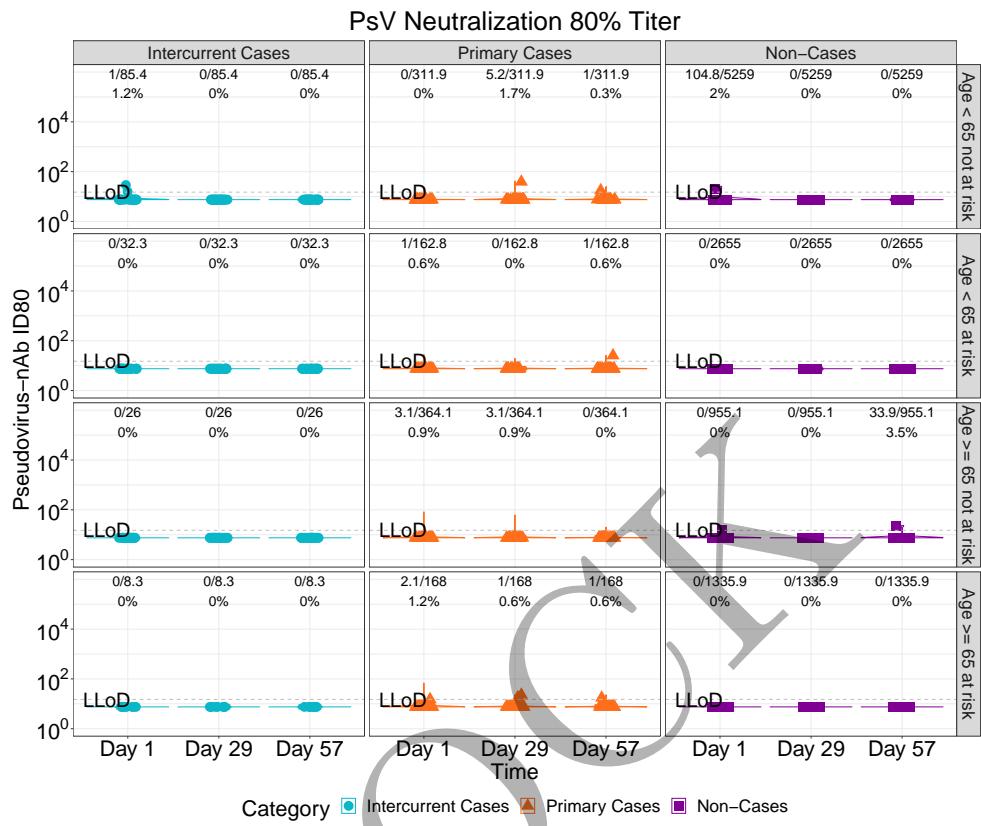


Figure 3.140: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (version 2)

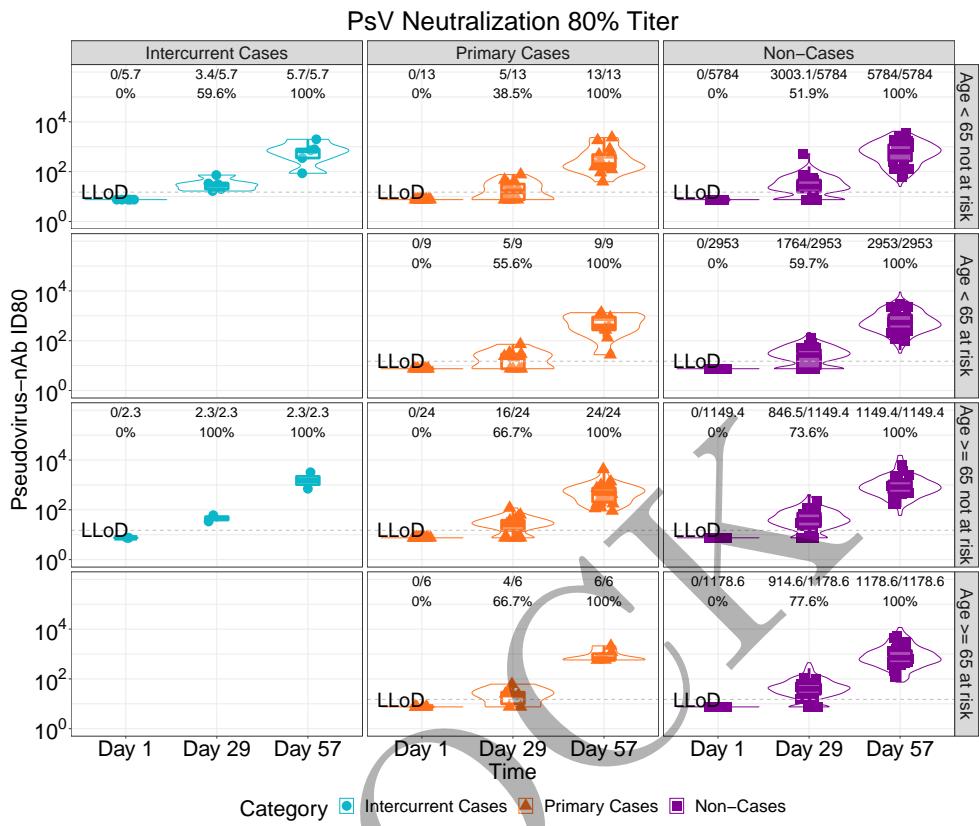


Figure 3.141: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (version 2)

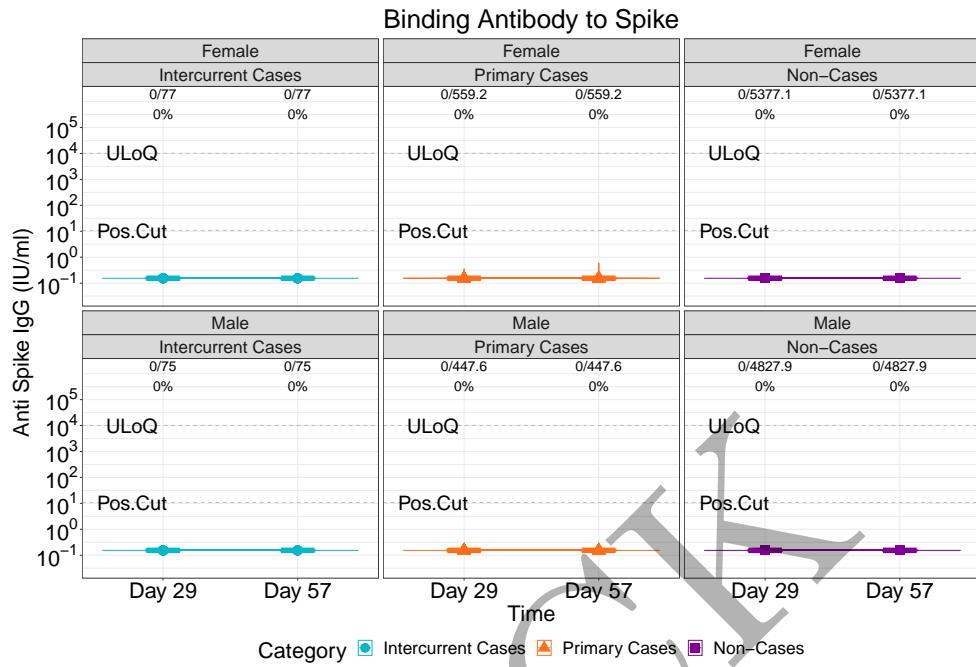


Figure 3.142: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

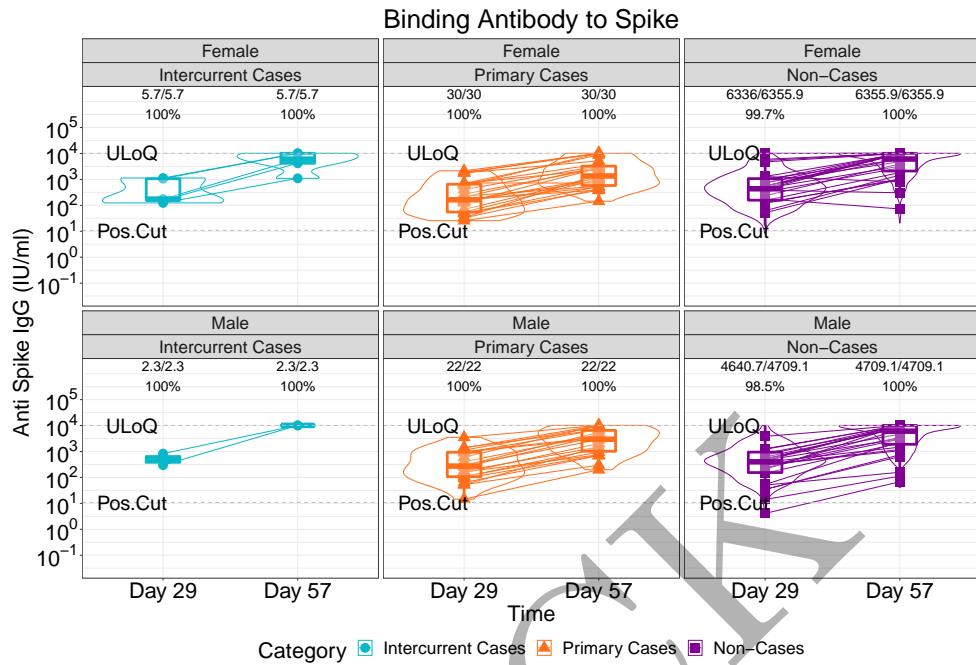


Figure 3.143: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

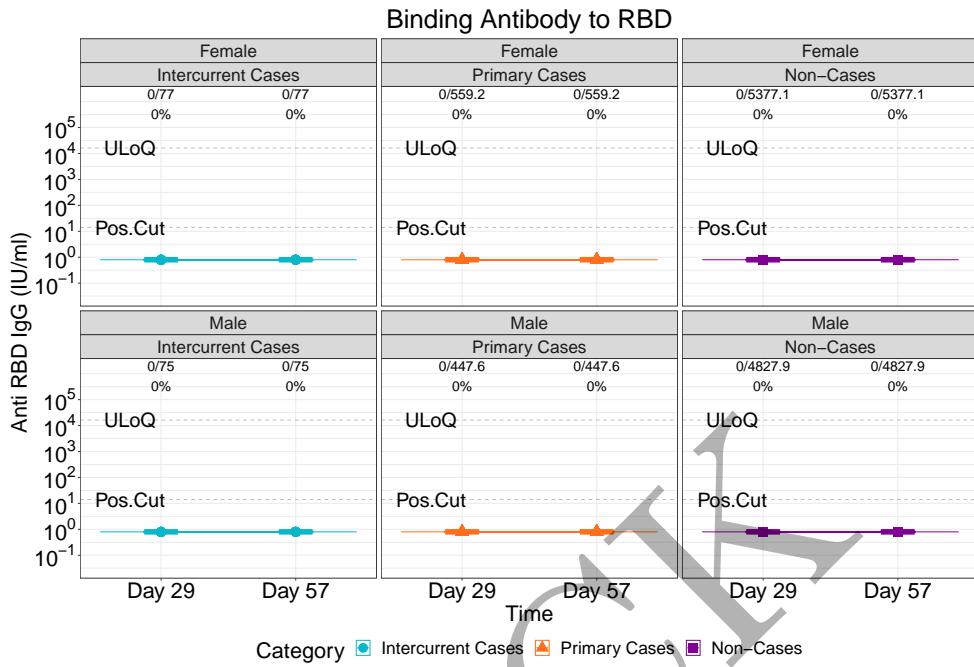


Figure 3.144: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

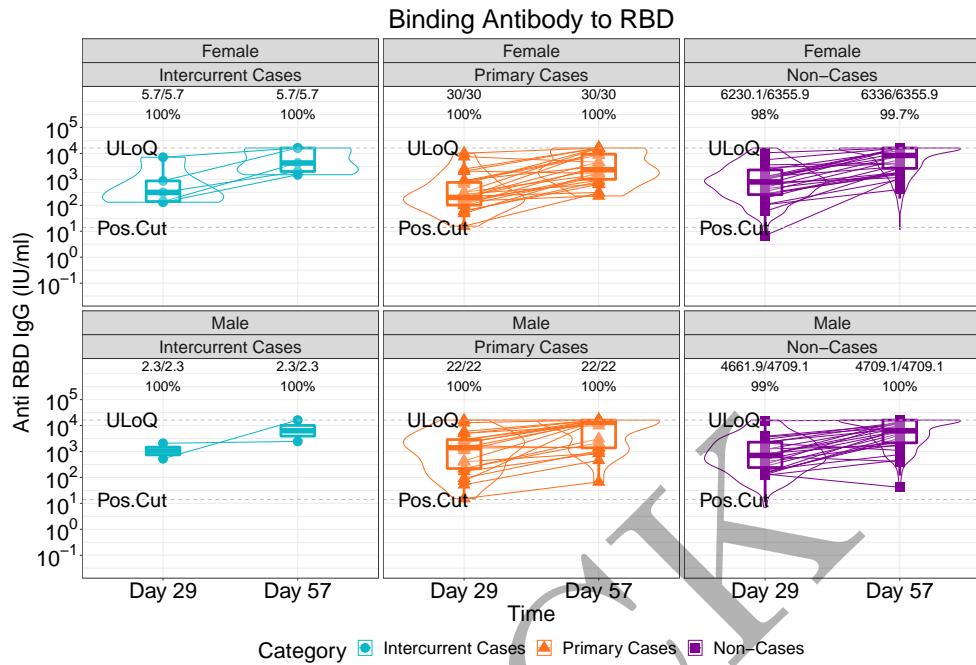


Figure 3.145: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

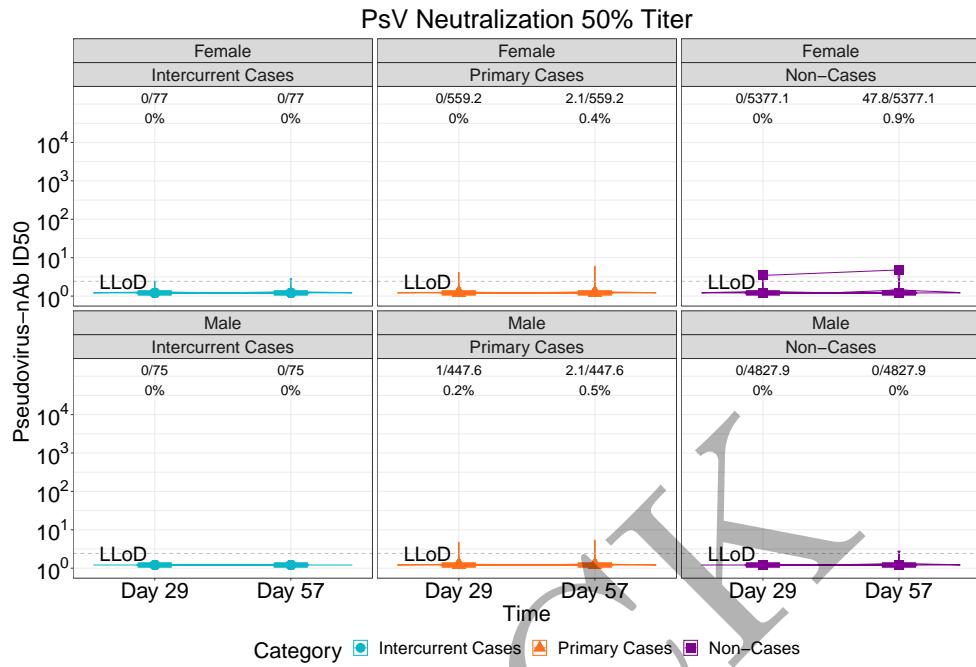


Figure 3.146: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

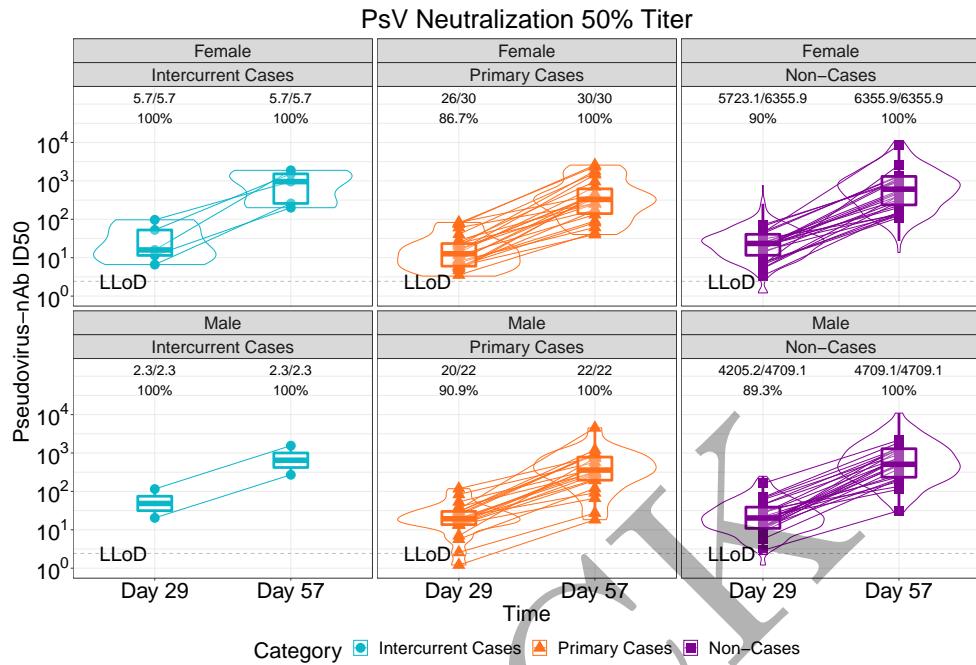


Figure 3.147: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

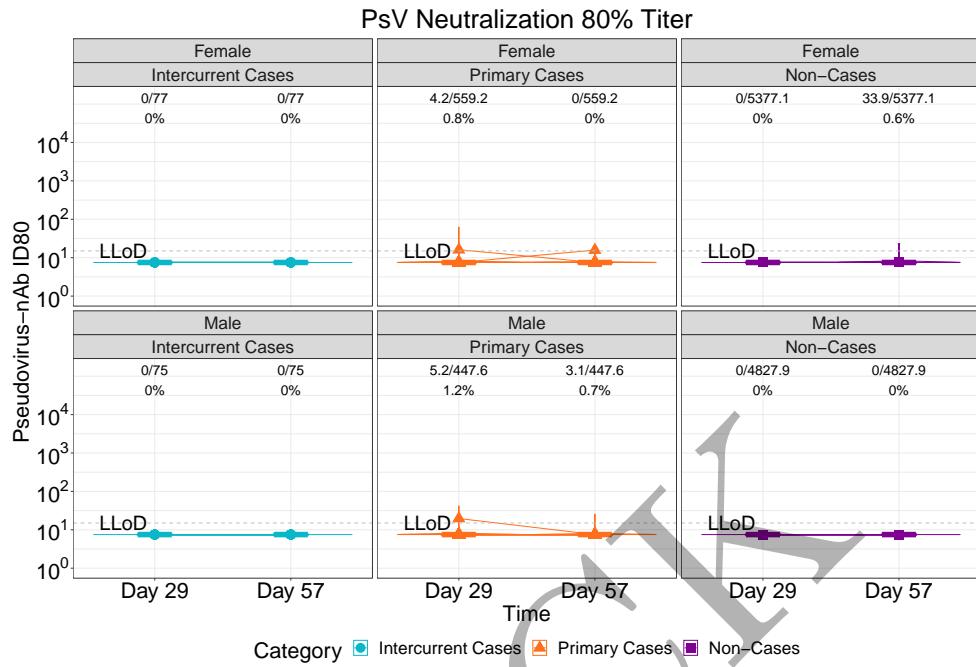


Figure 3.148: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

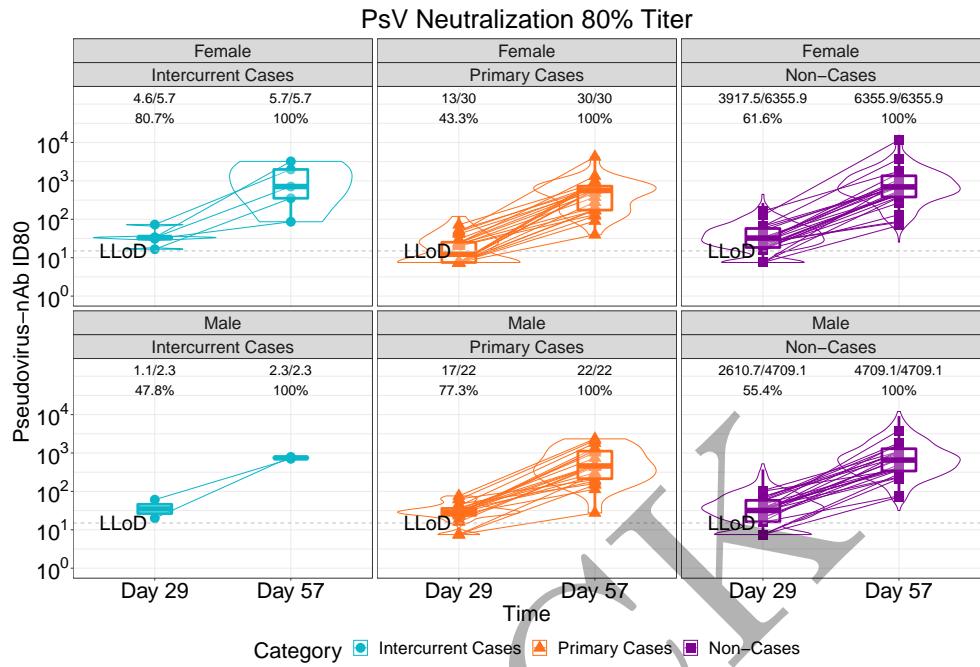


Figure 3.149: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

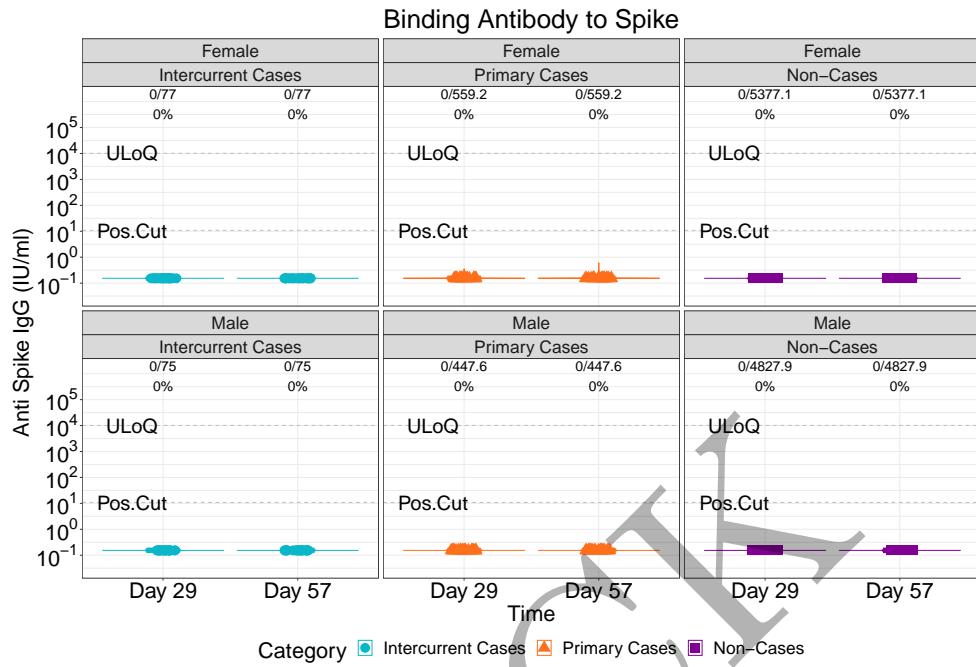


Figure 3.150: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 1)

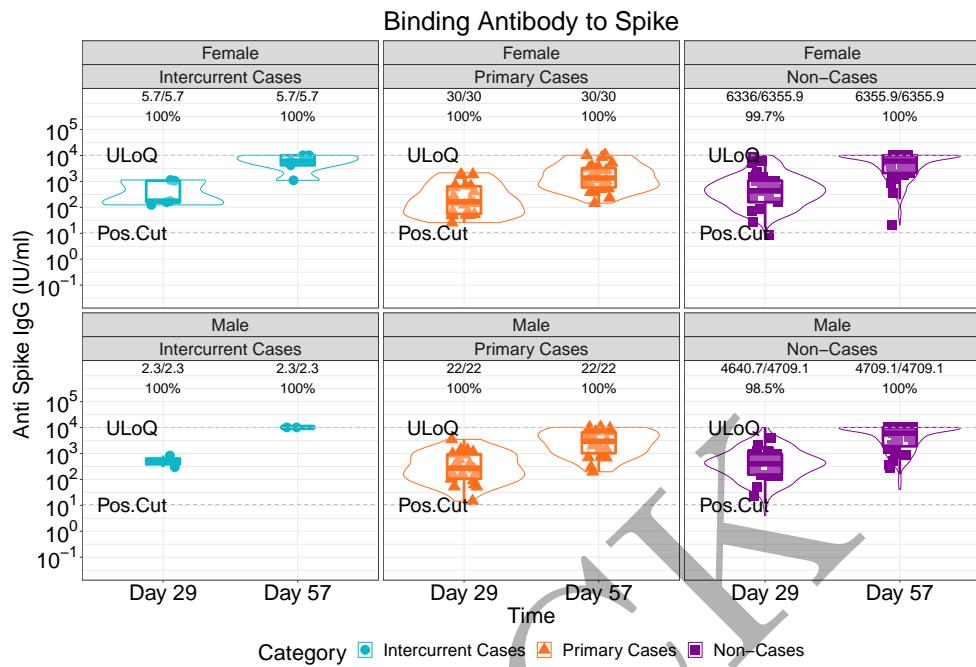


Figure 3.151: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 1)

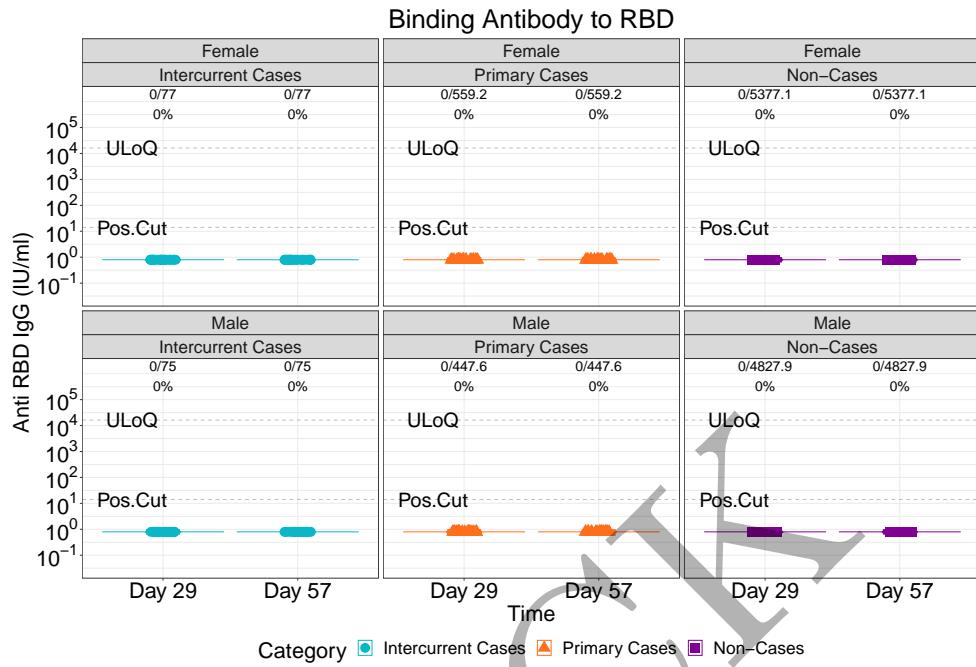


Figure 3.152: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 1)

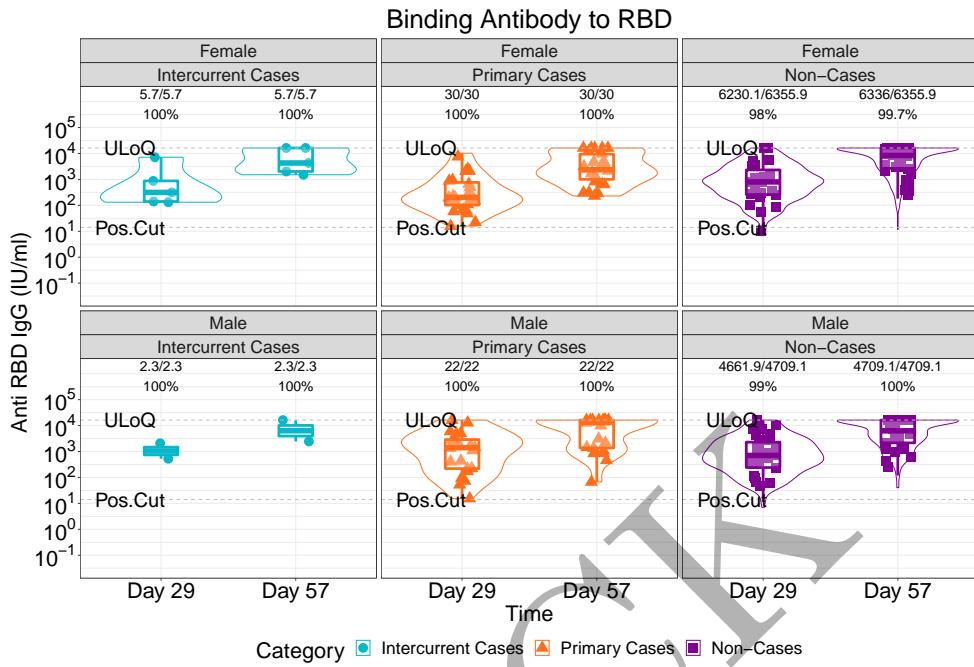


Figure 3.153: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 1)

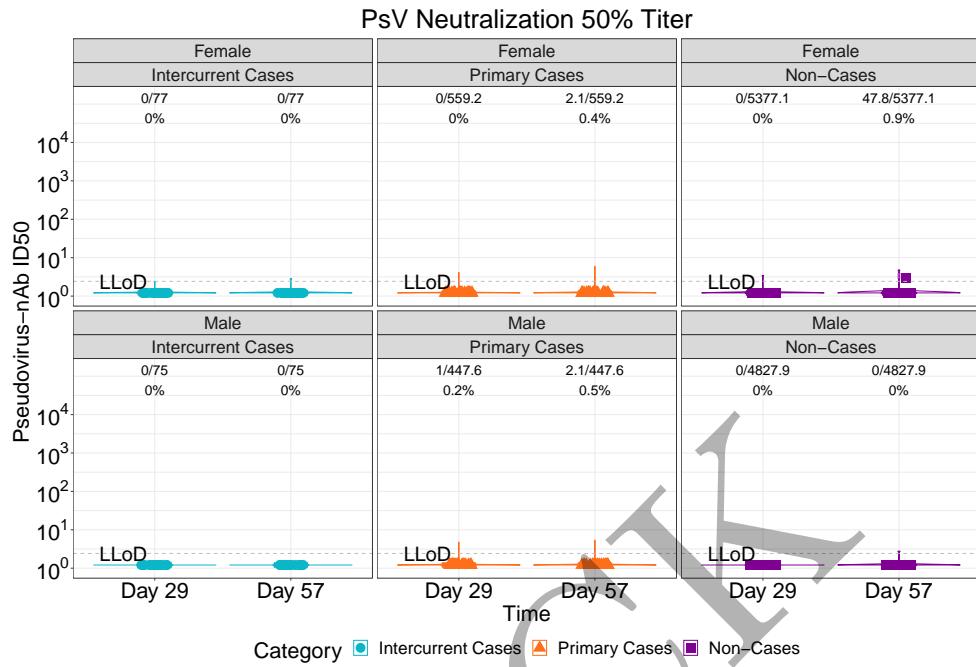


Figure 3.154: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 1)

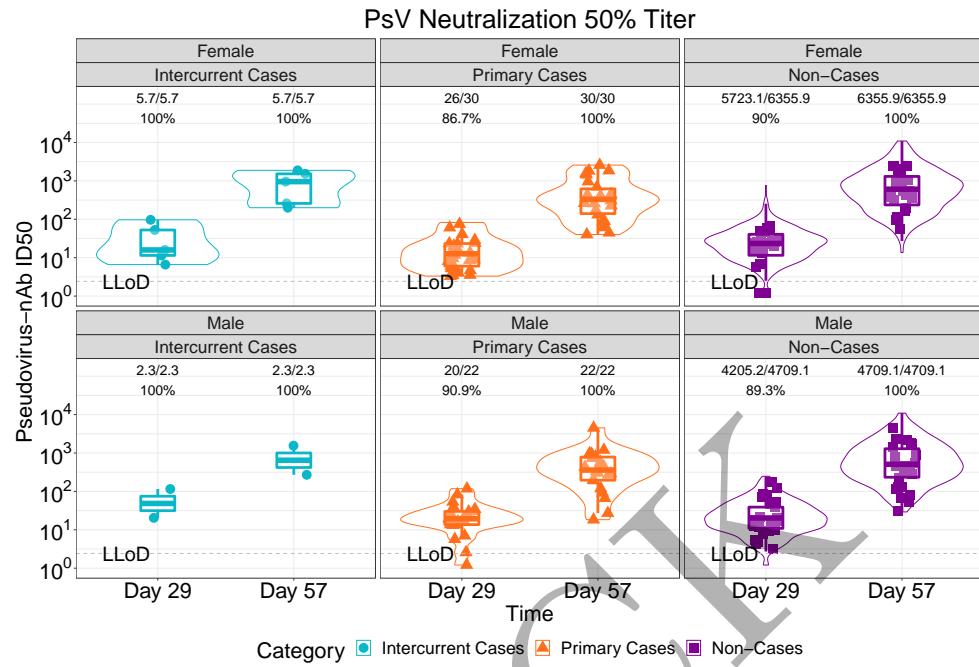


Figure 3.155: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 1)

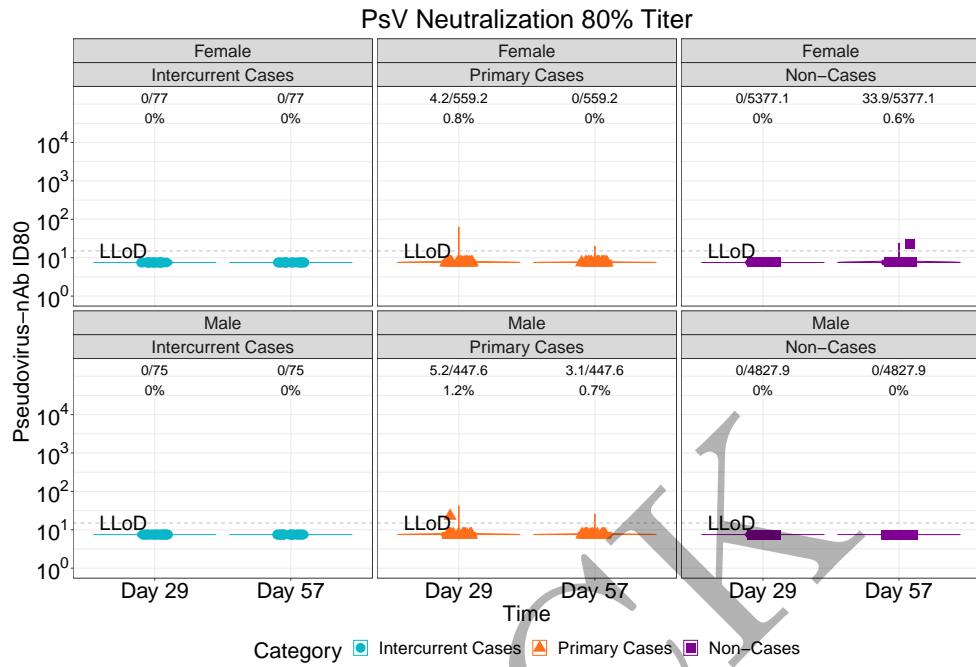


Figure 3.156: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 1)

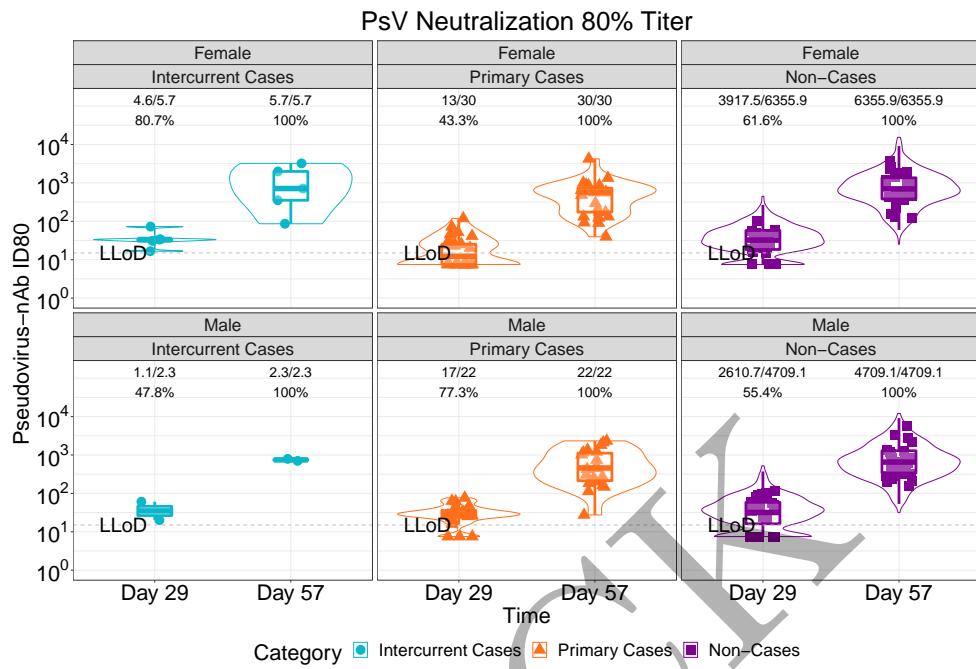


Figure 3.157: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 1)

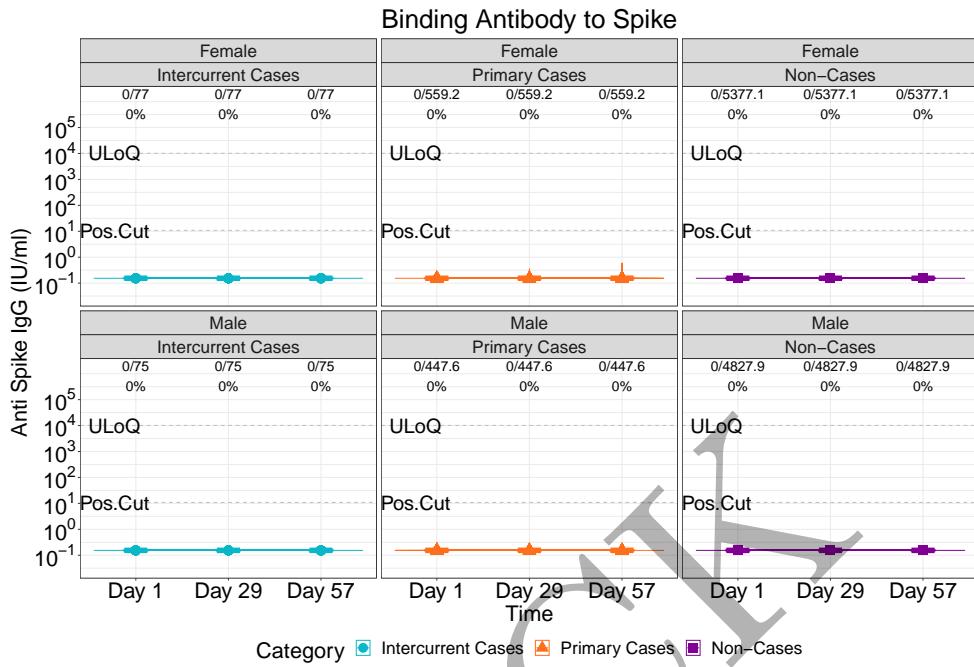


Figure 3.158: lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

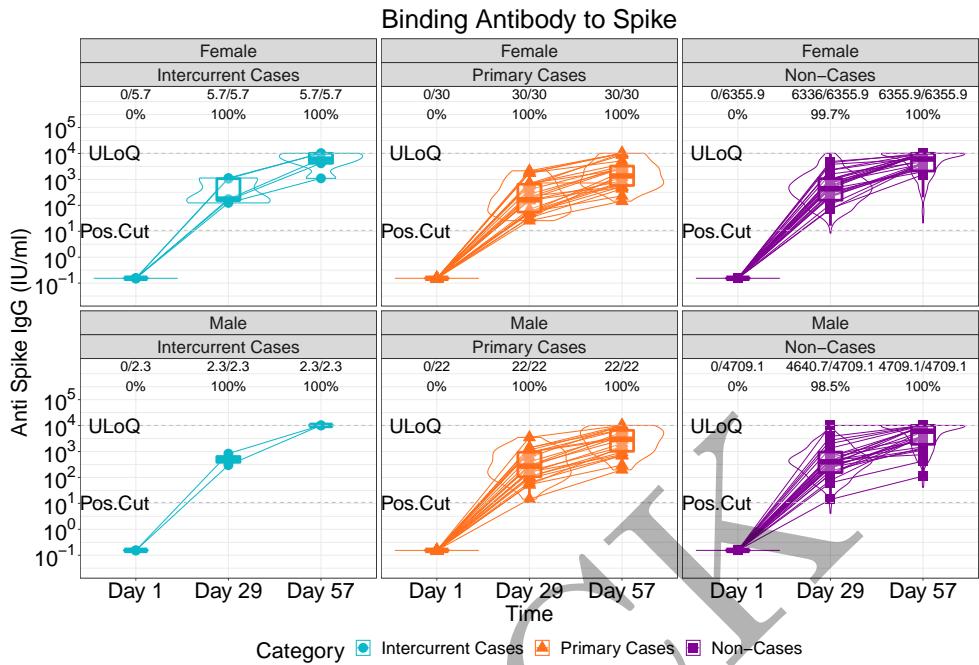


Figure 3.159: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

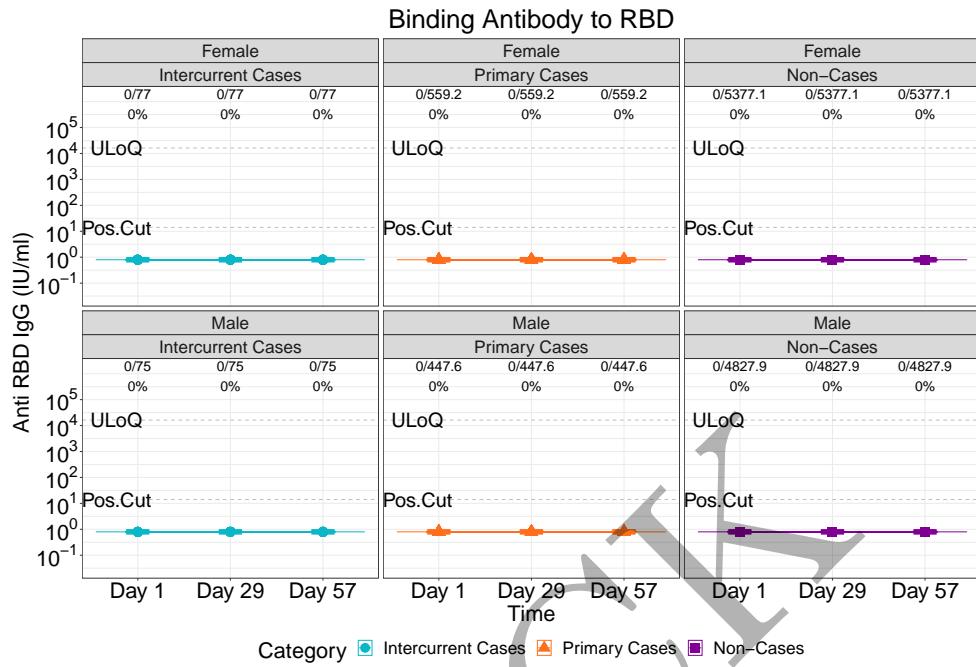


Figure 3.160: lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

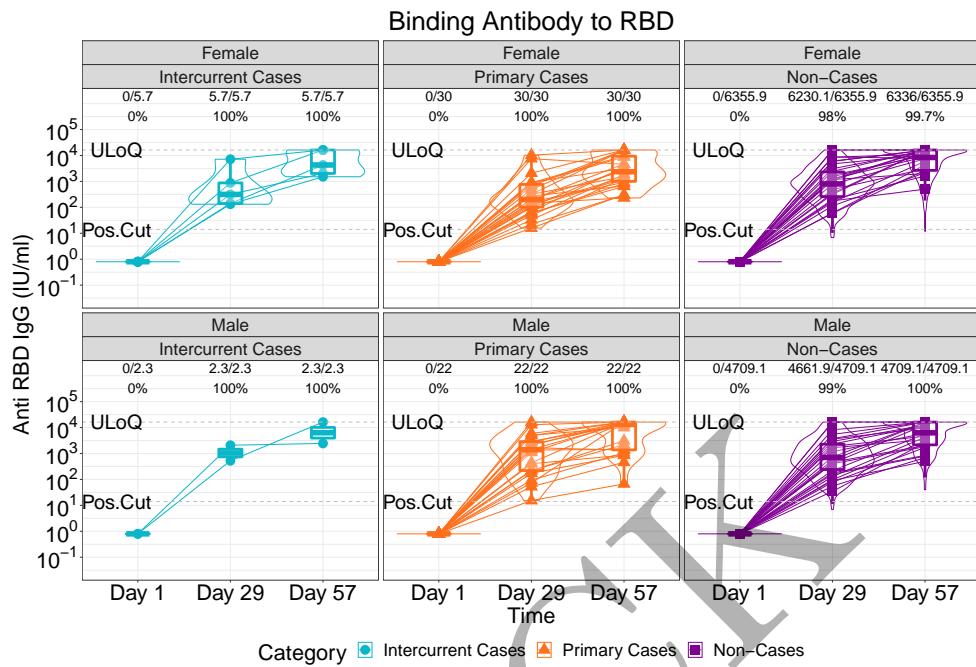


Figure 3.161: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

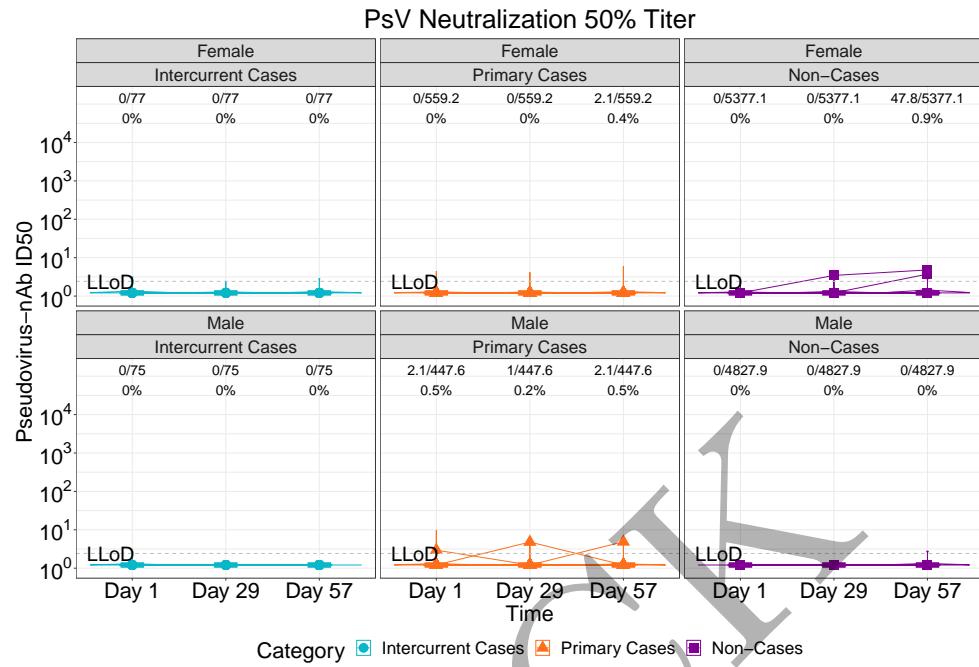


Figure 3.162: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

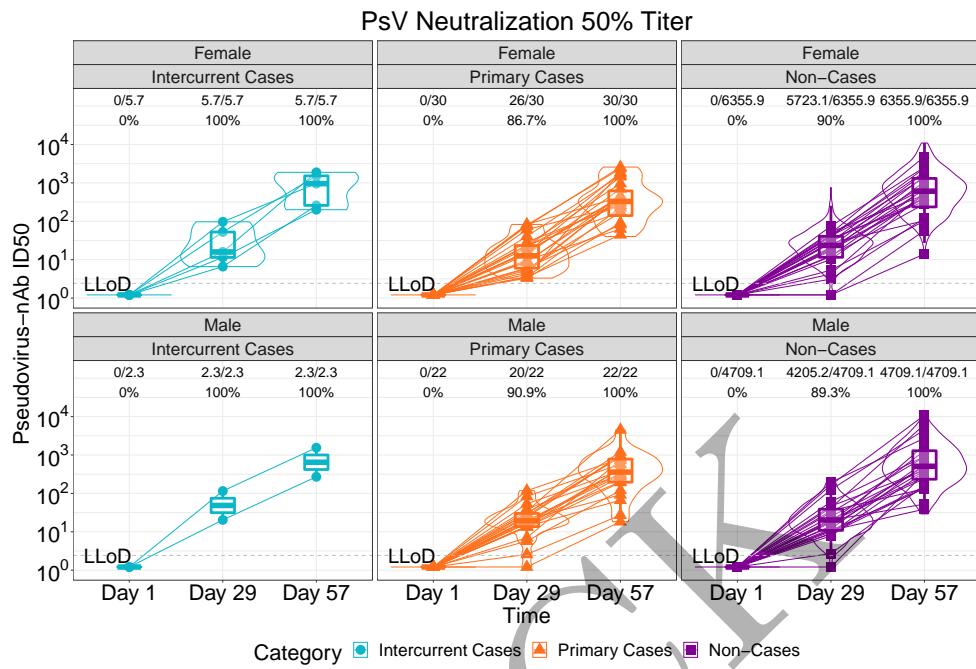


Figure 3.163: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

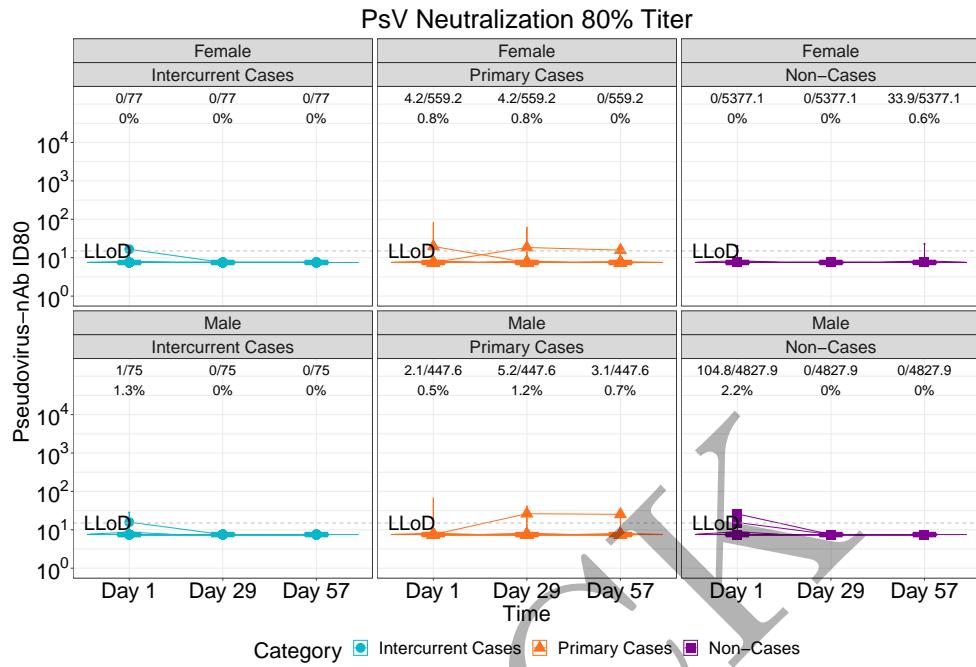


Figure 3.164: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

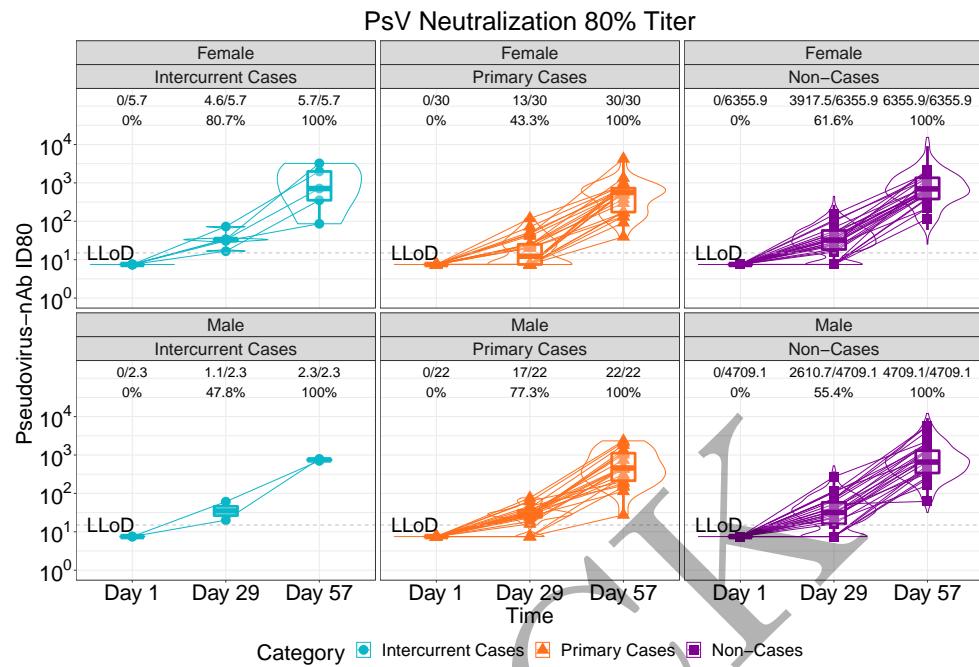


Figure 3.165: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

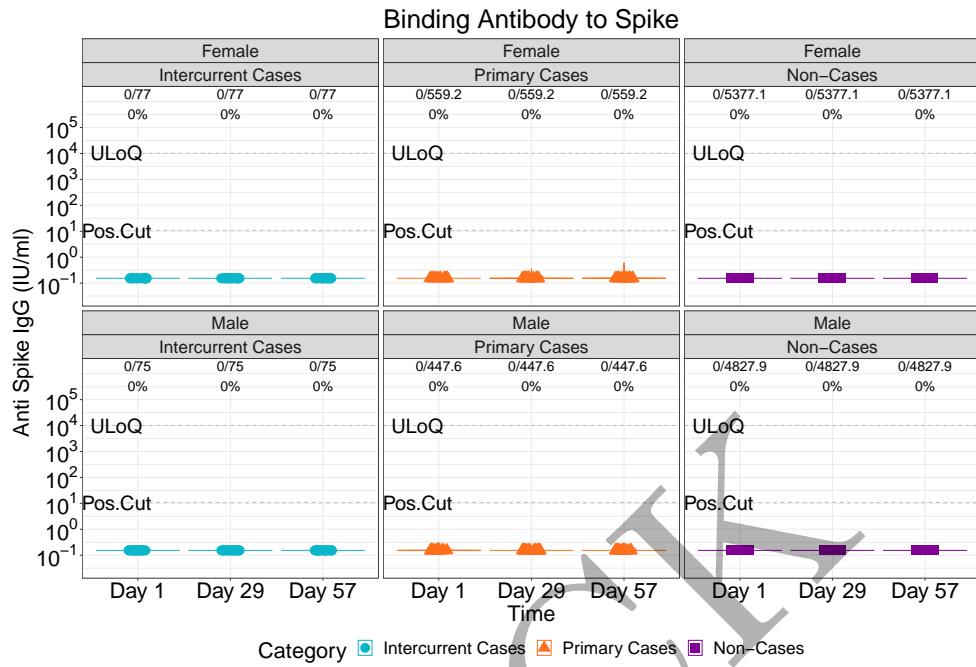


Figure 3.166: violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (version 2)

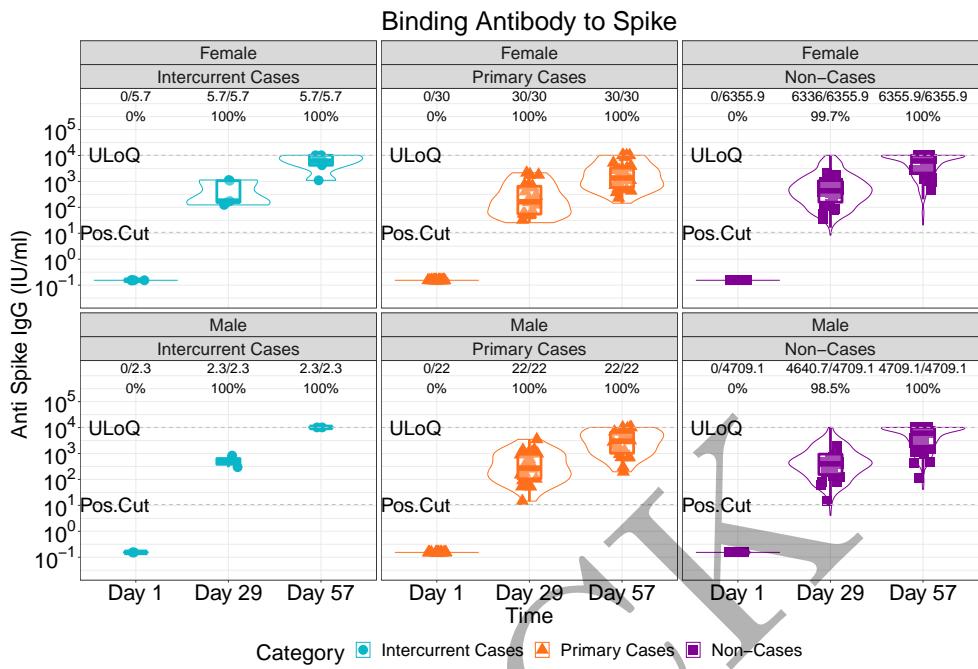


Figure 3.167: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (version 2)

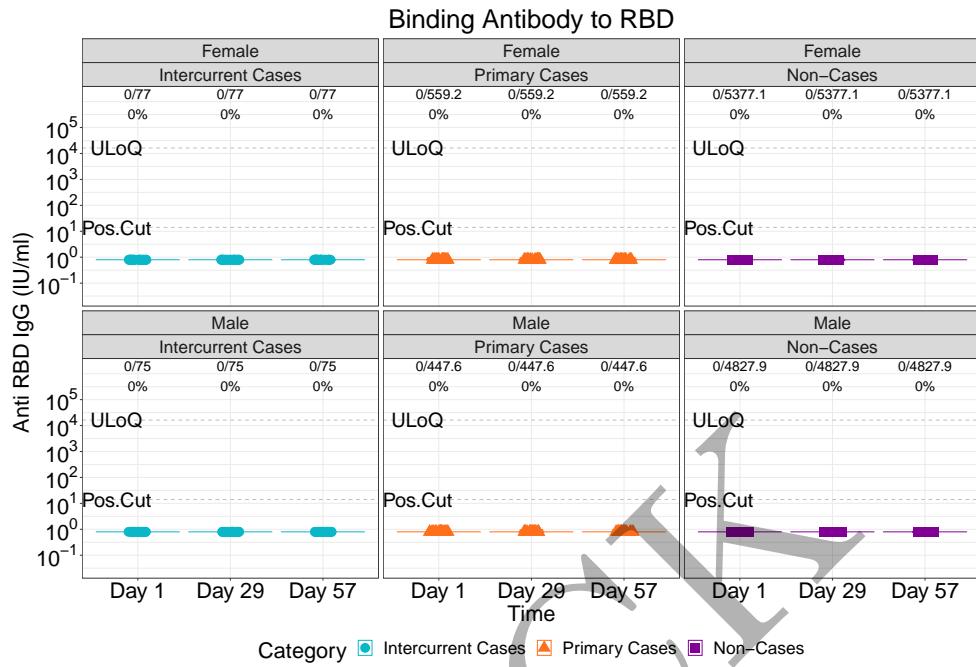


Figure 3.168: violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (version 2)

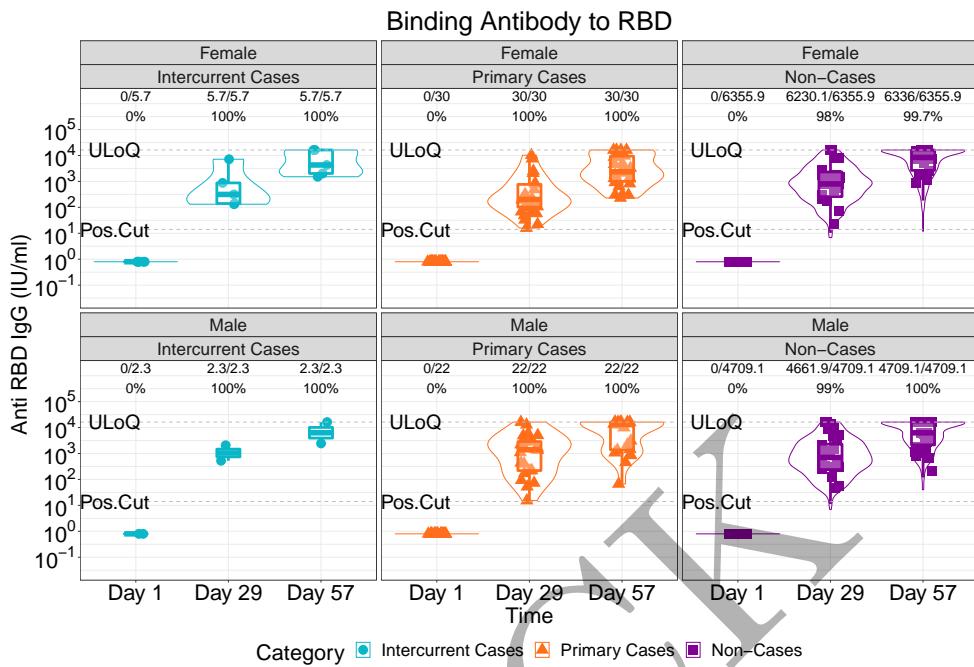


Figure 3.169: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (version 2)

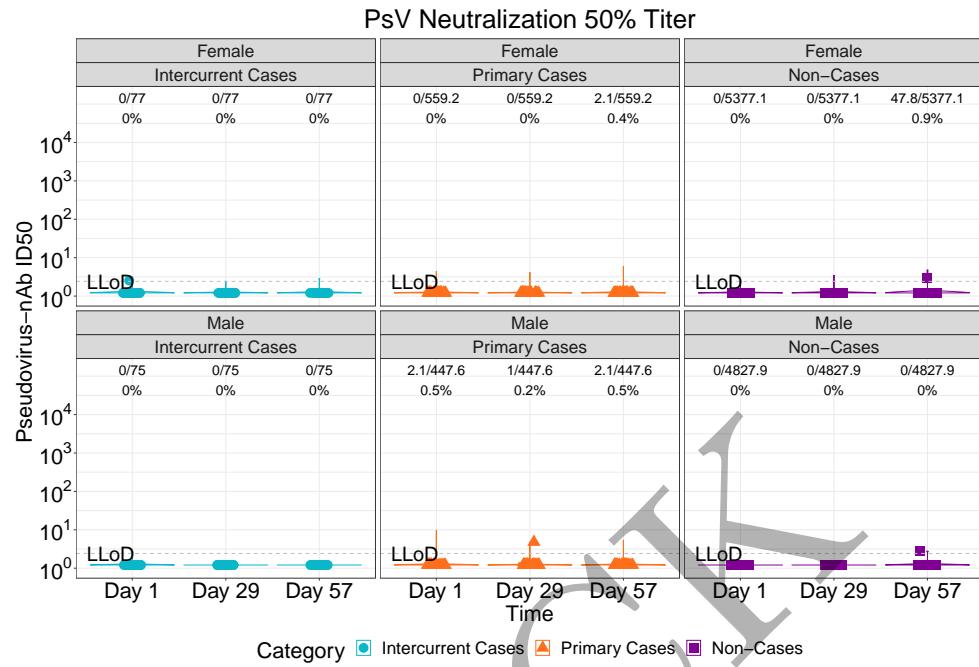


Figure 3.170: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (version 2)

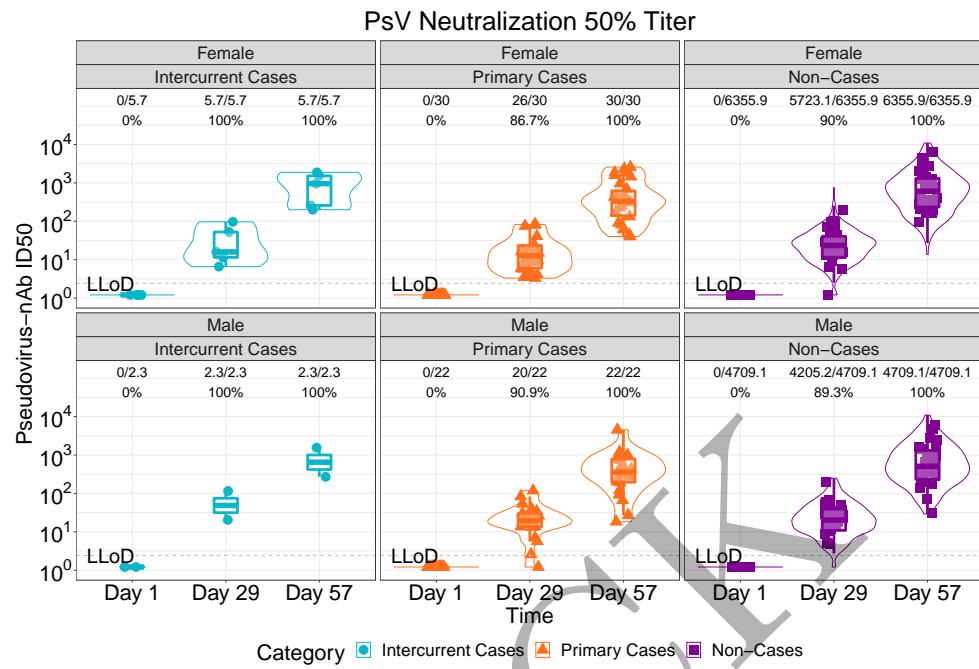


Figure 3.171: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (version 2)

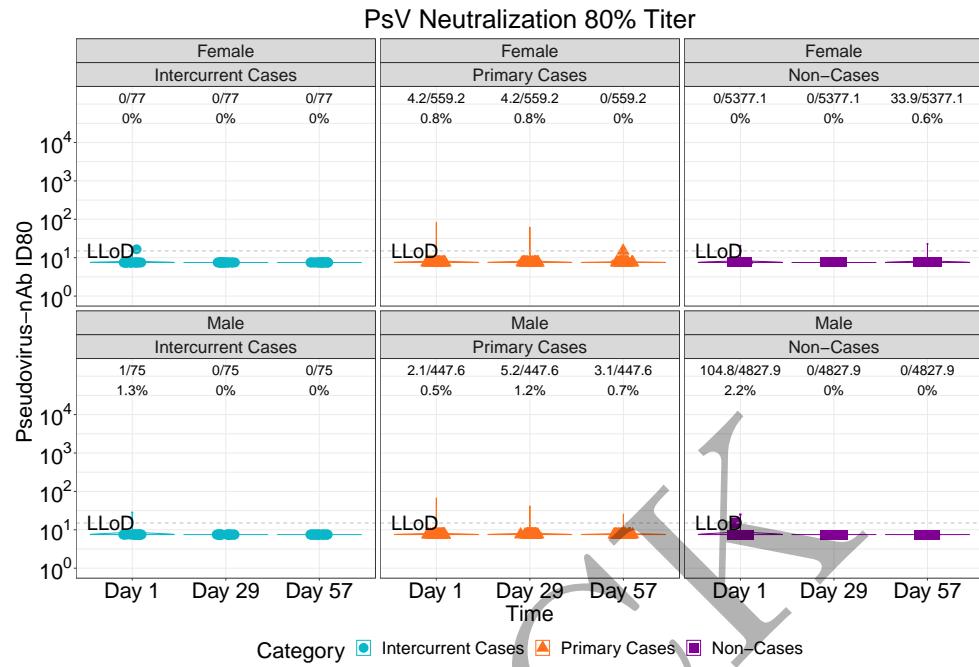


Figure 3.172: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (version 2)

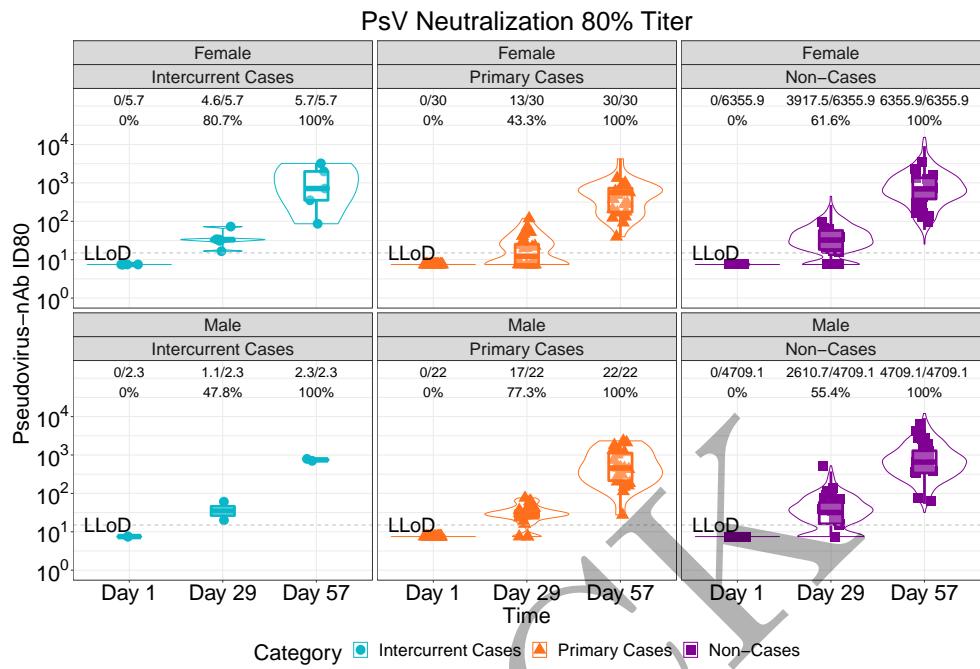


Figure 3.173: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (version 2)

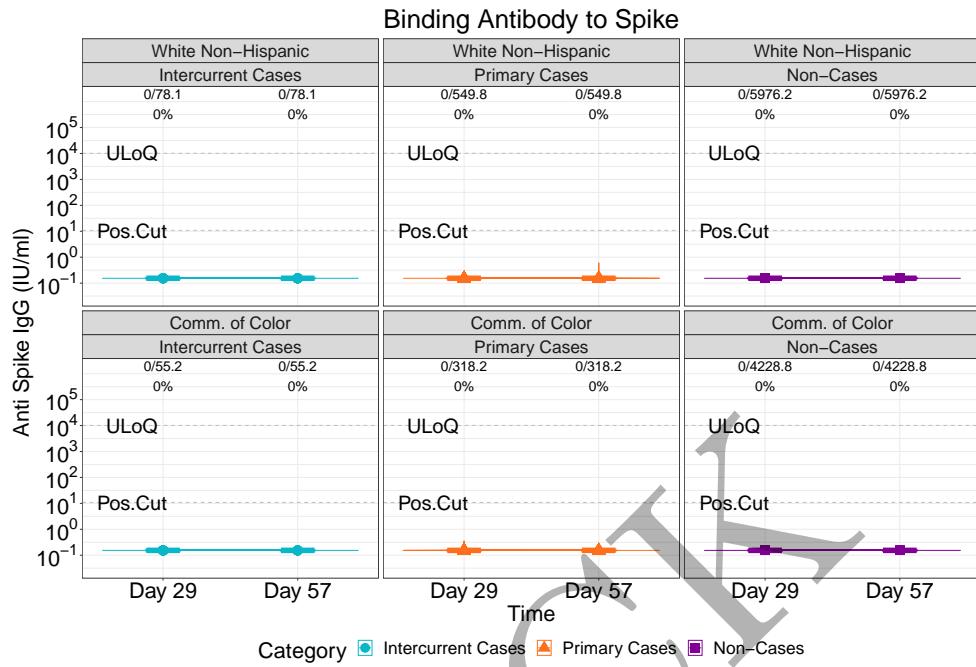


Figure 3.174: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

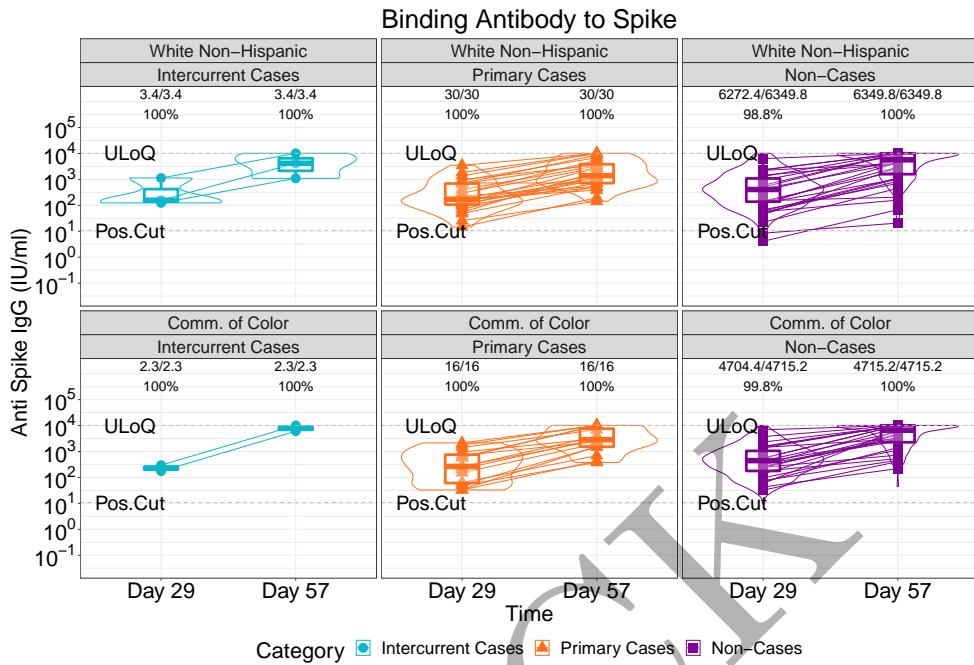


Figure 3.175: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

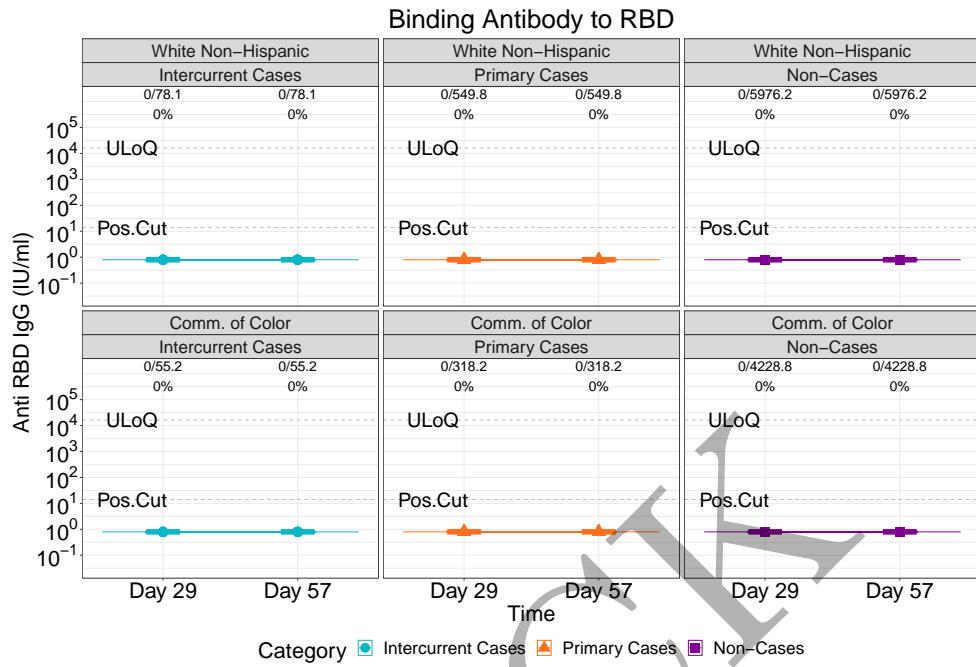


Figure 3.176: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

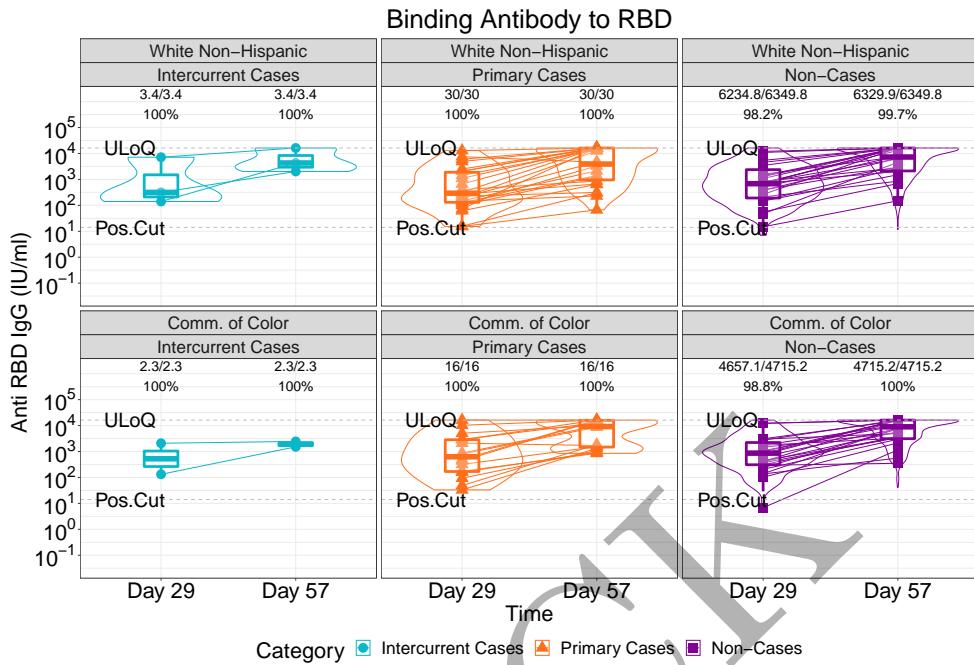


Figure 3.177: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

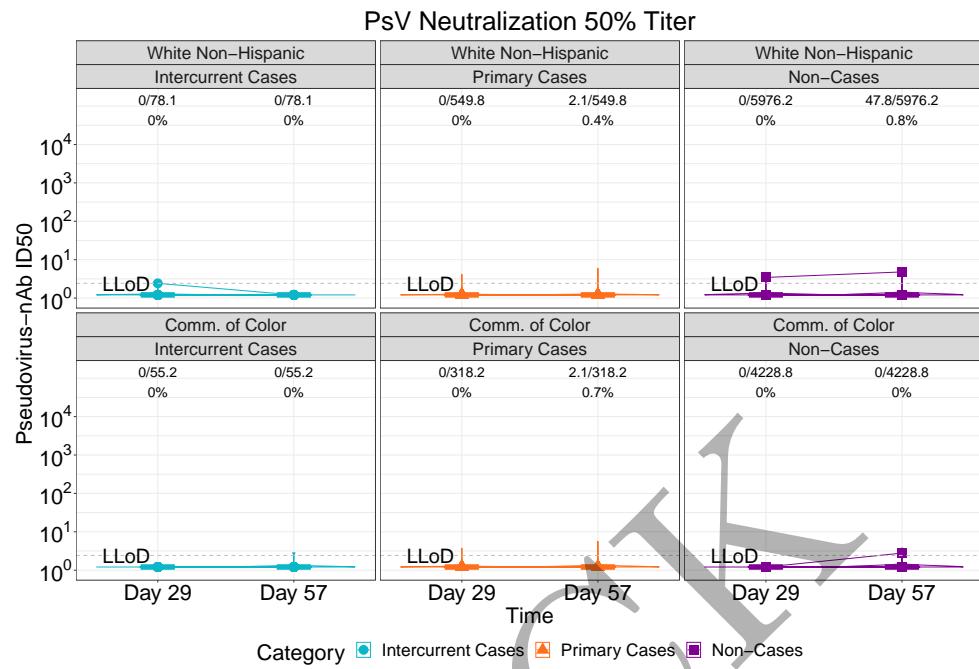


Figure 3.178: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

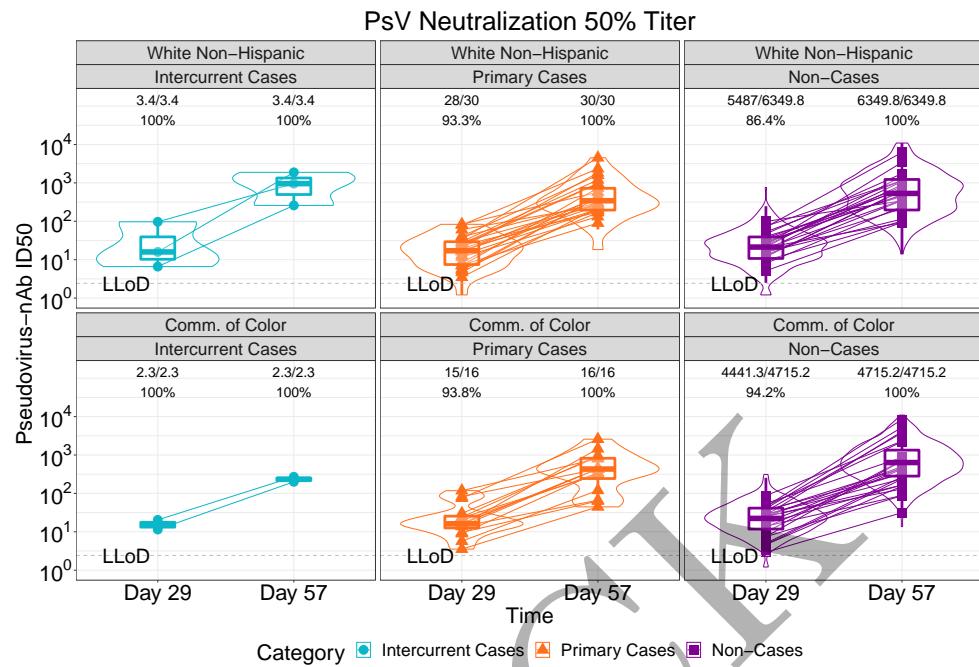


Figure 3.179: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

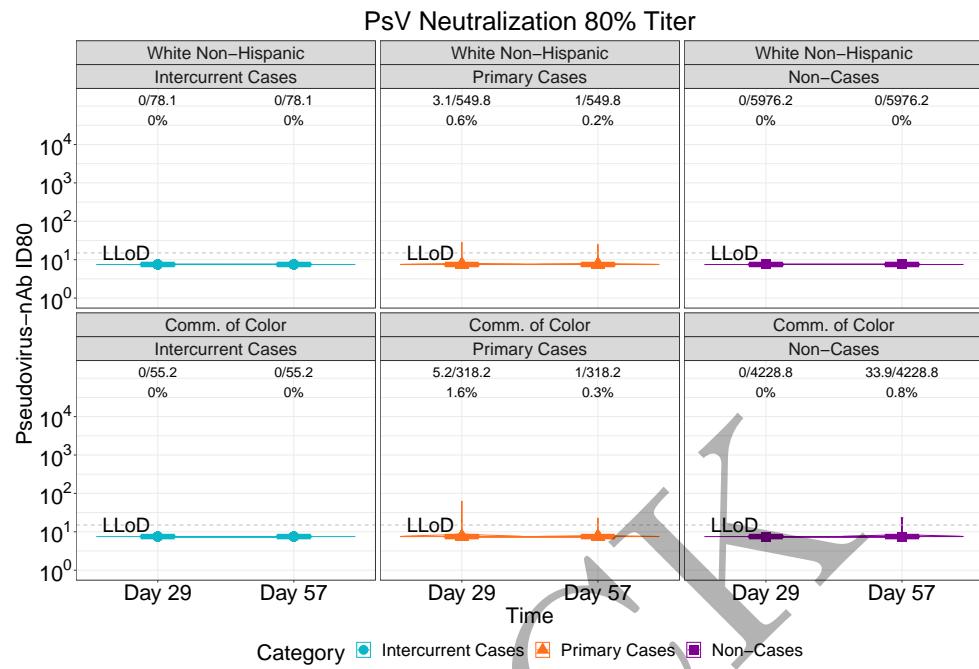


Figure 3.180: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

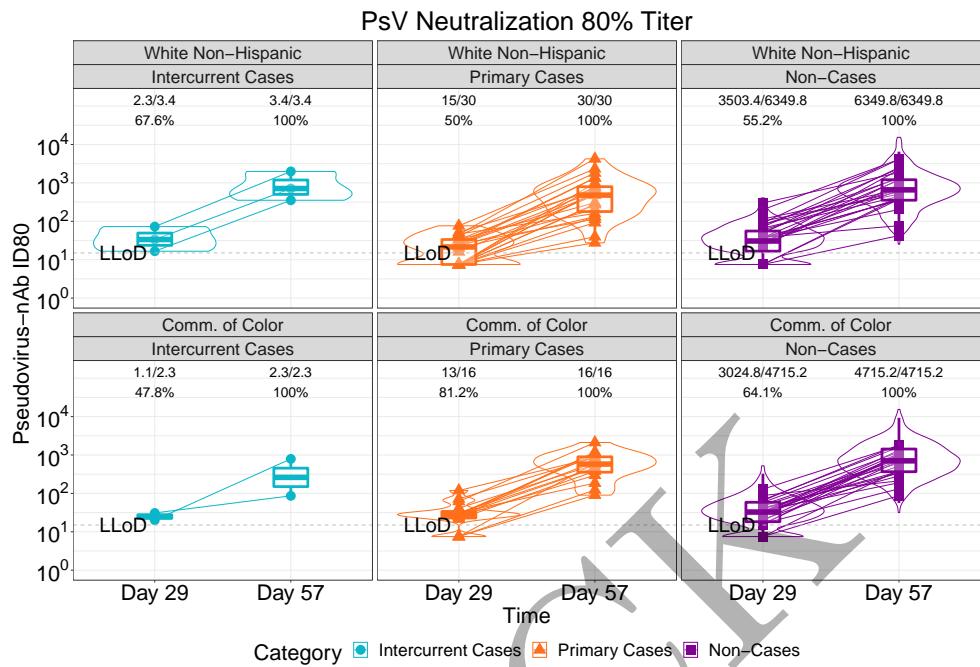


Figure 3.181: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

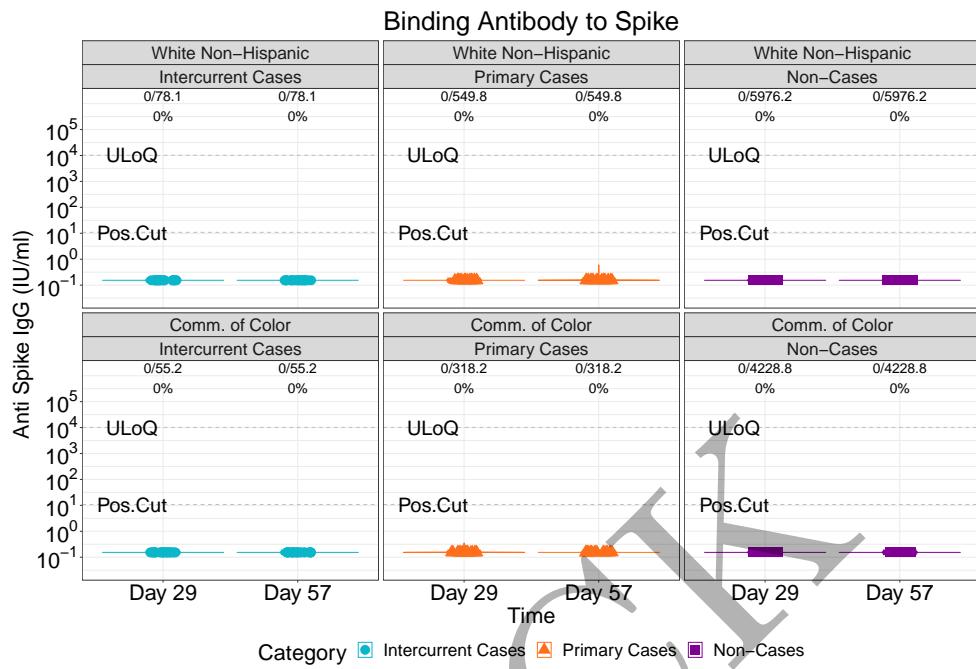


Figure 3.182: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 1)

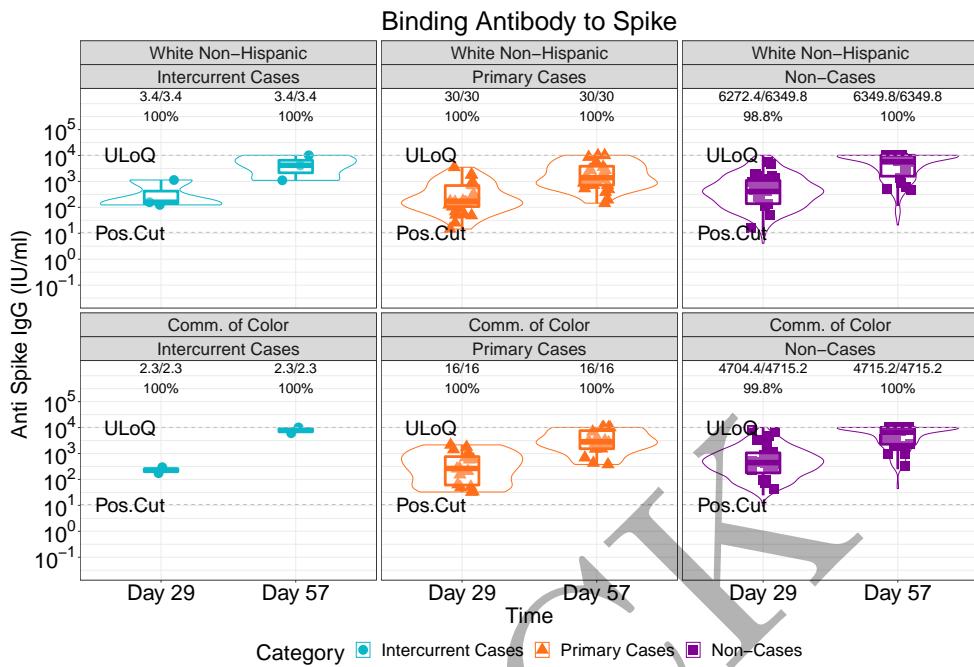


Figure 3.183: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 1)

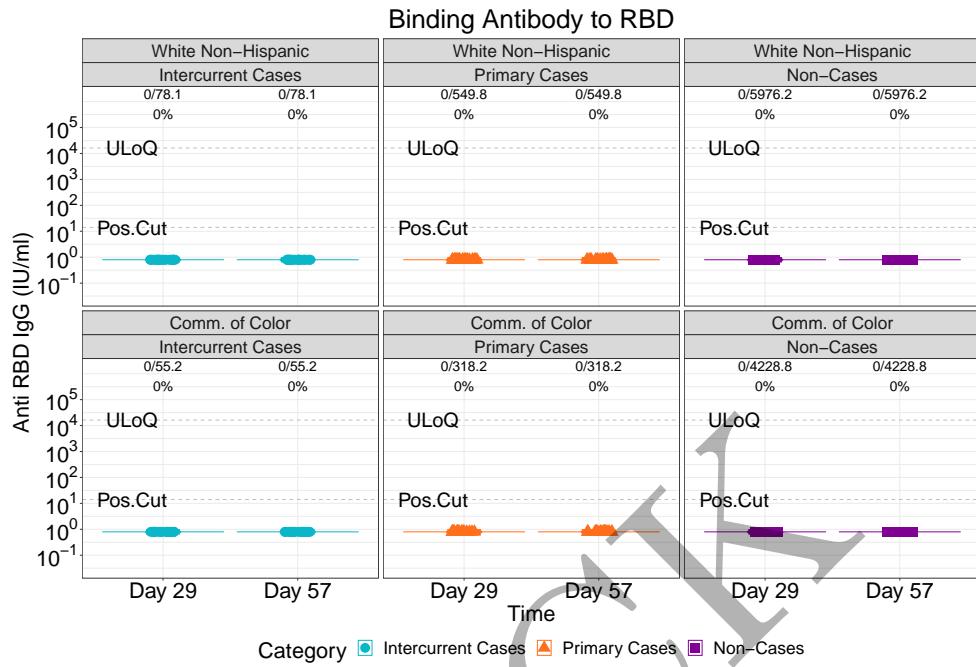


Figure 3.184: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 1)

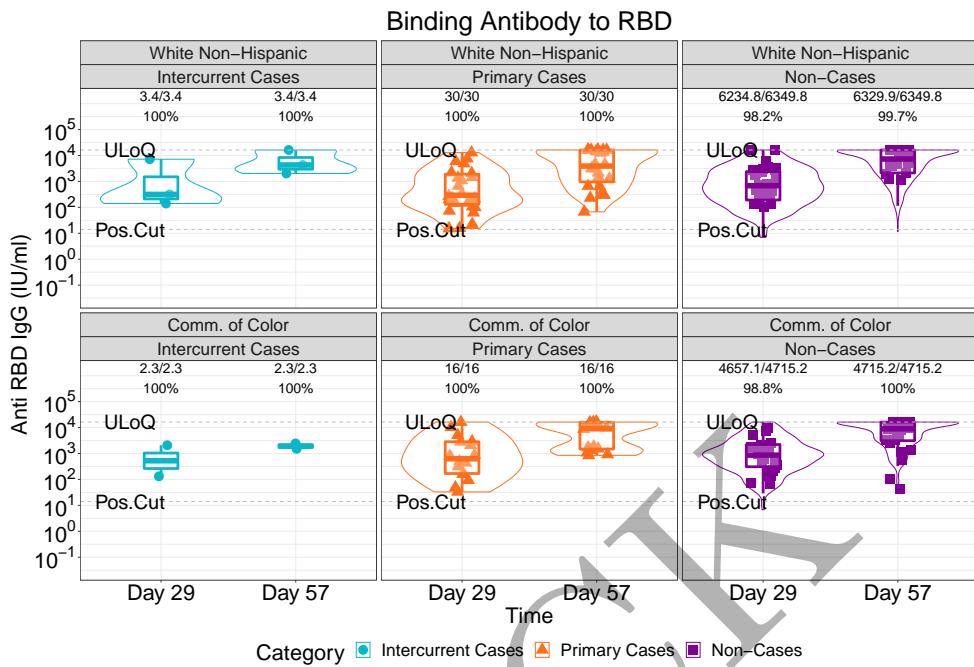


Figure 3.185: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 1)

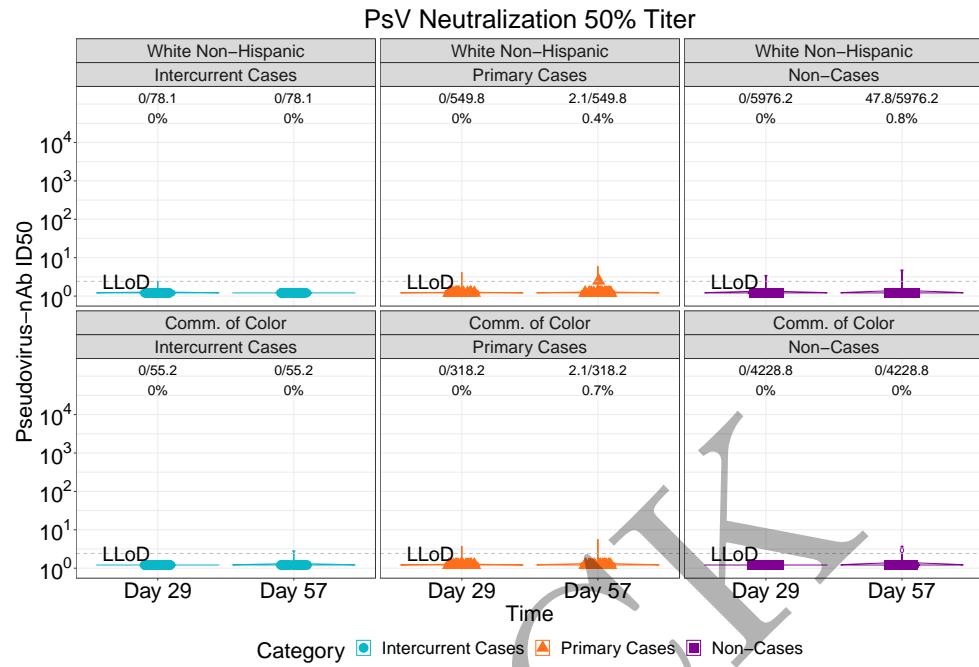


Figure 3.186: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 1)

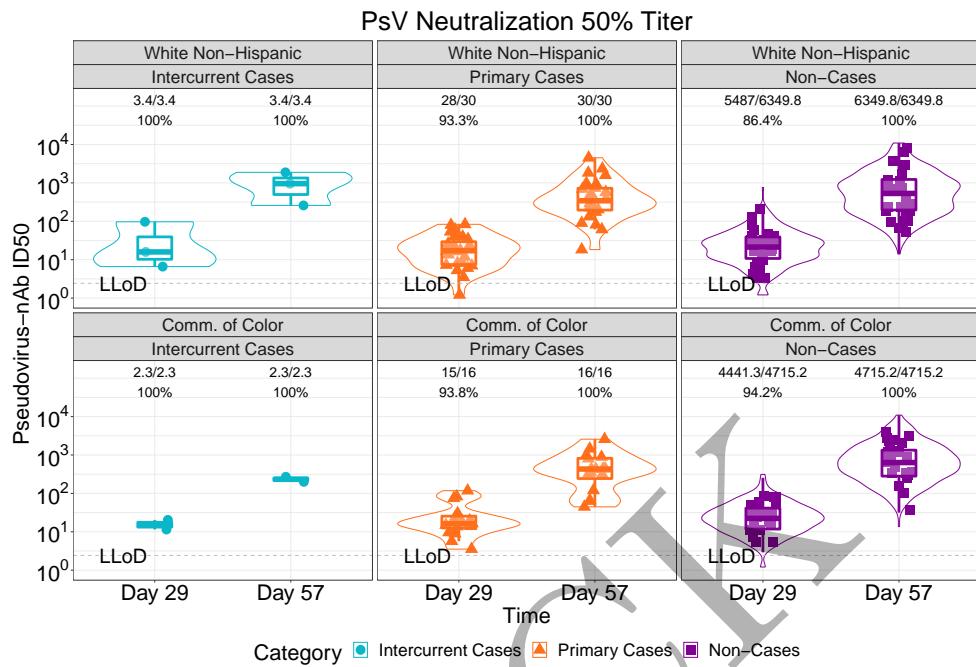


Figure 3.187: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 1)

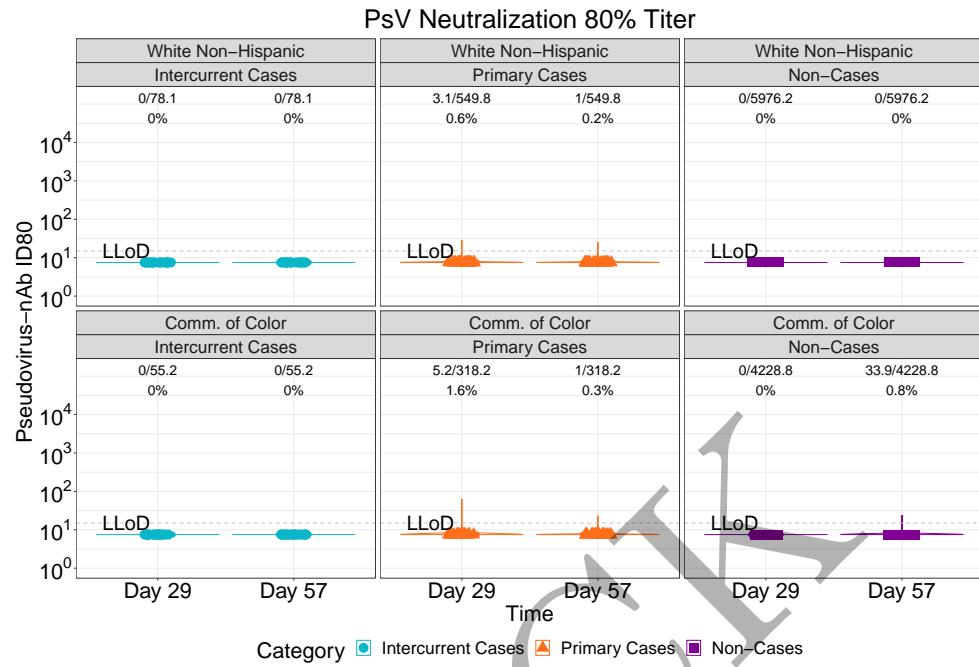


Figure 3.188: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 1)

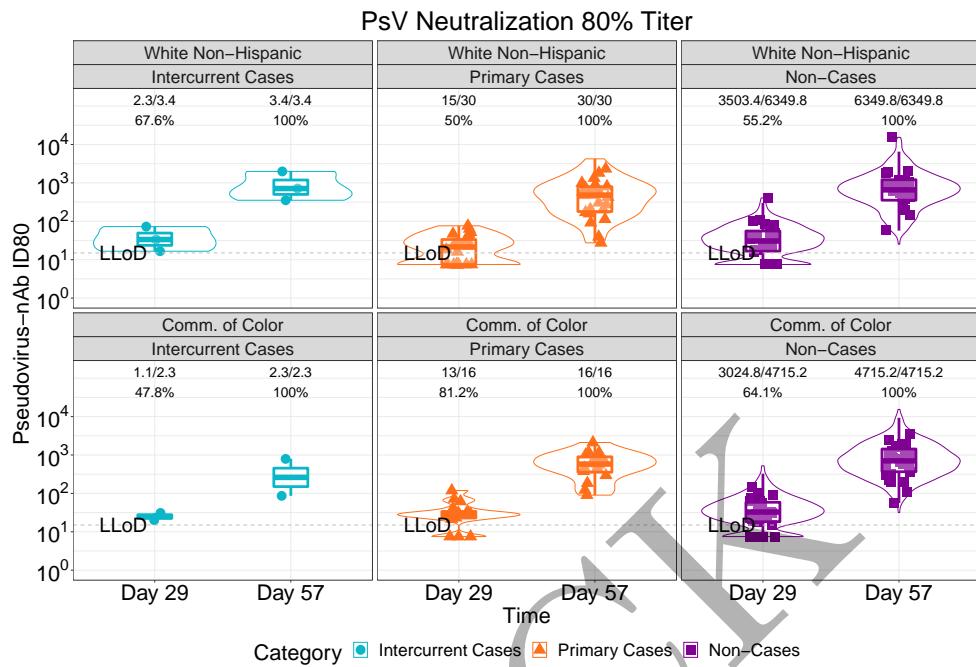


Figure 3.189: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 1)

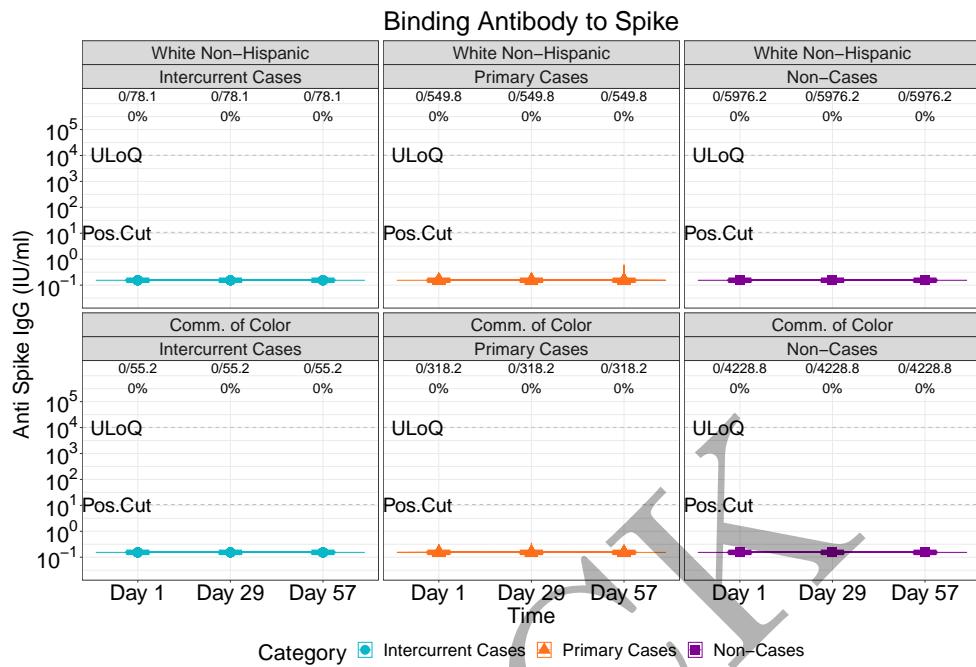


Figure 3.190: lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

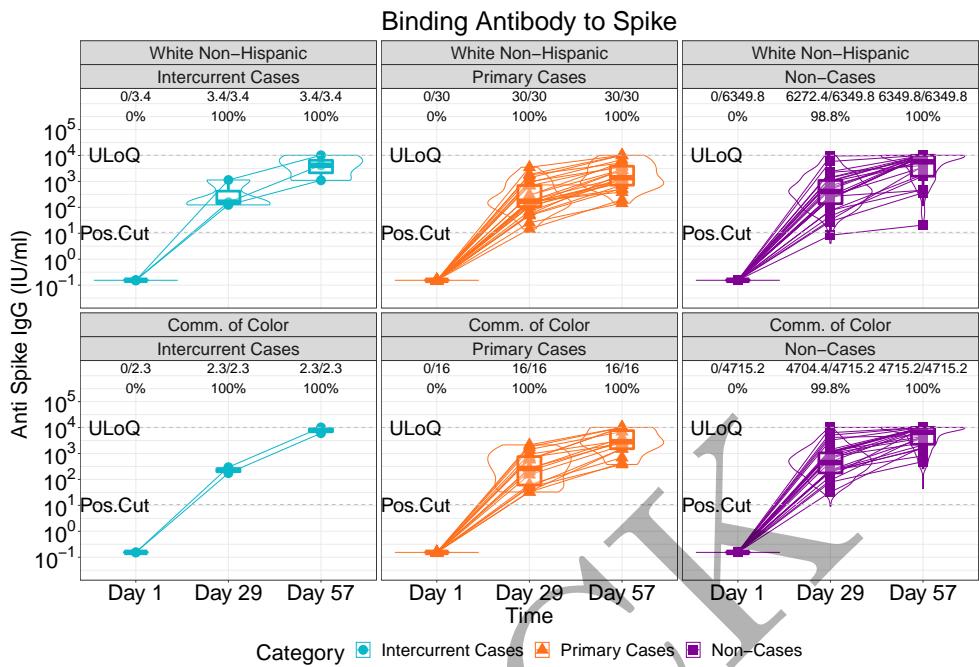


Figure 3.191: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

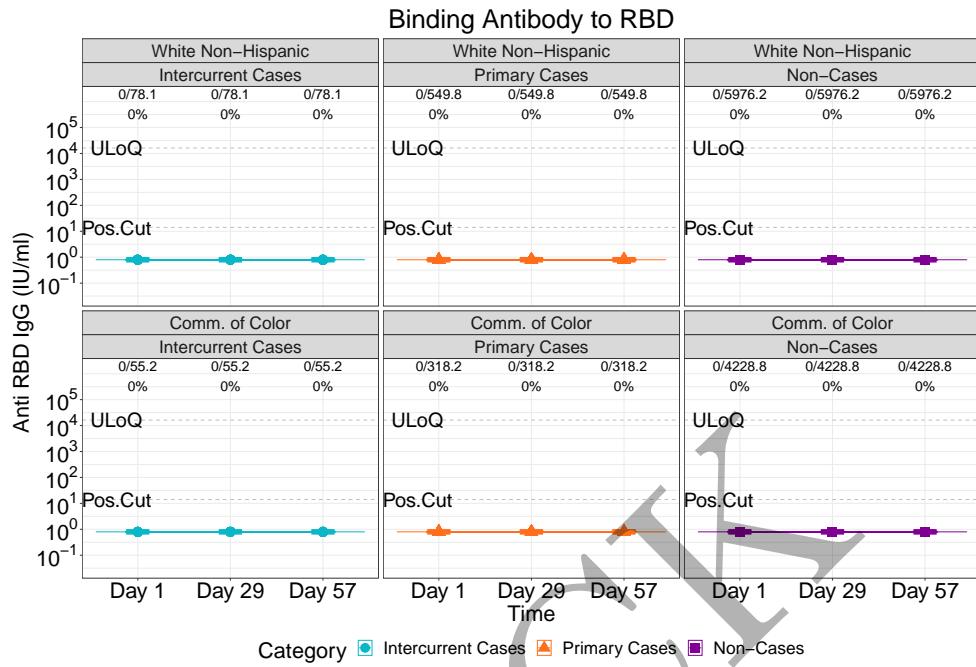


Figure 3.192: lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

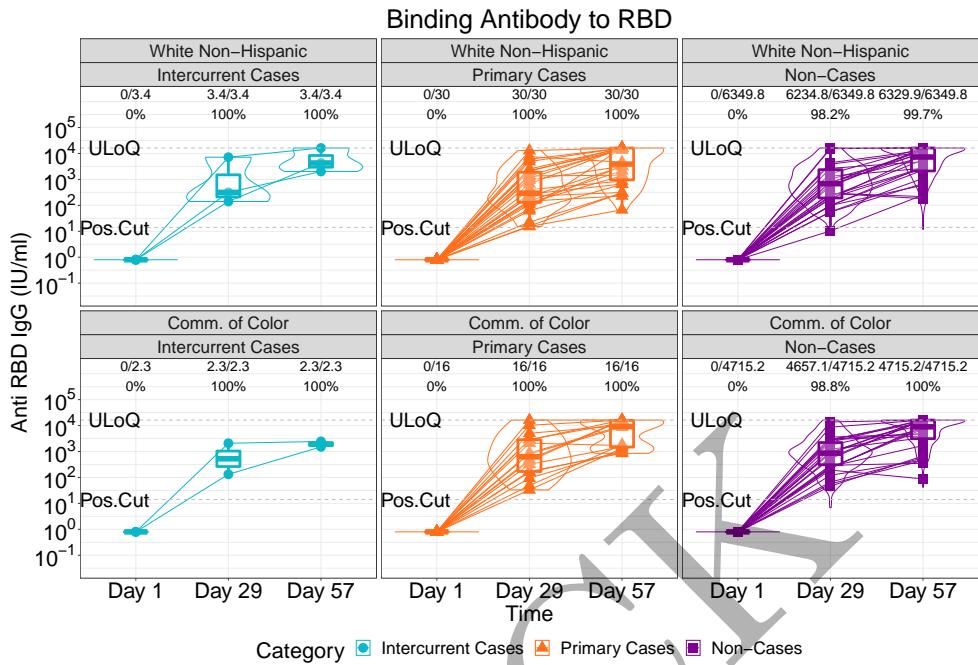


Figure 3.193: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

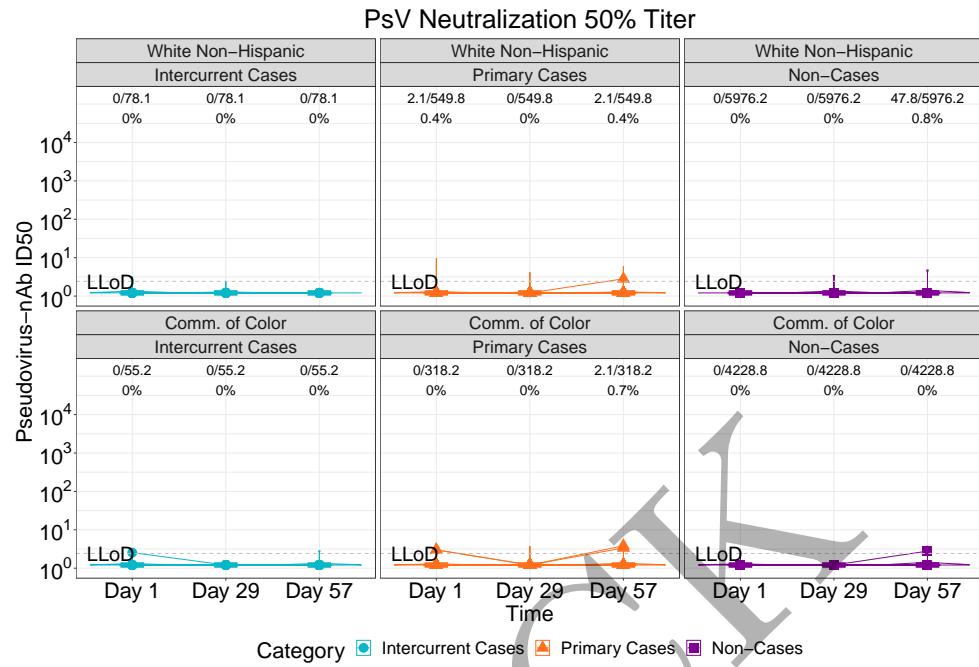


Figure 3.194: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

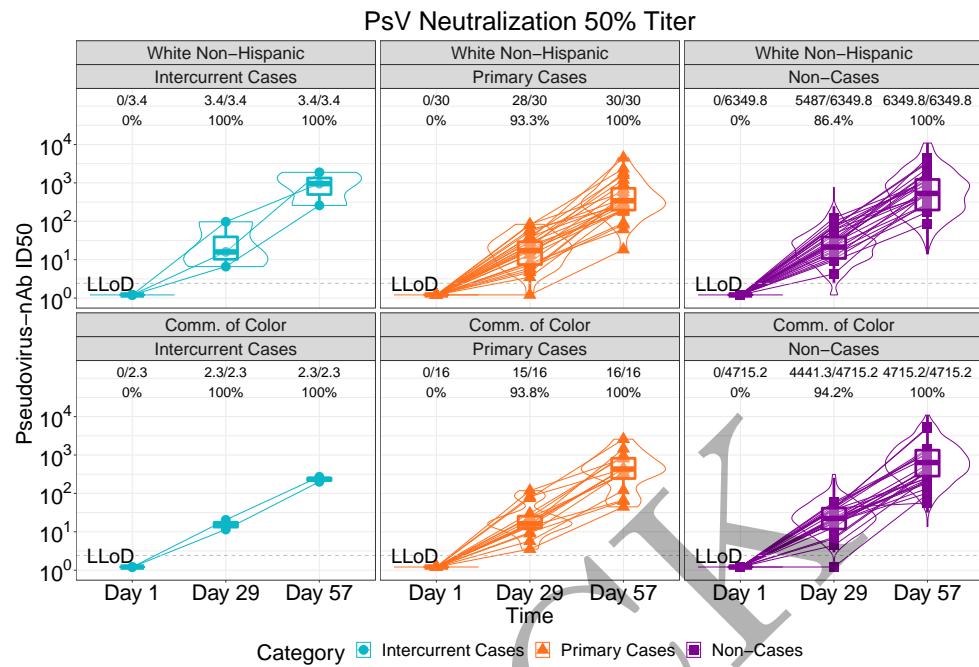


Figure 3.195: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

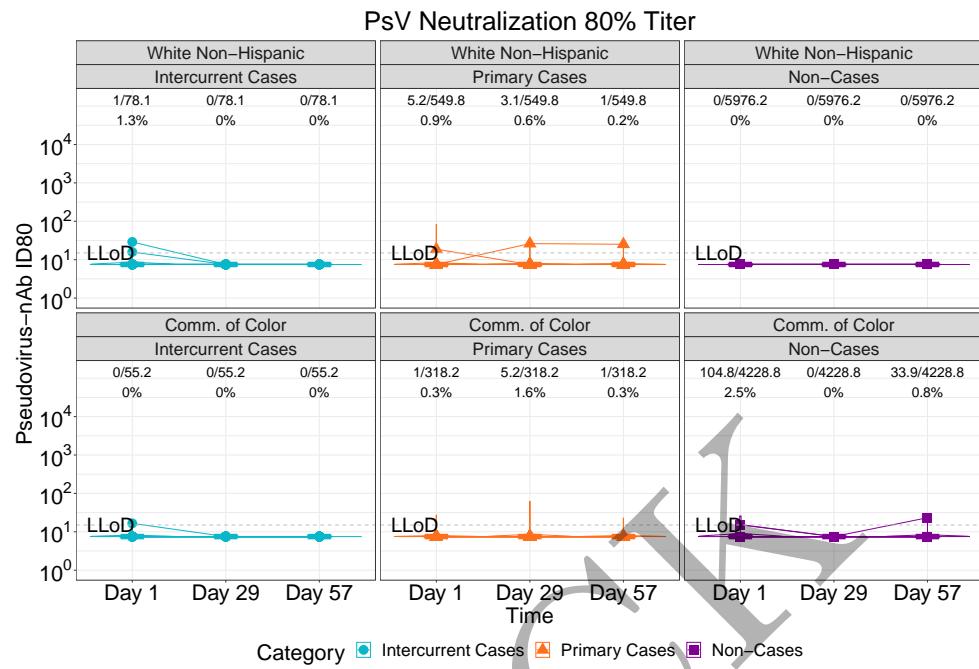


Figure 3.196: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

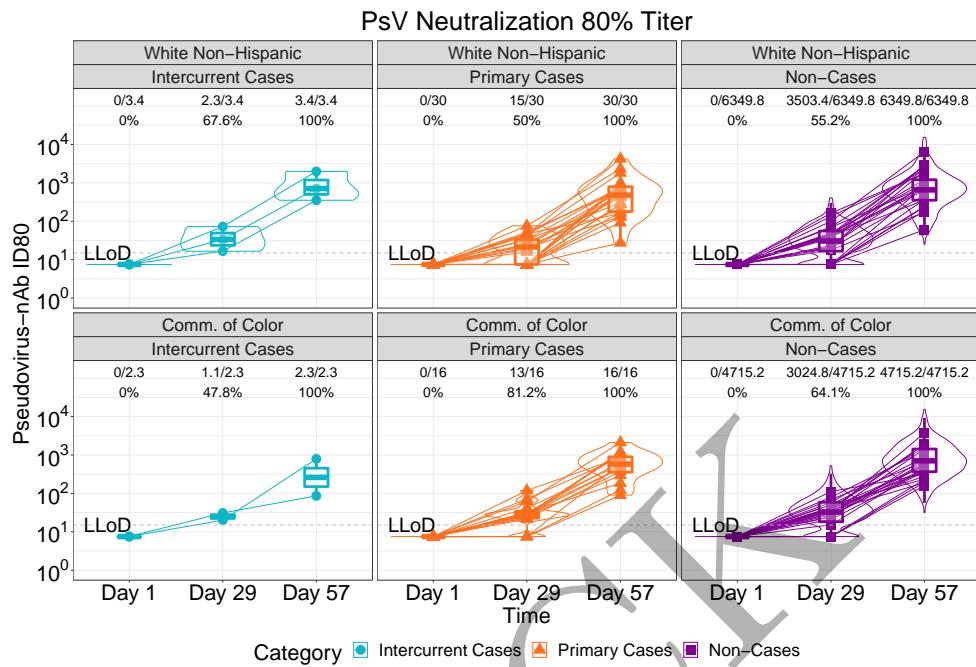


Figure 3.197: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

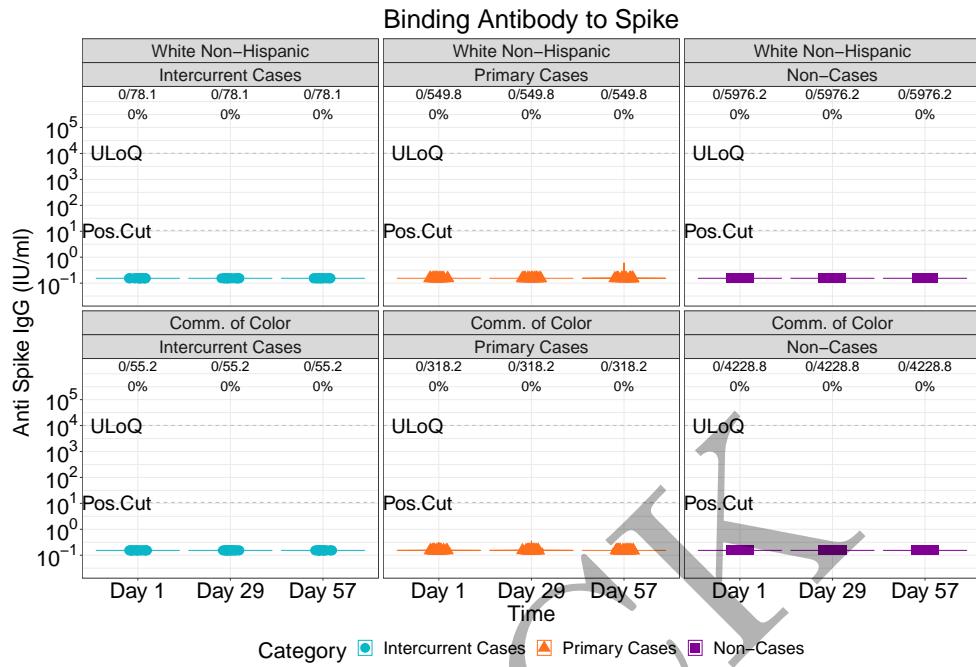


Figure 3.198: violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (version 2)

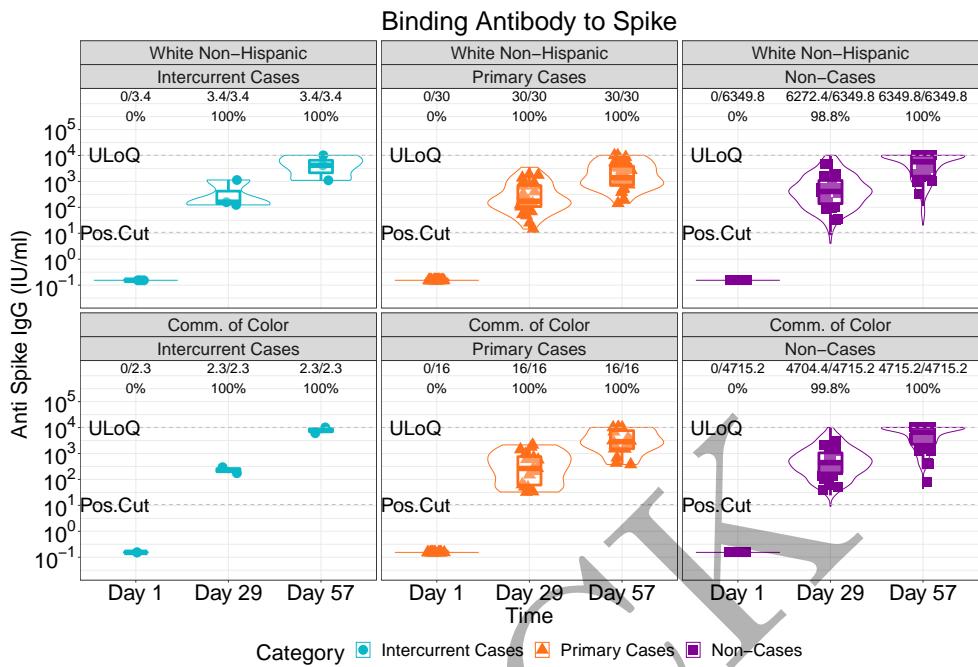


Figure 3.199: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (version 2)

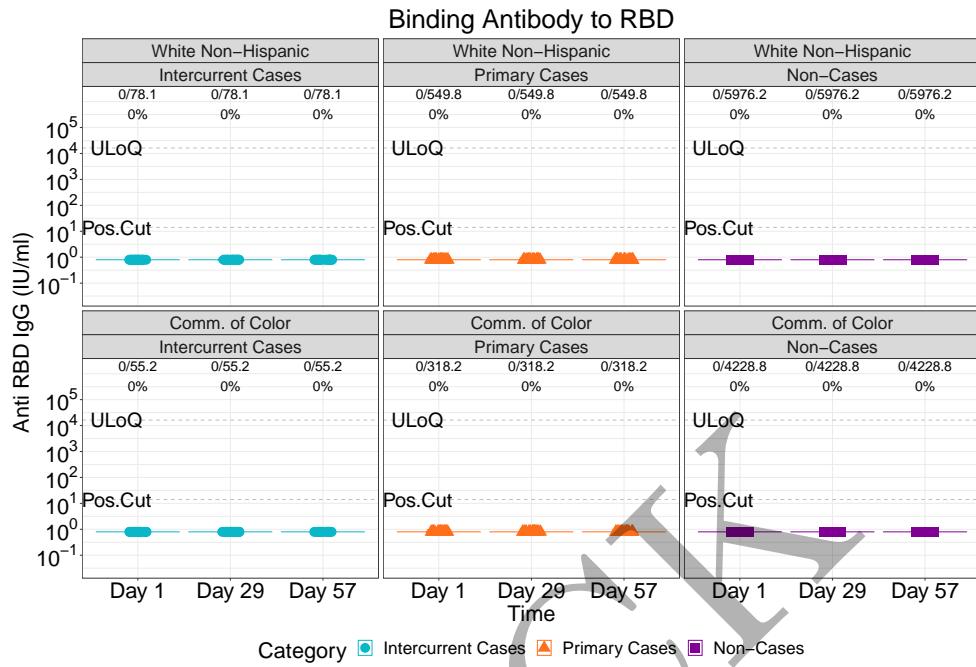


Figure 3.200: violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (version 2)

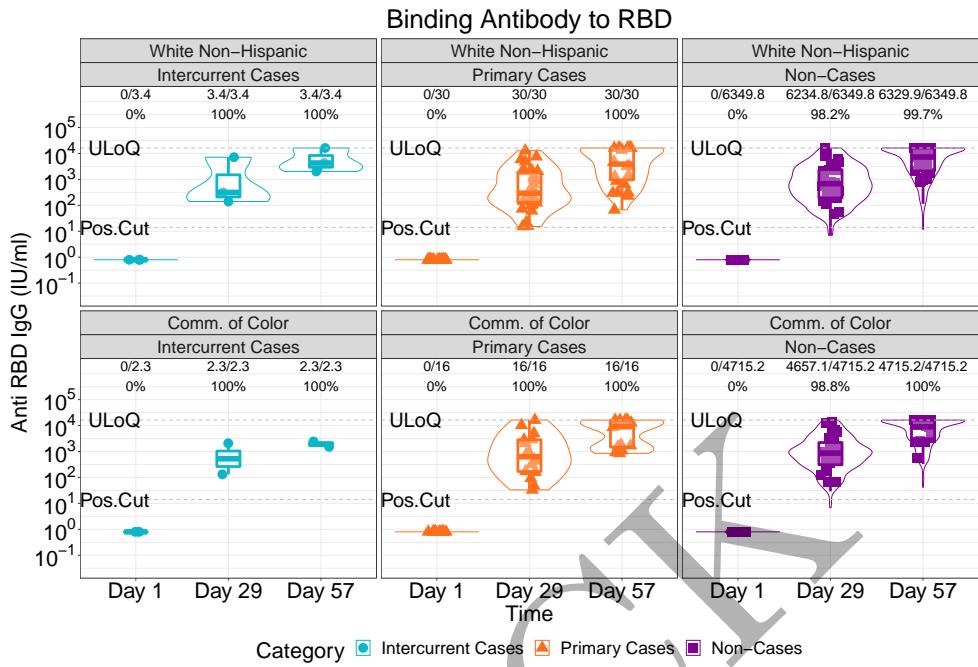


Figure 3.201: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (version 2)

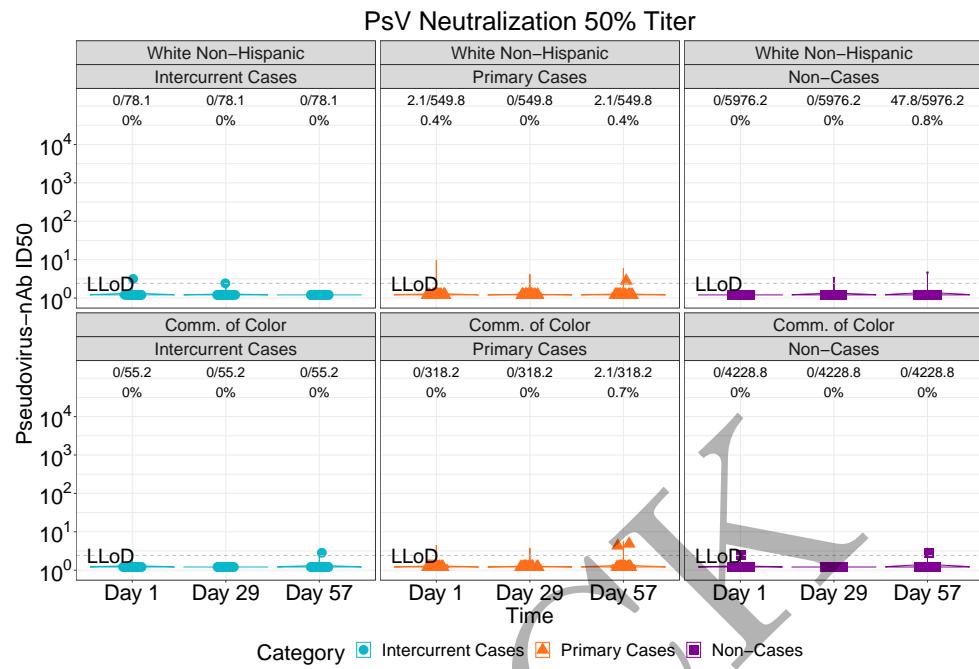


Figure 3.202: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (version 2)

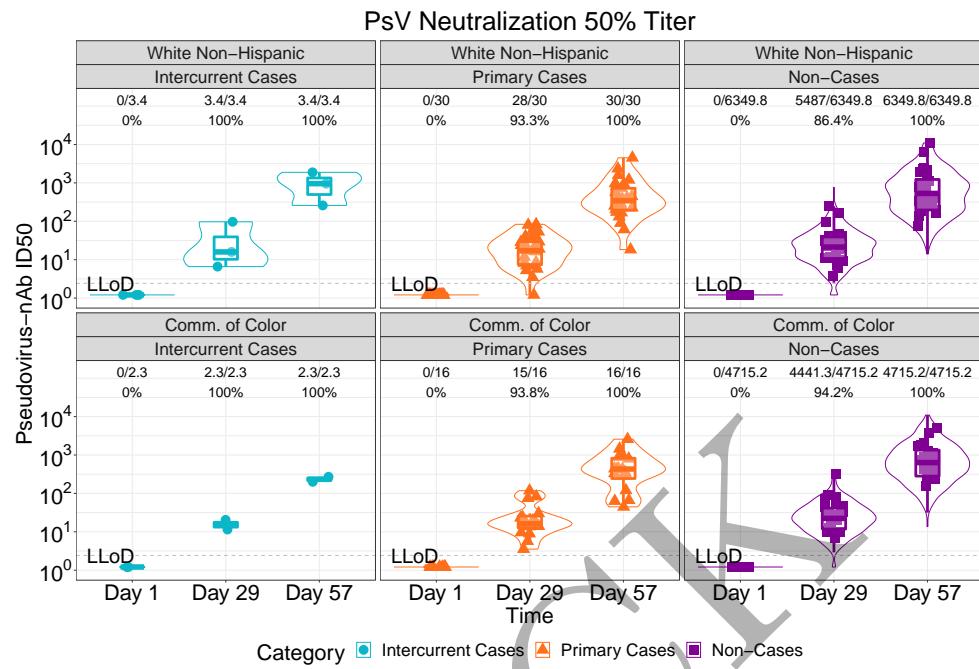


Figure 3.203: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (version 2)

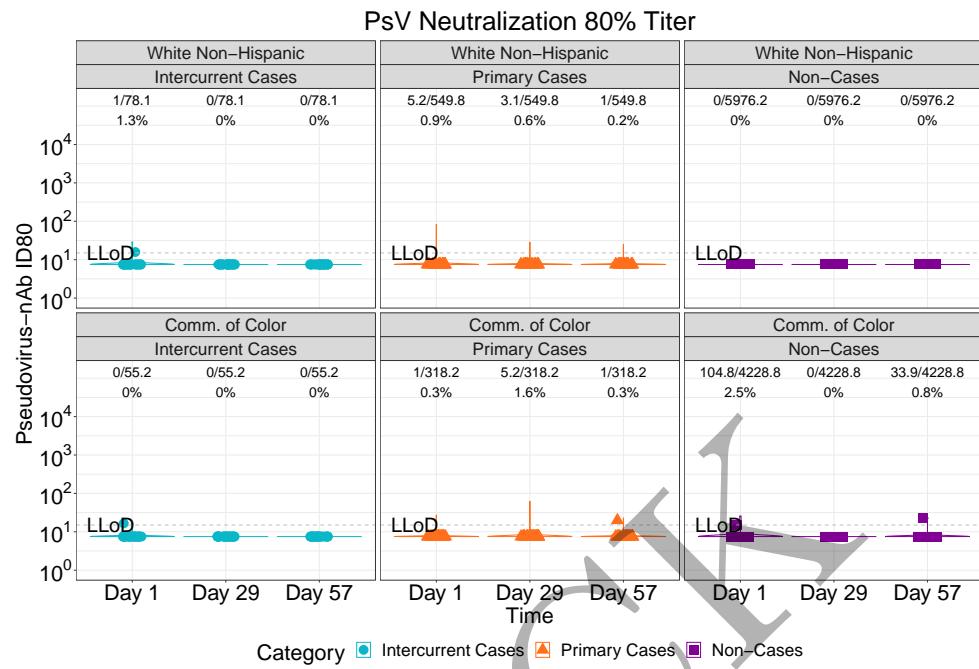


Figure 3.204: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (version 2)

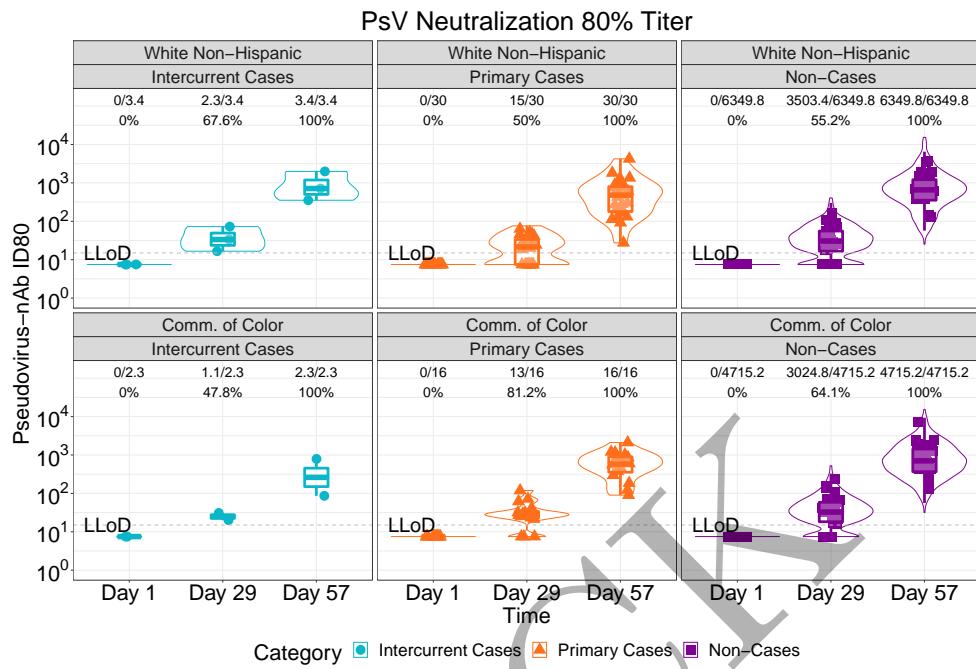


Figure 3.205: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (version 2)

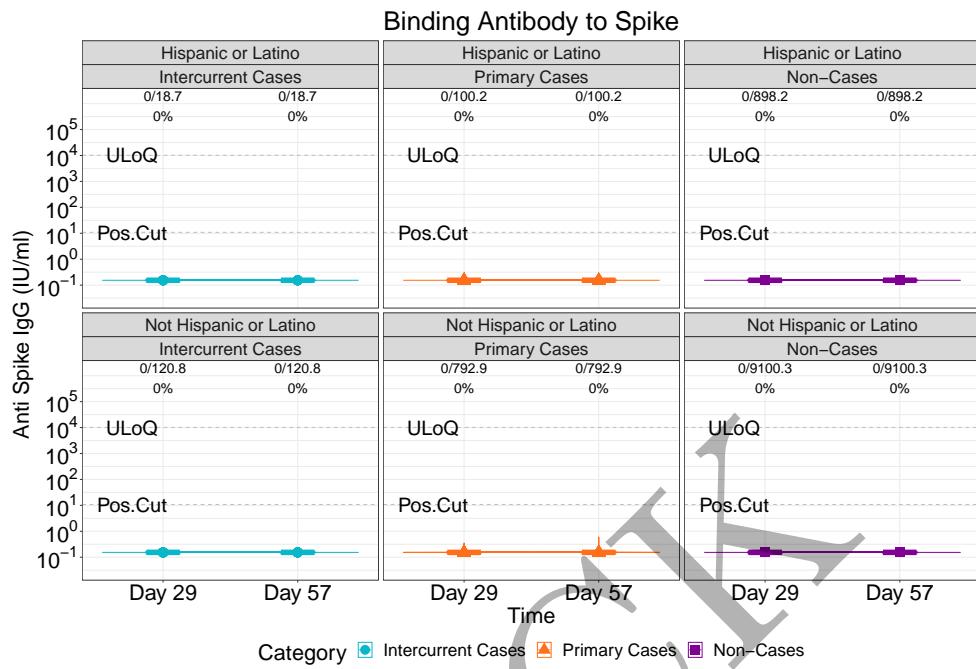


Figure 3.206: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

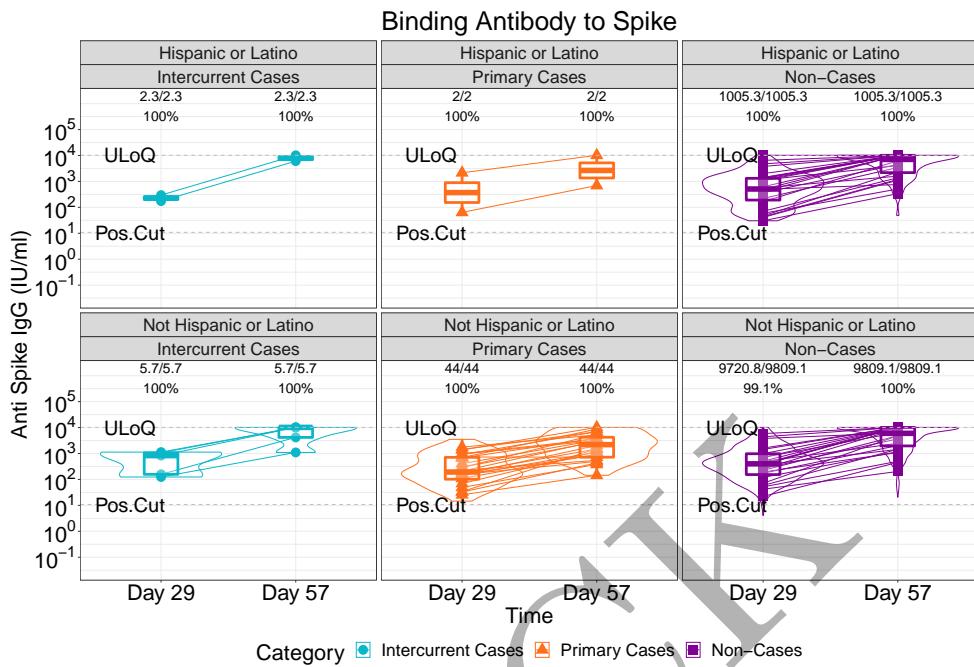


Figure 3.207: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

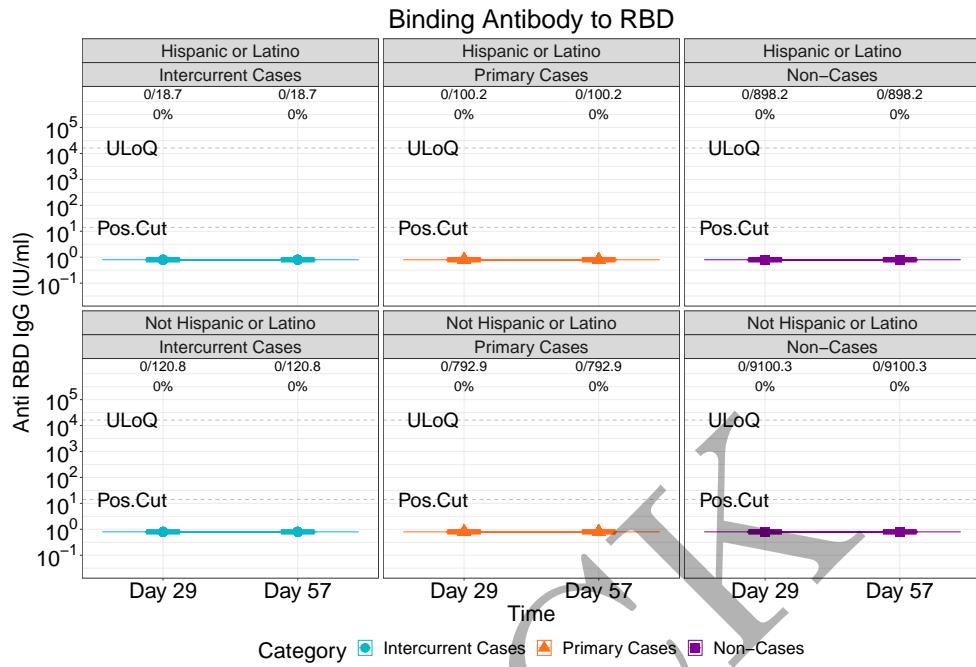


Figure 3.208: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

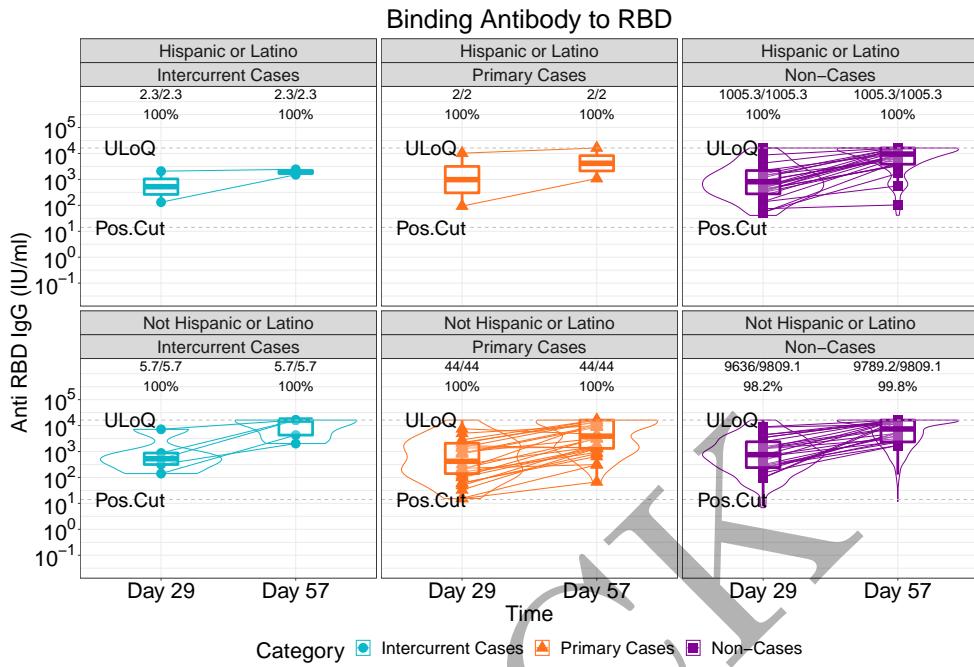


Figure 3.209: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

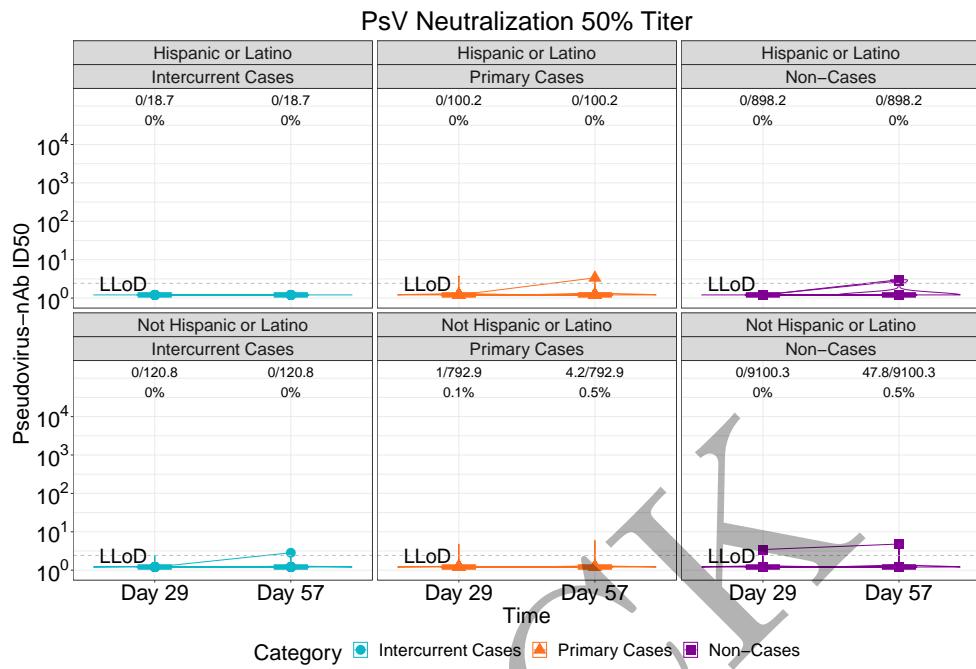


Figure 3.210: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

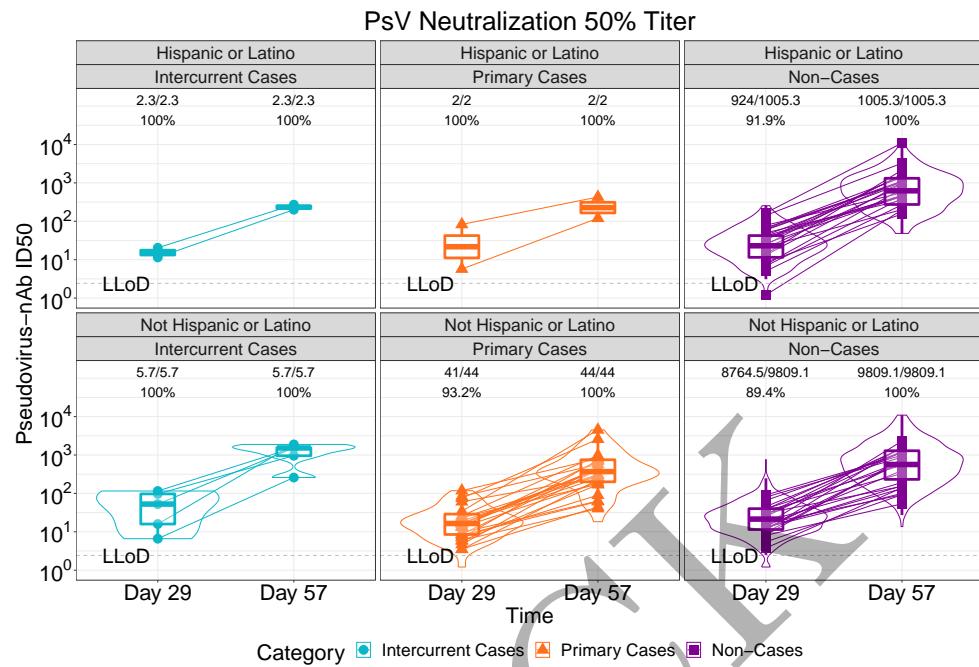


Figure 3.211: lineplots of Pseudovirus Neutralization ID₅₀: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

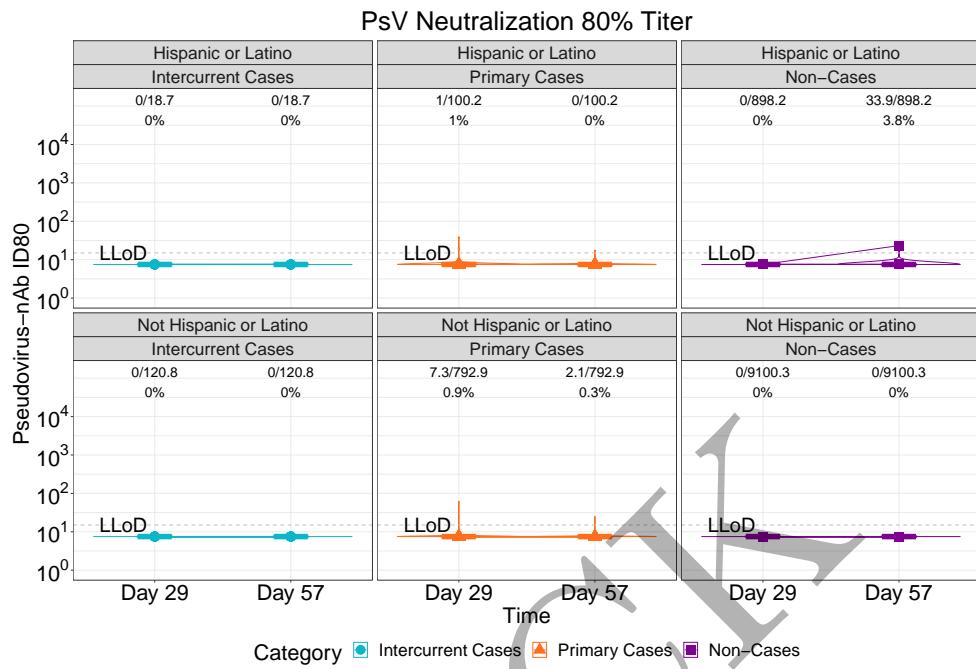


Figure 3.212: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

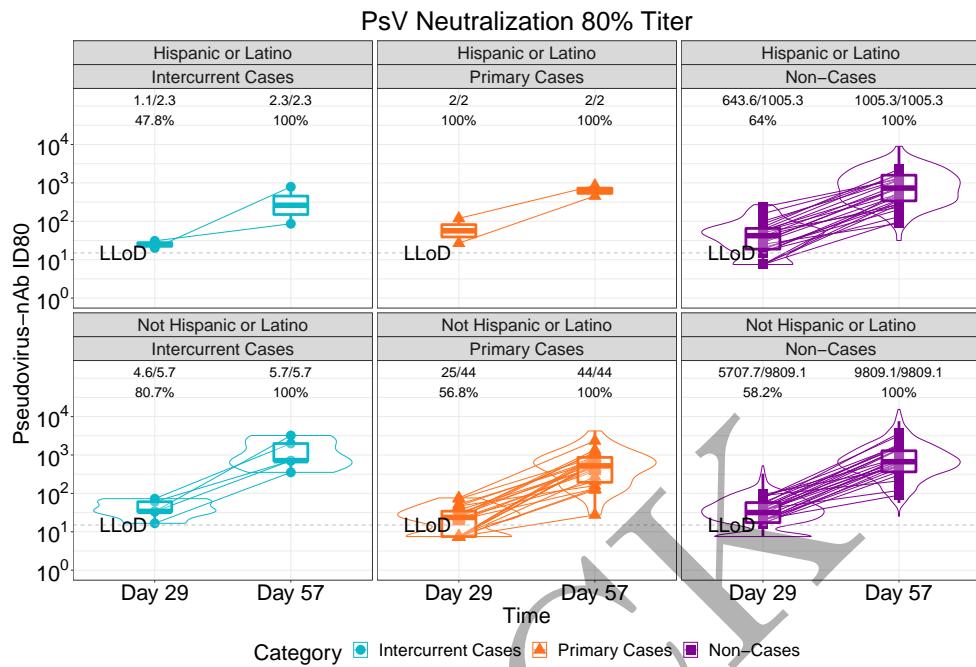


Figure 3.213: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

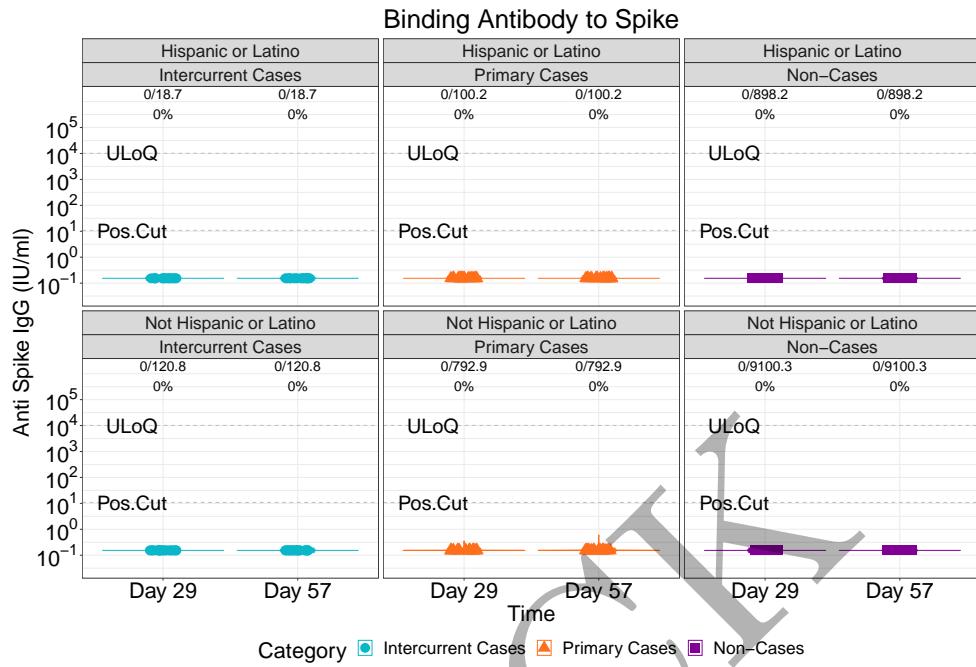


Figure 3.214: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

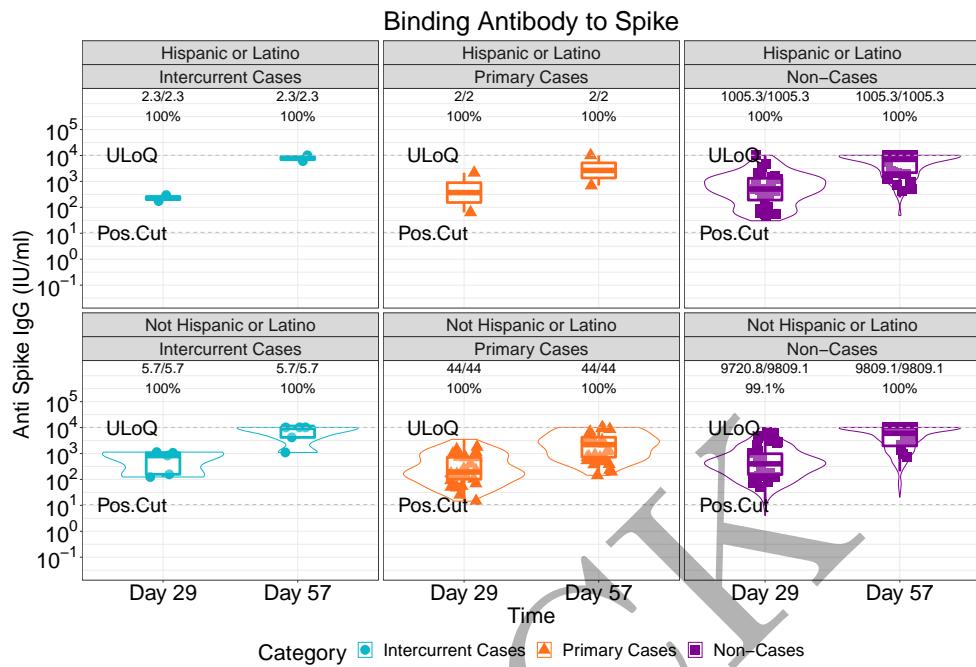


Figure 3.215: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

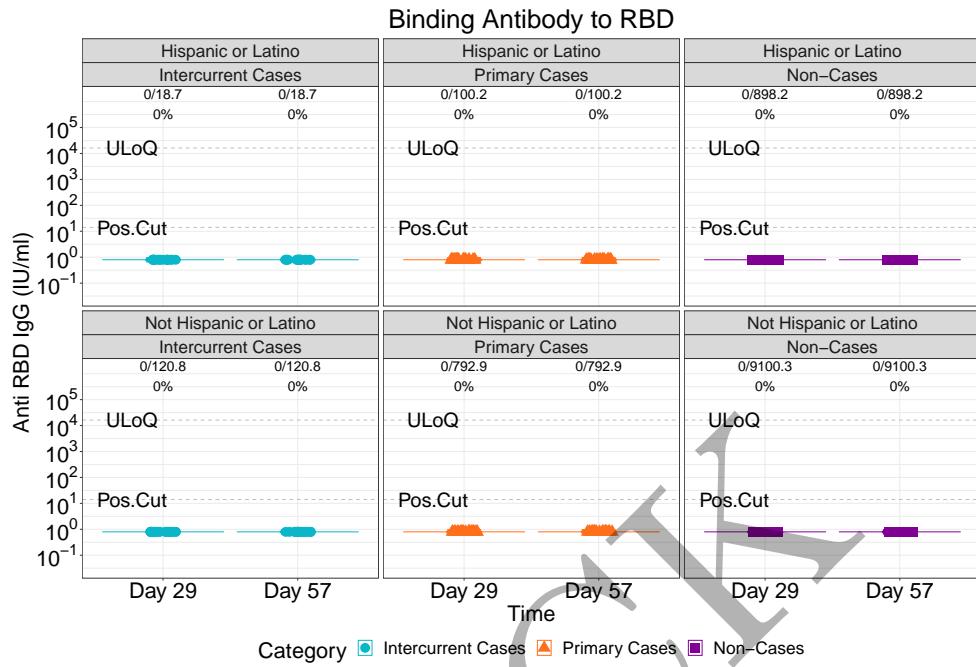


Figure 3.216: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

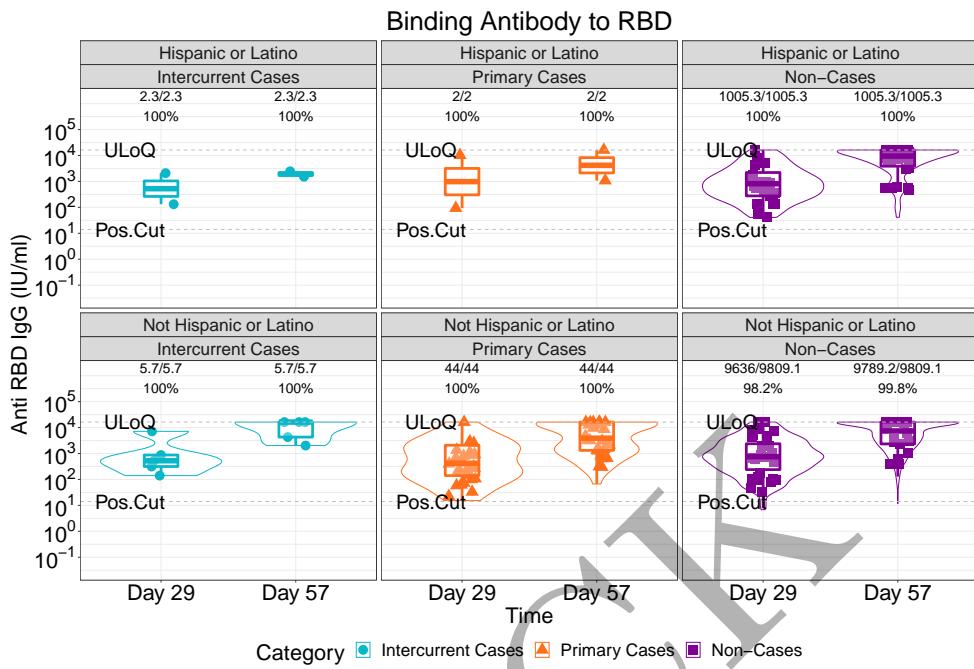


Figure 3.217: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

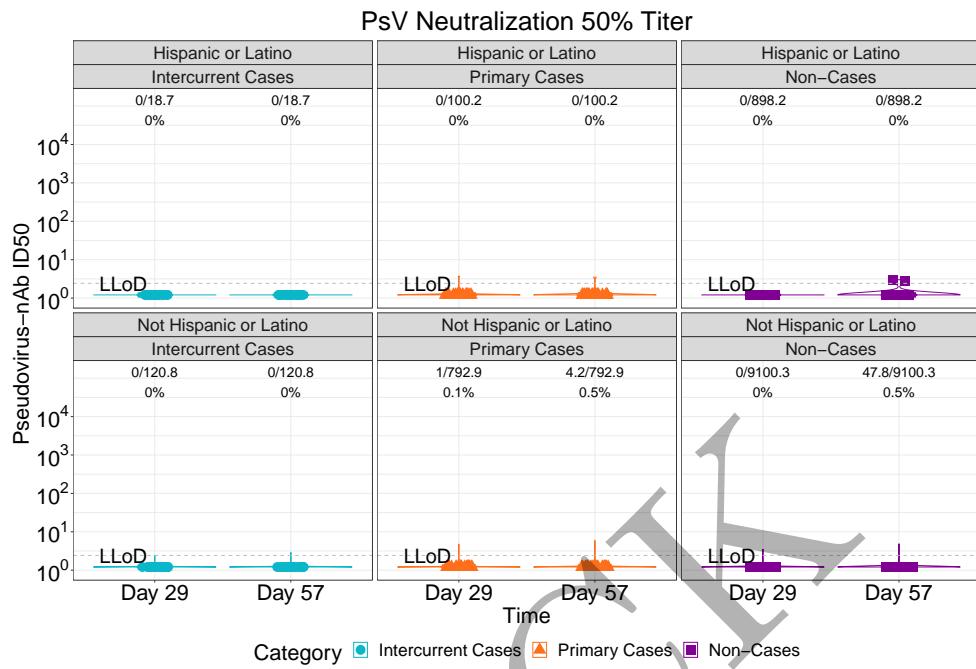


Figure 3.218: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

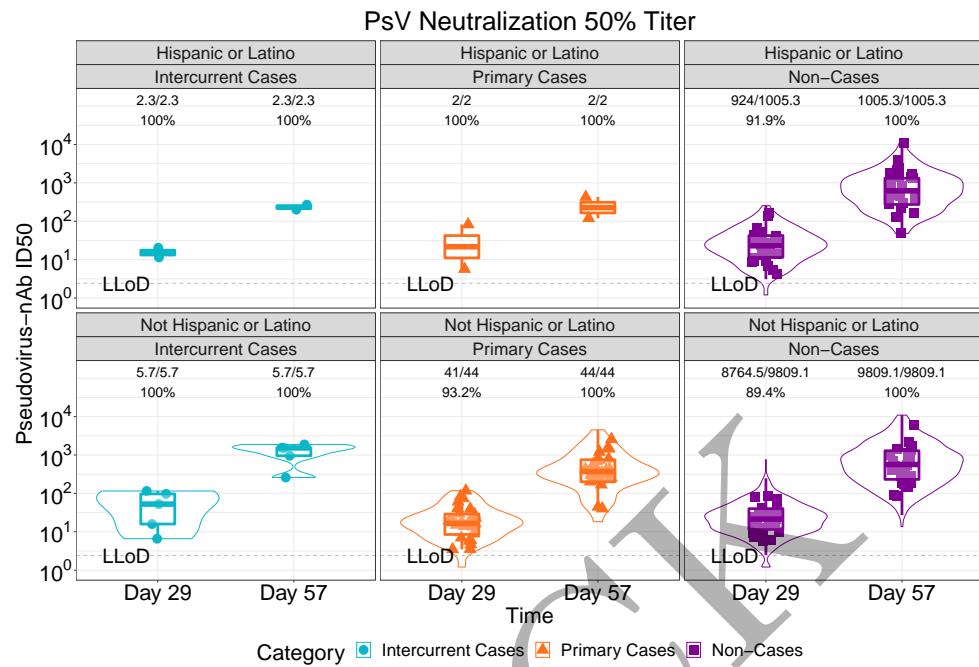


Figure 3.219: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

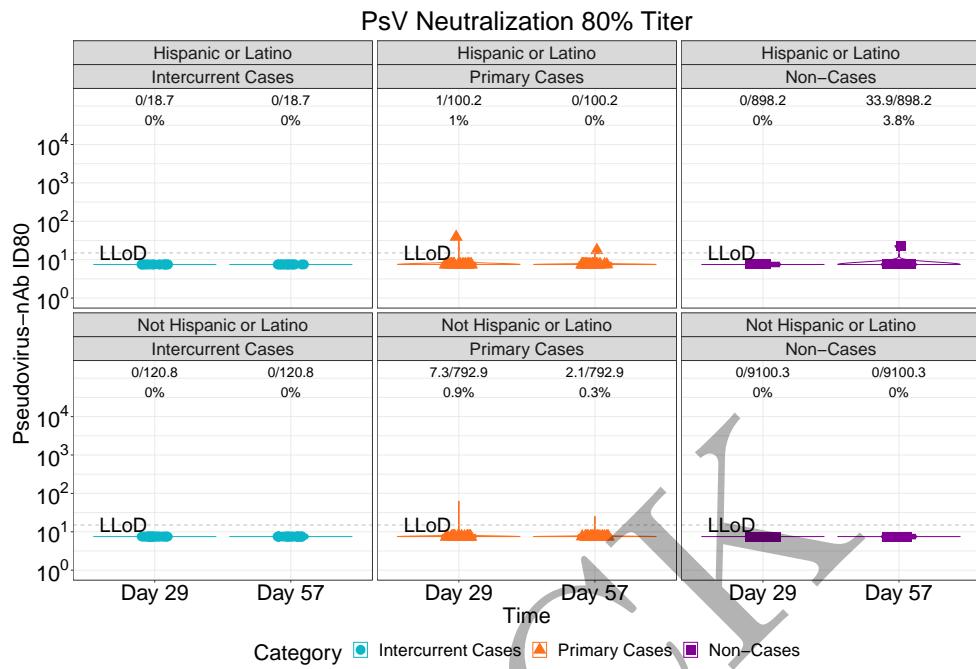


Figure 3.220: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 1)

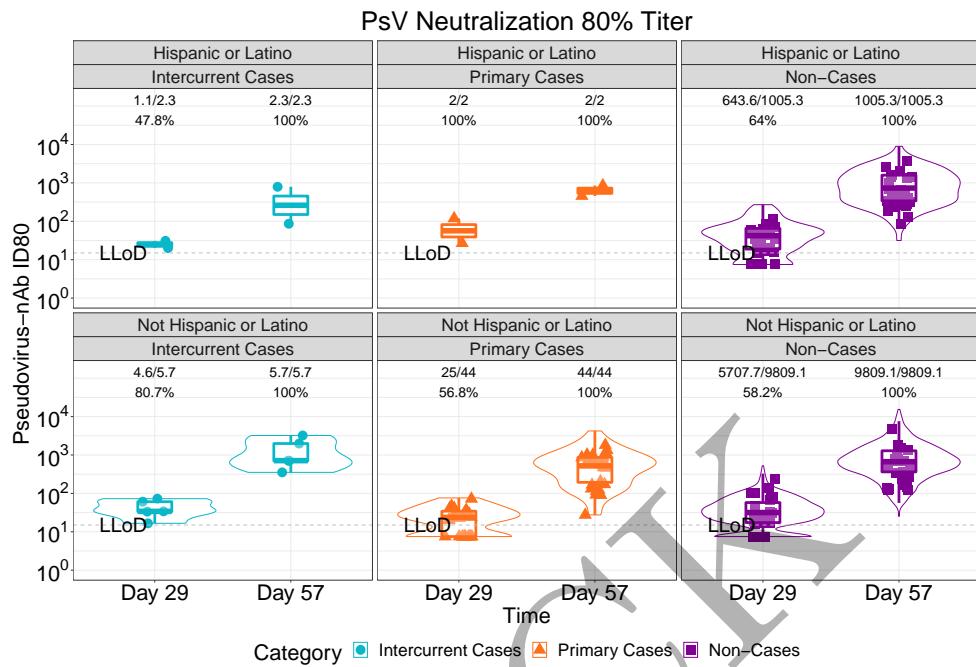


Figure 3.221: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 1)

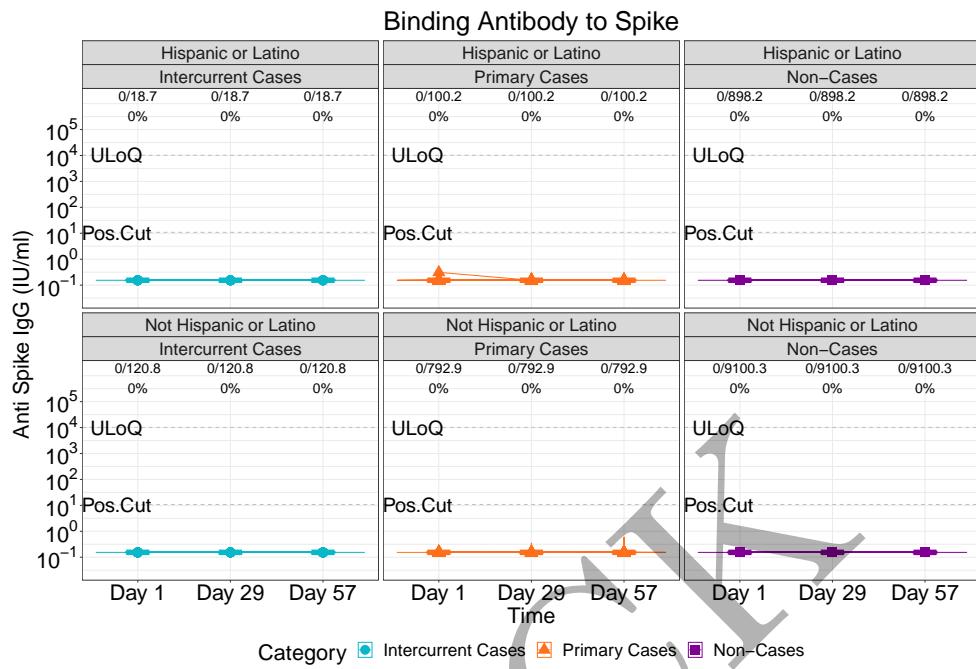


Figure 3.222: lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

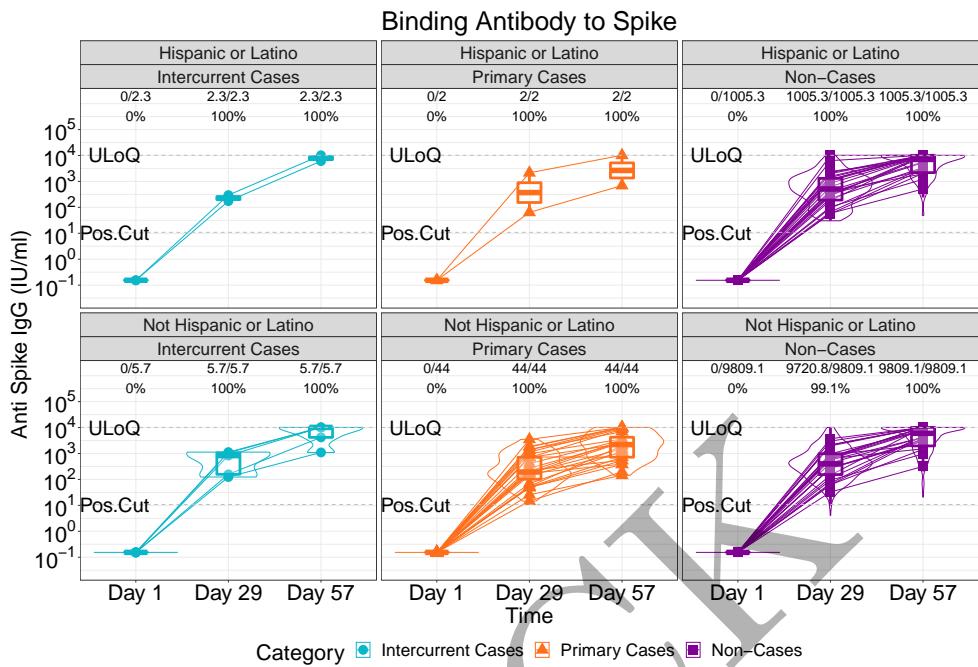


Figure 3.223: lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

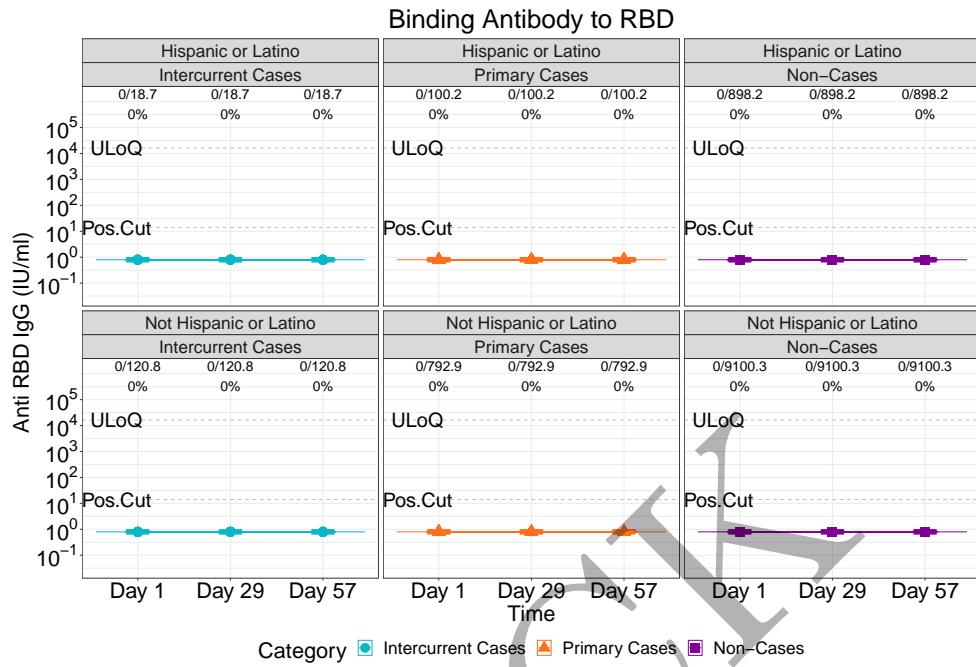


Figure 3.224: lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

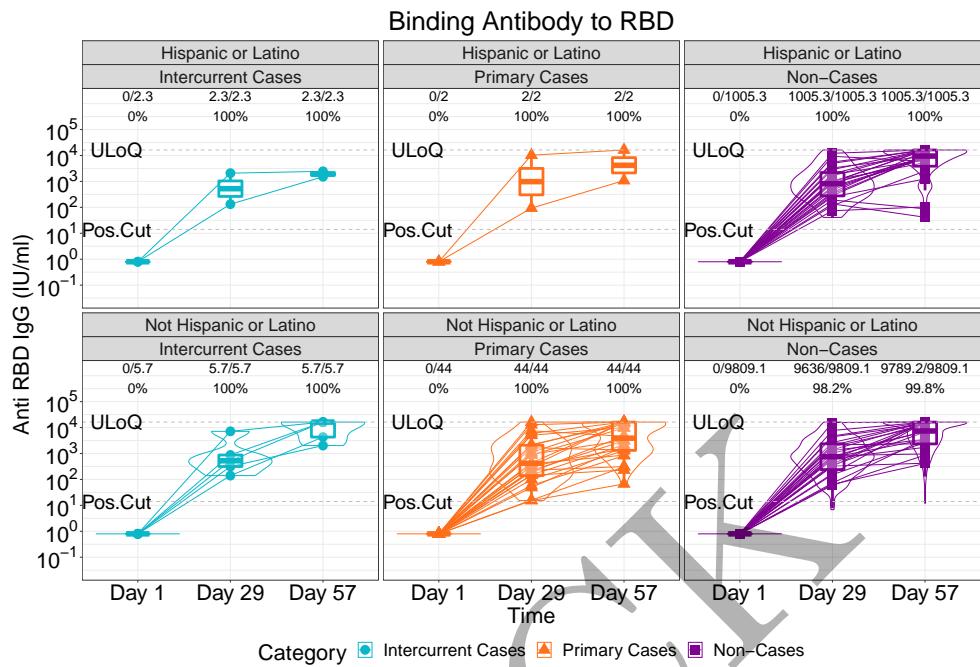


Figure 3.225: lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

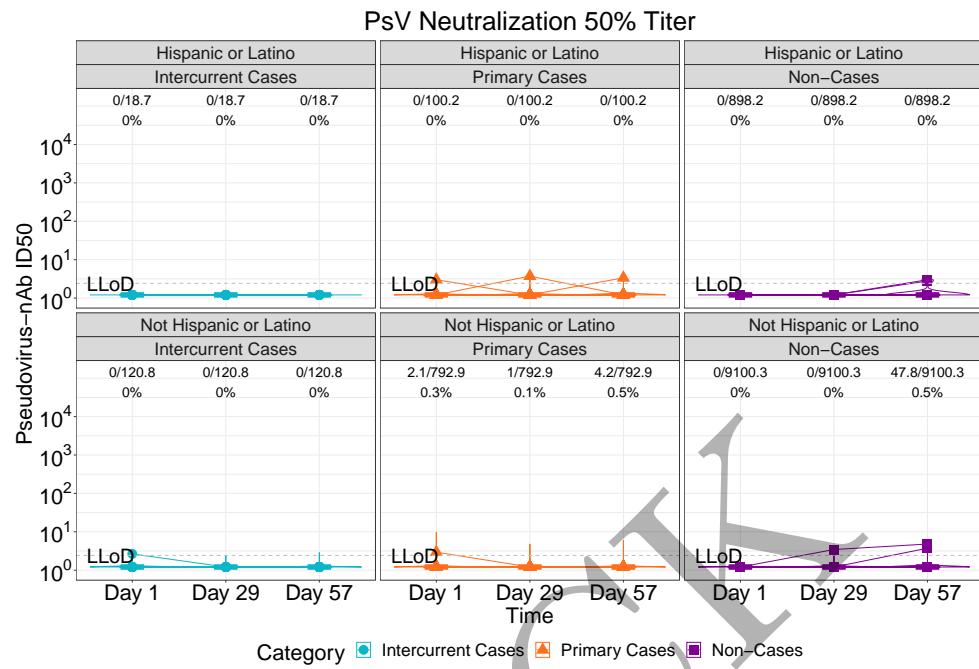


Figure 3.226: lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

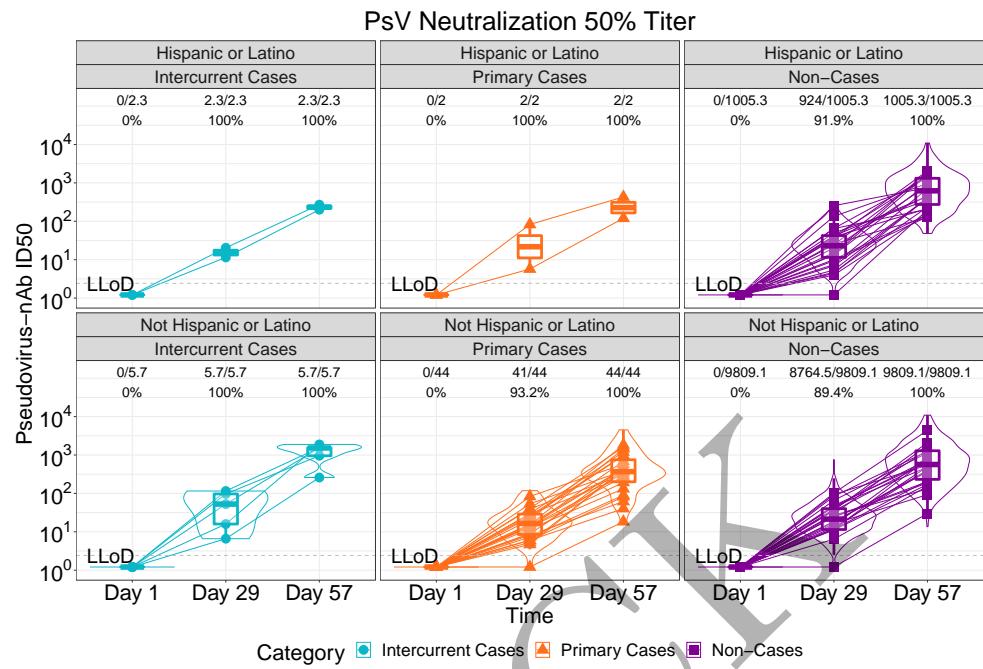


Figure 3.227: lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

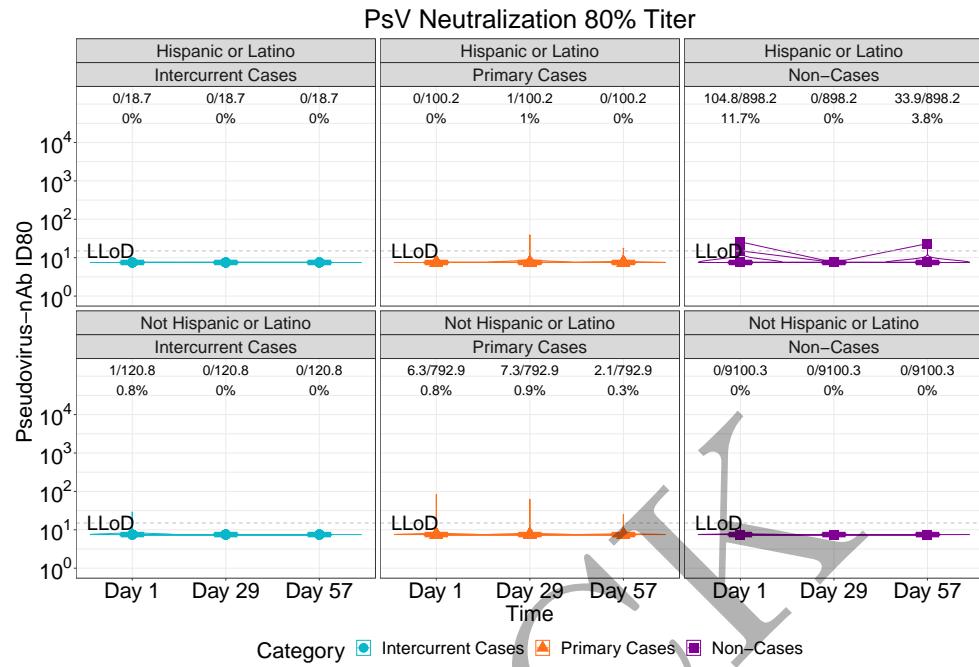


Figure 3.228: lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

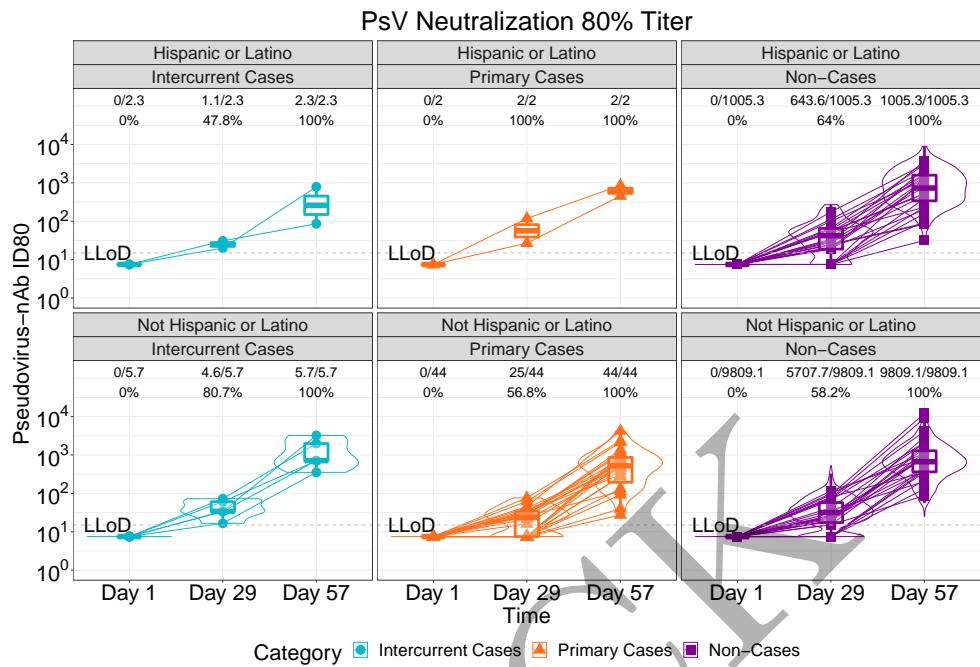


Figure 3.229: lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

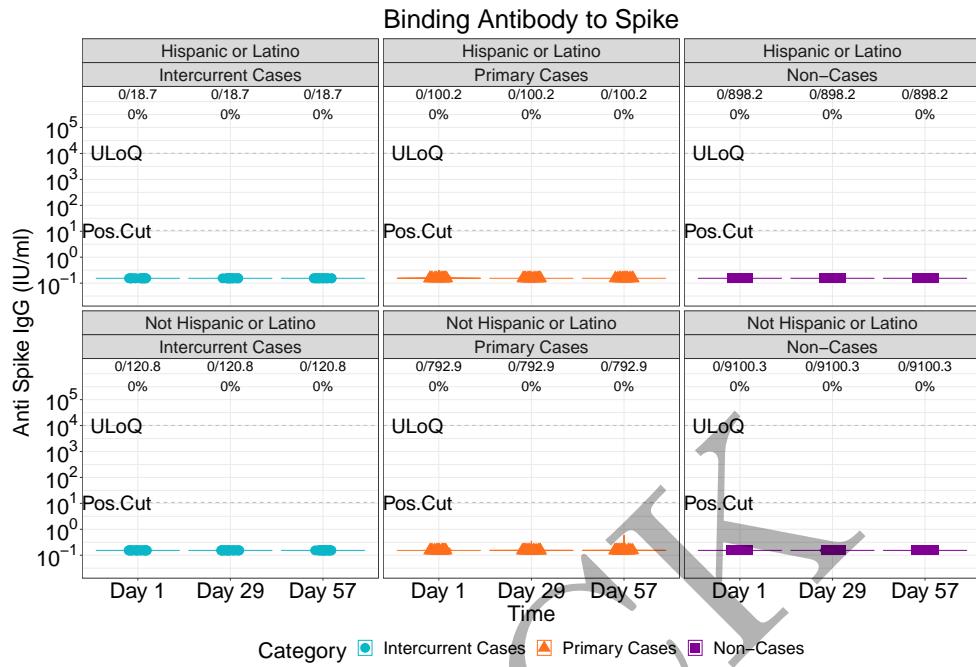


Figure 3.230: violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

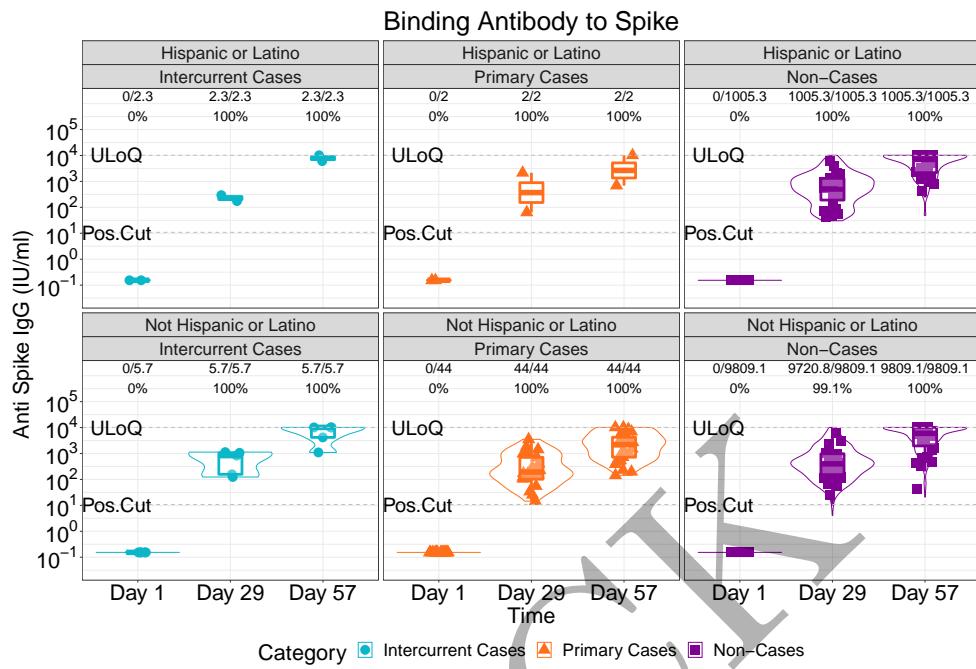


Figure 3.231: violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

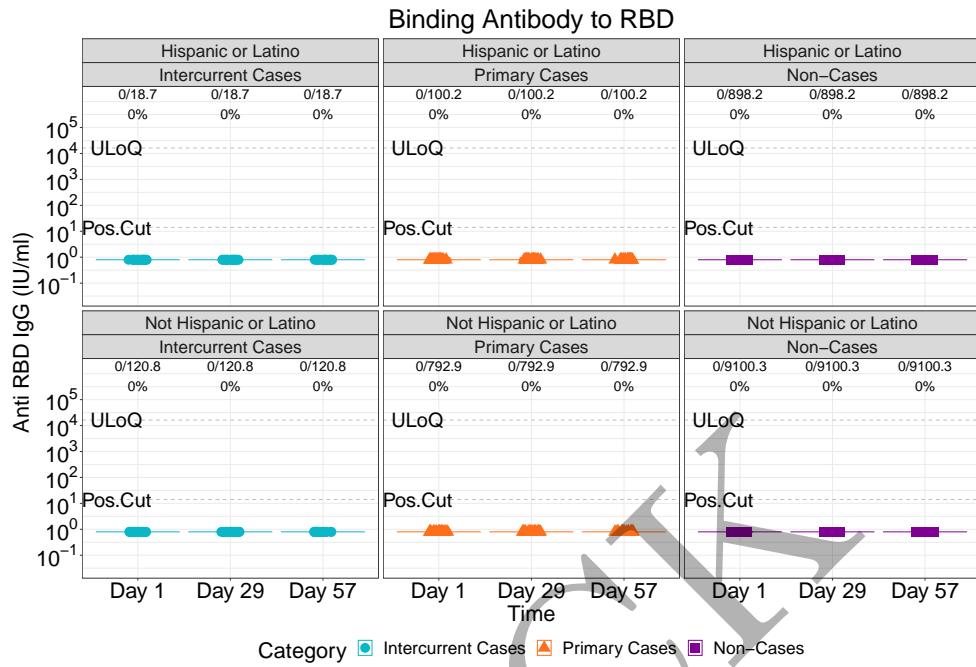


Figure 3.232: violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

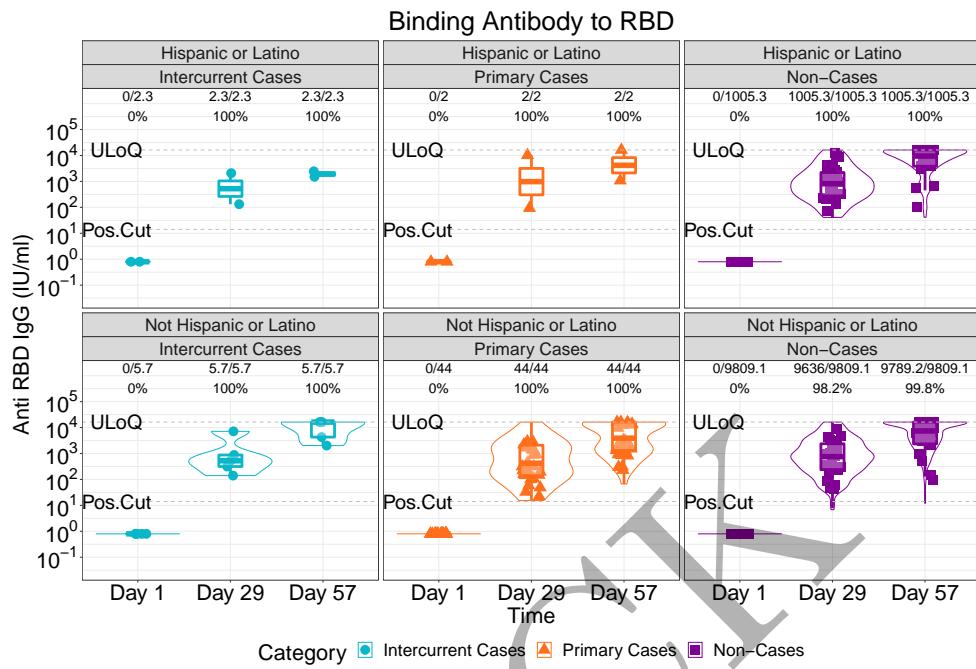


Figure 3.233: violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

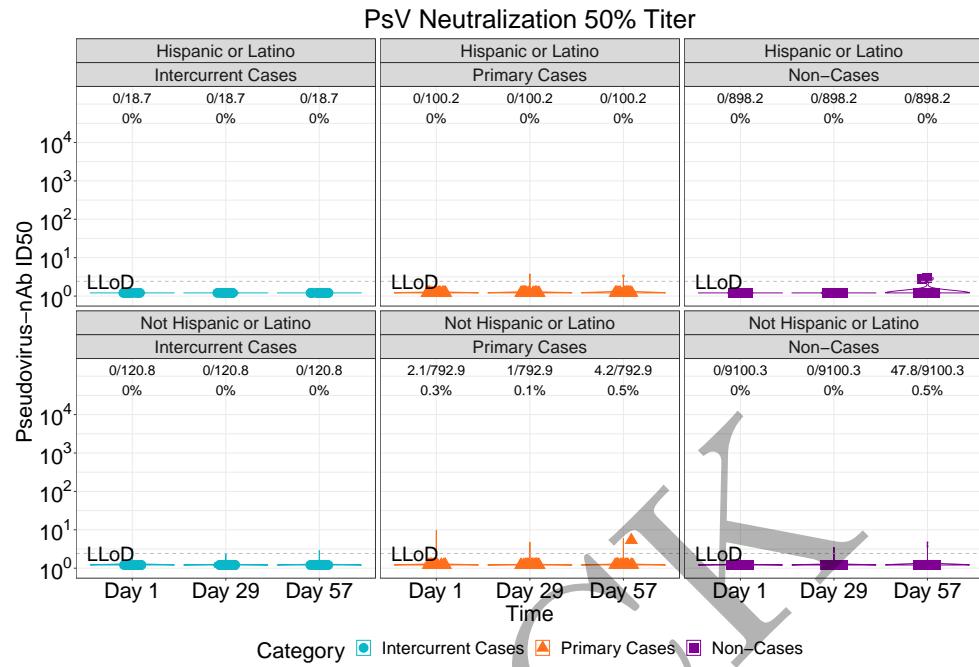


Figure 3.234: violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

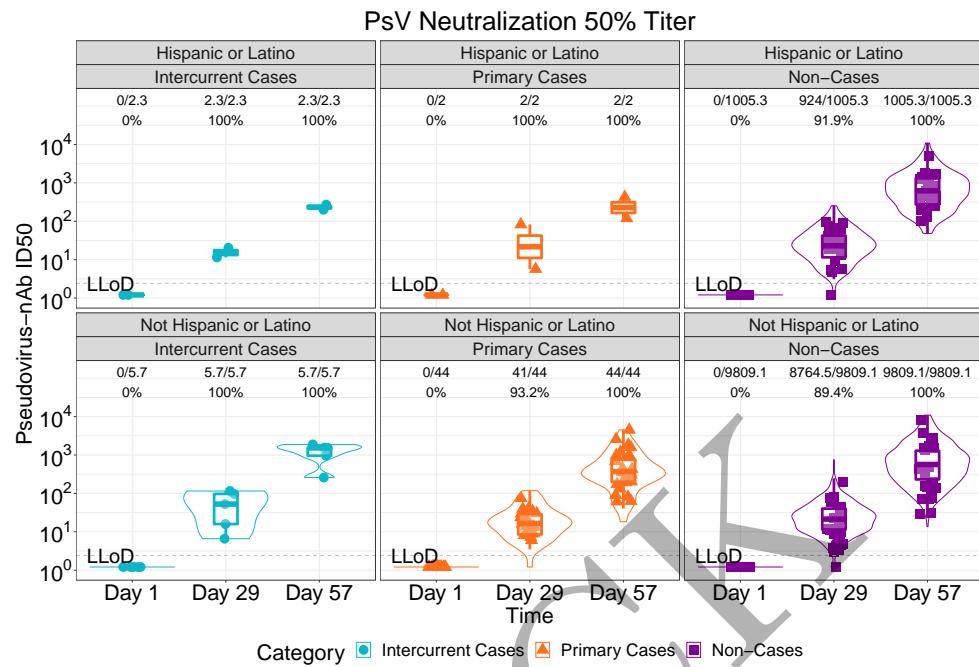


Figure 3.235: violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

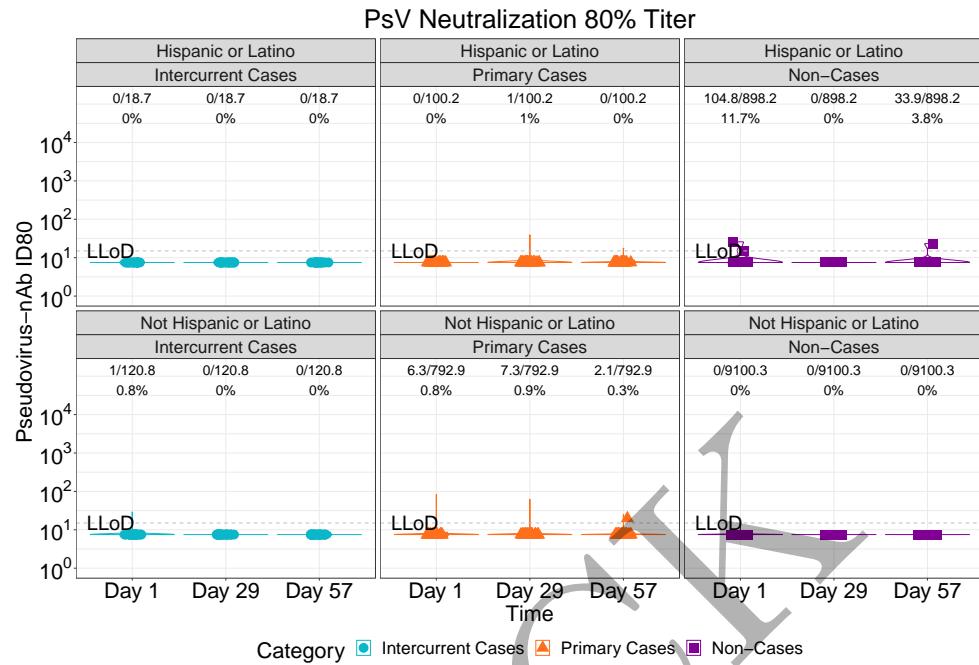


Figure 3.236: violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (version 2)

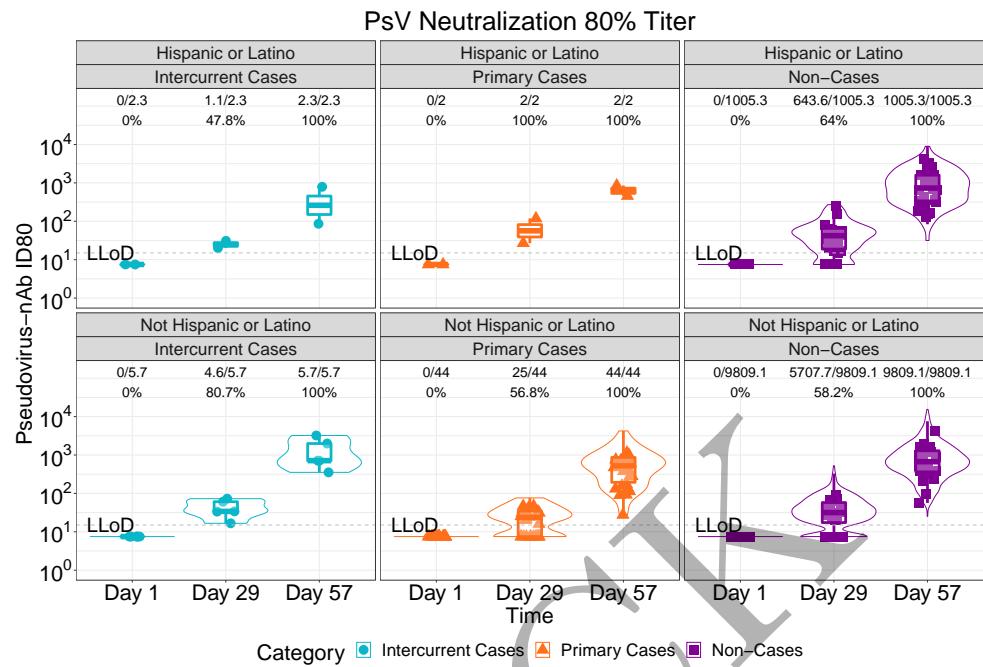


Figure 3.237: violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (version 2)

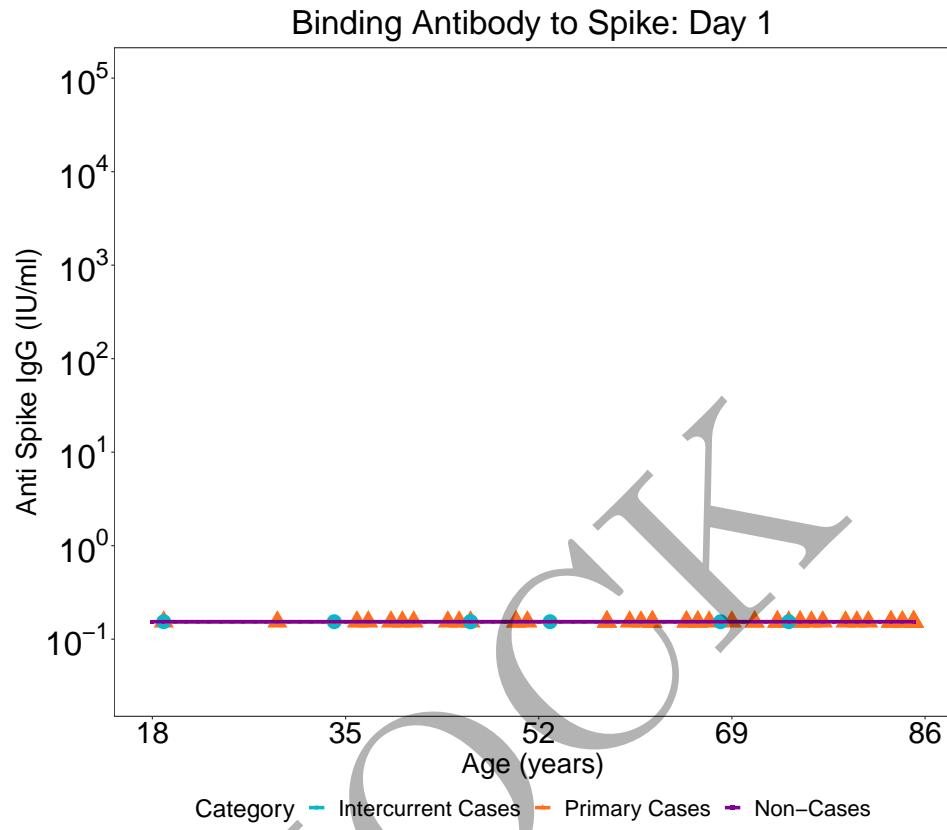


Figure 3.238: scatterplots of Binding Antibody to Spike vs Age: baseline negative vaccine arm at day 1

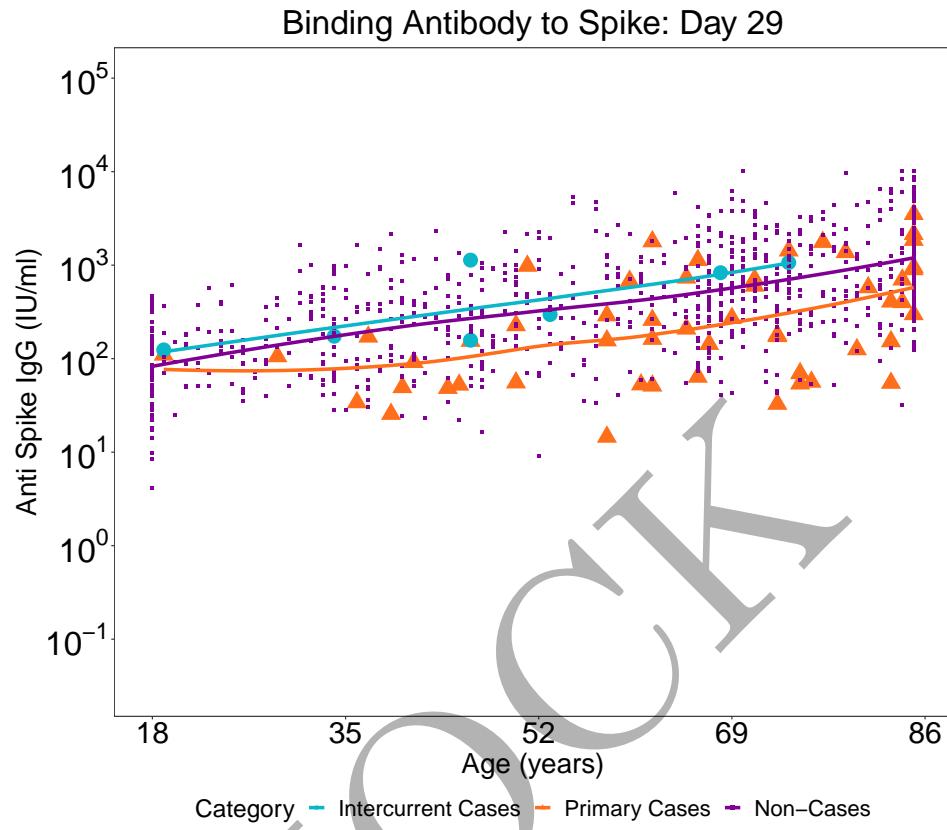


Figure 3.239: scatterplots of Binding Antibody to Spike vs Age: baseline negative vaccine arm at day 29

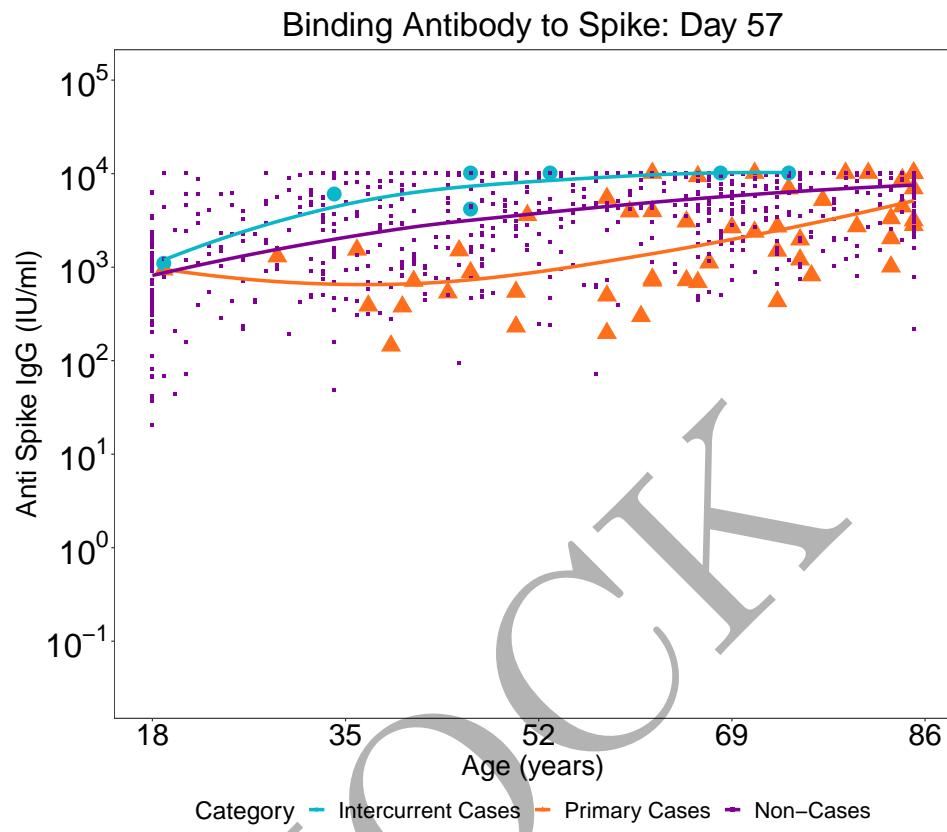


Figure 3.240: scatterplots of Binding Antibody to Spike vs Age: baseline negative vaccine arm at day 57

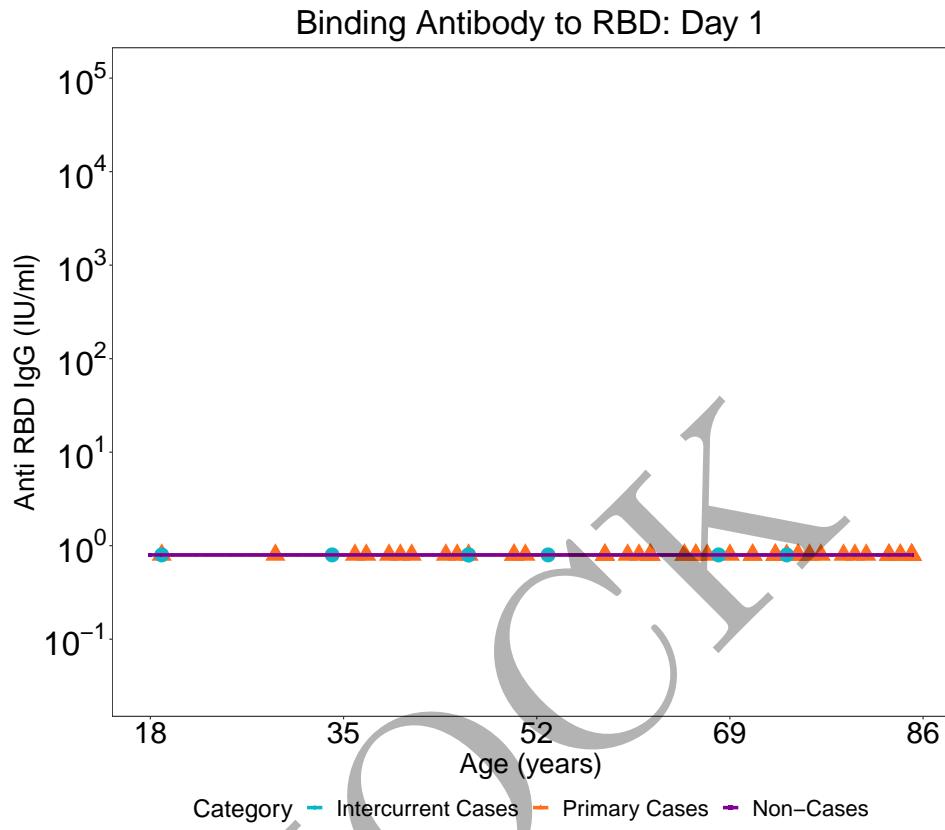


Figure 3.241: scatterplots of Binding Antibody to RBD vs Age: baseline negative vaccine arm at day 1

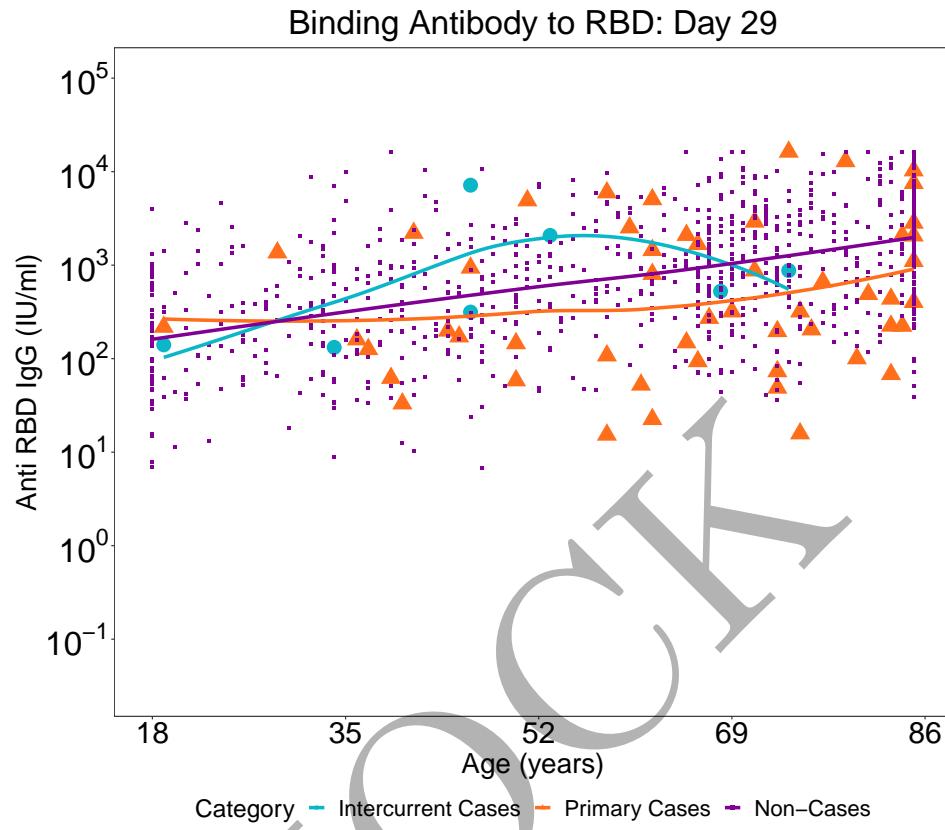


Figure 3.242: scatterplots of Binding Antibody to RBD vs Age: baseline negative vaccine arm at day 29

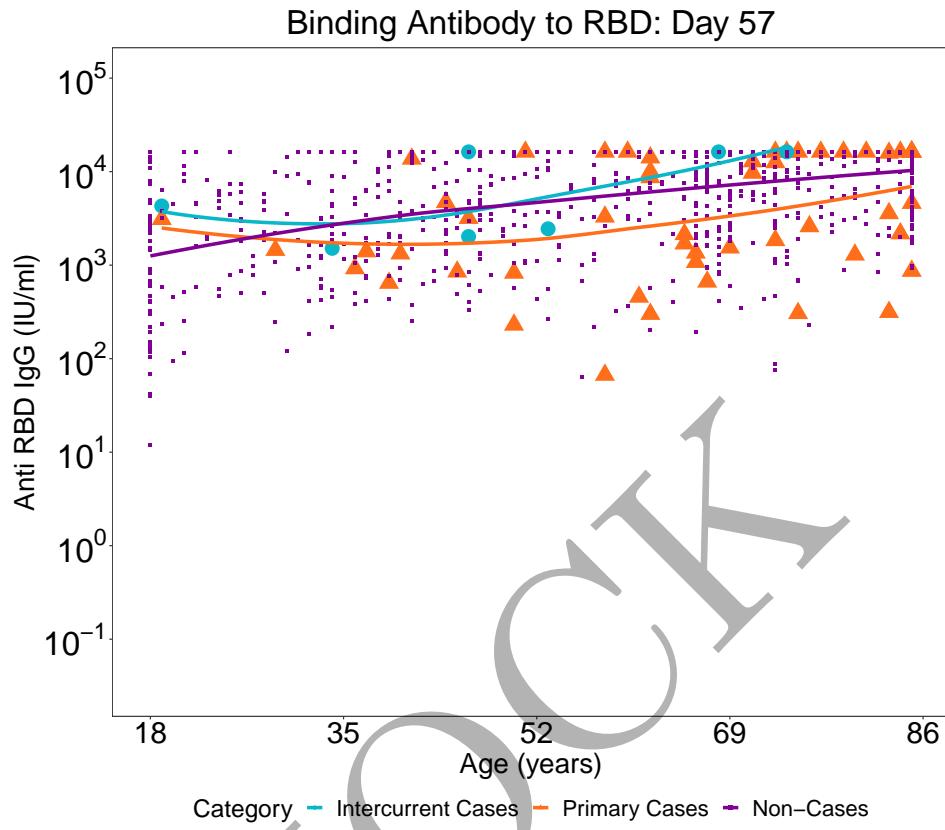


Figure 3.243: scatterplots of Binding Antibody to RBD vs Age: baseline negative vaccine arm at day 57

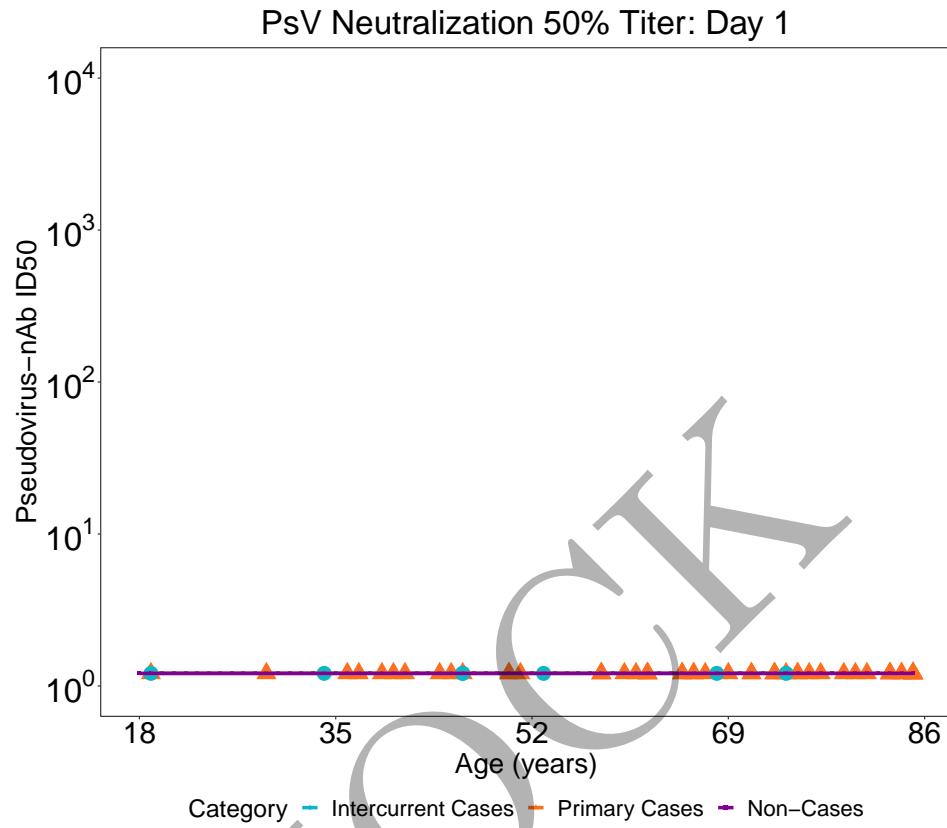


Figure 3.244: scatterplots of Pseudovirus Neutralization ID50 vs Age: baseline negative vaccine arm at day 1

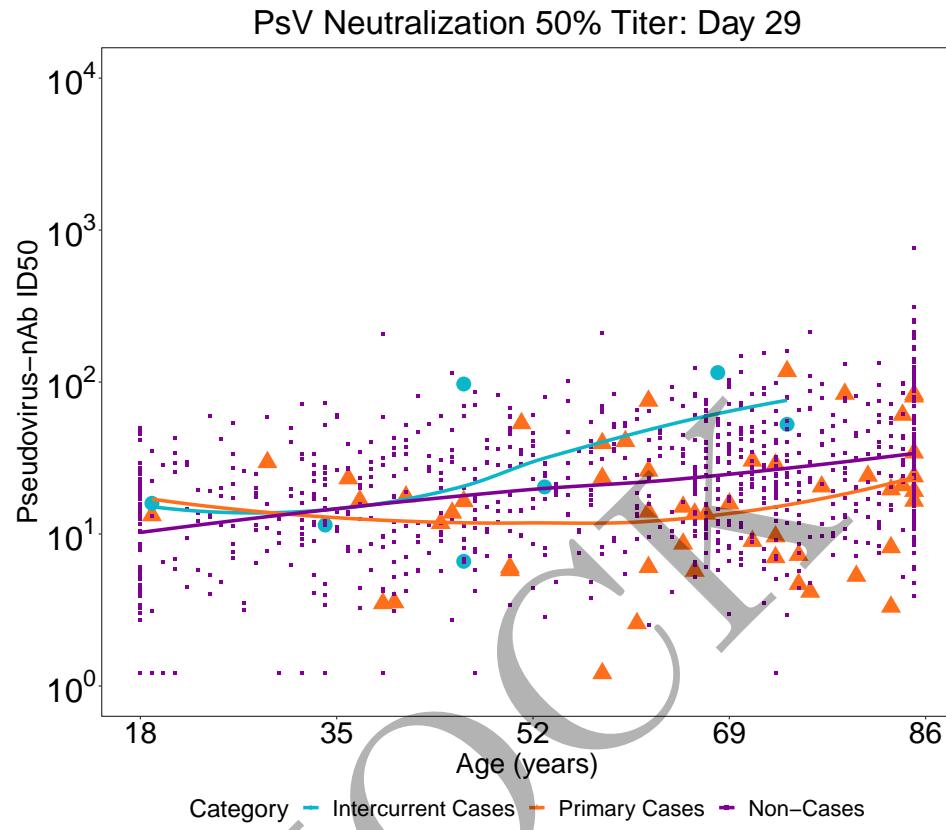


Figure 3.245: scatterplots of Pseudovirus Neutralization ID₅₀ vs Age: baseline negative vaccine arm at day 29

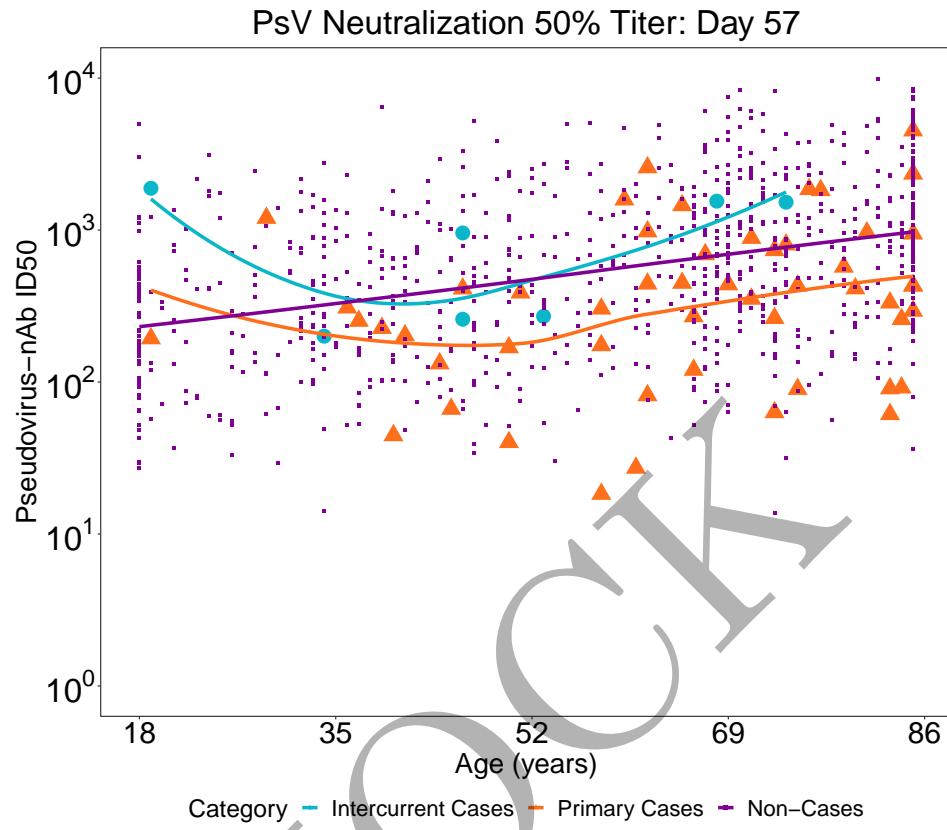


Figure 3.246: scatterplots of Pseudovirus Neutralization ID₅₀ vs Age: baseline negative vaccine arm at day 57

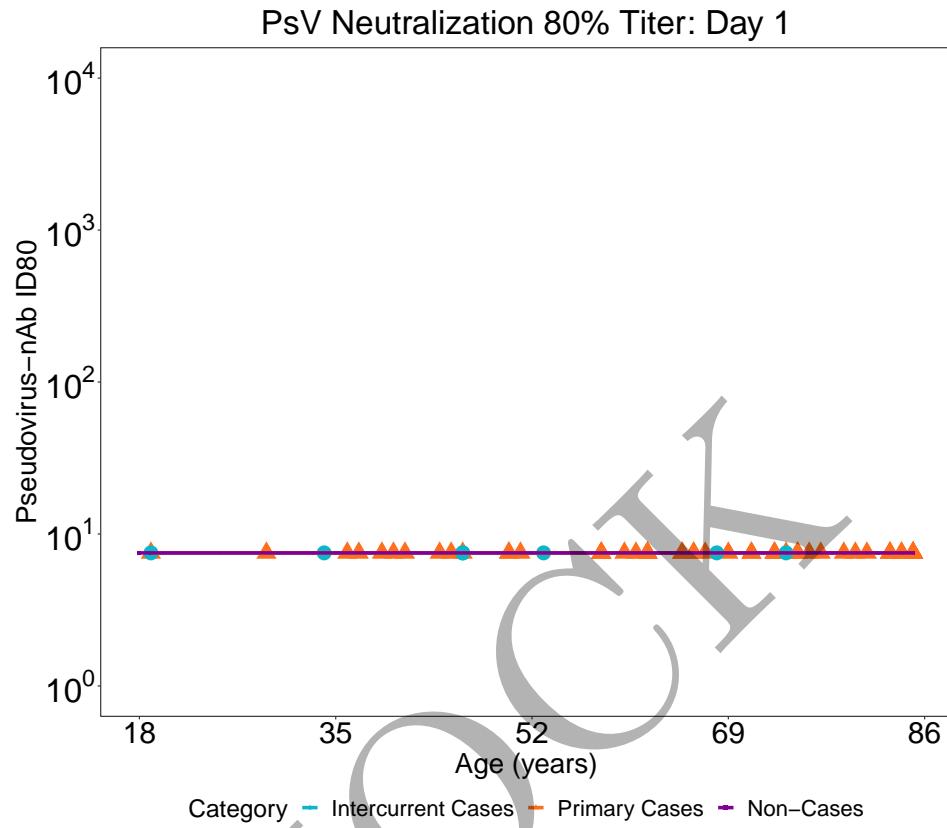


Figure 3.247: scatterplots of Pseudovirus Neutralization ID80 vs Age: baseline negative vaccine arm at day 1

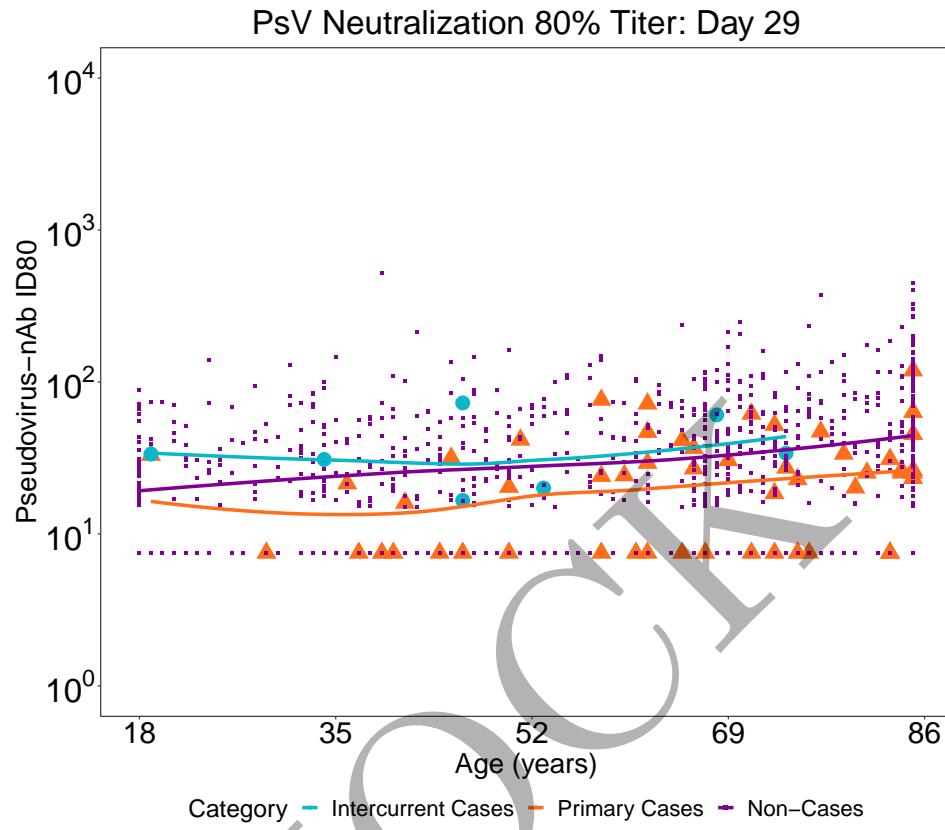


Figure 3.248: scatterplots of Pseudovirus Neutralization ID80 vs Age: baseline negative vaccine arm at day 29

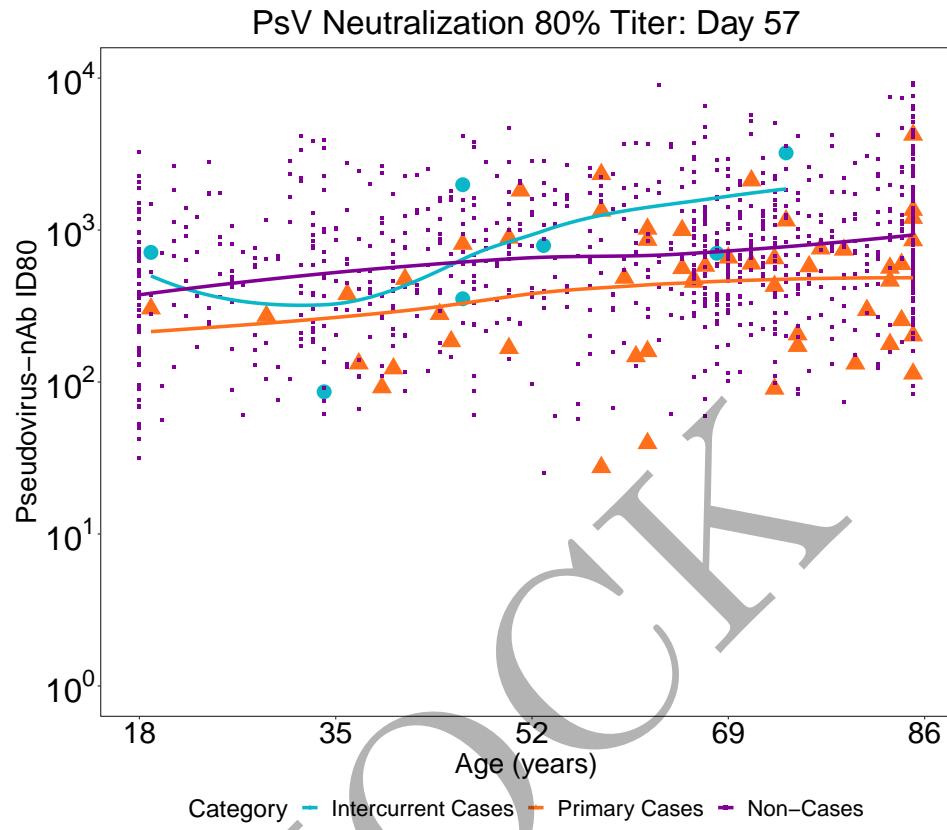


Figure 3.249: scatterplots of Pseudovirus Neutralization ID80 vs Age: baseline negative vaccine arm at day 57

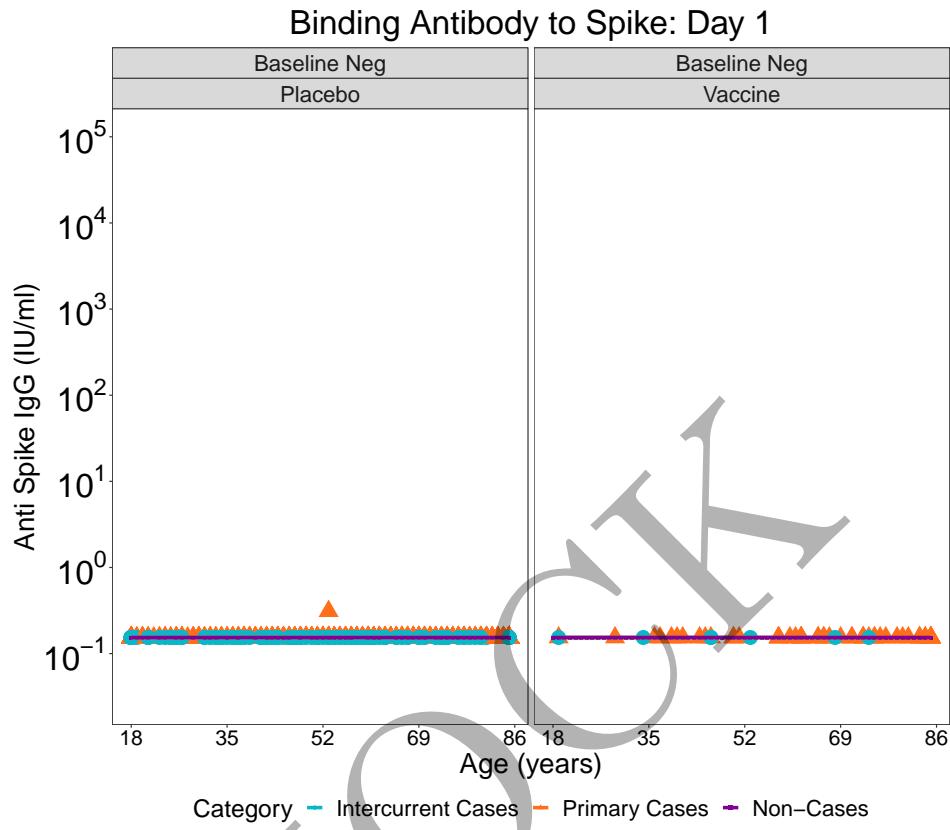


Figure 3.250: scatterplots of Binding Antibody to Spike vs Age: by arm at day 1

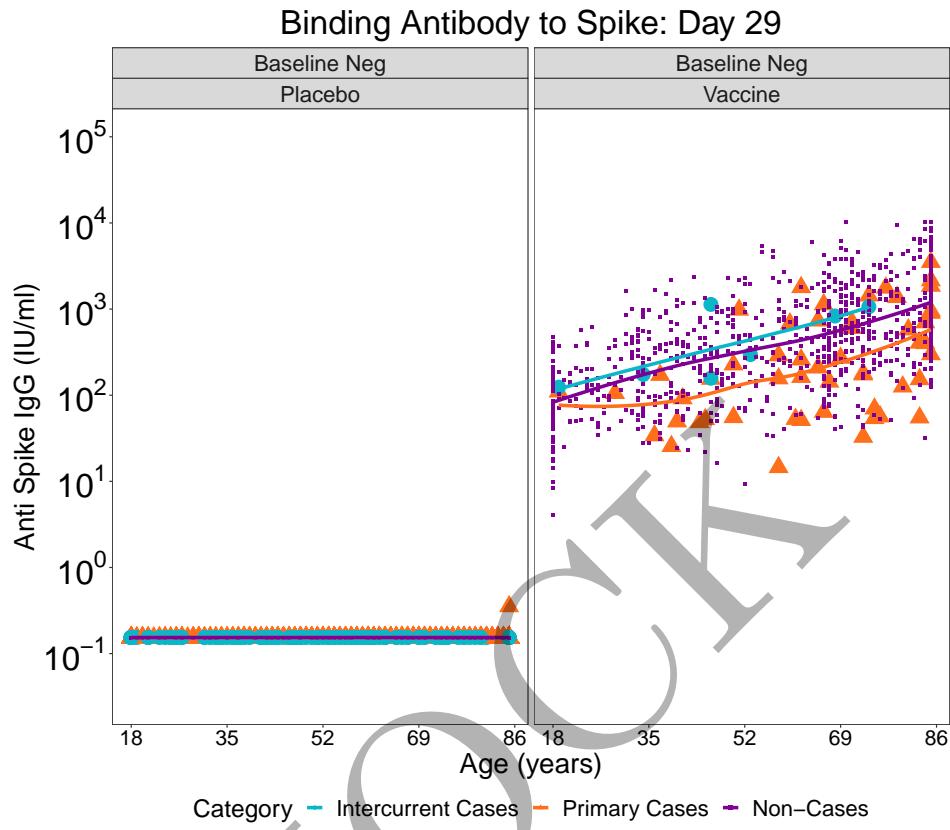


Figure 3.251: scatterplots of Binding Antibody to Spike vs Age: by arm at day 29

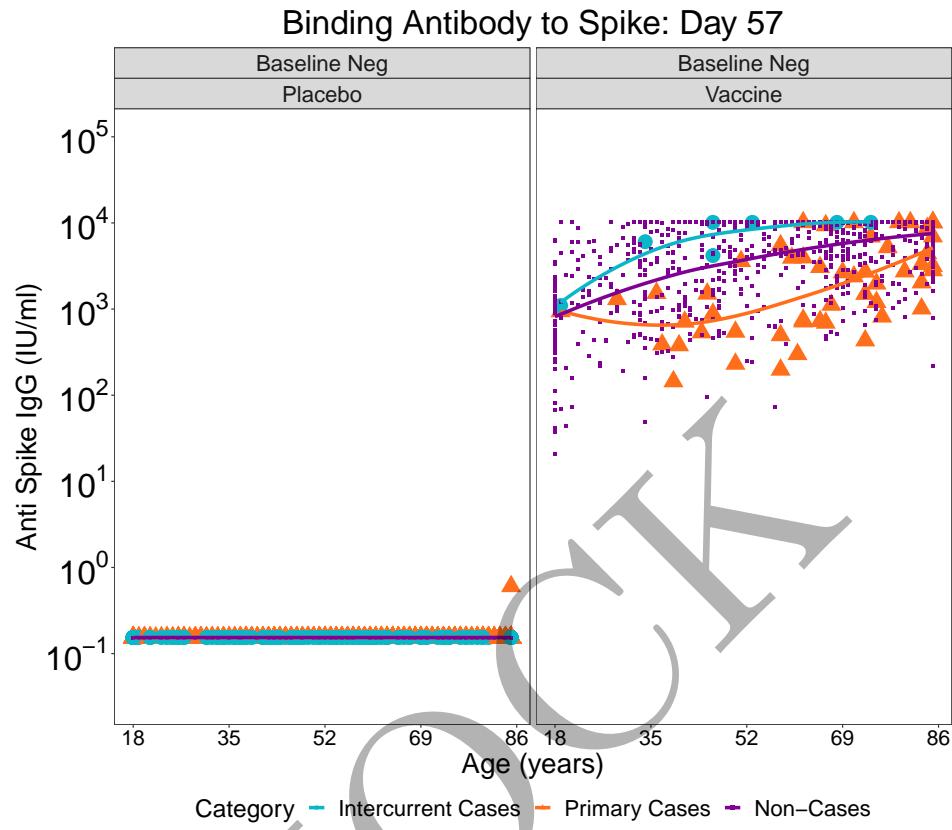


Figure 3.252: scatterplots of Binding Antibody to Spike vs Age: by arm at day 57

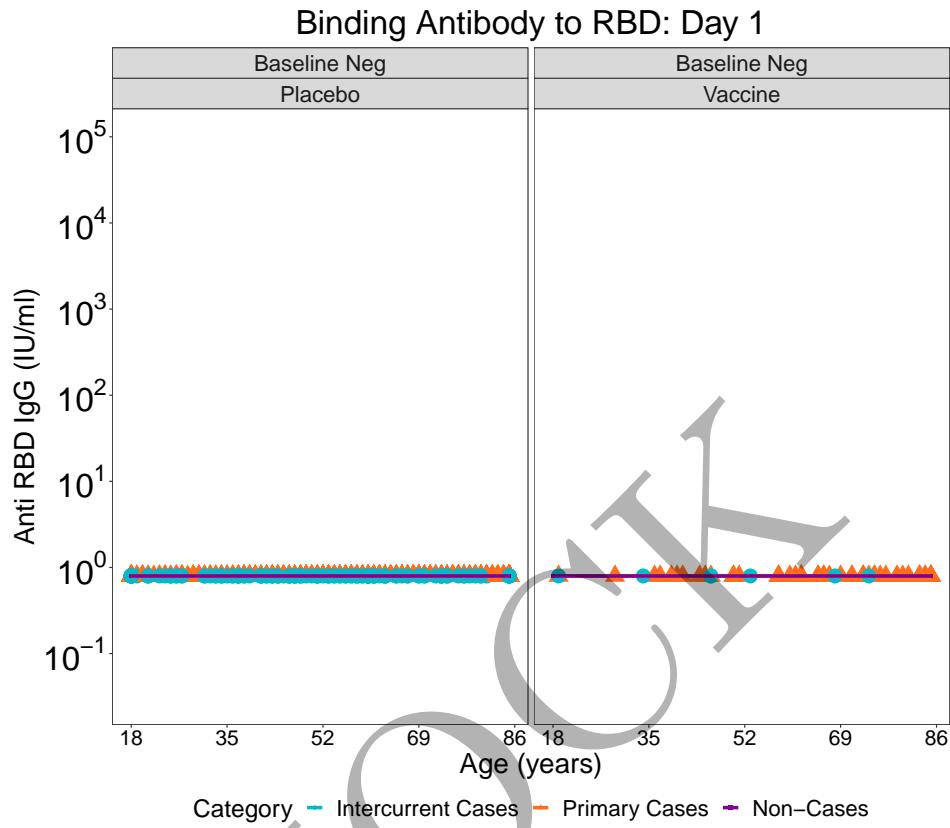


Figure 3.253: scatterplots of Binding Antibody to RBD vs Age: by arm at day 1

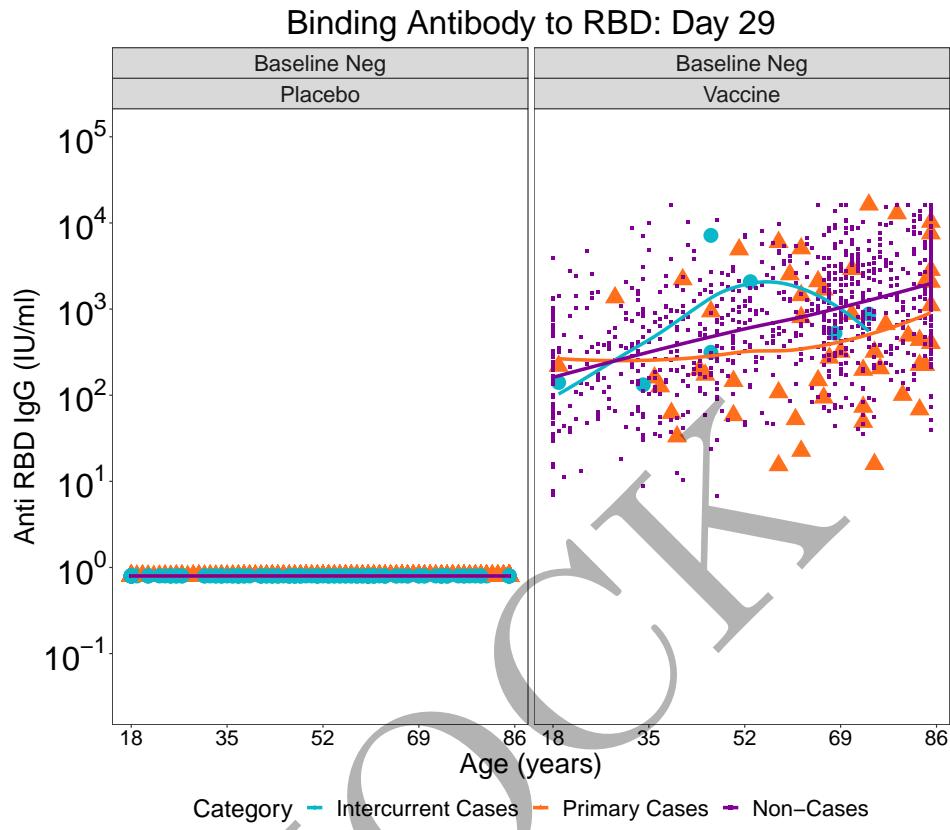


Figure 3.254: scatterplots of Binding Antibody to RBD vs Age: by arm at day 29

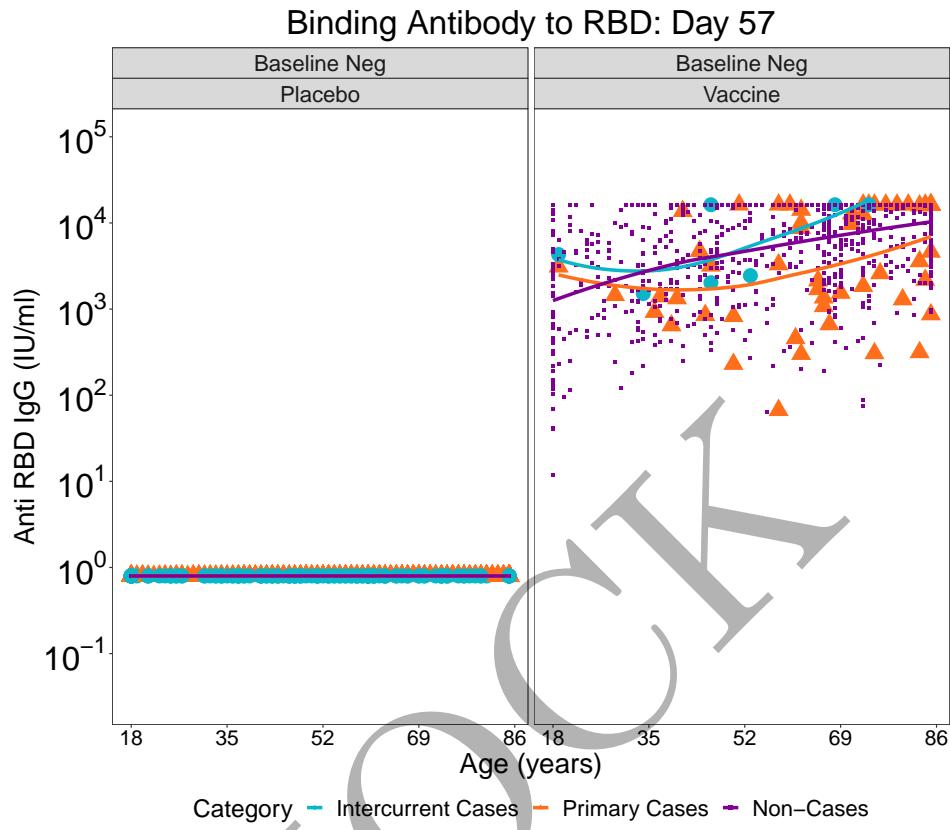


Figure 3.255: scatterplots of Binding Antibody to RBD vs Age: by arm at day 57

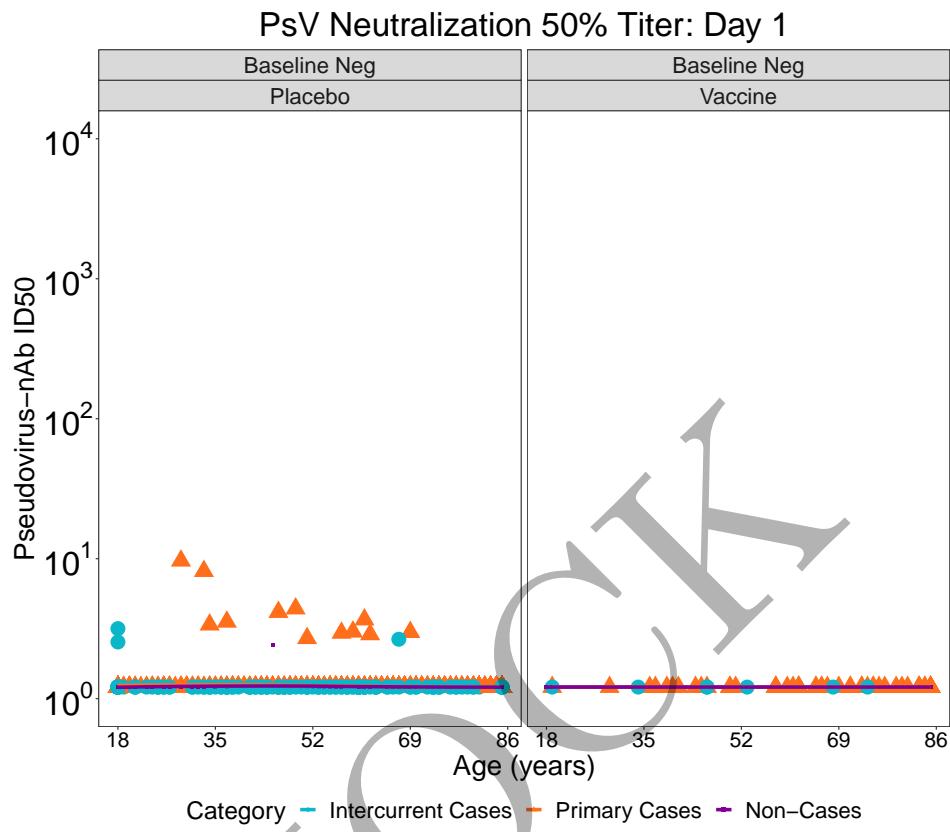


Figure 3.256: scatterplots of Pseudovirus Neutralization ID50 vs Age vs Age: by arm at day 1

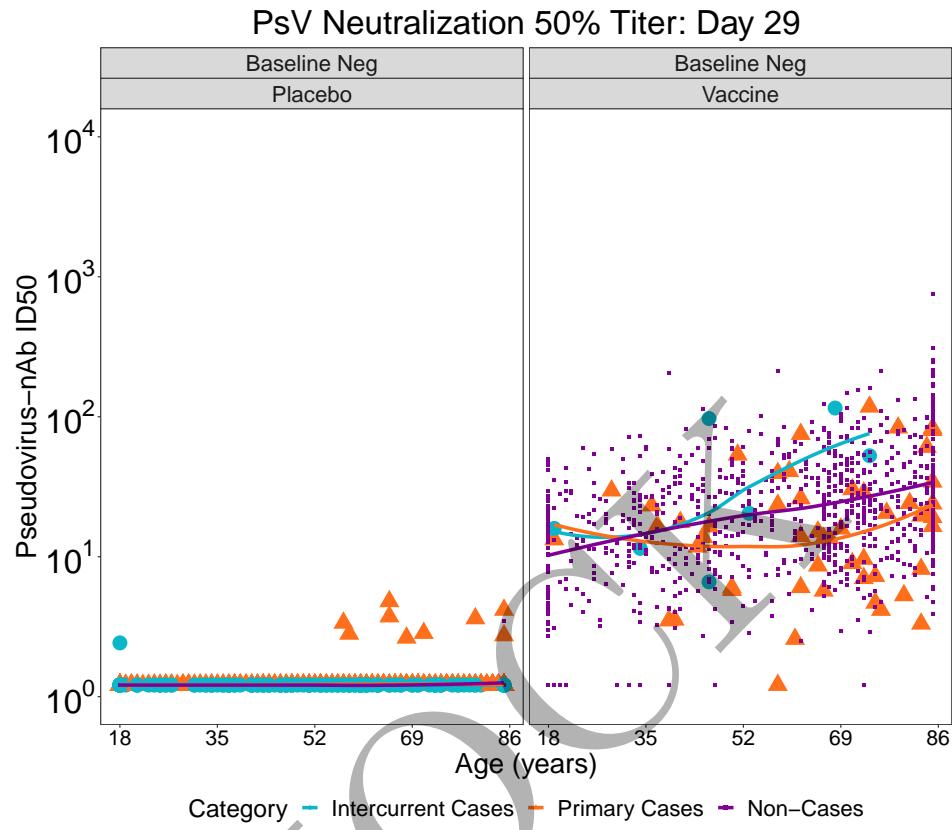


Figure 3.257: scatterplots of Pseudovirus Neutralization ID50 vs Age vs Age: by arm at day 29

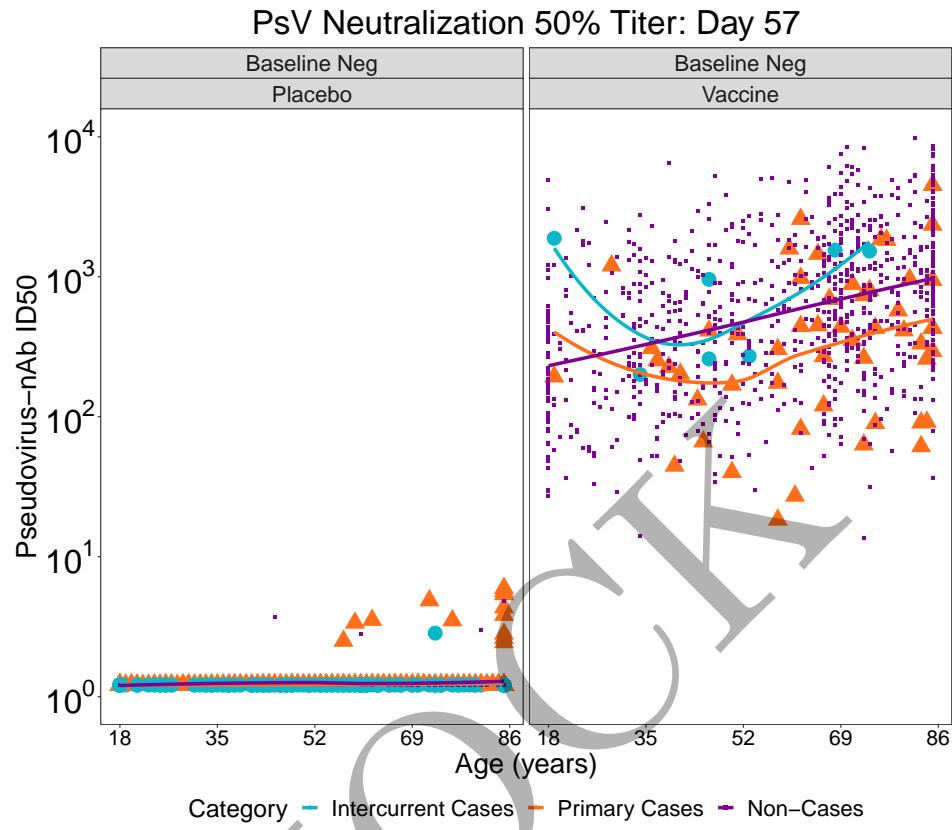


Figure 3.258: scatterplots of Pseudovirus Neutralization ID50 vs Age: by arm at day 57

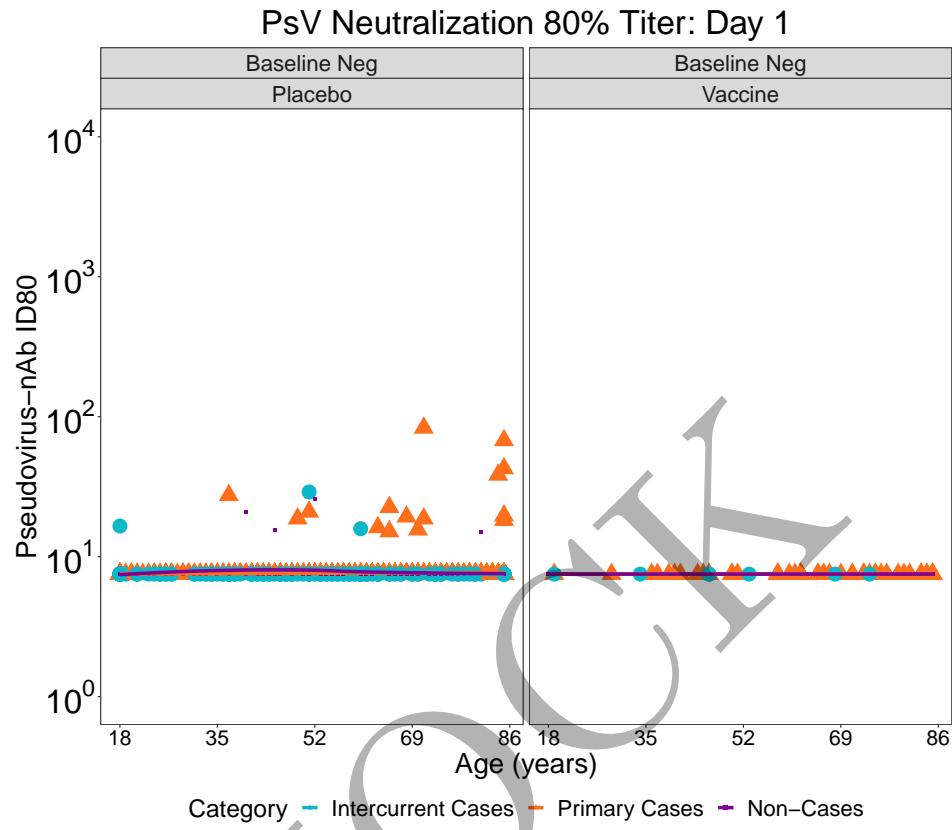


Figure 3.259: scatterplots of Pseudovirus Neutralization ID80 vs Age: by arm at day 1

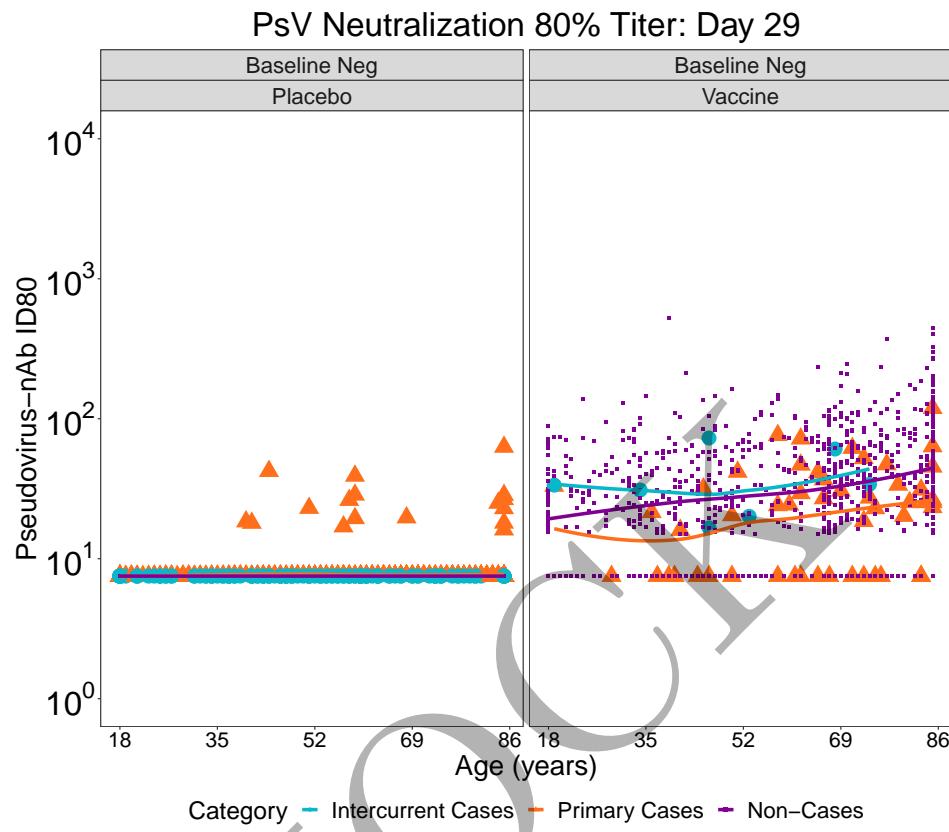


Figure 3.260: scatterplots of Pseudovirus Neutralization ID80 vs Age: by arm at day 29

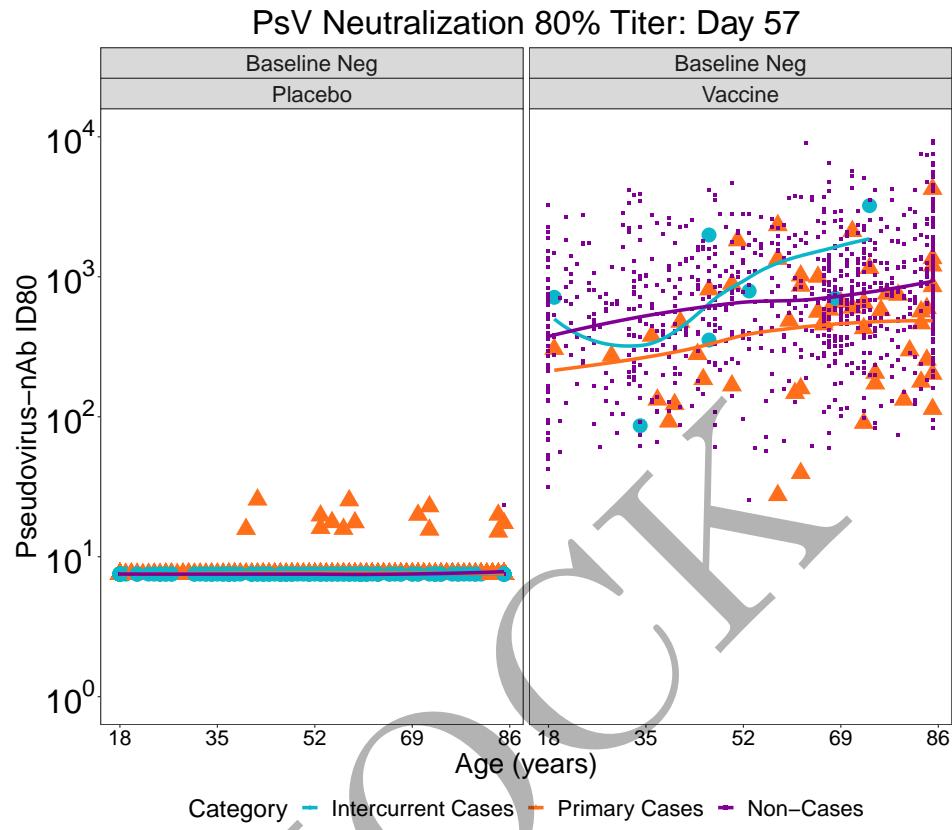


Figure 3.261: scatterplots of Pseudovirus Neutralization ID80 vs Age: by arm at day 57

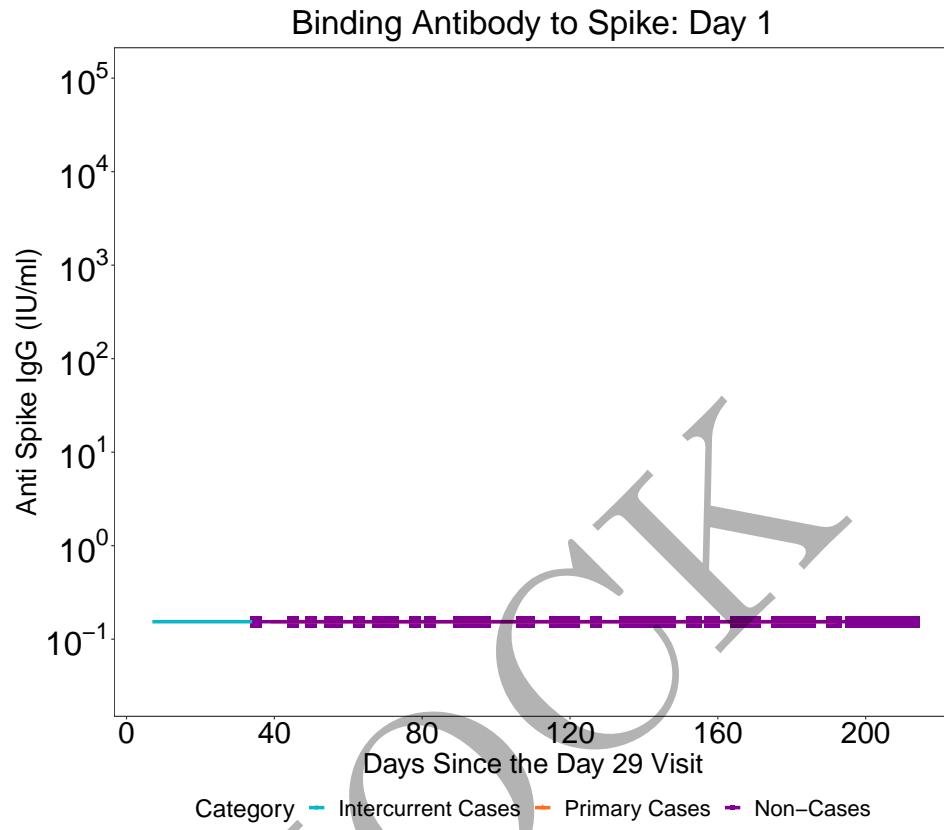


Figure 3.262: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 1

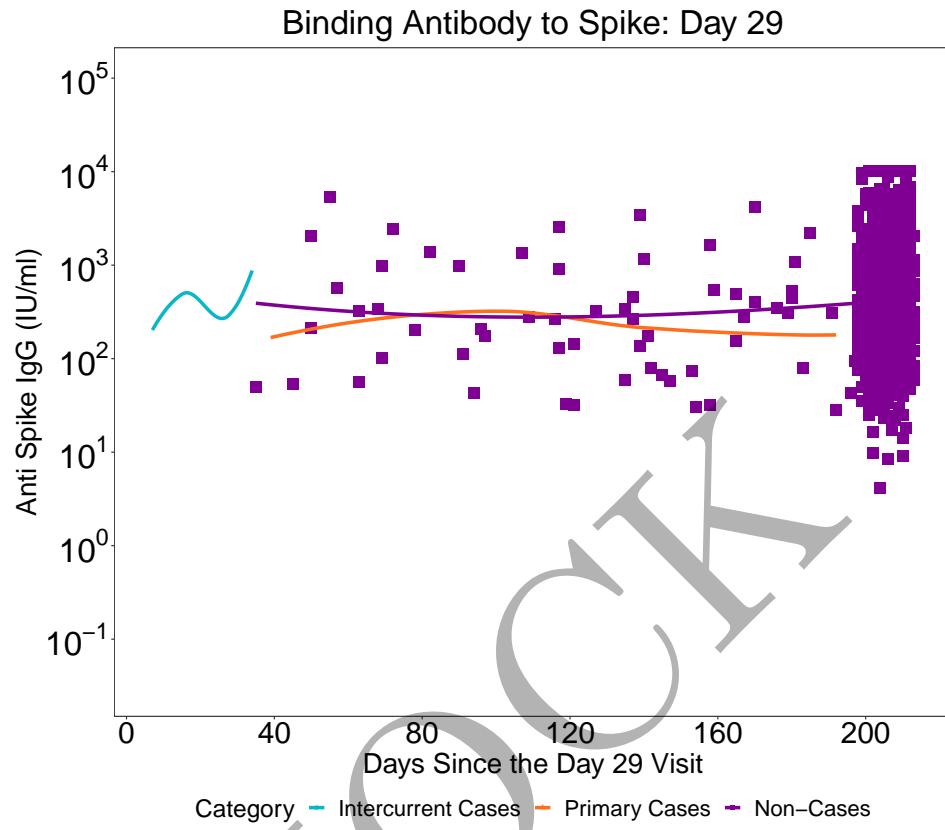


Figure 3.263: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 29

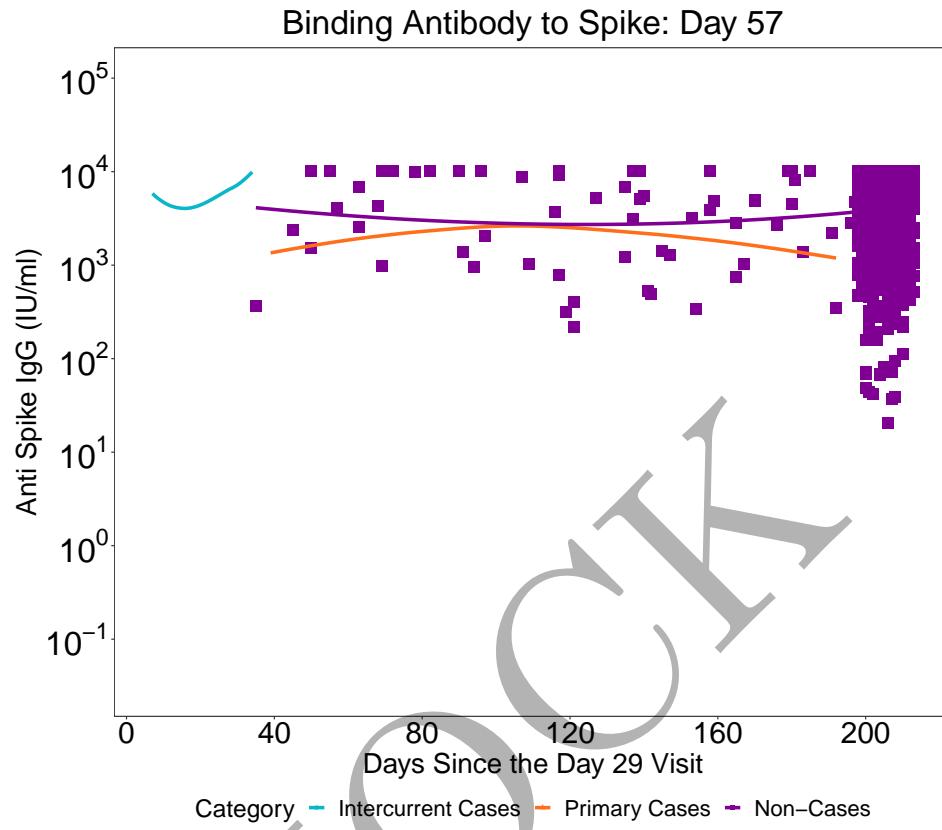


Figure 3.264: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 57

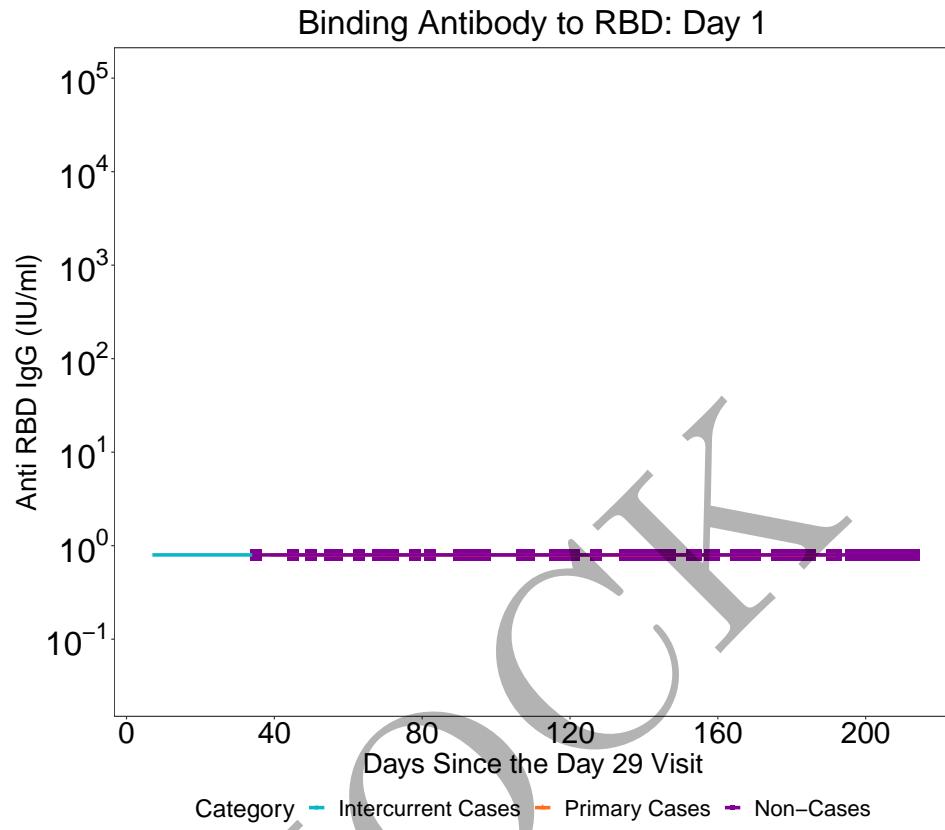


Figure 3.265: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 1

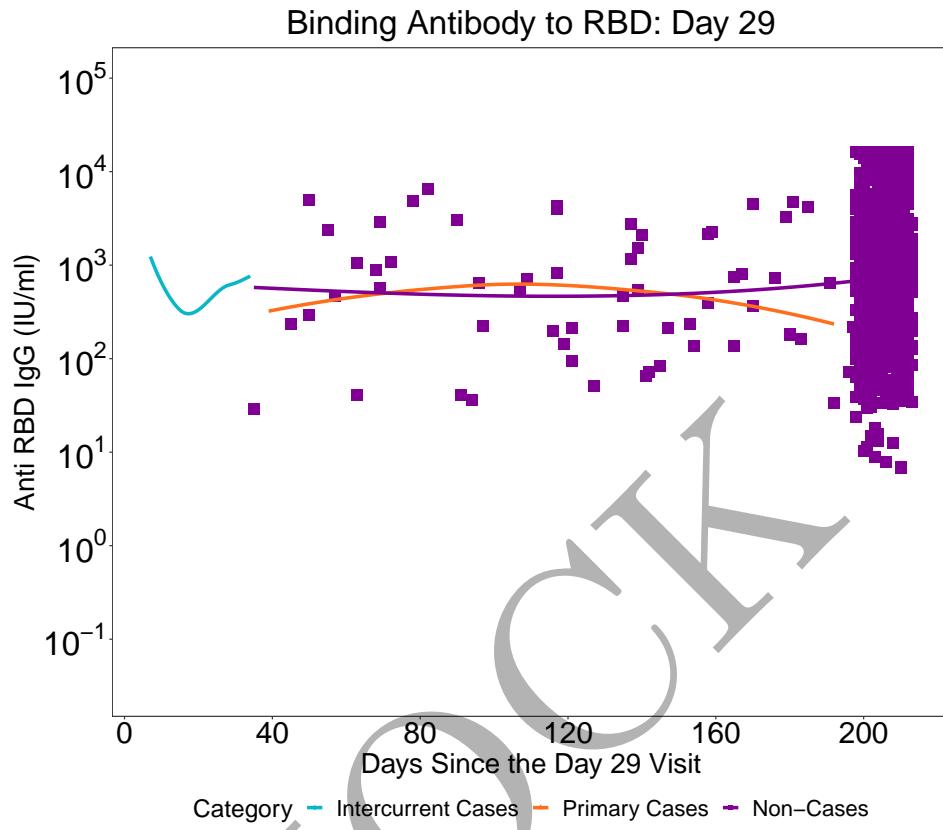


Figure 3.266: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 29

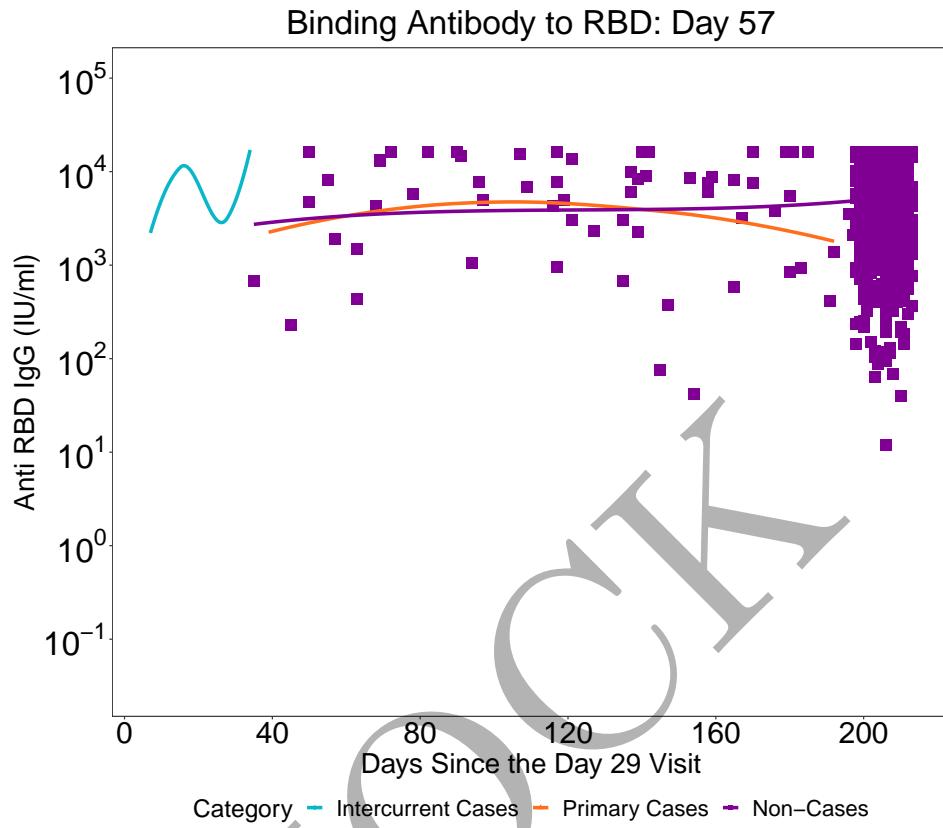


Figure 3.267: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 57

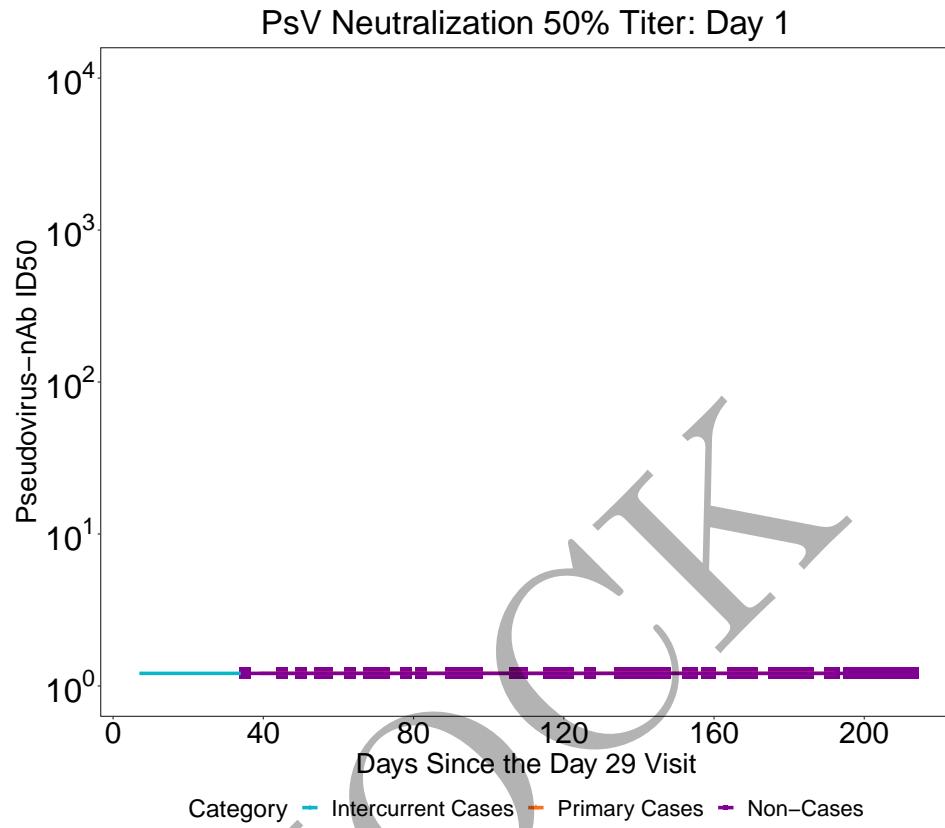


Figure 3.268: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 1

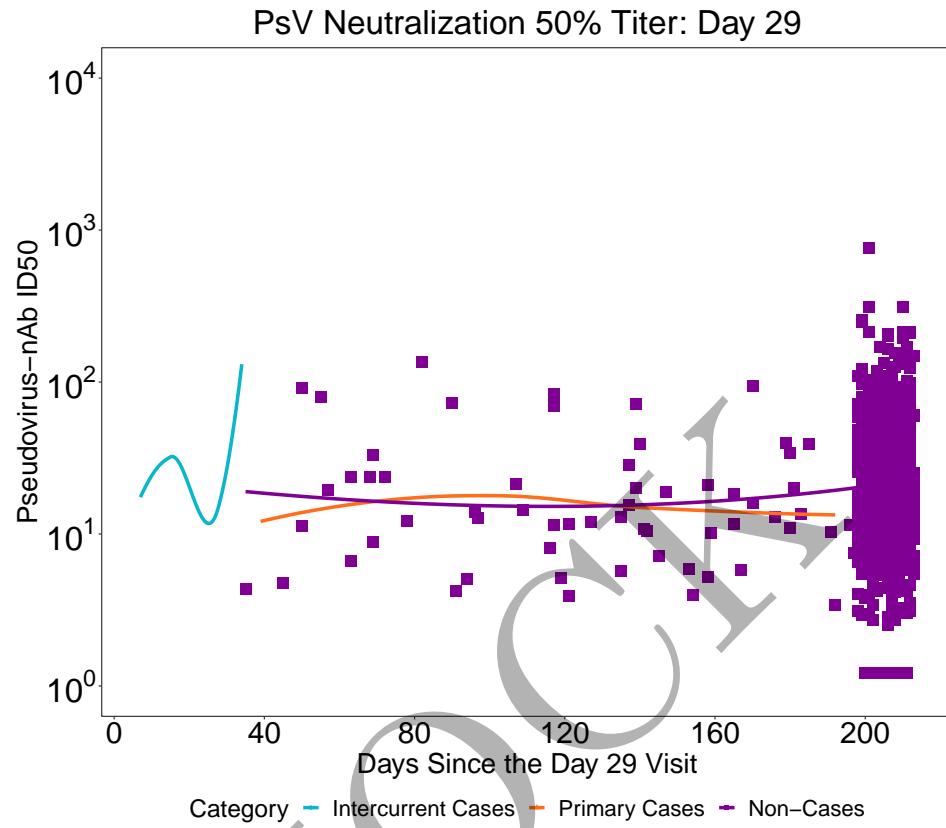


Figure 3.269: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 29

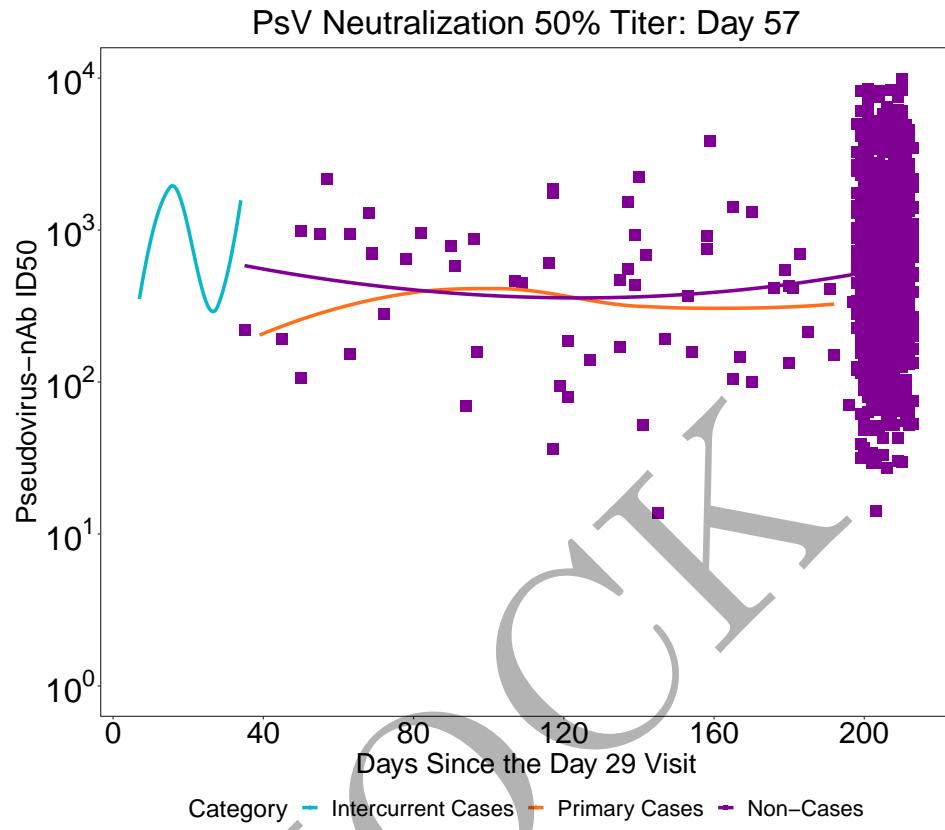


Figure 3.270: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 57

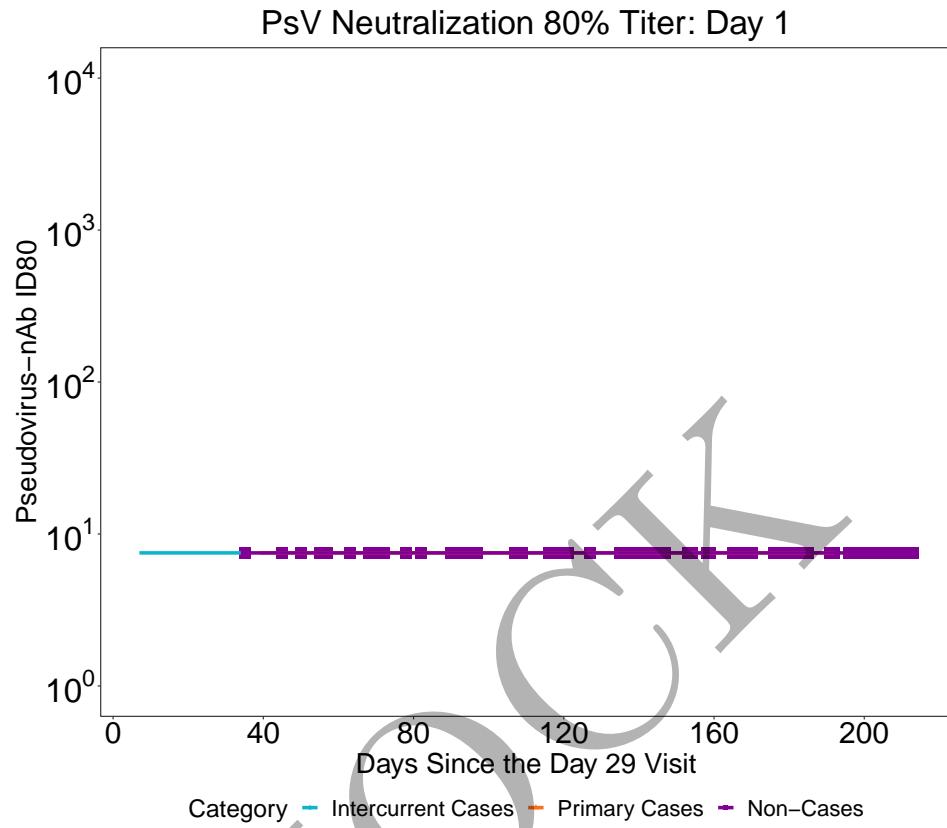


Figure 3.271: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 1

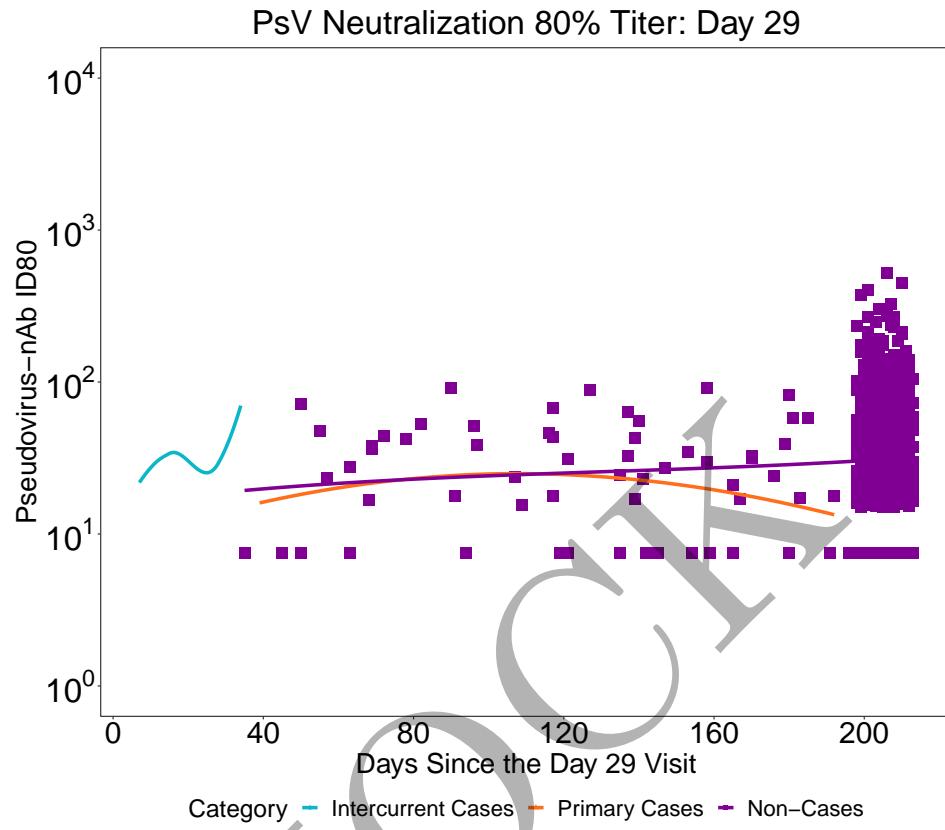


Figure 3.272: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 29

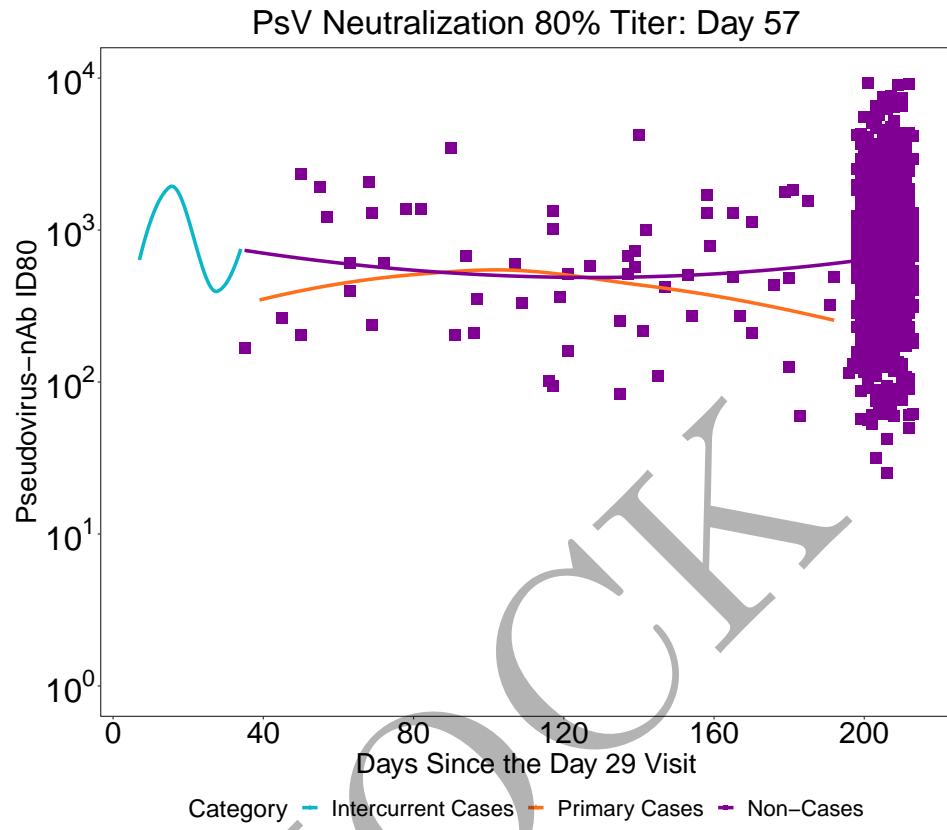


Figure 3.273: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: baseline negative vaccine arm at day 57

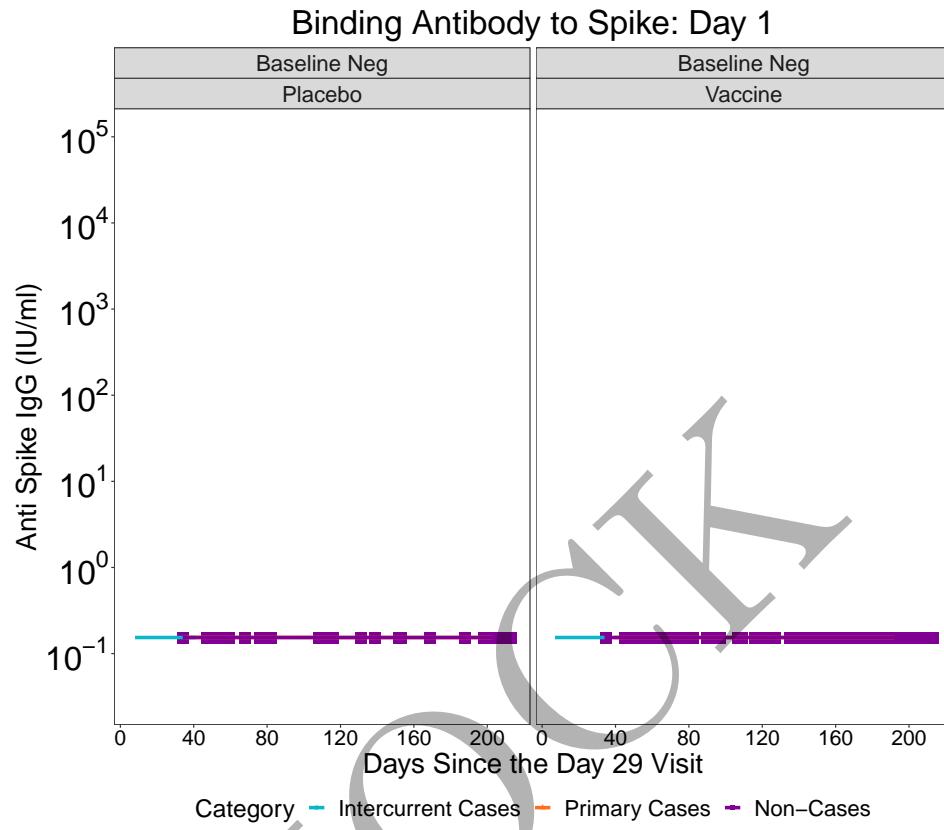


Figure 3.274: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: by arm at day 1

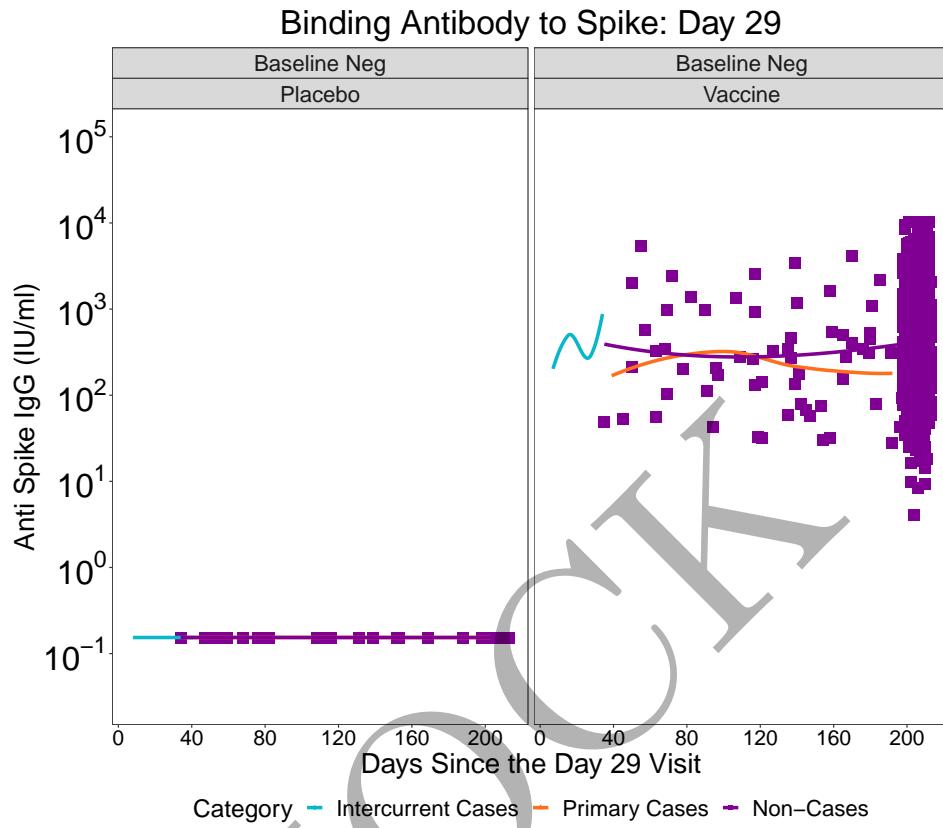


Figure 3.275: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: by arm at day 29

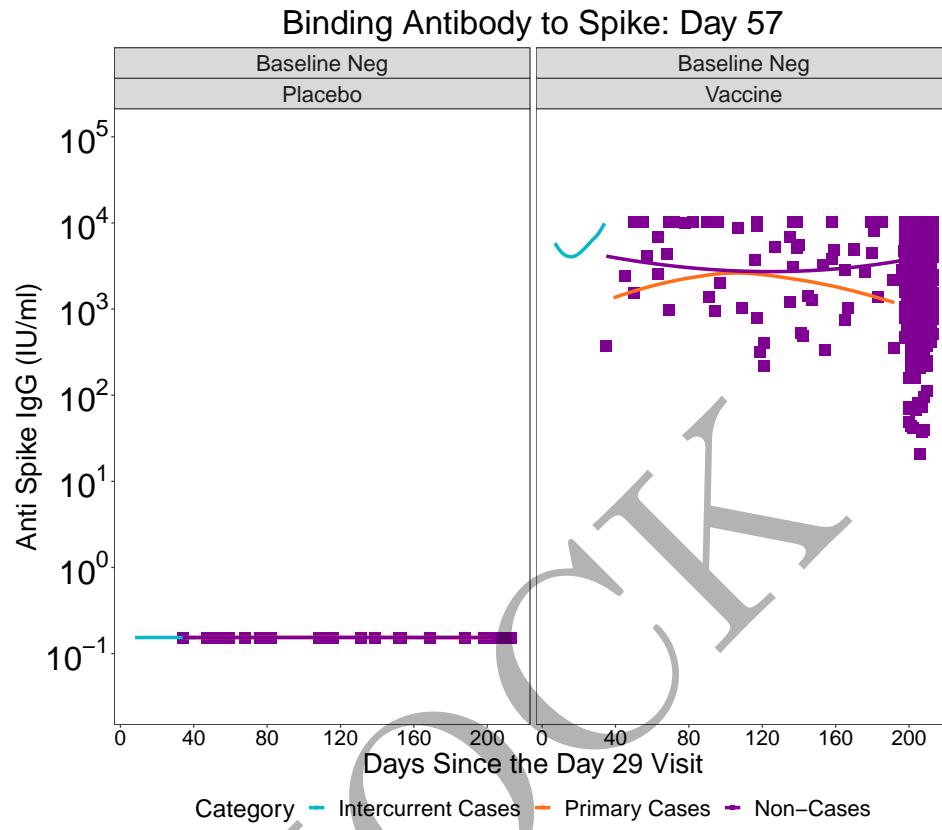


Figure 3.276: scatterplots of Binding Antibody to Spike vs Days Since the Day 29 Visit: by arm at day 57

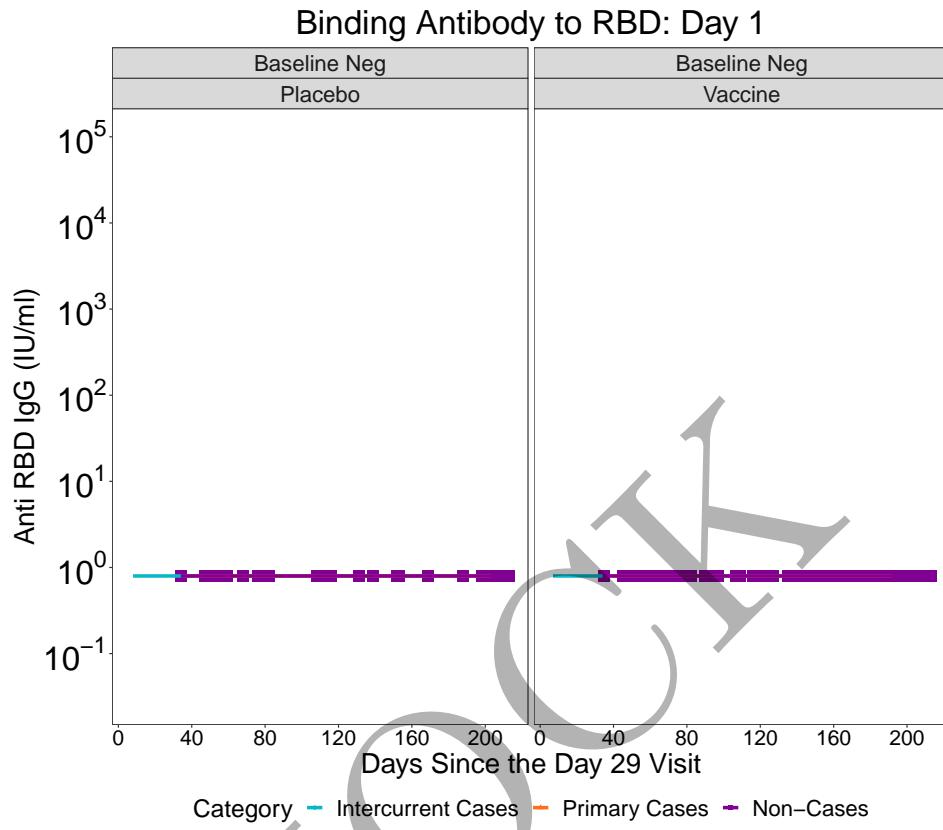


Figure 3.277: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: by arm at day 1

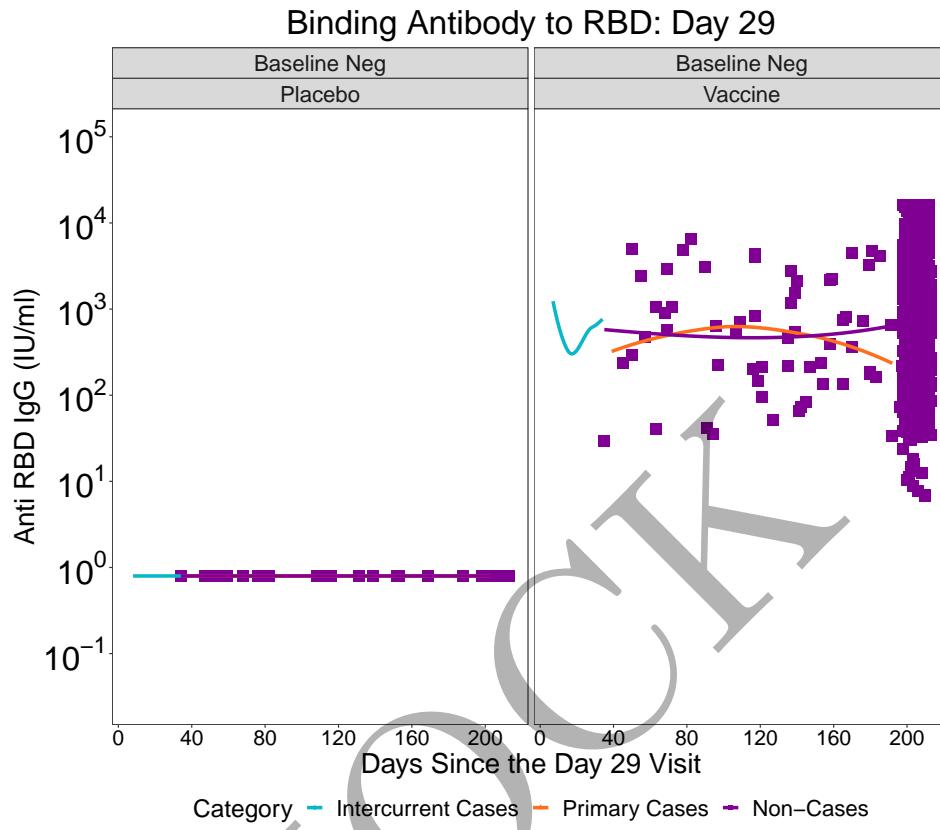


Figure 3.278: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: by arm at day 29

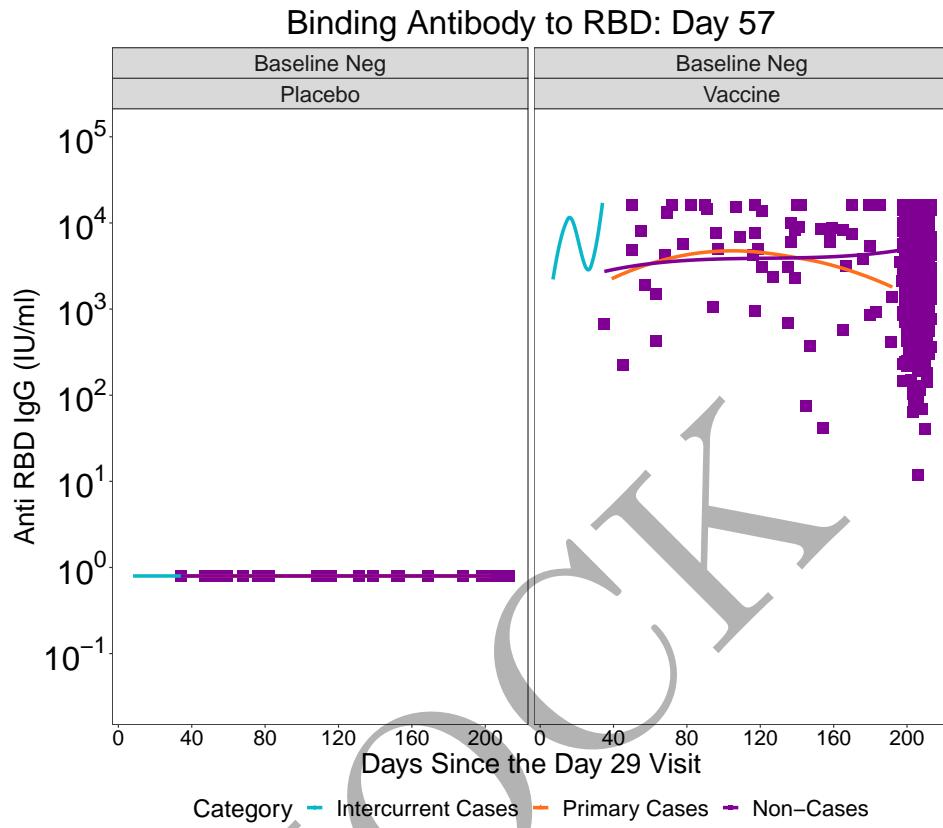


Figure 3.279: scatterplots of Binding Antibody to RBD vs Days Since the Day 29 Visit: by arm at day 57

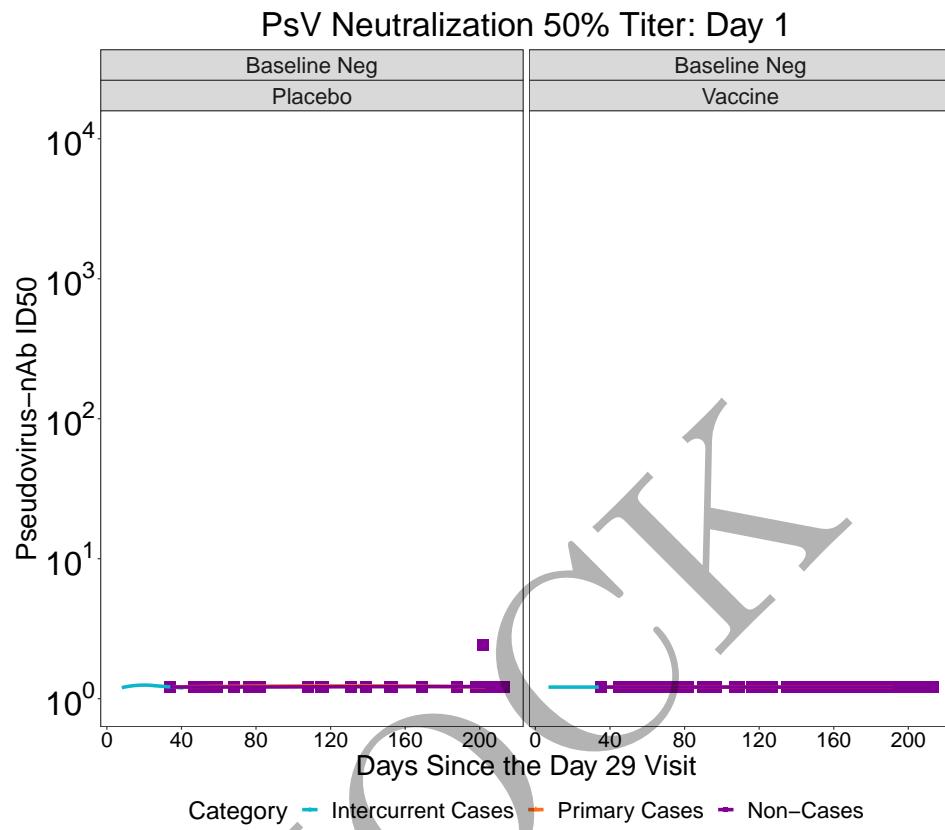


Figure 3.280: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit vs Days Since the Day 29 Visit: by arm at day 1

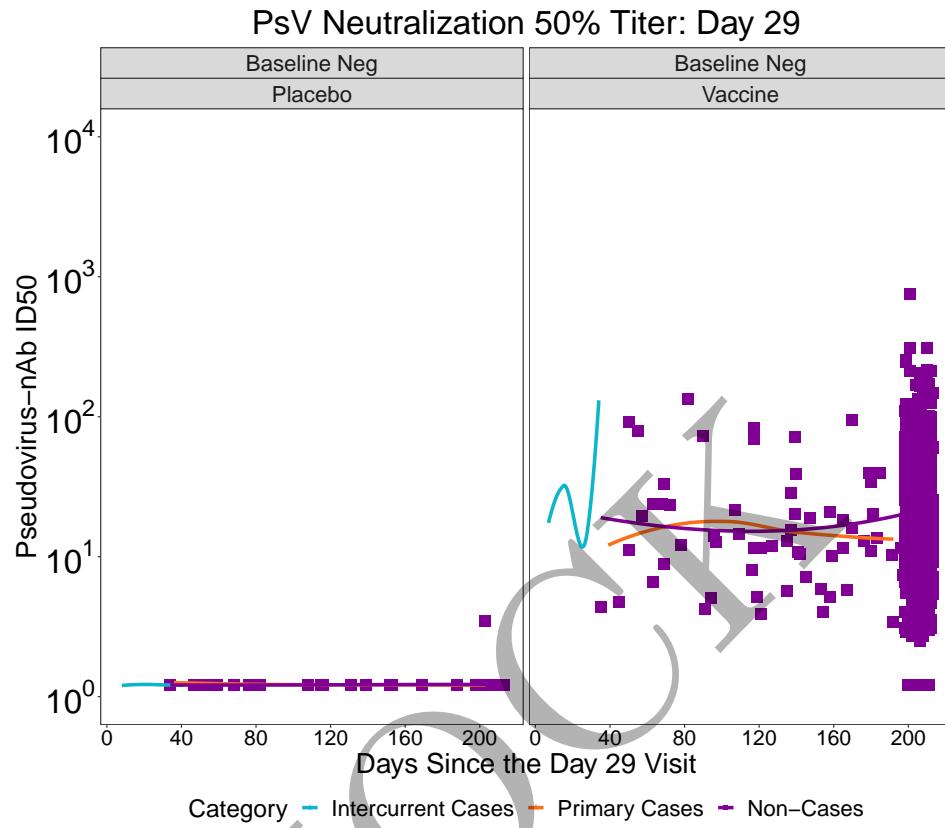


Figure 3.281: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit vs Days Since the Day 29 Visit: by arm at day 29

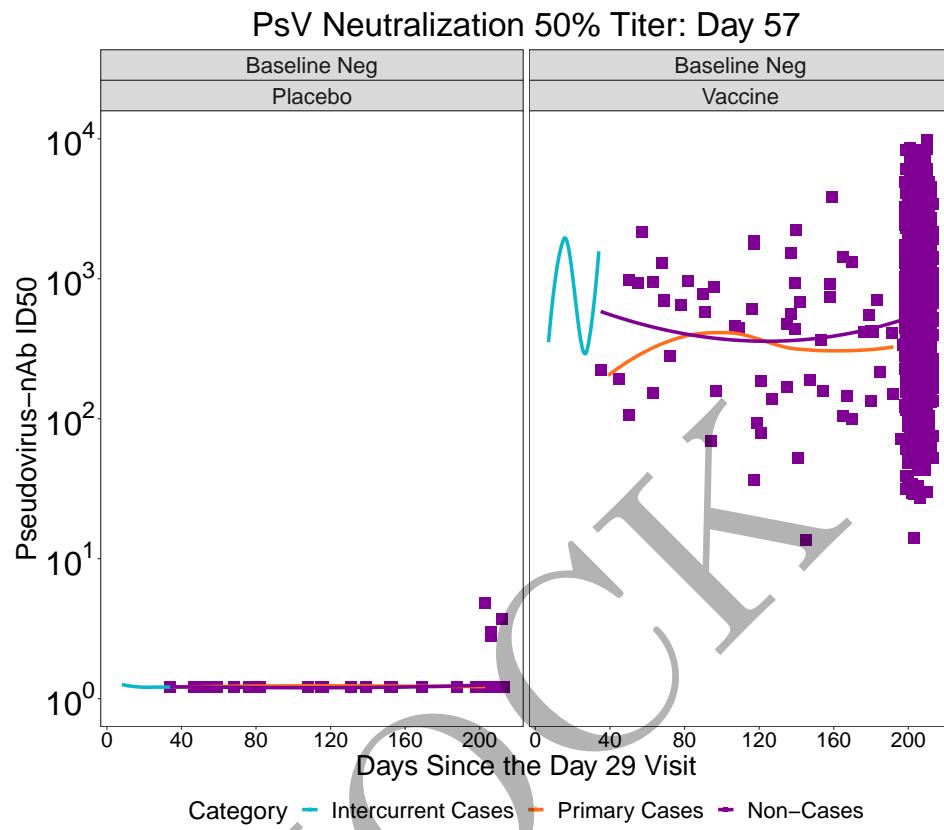


Figure 3.282: scatterplots of Pseudovirus Neutralization ID50 vs Days Since the Day 29 Visit: by arm at day 57

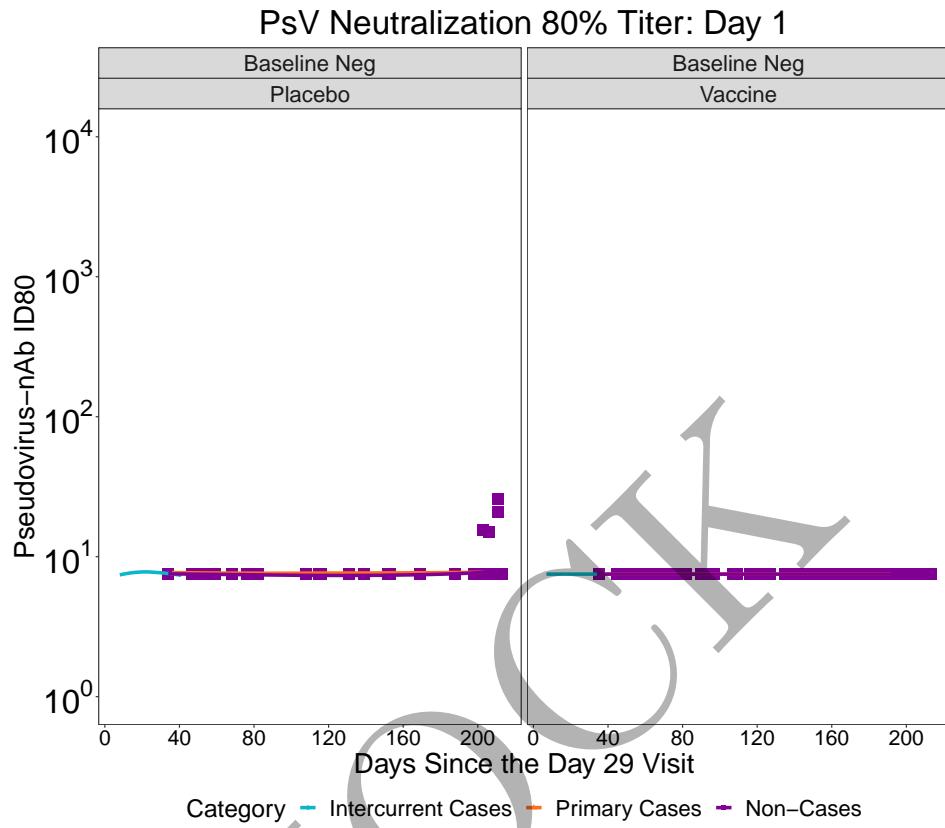


Figure 3.283: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: by arm at day 1

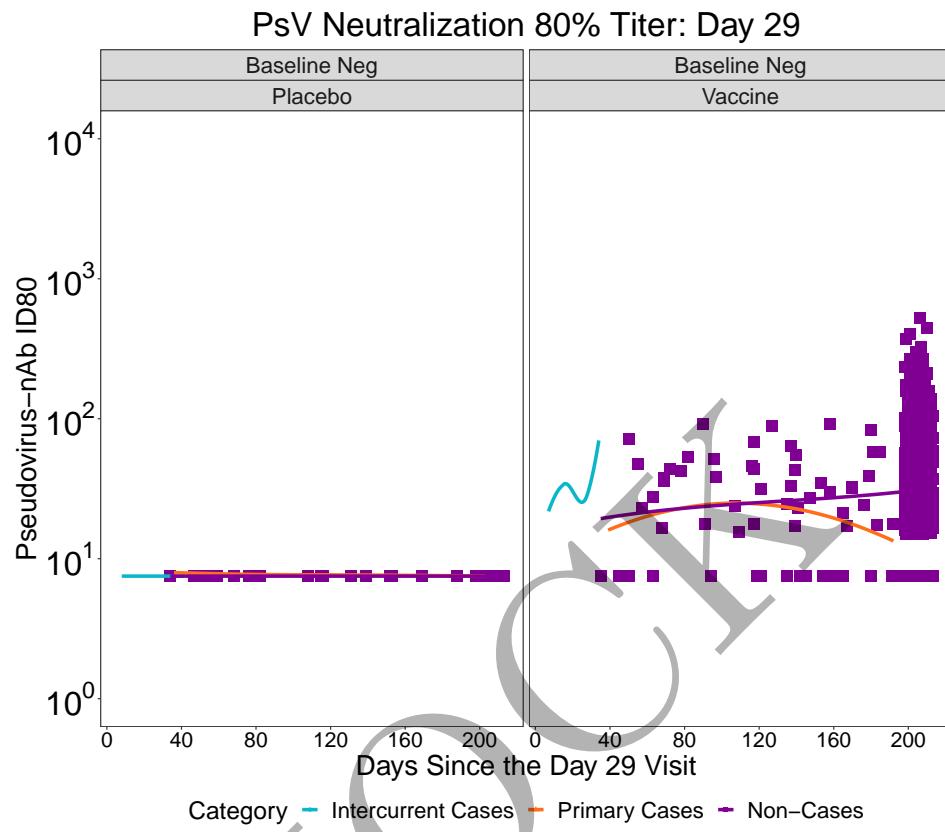


Figure 3.284: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: by arm at day 29

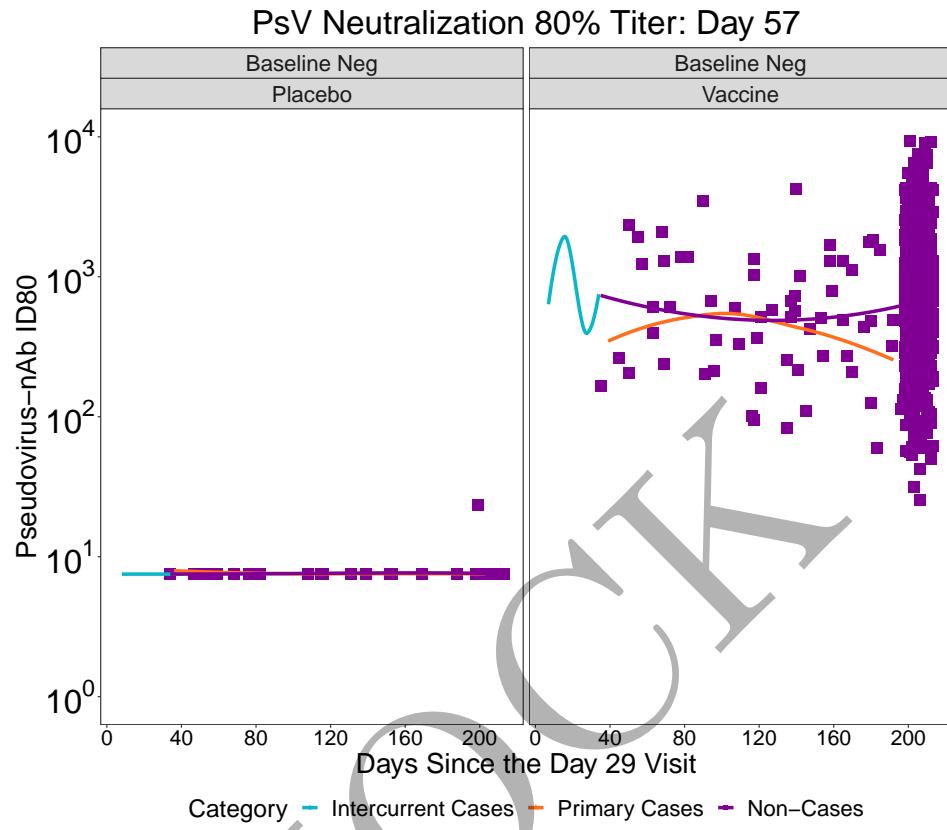


Figure 3.285: scatterplots of Pseudovirus Neutralization ID80 vs Days Since the Day 29 Visit: by arm at day 57

Chapter 4

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.

4.1 Hazard ratios

Table 4.1: 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*

| MockCOVE Immunologic Marker | No. cases / No. at-risk** | HR per 10-fold incr. Pt. Est. | 95% CI | P-value (2-sided) | q-value *** | FWER |
|--------------------------------|------------------------------|----------------------------------|-------------|----------------------|----------------|--------|
| Anti Spike IgG (IU/ml) | 52/11,117 | 0.20 | (0.11-0.35) | <0.001 | <0.001 | <0.001 |
| Anti RBD IgG (IU/ml) | 52/11,117 | 0.43 | (0.25-0.75) | 0.003 | <0.001 | <0.001 |
| Pseudovirus-nAb ID50 | 52/11,117 | 0.32 | (0.17-0.60) | <0.001 | <0.001 | <0.001 |
| Pseudovirus-nAb ID80 | 52/11,117 | 0.35 | (0.19-0.64) | <0.001 | <0.001 | <0.001 |

*Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not. Maximum failure event time 164 days.

**No. at-risk = estimated number in the population for analysis: baseline negative per-protocol vaccine recipients not experiencing the COVID endpoint through 6 days post Day 57 visit; no. cases = number of this cohort with an observed COVID endpoint.

***q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method (5 replicates).

Table 4.2: 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*

| MockCOVE Immunologic Marker | Tertile | No. cases / No. at-risk** | Attack rate | Pt. Est. | Haz. Ratio 95% CI | P-value (2-sided) | Overall P- value*** | Overall q- value † | Overall FWER |
|--------------------------------|---------|------------------------------|----------------|----------|----------------------|----------------------|------------------------|-----------------------|-----------------|
| Anti Spike IgG (IU/ml) | Lower | 27/4,235 | 0.0064 | 1 | N/A | N/A | <0.001 | <0.001 | <0.001 |
| | Middle | 18/4,243 | 0.0042 | 0.30 | (0.15-0.58) | <0.001 | | | |
| | Upper | 7/2,638 | 0.0027 | 0.08 | (0.03-0.21) | <0.001 | | | |
| Anti RBD IgG (IU/ml) | Lower | 24/4,242 | 0.0057 | 1 | N/A | N/A | 0.003 | <0.001 | <0.001 |
| | Middle | 14/4,209 | 0.0033 | 0.33 | (0.15-0.71) | 0.005 | | | |
| | Upper | 14/2,666 | 0.0053 | 0.29 | (0.13-0.64) | 0.002 | | | |
| Pseudovirus-nAb ID50 | Lower | 18/3,697 | 0.0049 | 1 | N/A | N/A | 0.036 | <0.001 | <0.001 |
| | Middle | 20/3,701 | 0.0054 | 0.80 | (0.39-1.64) | 0.539 | | | |
| | Upper | 14/3,719 | 0.0038 | 0.37 | (0.16-0.82) | 0.015 | | | |
| Pseudovirus-nAb ID80 | Lower | 22/3,724 | 0.0059 | 1 | N/A | N/A | 0.010 | <0.001 | <0.001 |
| | Middle | 20/3,707 | 0.0054 | 0.66 | (0.34-1.27) | 0.213 | | | |
| | Upper | 10/3,687 | 0.0027 | 0.29 | (0.13-0.65) | 0.002 | | | |
| Placebo | | 953/11,217 | 0.0850 | | | | | | |

*Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not. Maximum failure event time 164 days. Cutpoints: Anti Spike IgG (IU/ml) [3.34, 4.01], Anti RBD IgG (IU/ml) [3.48, 4.21], Pseudovirus-nAb ID50 [2.37, 2.86], Pseudovirus-nAb ID80 [2.58, 2.96], all on the log10 scale.

**No. at-risk = estimated number in the population for analysis: baseline negative per-protocol vaccine recipients not experiencing the COVID endpoint through 6 days post Day 57 visit; no. cases = number of this cohort with an observed COVID endpoint.

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

† q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method (5 replicates).



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

Binding Antibody to Spike: Day 57

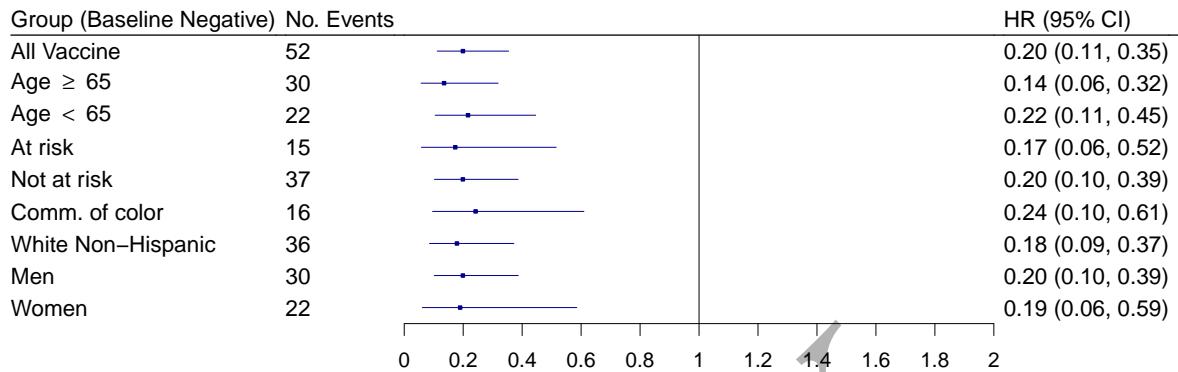


Figure 4.2: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to spike markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

Binding Antibody to RBD: Day 57

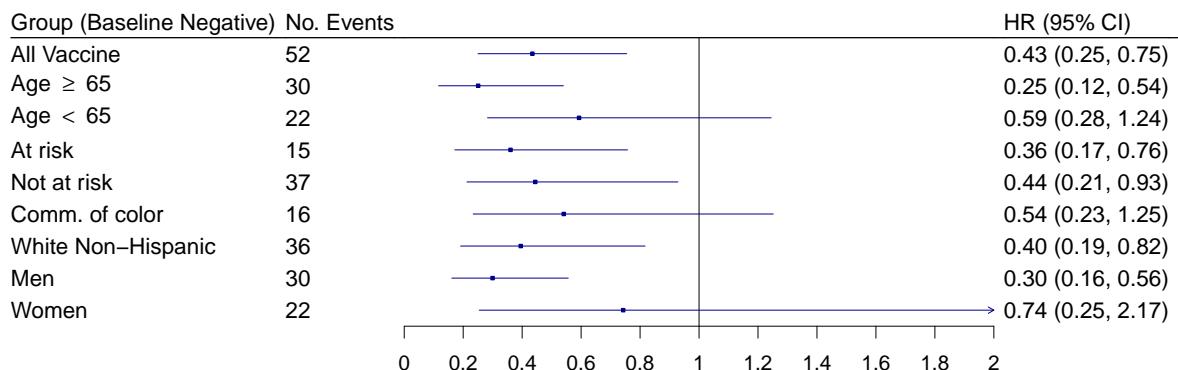


Figure 4.3: Forest plots of hazard ratios per 10-fold increase in the Day 57 binding Ab to RBD markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.



Figure 4.4: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID50 markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

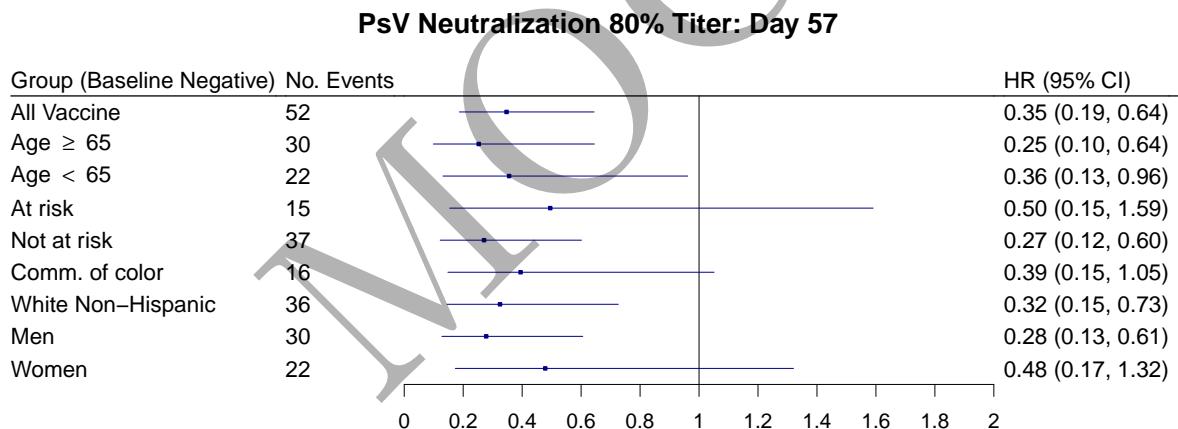


Figure 4.5: Forest plots of hazard ratios per 10-fold increase in the Day 57 pseudo neut ID80 markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

4.2 Marginalized risk and controlled vaccine efficacy plots

MOCK

Table 4.3: Analysis of Day 57 markers (upper vs. lower tertile) as a CoR and a controlled risk CoP.

| | marginalized risk | | controlled risk | | $e(0,1)^2$ | |
|------------------------|-------------------|-------------------|---------------------|-------------------|----------------------|------|
| | ratio $RR_M(0,1)$ | Point Est. 95% CI | ratio $RR_C(0,1)^1$ | Point Est. 95% CI | Point Est. 95% CI UL | |
| Anti Spike IgG (IU/ml) | 0.08 | 0.05–0.14 | 0.11 | 0.07–0.18 | 23.2 | 14.2 |
| Anti RBD IgG (IU/ml) | 0.29 | 0.27–0.37 | 0.39 | 0.36–0.49 | 6.3 | 4.8 |
| Pseudovirus-nAb ID50 | 0.37 | 0.25–0.48 | 0.49 | 0.34–0.64 | 4.9 | 3.6 |
| Pseudovirus-nAb ID80 | 0.30 | 0.13–0.65 | 0.39 | 0.18–0.87 | 6.2 | 2.4 |

¹Conservative (upper bound) estimate assuming unmeasured confounding at level $RR_{UD}(0,1) = RR_{EU}(0,1) = 2$ and thus $B(0,1) = 4/3$.

²E-values are computed for upper tertile ($s = 1$) vs. lower tertile ($s = 0$) biomarker subgroups after controlling for baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not; UL = upper limit.

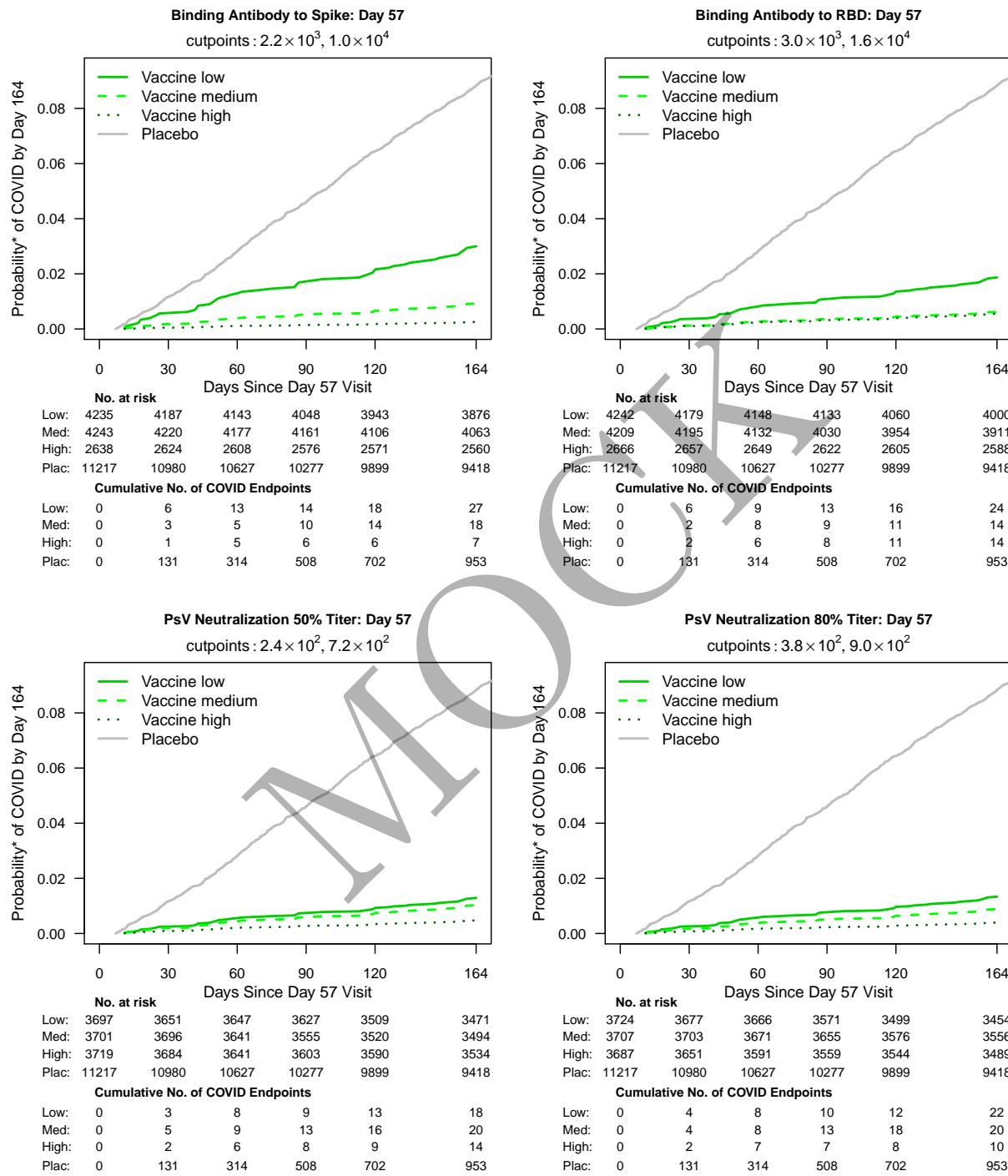


Figure 4.6: Marginalized cumulative incidence rate curves for trichotomized Day 57 markers among baseline negative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

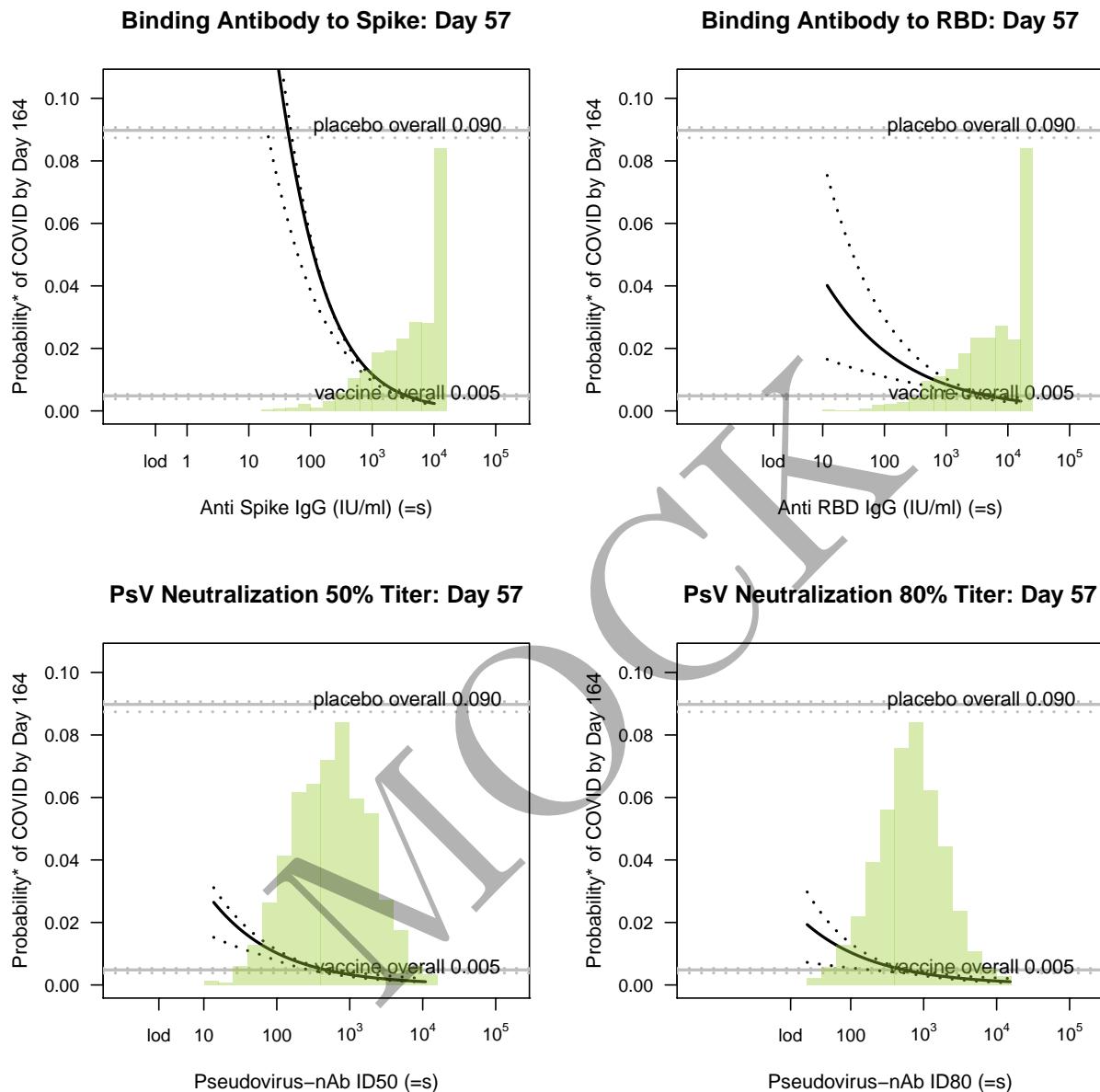


Figure 4.7: Marginalized cumulative risk by Day 164 as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 164 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.



Figure 4.8: Controlled VE with sensitivity analysis as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

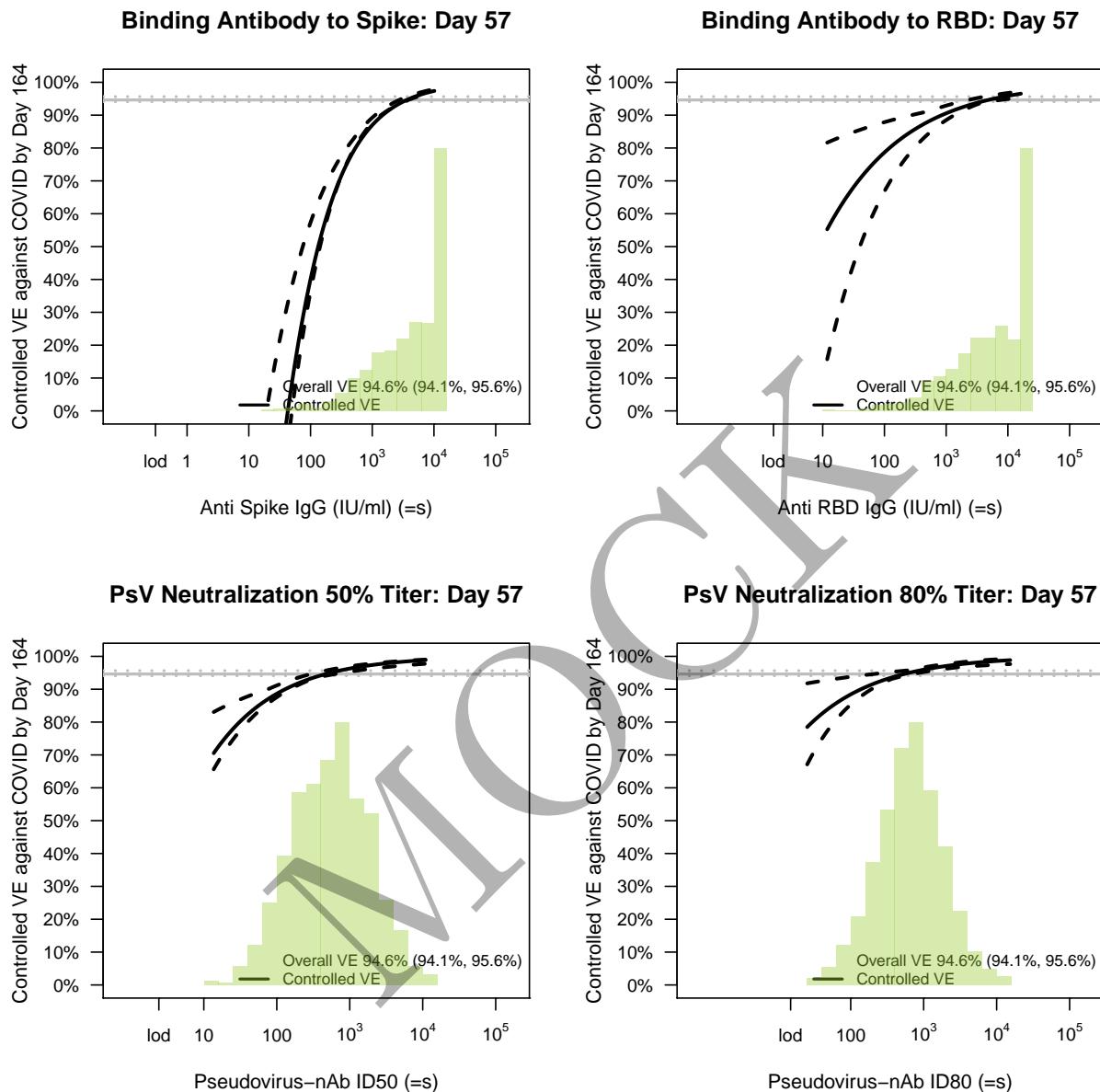


Figure 4.9: Controlled VE with sensitivity analysis as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

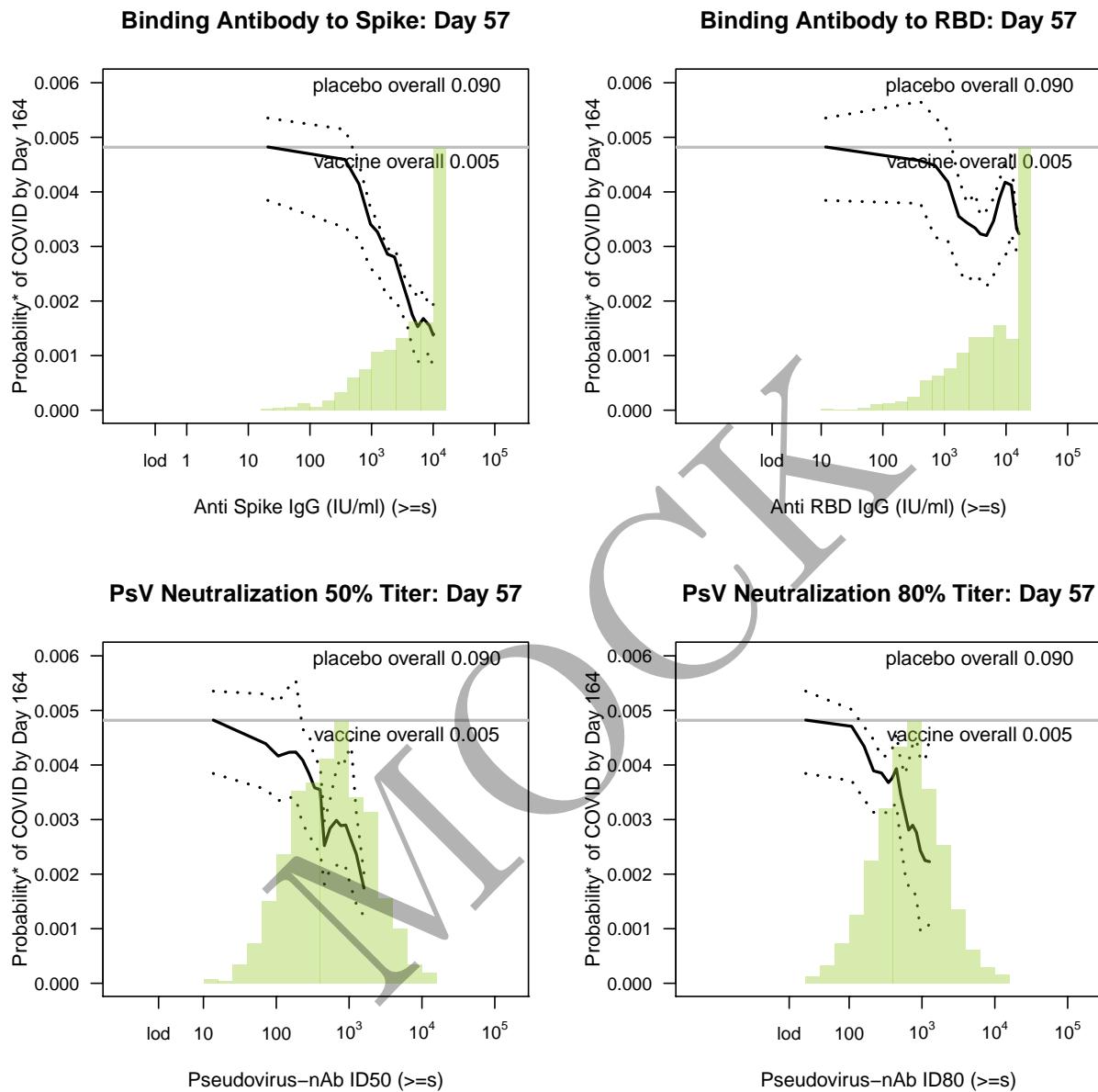


Figure 4.10: Marginalized cumulative risk by Day 164 as functions of Day 57 markers above a threshold ($\geq s$) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required, 5 replicates). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 164 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. $l_{od} = 0.3, 1.6, 2.4, 15$ for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

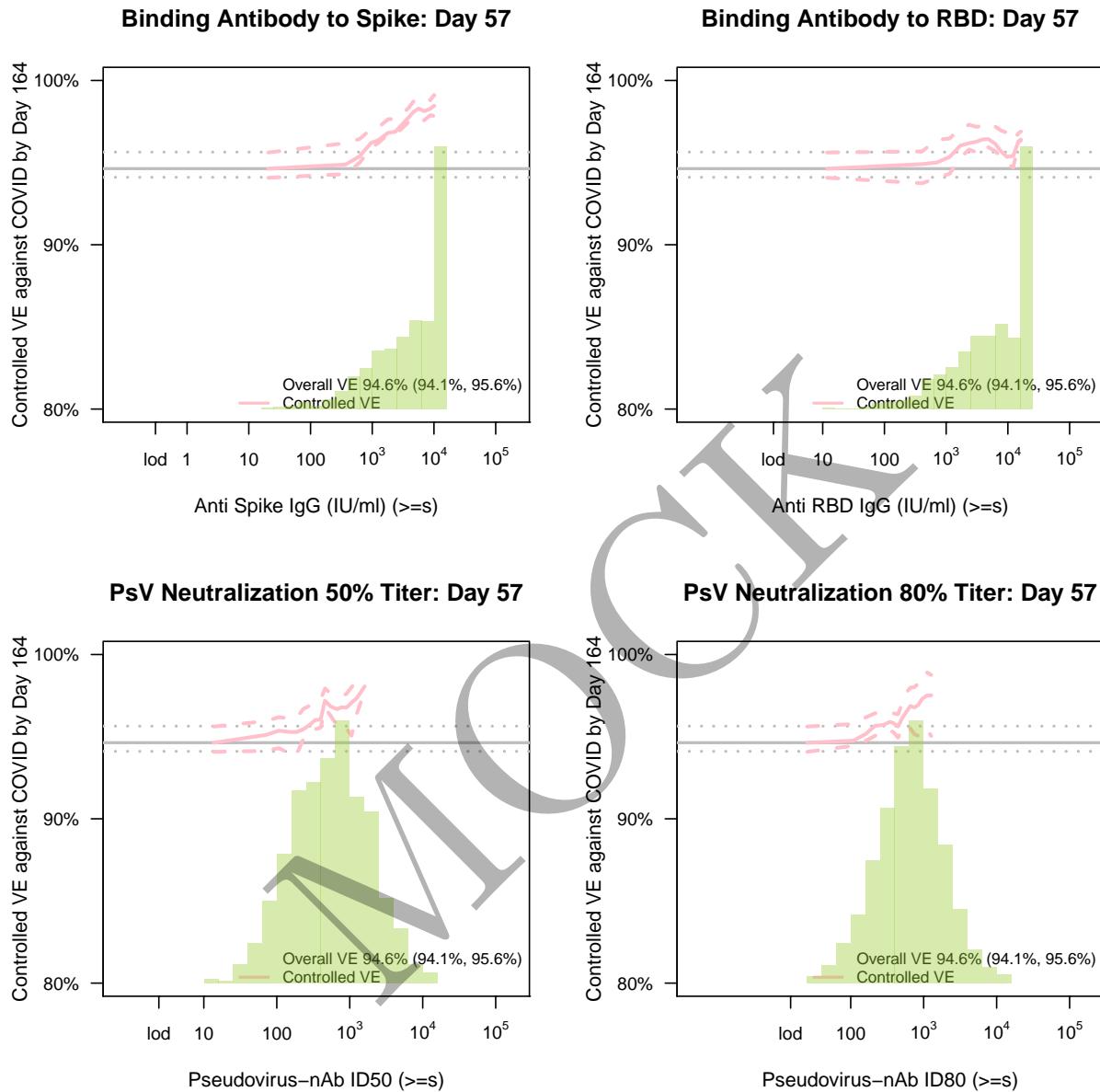


Figure 4.11: Controlled VE as functions of Day 57 markers ($\geq s$) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

Table 4.4: Marginalized cumulative risk by Day 164 as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 | |
|------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate |
| 20.7 | .1345 (.0877,.1469) | 11.8 | .0402 (.0165,.0754) | 13.7 | .0264 (.0152,.0311) | 25.3 | .0193 (.0072,.0298) |
| 500 | .0188 (.0151,.0178) | 500 | .0108 (.0079,.0142) | 113 | .0096 (.0074,.0105) | 166 | .0083 (.0049,.0099) |
| 653 | .0157 (.0126,.0147) | 763 | .0093 (.0068,.0117) | 150 | .0084 (.0064,.0091) | 216 | .0073 (.0047,.0085) |
| 960 | .0120 (.0097,.0112) | 1000 | .0085 (.0062,.0103) | 191 | .0075 (.0058,.0080) | 285 | .0065 (.0044,.0072) |
| 1000 | .0117 (.0095,.0109) | 1139 | .0081 (.0060,.0097) | 330 | .0057 (.0045,.0060) | 440 | .0053 (.0040,.0058) |
| 1297 | .0098 (.0079,.0093) | 1817 | .0068 (.0051,.0078) | 454 | .0049 (.0038,.0054) | 500 | .0050 (.0039,.0055) |
| 2957 | .0055 (.0045,.0056) | 3607 | .0054 (.0040,.0057) | 500 | .0047 (.0037,.0052) | 581 | .0047 (.0038,.0052) |
| 4553 | .0041 (.0033,.0044) | 6262 | .0044 (.0033,.0050) | 673 | .0040 (.0032,.0048) | 749 | .0042 (.0034,.0048) |
| 6937 | .0031 (.0024,.0034) | 9688 | .0038 (.0029,.0046) | 909 | .0035 (.0028,.0043) | 958 | .0037 (.0030,.0044) |
| 10145 | .0024 (.0018,.0028) | 15353 | .0032 (.0025,.0042) | 1000 | .0033 (.0027,.0042) | 1000 | .0036 (.0029,.0043) |
| 10156 | .0023 (.0018,.0028) | 16269 | .0031 (.0024,.0042) | 1491 | .0027 (.0022,.0037) | 1452 | .0031 (.0024,.0038) |
| 10156 | .0023 (.0018,.0028) | 16269 | .0031 (.0024,.0042) | 2027 | .0024 (.0019,.0034) | 1840 | .0028 (.0022,.0035) |
| 10156 | .0023 (.0018,.0028) | 16269 | .0031 (.0024,.0042) | 2440 | .0022 (.0017,.0032) | 2349 | .0025 (.0019,.0032) |
| 10156 | .0023 (.0018,.0028) | 16269 | .0031 (.0024,.0042) | 10919 | .0010 (.0009,.0020) | 15368 | .0010 (.0006,.0021) |

Table 4.5: Controlled VE as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 | |
|------------------------|-------------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate |
| 20.7 | -0.4978 (-0.6806,.0323) | 11.8 | .5528 (.1570,.8164) | 13.7 | .7054 (.6562,.8306) | 25.3 | .7848 (.6711,.9178) |
| 500 | .7910 (.7962,.8285) | 500 | .8792 (.8412,.9111) | 113 | .8930 (.8836,.9163) | 166 | .9079 (.8909,.9438) |
| 653 | .8256 (.8325,.8565) | 763 | .8961 (.8695,.9222) | 150 | .9067 (.8996,.9265) | 216 | .9184 (.9067,.9468) |
| 960 | .8659 (.8740,.8894) | 1000 | .9057 (.8849,.9290) | 191 | .9169 (.9114,.9343) | 285 | .9280 (.9206,.9499) |
| 1000 | .8696 (.8772,.8924) | 1139 | .9099 (.8917,.9321) | 330 | .9363 (.9333,.9491) | 440 | .9410 (.9361,.9543) |
| 1297 | .8909 (.8960,.9098) | 1817 | .9238 (.9129,.9420) | 454 | .9454 (.9404,.9562) | 500 | .9443 (.9390,.9555) |
| 2957 | .9382 (.9375,.9492) | 3607 | .9404 (.9366,.9540) | 500 | .9480 (.9422,.9581) | 581 | .9480 (.9423,.9569) |
| 4553 | .9542 (.9514,.9625) | 6262 | .9511 (.9443,.9619) | 673 | .9550 (.9473,.9636) | 749 | .9537 (.9471,.9614) |
| 6937 | .9659 (.9620,.9722) | 9688 | .9582 (.9488,.9671) | 909 | .9611 (.9520,.9684) | 958 | .9586 (.9514,.9657) |
| 10145 | .9738 (.9695,.9792) | 15353 | .9646 (.9532,.9720) | 1000 | .9629 (.9534,.9698) | 1000 | .9594 (.9521,.9665) |
| 10156 | .9738 (.9695,.9792) | 16269 | .9653 (.9537,.9726) | 1491 | .9695 (.9587,.9749) | 1452 | .9658 (.9579,.9723) |
| 10156 | .9738 (.9695,.9792) | 16269 | .9653 (.9537,.9726) | 2027 | .9737 (.9624,.9783) | 1840 | .9693 (.9612,.9755) |
| 10156 | .9738 (.9695,.9792) | 16269 | .9653 (.9537,.9726) | 2440 | .9760 (.9645,.9801) | 2349 | .9726 (.9642,.9784) |
| 10156 | .9738 (.9695,.9792) | 16269 | .9653 (.9537,.9726) | 10919 | .9885 (.9774,.9902) | 15368 | .9884 (.9764,.9931) |
| 237.6 | .6567 (.6510,.7364) | 24.5 | .6517 (.3816,.8407) | | (,) | | (,) |
| 1459 | .8994 (.9033,.9167) | 877 | .9011 (.8777,.9258) | 127 | .8986 (.8902,.9204) | 136 | .8993 (.8775,.9415) |
| 3972 | .9497 (.9473,.9588) | 5855 | .9499 (.9435,.9610) | 560 | .9508 (.9442,.9603) | 644 | .9504 (.9443,.9586) |

Table 4.6: Controlled VE with sensitivity analysis as functions of Day 57 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 | |
|------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate |
| 20.7 | .4199 (.3491,.6252) | 11.8 | .8346 (.6883,.9321) | 13.7 | .8175 (.7870,.8951) | 25.3 | .8723 (.8048,.9512) |
| 500 | .8326 (.8368,.8626) | 500 | .9040 (.8738,.9293) | 113 | .9044 (.8960,.9252) | 166 | .9182 (.9030,.9501) |
| 653 | .8536 (.8594,.8796) | 763 | .9118 (.8893,.9340) | 150 | .9137 (.9071,.9320) | 216 | .9245 (.9137,.9508) |
| 960 | .8804 (.8877,.9014) | 1000 | .9169 (.8986,.9374) | 191 | .9212 (.9159,.9376) | 285 | .9311 (.9240,.9520) |
| 1000 | .8830 (.8899,.9035) | 1139 | .9193 (.9029,.9391) | 330 | .9370 (.9340,.9497) | 440 | .9414 (.9365,.9547) |
| 1297 | .8987 (.9034,.9162) | 1817 | .9280 (.9177,.9452) | 454 | .9455 (.9405,.9562) | 500 | .9444 (.9391,.9556) |
| 2957 | .9385 (.9378,.9494) | 3607 | .9408 (.9370,.9544) | 500 | .9480 (.9422,.9581) | 581 | .9480 (.9423,.9569) |
| 4553 | .9541 (.9512,.9624) | 6262 | .9510 (.9441,.9618) | 673 | .9547 (.9470,.9634) | 749 | .9534 (.9468,.9611) |
| 6937 | .9649 (.9609,.9714) | 9688 | .9572 (.9475,.9663) | 909 | .9603 (.9509,.9677) | 958 | .9577 (.9503,.9649) |
| 10145 | .9720 (.9674,.9777) | 15353 | .9622 (.9500,.9701) | 1000 | .9618 (.9520,.9689) | 1000 | .9583 (.9509,.9656) |
| 10156 | .9720 (.9674,.9777) | 16269 | .9628 (.9503,.9706) | 1491 | .9674 (.9559,.9732) | 1452 | .9634 (.9549,.9704) |
| 10156 | .9720 (.9674,.9777) | 16269 | .9628 (.9503,.9706) | 2027 | .9709 (.9584,.9760) | 1840 | .9660 (.9570,.9728) |
| 10156 | .9720 (.9674,.9777) | 16269 | .9628 (.9503,.9706) | 2440 | .9728 (.9597,.9774) | 2349 | .9684 (.9587,.9751) |
| 10156 | .9720 (.9674,.9777) | 16269 | .9628 (.9503,.9706) | 10919 | .9832 (.9671,.9857) | 15368 | .9797 (.9588,.9879) |
| 237.6 | .6567 (.6510,.7364) | 24.5 | .6517 (.3816,.8407) | | (,) | | (,) |
| 1459 | .8994 (.9033,.9167) | 877 | .9011 (.8777,.9258) | 127 | .8986 (.8902,.9204) | 136 | .8993 (.8775,.9415) |
| 3972 | .9497 (.9473,.9588) | 5855 | .9499 (.9435,.9610) | 560 | .9508 (.9442,.9603) | 644 | .9504 (.9443,.9586) |

Chapter 5

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.

5.1 Hazard ratios

Table 5.1: 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*

| MockCOVE Immunologic Marker | No. cases / No. at-risk** | HR per 10-fold incr. Pt. Est. | 95% CI | P-value (2-sided) | q-value *** | FWER |
|--------------------------------|------------------------------|----------------------------------|-------------|----------------------|----------------|--------|
| Anti Spike IgG (IU/ml) | 60/11,157 | 0.30 | (0.17-0.54) | <0.001 | <0.001 | <0.001 |
| Anti RBD IgG (IU/ml) | 60/11,157 | 0.50 | (0.30-0.85) | 0.010 | <0.001 | <0.001 |
| Pseudovirus-nAb ID50 | 60/11,157 | 0.43 | (0.22-0.86) | 0.017 | <0.001 | <0.001 |
| Pseudovirus-nAb ID80 | 60/11,157 | 0.36 | (0.19-0.68) | 0.002 | <0.001 | <0.001 |

*Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not. Maximum failure event time 192 days.

**No. at-risk = estimated number in the population for analysis: baseline negative per-protocol vaccine recipients not experiencing the COVID endpoint through 6 days post Day 29 visit; no. cases = number of this cohort with an observed COVID endpoint.

***q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method (5 replicates).

Table 5.2: 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*

| MockCOVE Immunologic Marker | Tertile | No. cases / No. at-risk** | Attack rate | Pt. Est. | Haz. Ratio 95% CI | P-value (2-sided) | Overall P- value*** | Overall q- value † | Overall FWER |
|--------------------------------|---------|------------------------------|----------------|----------|----------------------|----------------------|------------------------|-----------------------|-----------------|
| Anti Spike IgG (IU/ml) | Lower | 20/3,702 | 0.0054 | 1 | N/A | N/A | 0.004 | <0.001 | <0.001 |
| | Middle | 19/3,705 | 0.0051 | 0.56 | (0.28-1.15) | 0.114 | | | |
| | Upper | 20/3,750 | 0.0053 | 0.25 | (0.11-0.58) | 0.001 | | | |
| Anti RBD IgG (IU/ml) | Lower | 26/3,722 | 0.0070 | 1 | N/A | N/A | 0.001 | <0.001 | <0.001 |
| | Middle | 13/3,740 | 0.0035 | 0.32 | (0.15-0.66) | 0.002 | | | |
| | Upper | 20/3,695 | 0.0054 | 0.28 | (0.13-0.60) | 0.001 | | | |
| Pseudovirus-nAb ID50 | Lower | 20/3,690 | 0.0054 | 1 | N/A | N/A | 0.052 | <0.001 | <0.001 |
| | Middle | 23/3,749 | 0.0061 | 0.98 | (0.50-1.91) | 0.953 | | | |
| | Upper | 16/3,718 | 0.0043 | 0.45 | (0.21-0.96) | 0.039 | | | |
| Pseudovirus-nAb ID80 | Lower | 20/3,754 | 0.0053 | 1 | N/A | N/A | 0.027 | <0.001 | <0.001 |
| | Middle | 26/3,719 | 0.0070 | 1.16 | (0.62-2.20) | 0.642 | | | |
| | Upper | 13/3,685 | 0.0035 | 0.45 | (0.21-0.96) | 0.039 | | | |
| Placebo | | 1112/11,426 | 0.0973 | | | | | | |

*Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not. Maximum failure event time 192 days. Cutpoints: Anti Spike IgG (IU/ml) [2.14, 2.65], Anti RBD IgG (IU/ml) [2.37, 2.98], Pseudovirus-nAb ID50 [1.07, 1.45], Pseudovirus-nAb ID80 [1.26, 1.61], all on the log10 scale.

**No. at-risk = estimated number in the population for analysis: baseline negative per-protocol vaccine recipients not experiencing the COVID endpoint through 6 days post Day 29 visit; no. cases = number of this cohort with an observed COVID endpoint.

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

† q-value and FWER (family-wide error rate) are computed over the set of p-values both for quantitative markers and categorical markers using the Westfall and Young permutation method (5 replicates).

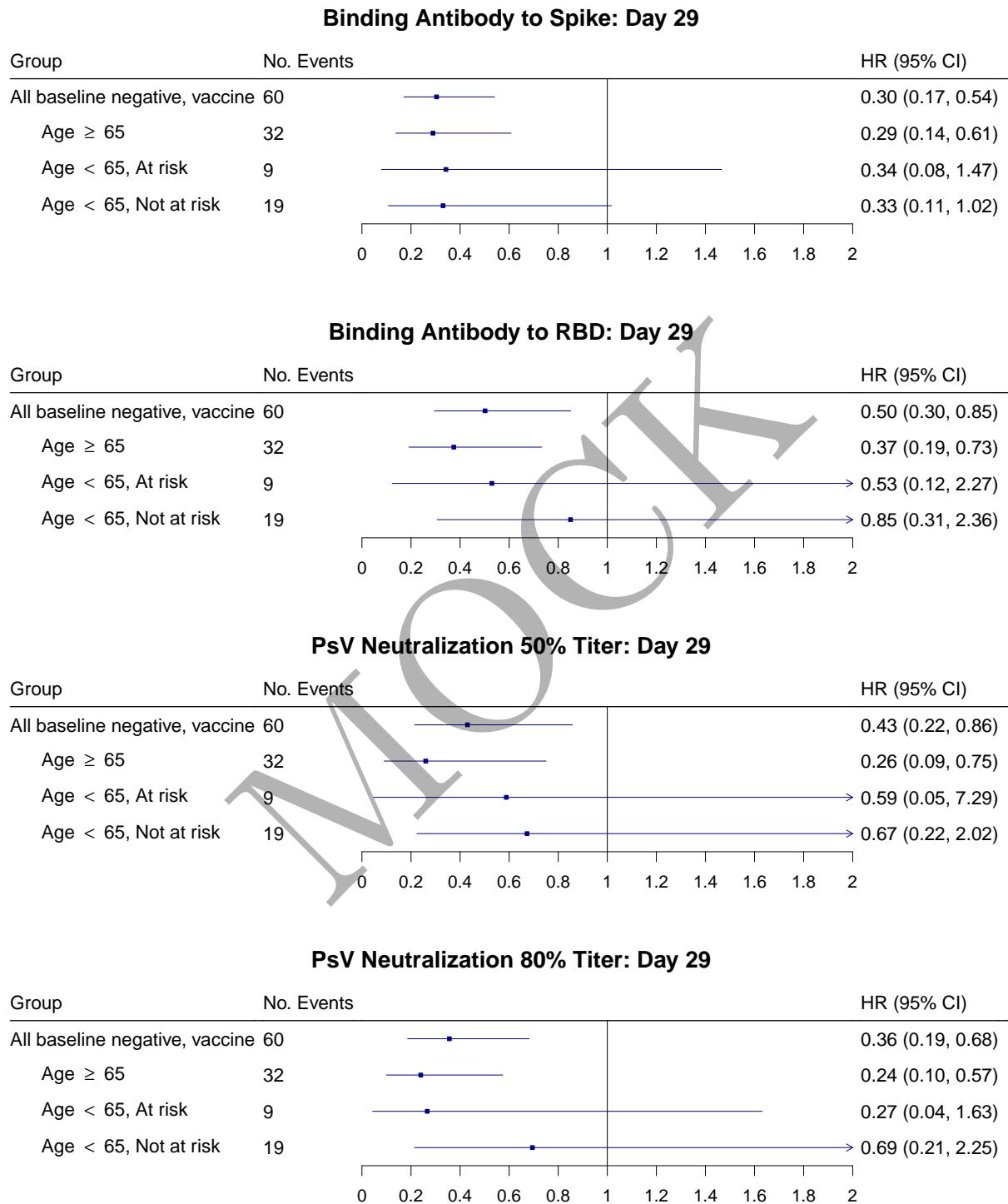


Figure 5.1: Forest plots of hazard ratios per 10-fold increase in the marker among baseline negative vaccine recipients and subgroups with 95% point-wise confidence intervals.

Binding Antibody to Spike: Day 29

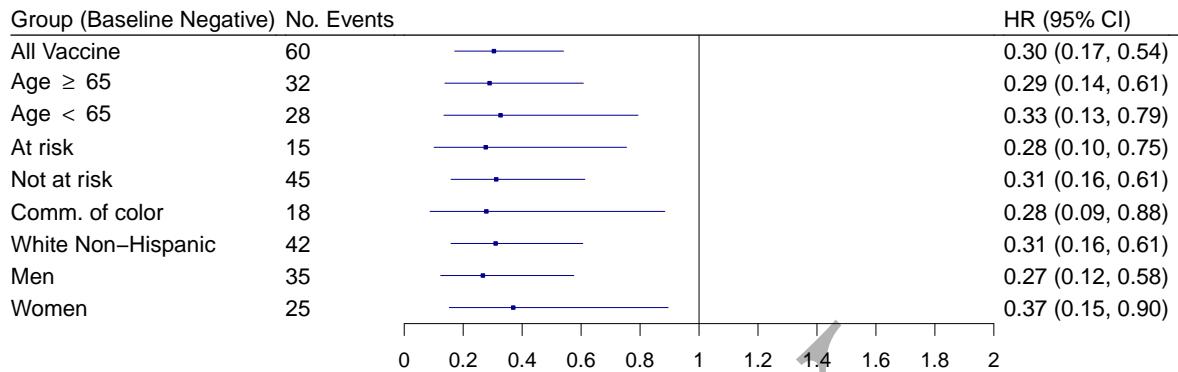


Figure 5.2: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to spike markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

Binding Antibody to RBD: Day 29

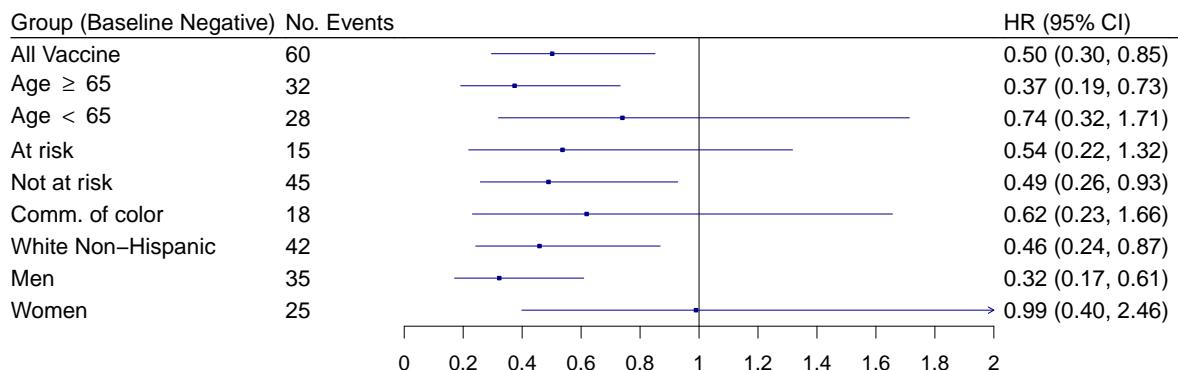


Figure 5.3: Forest plots of hazard ratios per 10-fold increase in the Day 29 binding Ab to RBD markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

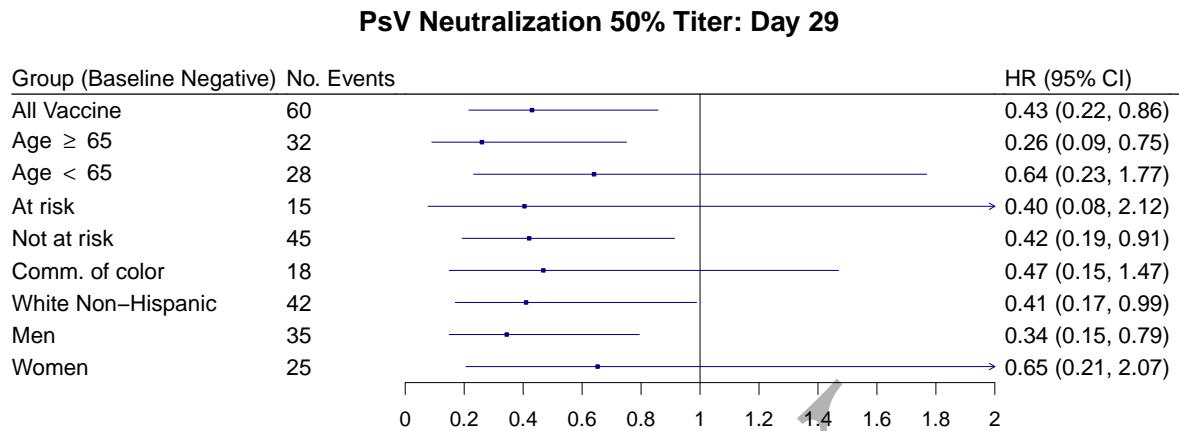


Figure 5.4: Forest plots of hazard ratios per 10-fold increase in the Day 29 pseudo neut ID50 markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

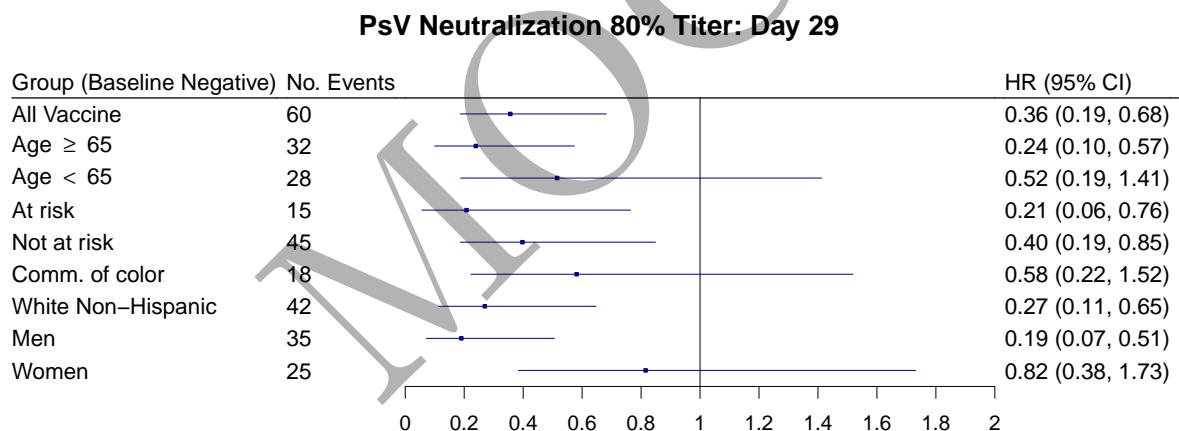


Figure 5.5: Forest plots of hazard ratios per 10-fold increase in the Day 29 pseudo neut ID80 markers among baseline negative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

5.2 Marginalized risk and controlled vaccine efficacy plots

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Table 5.3: Analysis of Day 29 markers (upper vs. lower tertile) as a CoR and a controlled risk CoP.

| | marginalized risk | | controlled risk | | | |
|------------------------|--------------------|-------------------|----------------------|-------------------|---------------------|----------------------|
| | ratio $RR_M(0, 1)$ | Point Est. 95% CI | ratio $RR_C(0, 1)^1$ | Point Est. 95% CI | e(0,1) ² | Point Est. 95% CI UL |
| Anti Spike IgG (IU/ml) | 0.26 | 0.13–0.68 | 0.34 | 0.17–0.91 | 7.2 | 2.3 |
| Anti RBD IgG (IU/ml) | 0.29 | 0.17–0.48 | 0.38 | 0.22–0.64 | 6.4 | 3.6 |
| Pseudovirus-nAb ID50 | 0.46 | 0.28–0.65 | 0.61 | 0.37–0.86 | 3.8 | 2.5 |
| Pseudovirus-nAb ID80 | 0.45 | 0.30–0.83 | 0.60 | 0.40–1.10 | 3.8 | 1.7 |

¹Conservative (upper bound) estimate assuming unmeasured confounding at level $RR_{UD}(0, 1) = RR_{EU}(0, 1) = 2$ and thus $B(0, 1) = 4/3$.

²E-values are computed for upper tertile ($s = 1$) vs. lower tertile ($s = 0$) biomarker subgroups after controlling for baseline risk score, meeting the protocol randomization stratification criterion for being at heightened risk of COVID (yes or no), community of color or not; UL = upper limit.

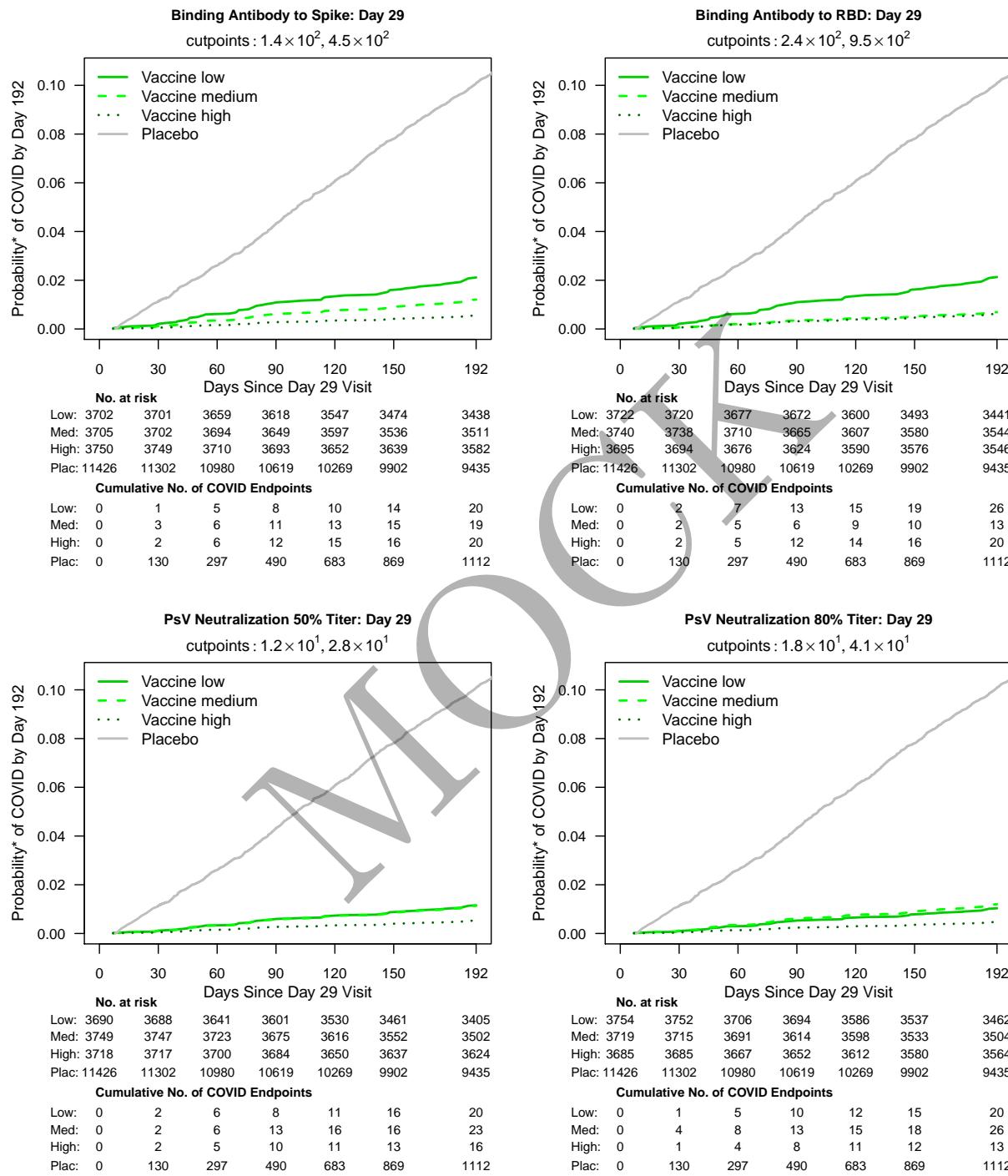


Figure 5.6: Marginalized cumulative incidence rate curves for trichotomized Day 29 markers among baseline negative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.

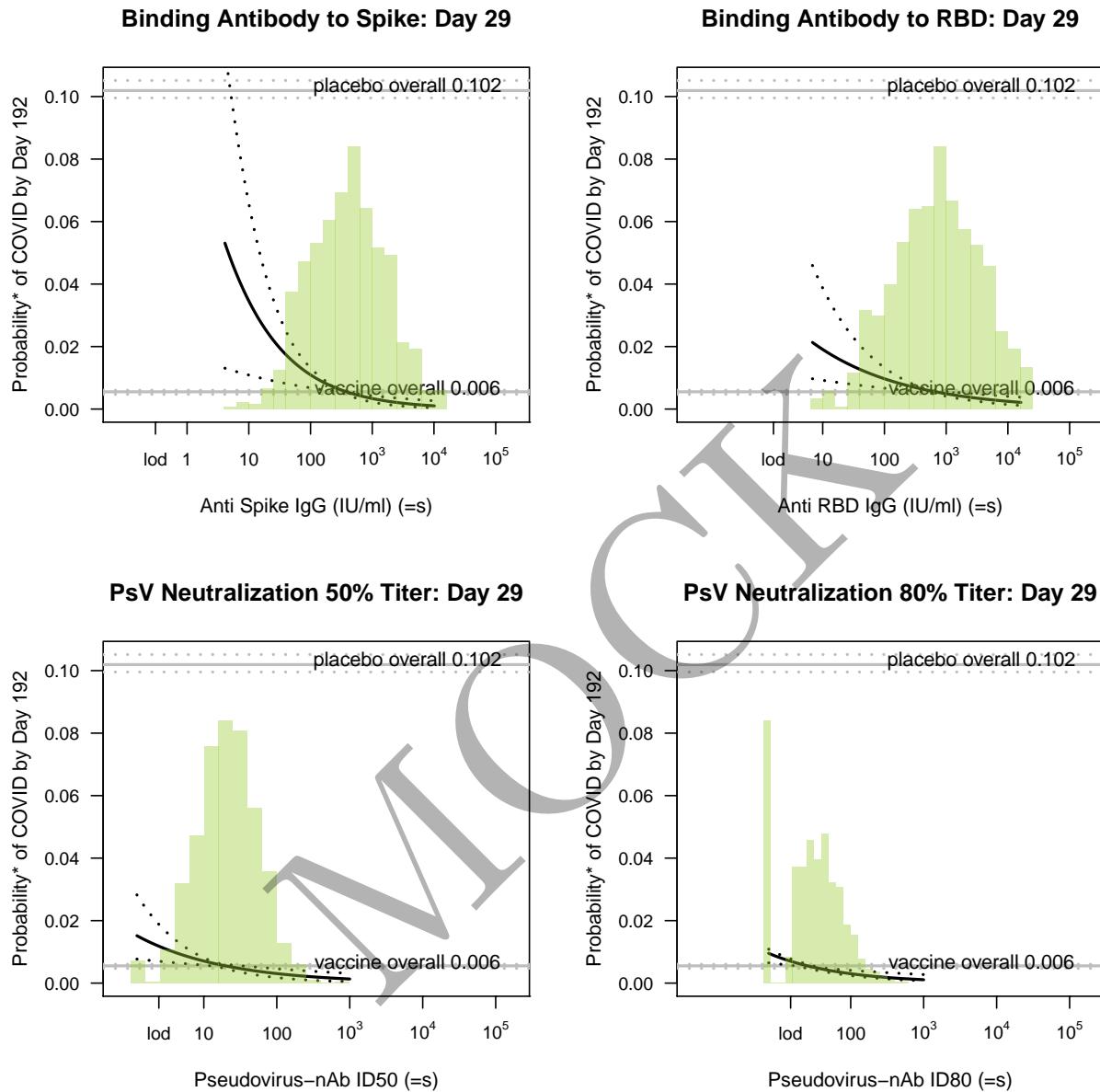


Figure 5.7: Marginalized cumulative risk by Day 192 as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 192 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

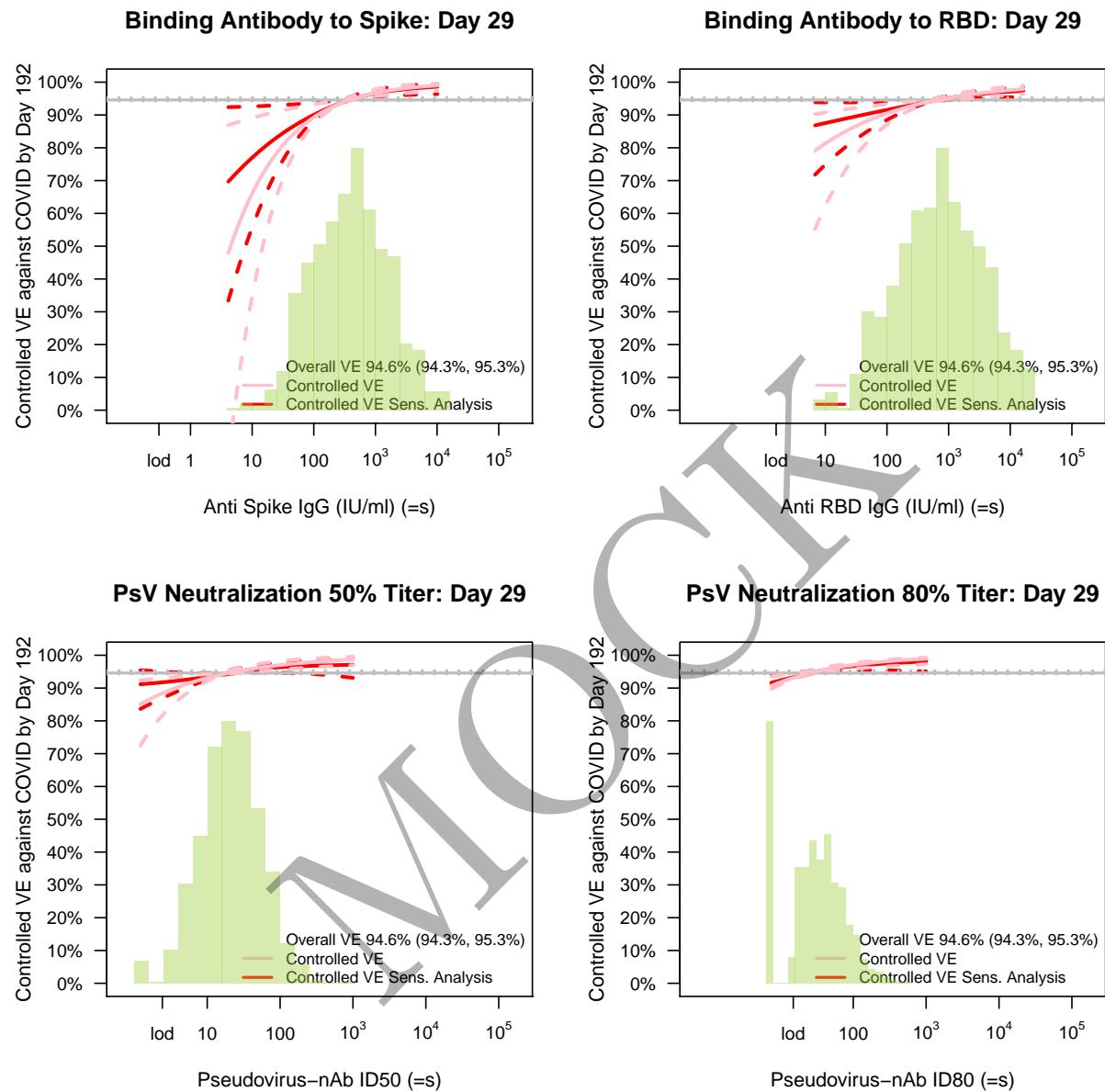


Figure 5.8: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

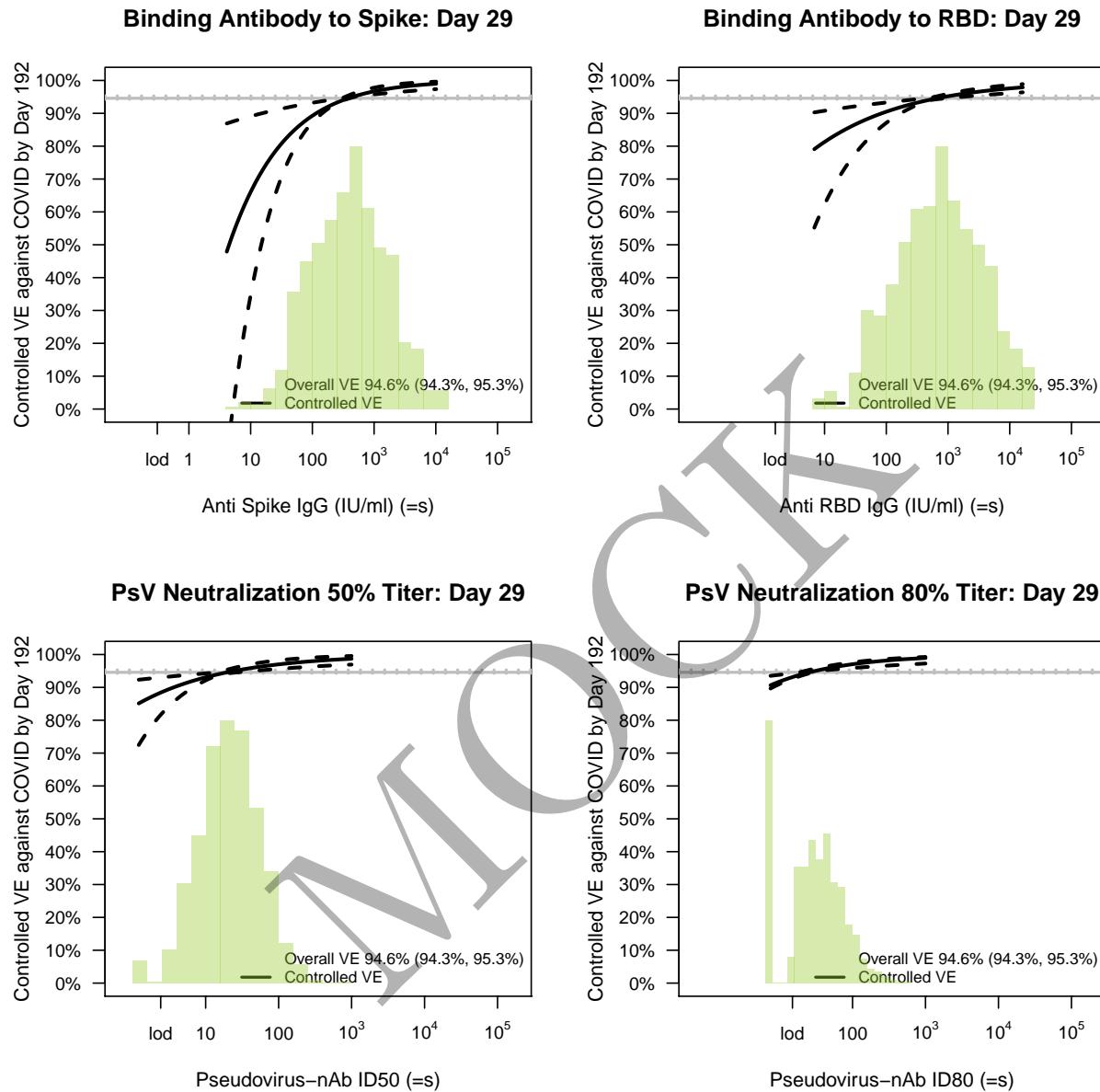


Figure 5.9: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

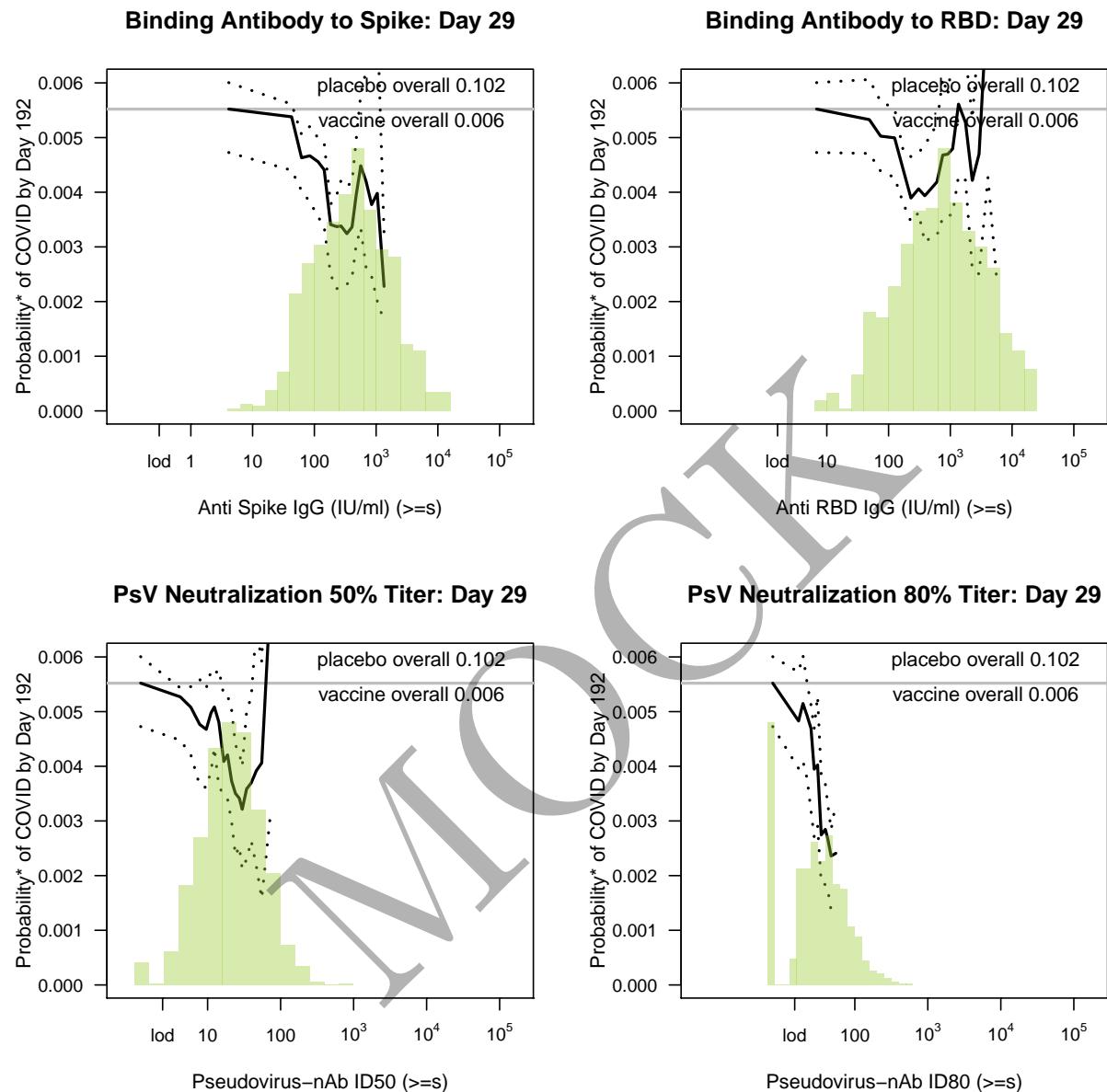


Figure 5.10: Marginalized cumulative risk by Day 192 as functions of Day 29 markers above a threshold ($\geq s$) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required, 5 replicates). The horizontal lines indicate the overall cumulative risk of the vaccine arm by Day 192 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. $l_{od} = 0.3, 1.6, 2.4, 15$ for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

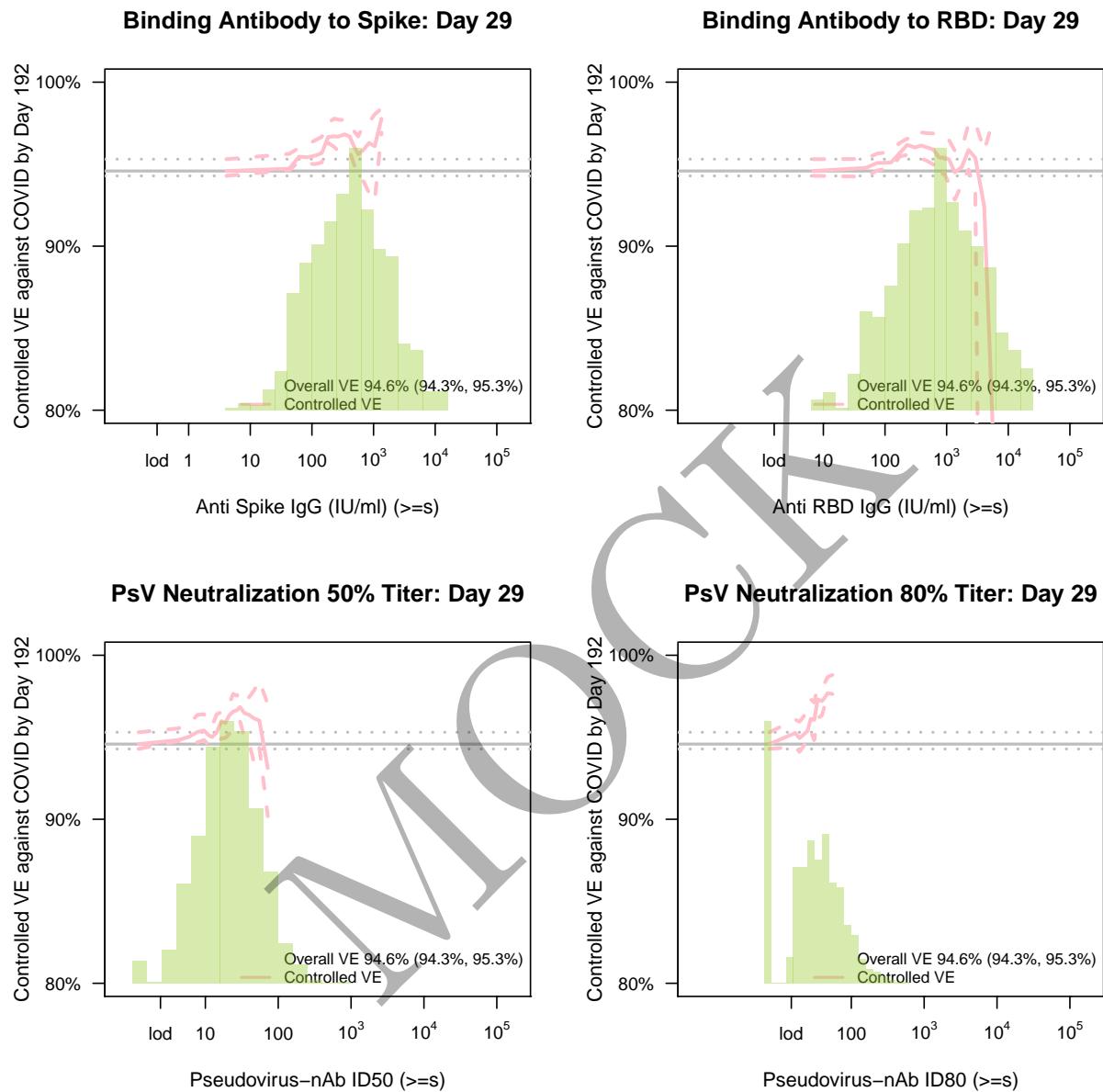


Figure 5.11: Controlled VE as functions of Day 29 markers ($\geq s$) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates). Histograms of the immunological markers in the vaccine arm are overlaid. $l_{od} = 0.3, 1.6, 2.4, 15$ for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

Table 5.4: Marginalized cumulative risk by Day 192 as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| | Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 |
|-------|------------------------|-------|----------------------|------|----------------------|------|----------------------|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate |
| 4.1 | .0531 (.0131,.1151) | 6.8 | .0213 (.0097,.0460) | 1.2 | .0152 (.0077,.0282) | 7.5 | .0095 (.0065,.0109) |
| 64 | .0137 (.0074,.0178) | 78 | .0104 (.0069,.0149) | 6 | .0085 (.0062,.0110) | 8 | .0095 (.0065,.0109) |
| 84 | .0119 (.0070,.0148) | 125 | .0091 (.0065,.0119) | 8 | .0077 (.0060,.0094) | 8 | .0095 (.0065,.0109) |
| 121 | .0100 (.0065,.0116) | 188 | .0080 (.0061,.0098) | 10 | .0071 (.0058,.0082) | 15 | .0070 (.0057,.0077) |
| 224 | .0073 (.0057,.0076) | 376 | .0066 (.0056,.0071) | 14 | .0062 (.0054,.0067) | 22 | .0059 (.0051,.0065) |
| 333 | .0059 (.0051,.0062) | 500 | .0060 (.0054,.0063) | 19 | .0056 (.0048,.0061) | 28 | .0054 (.0045,.0058) |
| 475 | .0049 (.0039,.0053) | 603 | .0057 (.0050,.0061) | 24 | .0051 (.0041,.0058) | 35 | .0048 (.0041,.0052) |
| 500 | .0048 (.0038,.0052) | 912 | .0050 (.0042,.0057) | 30 | .0047 (.0036,.0056) | 43 | .0044 (.0037,.0048) |
| 693 | .0041 (.0029,.0046) | 1000 | .0049 (.0041,.0056) | 45 | .0041 (.0028,.0052) | 63 | .0037 (.0030,.0044) |
| 1000 | .0034 (.0022,.0042) | 1395 | .0044 (.0035,.0054) | 55 | .0038 (.0025,.0051) | 74 | .0034 (.0028,.0043) |
| 1294 | .0030 (.0018,.0040) | 2891 | .0036 (.0026,.0049) | 71 | .0035 (.0022,.0049) | 90 | .0032 (.0025,.0042) |
| 1785 | .0025 (.0014,.0038) | 4073 | .0032 (.0022,.0046) | 500 | .0017 (.0007,.0035) | 500 | .0015 (.0011,.0031) |
| 2228 | .0022 (.0012,.0036) | 5444 | .0030 (.0019,.0044) | 757 | .0015 (.0005,.0033) | 524 | .0014 (.0010,.0031) |
| 10156 | .0010 (.0004,.0026) | 16269 | .0021 (.0011,.0038) | 1000 | .0013 (.0004,.0031) | 1000 | .0011 (.0007,.0027) |

Table 5.5: Controlled VE as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| | Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 | |
|-------|------------------------|-------|----------------------|------|----------------------|------|----------------------|--|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate | |
| 4.1 | .4790 (-0.1438,.8691) | 6.8 | .7908 (.5520,.9028) | 1.2 | .8512 (.7246,.9233) | 7.5 | .9065 (.8965,.9351) | |
| 64 | .8651 (.8241,.9255) | 78 | .8976 (.8546,.9305) | 6 | .9166 (.8931,.9384) | 8 | .9065 (.8965,.9351) | |
| 84 | .8829 (.8560,.9297) | 125 | .9110 (.8839,.9349) | 8 | .9241 (.9085,.9405) | 8 | .9065 (.8965,.9351) | |
| 121 | .9023 (.8869,.9346) | 188 | .9210 (.9043,.9385) | 10 | .9300 (.9199,.9423) | 15 | .9317 (.9269,.9430) | |
| 224 | .9288 (.9257,.9424) | 376 | .9357 (.9312,.9445) | 14 | .9387 (.9351,.9457) | 22 | .9418 (.9384,.9496) | |
| 333 | .9418 (.9408,.9495) | 500 | .9409 (.9396,.9468) | 19 | .9447 (.9418,.9525) | 28 | .9475 (.9448,.9549) | |
| 475 | .9515 (.9496,.9612) | 603 | .9441 (.9419,.9500) | 24 | .9497 (.9445,.9590) | 35 | .9527 (.9502,.9597) | |
| 500 | .9528 (.9507,.9627) | 912 | .9506 (.9455,.9578) | 30 | .9537 (.9466,.9642) | 43 | .9569 (.9524,.9636) | |
| 693 | .9601 (.9543,.9709) | 1000 | .9519 (.9462,.9594) | 45 | .9600 (.9501,.9719) | 63 | .9636 (.9554,.9699) | |
| 1000 | .9669 (.9576,.9780) | 1395 | .9565 (.9487,.9648) | 55 | .9628 (.9517,.9750) | 74 | .9662 (.9567,.9723) | |
| 1294 | .9710 (.9598,.9819) | 2891 | .9650 (.9538,.9744) | 71 | .9661 (.9537,.9785) | 90 | .9691 (.9582,.9750) | |
| 1785 | .9754 (.9623,.9859) | 4073 | .9684 (.9560,.9783) | 500 | .9834 (.9663,.9933) | 500 | .9856 (.9690,.9895) | |
| 2228 | .9781 (.9640,.9881) | 5444 | .9710 (.9577,.9811) | 757 | .9857 (.9681,.9948) | 524 | .9859 (.9693,.9898) | |
| 10156 | .9900 (.9736,.9963) | 16269 | .9791 (.9638,.9889) | 1000 | .9871 (.9693,.9956) | 1000 | .9894 (.9726,.9927) | |
| 9 | .6434 (.3015,.8887) | | (,) | | (,) | | (,) | |
| 113 | .8990 (.8818,.9337) | 84 | .8999 (.8599,.9313) | 4 | .9001 (.8562,.9341) | 8 | .9065 (.8965,.9351) | |
| 432 | .9491 (.9475,.9583) | 889 | .9502 (.9453,.9573) | 24 | .9497 (.9445,.9590) | 31 | .9501 (.9478,.9573) | |

Table 5.6: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline negative vaccine recipients with 95% bootstrap point-wise confidence intervals (5 replicates).

| | Anti Spike IgG (IU/ml) | | Anti RBD IgG (IU/ml) | | Pseudovirus-nAb ID50 | | Pseudovirus-nAb ID80 | |
|-------|------------------------|-------|----------------------|------|----------------------|------|----------------------|--|
| s | Estimate | s | Estimate | s | Estimate | s | Estimate | |
| 4.1 | .6968 (.3343,.9238) | 6.8 | .8683 (.7179,.9388) | 1.2 | .9116 (.8364,.9544) | 7.5 | .9163 (.9073,.9419) | |
| 64 | .8808 (.8445,.9341) | 78 | .9112 (.8739,.9398) | 6 | .9274 (.9070,.9464) | 8 | .9163 (.9073,.9419) | |
| 84 | .8933 (.8687,.9359) | 125 | .9191 (.8945,.9409) | 8 | .9308 (.9166,.9458) | 8 | .9163 (.9073,.9419) | |
| 121 | .9078 (.8934,.9383) | 188 | .9257 (.9099,.9421) | 10 | .9340 (.9245,.9456) | 15 | .9334 (.9288,.9445) | |
| 224 | .9298 (.9269,.9433) | 376 | .9368 (.9324,.9454) | 14 | .9398 (.9363,.9467) | 22 | .9420 (.9387,.9498) | |
| 333 | .9419 (.9409,.9496) | 500 | .9413 (.9400,.9471) | 19 | .9448 (.9419,.9526) | 28 | .9475 (.9448,.9549) | |
| 475 | .9514 (.9495,.9611) | 603 | .9442 (.9420,.9501) | 24 | .9496 (.9444,.9589) | 35 | .9524 (.9500,.9595) | |
| 500 | .9526 (.9506,.9626) | 912 | .9505 (.9454,.9577) | 30 | .9530 (.9458,.9637) | 43 | .9562 (.9516,.9630) | |
| 693 | .9595 (.9537,.9705) | 1000 | .9518 (.9461,.9593) | 45 | .9576 (.9471,.9702) | 63 | .9617 (.9531,.9683) | |
| 1000 | .9657 (.9560,.9772) | 1395 | .9559 (.9480,.9644) | 55 | .9594 (.9473,.9727) | 74 | .9637 (.9535,.9703) | |
| 1294 | .9693 (.9574,.9809) | 2891 | .9629 (.9511,.9729) | 71 | .9614 (.9473,.9755) | 90 | .9659 (.9539,.9725) | |
| 1785 | .9732 (.9589,.9846) | 4073 | .9656 (.9521,.9764) | 500 | .9695 (.9383,.9877) | 500 | .9781 (.9528,.9841) | |
| 2228 | .9755 (.9598,.9867) | 5444 | .9676 (.9528,.9789) | 757 | .9705 (.9342,.9892) | 524 | .9783 (.9527,.9843) | |
| 10156 | .9862 (.9638,.9949) | 16269 | .9736 (.9543,.9860) | 1000 | .9710 (.9311,.9901) | 1000 | .9811 (.9508,.9868) | |
| 9 | .6434 (.3015,.8887) | | (,) | | (,) | | (,) | |
| 113 | .8990 (.8818,.9337) | 84 | .8999 (.8599,.9313) | 4 | .9001 (.8562,.9341) | 8 | .9065 (.8965,.9351) | |
| 432 | .9491 (.9475,.9583) | 889 | .9502 (.9453,.9573) | 24 | .9497 (.9445,.9590) | 31 | .9501 (.9478,.9573) | |

Chapter 6

Univariate CoR: Nonparametric Threshold Modeling ($>= s$)

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

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

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

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

MOCK

6.1.1 Day 57 Spike protein binding antibody

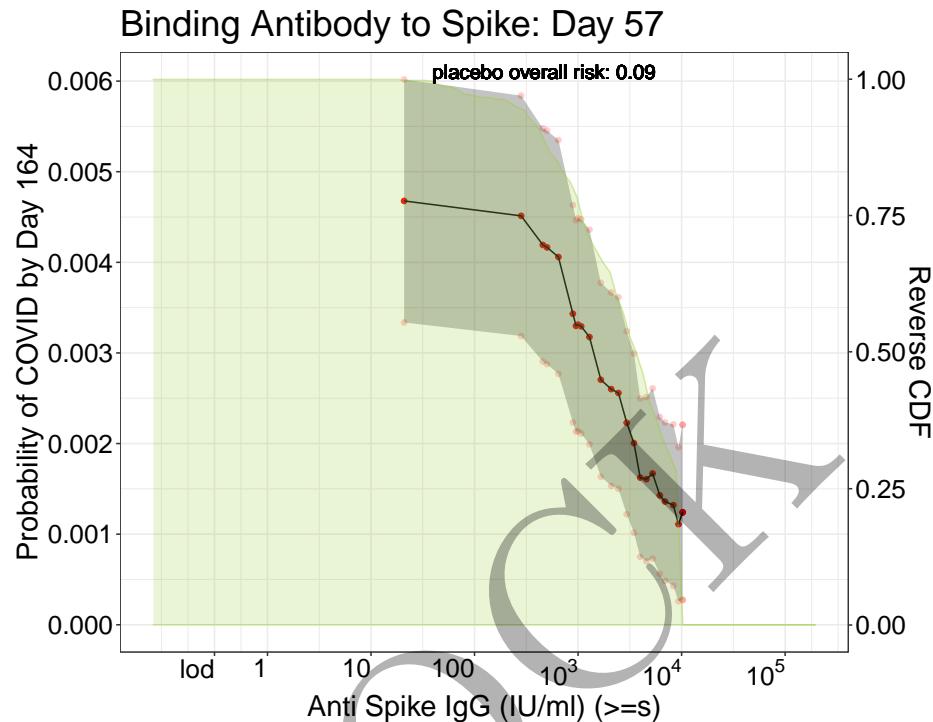


Figure 6.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.1: Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.316 | $2.07 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.699 | $5.00 * 10^2$ | 0.00417 | 0.00288 | 0.00545 |
| 2.815 | $6.53 * 10^2$ | 0.00406 | 0.00277 | 0.00535 |
| 2.982 | $9.59 * 10^2$ | 0.00330 | 0.00213 | 0.00447 |
| 3.000 | $1.00 * 10^3$ | 0.00331 | 0.00214 | 0.00449 |
| 3.113 | $1.30 * 10^3$ | 0.00318 | 0.00199 | 0.00436 |
| 3.471 | $2.96 * 10^3$ | 0.00223 | 0.00122 | 0.00324 |
| 3.658 | $4.55 * 10^3$ | 0.00161 | 0.00070 | 0.00251 |
| 3.841 | $6.93 * 10^3$ | 0.00136 | 0.00049 | 0.00223 |
| 4.006 | $1.01 * 10^4$ | 0.00124 | 0.00027 | 0.00221 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00027 | 0.00220 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00027 | 0.00220 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00027 | 0.00220 |

6.1.2 Day 57 RBD binding antibody

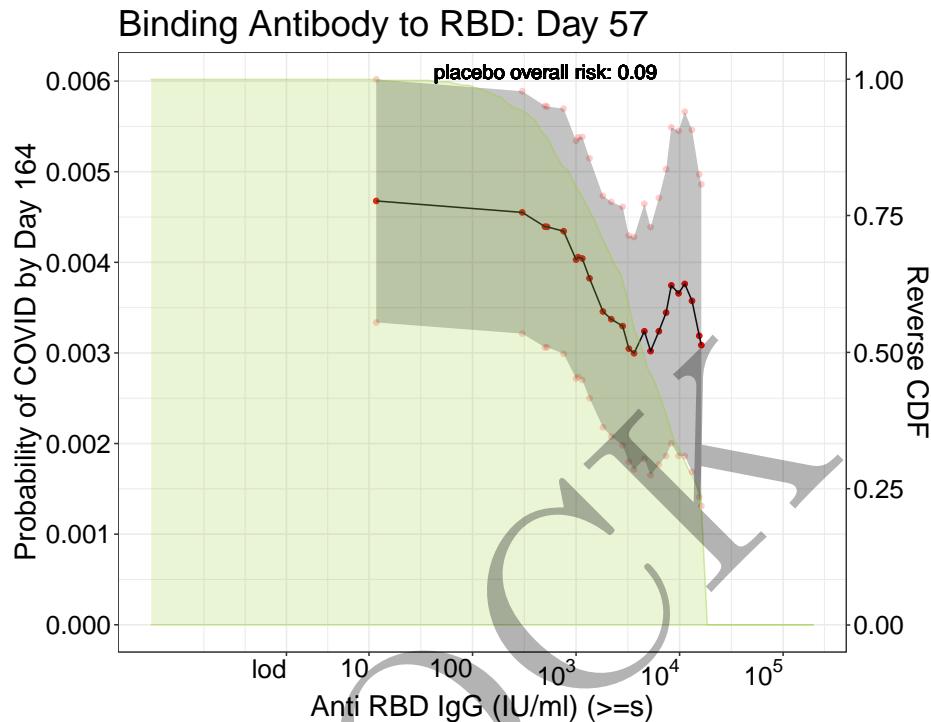


Figure 6.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.2: Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.073 | $1.18 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.699 | $5.00 * 10^2$ | 0.00439 | 0.00306 | 0.00573 |
| 2.882 | $7.62 * 10^2$ | 0.00434 | 0.00299 | 0.00570 |
| 3.000 | $1.00 * 10^3$ | 0.00403 | 0.00272 | 0.00534 |
| 3.056 | $1.14 * 10^3$ | 0.00404 | 0.00270 | 0.00538 |
| 3.259 | $1.82 * 10^3$ | 0.00346 | 0.00218 | 0.00473 |
| 3.557 | $3.61 * 10^3$ | 0.00300 | 0.00171 | 0.00428 |
| 3.797 | $6.27 * 10^3$ | 0.00324 | 0.00177 | 0.00471 |
| 3.986 | $9.68 * 10^3$ | 0.00366 | 0.00186 | 0.00545 |
| 4.186 | $1.53 * 10^4$ | 0.00319 | 0.00141 | 0.00497 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |

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

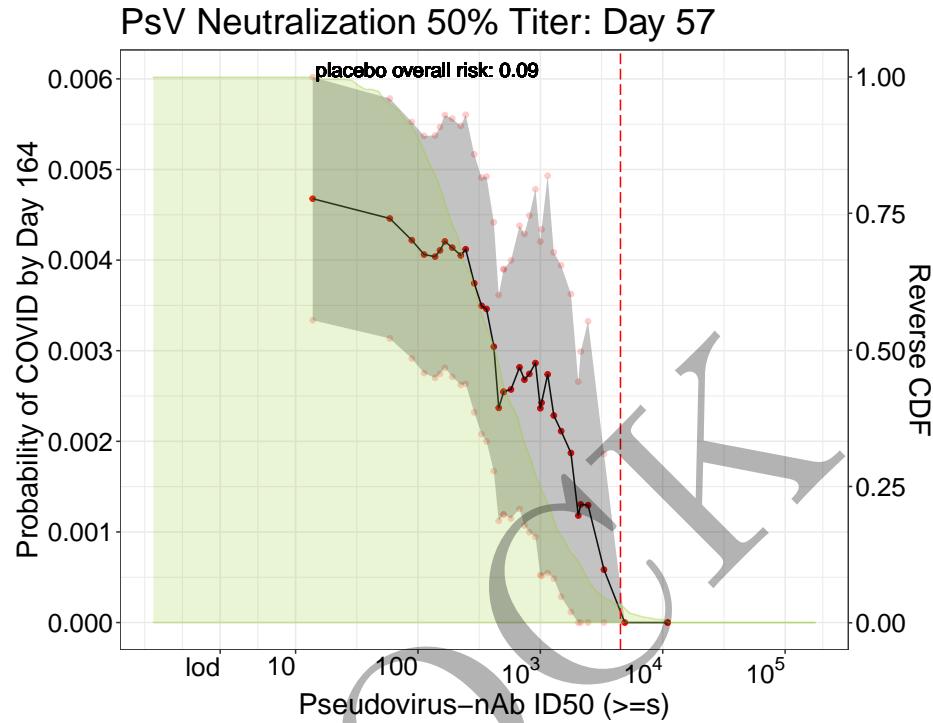


Figure 6.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.3: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.135 | $1.36 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.055 | $1.14 * 10^2$ | 0.00406 | 0.00275 | 0.00537 |
| 2.177 | $1.50 * 10^2$ | 0.00411 | 0.00275 | 0.00547 |
| 2.281 | $1.91 * 10^2$ | 0.00414 | 0.00271 | 0.00556 |
| 2.519 | $3.30 * 10^2$ | 0.00350 | 0.00208 | 0.00491 |
| 2.657 | $4.54 * 10^2$ | 0.00237 | 0.00112 | 0.00362 |
| 2.699 | $5.00 * 10^2$ | 0.00255 | 0.00120 | 0.00390 |
| 2.828 | $6.73 * 10^2$ | 0.00282 | 0.00125 | 0.00438 |
| 2.959 | $9.10 * 10^2$ | 0.00286 | 0.00094 | 0.00478 |
| 3.000 | $1.00 * 10^3$ | 0.00236 | 0.00053 | 0.00420 |
| 3.174 | $1.49 * 10^3$ | 0.00211 | 0.00028 | 0.00394 |
| 3.307 | $2.03 * 10^3$ | 0.00118 | 0.00000 | 0.00266 |
| 3.387 | $2.44 * 10^3$ | 0.00130 | 0.00000 | 0.00333 |
| 4.038 | $1.09 * 10^4$ | 0.00000 | 0.00000 | NA |

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

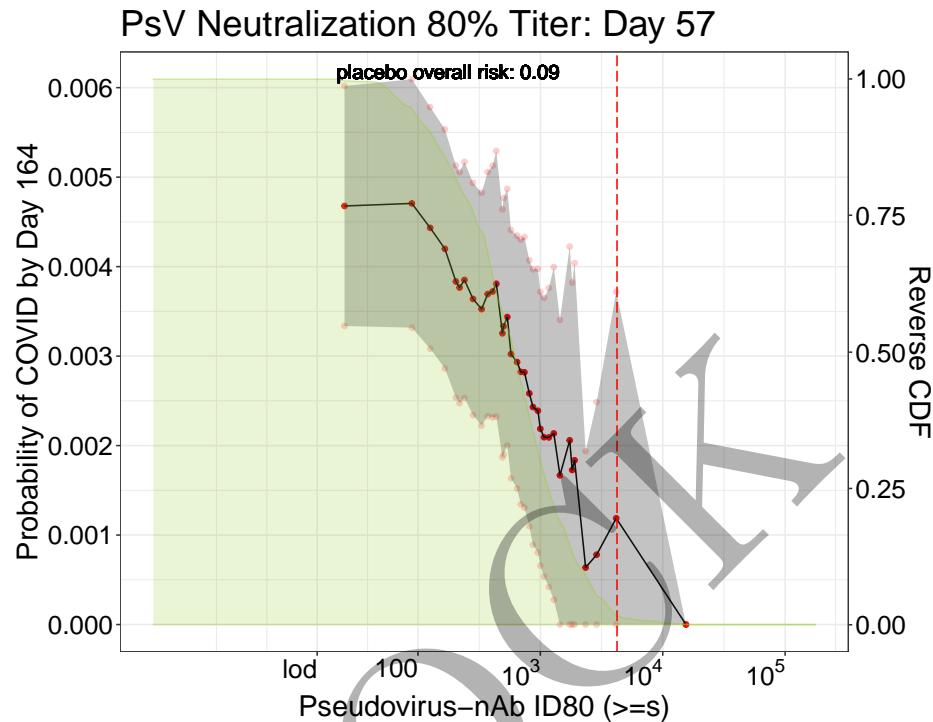


Figure 6.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.4: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.403 | $2.53 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.220 | $1.66 * 10^2$ | 0.00420 | 0.00286 | 0.00553 |
| 2.335 | $2.16 * 10^2$ | 0.00377 | 0.00247 | 0.00506 |
| 2.455 | $2.85 * 10^2$ | 0.00364 | 0.00234 | 0.00494 |
| 2.644 | $4.41 * 10^2$ | 0.00381 | 0.00232 | 0.00529 |
| 2.699 | $5.00 * 10^2$ | 0.00333 | 0.00190 | 0.00477 |
| 2.764 | $5.81 * 10^2$ | 0.00302 | 0.00163 | 0.00441 |
| 2.874 | $7.48 * 10^2$ | 0.00282 | 0.00131 | 0.00433 |
| 2.981 | $9.57 * 10^2$ | 0.00239 | 0.00080 | 0.00397 |
| 3.000 | $1.00 * 10^3$ | 0.00219 | 0.00066 | 0.00372 |
| 3.162 | $1.45 * 10^3$ | 0.00167 | 0.00000 | 0.00340 |
| 3.265 | $1.84 * 10^3$ | 0.00173 | 0.00000 | 0.00382 |
| 3.371 | $2.35 * 10^3$ | 0.00064 | 0.00000 | 0.00194 |
| 4.187 | $1.54 * 10^4$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.2.1 Day 29 Spike protein antibody

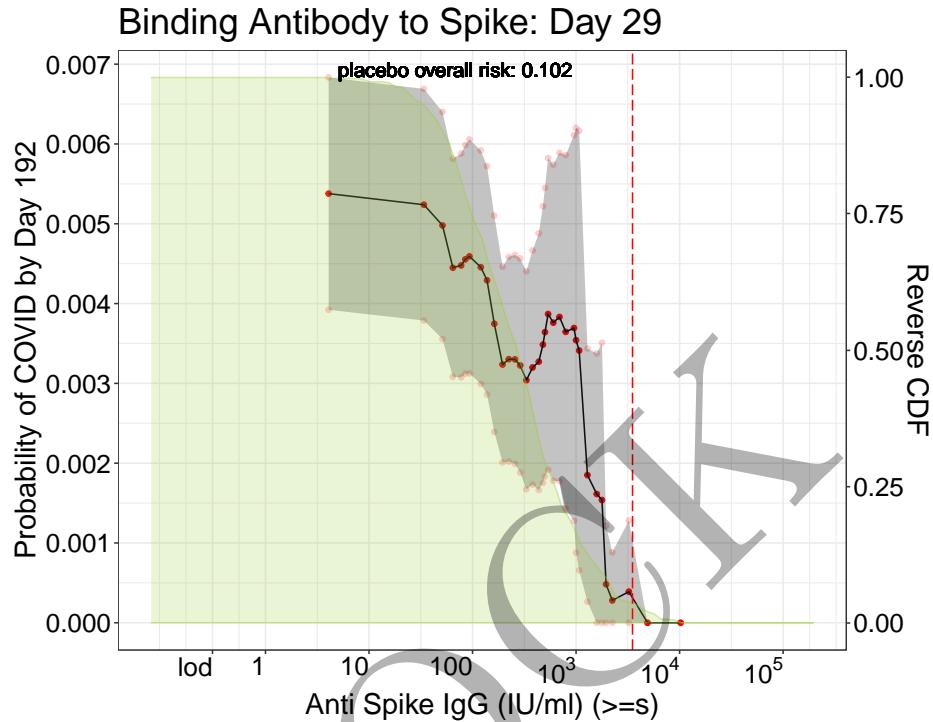


Figure 6.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.5: Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.613 | $4.10 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 1.805 | $6.38 * 10^1$ | 0.00445 | 0.00308 | 0.00581 |
| 1.927 | $8.45 * 10^1$ | 0.00455 | 0.00312 | 0.00599 |
| 2.081 | $1.21 * 10^2$ | 0.00446 | 0.00299 | 0.00592 |
| 2.351 | $2.24 * 10^2$ | 0.00330 | 0.00202 | 0.00459 |
| 2.522 | $3.33 * 10^2$ | 0.00304 | 0.00167 | 0.00441 |
| 2.677 | $4.75 * 10^2$ | 0.00349 | 0.00175 | 0.00522 |
| 2.699 | $5.00 * 10^2$ | 0.00364 | 0.00183 | 0.00545 |
| 2.841 | $6.93 * 10^2$ | 0.00383 | 0.00177 | 0.00589 |
| 3.000 | $1.00 * 10^3$ | 0.00354 | 0.00088 | 0.00620 |
| 3.112 | $1.29 * 10^3$ | 0.00185 | 0.00026 | 0.00344 |
| 3.252 | $1.79 * 10^3$ | 0.00154 | 0.00000 | 0.00351 |
| 3.348 | $2.23 * 10^3$ | 0.00028 | 0.00000 | 0.00088 |
| 4.007 | $1.02 * 10^4$ | 0.00000 | 0.00000 | NA |

6.2.2 Day 29 RBD binding antibody

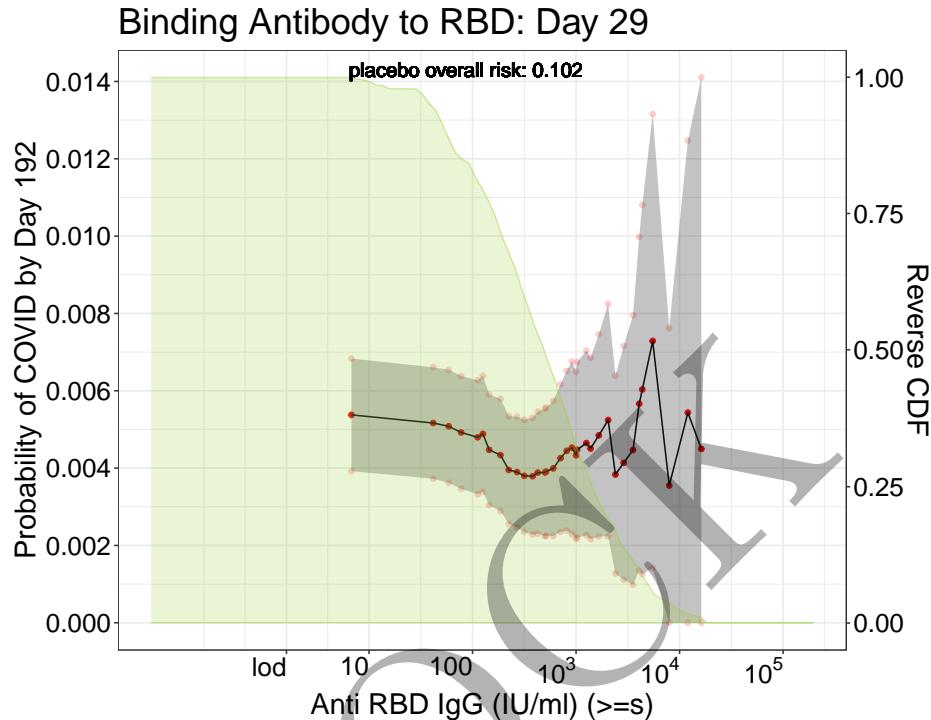


Figure 6.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.6: Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.834 | $6.82 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 1.892 | $7.80 * 10^1$ | 0.00492 | 0.00346 | 0.00638 |
| 2.098 | $1.25 * 10^2$ | 0.00489 | 0.00338 | 0.00639 |
| 2.273 | $1.87 * 10^2$ | 0.00434 | 0.00288 | 0.00579 |
| 2.575 | $3.76 * 10^2$ | 0.00379 | 0.00228 | 0.00530 |
| 2.699 | $5.00 * 10^2$ | 0.00389 | 0.00224 | 0.00554 |
| 2.780 | $6.03 * 10^2$ | 0.00399 | 0.00225 | 0.00574 |
| 2.960 | $9.12 * 10^2$ | 0.00453 | 0.00230 | 0.00676 |
| 3.000 | $1.00 * 10^3$ | 0.00433 | 0.00217 | 0.00650 |
| 3.144 | $1.39 * 10^3$ | 0.00451 | 0.00216 | 0.00685 |
| 3.461 | $2.89 * 10^3$ | 0.00413 | 0.00111 | 0.00716 |
| 3.610 | $4.07 * 10^3$ | 0.00566 | 0.00135 | 0.00998 |
| 3.736 | $5.45 * 10^3$ | 0.00729 | 0.00142 | 0.01316 |
| 4.211 | $1.63 * 10^4$ | 0.00450 | 0.00000 | 0.01410 |

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

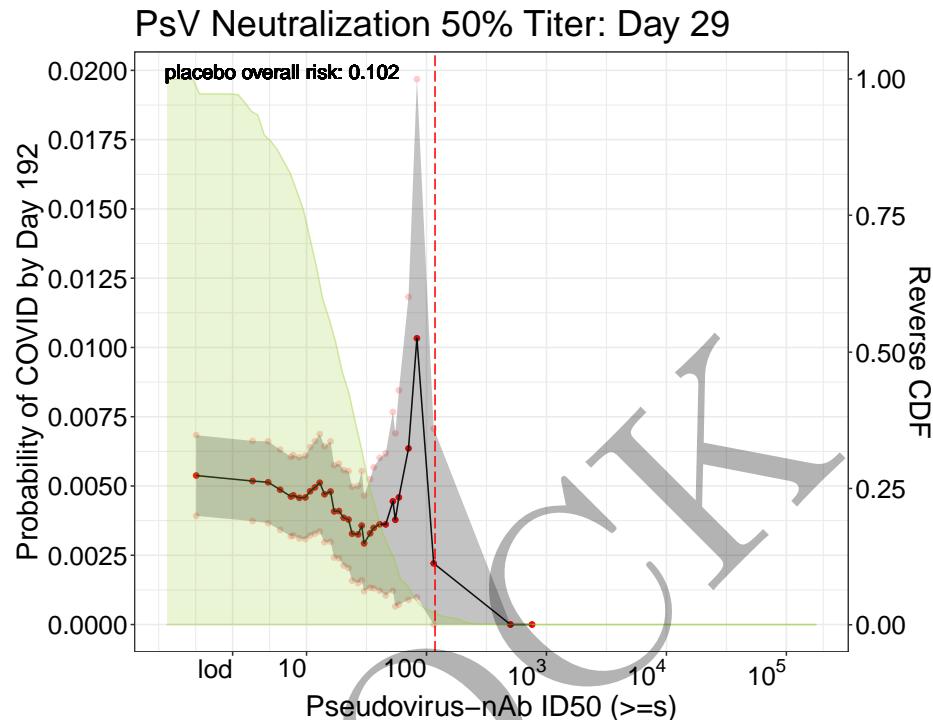


Figure 6.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.7: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.083 | $1.21 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.779 | $6.01 * 10^0$ | 0.00487 | 0.00342 | 0.00631 |
| 0.892 | $7.80 * 10^0$ | 0.00466 | 0.00321 | 0.00611 |
| 0.988 | $9.73 * 10^0$ | 0.00459 | 0.00308 | 0.00609 |
| 1.147 | $1.40 * 10^1$ | 0.00470 | 0.00297 | 0.00643 |
| 1.271 | $1.87 * 10^1$ | 0.00410 | 0.00239 | 0.00581 |
| 1.382 | $2.41 * 10^1$ | 0.00328 | 0.00158 | 0.00497 |
| 1.481 | $3.03 * 10^1$ | 0.00293 | 0.00121 | 0.00465 |
| 1.656 | $4.53 * 10^1$ | 0.00361 | 0.00105 | 0.00618 |
| 1.741 | $5.51 * 10^1$ | 0.00378 | 0.00066 | 0.00690 |
| 1.852 | $7.11 * 10^1$ | 0.00636 | 0.00089 | 0.01182 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |

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

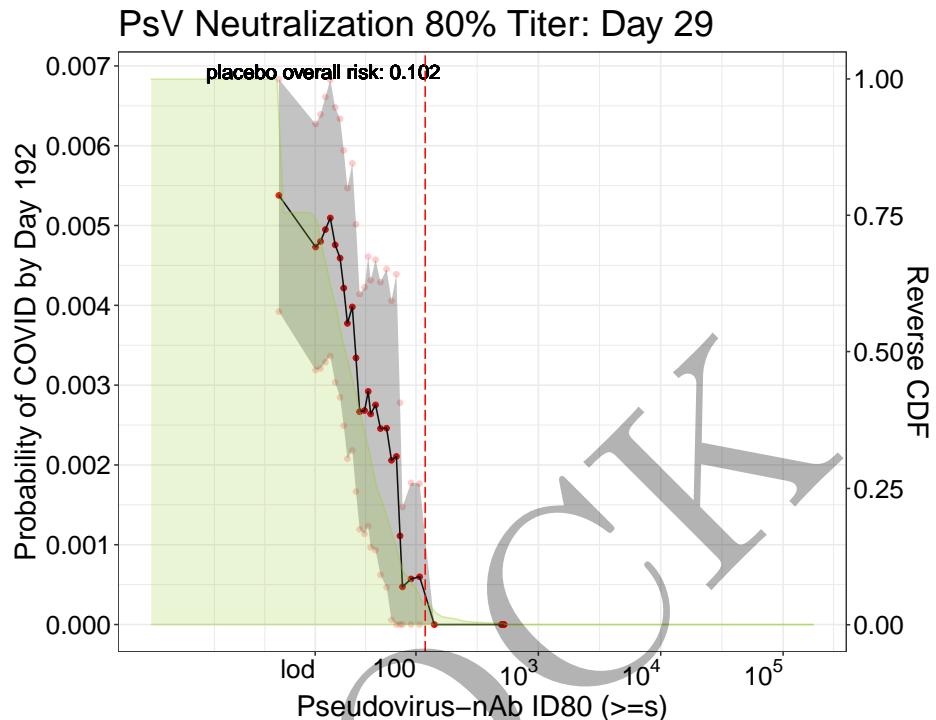


Figure 6.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.8: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 1.183 | $1.52 * 10^1$ | 0.00473 | 0.00319 | 0.00627 |
| 1.339 | $2.18 * 10^1$ | 0.00476 | 0.00304 | 0.00648 |
| 1.440 | $2.75 * 10^1$ | 0.00377 | 0.00208 | 0.00547 |
| 1.541 | $3.48 * 10^1$ | 0.00267 | 0.00119 | 0.00414 |
| 1.632 | $4.29 * 10^1$ | 0.00264 | 0.00097 | 0.00431 |
| 1.796 | $6.25 * 10^1$ | 0.00206 | 0.00006 | 0.00406 |
| 1.868 | $7.38 * 10^1$ | 0.00111 | 0.00000 | 0.00278 |
| 1.956 | $9.04 * 10^1$ | 0.00057 | 0.00000 | 0.00178 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.3.1 Day 57 Spike protein binding antibody

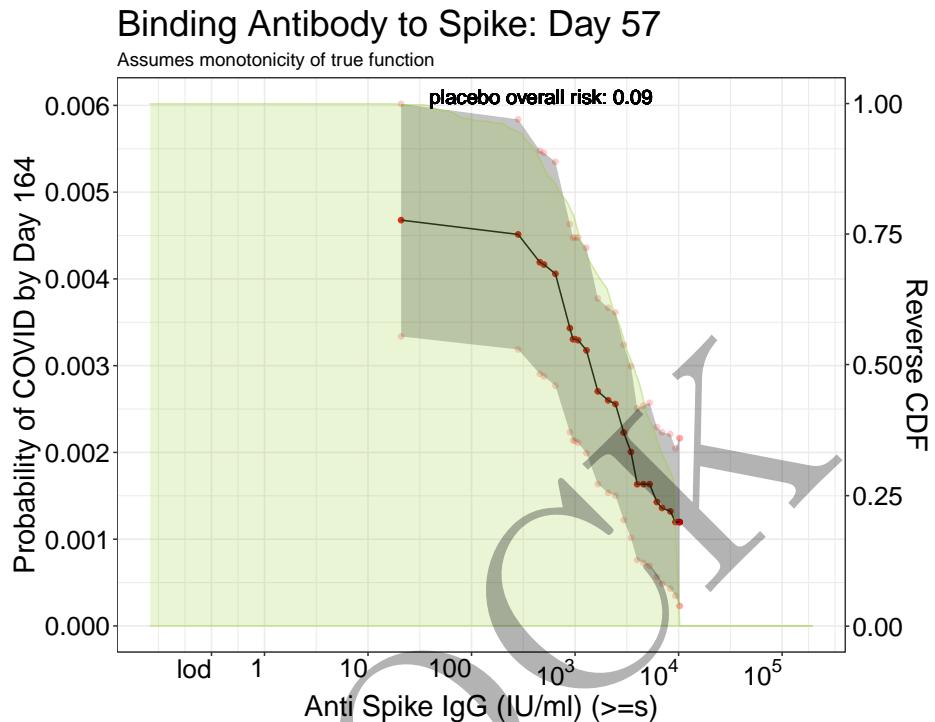


Figure 6.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.9: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

| log ₁₀ -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------------|------------------------|---------------|---------|----------|
| 1.316 | 2.07 * 10 ¹ | 0.00468 | 0.00334 | 0.00602 |
| 2.699 | 5.00 * 10 ² | 0.00417 | 0.00288 | 0.00545 |
| 2.815 | 6.53 * 10 ² | 0.00406 | 0.00277 | 0.00535 |
| 2.982 | 9.59 * 10 ² | 0.00331 | 0.00214 | 0.00447 |
| 3.000 | 1.00 * 10 ³ | 0.00331 | 0.00213 | 0.00448 |
| 3.113 | 1.30 * 10 ³ | 0.00318 | 0.00199 | 0.00436 |
| 3.471 | 2.96 * 10 ³ | 0.00223 | 0.00122 | 0.00324 |
| 3.658 | 4.55 * 10 ³ | 0.00163 | 0.00073 | 0.00254 |
| 3.841 | 6.93 * 10 ³ | 0.00136 | 0.00049 | 0.00223 |
| 4.006 | 1.01 * 10 ⁴ | 0.00120 | 0.00023 | 0.00217 |
| 4.007 | 1.02 * 10 ⁴ | 0.00120 | 0.00023 | 0.00216 |
| 4.007 | 1.02 * 10 ⁴ | 0.00120 | 0.00023 | 0.00216 |
| 4.007 | 1.02 * 10 ⁴ | 0.00120 | 0.00023 | 0.00216 |

6.3.2 Day 57 RBD binding antibody

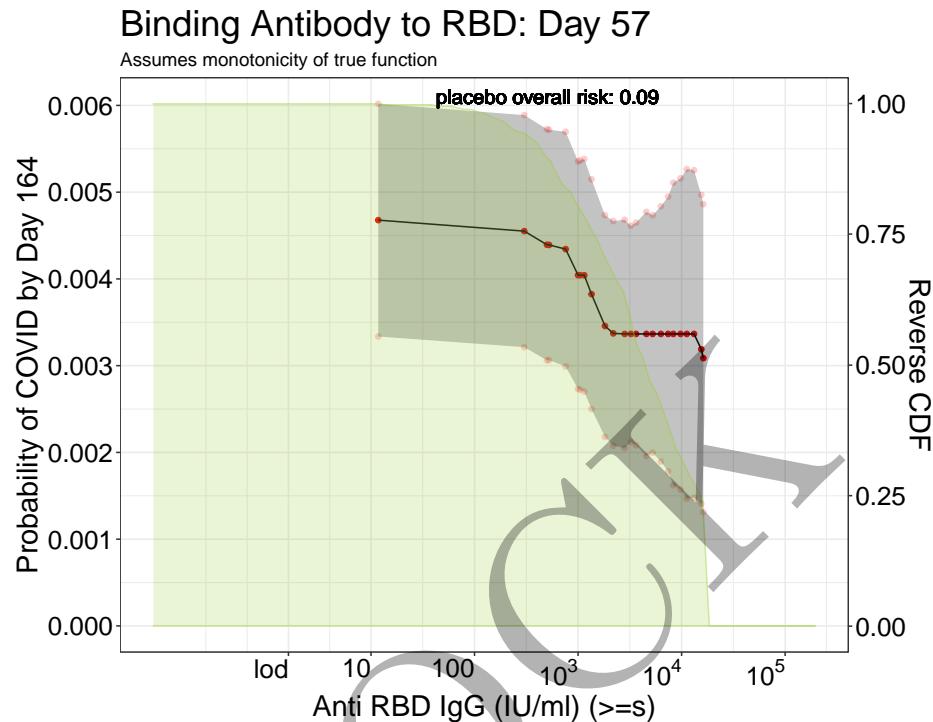


Figure 6.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.10: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.073 | $1.18 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.699 | $5.00 * 10^2$ | 0.00439 | 0.00306 | 0.00573 |
| 2.882 | $7.62 * 10^2$ | 0.00434 | 0.00299 | 0.00570 |
| 3.000 | $1.00 * 10^3$ | 0.00404 | 0.00273 | 0.00536 |
| 3.056 | $1.14 * 10^3$ | 0.00404 | 0.00270 | 0.00538 |
| 3.259 | $1.82 * 10^3$ | 0.00346 | 0.00218 | 0.00473 |
| 3.557 | $3.61 * 10^3$ | 0.00337 | 0.00208 | 0.00465 |
| 3.797 | $6.27 * 10^3$ | 0.00337 | 0.00190 | 0.00484 |
| 3.986 | $9.68 * 10^3$ | 0.00337 | 0.00157 | 0.00516 |
| 4.186 | $1.53 * 10^4$ | 0.00319 | 0.00141 | 0.00497 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00131 | 0.00486 |

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

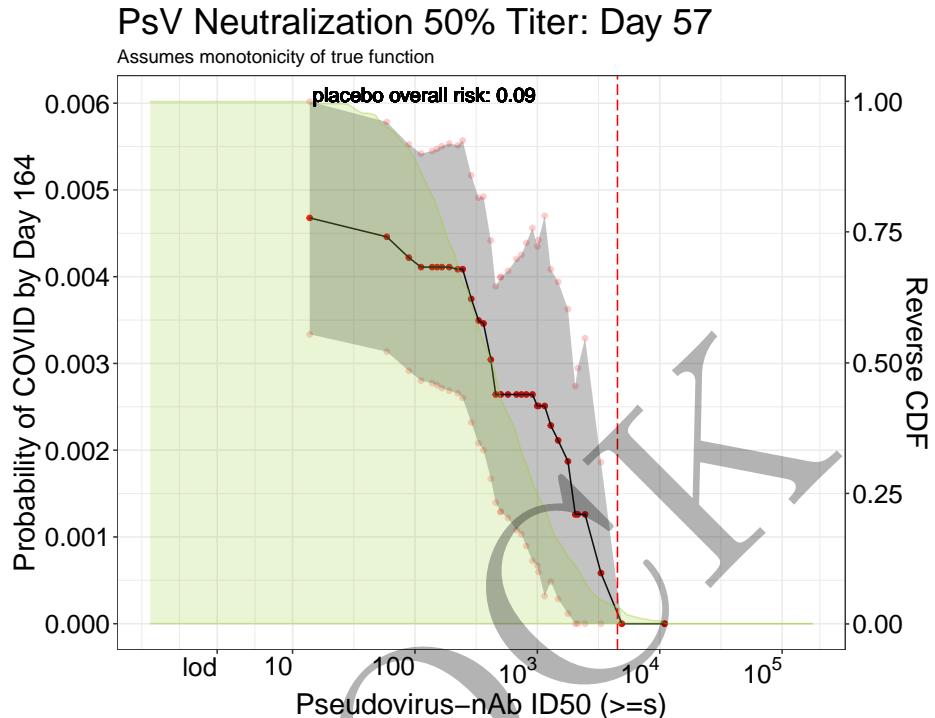


Figure 6.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.11: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.135 | $1.36 * 10^1$ | 0.00468 | 0.00334 | 0.00602 |
| 2.055 | $1.14 * 10^2$ | 0.00411 | 0.00280 | 0.00542 |
| 2.177 | $1.50 * 10^2$ | 0.00411 | 0.00275 | 0.00547 |
| 2.281 | $1.91 * 10^2$ | 0.00411 | 0.00269 | 0.00553 |
| 2.519 | $3.30 * 10^2$ | 0.00350 | 0.00208 | 0.00491 |
| 2.657 | $4.54 * 10^2$ | 0.00264 | 0.00140 | 0.00389 |
| 2.699 | $5.00 * 10^2$ | 0.00264 | 0.00129 | 0.00400 |
| 2.828 | $6.73 * 10^2$ | 0.00264 | 0.00108 | 0.00420 |
| 2.959 | $9.10 * 10^2$ | 0.00264 | 0.00072 | 0.00456 |
| 3.000 | $1.00 * 10^3$ | 0.00251 | 0.00067 | 0.00435 |
| 3.174 | $1.49 * 10^3$ | 0.00211 | 0.00028 | 0.00394 |
| 3.307 | $2.03 * 10^3$ | 0.00126 | 0.00000 | 0.00274 |
| 3.387 | $2.44 * 10^3$ | 0.00126 | 0.00000 | 0.00329 |
| 4.038 | $1.09 * 10^4$ | 0.00000 | 0.00000 | NA |

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

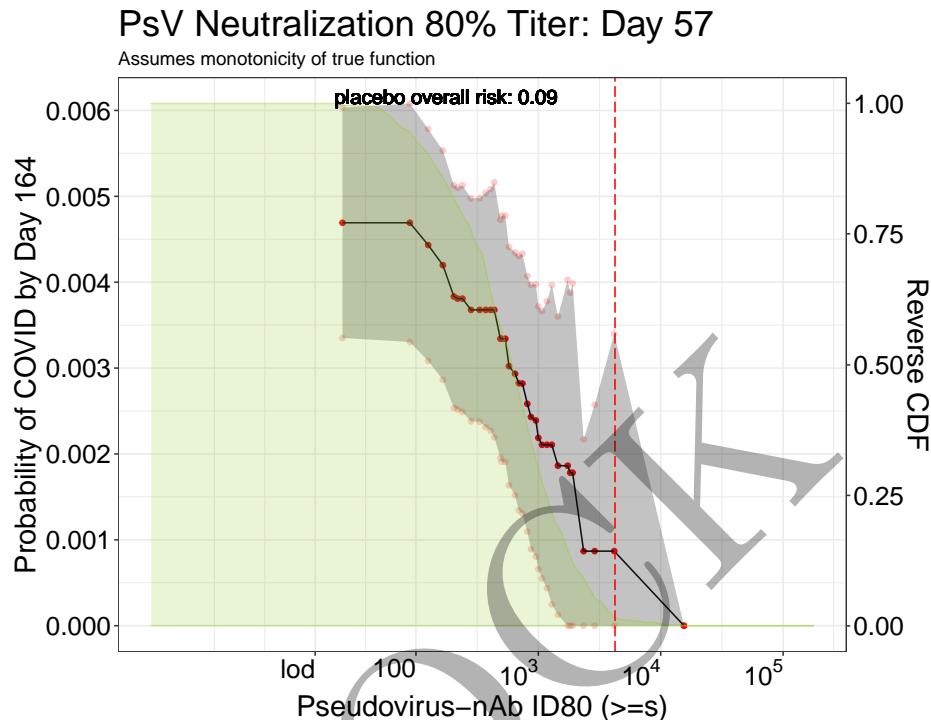


Figure 6.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.12: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.403 | $2.53 * 10^1$ | 0.00469 | 0.00335 | 0.00603 |
| 2.220 | $1.66 * 10^2$ | 0.00420 | 0.00286 | 0.00553 |
| 2.335 | $2.16 * 10^2$ | 0.00381 | 0.00252 | 0.00510 |
| 2.455 | $2.85 * 10^2$ | 0.00368 | 0.00238 | 0.00497 |
| 2.644 | $4.41 * 10^2$ | 0.00368 | 0.00219 | 0.00516 |
| 2.699 | $5.00 * 10^2$ | 0.00334 | 0.00191 | 0.00477 |
| 2.764 | $5.81 * 10^2$ | 0.00302 | 0.00163 | 0.00441 |
| 2.874 | $7.48 * 10^2$ | 0.00282 | 0.00131 | 0.00433 |
| 2.981 | $9.57 * 10^2$ | 0.00239 | 0.00080 | 0.00397 |
| 3.000 | $1.00 * 10^3$ | 0.00219 | 0.00066 | 0.00372 |
| 3.162 | $1.45 * 10^3$ | 0.00186 | 0.00013 | 0.00360 |
| 3.265 | $1.84 * 10^3$ | 0.00178 | 0.00000 | 0.00388 |
| 3.371 | $2.35 * 10^3$ | 0.00087 | 0.00000 | 0.00217 |
| 4.187 | $1.54 * 10^4$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.4.1 Day 29 Spike protein antibody

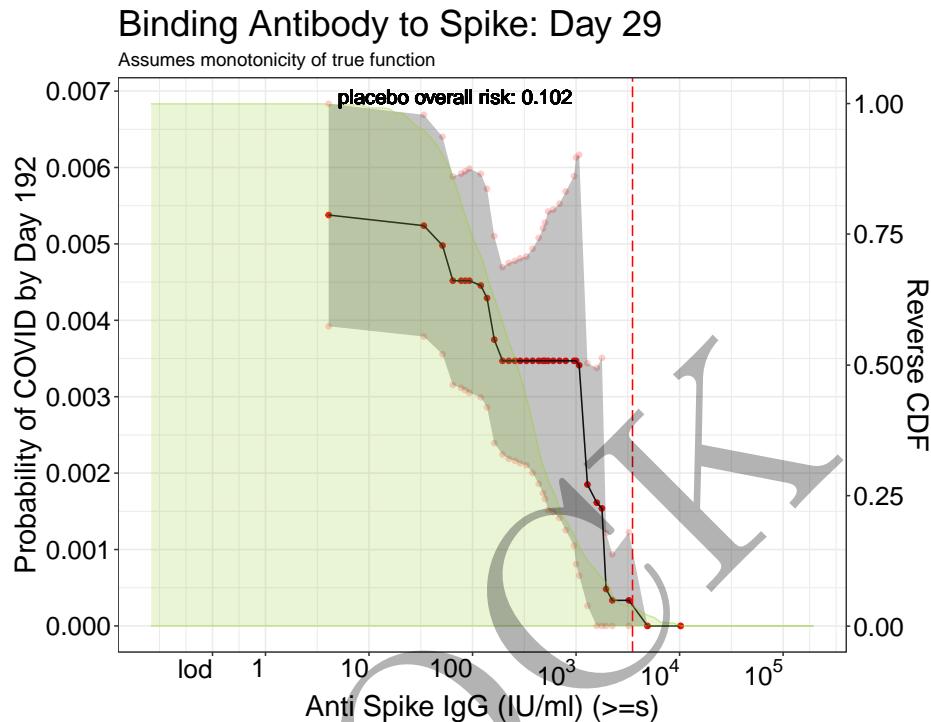


Figure 6.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.13: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|--------------------|---------------|---------|----------|
| 0.613 | 4.10×10^0 | 0.00538 | 0.00392 | 0.00683 |
| 1.805 | 6.38×10^1 | 0.00452 | 0.00315 | 0.00588 |
| 1.927 | 8.45×10^1 | 0.00452 | 0.00309 | 0.00595 |
| 2.081 | 1.21×10^2 | 0.00446 | 0.00299 | 0.00592 |
| 2.351 | 2.24×10^2 | 0.00347 | 0.00219 | 0.00475 |
| 2.522 | 3.33×10^2 | 0.00347 | 0.00210 | 0.00484 |
| 2.677 | 4.75×10^2 | 0.00347 | 0.00174 | 0.00520 |
| 2.699 | 5.00×10^2 | 0.00347 | 0.00166 | 0.00528 |
| 2.841 | 6.93×10^2 | 0.00347 | 0.00141 | 0.00553 |
| 3.000 | 1.00×10^3 | 0.00347 | 0.00081 | 0.00613 |
| 3.112 | 1.29×10^3 | 0.00185 | 0.00026 | 0.00344 |
| 3.252 | 1.79×10^3 | 0.00154 | 0.00000 | 0.00351 |
| 3.348 | 2.23×10^3 | 0.00033 | 0.00000 | 0.00094 |
| 4.007 | 1.02×10^4 | 0.00000 | 0.00000 | NA |

6.4.2 Day 29 RBD binding antibody

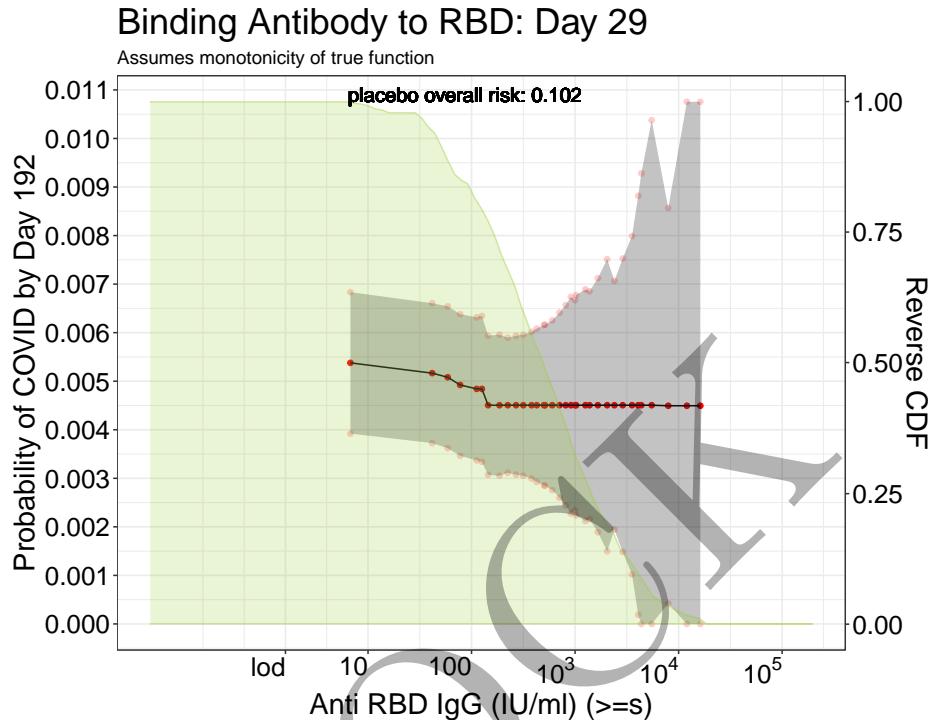


Figure 6.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.14: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.834 | $6.82 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 1.892 | $7.80 * 10^1$ | 0.00492 | 0.00346 | 0.00638 |
| 2.098 | $1.25 * 10^2$ | 0.00484 | 0.00334 | 0.00634 |
| 2.273 | $1.87 * 10^2$ | 0.00451 | 0.00305 | 0.00596 |
| 2.575 | $3.76 * 10^2$ | 0.00451 | 0.00299 | 0.00602 |
| 2.699 | $5.00 * 10^2$ | 0.00451 | 0.00285 | 0.00616 |
| 2.780 | $6.03 * 10^2$ | 0.00451 | 0.00276 | 0.00625 |
| 2.960 | $9.12 * 10^2$ | 0.00451 | 0.00227 | 0.00674 |
| 3.000 | $1.00 * 10^3$ | 0.00451 | 0.00234 | 0.00667 |
| 3.144 | $1.39 * 10^3$ | 0.00451 | 0.00216 | 0.00685 |
| 3.461 | $2.89 * 10^3$ | 0.00451 | 0.00148 | 0.00753 |
| 3.610 | $4.07 * 10^3$ | 0.00451 | 0.00019 | 0.00882 |
| 3.736 | $5.45 * 10^3$ | 0.00451 | 0.00000 | 0.01037 |
| 4.211 | $1.63 * 10^4$ | 0.00449 | 0.00000 | 0.01410 |

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

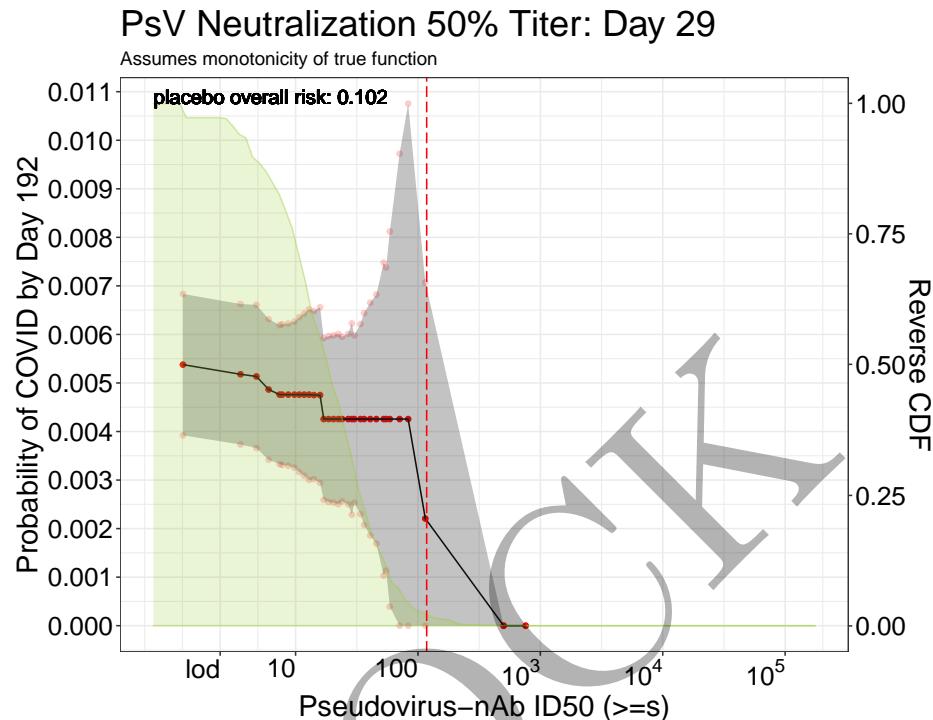


Figure 6.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.15: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.083 | $1.21 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.779 | $6.01 * 10^0$ | 0.00487 | 0.00342 | 0.00631 |
| 0.892 | $7.80 * 10^0$ | 0.00476 | 0.00331 | 0.00621 |
| 0.988 | $9.73 * 10^0$ | 0.00476 | 0.00326 | 0.00626 |
| 1.147 | $1.40 * 10^1$ | 0.00475 | 0.00302 | 0.00648 |
| 1.271 | $1.87 * 10^1$ | 0.00426 | 0.00255 | 0.00597 |
| 1.382 | $2.41 * 10^1$ | 0.00426 | 0.00256 | 0.00595 |
| 1.481 | $3.03 * 10^1$ | 0.00426 | 0.00253 | 0.00598 |
| 1.656 | $4.53 * 10^1$ | 0.00426 | 0.00169 | 0.00682 |
| 1.741 | $5.51 * 10^1$ | 0.00426 | 0.00113 | 0.00738 |
| 1.852 | $7.11 * 10^1$ | 0.00426 | 0.00000 | 0.00972 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |

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

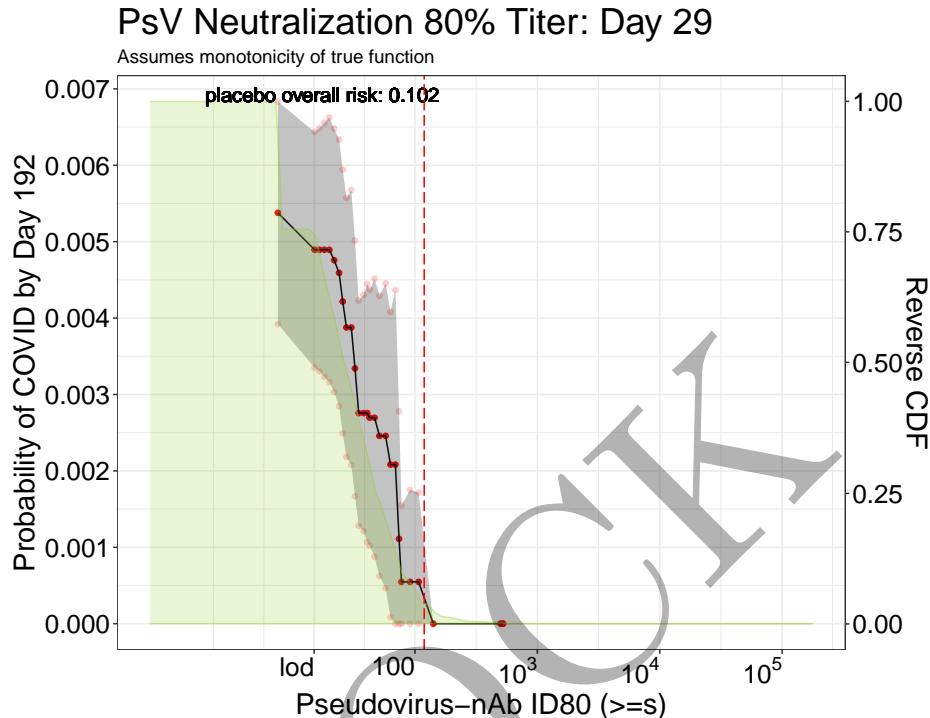


Figure 6.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.16: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00392 | 0.00683 |
| 1.183 | $1.52 * 10^1$ | 0.00489 | 0.00335 | 0.00644 |
| 1.339 | $2.18 * 10^1$ | 0.00476 | 0.00304 | 0.00648 |
| 1.440 | $2.75 * 10^1$ | 0.00388 | 0.00218 | 0.00557 |
| 1.541 | $3.48 * 10^1$ | 0.00276 | 0.00128 | 0.00423 |
| 1.632 | $4.29 * 10^1$ | 0.00270 | 0.00102 | 0.00437 |
| 1.796 | $6.25 * 10^1$ | 0.00208 | 0.00008 | 0.00408 |
| 1.868 | $7.38 * 10^1$ | 0.00111 | 0.00000 | 0.00278 |
| 1.956 | $9.04 * 10^1$ | 0.00055 | 0.00000 | 0.00175 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.5.1 Day 57 Spike protein binding antibody

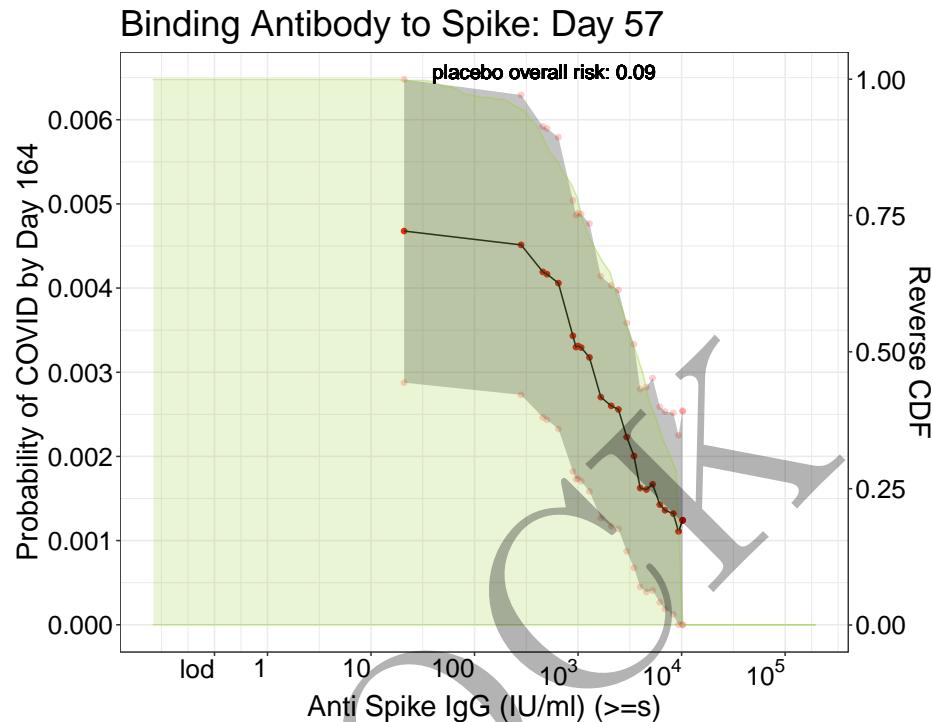


Figure 6.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.17: Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.316 | $2.07 * 10^1$ | 0.00468 | 0.00288 | 0.00648 |
| 2.699 | $5.00 * 10^2$ | 0.00417 | 0.00243 | 0.00590 |
| 2.815 | $6.53 * 10^2$ | 0.00406 | 0.00233 | 0.00579 |
| 2.982 | $9.59 * 10^2$ | 0.00330 | 0.00173 | 0.00487 |
| 3.000 | $1.00 * 10^3$ | 0.00331 | 0.00173 | 0.00489 |
| 3.113 | $1.30 * 10^3$ | 0.00318 | 0.00159 | 0.00477 |
| 3.471 | $2.96 * 10^3$ | 0.00223 | 0.00087 | 0.00359 |
| 3.658 | $4.55 * 10^3$ | 0.00161 | 0.00039 | 0.00282 |
| 3.841 | $6.93 * 10^3$ | 0.00136 | 0.00019 | 0.00253 |
| 4.006 | $1.01 * 10^4$ | 0.00124 | 0.00000 | 0.00254 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00000 | 0.00253 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00000 | 0.00253 |
| 4.007 | $1.02 * 10^4$ | 0.00124 | 0.00000 | 0.00253 |

6.5.2 Day 57 RBD binding antibody

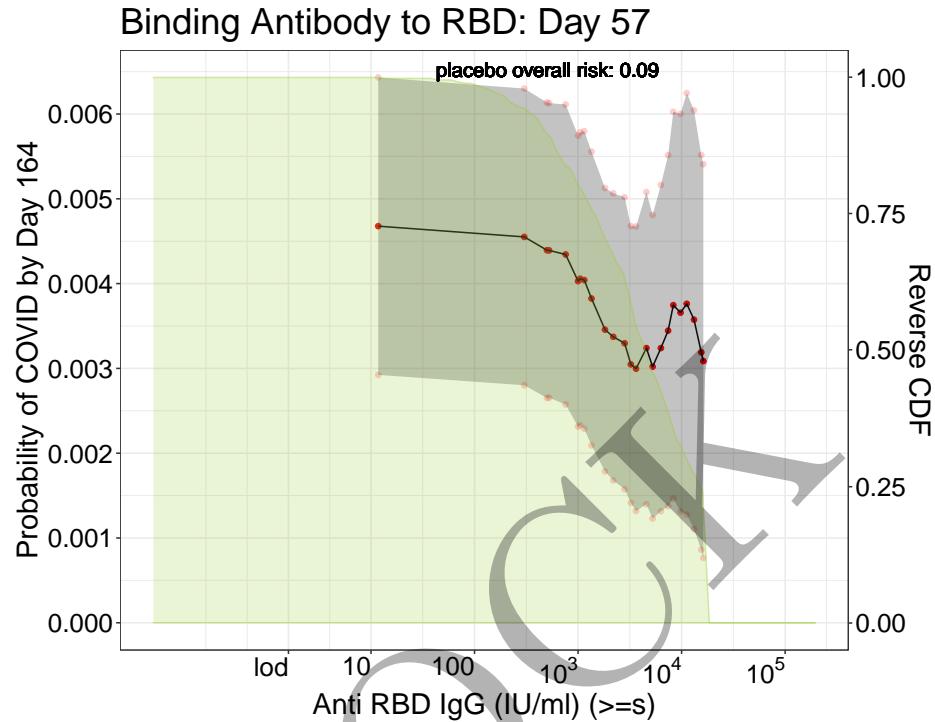


Figure 6.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.18: Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.073 | $1.18 * 10^1$ | 0.00468 | 0.00292 | 0.00643 |
| 2.699 | $5.00 * 10^2$ | 0.00439 | 0.00265 | 0.00614 |
| 2.882 | $7.62 * 10^2$ | 0.00434 | 0.00257 | 0.00611 |
| 3.000 | $1.00 * 10^3$ | 0.00403 | 0.00231 | 0.00575 |
| 3.056 | $1.14 * 10^3$ | 0.00404 | 0.00229 | 0.00580 |
| 3.259 | $1.82 * 10^3$ | 0.00346 | 0.00179 | 0.00513 |
| 3.557 | $3.61 * 10^3$ | 0.00300 | 0.00132 | 0.00467 |
| 3.797 | $6.27 * 10^3$ | 0.00324 | 0.00132 | 0.00516 |
| 3.986 | $9.68 * 10^3$ | 0.00366 | 0.00131 | 0.00600 |
| 4.186 | $1.53 * 10^4$ | 0.00319 | 0.00086 | 0.00552 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |

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

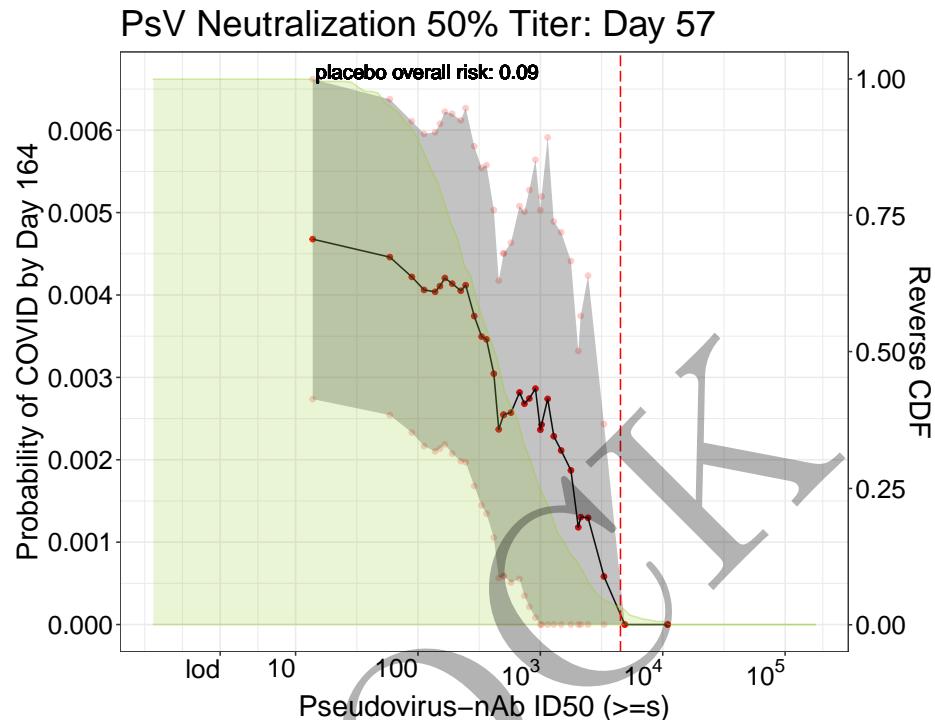


Figure 6.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.19: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.135 | $1.36 * 10^1$ | 0.00468 | 0.00274 | 0.00662 |
| 2.055 | $1.14 * 10^2$ | 0.00406 | 0.00217 | 0.00596 |
| 2.177 | $1.50 * 10^2$ | 0.00411 | 0.00214 | 0.00608 |
| 2.281 | $1.91 * 10^2$ | 0.00414 | 0.00208 | 0.00620 |
| 2.519 | $3.30 * 10^2$ | 0.00350 | 0.00145 | 0.00554 |
| 2.657 | $4.54 * 10^2$ | 0.00237 | 0.00056 | 0.00417 |
| 2.699 | $5.00 * 10^2$ | 0.00255 | 0.00059 | 0.00451 |
| 2.828 | $6.73 * 10^2$ | 0.00282 | 0.00055 | 0.00508 |
| 2.959 | $9.10 * 10^2$ | 0.00286 | 0.00009 | 0.00564 |
| 3.000 | $1.00 * 10^3$ | 0.00236 | 0.00000 | 0.00503 |
| 3.174 | $1.49 * 10^3$ | 0.00211 | 0.00000 | 0.00476 |
| 3.307 | $2.03 * 10^3$ | 0.00118 | 0.00000 | 0.00332 |
| 3.387 | $2.44 * 10^3$ | 0.00130 | 0.00000 | 0.00424 |
| 4.038 | $1.09 * 10^4$ | 0.00000 | 0.00000 | NA |

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

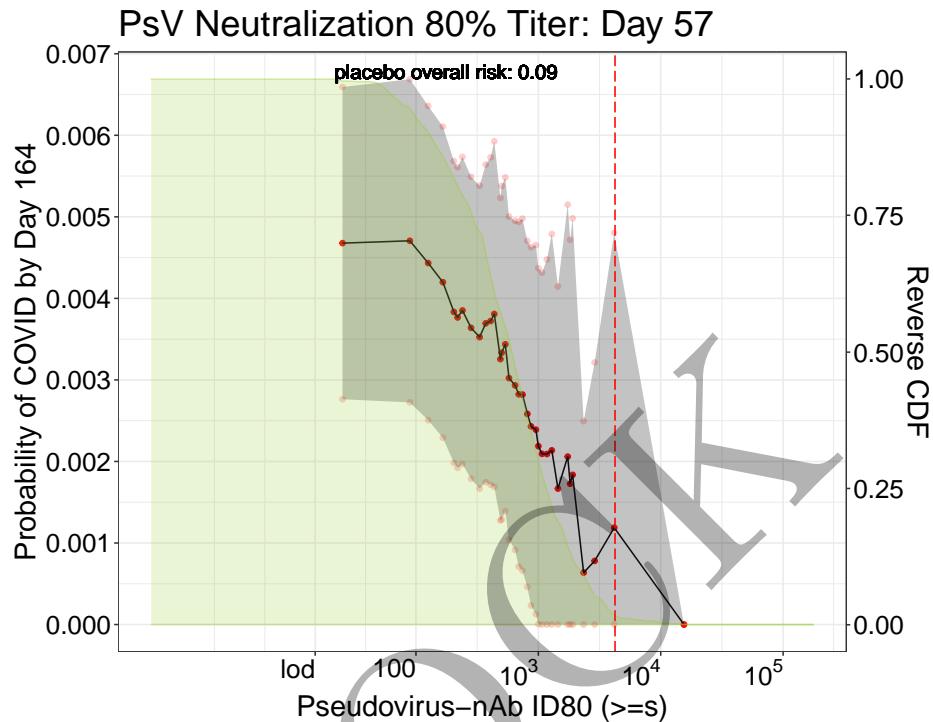


Figure 6.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.20: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.403 | $2.53 * 10^1$ | 0.00468 | 0.00276 | 0.00659 |
| 2.220 | $1.66 * 10^2$ | 0.00420 | 0.00229 | 0.00611 |
| 2.335 | $2.16 * 10^2$ | 0.00377 | 0.00192 | 0.00561 |
| 2.455 | $2.85 * 10^2$ | 0.00364 | 0.00179 | 0.00549 |
| 2.644 | $4.41 * 10^2$ | 0.00381 | 0.00169 | 0.00593 |
| 2.699 | $5.00 * 10^2$ | 0.00333 | 0.00129 | 0.00538 |
| 2.764 | $5.81 * 10^2$ | 0.00302 | 0.00104 | 0.00500 |
| 2.874 | $7.48 * 10^2$ | 0.00282 | 0.00066 | 0.00498 |
| 2.981 | $9.57 * 10^2$ | 0.00239 | 0.00013 | 0.00465 |
| 3.000 | $1.00 * 10^3$ | 0.00219 | 0.00000 | 0.00437 |
| 3.162 | $1.45 * 10^3$ | 0.00167 | 0.00000 | 0.00415 |
| 3.265 | $1.84 * 10^3$ | 0.00173 | 0.00000 | 0.00472 |
| 3.371 | $2.35 * 10^3$ | 0.00064 | 0.00000 | 0.00249 |
| 4.187 | $1.54 * 10^4$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.6.1 Day 29 Spike protein antibody

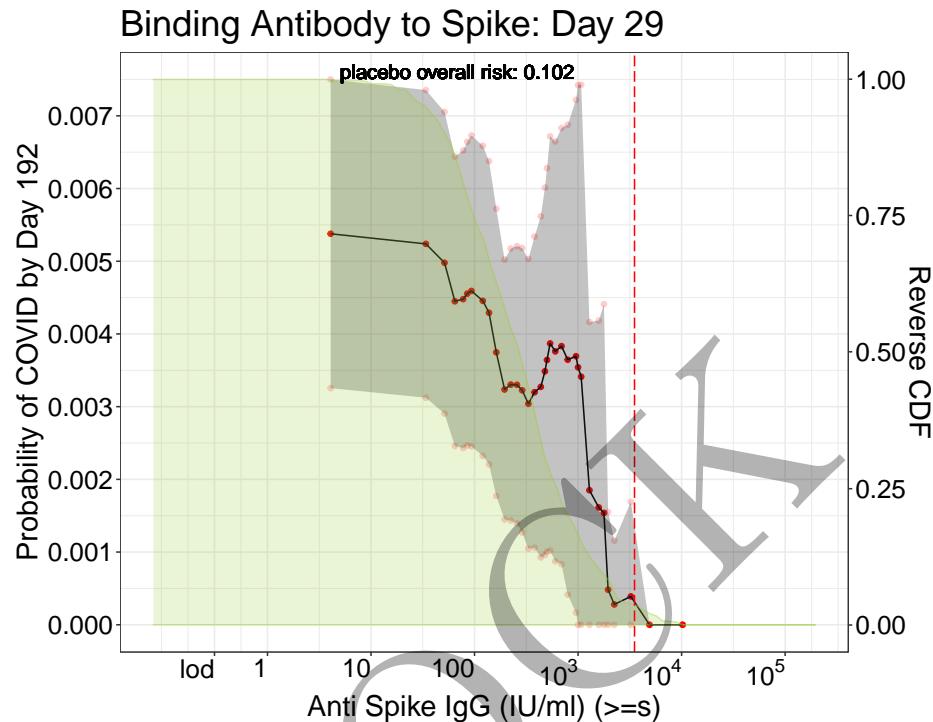


Figure 6.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.21: Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.613 | $4.10 * 10^0$ | 0.00538 | 0.00325 | 0.00750 |
| 1.805 | $6.38 * 10^1$ | 0.00445 | 0.00246 | 0.00644 |
| 1.927 | $8.45 * 10^1$ | 0.00455 | 0.00247 | 0.00664 |
| 2.081 | $1.21 * 10^2$ | 0.00446 | 0.00232 | 0.00659 |
| 2.351 | $2.24 * 10^2$ | 0.00330 | 0.00143 | 0.00517 |
| 2.522 | $3.33 * 10^2$ | 0.00304 | 0.00105 | 0.00503 |
| 2.677 | $4.75 * 10^2$ | 0.00349 | 0.00096 | 0.00601 |
| 2.699 | $5.00 * 10^2$ | 0.00364 | 0.00101 | 0.00628 |
| 2.841 | $6.93 * 10^2$ | 0.00383 | 0.00083 | 0.00683 |
| 3.000 | $1.00 * 10^3$ | 0.00354 | 0.00000 | 0.00742 |
| 3.112 | $1.29 * 10^3$ | 0.00185 | 0.00000 | 0.00416 |
| 3.252 | $1.79 * 10^3$ | 0.00154 | 0.00000 | 0.00441 |
| 3.348 | $2.23 * 10^3$ | 0.00028 | 0.00000 | 0.00116 |
| 4.007 | $1.02 * 10^4$ | 0.00000 | 0.00000 | NA |

6.6.2 Day 29 RBD binding antibody

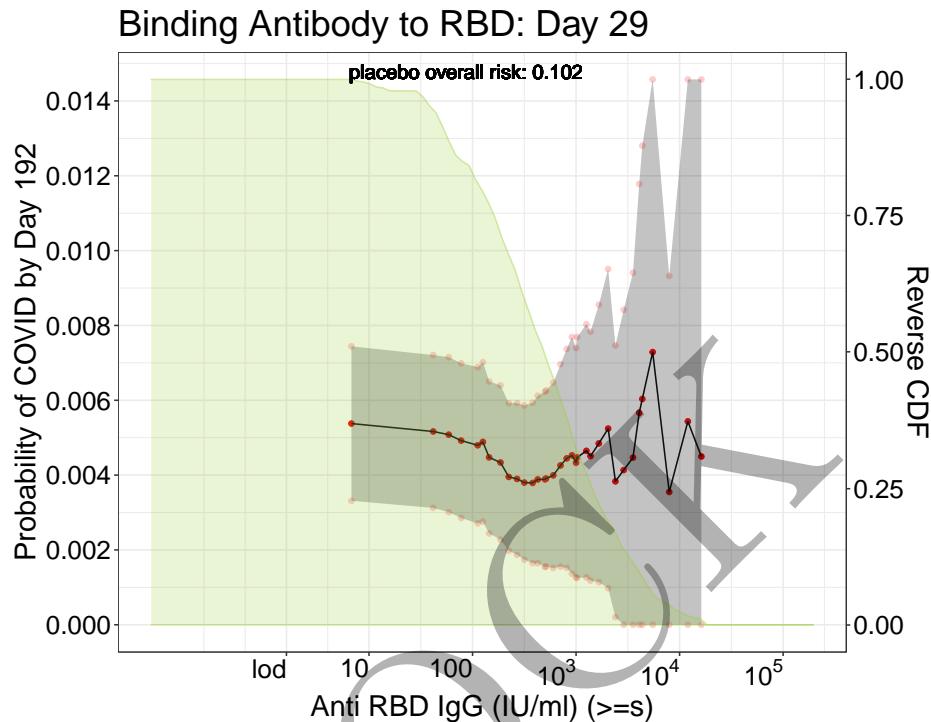


Figure 6.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.22: Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.834 | $6.82 * 10^0$ | 0.00538 | 0.00331 | 0.00744 |
| 1.892 | $7.80 * 10^1$ | 0.00492 | 0.00285 | 0.00699 |
| 2.098 | $1.25 * 10^2$ | 0.00489 | 0.00276 | 0.00702 |
| 2.273 | $1.87 * 10^2$ | 0.00434 | 0.00228 | 0.00640 |
| 2.575 | $3.76 * 10^2$ | 0.00379 | 0.00165 | 0.00593 |
| 2.699 | $5.00 * 10^2$ | 0.00389 | 0.00155 | 0.00623 |
| 2.780 | $6.03 * 10^2$ | 0.00399 | 0.00152 | 0.00647 |
| 2.960 | $9.12 * 10^2$ | 0.00453 | 0.00136 | 0.00769 |
| 3.000 | $1.00 * 10^3$ | 0.00433 | 0.00127 | 0.00740 |
| 3.144 | $1.39 * 10^3$ | 0.00451 | 0.00118 | 0.00783 |
| 3.461 | $2.89 * 10^3$ | 0.00413 | 0.00000 | 0.00842 |
| 3.610 | $4.07 * 10^3$ | 0.00566 | 0.00000 | 0.01178 |
| 3.736 | $5.45 * 10^3$ | 0.00729 | 0.00000 | 0.01561 |
| 4.211 | $1.63 * 10^4$ | 0.00450 | 0.00000 | 0.01812 |

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

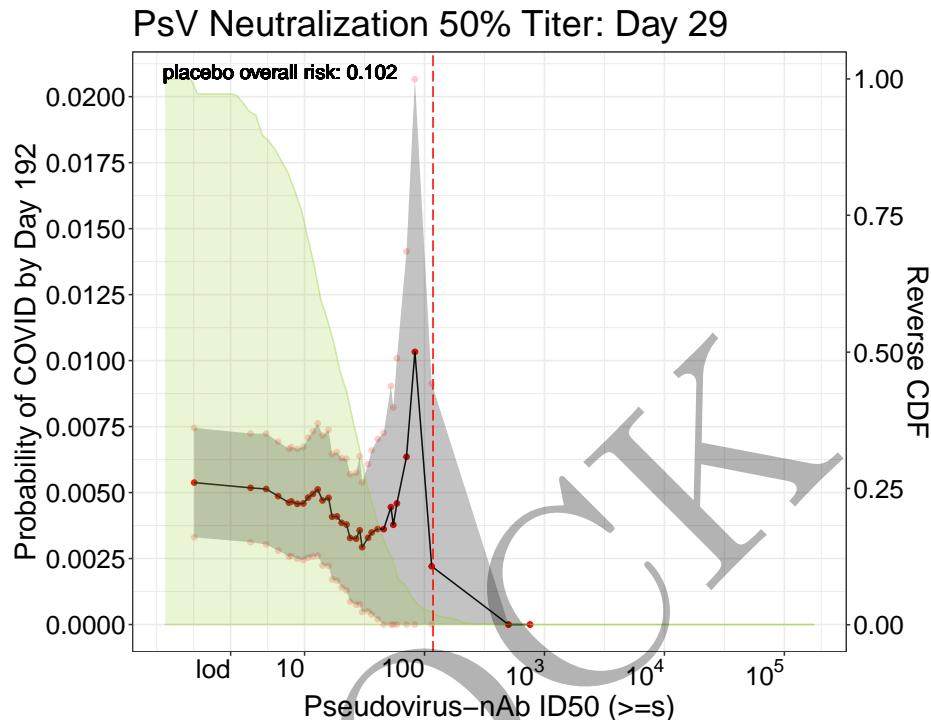


Figure 6.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.23: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|--------------------|---------------|---------|----------|
| 0.083 | 1.21×10^0 | 0.00538 | 0.00331 | 0.00745 |
| 0.779 | 6.01×10^0 | 0.00487 | 0.00280 | 0.00693 |
| 0.892 | 7.80×10^0 | 0.00466 | 0.00260 | 0.00673 |
| 0.988 | 9.73×10^0 | 0.00459 | 0.00245 | 0.00673 |
| 1.147 | 1.40×10^1 | 0.00470 | 0.00224 | 0.00717 |
| 1.271 | 1.87×10^1 | 0.00410 | 0.00166 | 0.00653 |
| 1.382 | 2.41×10^1 | 0.00328 | 0.00086 | 0.00569 |
| 1.481 | 3.03×10^1 | 0.00293 | 0.00048 | 0.00538 |
| 1.656 | 4.53×10^1 | 0.00361 | 0.00000 | 0.00726 |
| 1.741 | 5.51×10^1 | 0.00378 | 0.00000 | 0.00823 |
| 1.852 | 7.11×10^1 | 0.00636 | 0.00000 | 0.01414 |
| 2.699 | 5.00×10^2 | 0.00000 | 0.00000 | NA |
| 2.879 | 7.57×10^2 | 0.00000 | 0.00000 | NA |
| 2.879 | 7.57×10^2 | 0.00000 | 0.00000 | NA |

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

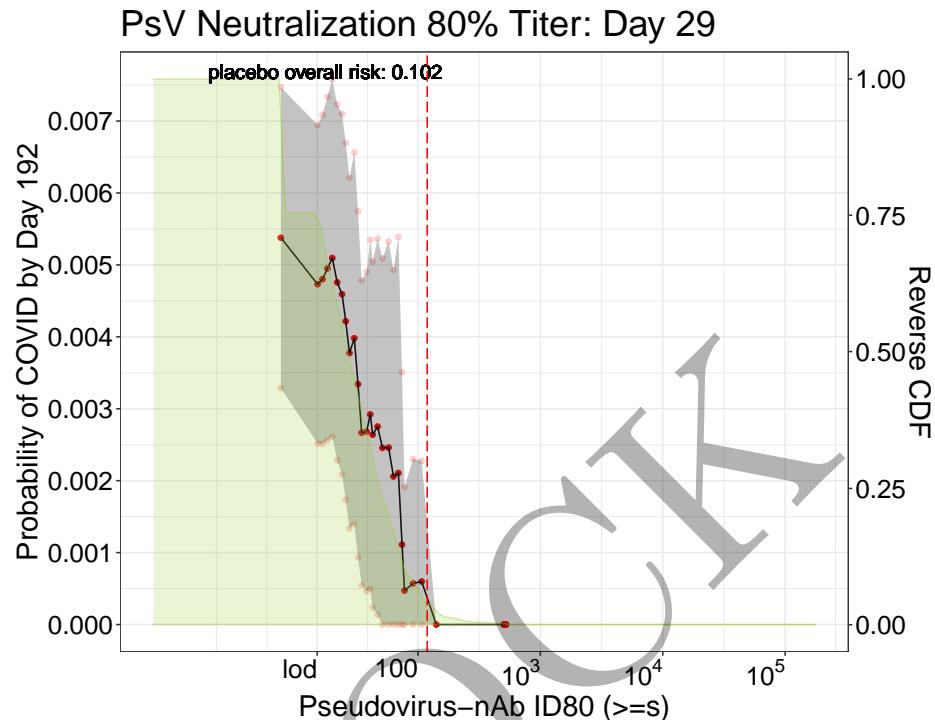


Figure 6.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

Table 6.24: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| log ₁₀ -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------------|------------------------|---------------|---------|----------|
| 0.876 | 7.52 * 10 ⁰ | 0.00538 | 0.00329 | 0.00747 |
| 0.876 | 7.52 * 10 ⁰ | 0.00538 | 0.00329 | 0.00747 |
| 0.876 | 7.52 * 10 ⁰ | 0.00538 | 0.00329 | 0.00747 |
| 1.183 | 1.52 * 10 ¹ | 0.00473 | 0.00252 | 0.00695 |
| 1.339 | 2.18 * 10 ¹ | 0.00476 | 0.00228 | 0.00723 |
| 1.440 | 2.75 * 10 ¹ | 0.00377 | 0.00134 | 0.00621 |
| 1.541 | 3.48 * 10 ¹ | 0.00267 | 0.00055 | 0.00478 |
| 1.632 | 4.29 * 10 ¹ | 0.00264 | 0.00023 | 0.00504 |
| 1.796 | 6.25 * 10 ¹ | 0.00206 | 0.00000 | 0.00493 |
| 1.868 | 7.38 * 10 ¹ | 0.00111 | 0.00000 | 0.00351 |
| 1.956 | 9.04 * 10 ¹ | 0.00057 | 0.00000 | 0.00230 |
| 2.699 | 5.00 * 10 ² | 0.00000 | 0.00000 | NA |
| 2.719 | 5.24 * 10 ² | 0.00000 | 0.00000 | NA |
| 2.719 | 5.24 * 10 ² | 0.00000 | 0.00000 | NA |

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

MOCK

6.7.1 Day 57 Spike protein binding antibody

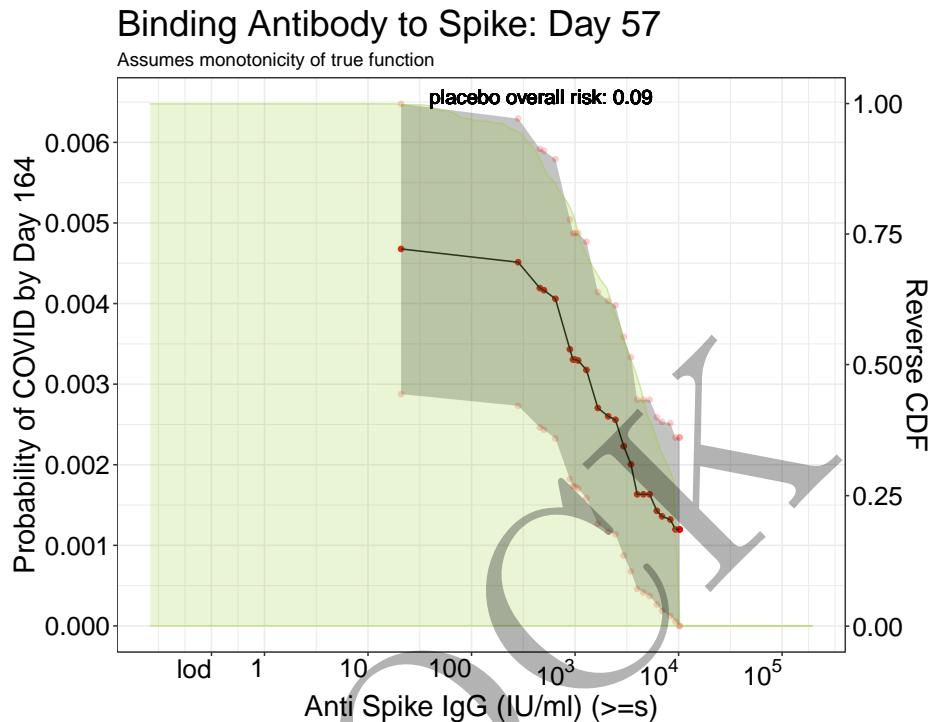


Figure 6.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.25: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

| log ₁₀ -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------------|---------------|---------------|---------|----------|
| 1.316 | $2.07 * 10^1$ | 0.00468 | 0.00288 | 0.00648 |
| 2.699 | $5.00 * 10^2$ | 0.00417 | 0.00243 | 0.00590 |
| 2.815 | $6.53 * 10^2$ | 0.00406 | 0.00233 | 0.00579 |
| 2.982 | $9.59 * 10^2$ | 0.00331 | 0.00174 | 0.00487 |
| 3.000 | $1.00 * 10^3$ | 0.00331 | 0.00173 | 0.00488 |
| 3.113 | $1.30 * 10^3$ | 0.00318 | 0.00159 | 0.00477 |
| 3.471 | $2.96 * 10^3$ | 0.00223 | 0.00087 | 0.00359 |
| 3.658 | $4.55 * 10^3$ | 0.00163 | 0.00042 | 0.00285 |
| 3.841 | $6.93 * 10^3$ | 0.00136 | 0.00019 | 0.00253 |
| 4.006 | $1.01 * 10^4$ | 0.00120 | 0.00000 | 0.00250 |
| 4.007 | $1.02 * 10^4$ | 0.00120 | 0.00000 | 0.00249 |
| 4.007 | $1.02 * 10^4$ | 0.00120 | 0.00000 | 0.00249 |
| 4.007 | $1.02 * 10^4$ | 0.00120 | 0.00000 | 0.00249 |

6.7.2 Day 57 RBD binding antibody

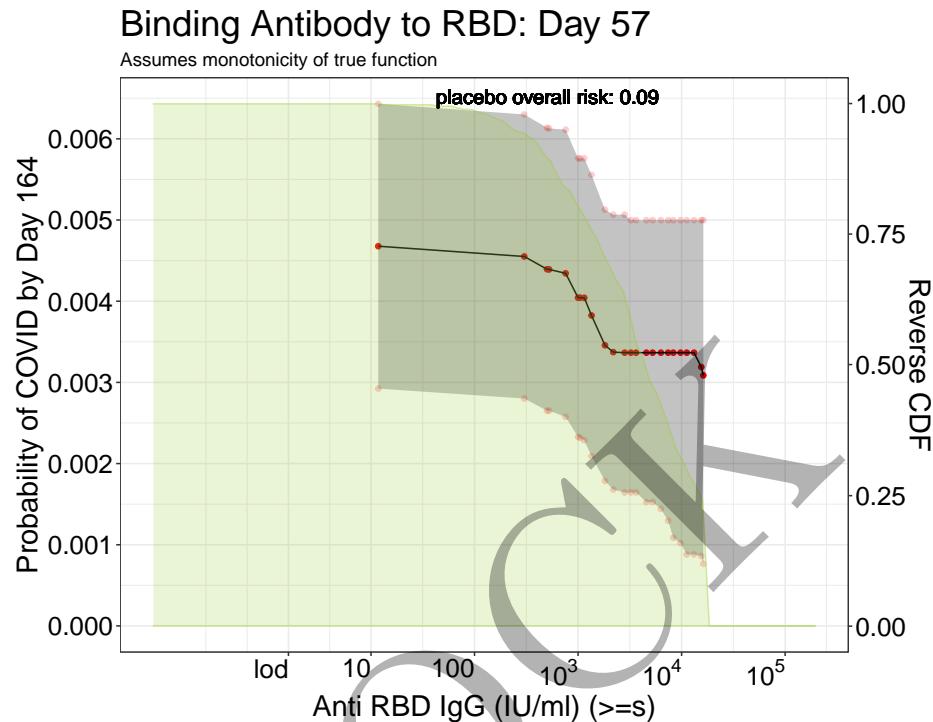


Figure 6.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.26: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.073 | $1.18 * 10^1$ | 0.00468 | 0.00292 | 0.00643 |
| 2.699 | $5.00 * 10^2$ | 0.00439 | 0.00265 | 0.00614 |
| 2.882 | $7.62 * 10^2$ | 0.00434 | 0.00257 | 0.00611 |
| 3.000 | $1.00 * 10^3$ | 0.00404 | 0.00233 | 0.00576 |
| 3.056 | $1.14 * 10^3$ | 0.00404 | 0.00229 | 0.00580 |
| 3.259 | $1.82 * 10^3$ | 0.00346 | 0.00179 | 0.00513 |
| 3.557 | $3.61 * 10^3$ | 0.00337 | 0.00169 | 0.00504 |
| 3.797 | $6.27 * 10^3$ | 0.00337 | 0.00144 | 0.00529 |
| 3.986 | $9.68 * 10^3$ | 0.00337 | 0.00102 | 0.00571 |
| 4.186 | $1.53 * 10^4$ | 0.00319 | 0.00086 | 0.00552 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |
| 4.211 | $1.63 * 10^4$ | 0.00309 | 0.00077 | 0.00541 |

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

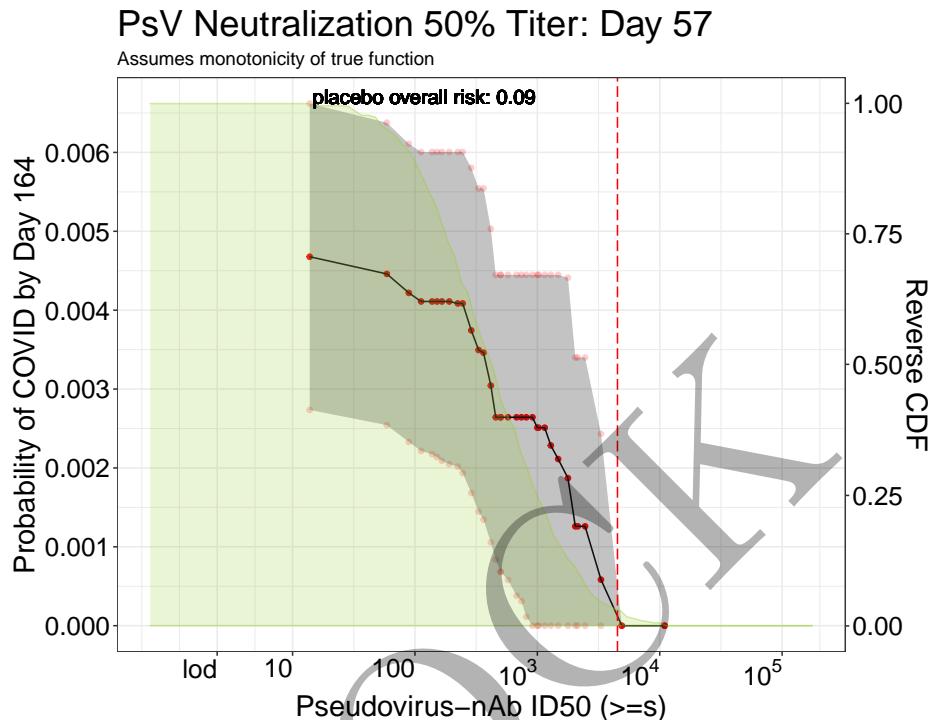


Figure 6.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.27: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.135 | $1.36 * 10^1$ | 0.00468 | 0.00274 | 0.00662 |
| 2.055 | $1.14 * 10^2$ | 0.00411 | 0.00222 | 0.00601 |
| 2.177 | $1.50 * 10^2$ | 0.00411 | 0.00214 | 0.00608 |
| 2.281 | $1.91 * 10^2$ | 0.00411 | 0.00205 | 0.00617 |
| 2.519 | $3.30 * 10^2$ | 0.00350 | 0.00145 | 0.00554 |
| 2.657 | $4.54 * 10^2$ | 0.00264 | 0.00084 | 0.00445 |
| 2.699 | $5.00 * 10^2$ | 0.00264 | 0.00068 | 0.00460 |
| 2.828 | $6.73 * 10^2$ | 0.00264 | 0.00038 | 0.00490 |
| 2.959 | $9.10 * 10^2$ | 0.00264 | 0.00000 | 0.00542 |
| 3.000 | $1.00 * 10^3$ | 0.00251 | 0.00000 | 0.00517 |
| 3.174 | $1.49 * 10^3$ | 0.00211 | 0.00000 | 0.00476 |
| 3.307 | $2.03 * 10^3$ | 0.00126 | 0.00000 | 0.00340 |
| 3.387 | $2.44 * 10^3$ | 0.00126 | 0.00000 | 0.00420 |
| 4.038 | $1.09 * 10^4$ | 0.00000 | 0.00000 | NA |

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

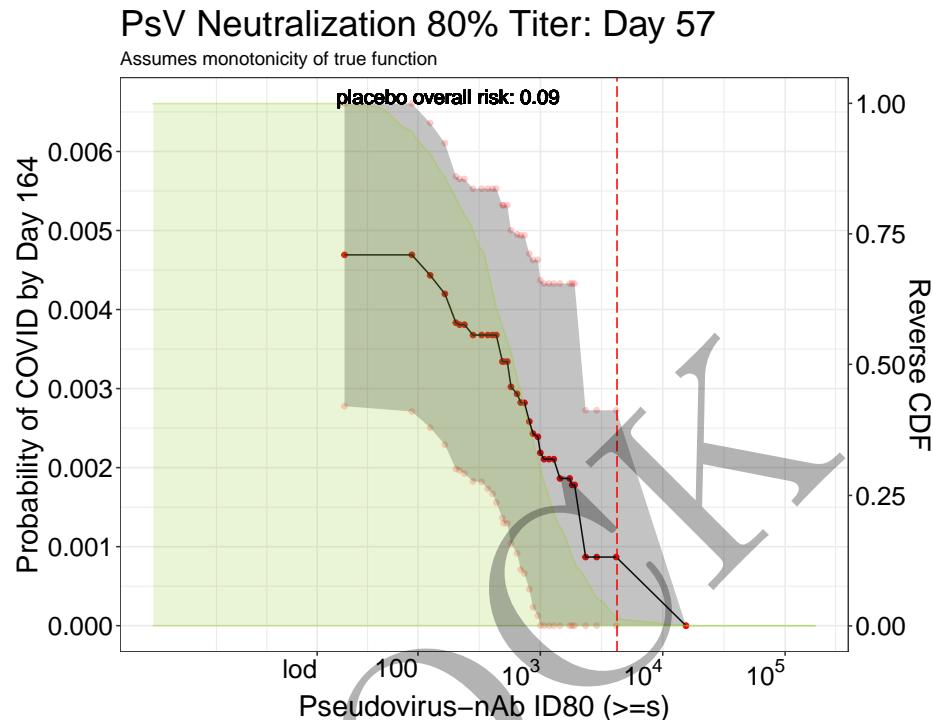


Figure 6.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.28: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.403 | $2.53 * 10^1$ | 0.00469 | 0.00278 | 0.00661 |
| 2.220 | $1.66 * 10^2$ | 0.00420 | 0.00229 | 0.00611 |
| 2.335 | $2.16 * 10^2$ | 0.00381 | 0.00196 | 0.00565 |
| 2.455 | $2.85 * 10^2$ | 0.00368 | 0.00183 | 0.00553 |
| 2.644 | $4.41 * 10^2$ | 0.00368 | 0.00156 | 0.00580 |
| 2.699 | $5.00 * 10^2$ | 0.00334 | 0.00130 | 0.00539 |
| 2.764 | $5.81 * 10^2$ | 0.00302 | 0.00104 | 0.00500 |
| 2.874 | $7.48 * 10^2$ | 0.00282 | 0.00066 | 0.00498 |
| 2.981 | $9.57 * 10^2$ | 0.00239 | 0.00013 | 0.00465 |
| 3.000 | $1.00 * 10^3$ | 0.00219 | 0.00000 | 0.00437 |
| 3.162 | $1.45 * 10^3$ | 0.00186 | 0.00000 | 0.00434 |
| 3.265 | $1.84 * 10^3$ | 0.00178 | 0.00000 | 0.00477 |
| 3.371 | $2.35 * 10^3$ | 0.00087 | 0.00000 | 0.00273 |
| 4.187 | $1.54 * 10^4$ | 0.00000 | 0.00000 | NA |

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

MOCK

6.8.1 Day 29 Spike protein antibody

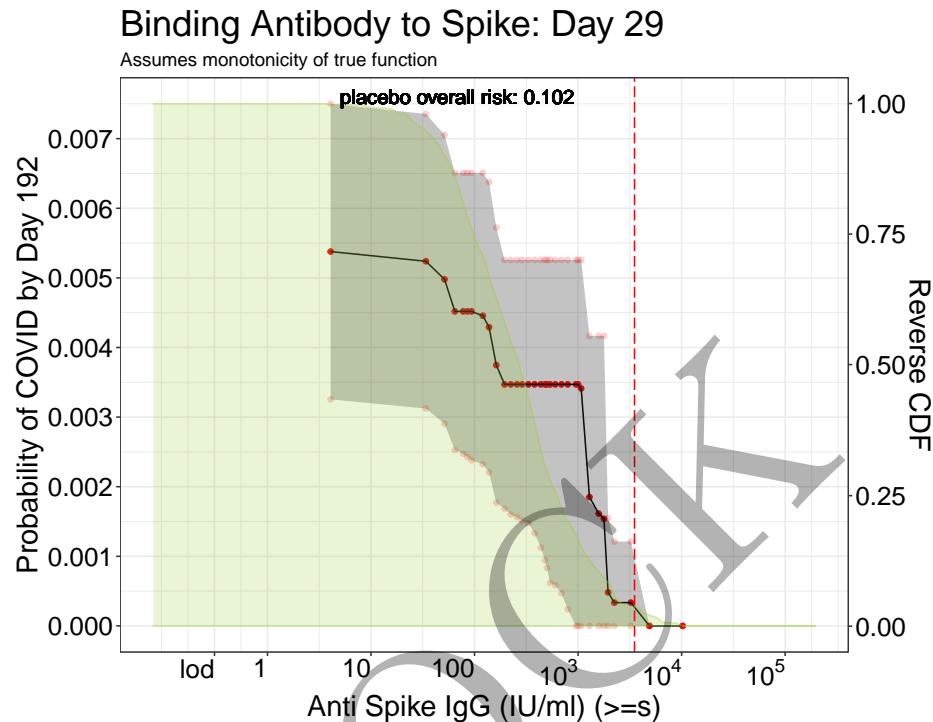


Figure 6.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.29: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|--------------------|---------------|---------|----------|
| 0.613 | 4.10×10^0 | 0.00538 | 0.00325 | 0.00750 |
| 1.805 | 6.38×10^1 | 0.00452 | 0.00253 | 0.00651 |
| 1.927 | 8.45×10^1 | 0.00452 | 0.00243 | 0.00661 |
| 2.081 | 1.21×10^2 | 0.00446 | 0.00232 | 0.00659 |
| 2.351 | 2.24×10^2 | 0.00347 | 0.00160 | 0.00534 |
| 2.522 | 3.33×10^2 | 0.00347 | 0.00148 | 0.00546 |
| 2.677 | 4.75×10^2 | 0.00347 | 0.00094 | 0.00600 |
| 2.699 | 5.00×10^2 | 0.00347 | 0.00083 | 0.00611 |
| 2.841 | 6.93×10^2 | 0.00347 | 0.00047 | 0.00647 |
| 3.000 | 1.00×10^3 | 0.00347 | 0.00000 | 0.00735 |
| 3.112 | 1.29×10^3 | 0.00185 | 0.00000 | 0.00416 |
| 3.252 | 1.79×10^3 | 0.00154 | 0.00000 | 0.00441 |
| 3.348 | 2.23×10^3 | 0.00033 | 0.00000 | 0.00121 |
| 4.007 | 1.02×10^4 | 0.00000 | 0.00000 | NA |

6.8.2 Day 29 RBD binding antibody

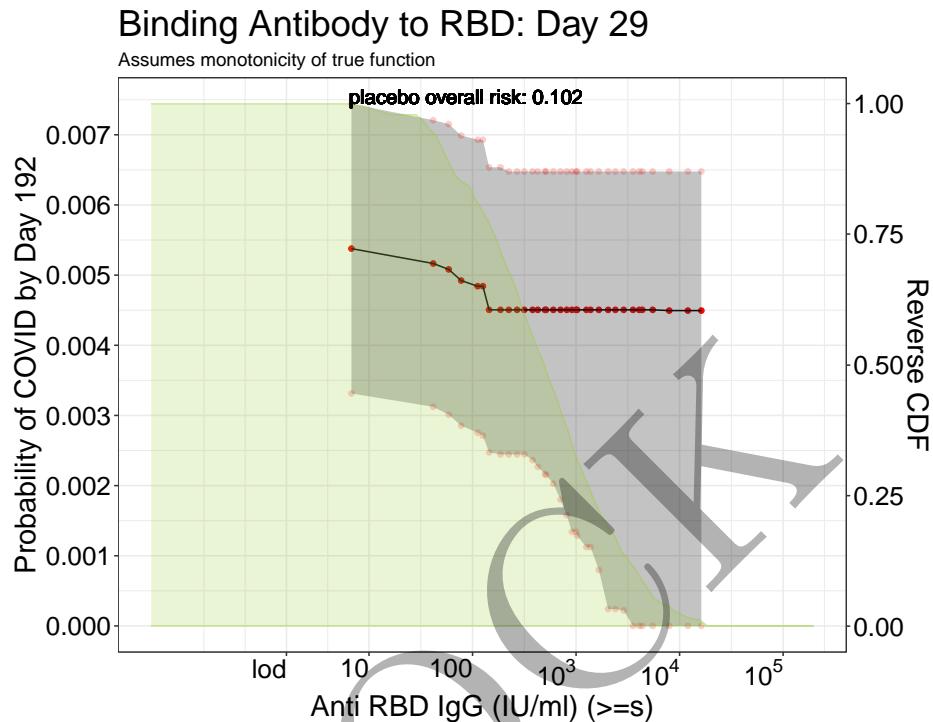


Figure 6.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.30: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.834 | $6.82 * 10^0$ | 0.00538 | 0.00331 | 0.00744 |
| 1.892 | $7.80 * 10^1$ | 0.00492 | 0.00285 | 0.00699 |
| 2.098 | $1.25 * 10^2$ | 0.00484 | 0.00271 | 0.00697 |
| 2.273 | $1.87 * 10^2$ | 0.00451 | 0.00244 | 0.00657 |
| 2.575 | $3.76 * 10^2$ | 0.00451 | 0.00236 | 0.00665 |
| 2.699 | $5.00 * 10^2$ | 0.00451 | 0.00216 | 0.00685 |
| 2.780 | $6.03 * 10^2$ | 0.00451 | 0.00203 | 0.00698 |
| 2.960 | $9.12 * 10^2$ | 0.00451 | 0.00134 | 0.00767 |
| 3.000 | $1.00 * 10^3$ | 0.00451 | 0.00144 | 0.00757 |
| 3.144 | $1.39 * 10^3$ | 0.00451 | 0.00118 | 0.00783 |
| 3.461 | $2.89 * 10^3$ | 0.00451 | 0.00022 | 0.00879 |
| 3.610 | $4.07 * 10^3$ | 0.00451 | 0.00000 | 0.01062 |
| 3.736 | $5.45 * 10^3$ | 0.00451 | 0.00000 | 0.01283 |
| 4.211 | $1.63 * 10^4$ | 0.00449 | 0.00000 | 0.01811 |

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

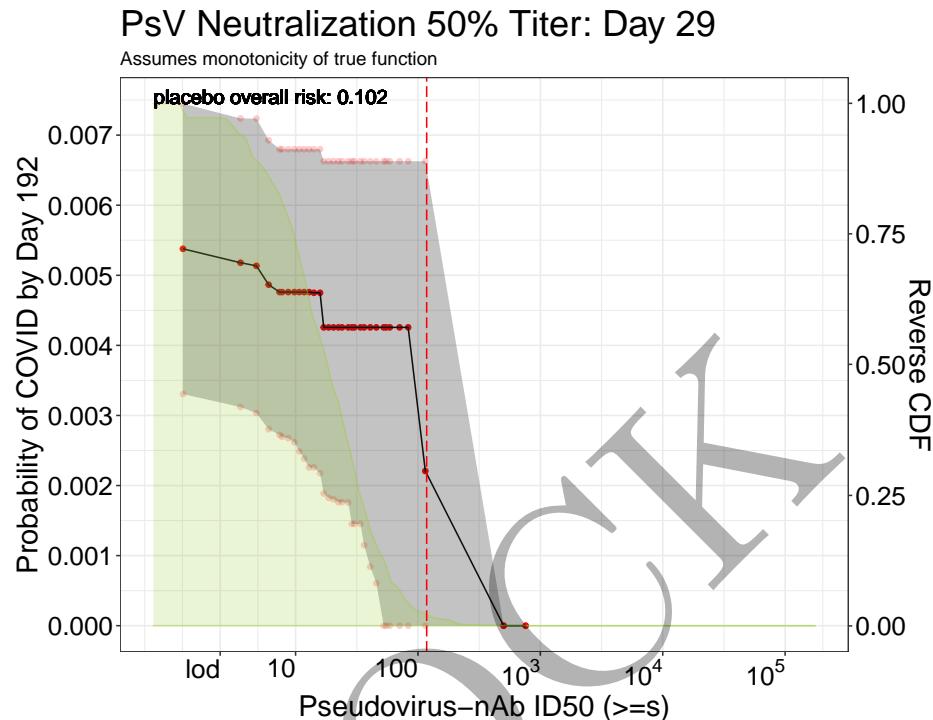


Figure 6.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.31: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.083 | $1.21 * 10^0$ | 0.00538 | 0.00331 | 0.00745 |
| 0.779 | $6.01 * 10^0$ | 0.00487 | 0.00280 | 0.00693 |
| 0.892 | $7.80 * 10^0$ | 0.00476 | 0.00270 | 0.00682 |
| 0.988 | $9.73 * 10^0$ | 0.00476 | 0.00262 | 0.00690 |
| 1.147 | $1.40 * 10^1$ | 0.00475 | 0.00229 | 0.00722 |
| 1.271 | $1.87 * 10^1$ | 0.00426 | 0.00182 | 0.00669 |
| 1.382 | $2.41 * 10^1$ | 0.00426 | 0.00184 | 0.00667 |
| 1.481 | $3.03 * 10^1$ | 0.00426 | 0.00180 | 0.00671 |
| 1.656 | $4.53 * 10^1$ | 0.00426 | 0.00061 | 0.00791 |
| 1.741 | $5.51 * 10^1$ | 0.00426 | 0.00000 | 0.00870 |
| 1.852 | $7.11 * 10^1$ | 0.00426 | 0.00000 | 0.01204 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.879 | $7.57 * 10^2$ | 0.00000 | 0.00000 | NA |

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

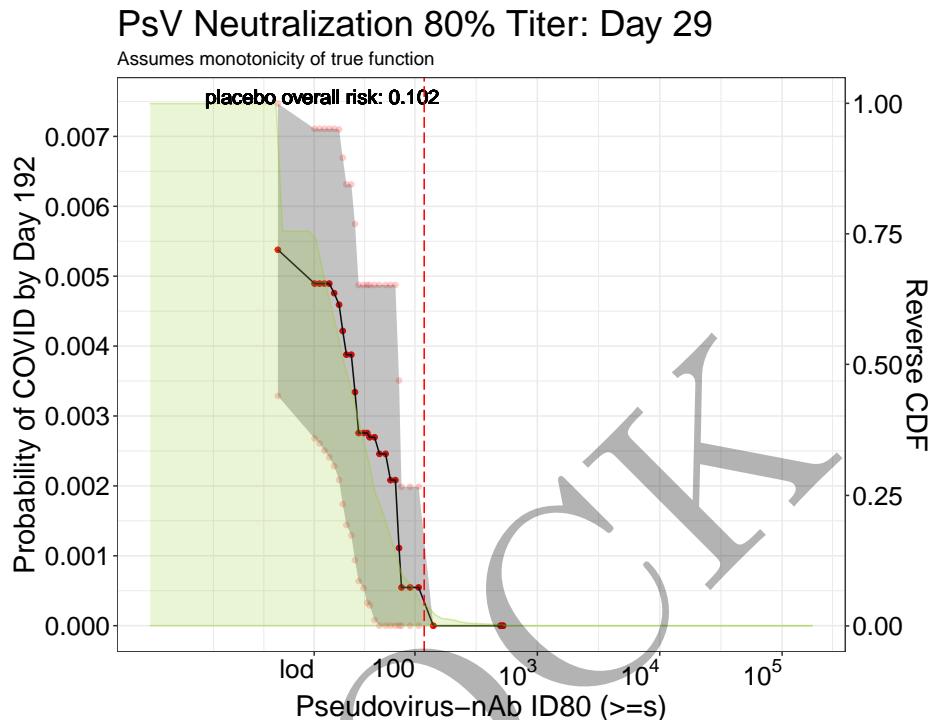


Figure 6.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 6.32: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00329 | 0.00747 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00329 | 0.00747 |
| 0.876 | $7.52 * 10^0$ | 0.00538 | 0.00329 | 0.00747 |
| 1.183 | $1.52 * 10^1$ | 0.00489 | 0.00268 | 0.00711 |
| 1.339 | $2.18 * 10^1$ | 0.00476 | 0.00228 | 0.00723 |
| 1.440 | $2.75 * 10^1$ | 0.00388 | 0.00144 | 0.00631 |
| 1.541 | $3.48 * 10^1$ | 0.00276 | 0.00064 | 0.00487 |
| 1.632 | $4.29 * 10^1$ | 0.00270 | 0.00029 | 0.00510 |
| 1.796 | $6.25 * 10^1$ | 0.00208 | 0.00000 | 0.00495 |
| 1.868 | $7.38 * 10^1$ | 0.00111 | 0.00000 | 0.00351 |
| 1.956 | $9.04 * 10^1$ | 0.00055 | 0.00000 | 0.00228 |
| 2.699 | $5.00 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |
| 2.719 | $5.24 * 10^2$ | 0.00000 | 0.00000 | NA |

MOCK

Chapter 7

Univariate CoR: Nonparametric Threshold Modeling ($\leq s$)

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

7.1 Plots and Tables with estimates and pointwise confidence interval for Day 57

7.1.1 Day 57 Spike protein binding antibody

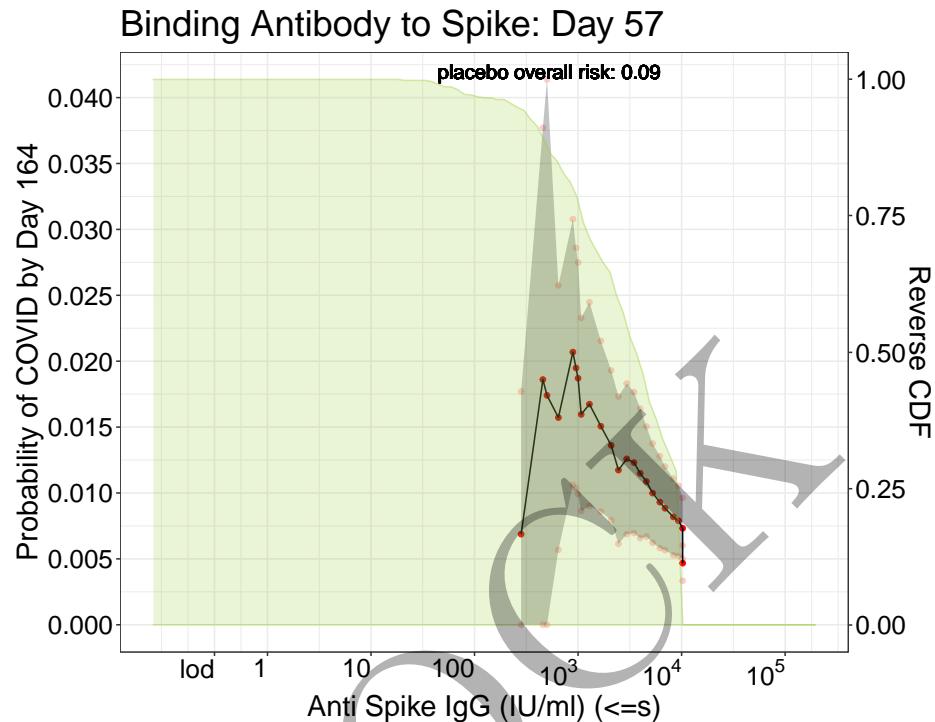


Figure 7.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

Table 7.1: Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.450 | $2.82 * 10^2$ | 0.00687 | 0.00000 | 0.01771 |
| 2.699 | $5.00 * 10^2$ | 0.01741 | 0.00000 | 0.04344 |
| 2.815 | $6.53 * 10^2$ | 0.01572 | 0.00569 | 0.02576 |
| 2.982 | $9.59 * 10^2$ | 0.01948 | 0.01036 | 0.02860 |
| 3.000 | $1.00 * 10^3$ | 0.01870 | 0.00992 | 0.02749 |
| 3.113 | $1.30 * 10^3$ | 0.01674 | 0.00901 | 0.02447 |
| 3.471 | $2.96 * 10^3$ | 0.01259 | 0.00687 | 0.01831 |
| 3.658 | $4.55 * 10^3$ | 0.01087 | 0.00669 | 0.01505 |
| 3.841 | $6.93 * 10^3$ | 0.00884 | 0.00566 | 0.01201 |
| 4.006 | $1.01 * 10^4$ | 0.00732 | 0.00501 | 0.00964 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

7.1.2 Day 57 RBD binding antibody

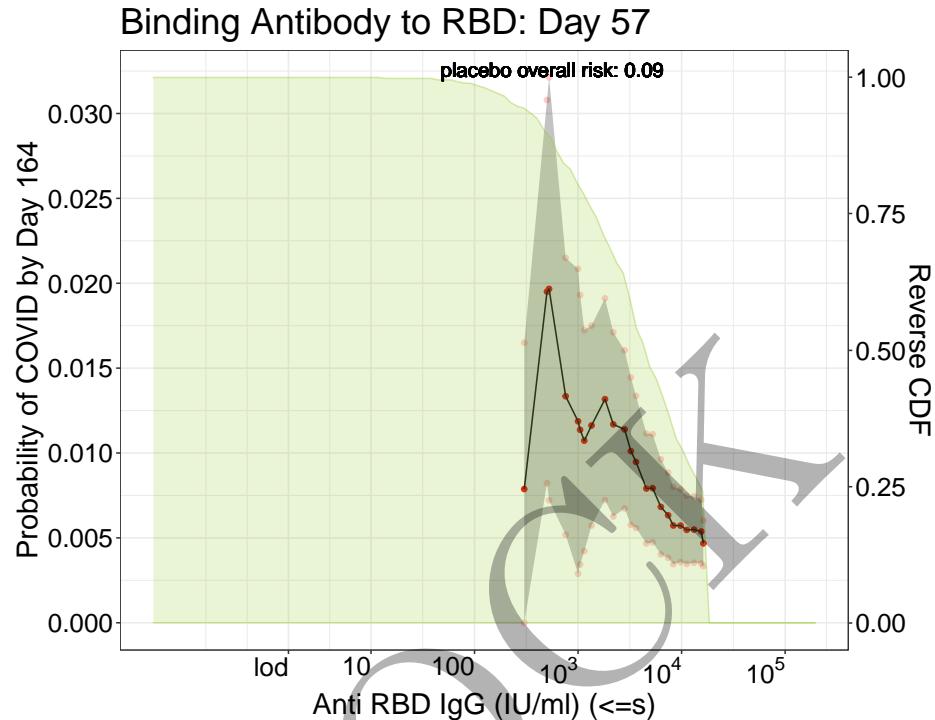


Figure 7.2: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

Table 7.2: Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.478 | $3.01 * 10^2$ | 0.00787 | 0.00000 | 0.01650 |
| 2.699 | $5.00 * 10^2$ | 0.01950 | 0.00822 | 0.03079 |
| 2.882 | $7.62 * 10^2$ | 0.01334 | 0.00519 | 0.02150 |
| 3.000 | $1.00 * 10^3$ | 0.01187 | 0.00289 | 0.02085 |
| 3.056 | $1.14 * 10^3$ | 0.01073 | 0.00422 | 0.01724 |
| 3.259 | $1.82 * 10^3$ | 0.01317 | 0.00723 | 0.01911 |
| 3.557 | $3.61 * 10^3$ | 0.00948 | 0.00559 | 0.01337 |
| 3.797 | $6.27 * 10^3$ | 0.00683 | 0.00403 | 0.00963 |
| 3.986 | $9.68 * 10^3$ | 0.00572 | 0.00358 | 0.00787 |
| 4.186 | $1.53 * 10^4$ | 0.00537 | 0.00350 | 0.00725 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

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

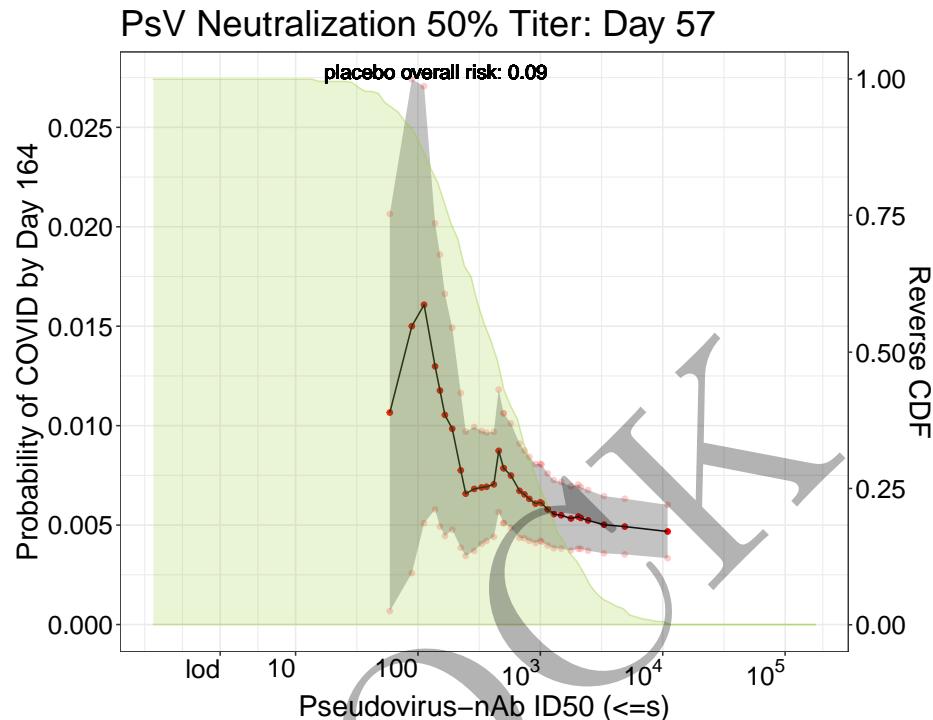


Figure 7.3: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

Table 7.3: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.765 | $5.82 * 10^1$ | 0.01066 | 0.00067 | 0.02064 |
| 2.055 | $1.14 * 10^2$ | 0.01608 | 0.00510 | 0.02706 |
| 2.177 | $1.50 * 10^2$ | 0.01177 | 0.00493 | 0.01860 |
| 2.281 | $1.91 * 10^2$ | 0.00985 | 0.00477 | 0.01492 |
| 2.519 | $3.30 * 10^2$ | 0.00689 | 0.00405 | 0.00973 |
| 2.657 | $4.54 * 10^2$ | 0.00874 | 0.00566 | 0.01181 |
| 2.699 | $5.00 * 10^2$ | 0.00786 | 0.00510 | 0.01062 |
| 2.828 | $6.73 * 10^2$ | 0.00672 | 0.00435 | 0.00909 |
| 2.959 | $9.10 * 10^2$ | 0.00608 | 0.00410 | 0.00807 |
| 3.000 | $1.00 * 10^3$ | 0.00615 | 0.00421 | 0.00808 |
| 3.174 | $1.49 * 10^3$ | 0.00549 | 0.00382 | 0.00717 |
| 3.307 | $2.03 * 10^3$ | 0.00543 | 0.00381 | 0.00704 |
| 3.387 | $2.44 * 10^3$ | 0.00524 | 0.00371 | 0.00676 |
| 4.038 | $1.09 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

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

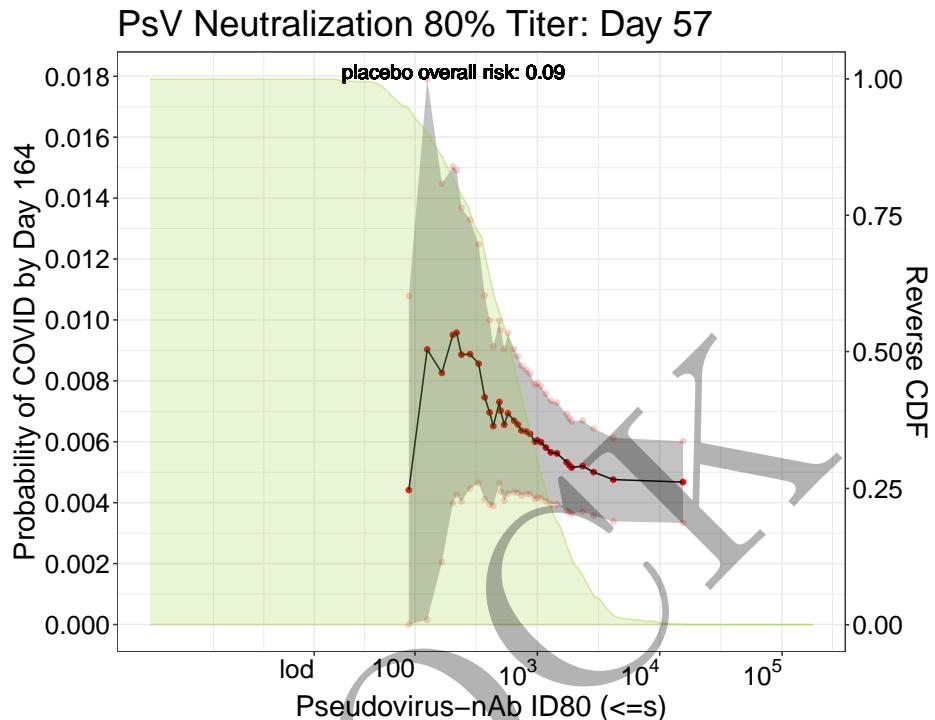


Figure 7.4: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

Table 7.4: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.954 | $8.99 * 10^1$ | 0.00441 | 0.00000 | 0.01079 |
| 2.220 | $1.66 * 10^2$ | 0.00826 | 0.00205 | 0.01447 |
| 2.335 | $2.16 * 10^2$ | 0.00958 | 0.00426 | 0.01491 |
| 2.455 | $2.85 * 10^2$ | 0.00888 | 0.00446 | 0.01329 |
| 2.644 | $4.41 * 10^2$ | 0.00652 | 0.00390 | 0.00913 |
| 2.699 | $5.00 * 10^2$ | 0.00702 | 0.00437 | 0.00967 |
| 2.764 | $5.81 * 10^2$ | 0.00693 | 0.00429 | 0.00957 |
| 2.874 | $7.48 * 10^2$ | 0.00637 | 0.00424 | 0.00850 |
| 2.981 | $9.57 * 10^2$ | 0.00600 | 0.00412 | 0.00789 |
| 3.000 | $1.00 * 10^3$ | 0.00604 | 0.00416 | 0.00793 |
| 3.162 | $1.45 * 10^3$ | 0.00562 | 0.00395 | 0.00729 |
| 3.265 | $1.84 * 10^3$ | 0.00524 | 0.00370 | 0.00677 |
| 3.371 | $2.35 * 10^3$ | 0.00520 | 0.00370 | 0.00670 |
| 4.187 | $1.54 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

7.2 Plots and Tables with estimates and pointwise confidence intervals for Day 29

MOCK

7.2.1 Day 29 Spike protein antibody

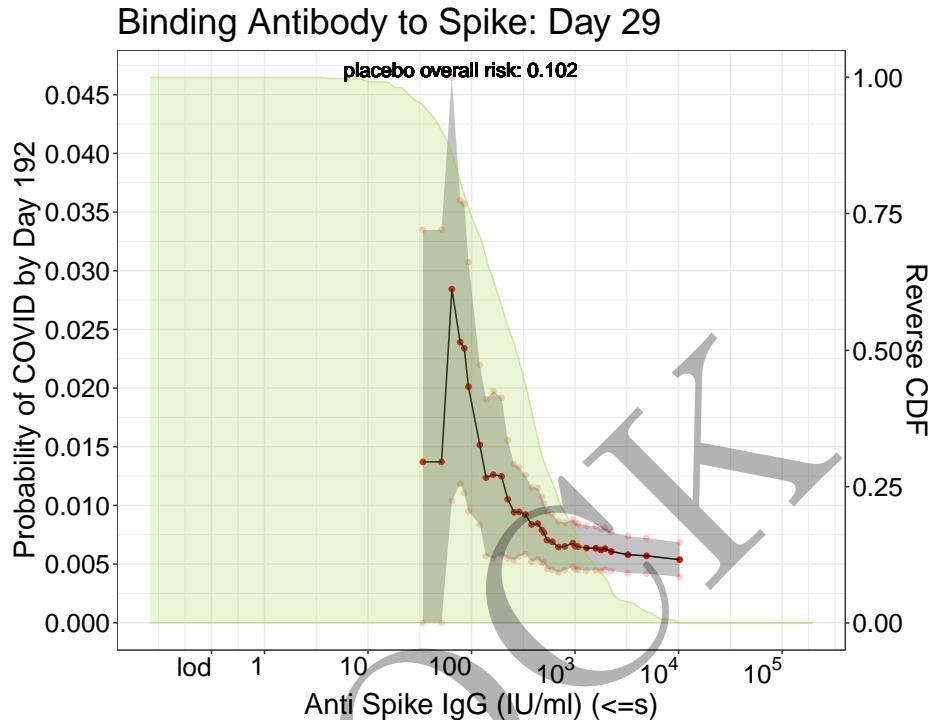


Figure 7.5: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

Table 7.5: Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.532 | $3.40 * 10^1$ | 0.01371 | 0.00000 | 0.03348 |
| 1.805 | $6.38 * 10^1$ | 0.02843 | 0.01039 | 0.04647 |
| 1.927 | $8.45 * 10^1$ | 0.02339 | 0.01106 | 0.03571 |
| 2.081 | $1.21 * 10^2$ | 0.01516 | 0.00836 | 0.02196 |
| 2.351 | $2.24 * 10^2$ | 0.01053 | 0.00549 | 0.01557 |
| 2.522 | $3.33 * 10^2$ | 0.00921 | 0.00586 | 0.01257 |
| 2.677 | $4.75 * 10^2$ | 0.00790 | 0.00510 | 0.01071 |
| 2.699 | $5.00 * 10^2$ | 0.00767 | 0.00515 | 0.01019 |
| 2.841 | $6.93 * 10^2$ | 0.00646 | 0.00428 | 0.00863 |
| 3.000 | $1.00 * 10^3$ | 0.00653 | 0.00455 | 0.00852 |
| 3.112 | $1.29 * 10^3$ | 0.00637 | 0.00445 | 0.00828 |
| 3.252 | $1.79 * 10^3$ | 0.00621 | 0.00441 | 0.00800 |
| 3.348 | $2.23 * 10^3$ | 0.00607 | 0.00441 | 0.00773 |
| 4.007 | $1.02 * 10^4$ | 0.00538 | 0.00392 | 0.00683 |

7.2.2 Day 29 RBD binding antibody

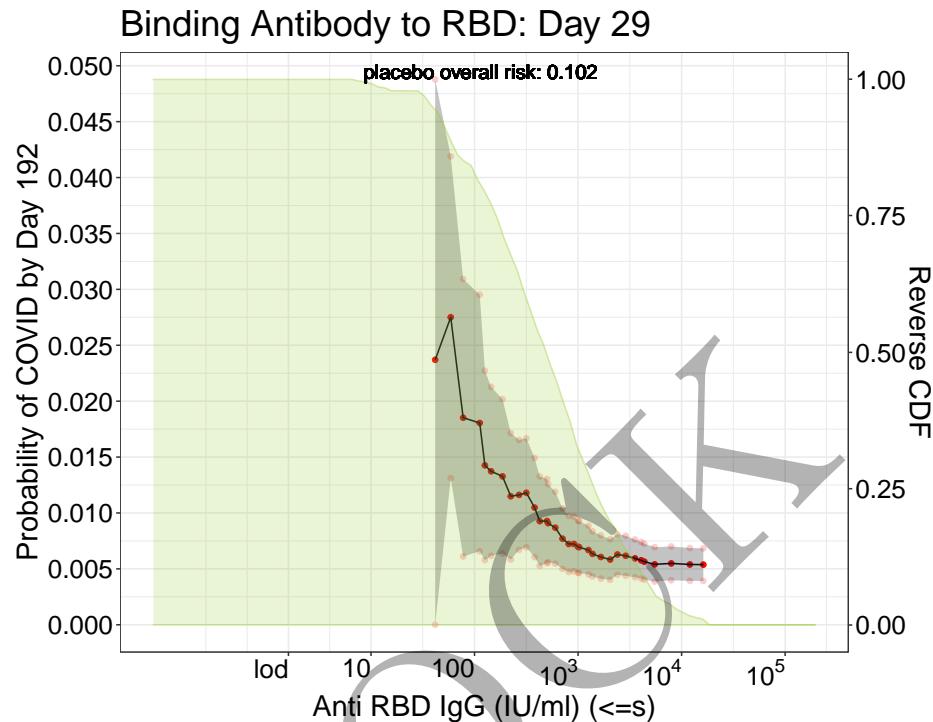


Figure 7.6: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

Table 7.6: Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.620 | $4.17 * 10^1$ | 0.02370 | 0.00000 | 0.04878 |
| 1.892 | $7.80 * 10^1$ | 0.01852 | 0.00611 | 0.03093 |
| 2.098 | $1.25 * 10^2$ | 0.01426 | 0.00579 | 0.02273 |
| 2.273 | $1.87 * 10^2$ | 0.01327 | 0.00637 | 0.02018 |
| 2.575 | $3.76 * 10^2$ | 0.01048 | 0.00605 | 0.01492 |
| 2.699 | $5.00 * 10^2$ | 0.00928 | 0.00551 | 0.01305 |
| 2.780 | $6.03 * 10^2$ | 0.00868 | 0.00547 | 0.01189 |
| 2.960 | $9.12 * 10^2$ | 0.00723 | 0.00478 | 0.00968 |
| 3.000 | $1.00 * 10^3$ | 0.00697 | 0.00466 | 0.00929 |
| 3.144 | $1.39 * 10^3$ | 0.00634 | 0.00432 | 0.00835 |
| 3.461 | $2.89 * 10^3$ | 0.00617 | 0.00438 | 0.00796 |
| 3.610 | $4.07 * 10^3$ | 0.00576 | 0.00413 | 0.00740 |
| 3.736 | $5.45 * 10^3$ | 0.00540 | 0.00386 | 0.00694 |
| 4.211 | $1.63 * 10^4$ | 0.00538 | 0.00392 | 0.00683 |

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

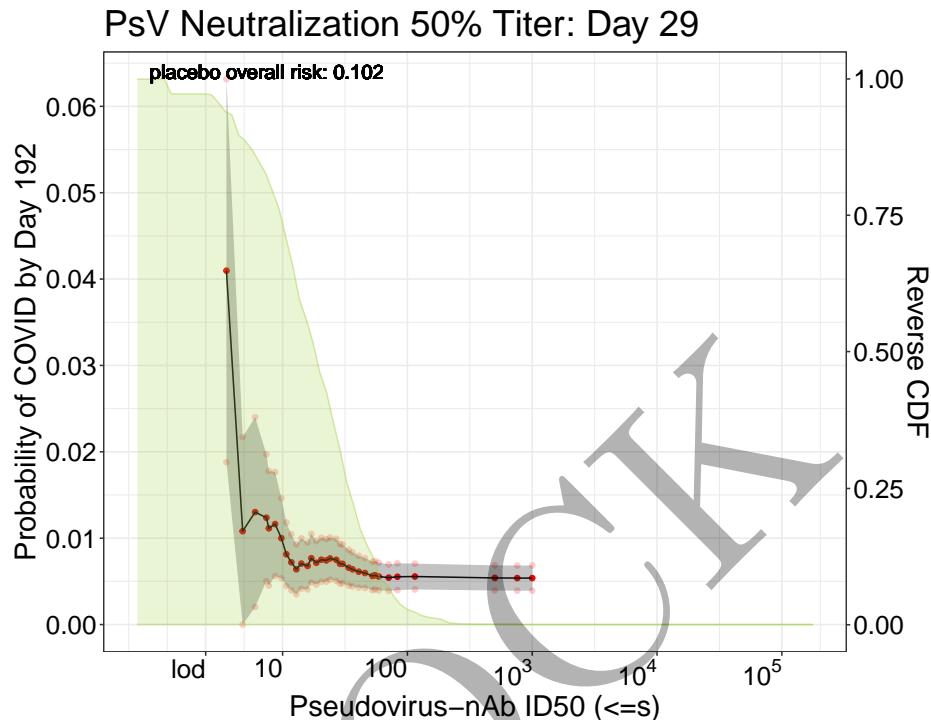


Figure 7.7: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

Table 7.7: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| log ₁₀ -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------------|------------------------|---------------|---------|----------|
| 0.548 | 3.53 * 10 ⁰ | 0.04097 | 0.01880 | 0.06314 |
| 0.779 | 6.01 * 10 ⁰ | 0.01302 | 0.00203 | 0.02401 |
| 0.892 | 7.80 * 10 ⁰ | 0.01114 | 0.00451 | 0.01777 |
| 0.988 | 9.73 * 10 ⁰ | 0.01000 | 0.00536 | 0.01463 |
| 1.147 | 1.40 * 10 ¹ | 0.00705 | 0.00413 | 0.00997 |
| 1.271 | 1.87 * 10 ¹ | 0.00715 | 0.00465 | 0.00966 |
| 1.382 | 2.41 * 10 ¹ | 0.00765 | 0.00522 | 0.01008 |
| 1.481 | 3.03 * 10 ¹ | 0.00703 | 0.00479 | 0.00926 |
| 1.656 | 4.53 * 10 ¹ | 0.00597 | 0.00423 | 0.00770 |
| 1.741 | 5.51 * 10 ¹ | 0.00571 | 0.00406 | 0.00736 |
| 1.852 | 7.11 * 10 ¹ | 0.00543 | 0.00389 | 0.00697 |
| 2.699 | 5.00 * 10 ² | 0.00540 | 0.00394 | 0.00685 |
| 2.879 | 7.57 * 10 ² | 0.00538 | 0.00392 | 0.00683 |
| 3.000 | 1.00 * 10 ³ | 0.00538 | 0.00392 | 0.00683 |

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

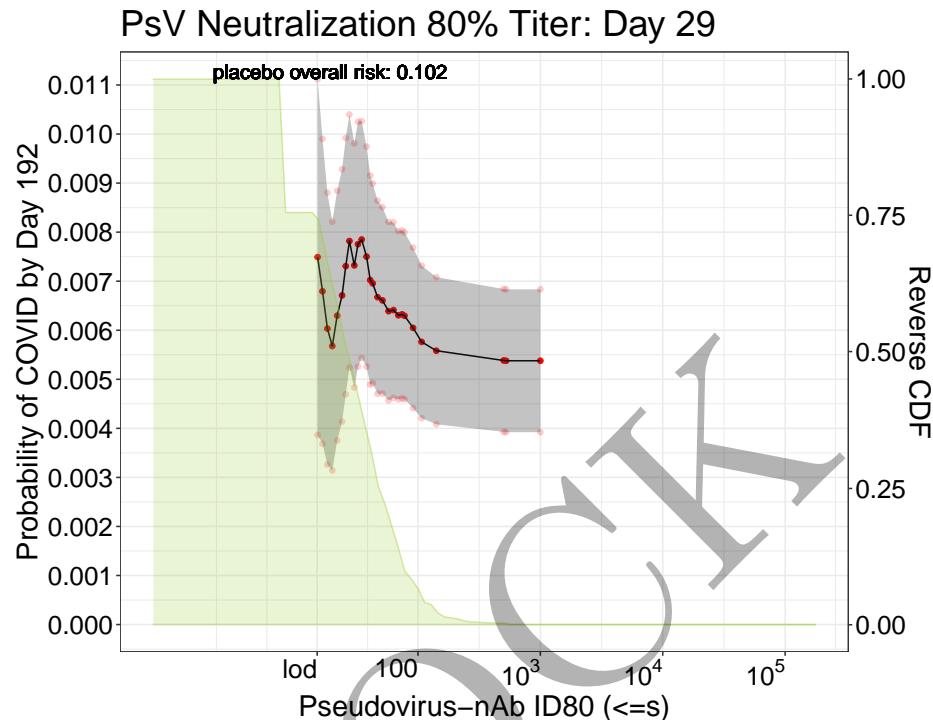


Figure 7.8: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

Table 7.8: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.339 | $2.18 * 10^1$ | 0.00630 | 0.00375 | 0.00884 |
| 1.440 | $2.75 * 10^1$ | 0.00782 | 0.00524 | 0.01040 |
| 1.541 | $3.48 * 10^1$ | 0.00785 | 0.00543 | 0.01026 |
| 1.632 | $4.29 * 10^1$ | 0.00696 | 0.00492 | 0.00899 |
| 1.796 | $6.25 * 10^1$ | 0.00641 | 0.00462 | 0.00820 |
| 1.868 | $7.38 * 10^1$ | 0.00632 | 0.00461 | 0.00803 |
| 1.956 | $9.04 * 10^1$ | 0.00605 | 0.00441 | 0.00768 |
| 2.699 | $5.00 * 10^2$ | 0.00538 | 0.00393 | 0.00684 |
| 2.719 | $5.24 * 10^2$ | 0.00538 | 0.00392 | 0.00683 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00392 | 0.00683 |

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

MOCK

7.3.1 Day 57 Spike protein binding antibody

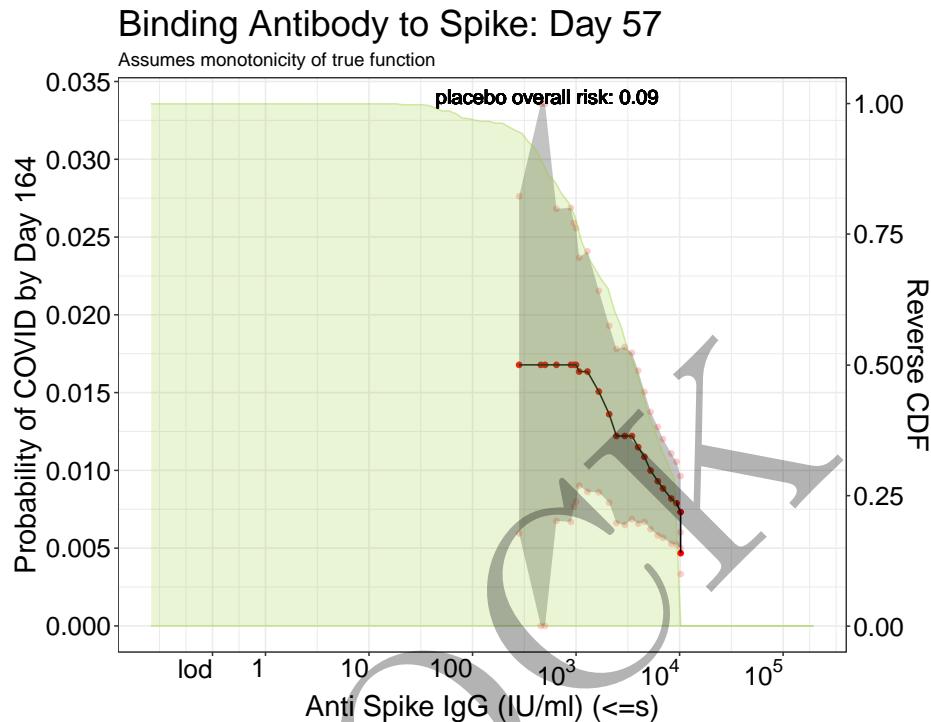


Figure 7.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.9: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.450 | $2.82 * 10^2$ | 0.01678 | 0.00594 | 0.02762 |
| 2.699 | $5.00 * 10^2$ | 0.01678 | 0.00000 | 0.04282 |
| 2.815 | $6.53 * 10^2$ | 0.01678 | 0.00675 | 0.02682 |
| 2.982 | $9.59 * 10^2$ | 0.01678 | 0.00766 | 0.02590 |
| 3.000 | $1.00 * 10^3$ | 0.01678 | 0.00800 | 0.02557 |
| 3.113 | $1.30 * 10^3$ | 0.01635 | 0.00862 | 0.02408 |
| 3.471 | $2.96 * 10^3$ | 0.01221 | 0.00649 | 0.01793 |
| 3.658 | $4.55 * 10^3$ | 0.01087 | 0.00669 | 0.01505 |
| 3.841 | $6.93 * 10^3$ | 0.00884 | 0.00566 | 0.01201 |
| 4.006 | $1.01 * 10^4$ | 0.00732 | 0.00501 | 0.00964 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

7.3.2 Day 57 RBD binding antibody

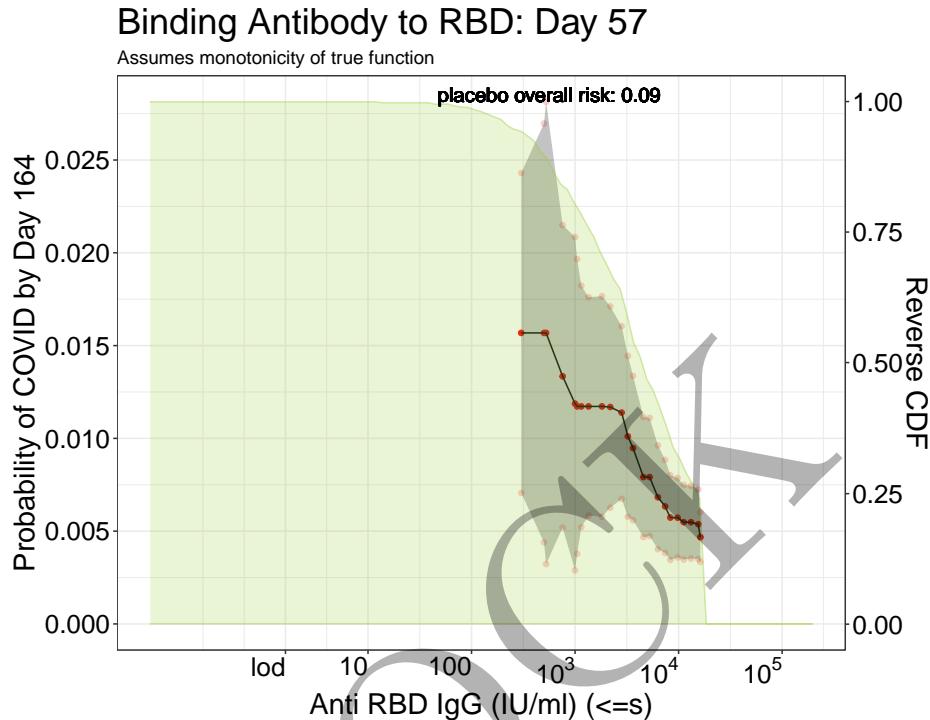


Figure 7.10: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.10: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.478 | $3.01 * 10^2$ | 0.01568 | 0.00706 | 0.02431 |
| 2.699 | $5.00 * 10^2$ | 0.01568 | 0.00439 | 0.02697 |
| 2.882 | $7.62 * 10^2$ | 0.01334 | 0.00519 | 0.02150 |
| 3.000 | $1.00 * 10^3$ | 0.01187 | 0.00289 | 0.02085 |
| 3.056 | $1.14 * 10^3$ | 0.01172 | 0.00521 | 0.01823 |
| 3.259 | $1.82 * 10^3$ | 0.01172 | 0.00578 | 0.01766 |
| 3.557 | $3.61 * 10^3$ | 0.00948 | 0.00559 | 0.01337 |
| 3.797 | $6.27 * 10^3$ | 0.00683 | 0.00403 | 0.00963 |
| 3.986 | $9.68 * 10^3$ | 0.00572 | 0.00358 | 0.00787 |
| 4.186 | $1.53 * 10^4$ | 0.00537 | 0.00350 | 0.00725 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

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

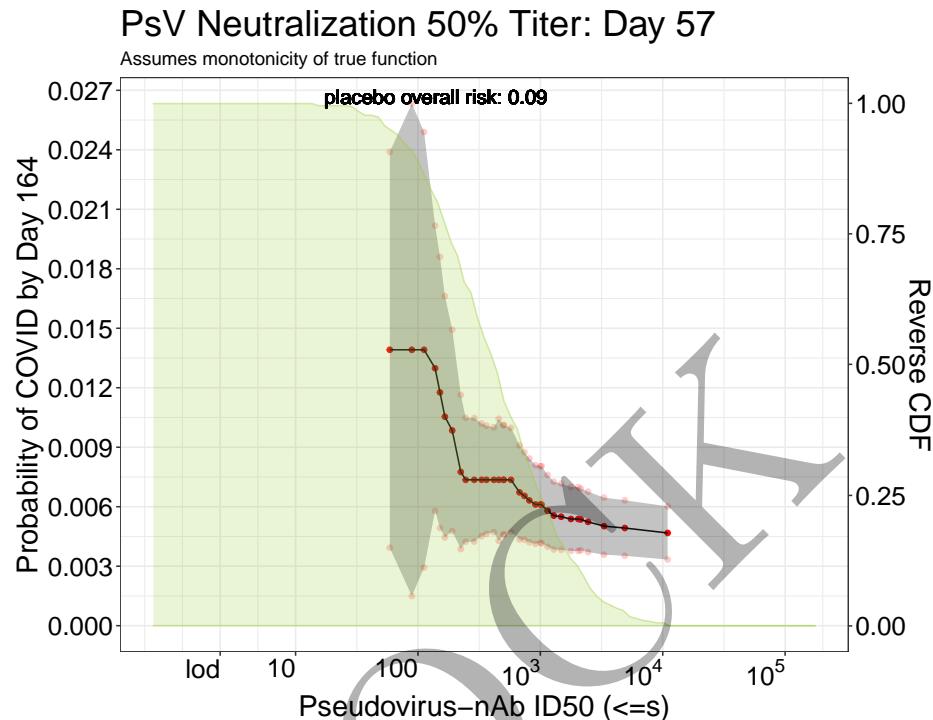


Figure 7.11: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.11: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.765 | $5.82 * 10^1$ | 0.01391 | 0.00393 | 0.02390 |
| 2.055 | $1.14 * 10^2$ | 0.01391 | 0.00293 | 0.02490 |
| 2.177 | $1.50 * 10^2$ | 0.01177 | 0.00493 | 0.01860 |
| 2.281 | $1.91 * 10^2$ | 0.00985 | 0.00477 | 0.01492 |
| 2.519 | $3.30 * 10^2$ | 0.00736 | 0.00452 | 0.01020 |
| 2.657 | $4.54 * 10^2$ | 0.00736 | 0.00428 | 0.01044 |
| 2.699 | $5.00 * 10^2$ | 0.00736 | 0.00460 | 0.01012 |
| 2.828 | $6.73 * 10^2$ | 0.00672 | 0.00435 | 0.00909 |
| 2.959 | $9.10 * 10^2$ | 0.00611 | 0.00413 | 0.00810 |
| 3.000 | $1.00 * 10^3$ | 0.00611 | 0.00418 | 0.00804 |
| 3.174 | $1.49 * 10^3$ | 0.00549 | 0.00382 | 0.00717 |
| 3.307 | $2.03 * 10^3$ | 0.00538 | 0.00377 | 0.00699 |
| 3.387 | $2.44 * 10^3$ | 0.00524 | 0.00371 | 0.00676 |
| 4.038 | $1.09 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

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

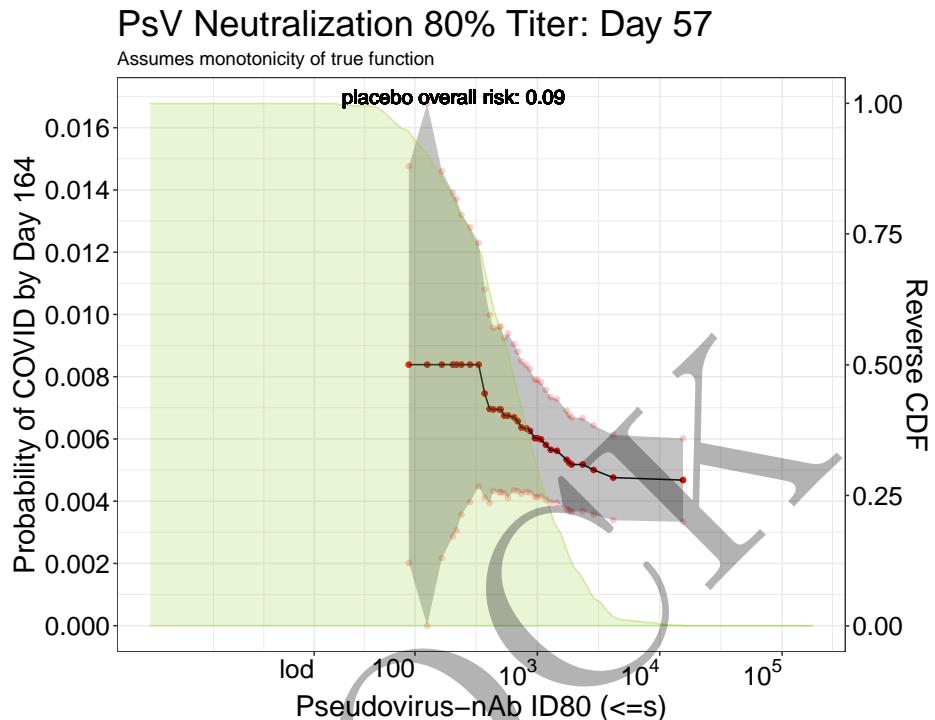


Figure 7.12: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.12: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.954 | $8.99 * 10^1$ | 0.00839 | 0.00202 | 0.01476 |
| 2.220 | $1.66 * 10^2$ | 0.00839 | 0.00217 | 0.01460 |
| 2.335 | $2.16 * 10^2$ | 0.00839 | 0.00306 | 0.01371 |
| 2.455 | $2.85 * 10^2$ | 0.00839 | 0.00398 | 0.01280 |
| 2.644 | $4.41 * 10^2$ | 0.00695 | 0.00433 | 0.00956 |
| 2.699 | $5.00 * 10^2$ | 0.00695 | 0.00430 | 0.00960 |
| 2.764 | $5.81 * 10^2$ | 0.00675 | 0.00411 | 0.00939 |
| 2.874 | $7.48 * 10^2$ | 0.00637 | 0.00424 | 0.00850 |
| 2.981 | $9.57 * 10^2$ | 0.00602 | 0.00414 | 0.00791 |
| 3.000 | $1.00 * 10^3$ | 0.00602 | 0.00414 | 0.00791 |
| 3.162 | $1.45 * 10^3$ | 0.00562 | 0.00395 | 0.00729 |
| 3.265 | $1.84 * 10^3$ | 0.00524 | 0.00370 | 0.00677 |
| 3.371 | $2.35 * 10^3$ | 0.00518 | 0.00368 | 0.00668 |
| 4.187 | $1.54 * 10^4$ | 0.00468 | 0.00334 | 0.00602 |

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

MOCK

7.4.1 Day 29 Spike protein antibody

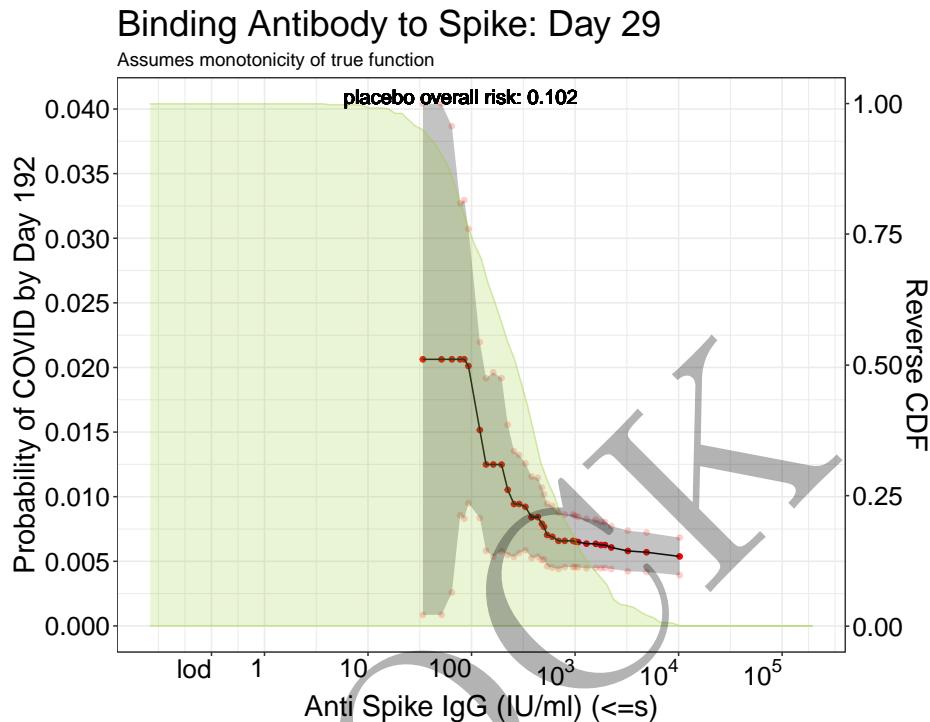


Figure 7.13: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.13: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.532 | $3.40 * 10^1$ | 0.02063 | 0.00086 | 0.04040 |
| 1.805 | $6.38 * 10^1$ | 0.02063 | 0.00259 | 0.03867 |
| 1.927 | $8.45 * 10^1$ | 0.02063 | 0.00831 | 0.03295 |
| 2.081 | $1.21 * 10^2$ | 0.01516 | 0.00836 | 0.02196 |
| 2.351 | $2.24 * 10^2$ | 0.01053 | 0.00549 | 0.01557 |
| 2.522 | $3.33 * 10^2$ | 0.00921 | 0.00586 | 0.01257 |
| 2.677 | $4.75 * 10^2$ | 0.00790 | 0.00510 | 0.01071 |
| 2.699 | $5.00 * 10^2$ | 0.00767 | 0.00515 | 0.01019 |
| 2.841 | $6.93 * 10^2$ | 0.00659 | 0.00441 | 0.00876 |
| 3.000 | $1.00 * 10^3$ | 0.00653 | 0.00455 | 0.00852 |
| 3.112 | $1.29 * 10^3$ | 0.00637 | 0.00445 | 0.00828 |
| 3.252 | $1.79 * 10^3$ | 0.00626 | 0.00447 | 0.00805 |
| 3.348 | $2.23 * 10^3$ | 0.00607 | 0.00441 | 0.00773 |
| 4.007 | $1.02 * 10^4$ | 0.00538 | 0.00392 | 0.00683 |

7.4.2 Day 29 RBD binding antibody

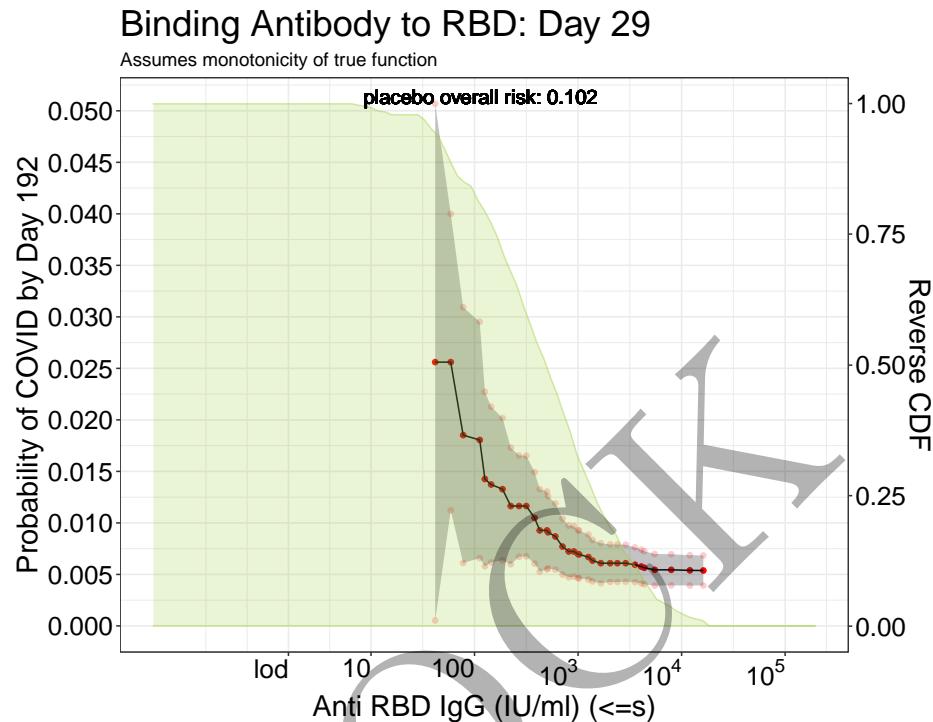


Figure 7.14: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.14: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.620 | $4.17 * 10^1$ | 0.02560 | 0.00053 | 0.05068 |
| 1.892 | $7.80 * 10^1$ | 0.01852 | 0.00611 | 0.03093 |
| 2.098 | $1.25 * 10^2$ | 0.01426 | 0.00579 | 0.02273 |
| 2.273 | $1.87 * 10^2$ | 0.01327 | 0.00637 | 0.02018 |
| 2.575 | $3.76 * 10^2$ | 0.01048 | 0.00605 | 0.01492 |
| 2.699 | $5.00 * 10^2$ | 0.00927 | 0.00550 | 0.01304 |
| 2.780 | $6.03 * 10^2$ | 0.00868 | 0.00547 | 0.01189 |
| 2.960 | $9.12 * 10^2$ | 0.00723 | 0.00478 | 0.00968 |
| 3.000 | $1.00 * 10^3$ | 0.00697 | 0.00466 | 0.00929 |
| 3.144 | $1.39 * 10^3$ | 0.00634 | 0.00432 | 0.00835 |
| 3.461 | $2.89 * 10^3$ | 0.00609 | 0.00429 | 0.00788 |
| 3.610 | $4.07 * 10^3$ | 0.00576 | 0.00413 | 0.00740 |
| 3.736 | $5.45 * 10^3$ | 0.00545 | 0.00391 | 0.00698 |
| 4.211 | $1.63 * 10^4$ | 0.00538 | 0.00392 | 0.00683 |

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

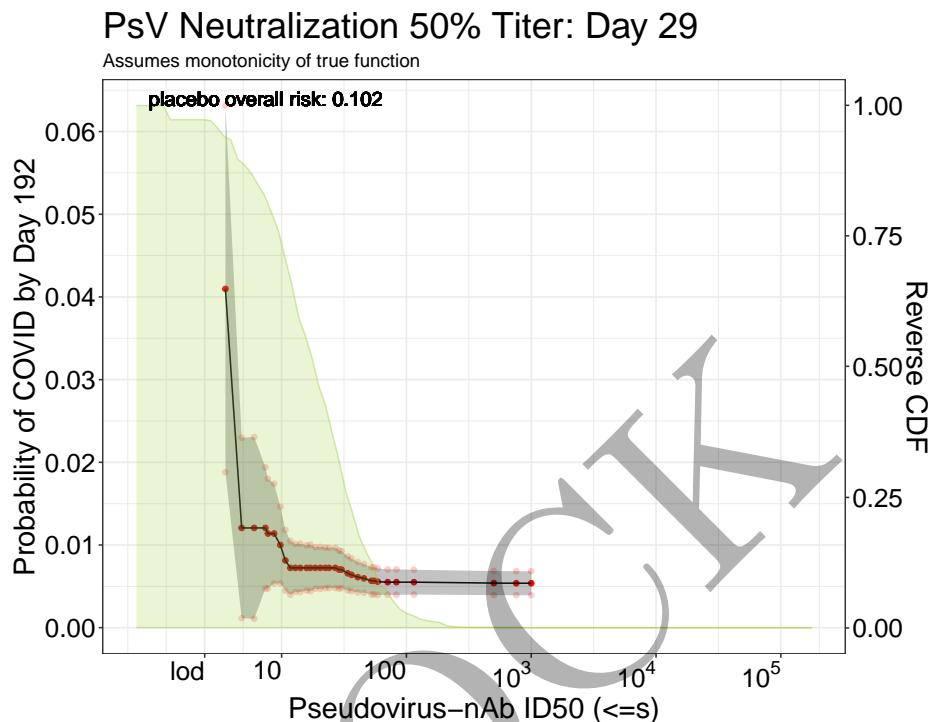


Figure 7.15: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.15: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.548 | $3.53 * 10^0$ | 0.04097 | 0.01880 | 0.06314 |
| 0.779 | $6.01 * 10^0$ | 0.01207 | 0.00108 | 0.02305 |
| 0.892 | $7.80 * 10^0$ | 0.01139 | 0.00475 | 0.01802 |
| 0.988 | $9.73 * 10^0$ | 0.01000 | 0.00536 | 0.01463 |
| 1.147 | $1.40 * 10^1$ | 0.00724 | 0.00432 | 0.01016 |
| 1.271 | $1.87 * 10^1$ | 0.00724 | 0.00473 | 0.00974 |
| 1.382 | $2.41 * 10^1$ | 0.00724 | 0.00480 | 0.00967 |
| 1.481 | $3.03 * 10^1$ | 0.00703 | 0.00479 | 0.00926 |
| 1.656 | $4.53 * 10^1$ | 0.00597 | 0.00423 | 0.00770 |
| 1.741 | $5.51 * 10^1$ | 0.00567 | 0.00402 | 0.00732 |
| 1.852 | $7.11 * 10^1$ | 0.00551 | 0.00397 | 0.00704 |
| 2.699 | $5.00 * 10^2$ | 0.00540 | 0.00394 | 0.00685 |
| 2.879 | $7.57 * 10^2$ | 0.00538 | 0.00392 | 0.00683 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00392 | 0.00683 |

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

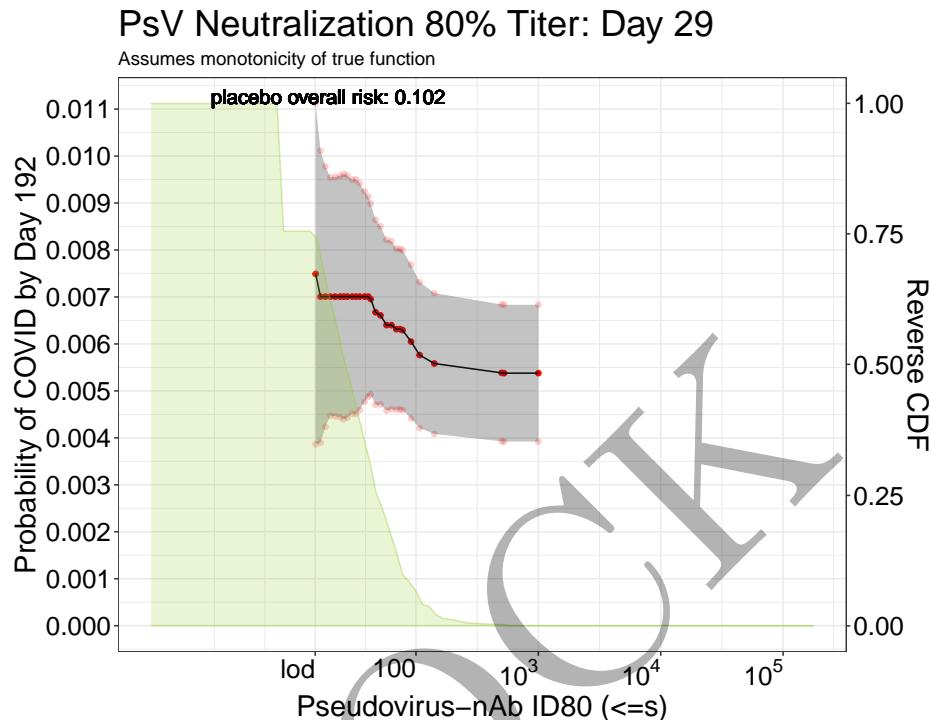


Figure 7.16: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.16: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with pointwise 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00386 | 0.01112 |
| 1.339 | $2.18 * 10^1$ | 0.00701 | 0.00446 | 0.00955 |
| 1.440 | $2.75 * 10^1$ | 0.00701 | 0.00443 | 0.00959 |
| 1.541 | $3.48 * 10^1$ | 0.00701 | 0.00459 | 0.00942 |
| 1.632 | $4.29 * 10^1$ | 0.00696 | 0.00492 | 0.00899 |
| 1.796 | $6.25 * 10^1$ | 0.00640 | 0.00461 | 0.00819 |
| 1.868 | $7.38 * 10^1$ | 0.00631 | 0.00460 | 0.00803 |
| 1.956 | $9.04 * 10^1$ | 0.00605 | 0.00441 | 0.00768 |
| 2.699 | $5.00 * 10^2$ | 0.00538 | 0.00393 | 0.00684 |
| 2.719 | $5.24 * 10^2$ | 0.00538 | 0.00392 | 0.00683 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00392 | 0.00683 |

7.5 Plots and Tables with estimates and simultaneous confidence bands for Day 57

MOCK

7.5.1 Day 57 Spike protein binding antibody

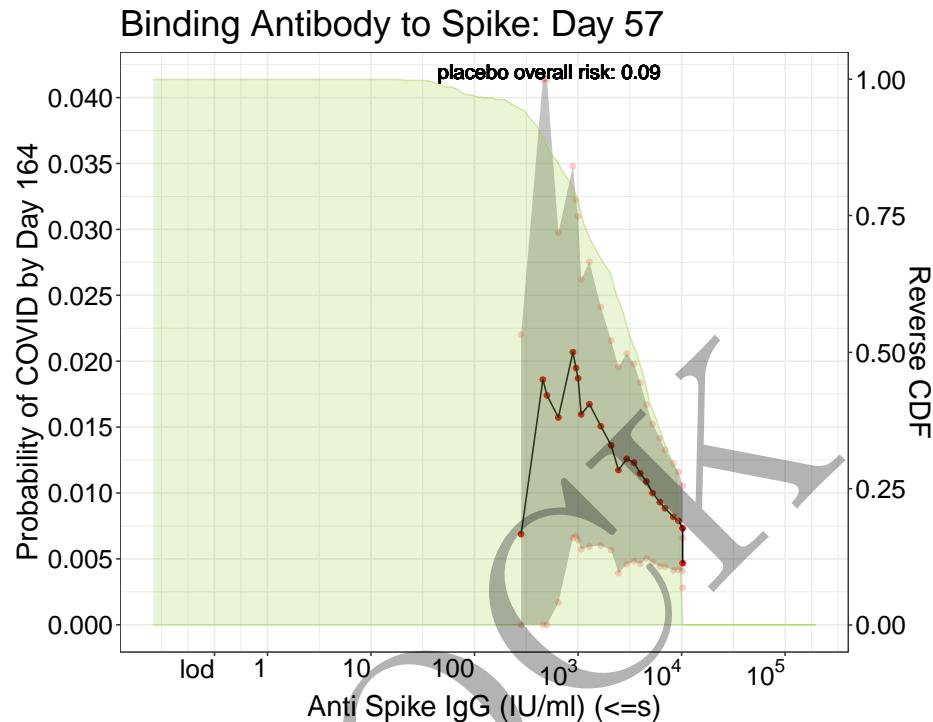


Figure 7.17: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

Table 7.17: Table of risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.450 | $2.82 * 10^2$ | 0.00687 | 0.00000 | 0.02202 |
| 2.699 | $5.00 * 10^2$ | 0.01741 | 0.00000 | 0.05379 |
| 2.815 | $6.53 * 10^2$ | 0.01572 | 0.00170 | 0.02975 |
| 2.982 | $9.59 * 10^2$ | 0.01948 | 0.00674 | 0.03223 |
| 3.000 | $1.00 * 10^3$ | 0.01870 | 0.00643 | 0.03098 |
| 3.113 | $1.30 * 10^3$ | 0.01674 | 0.00594 | 0.02754 |
| 3.471 | $2.96 * 10^3$ | 0.01259 | 0.00460 | 0.02058 |
| 3.658 | $4.55 * 10^3$ | 0.01087 | 0.00503 | 0.01671 |
| 3.841 | $6.93 * 10^3$ | 0.00884 | 0.00440 | 0.01327 |
| 4.006 | $1.01 * 10^4$ | 0.00732 | 0.00409 | 0.01056 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |

7.5.2 Day 57 RBD binding antibody

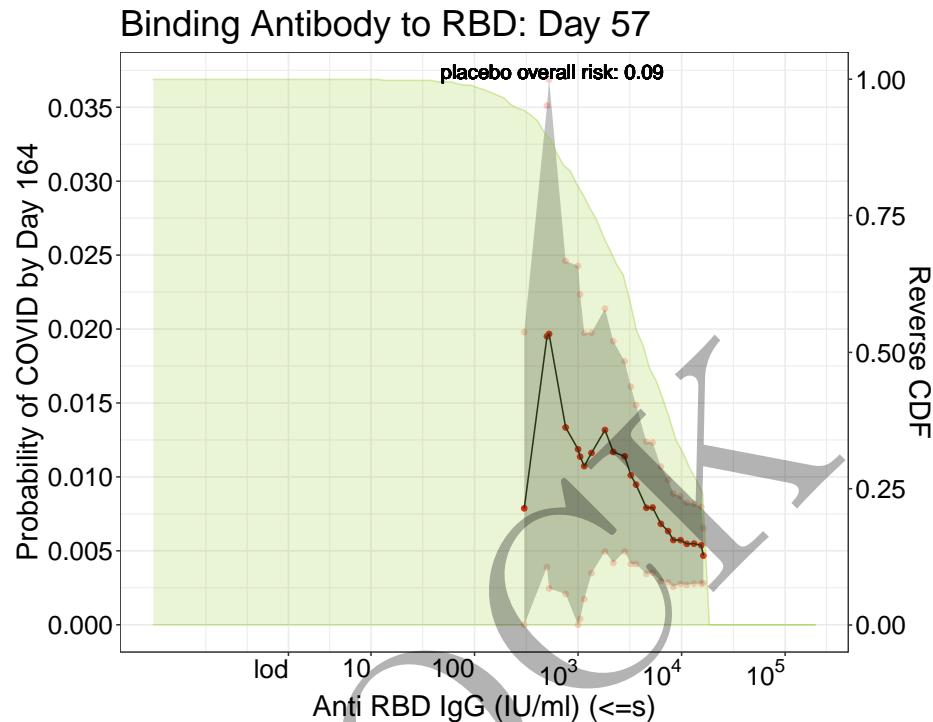


Figure 7.18: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

Table 7.18: Table of risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.478 | $3.01 * 10^2$ | 0.00787 | 0.00000 | 0.01979 |
| 2.699 | $5.00 * 10^2$ | 0.01950 | 0.00390 | 0.03511 |
| 2.882 | $7.62 * 10^2$ | 0.01334 | 0.00208 | 0.02461 |
| 3.000 | $1.00 * 10^3$ | 0.01187 | 0.00000 | 0.02428 |
| 3.056 | $1.14 * 10^3$ | 0.01073 | 0.00173 | 0.01973 |
| 3.259 | $1.82 * 10^3$ | 0.01317 | 0.00496 | 0.02138 |
| 3.557 | $3.61 * 10^3$ | 0.00948 | 0.00410 | 0.01485 |
| 3.797 | $6.27 * 10^3$ | 0.00683 | 0.00296 | 0.01070 |
| 3.986 | $9.68 * 10^3$ | 0.00572 | 0.00276 | 0.00868 |
| 4.186 | $1.53 * 10^4$ | 0.00537 | 0.00278 | 0.00797 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |

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

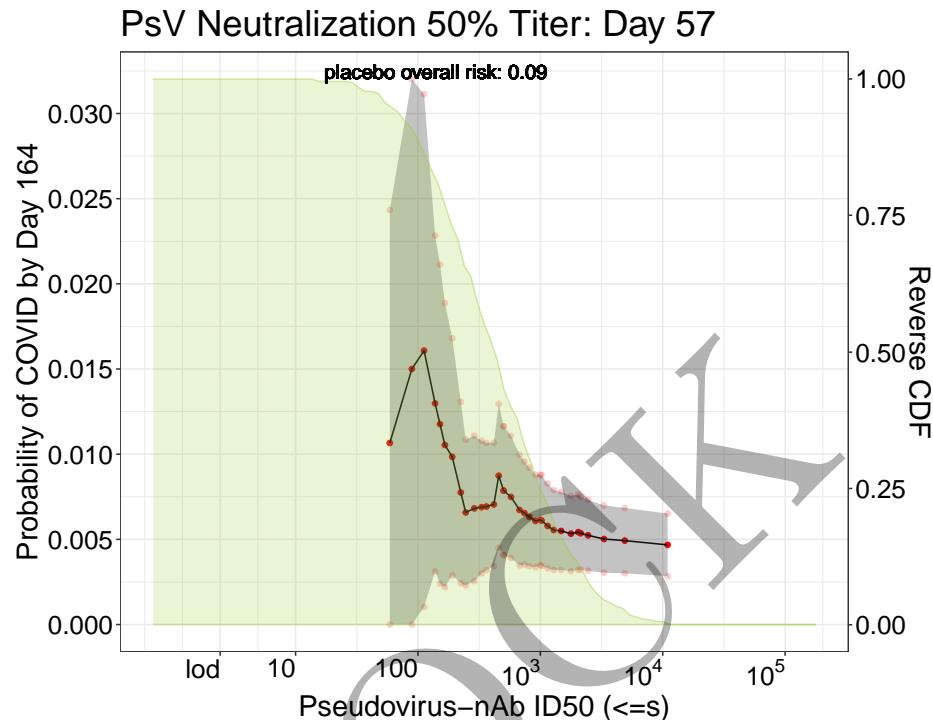


Figure 7.19: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

Table 7.19: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.765 | $5.82 * 10^1$ | 0.01066 | 0.00000 | 0.02434 |
| 2.055 | $1.14 * 10^2$ | 0.01608 | 0.00103 | 0.03113 |
| 2.177 | $1.50 * 10^2$ | 0.01177 | 0.00240 | 0.02113 |
| 2.281 | $1.91 * 10^2$ | 0.00985 | 0.00289 | 0.01680 |
| 2.519 | $3.30 * 10^2$ | 0.00689 | 0.00300 | 0.01078 |
| 2.657 | $4.54 * 10^2$ | 0.00874 | 0.00452 | 0.01295 |
| 2.699 | $5.00 * 10^2$ | 0.00786 | 0.00408 | 0.01164 |
| 2.828 | $6.73 * 10^2$ | 0.00672 | 0.00348 | 0.00997 |
| 2.959 | $9.10 * 10^2$ | 0.00608 | 0.00336 | 0.00880 |
| 3.000 | $1.00 * 10^3$ | 0.00615 | 0.00350 | 0.00879 |
| 3.174 | $1.49 * 10^3$ | 0.00549 | 0.00320 | 0.00778 |
| 3.307 | $2.03 * 10^3$ | 0.00543 | 0.00322 | 0.00763 |
| 3.387 | $2.44 * 10^3$ | 0.00524 | 0.00315 | 0.00732 |
| 4.038 | $1.09 * 10^4$ | 0.00468 | 0.00284 | 0.00651 |

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

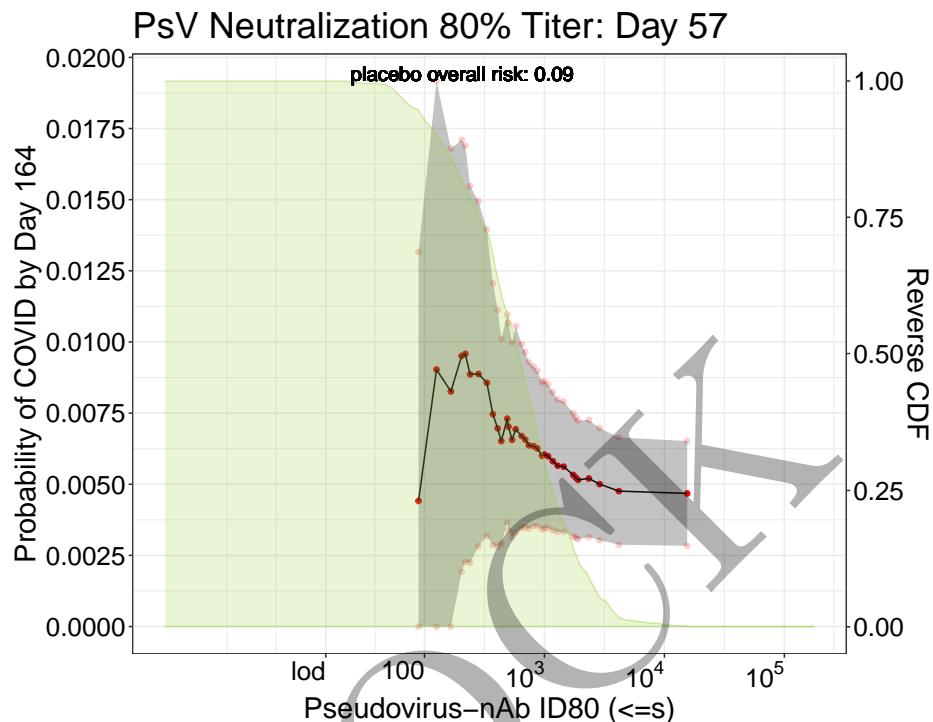


Figure 7.20: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

Table 7.20: Table of risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.954 | $8.99 * 10^1$ | 0.00441 | 0.00000 | 0.01317 |
| 2.220 | $1.66 * 10^2$ | 0.00826 | 0.00000 | 0.01679 |
| 2.335 | $2.16 * 10^2$ | 0.00958 | 0.00227 | 0.01689 |
| 2.455 | $2.85 * 10^2$ | 0.00888 | 0.00281 | 0.01494 |
| 2.644 | $4.41 * 10^2$ | 0.00652 | 0.00292 | 0.01011 |
| 2.699 | $5.00 * 10^2$ | 0.00702 | 0.00338 | 0.01066 |
| 2.764 | $5.81 * 10^2$ | 0.00693 | 0.00331 | 0.01056 |
| 2.874 | $7.48 * 10^2$ | 0.00637 | 0.00344 | 0.00930 |
| 2.981 | $9.57 * 10^2$ | 0.00600 | 0.00342 | 0.00859 |
| 3.000 | $1.00 * 10^3$ | 0.00604 | 0.00346 | 0.00863 |
| 3.162 | $1.45 * 10^3$ | 0.00562 | 0.00332 | 0.00791 |
| 3.265 | $1.84 * 10^3$ | 0.00524 | 0.00312 | 0.00735 |
| 3.371 | $2.35 * 10^3$ | 0.00520 | 0.00315 | 0.00726 |
| 4.187 | $1.54 * 10^4$ | 0.00468 | 0.00284 | 0.00652 |

7.6 Plots and Tables with estimates and simultaneous confidence bands for Day 29

MOCK

7.6.1 Day 29 Spike protein antibody

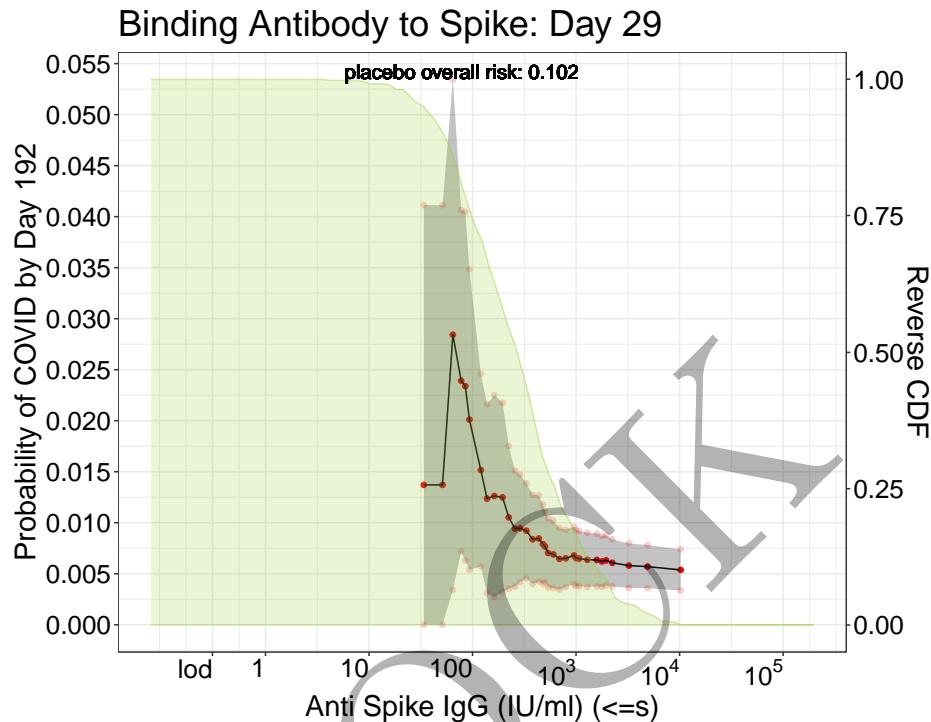


Figure 7.21: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

Table 7.21: Table of risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.532 | $3.40 * 10^1$ | 0.01371 | 0.00000 | 0.04113 |
| 1.805 | $6.38 * 10^1$ | 0.02843 | 0.00342 | 0.05345 |
| 1.927 | $8.45 * 10^1$ | 0.02339 | 0.00630 | 0.04047 |
| 2.081 | $1.21 * 10^2$ | 0.01516 | 0.00572 | 0.02460 |
| 2.351 | $2.24 * 10^2$ | 0.01053 | 0.00354 | 0.01752 |
| 2.522 | $3.33 * 10^2$ | 0.00921 | 0.00456 | 0.01387 |
| 2.677 | $4.75 * 10^2$ | 0.00790 | 0.00402 | 0.01179 |
| 2.699 | $5.00 * 10^2$ | 0.00767 | 0.00417 | 0.01116 |
| 2.841 | $6.93 * 10^2$ | 0.00646 | 0.00343 | 0.00948 |
| 3.000 | $1.00 * 10^3$ | 0.00653 | 0.00379 | 0.00928 |
| 3.112 | $1.29 * 10^3$ | 0.00637 | 0.00371 | 0.00902 |
| 3.252 | $1.79 * 10^3$ | 0.00621 | 0.00372 | 0.00869 |
| 3.348 | $2.23 * 10^3$ | 0.00607 | 0.00377 | 0.00838 |
| 4.007 | $1.02 * 10^4$ | 0.00538 | 0.00336 | 0.00740 |

7.6.2 Day 29 RBD binding antibody

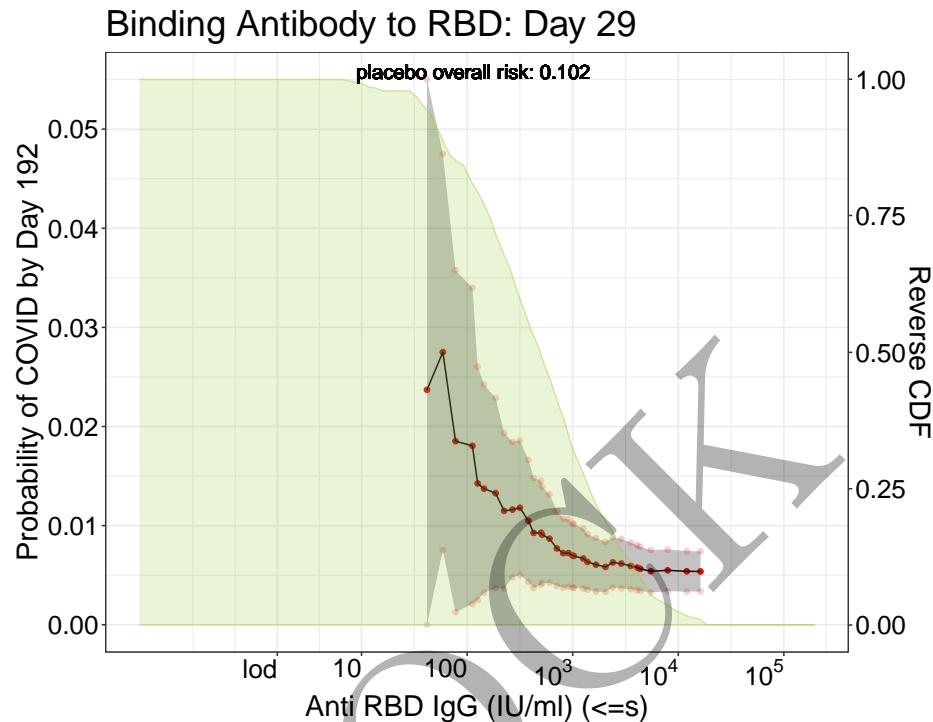


Figure 7.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

Table 7.22: Table of risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.620 | $4.17 * 10^1$ | 0.02370 | 0.00000 | 0.05854 |
| 1.892 | $7.80 * 10^1$ | 0.01852 | 0.00128 | 0.03576 |
| 2.098 | $1.25 * 10^2$ | 0.01426 | 0.00249 | 0.02603 |
| 2.273 | $1.87 * 10^2$ | 0.01327 | 0.00368 | 0.02287 |
| 2.575 | $3.76 * 10^2$ | 0.01048 | 0.00432 | 0.01664 |
| 2.699 | $5.00 * 10^2$ | 0.00928 | 0.00405 | 0.01452 |
| 2.780 | $6.03 * 10^2$ | 0.00868 | 0.00422 | 0.01314 |
| 2.960 | $9.12 * 10^2$ | 0.00723 | 0.00383 | 0.01063 |
| 3.000 | $1.00 * 10^3$ | 0.00697 | 0.00375 | 0.01020 |
| 3.144 | $1.39 * 10^3$ | 0.00634 | 0.00354 | 0.00914 |
| 3.461 | $2.89 * 10^3$ | 0.00617 | 0.00368 | 0.00866 |
| 3.610 | $4.07 * 10^3$ | 0.00576 | 0.00349 | 0.00804 |
| 3.736 | $5.45 * 10^3$ | 0.00540 | 0.00327 | 0.00754 |
| 4.211 | $1.63 * 10^4$ | 0.00538 | 0.00335 | 0.00740 |

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

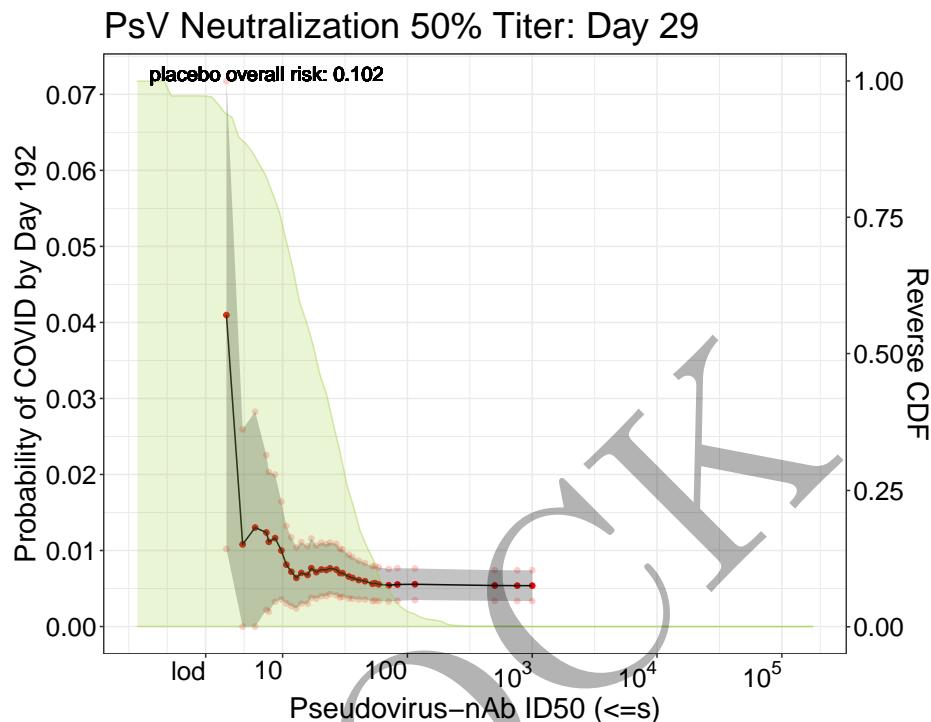


Figure 7.23: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

Table 7.23: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.548 | $3.53 * 10^0$ | 0.04097 | 0.01021 | 0.07173 |
| 0.779 | $6.01 * 10^0$ | 0.01302 | 0.00000 | 0.02826 |
| 0.892 | $7.80 * 10^0$ | 0.01114 | 0.00194 | 0.02034 |
| 0.988 | $9.73 * 10^0$ | 0.01000 | 0.00356 | 0.01643 |
| 1.147 | $1.40 * 10^1$ | 0.00705 | 0.00300 | 0.01111 |
| 1.271 | $1.87 * 10^1$ | 0.00715 | 0.00367 | 0.01063 |
| 1.382 | $2.41 * 10^1$ | 0.00765 | 0.00427 | 0.01103 |
| 1.481 | $3.03 * 10^1$ | 0.00703 | 0.00392 | 0.01013 |
| 1.656 | $4.53 * 10^1$ | 0.00597 | 0.00356 | 0.00837 |
| 1.741 | $5.51 * 10^1$ | 0.00571 | 0.00342 | 0.00799 |
| 1.852 | $7.11 * 10^1$ | 0.00543 | 0.00330 | 0.00756 |
| 2.699 | $5.00 * 10^2$ | 0.00540 | 0.00337 | 0.00742 |
| 2.879 | $7.57 * 10^2$ | 0.00538 | 0.00336 | 0.00740 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00336 | 0.00740 |

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

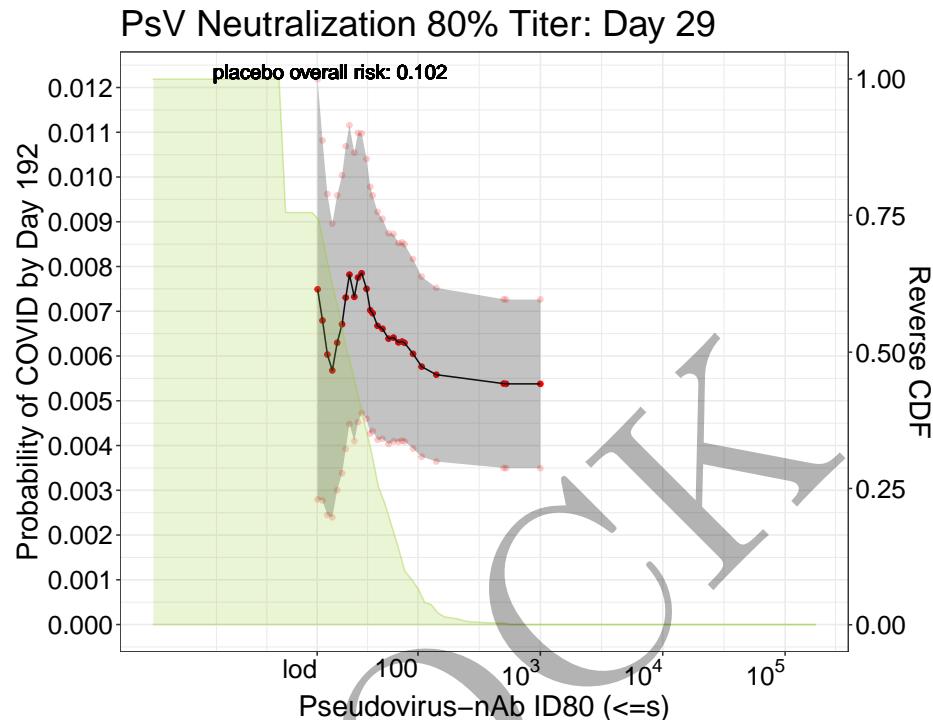


Figure 7.24: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

Table 7.24: Table of risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.339 | $2.18 * 10^1$ | 0.00630 | 0.00300 | 0.00959 |
| 1.440 | $2.75 * 10^1$ | 0.00782 | 0.00448 | 0.01116 |
| 1.541 | $3.48 * 10^1$ | 0.00785 | 0.00472 | 0.01097 |
| 1.632 | $4.29 * 10^1$ | 0.00696 | 0.00432 | 0.00959 |
| 1.796 | $6.25 * 10^1$ | 0.00641 | 0.00409 | 0.00873 |
| 1.868 | $7.38 * 10^1$ | 0.00632 | 0.00411 | 0.00854 |
| 1.956 | $9.04 * 10^1$ | 0.00605 | 0.00393 | 0.00817 |
| 2.699 | $5.00 * 10^2$ | 0.00538 | 0.00350 | 0.00727 |
| 2.719 | $5.24 * 10^2$ | 0.00538 | 0.00349 | 0.00726 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00349 | 0.00726 |

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

MOCK

7.7.1 Day 57 Spike protein binding antibody

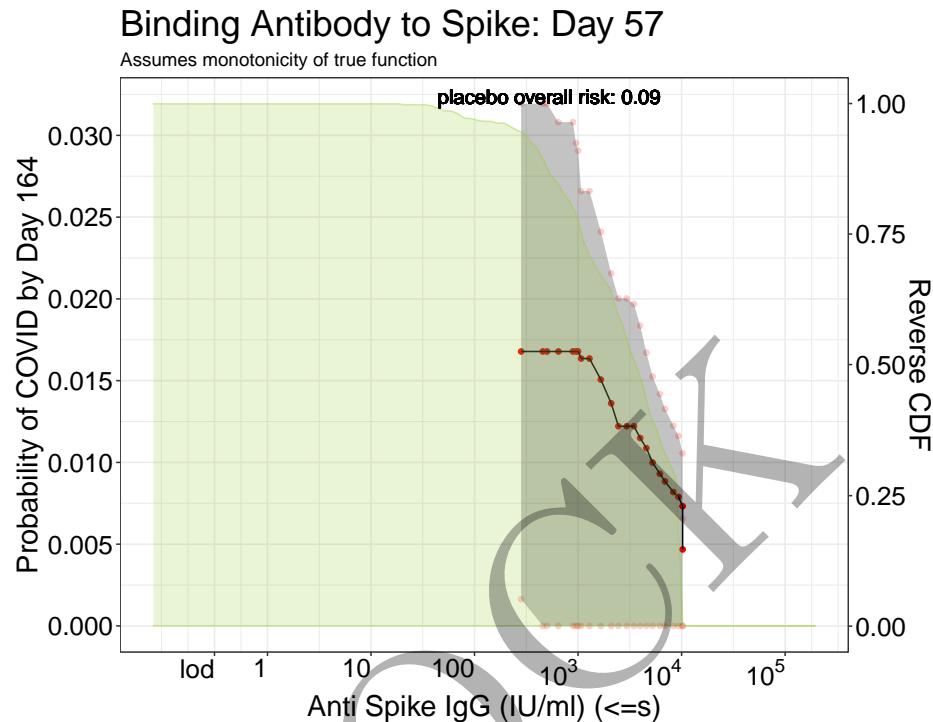


Figure 7.25: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.25: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Spike protein binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.450 | $2.82 * 10^2$ | 0.01678 | 0.00164 | 0.03193 |
| 2.699 | $5.00 * 10^2$ | 0.01678 | 0.00000 | 0.05316 |
| 2.815 | $6.53 * 10^2$ | 0.01678 | 0.00276 | 0.03081 |
| 2.982 | $9.59 * 10^2$ | 0.01678 | 0.00404 | 0.02953 |
| 3.000 | $1.00 * 10^3$ | 0.01678 | 0.00451 | 0.02906 |
| 3.113 | $1.30 * 10^3$ | 0.01635 | 0.00555 | 0.02715 |
| 3.471 | $2.96 * 10^3$ | 0.01221 | 0.00422 | 0.02020 |
| 3.658 | $4.55 * 10^3$ | 0.01087 | 0.00503 | 0.01671 |
| 3.841 | $6.93 * 10^3$ | 0.00884 | 0.00440 | 0.01327 |
| 4.006 | $1.01 * 10^4$ | 0.00732 | 0.00409 | 0.01056 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |
| 4.007 | $1.02 * 10^4$ | 0.00468 | 0.00280 | 0.00655 |

7.7.2 Day 57 RBD binding antibody

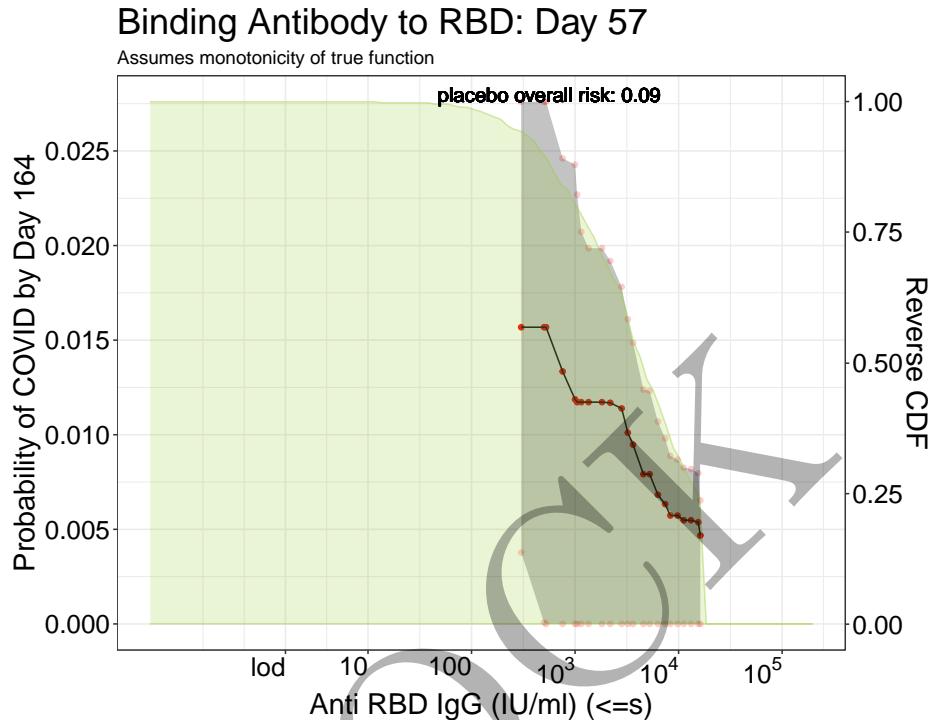


Figure 7.26: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.26: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 2.478 | $3.01 * 10^2$ | 0.01568 | 0.00377 | 0.02760 |
| 2.699 | $5.00 * 10^2$ | 0.01568 | 0.00008 | 0.03128 |
| 2.882 | $7.62 * 10^2$ | 0.01334 | 0.00208 | 0.02461 |
| 3.000 | $1.00 * 10^3$ | 0.01187 | 0.00000 | 0.02428 |
| 3.056 | $1.14 * 10^3$ | 0.01172 | 0.00273 | 0.02072 |
| 3.259 | $1.82 * 10^3$ | 0.01172 | 0.00351 | 0.01993 |
| 3.557 | $3.61 * 10^3$ | 0.00948 | 0.00410 | 0.01485 |
| 3.797 | $6.27 * 10^3$ | 0.00683 | 0.00296 | 0.01070 |
| 3.986 | $9.68 * 10^3$ | 0.00572 | 0.00276 | 0.00868 |
| 4.186 | $1.53 * 10^4$ | 0.00537 | 0.00278 | 0.00797 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |
| 4.211 | $1.63 * 10^4$ | 0.00468 | 0.00282 | 0.00653 |

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

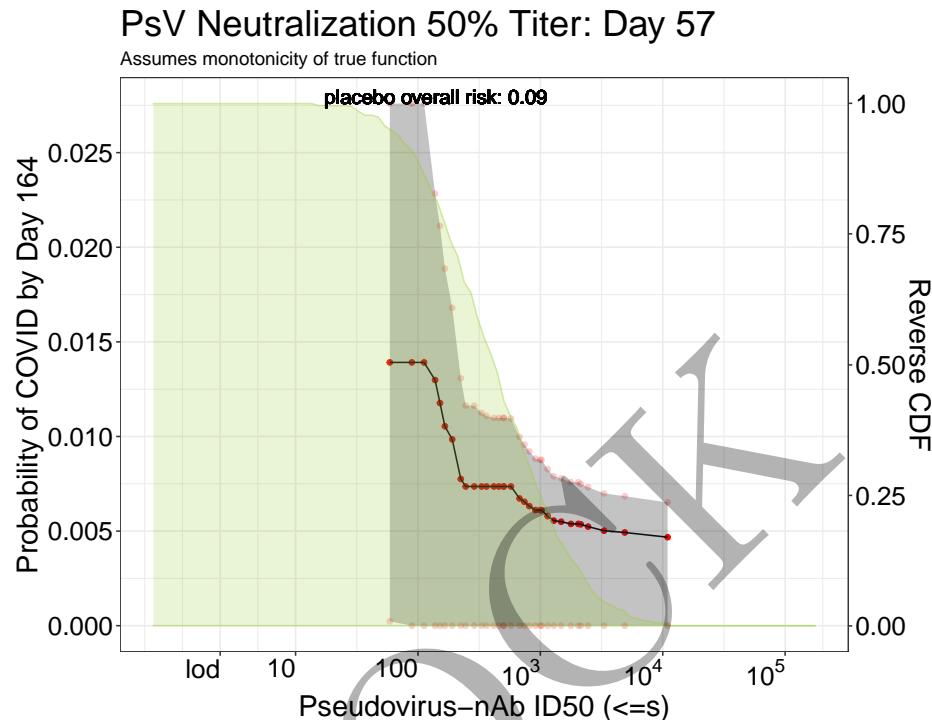


Figure 7.27: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.27: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.765 | $5.82 * 10^1$ | 0.01391 | 0.00023 | 0.02759 |
| 2.055 | $1.14 * 10^2$ | 0.01391 | 0.00000 | 0.02896 |
| 2.177 | $1.50 * 10^2$ | 0.01177 | 0.00240 | 0.02113 |
| 2.281 | $1.91 * 10^2$ | 0.00985 | 0.00289 | 0.01680 |
| 2.519 | $3.30 * 10^2$ | 0.00736 | 0.00347 | 0.01125 |
| 2.657 | $4.54 * 10^2$ | 0.00736 | 0.00314 | 0.01157 |
| 2.699 | $5.00 * 10^2$ | 0.00736 | 0.00357 | 0.01114 |
| 2.828 | $6.73 * 10^2$ | 0.00672 | 0.00348 | 0.00997 |
| 2.959 | $9.10 * 10^2$ | 0.00611 | 0.00339 | 0.00883 |
| 3.000 | $1.00 * 10^3$ | 0.00611 | 0.00347 | 0.00876 |
| 3.174 | $1.49 * 10^3$ | 0.00549 | 0.00320 | 0.00778 |
| 3.307 | $2.03 * 10^3$ | 0.00538 | 0.00317 | 0.00759 |
| 3.387 | $2.44 * 10^3$ | 0.00524 | 0.00315 | 0.00732 |
| 4.038 | $1.09 * 10^4$ | 0.00468 | 0.00284 | 0.00651 |

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

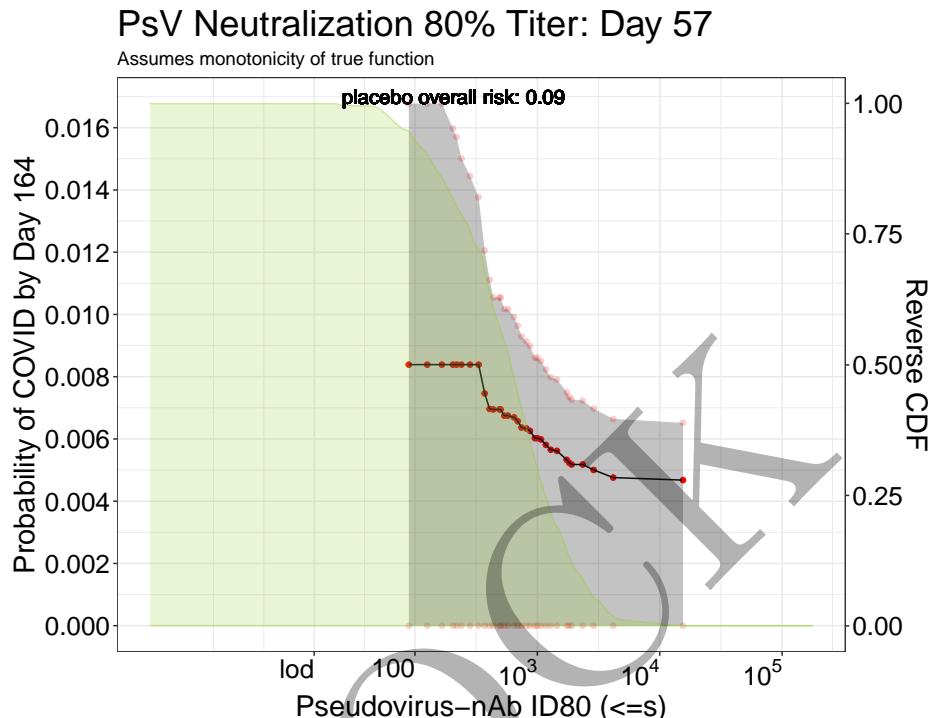


Figure 7.28: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.28: Table of monotone-corrected risk estimates for a range of thresholds of Day 57 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.954 | $8.99 * 10^1$ | 0.00839 | 0.00000 | 0.01714 |
| 2.220 | $1.66 * 10^2$ | 0.00839 | 0.00000 | 0.01692 |
| 2.335 | $2.16 * 10^2$ | 0.00839 | 0.00107 | 0.01570 |
| 2.455 | $2.85 * 10^2$ | 0.00839 | 0.00233 | 0.01445 |
| 2.644 | $4.41 * 10^2$ | 0.00695 | 0.00335 | 0.01054 |
| 2.699 | $5.00 * 10^2$ | 0.00695 | 0.00330 | 0.01059 |
| 2.764 | $5.81 * 10^2$ | 0.00675 | 0.00312 | 0.01037 |
| 2.874 | $7.48 * 10^2$ | 0.00637 | 0.00344 | 0.00930 |
| 2.981 | $9.57 * 10^2$ | 0.00602 | 0.00344 | 0.00861 |
| 3.000 | $1.00 * 10^3$ | 0.00602 | 0.00344 | 0.00861 |
| 3.162 | $1.45 * 10^3$ | 0.00562 | 0.00332 | 0.00791 |
| 3.265 | $1.84 * 10^3$ | 0.00524 | 0.00312 | 0.00735 |
| 3.371 | $2.35 * 10^3$ | 0.00518 | 0.00312 | 0.00723 |
| 4.187 | $1.54 * 10^4$ | 0.00468 | 0.00284 | 0.00652 |

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

MOCK

7.8.1 Day 29 Spike protein antibody

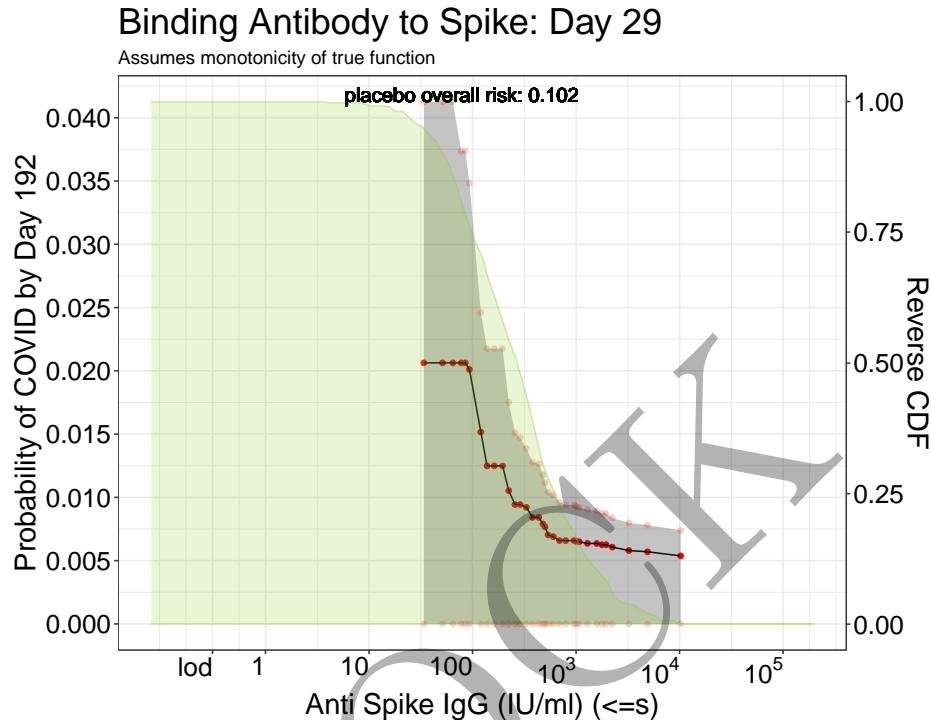


Figure 7.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.29: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Spike protein antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.532 | $3.40 * 10^1$ | 0.02063 | 0.00000 | 0.04805 |
| 1.805 | $6.38 * 10^1$ | 0.02063 | 0.00000 | 0.04565 |
| 1.927 | $8.45 * 10^1$ | 0.02063 | 0.00354 | 0.03772 |
| 2.081 | $1.21 * 10^2$ | 0.01516 | 0.00572 | 0.02460 |
| 2.351 | $2.24 * 10^2$ | 0.01053 | 0.00354 | 0.01752 |
| 2.522 | $3.33 * 10^2$ | 0.00921 | 0.00456 | 0.01387 |
| 2.677 | $4.75 * 10^2$ | 0.00790 | 0.00402 | 0.01179 |
| 2.699 | $5.00 * 10^2$ | 0.00767 | 0.00417 | 0.01116 |
| 2.841 | $6.93 * 10^2$ | 0.00659 | 0.00357 | 0.00961 |
| 3.000 | $1.00 * 10^3$ | 0.00653 | 0.00379 | 0.00928 |
| 3.112 | $1.29 * 10^3$ | 0.00637 | 0.00371 | 0.00902 |
| 3.252 | $1.79 * 10^3$ | 0.00626 | 0.00377 | 0.00874 |
| 3.348 | $2.23 * 10^3$ | 0.00607 | 0.00377 | 0.00838 |
| 4.007 | $1.02 * 10^4$ | 0.00538 | 0.00336 | 0.00740 |

7.8.2 Day 29 RBD binding antibody

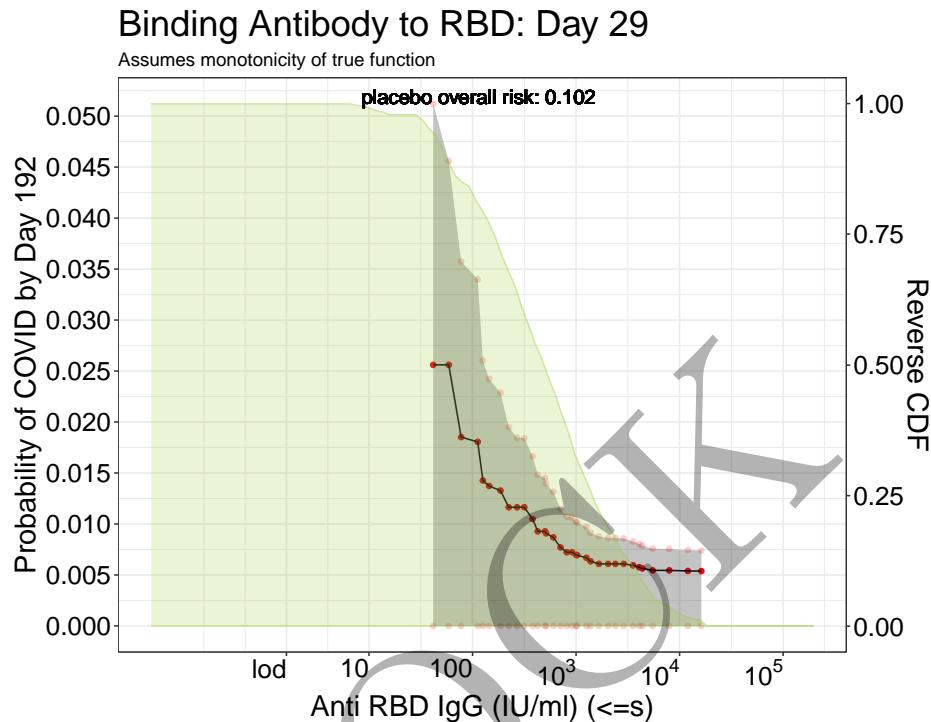


Figure 7.30: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.30: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 RBD binding antibody levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.620 | $4.17 * 10^1$ | 0.02560 | 0.00000 | 0.06044 |
| 1.892 | $7.80 * 10^1$ | 0.01852 | 0.00128 | 0.03576 |
| 2.098 | $1.25 * 10^2$ | 0.01426 | 0.00249 | 0.02603 |
| 2.273 | $1.87 * 10^2$ | 0.01327 | 0.00368 | 0.02287 |
| 2.575 | $3.76 * 10^2$ | 0.01048 | 0.00432 | 0.01664 |
| 2.699 | $5.00 * 10^2$ | 0.00927 | 0.00404 | 0.01451 |
| 2.780 | $6.03 * 10^2$ | 0.00868 | 0.00422 | 0.01314 |
| 2.960 | $9.12 * 10^2$ | 0.00723 | 0.00382 | 0.01063 |
| 3.000 | $1.00 * 10^3$ | 0.00697 | 0.00375 | 0.01020 |
| 3.144 | $1.39 * 10^3$ | 0.00634 | 0.00354 | 0.00914 |
| 3.461 | $2.89 * 10^3$ | 0.00609 | 0.00360 | 0.00858 |
| 3.610 | $4.07 * 10^3$ | 0.00576 | 0.00349 | 0.00804 |
| 3.736 | $5.45 * 10^3$ | 0.00545 | 0.00331 | 0.00758 |
| 4.211 | $1.63 * 10^4$ | 0.00538 | 0.00335 | 0.00740 |

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

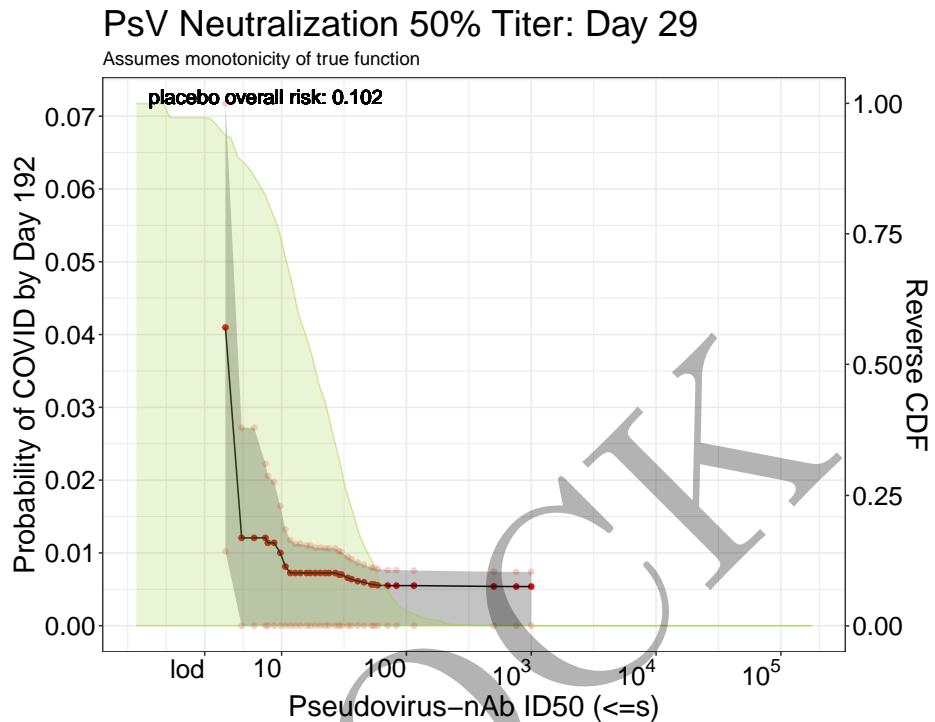


Figure 7.31: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.31: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (50% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 0.548 | $3.53 * 10^0$ | 0.04097 | 0.01021 | 0.07173 |
| 0.779 | $6.01 * 10^0$ | 0.01207 | 0.00000 | 0.02731 |
| 0.892 | $7.80 * 10^0$ | 0.01139 | 0.00219 | 0.02059 |
| 0.988 | $9.73 * 10^0$ | 0.01000 | 0.00356 | 0.01643 |
| 1.147 | $1.40 * 10^1$ | 0.00724 | 0.00318 | 0.01129 |
| 1.271 | $1.87 * 10^1$ | 0.00724 | 0.00376 | 0.01072 |
| 1.382 | $2.41 * 10^1$ | 0.00724 | 0.00386 | 0.01061 |
| 1.481 | $3.03 * 10^1$ | 0.00703 | 0.00392 | 0.01013 |
| 1.656 | $4.53 * 10^1$ | 0.00597 | 0.00356 | 0.00837 |
| 1.741 | $5.51 * 10^1$ | 0.00567 | 0.00338 | 0.00795 |
| 1.852 | $7.11 * 10^1$ | 0.00551 | 0.00337 | 0.00764 |
| 2.699 | $5.00 * 10^2$ | 0.00540 | 0.00337 | 0.00742 |
| 2.879 | $7.57 * 10^2$ | 0.00538 | 0.00336 | 0.00740 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00336 | 0.00740 |

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

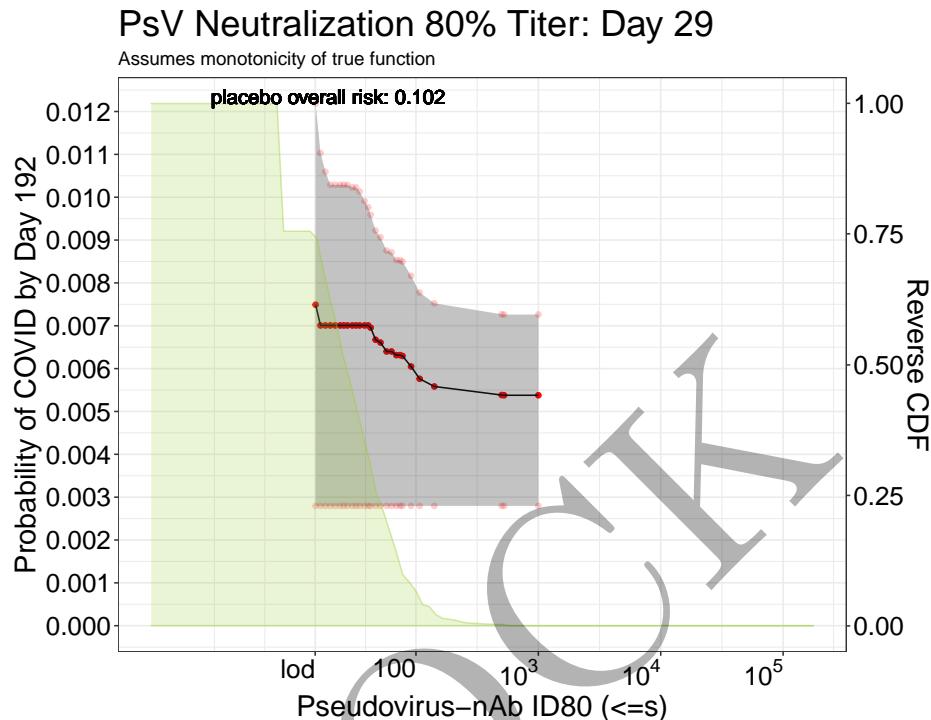


Figure 7.32: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals. The estimates and confidence intervals are adjusted using the assumption that the true threshold-response is nonincreasing.

Table 7.32: Table of monotone-corrected risk estimates for a range of thresholds of Day 29 Pseudo virus-neutralizing antibody (80% titer) levels with simultaneous 95% confidence intervals.

| \log_{10} -Threshold | Threshold | Risk estimate | CI left | CI right |
|------------------------|---------------|---------------|---------|----------|
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.183 | $1.52 * 10^1$ | 0.00749 | 0.00280 | 0.01219 |
| 1.339 | $2.18 * 10^1$ | 0.00701 | 0.00371 | 0.01030 |
| 1.440 | $2.75 * 10^1$ | 0.00701 | 0.00367 | 0.01034 |
| 1.541 | $3.48 * 10^1$ | 0.00701 | 0.00388 | 0.01013 |
| 1.632 | $4.29 * 10^1$ | 0.00696 | 0.00432 | 0.00959 |
| 1.796 | $6.25 * 10^1$ | 0.00640 | 0.00408 | 0.00872 |
| 1.868 | $7.38 * 10^1$ | 0.00631 | 0.00410 | 0.00853 |
| 1.956 | $9.04 * 10^1$ | 0.00605 | 0.00393 | 0.00817 |
| 2.699 | $5.00 * 10^2$ | 0.00538 | 0.00350 | 0.00727 |
| 2.719 | $5.24 * 10^2$ | 0.00538 | 0.00349 | 0.00726 |
| 3.000 | $1.00 * 10^3$ | 0.00538 | 0.00349 | 0.00726 |

Chapter 8

Day 57 Univariate CoR: Nonlinear modeling

To explore nonlinear association and threshold modeling, we fit smoothing spline models using the mgcv R package and two-phase models using the chngpt R package.

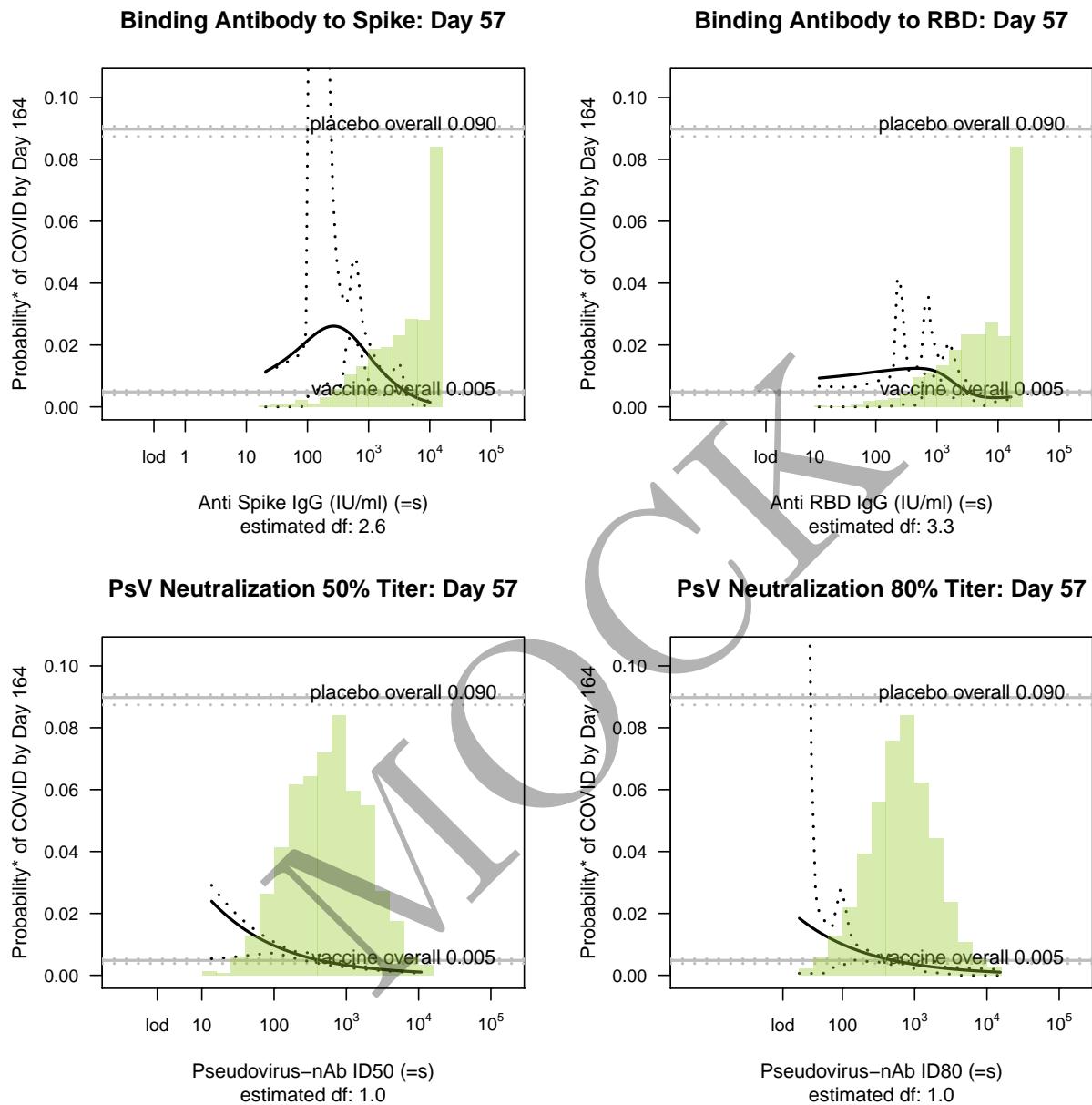


Figure 8.1: Marginalized risk as functions of Day 57 markers ($=s$) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates) as modeled by GAM with automatic smoothness estimation. Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization criterion for being at heightened risk of COVID (yes or no), community of color or not. The horizontal lines indicate the overall cumulative risk of the vaccine and placebo arms by Day 164 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

Chapter 9

Day 29 Univariate CoR: Nonlinear modeling

To explore nonlinear association and threshold modeling, we fit smoothing spline models using the mgcv R package and two-phase models using the chngpt R package.

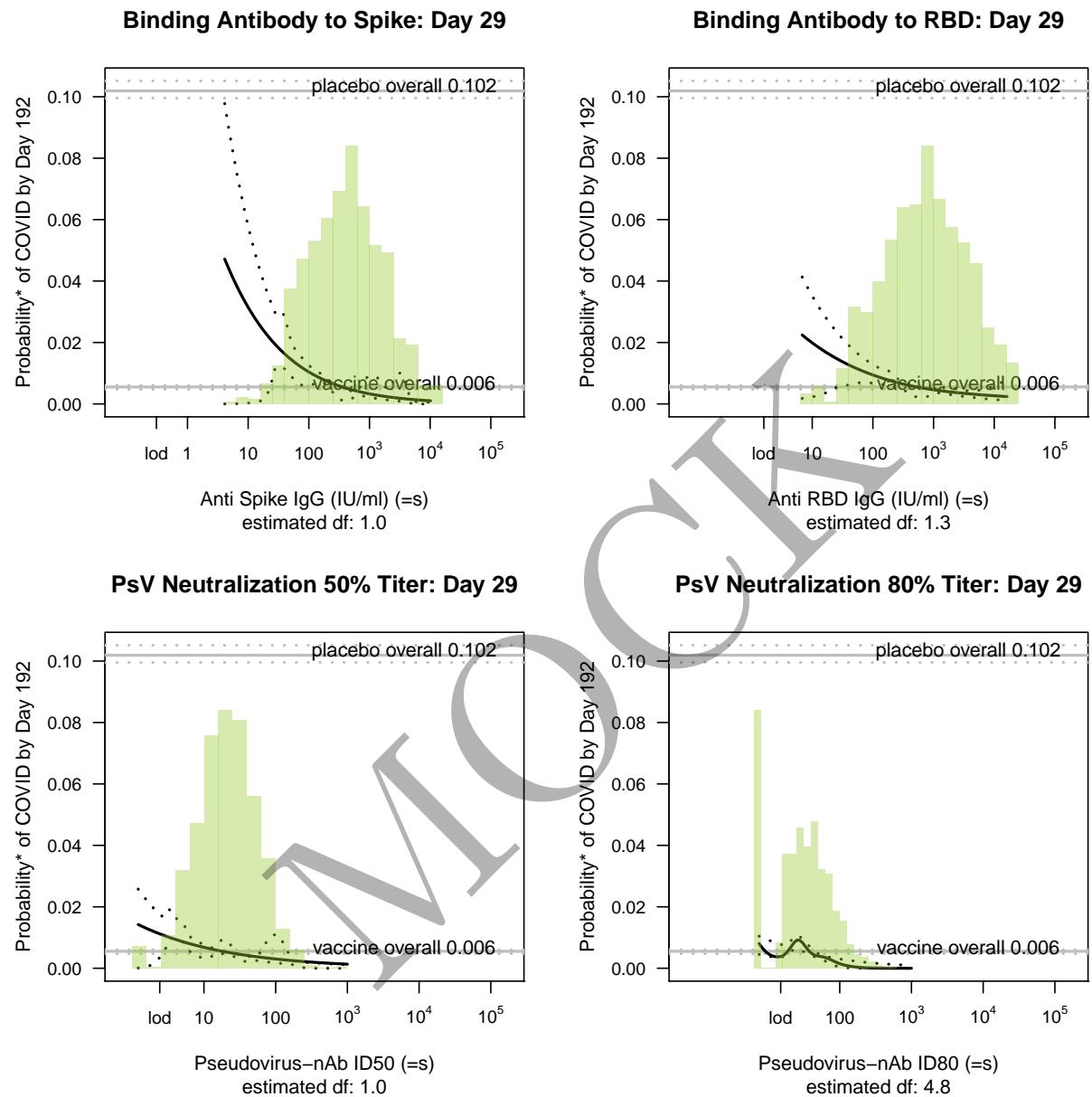


Figure 9.1: Marginalized risk as functions of Day 29 markers ($=s$) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (5 replicates) as modeled by GAM with automatic smoothness estimation. Baseline covariates adjusted for: baseline risk score, meeting the protocol randomization criterion for being at heightened risk of COVID (yes or no), community of color or not. The horizontal lines indicate the overall cumulative risk of the vaccine and placebo arms by Day 192 and its 95% point-wise confidence interval. Histograms of the immunological markers in the vaccine arm are overlaid. lod = 0.3, 1.6, 2.4, 15 for bAb Spike, bAb RBD, PsV nAb ID50, PsV nAb ID80, respectively.

Chapter 10

Mediators of Vaccine Efficacy

Table 10.1: Table of mediation effect estimates for quantitative markers with 95% confidence intervals.
Direct VE = VE comparing vaccine vs. placebo with marker set to distribution in placebo.

Indirect VE = VE in vaccinated comparing observed marker vs. hypothetical marker under placebo.

Prop. mediated = fraction of total risk reduction from vaccine attributed to antibody response.

| Time | Assay | Direct VE | Indirect VE | Prop. mediated |
|--------|------------------------------|----------------------|----------------------|----------------------|
| Day 29 | PsV Neutralization 80% Titer | 0.906 (0.846, 0.943) | 0.402 (0.066, 0.617) | 0.179 (0.024, 0.333) |

Table 10.2: Table of mediation effect estimates for tertile markers with 95% confidence intervals.

Direct VE = VE comparing vaccine vs. placebo with marker set to distribution in placebo.

Indirect VE = VE in vaccinated comparing observed marker vs. hypothetical marker under placebo.

Prop. mediated = fraction of total risk reduction from vaccine attributed to antibody response.

| Time | Assay | Direct VE | Indirect VE | Prop. mediated |
|--------|------------------------------|----------------------|----------------------|----------------------|
| Day 29 | PsV Neutralization 80% Titer | 0.914 (0.869, 0.943) | 0.349 (0.051, 0.553) | 0.149 (0.020, 0.278) |

MOCK

Chapter 11

Appendix

- This report was built from the [CoVPN/correlates_reporting](#) repository with commit hash dd76377a281f689685f2b7b2cf55eb12c48b19d9. A diff of the changes introduced by that commit may be viewed at https://github.com/CoVPN/correlates_reporting/commit/dd76377a281f689685f2b7b2cf55eb12c48b19d9
- The sha256 hash sum of the raw input file, “COVID_VEtiral_practicedata_primarystage1.csv”: 83d0f55d1745ffd42be124d8f9ec9a9903abcc13cd22f95e537542a08b41300a
- The sha256 hash sum of the processed file, “moderna_mock_data_processed.csv”: 28964ce20cfcd70a621aff9df412c42b11