

# COVID-19 Correlates of Risk Analysis Report

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# Chapter 1

## Graphical Description of Antibody Marker Data

### 1.1 Boxplots

1.1.1 Baseline seronegative

1.1.2 Baseline seropositive

### 1.2 Weighted RCDF plots

1.2.1 Baseline seronegative

1.2.2 Baseline seropositive

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

1.3.1 Baseline seronegative

1.3.2 Baseline seropositive

### 1.4 Spaghetti plots

### 1.5 Violin and line plots

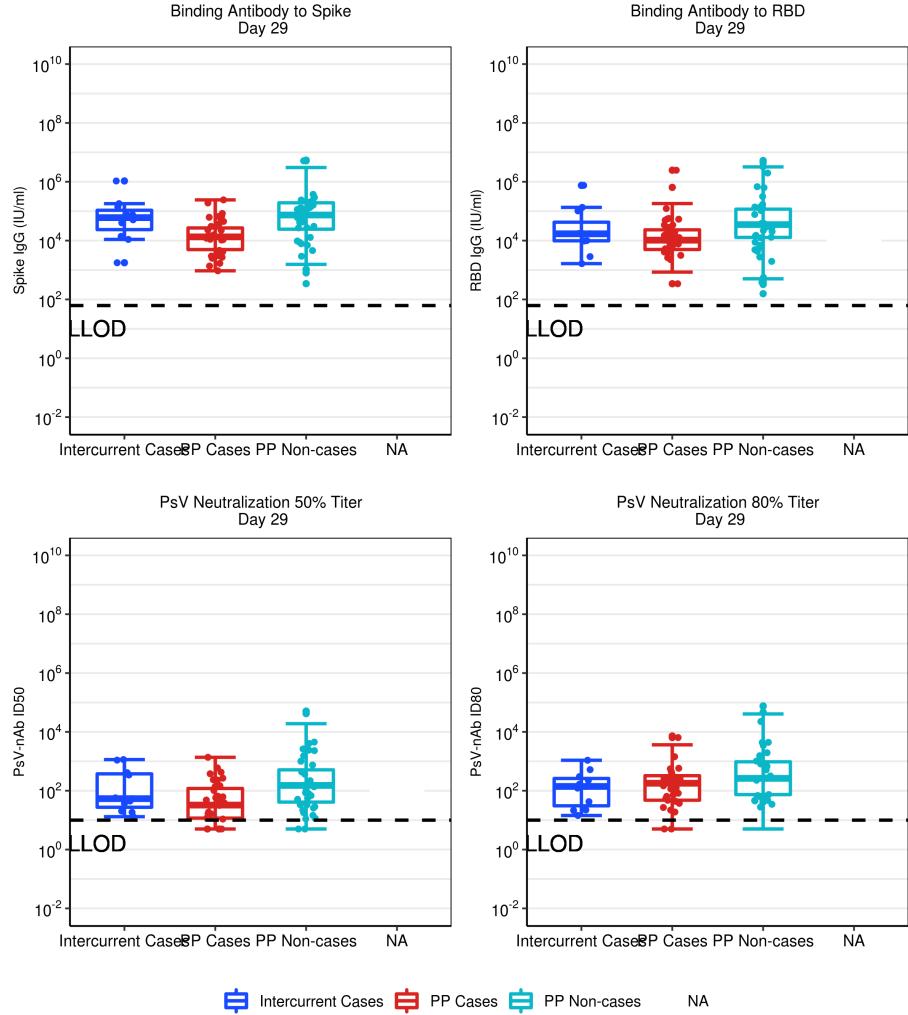


Figure 1.1: (Mock data) Boxplots of D29 Ab markers: baseline negative vaccine arm by event status

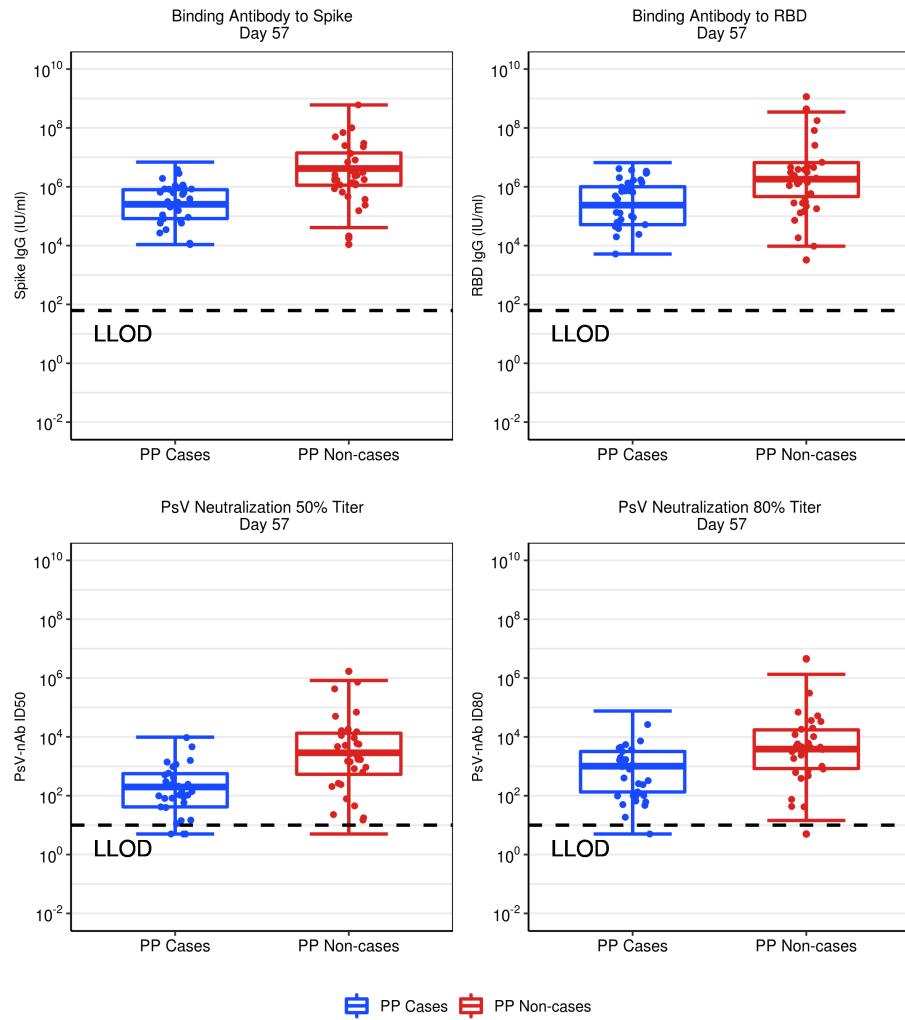


Figure 1.2: (Mock data) Boxplots of D57 Ab markers: baseline negative vaccine arm by event status

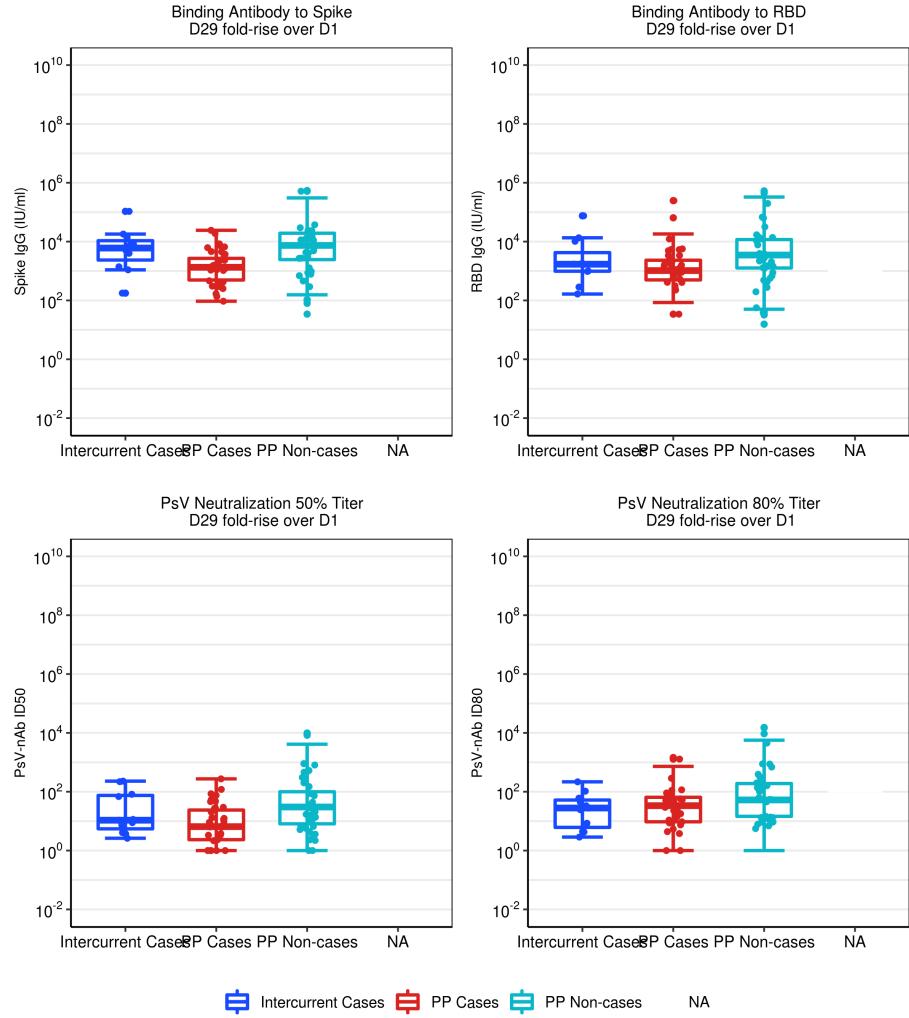


Figure 1.3: (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status

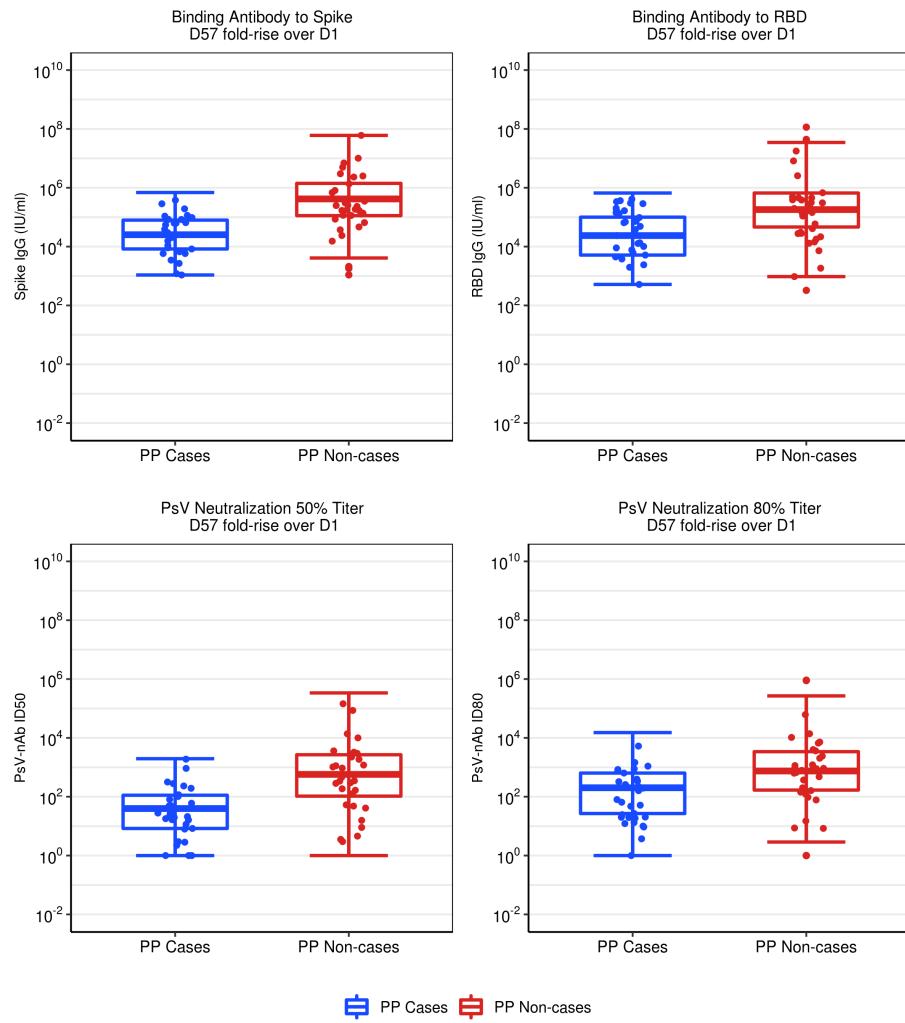


Figure 1.4: (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline negative vaccine arm by event status

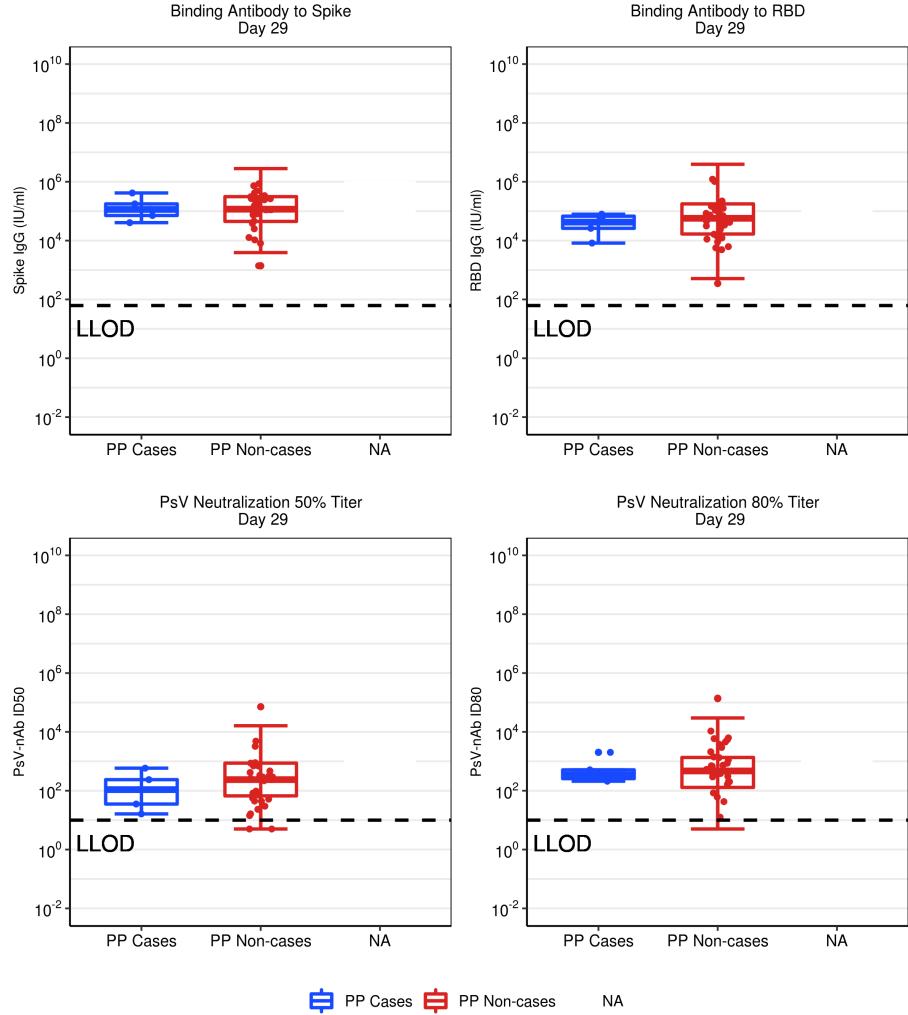


Figure 1.5: (Mock data) Boxplots of D29 Ab markers: baseline positive vaccine arm by event status

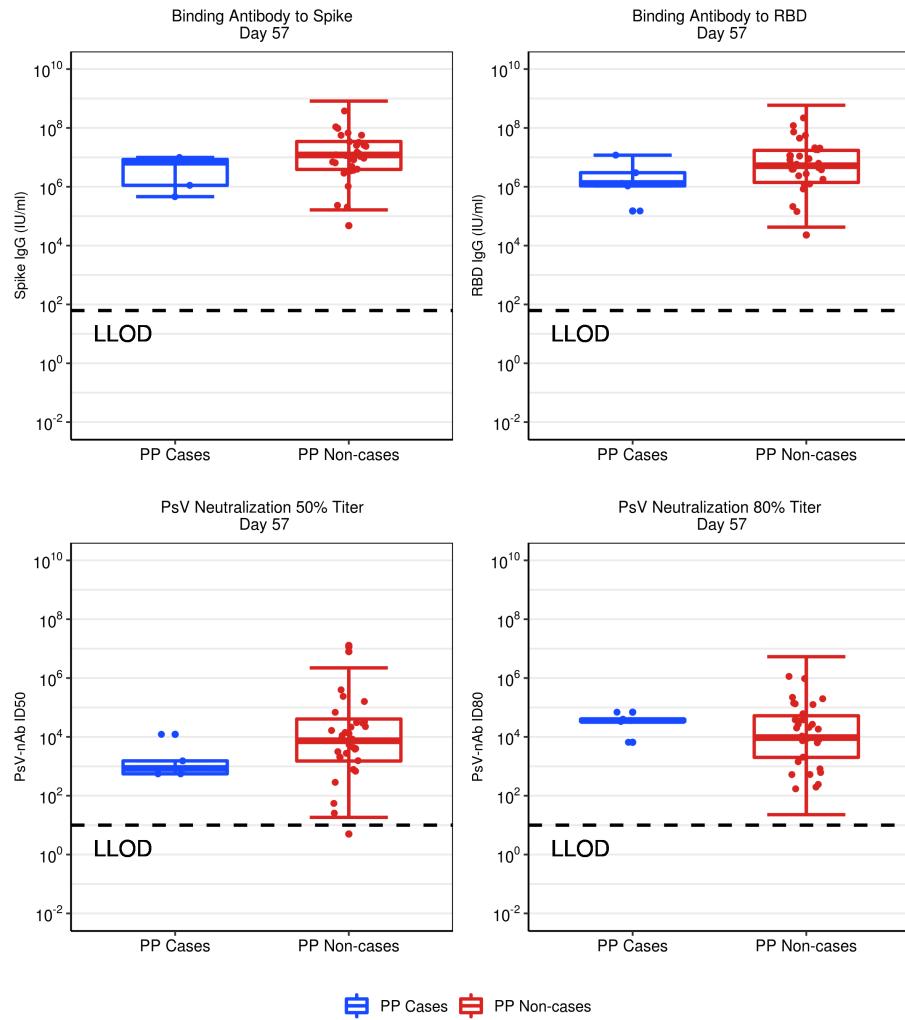


Figure 1.6: (Mock data) Boxplots of D57 Ab markers: baseline positive vaccine arm by event status

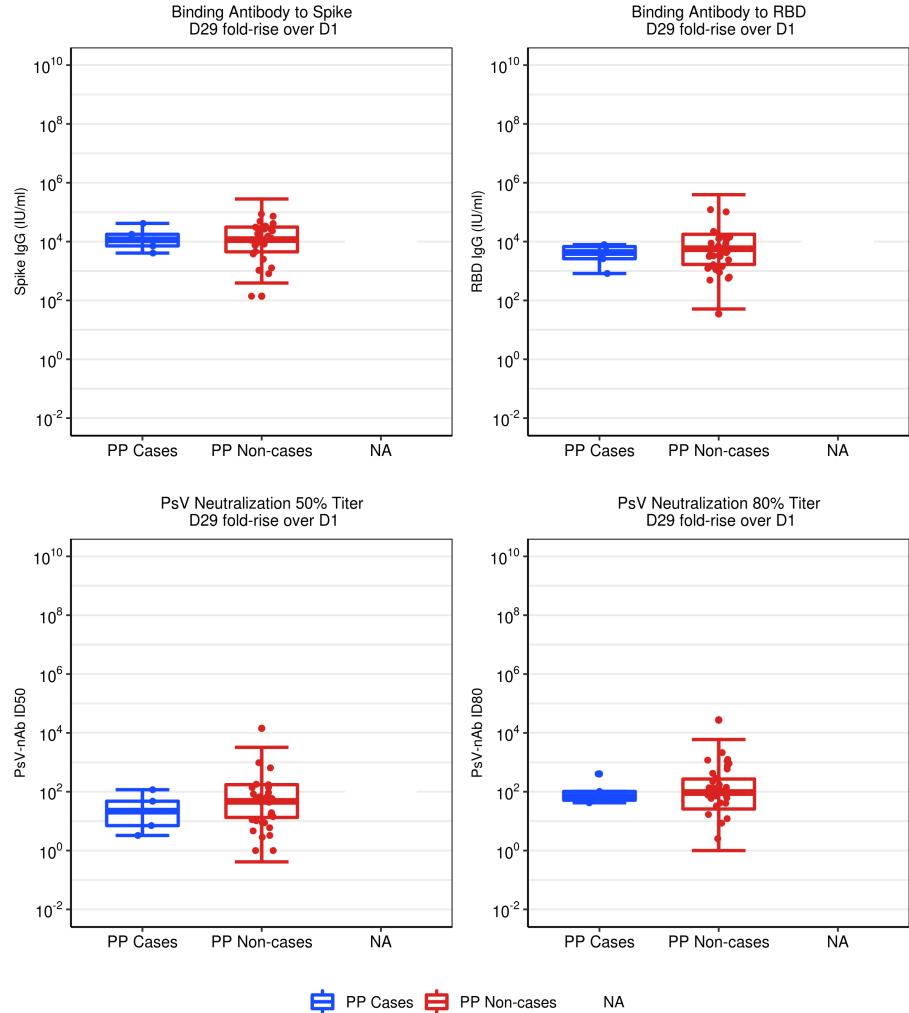


Figure 1.7: (Mock data) Boxplots of D29 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status

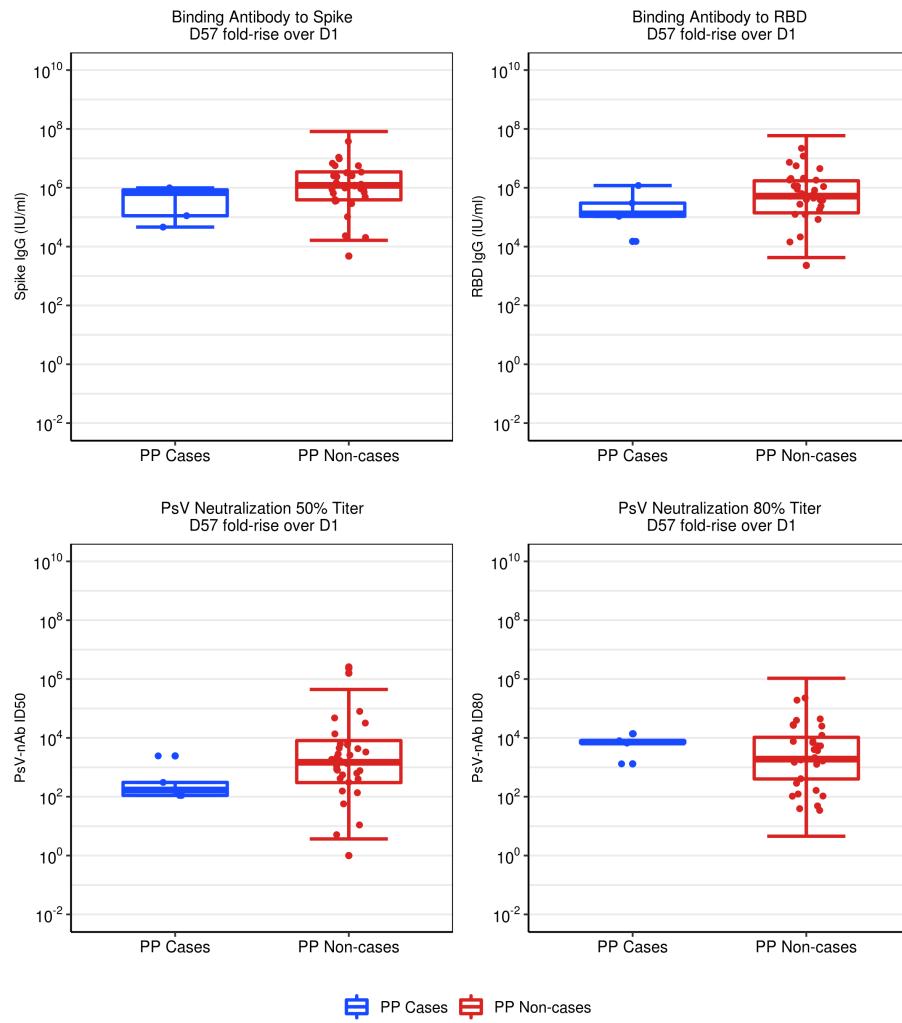


Figure 1.8: (Mock data) Boxplots of D57 fold-rise over D1 Ab markers: baseline positive vaccine arm by event status

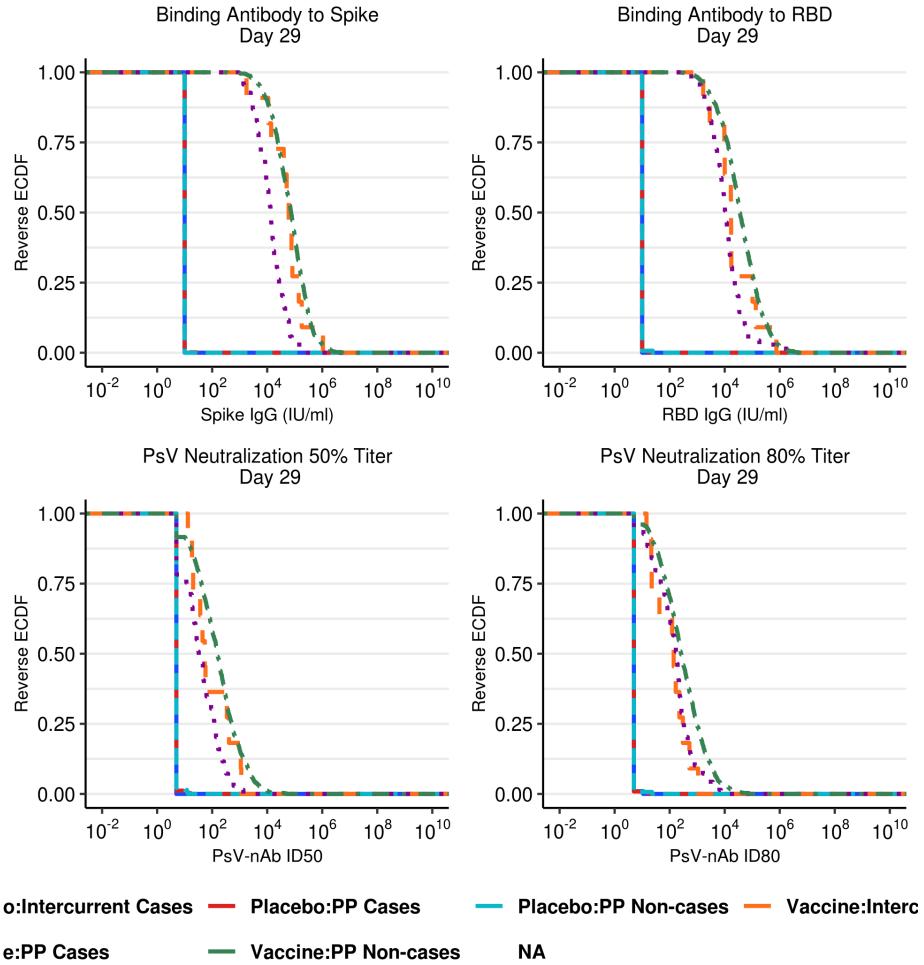


Figure 1.9: (Mock data) RCDF plots for D29 Ab markers: baseline negative by treatment arm and event status.

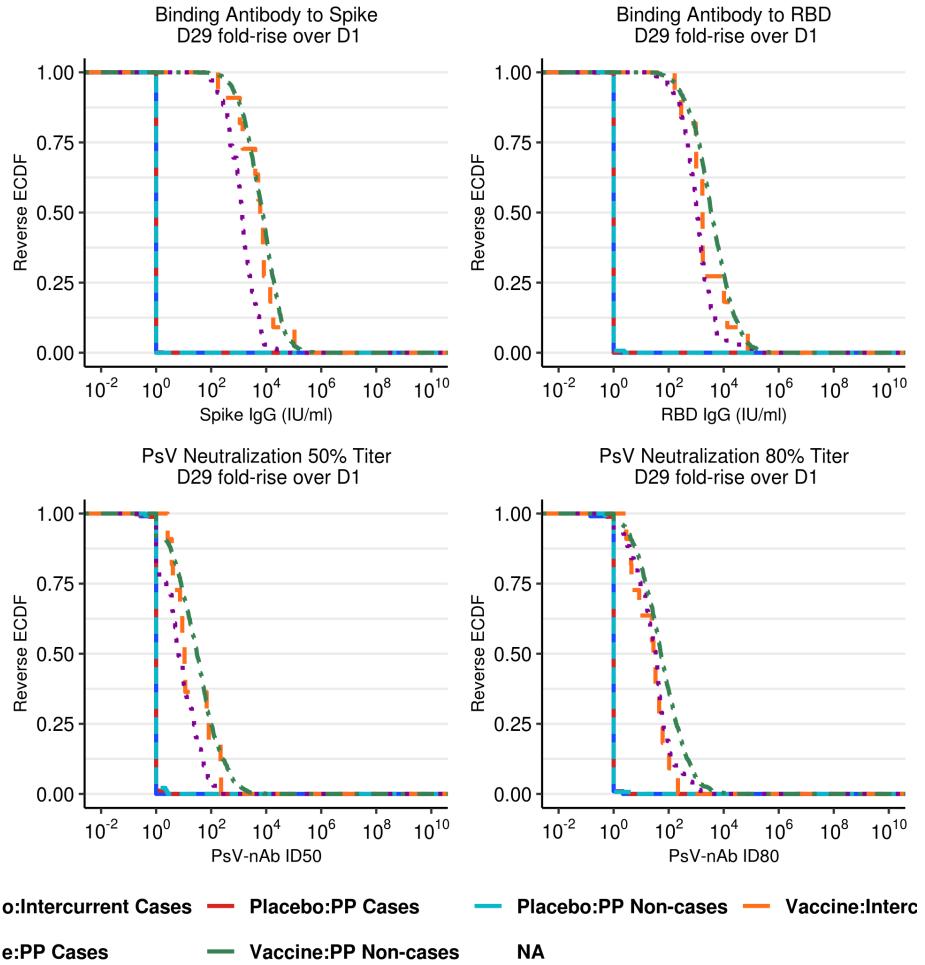


Figure 1.10: (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline negative by treatment arm and D29 event status.

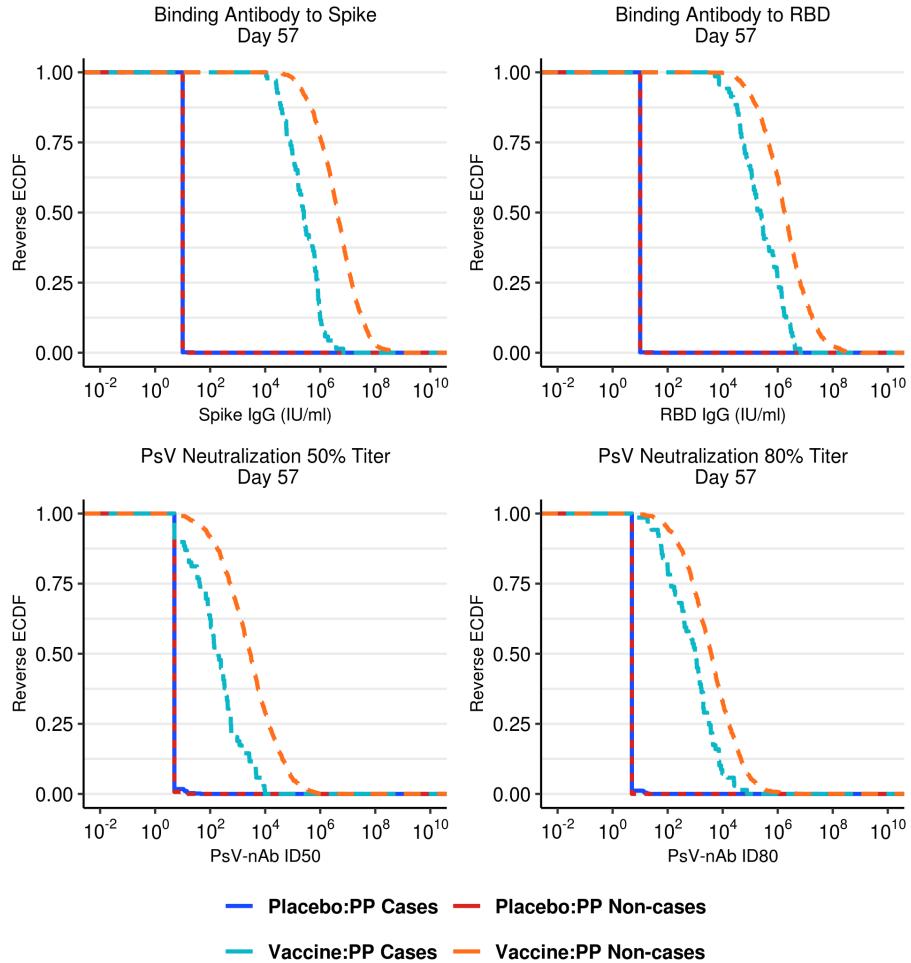


Figure 1.11: (Mock data) RCDF plots for D57 Ab markers: baseline negative by treatment arm and D57 event status.

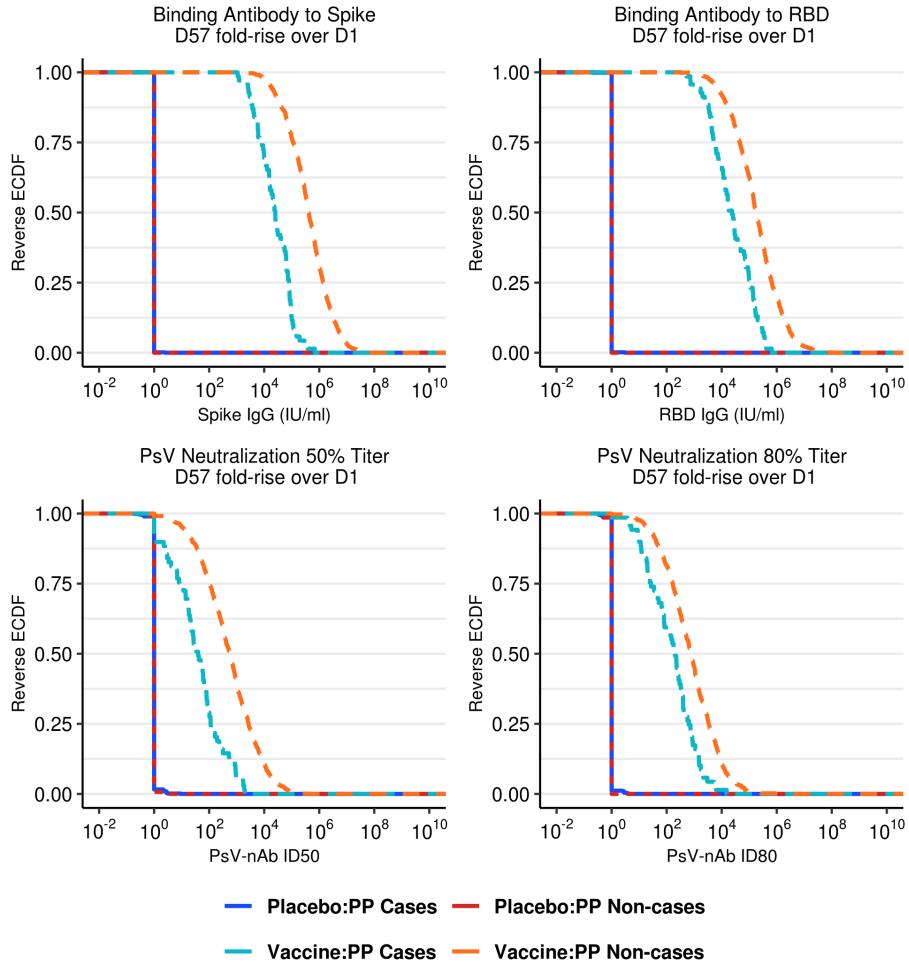


Figure 1.12: (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline negative by treatment arm and D57 event status.

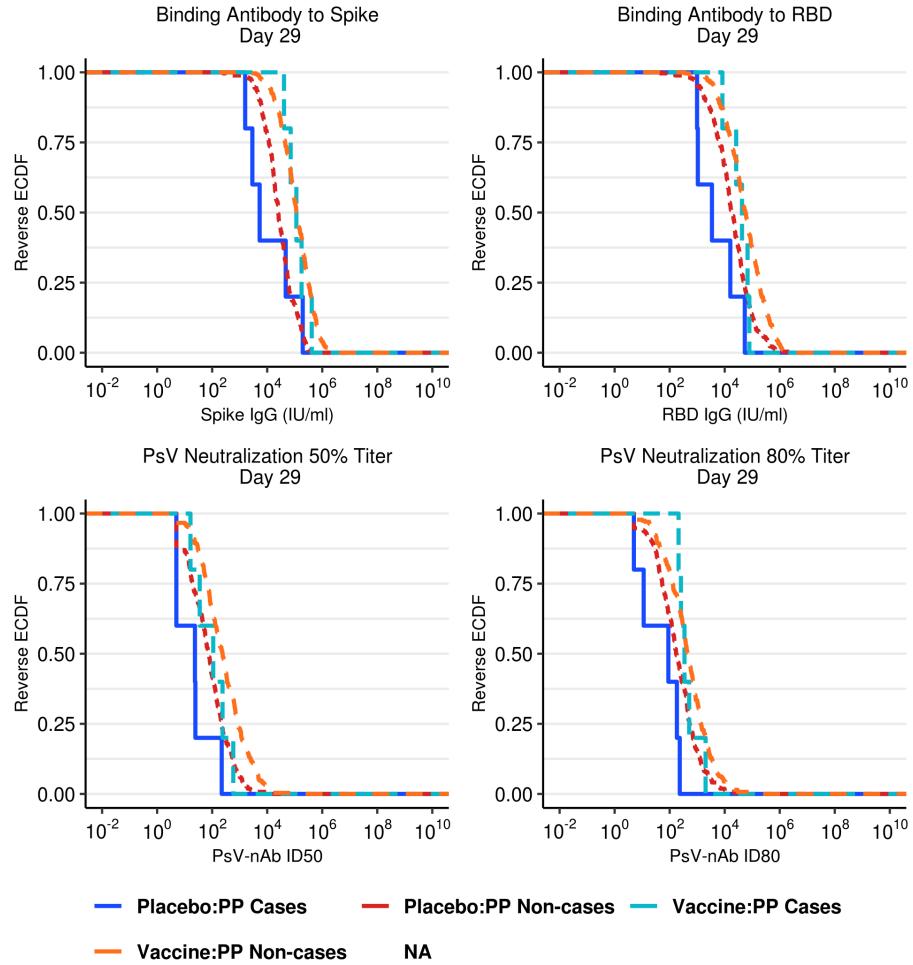


Figure 1.13: (Mock data) RCDF plots for D29 Ab markers: baseline positive by treatment arm and event status.

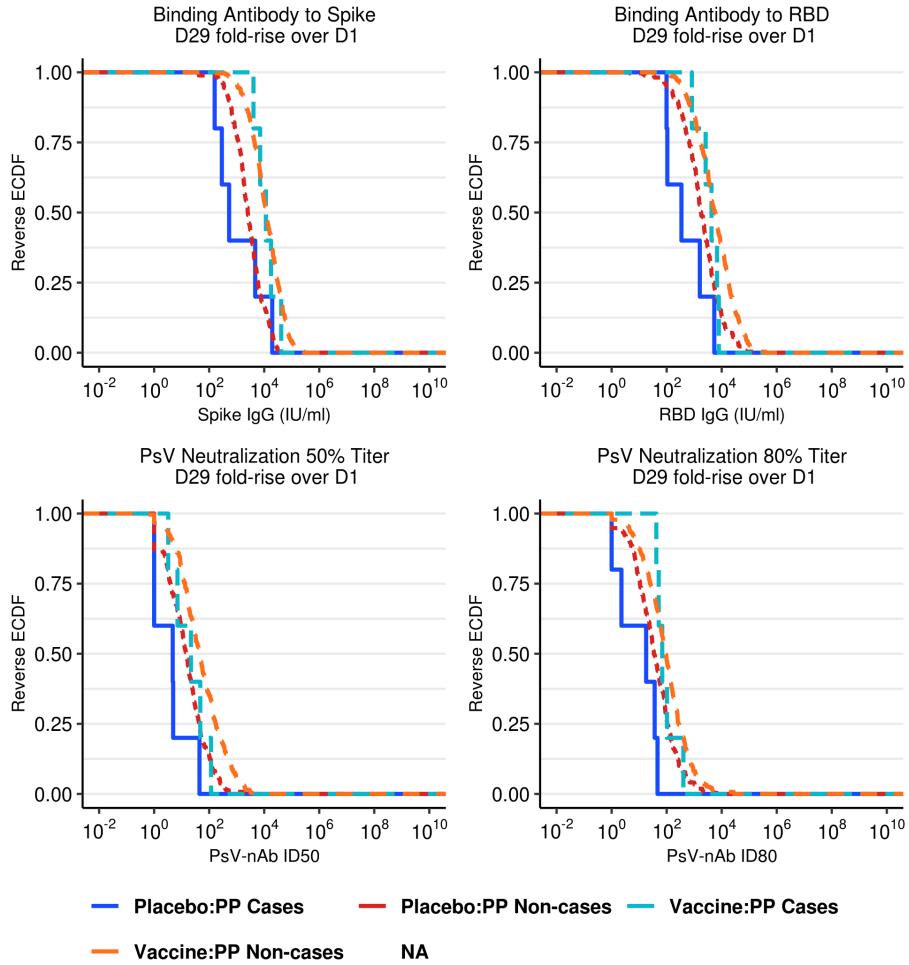


Figure 1.14: (Mock data) RCDF plots for D29 fold-rise over D1 Ab markers: baseline positive by treatment arm and D29 event status.

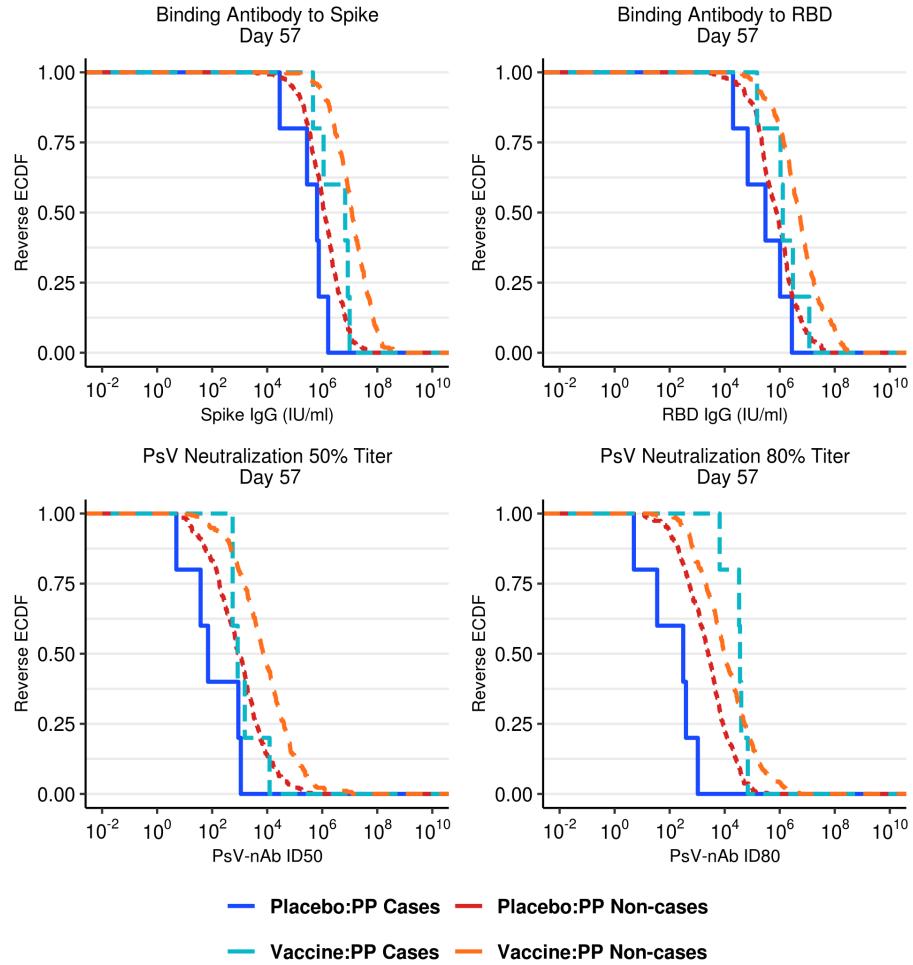


Figure 1.15: (Mock data) RCDF plots for D57 Ab markers: baseline positive by treatment arm and D57 event status.

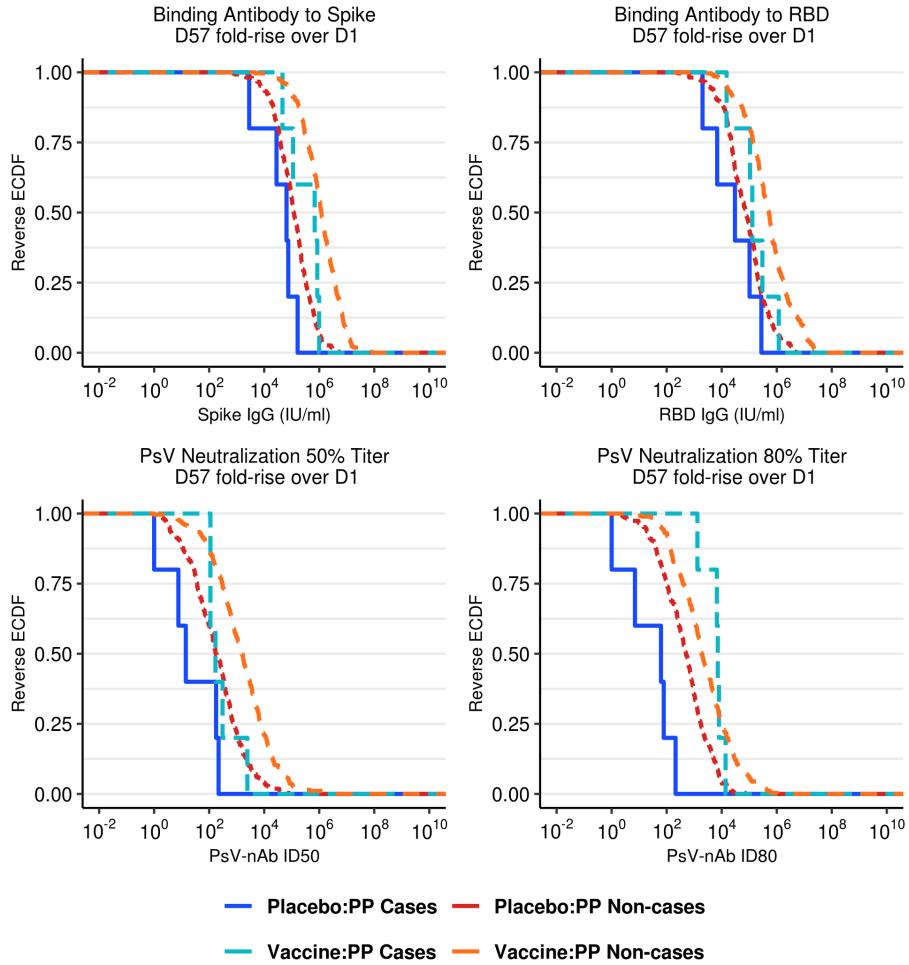


Figure 1.16: (Mock data) RCDF plots for D57 fold-rise over D1 Ab markers: baseline positive by treatment arm and D57 event status.

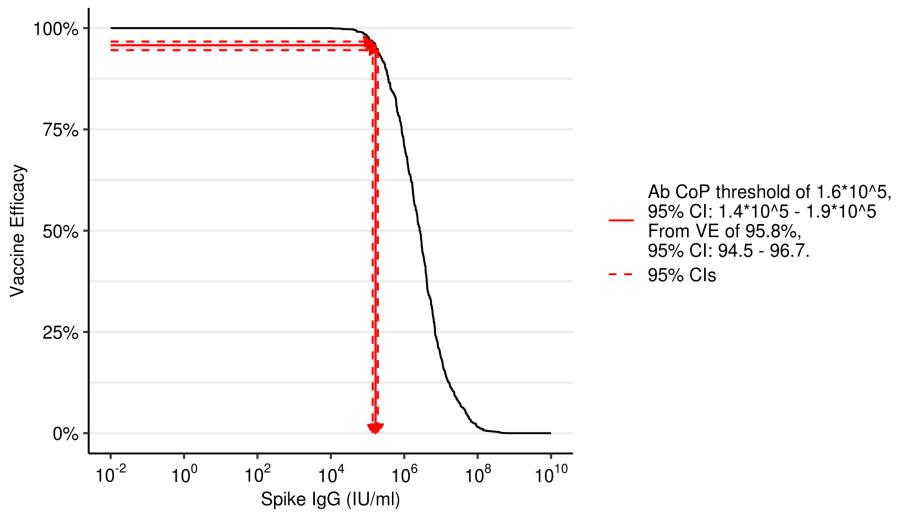


Figure 1.17: (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline negative vaccine arm

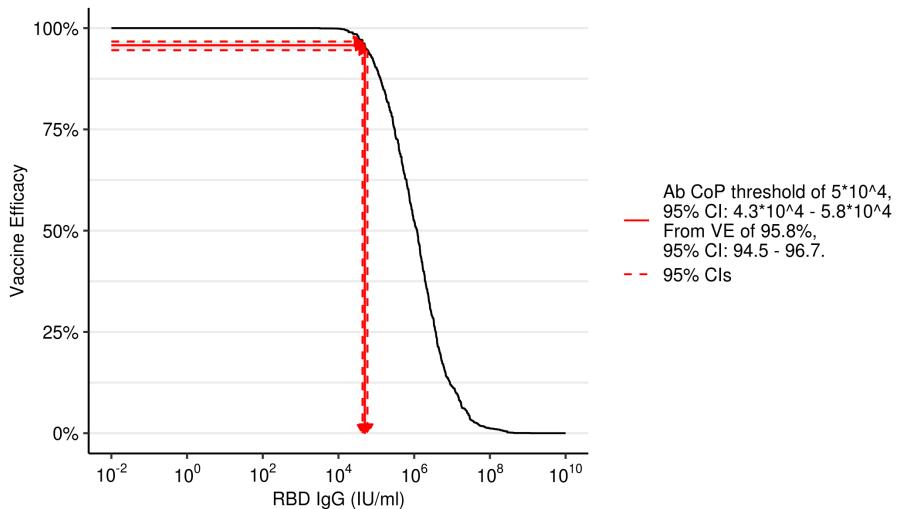


Figure 1.18: (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline negative vaccine arm

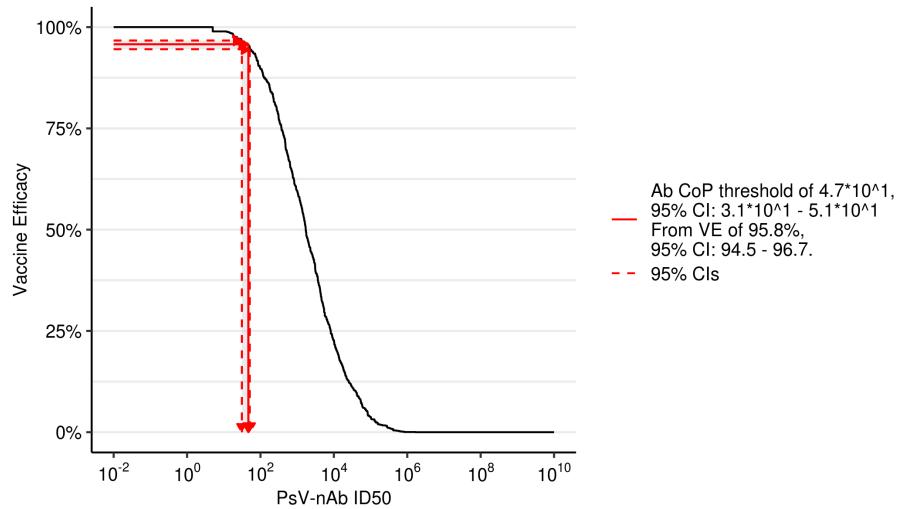


Figure 1.19: (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline negative vaccine arm

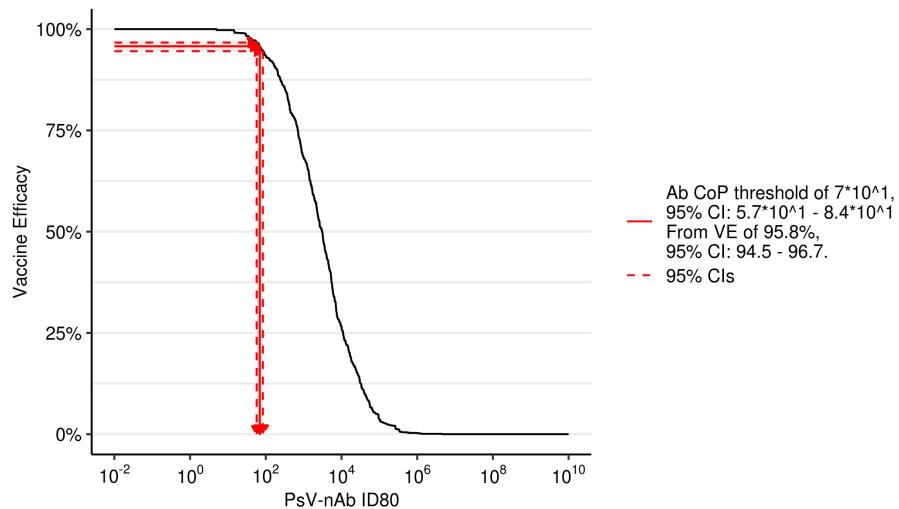


Figure 1.20: (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline negative vaccine arm

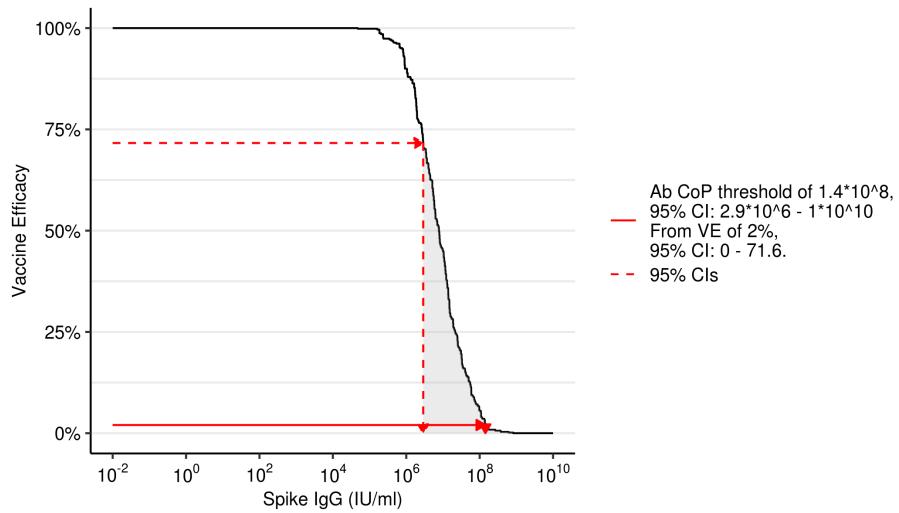


Figure 1.21: (Mock data) Marker RCDF of D57 anti-Spike binding Ab: baseline positive vaccine arm

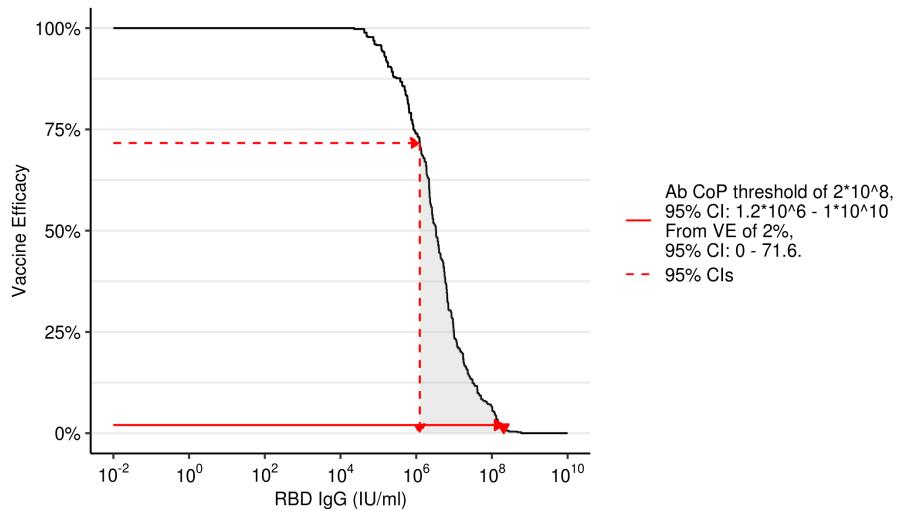


Figure 1.22: (Mock data) Marker RCDF of D57 anti-RBD binding Ab: baseline positive vaccine arm

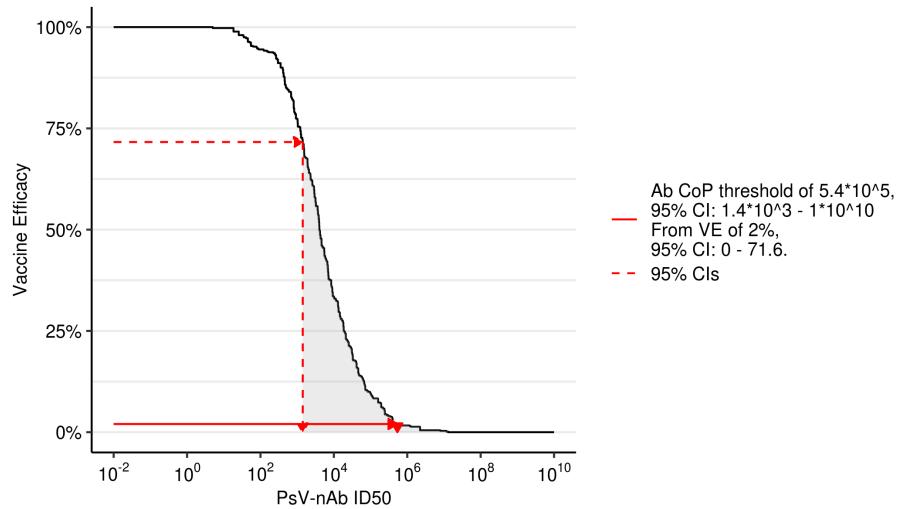


Figure 1.23: (Mock data) Marker RCDF of D57 PsV-nAb ID50: baseline positive vaccine arm

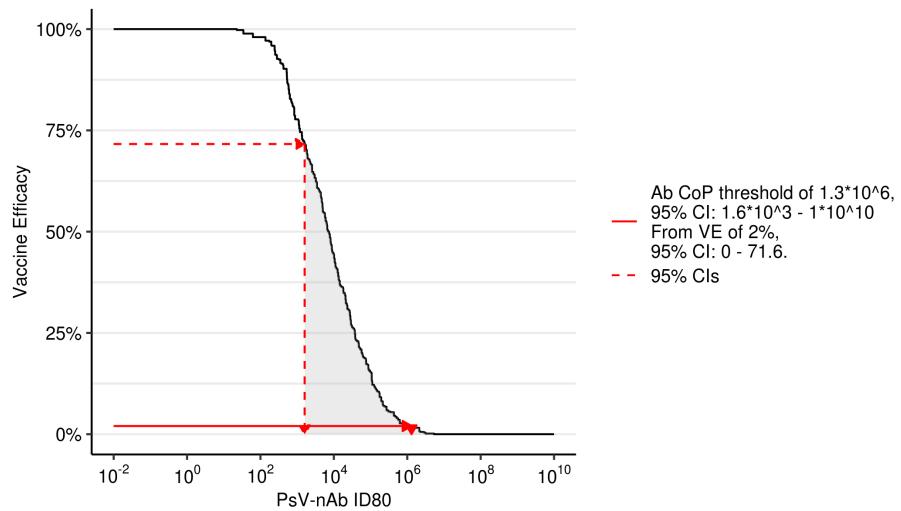


Figure 1.24: (Mock data) Marker RCDF of D57 PsV-nAb ID80: baseline positive vaccine arm

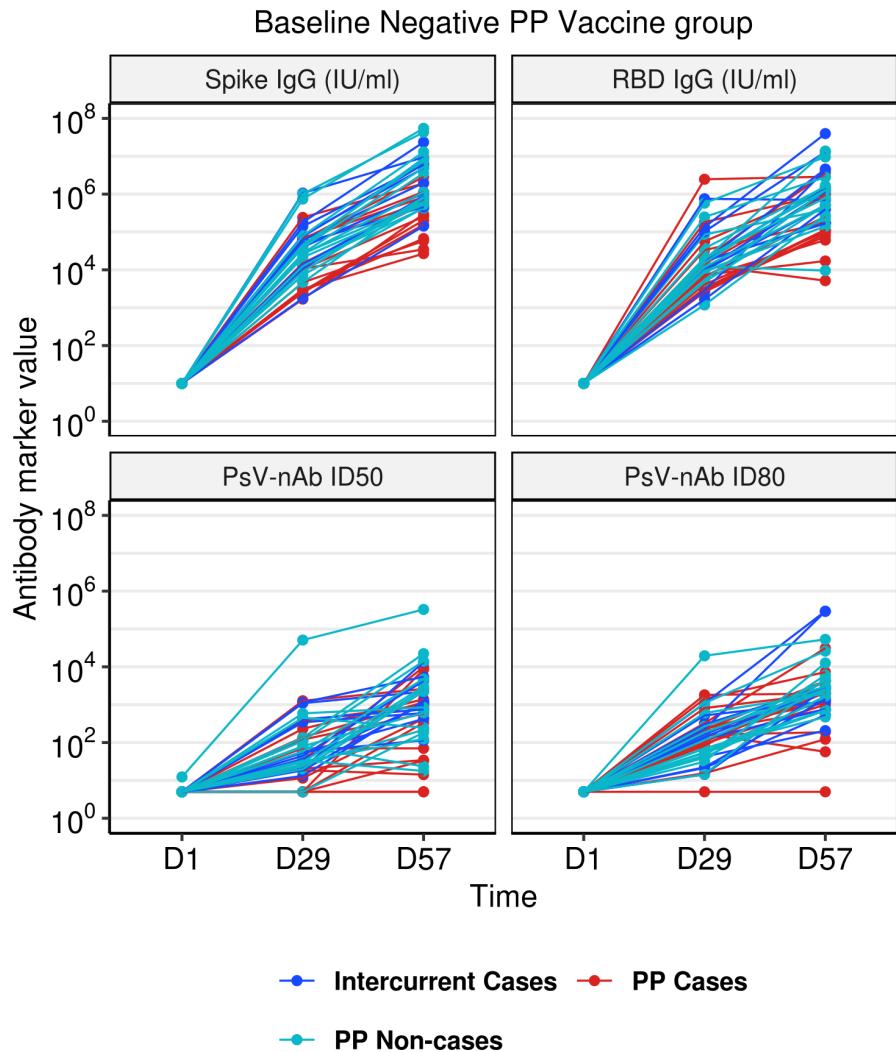


Figure 1.25: (Mock data) Spaghetti Plots of Marker Trajectory: baseline negative vaccine arm

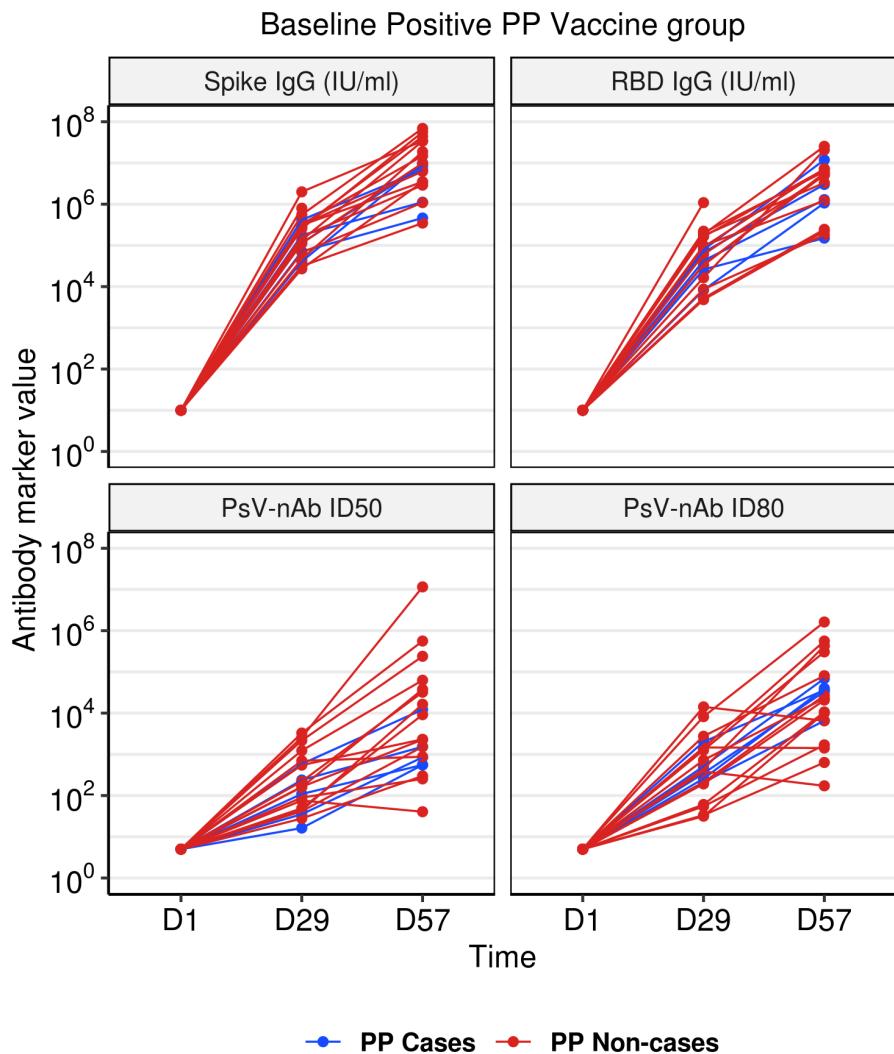


Figure 1.26: (Mock data) Spaghetti Plots of Marker Trajectory: baseline positive vaccine arm

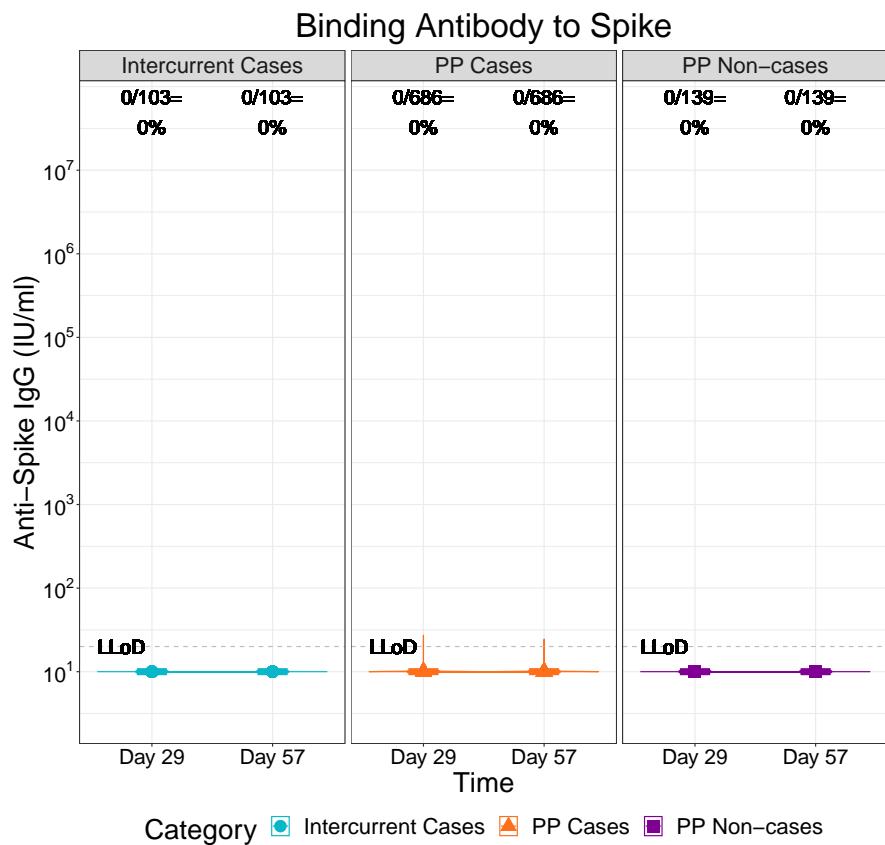


Figure 1.27: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints)

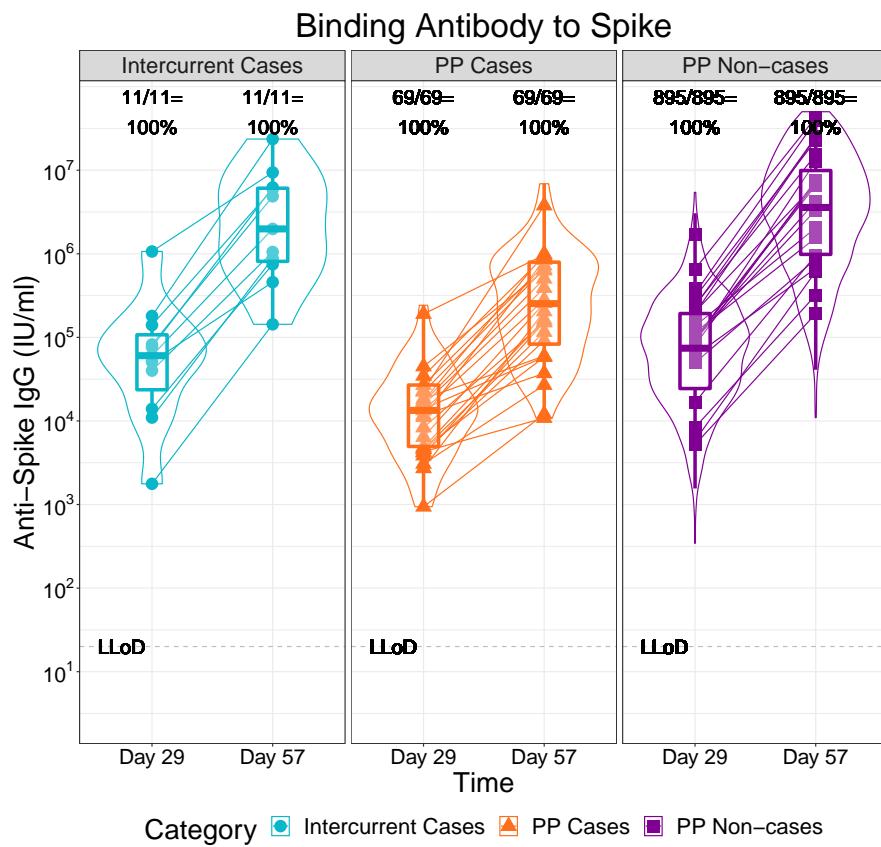


Figure 1.28: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints)

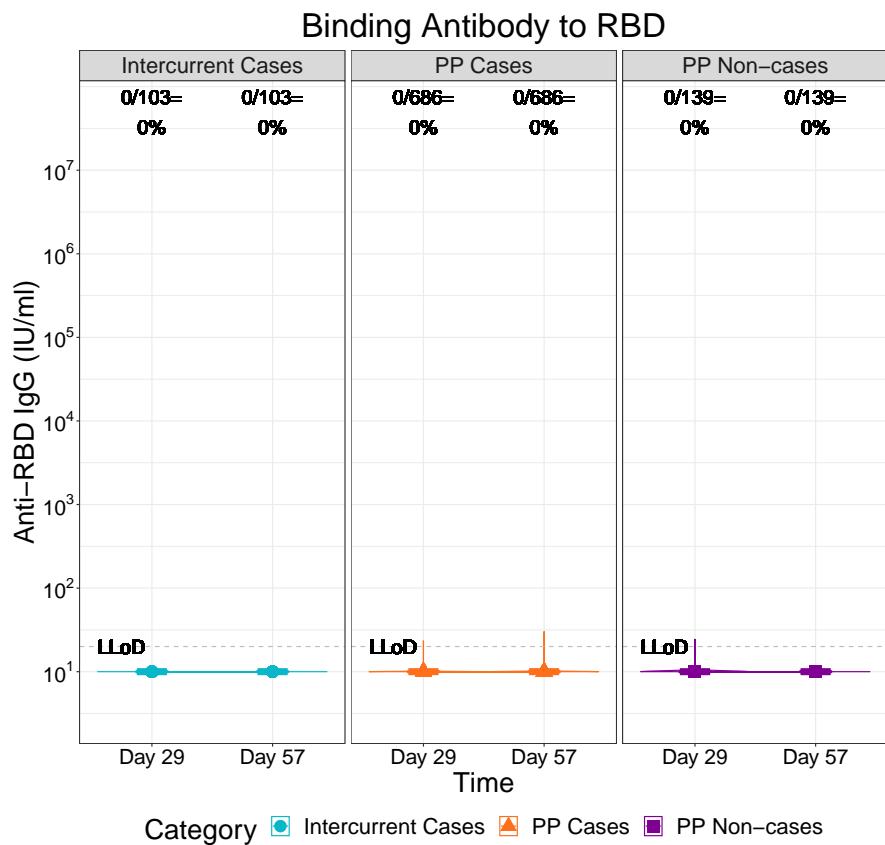


Figure 1.29: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints)

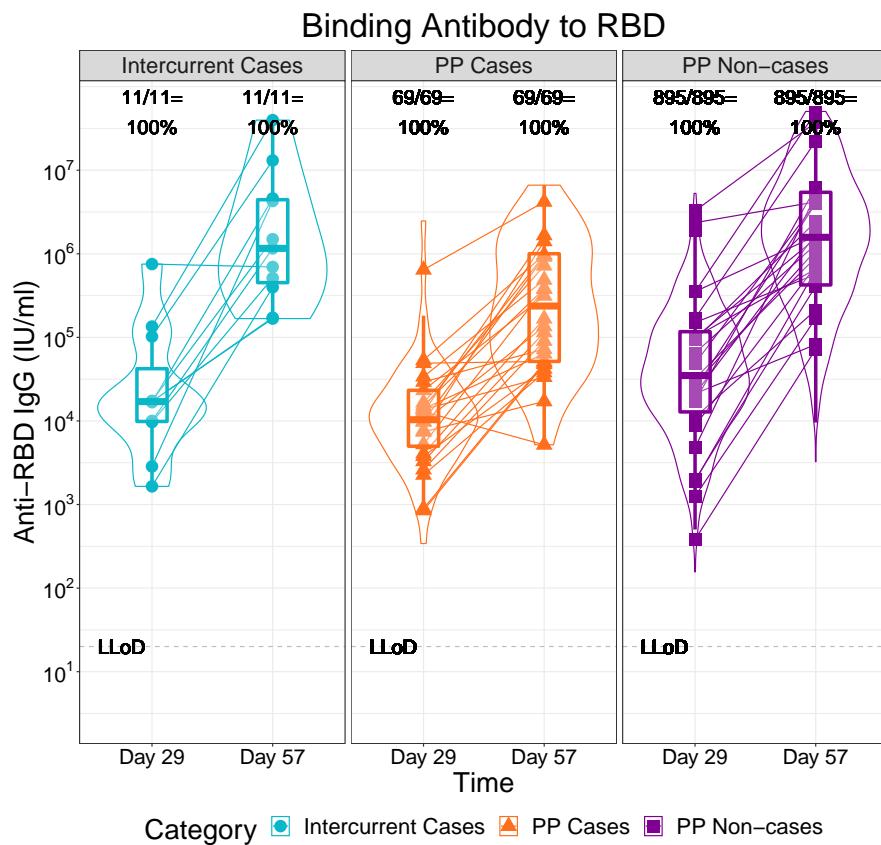


Figure 1.30: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints)

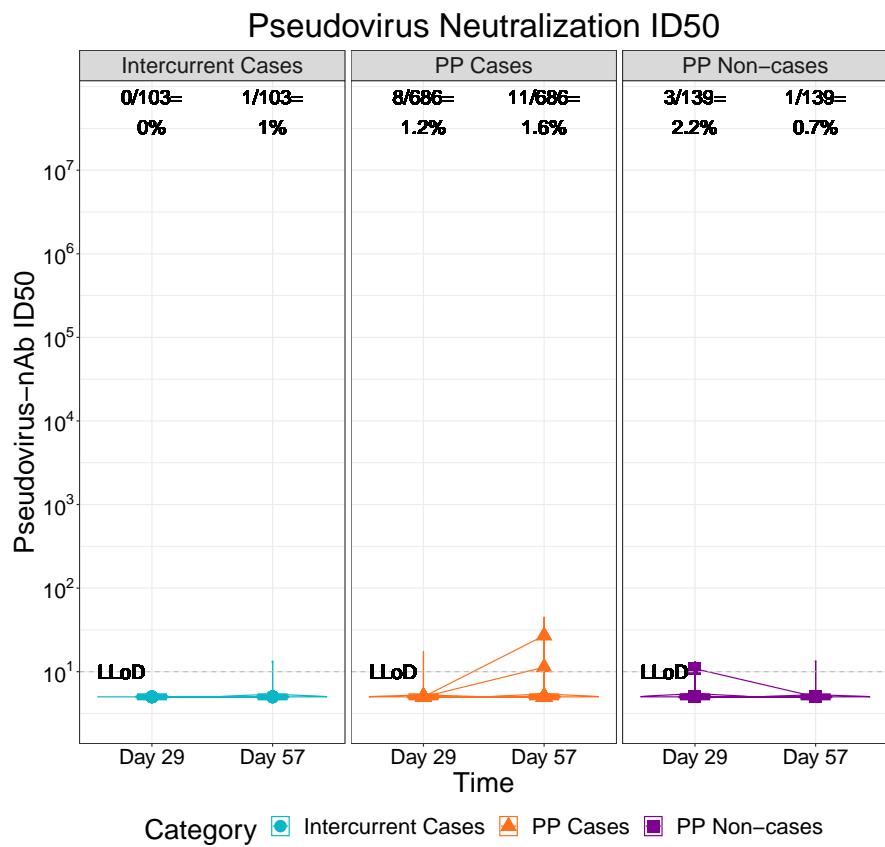


Figure 1.31: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints)

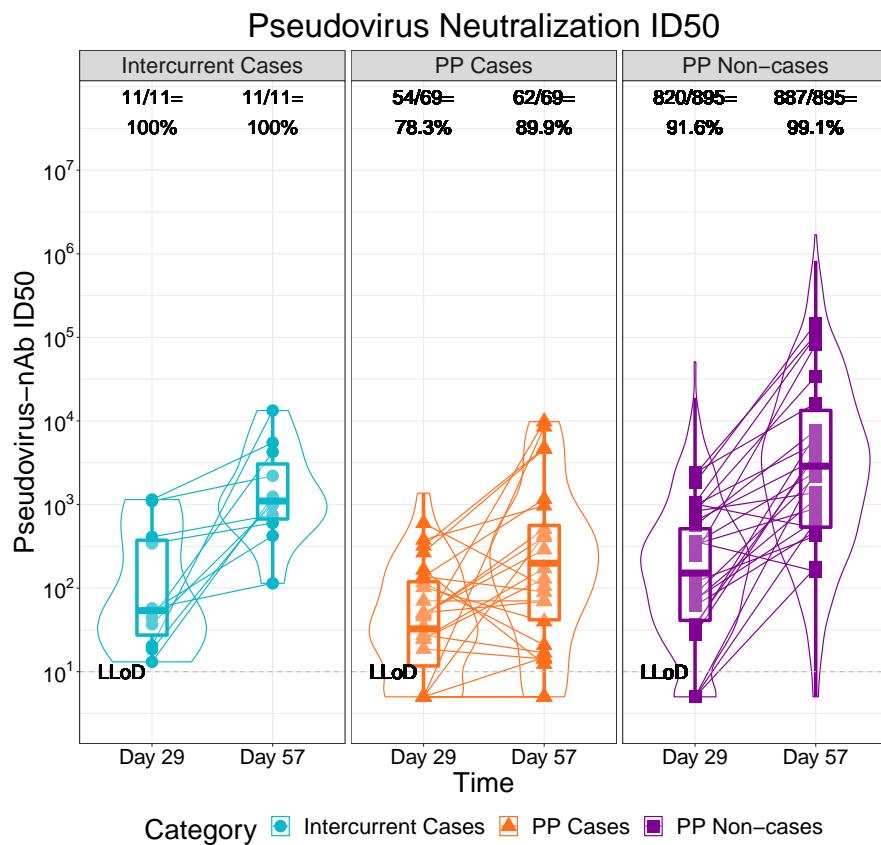


Figure 1.32: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (2 timepoints)

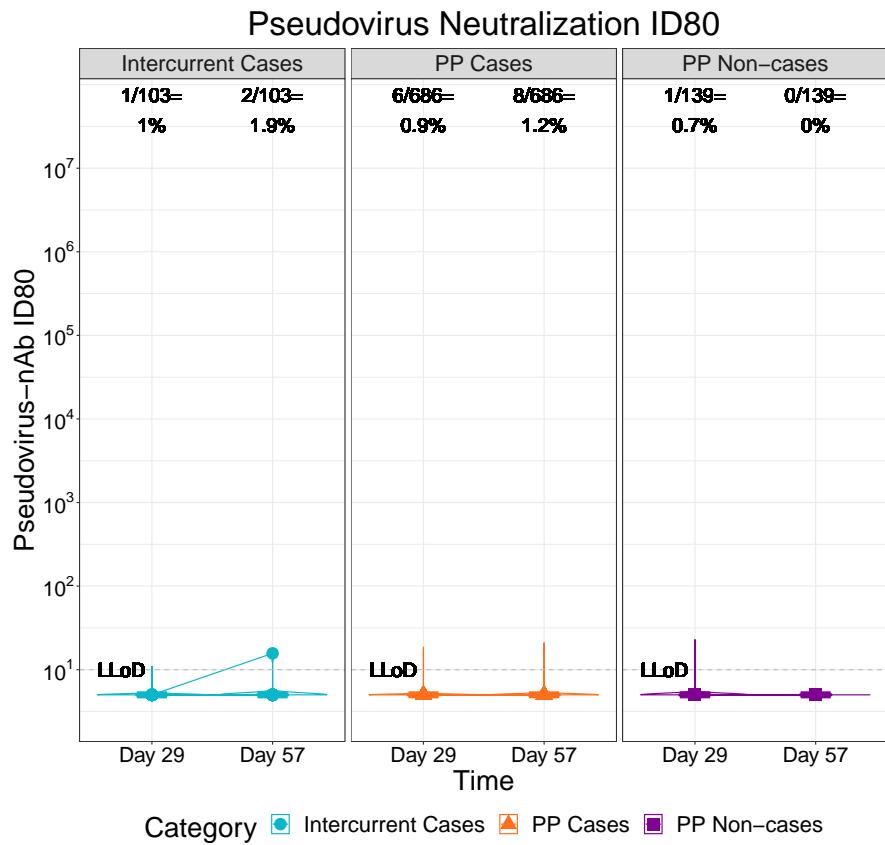


Figure 1.33: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints)

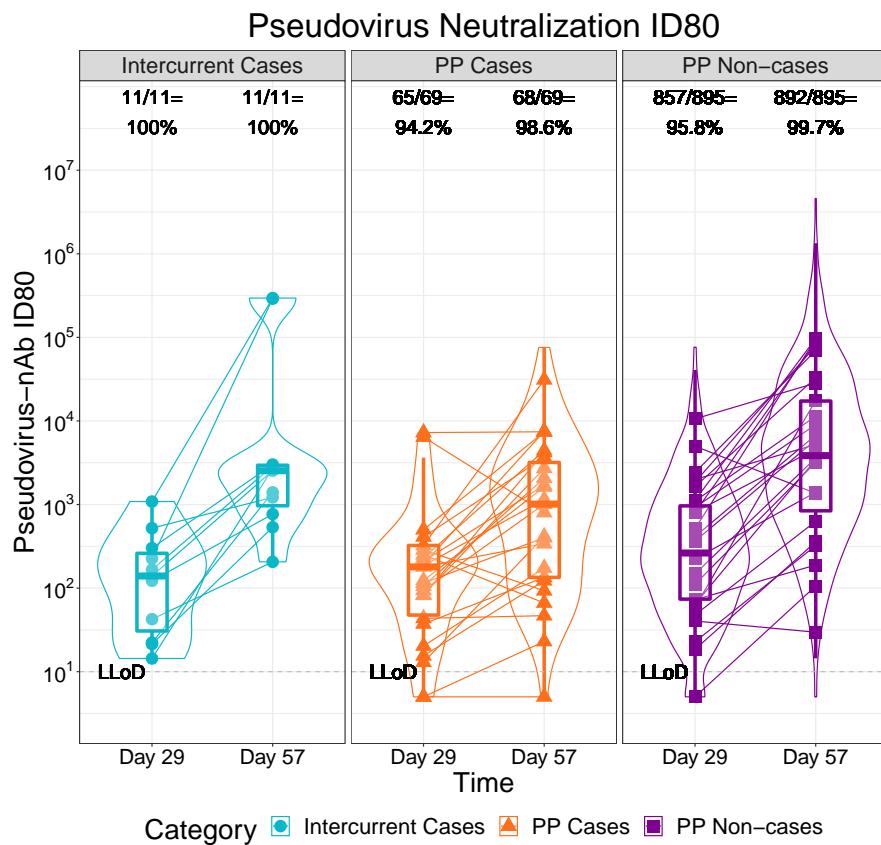


Figure 1.34: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (2 timepoints)

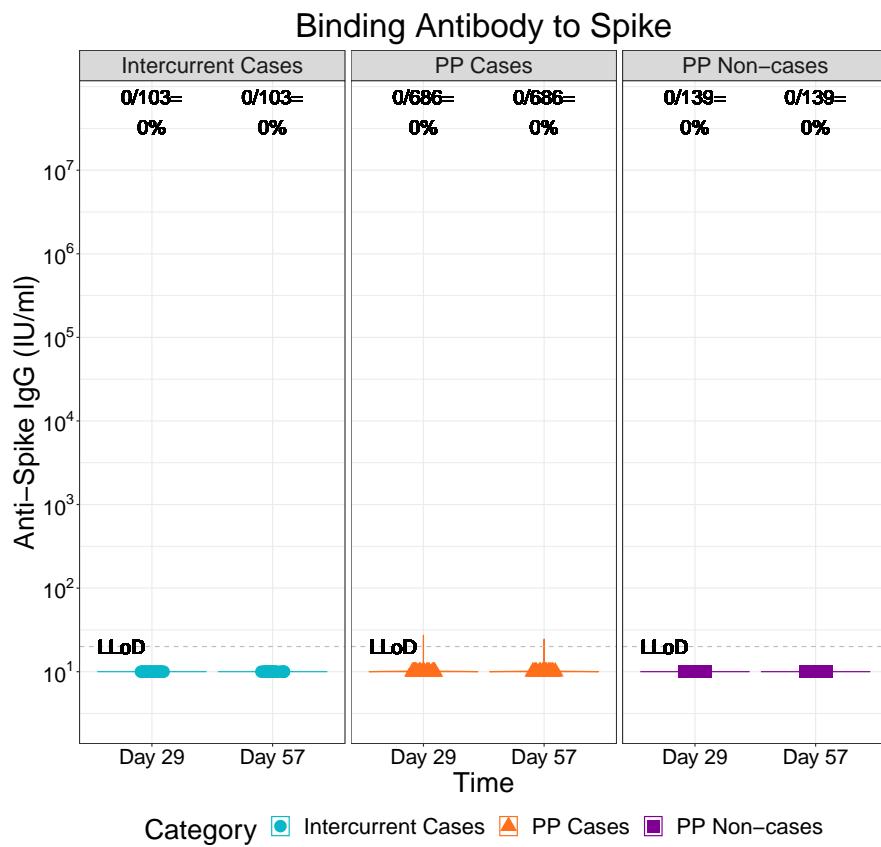


Figure 1.35: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (2 timepoints)

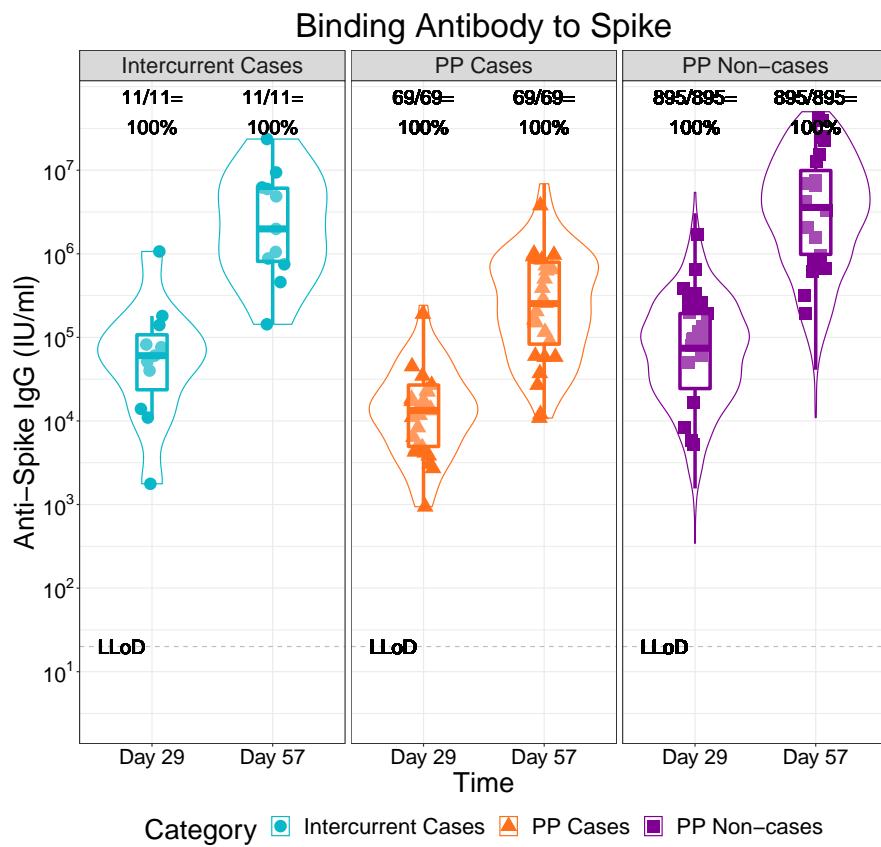


Figure 1.36: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (2 timepoints)

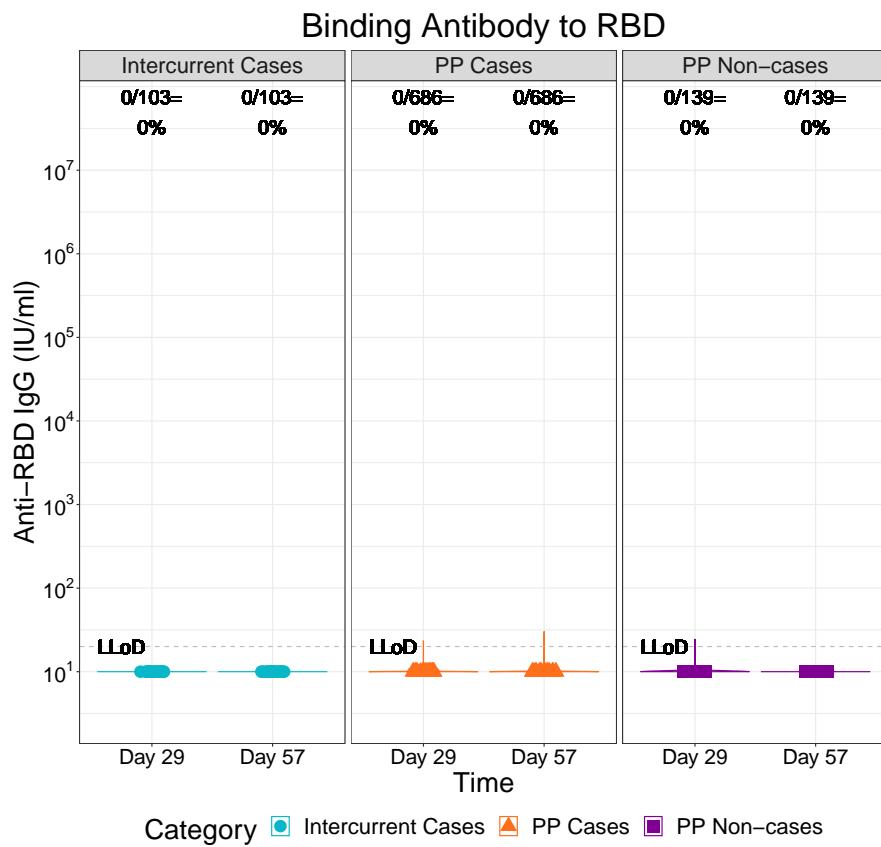


Figure 1.37: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (2 timepoints)

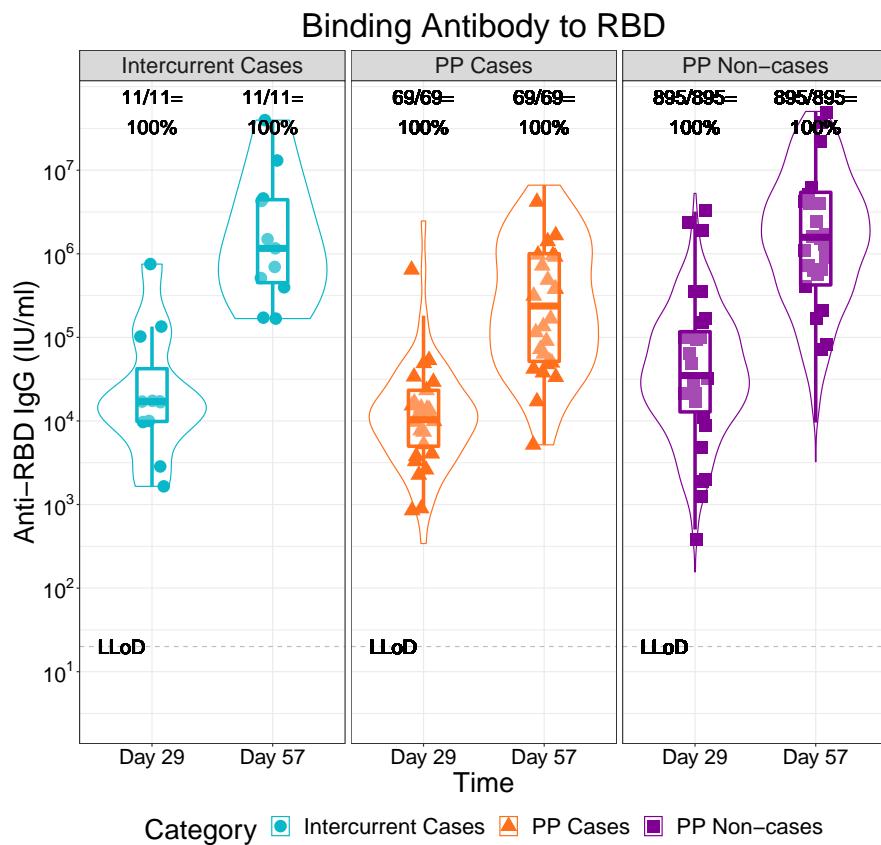


Figure 1.38: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (2 timepoints)

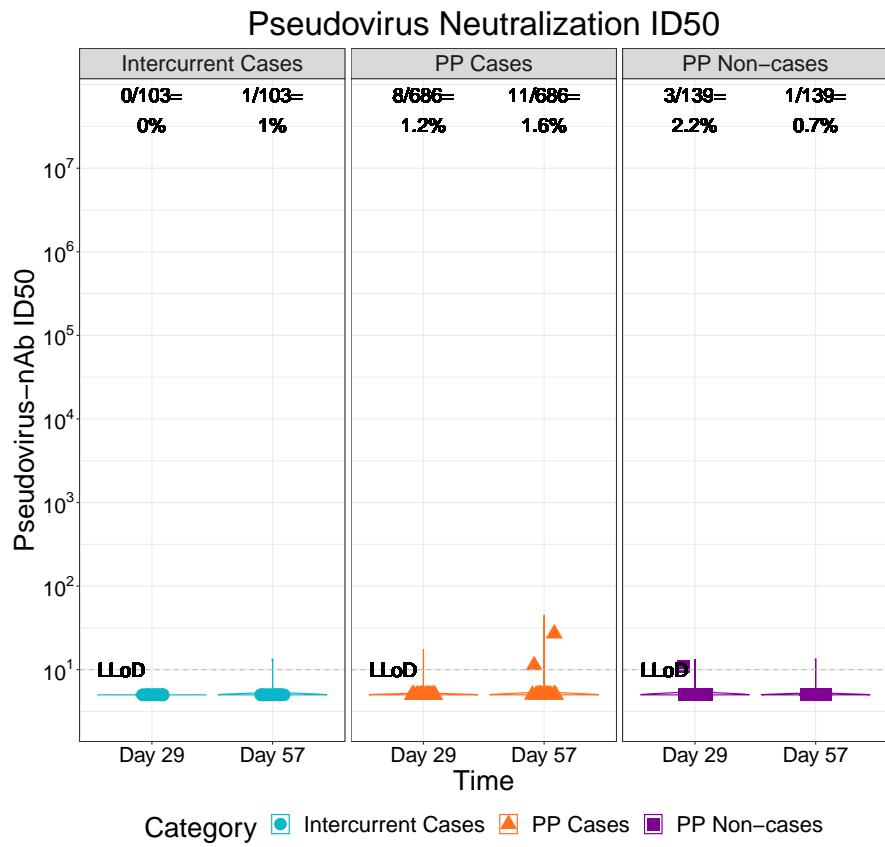


Figure 1.39: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (2 timepoints)

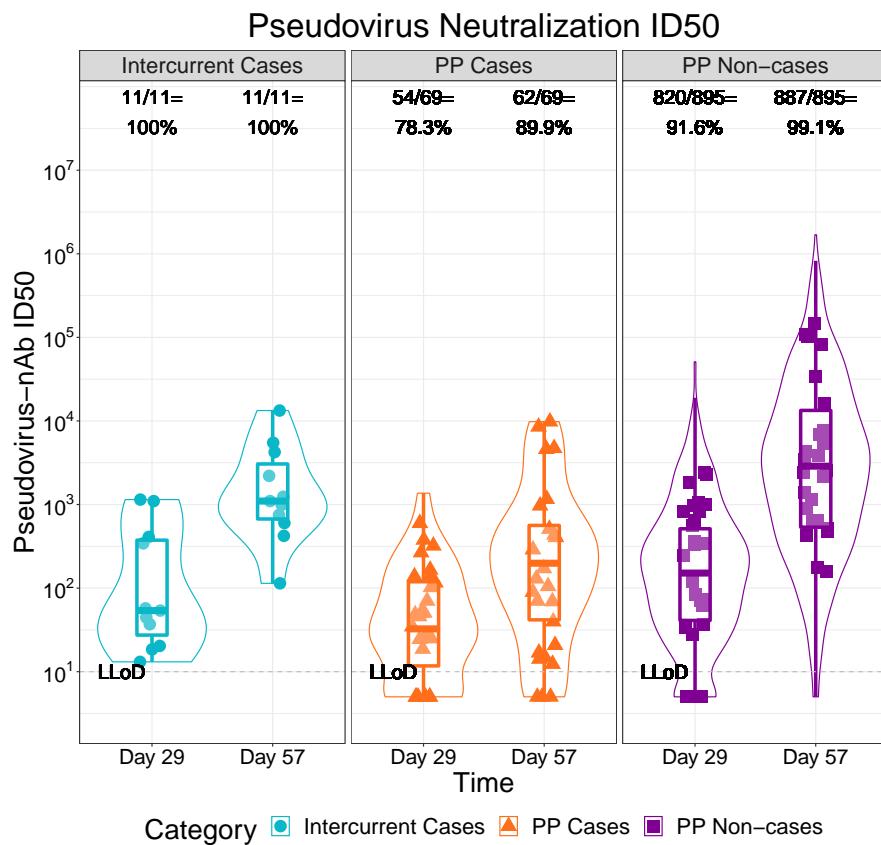


Figure 1.40: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (2 timepoints)

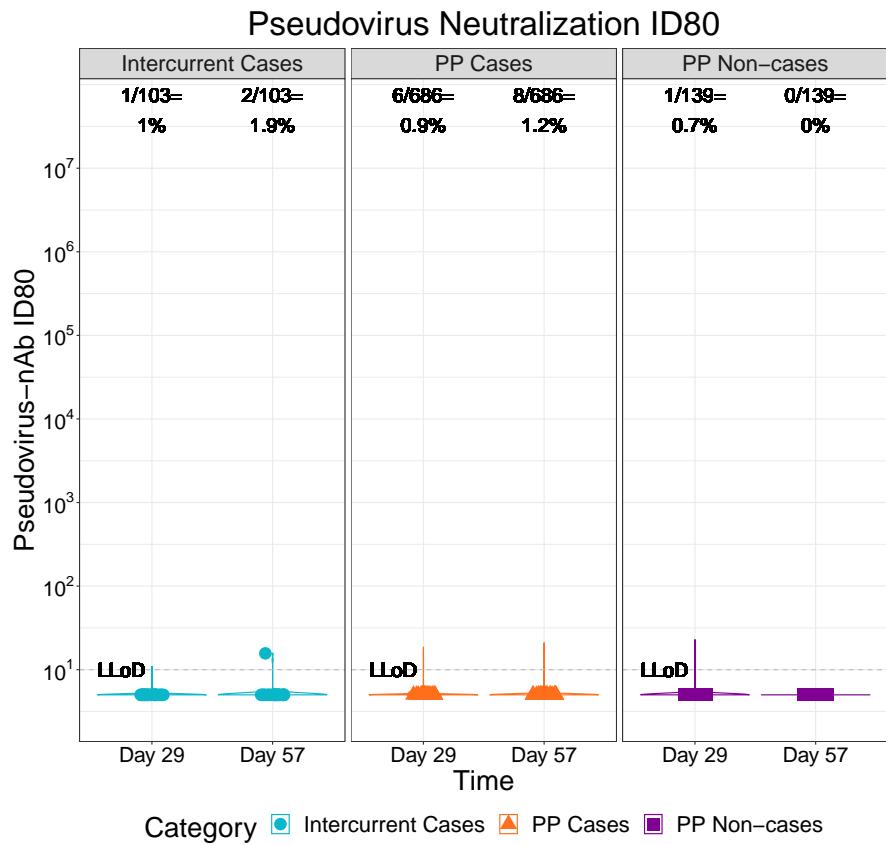


Figure 1.41: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (2 timepoints)

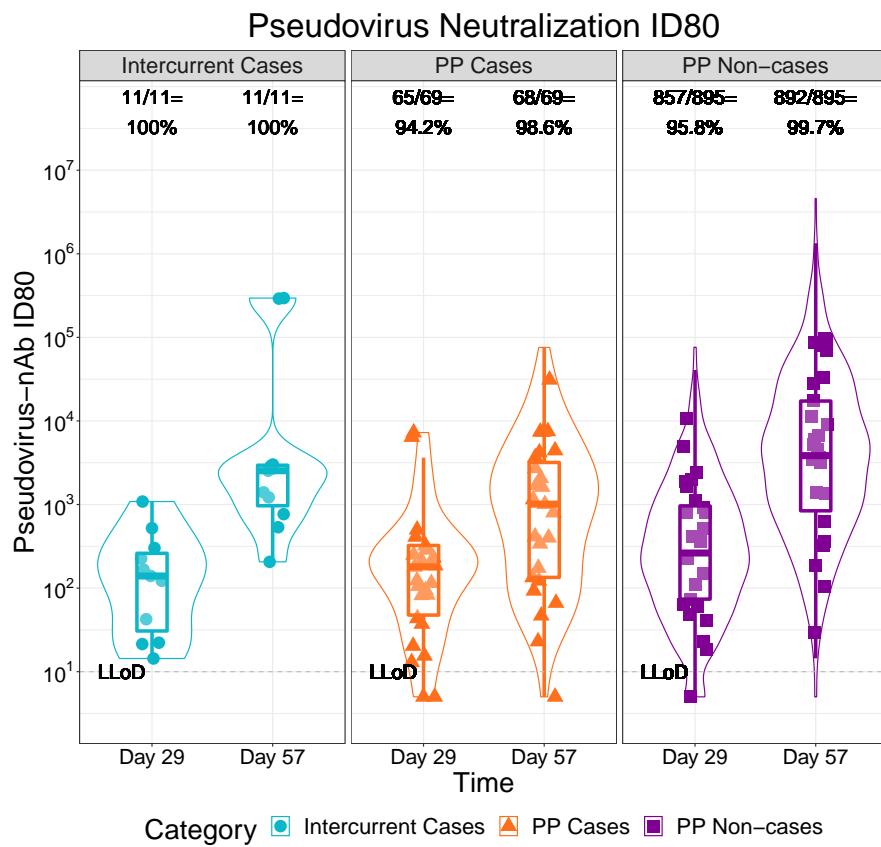


Figure 1.42: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (2 timepoints)

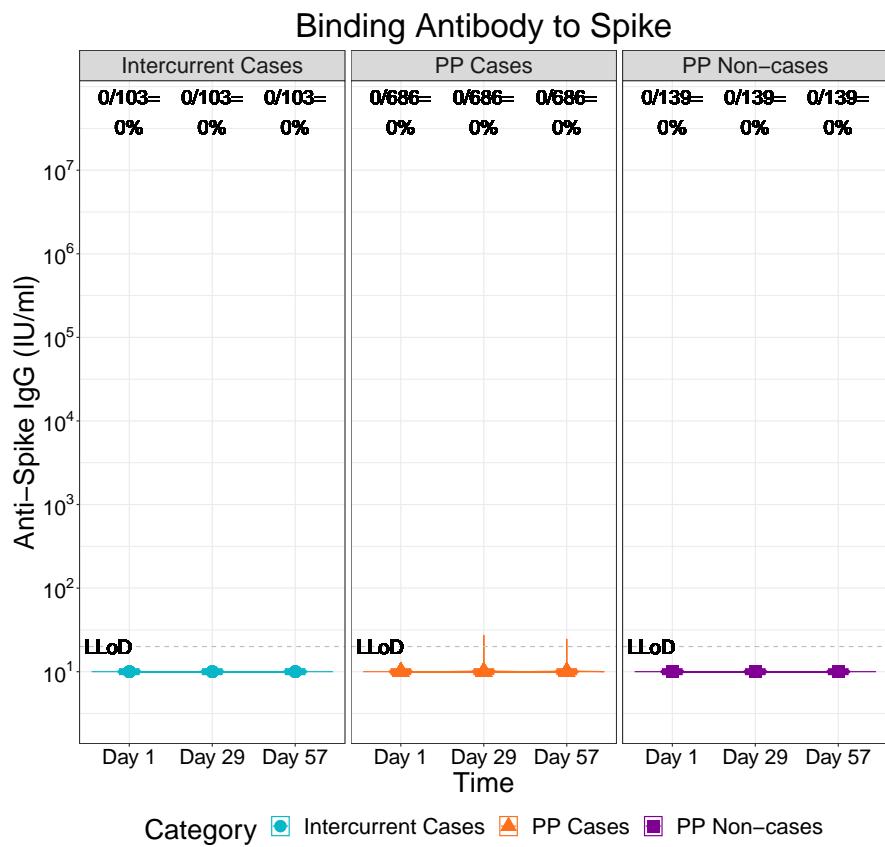


Figure 1.43: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints)

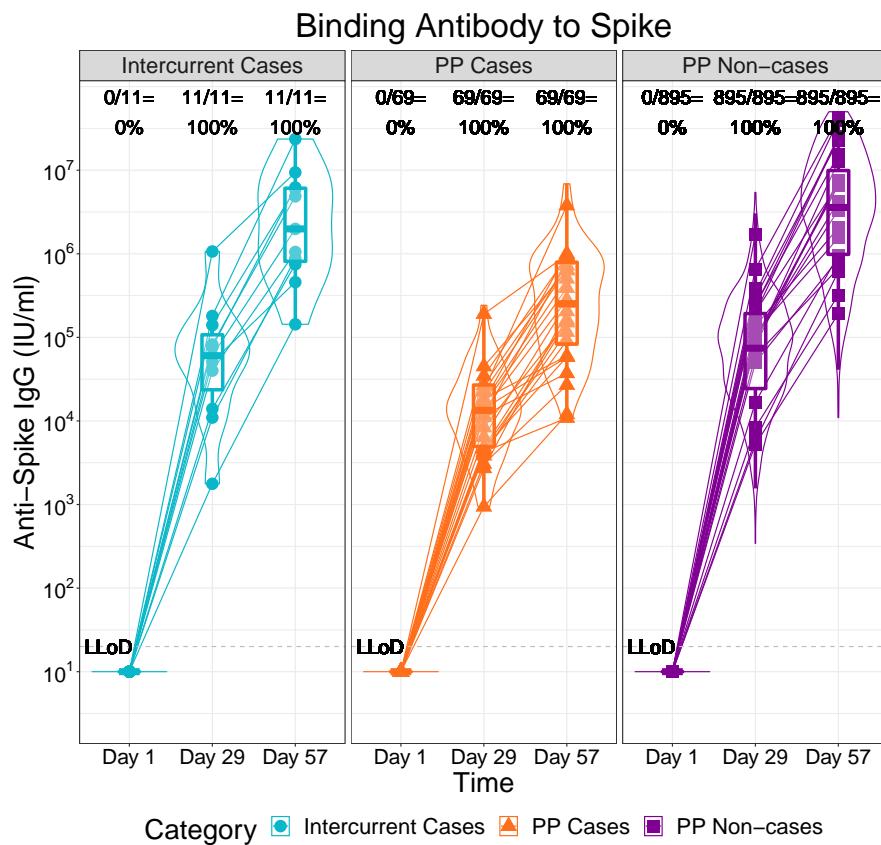


Figure 1.44: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints)

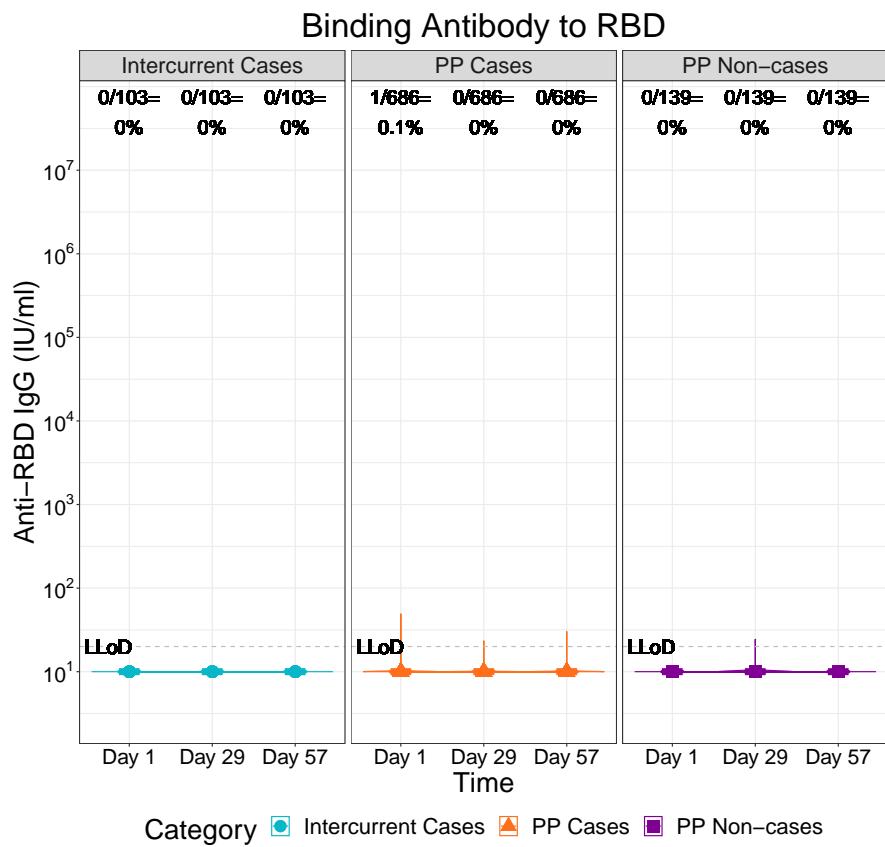


Figure 1.45: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints)

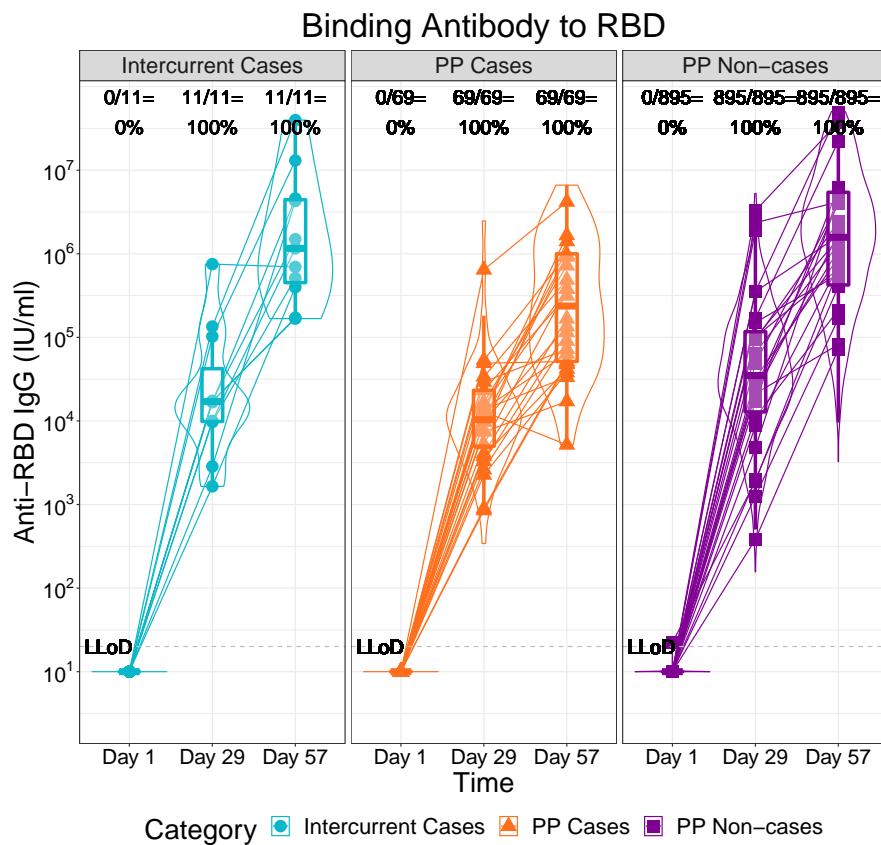


Figure 1.46: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints)

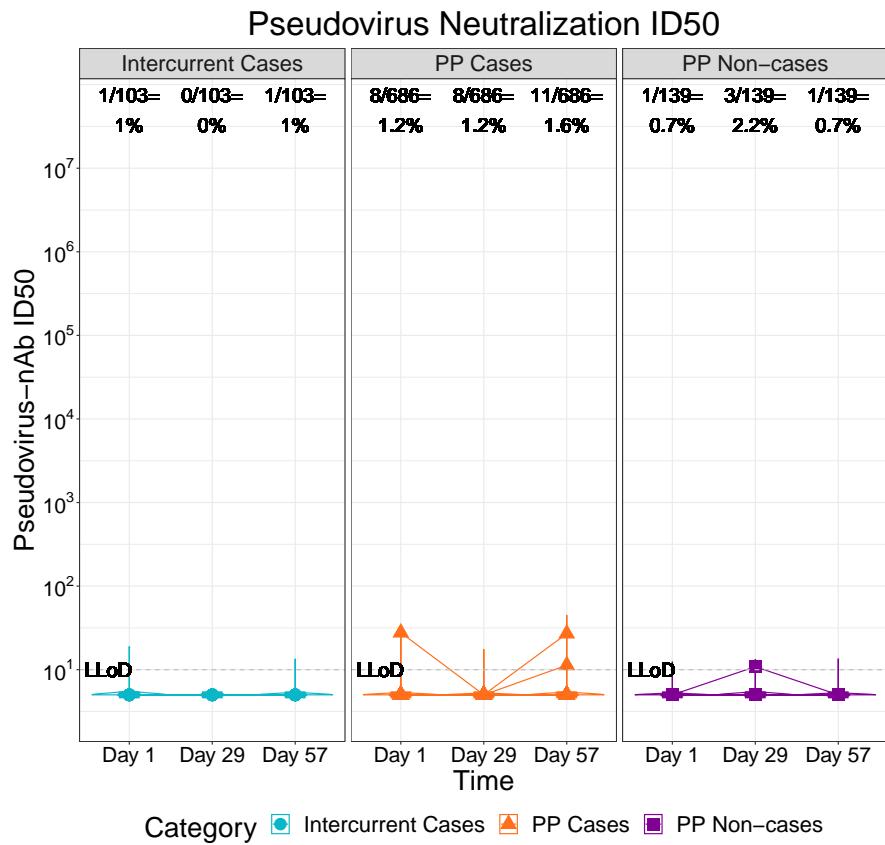


Figure 1.47: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints)

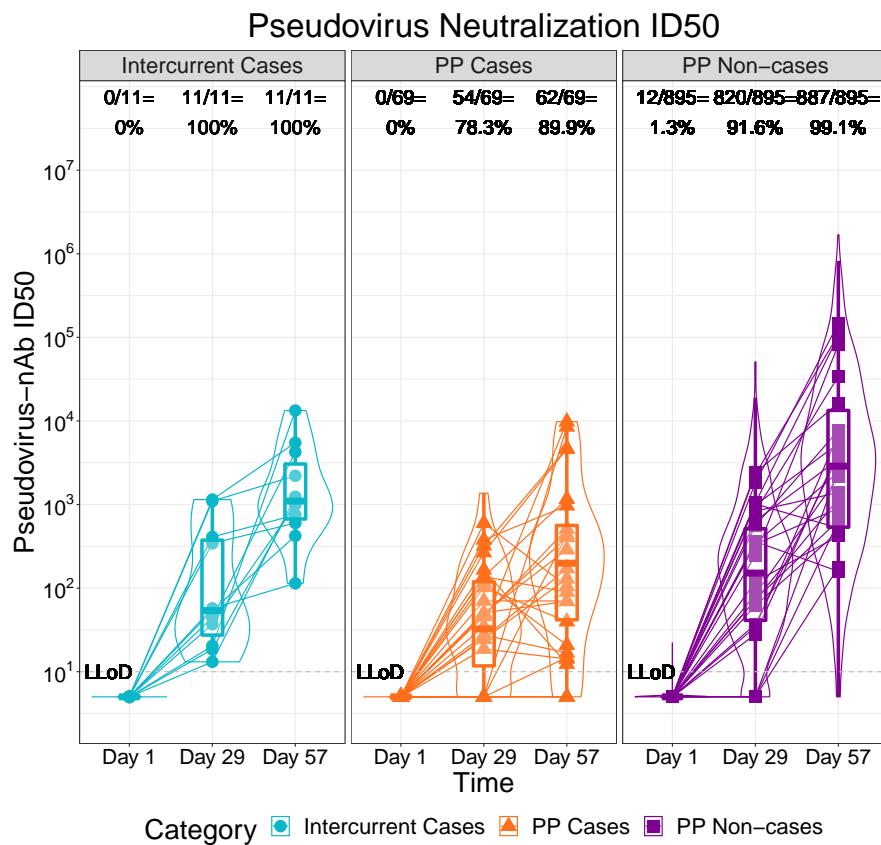


Figure 1.48: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (3 timepoints)

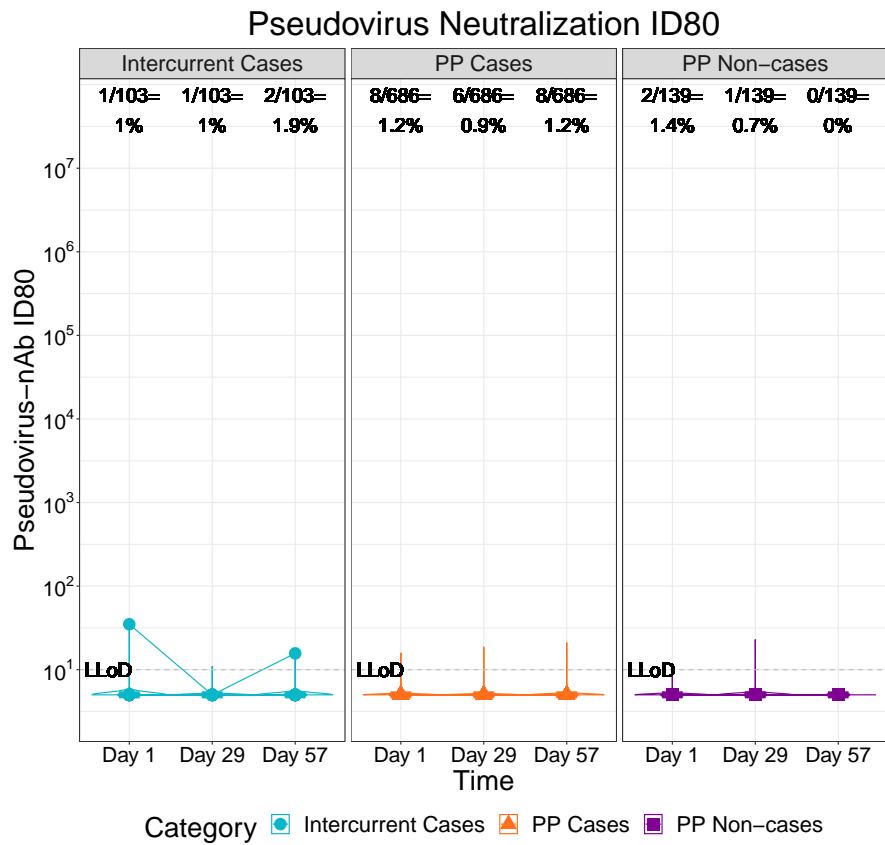


Figure 1.49: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints)

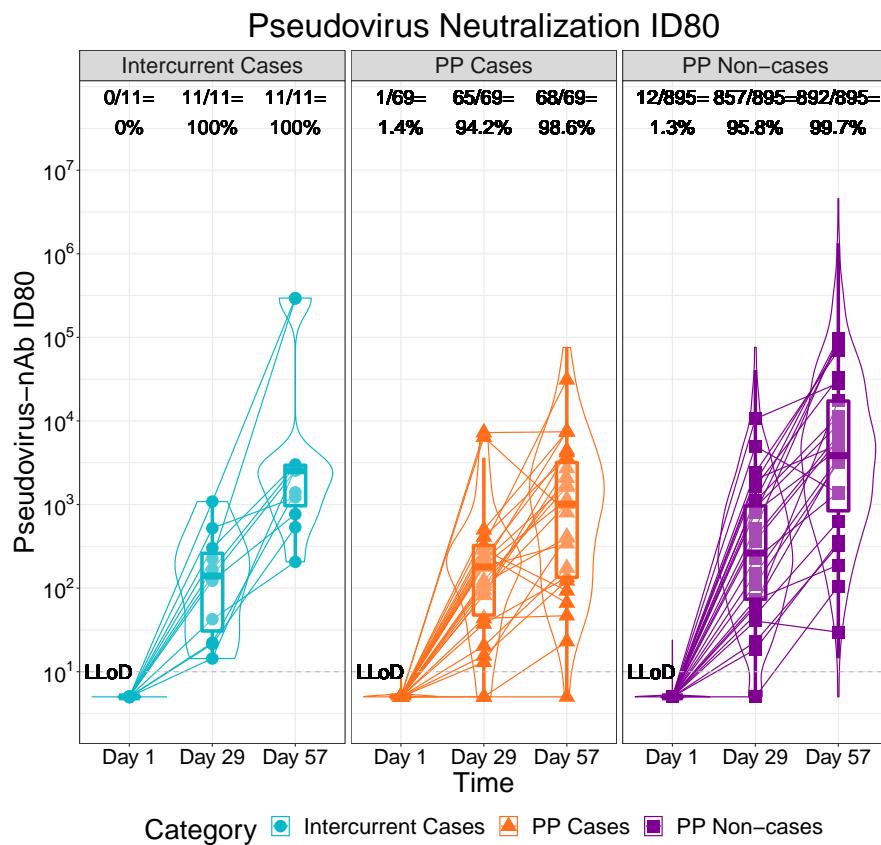


Figure 1.50: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (3 timepoints)

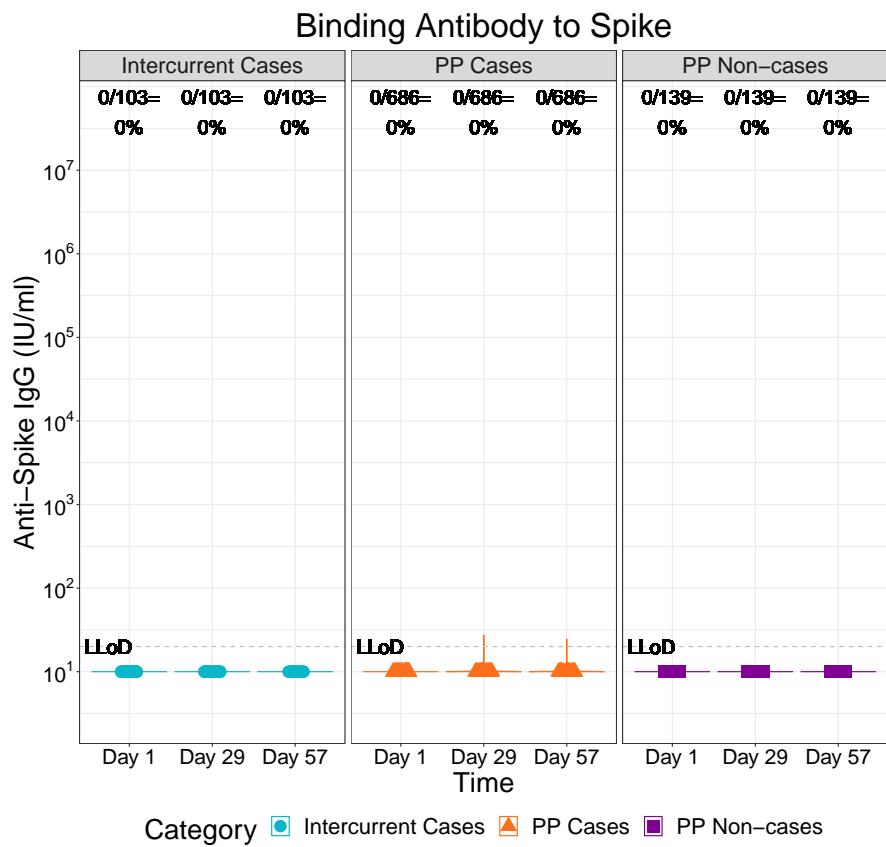


Figure 1.51: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm (3 timepoints)

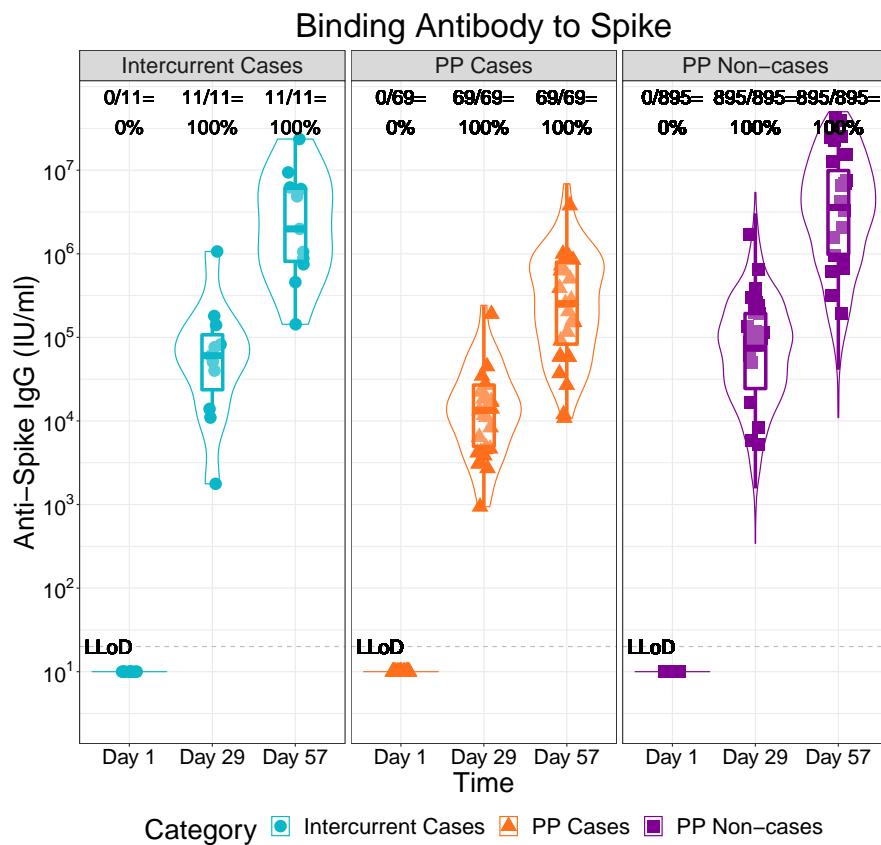


Figure 1.52: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm (3 timepoints)

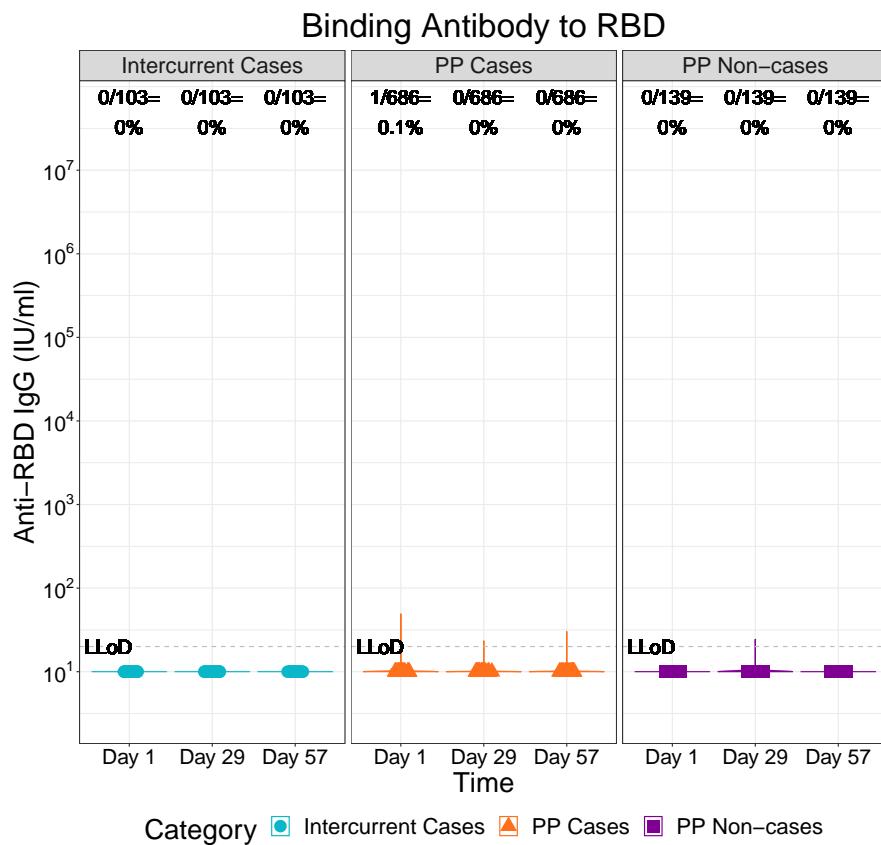


Figure 1.53: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm (3 timepoints)

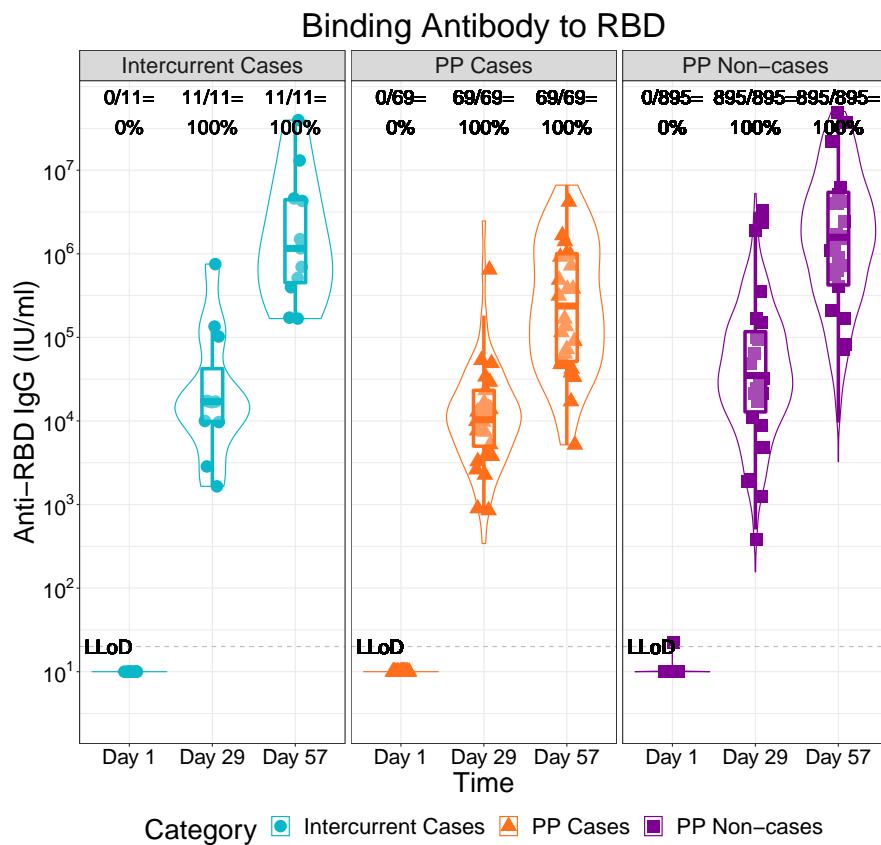


Figure 1.54: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm (3 timepoints)

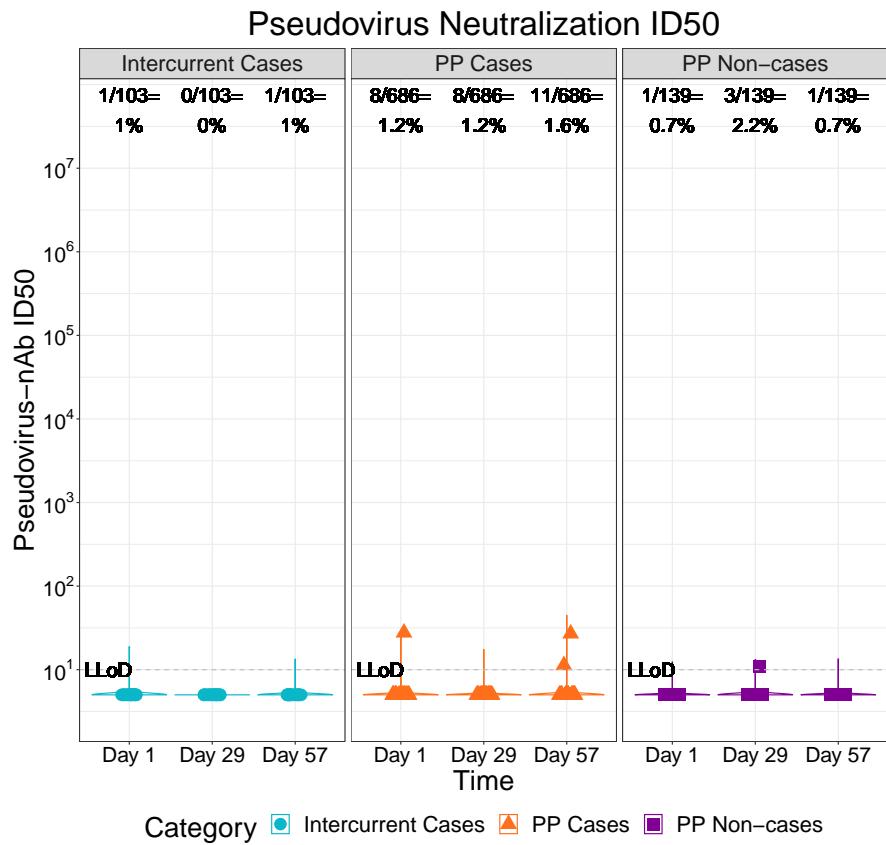


Figure 1.55: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm (3 timepoints)

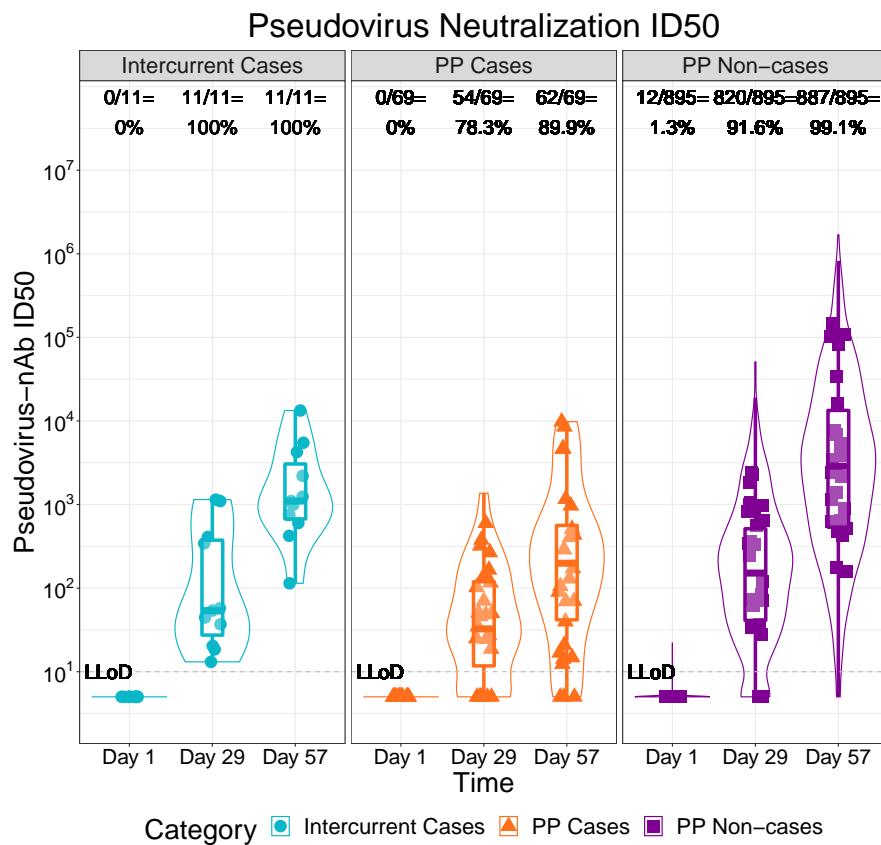


Figure 1.56: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm (3 timepoints)

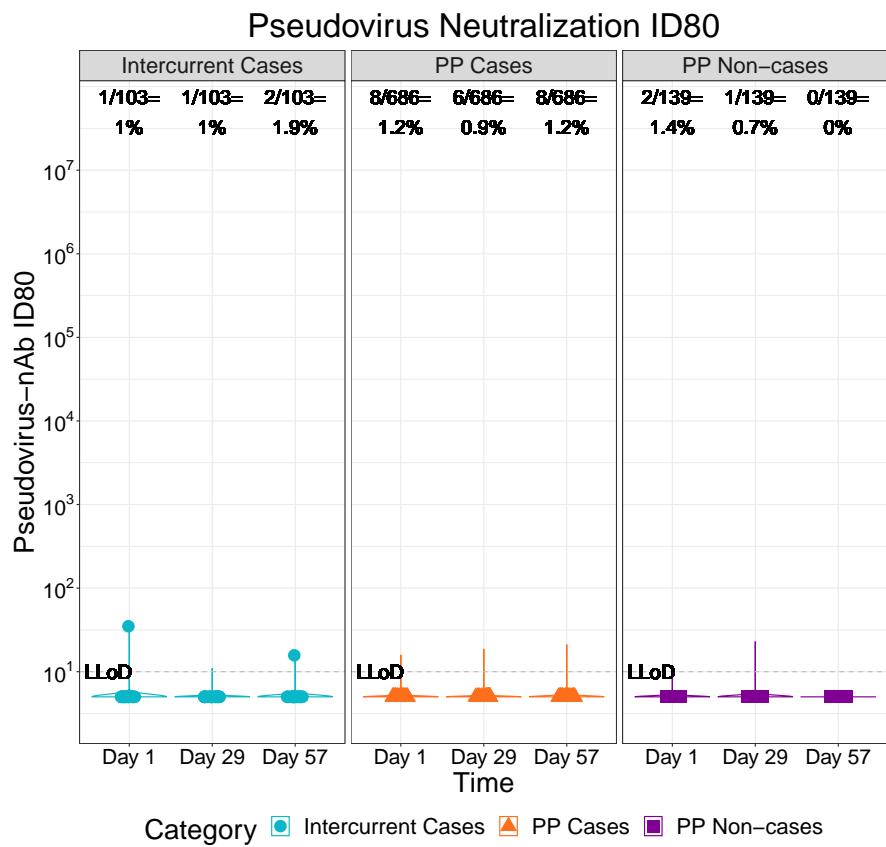


Figure 1.57: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm (3 timepoints)

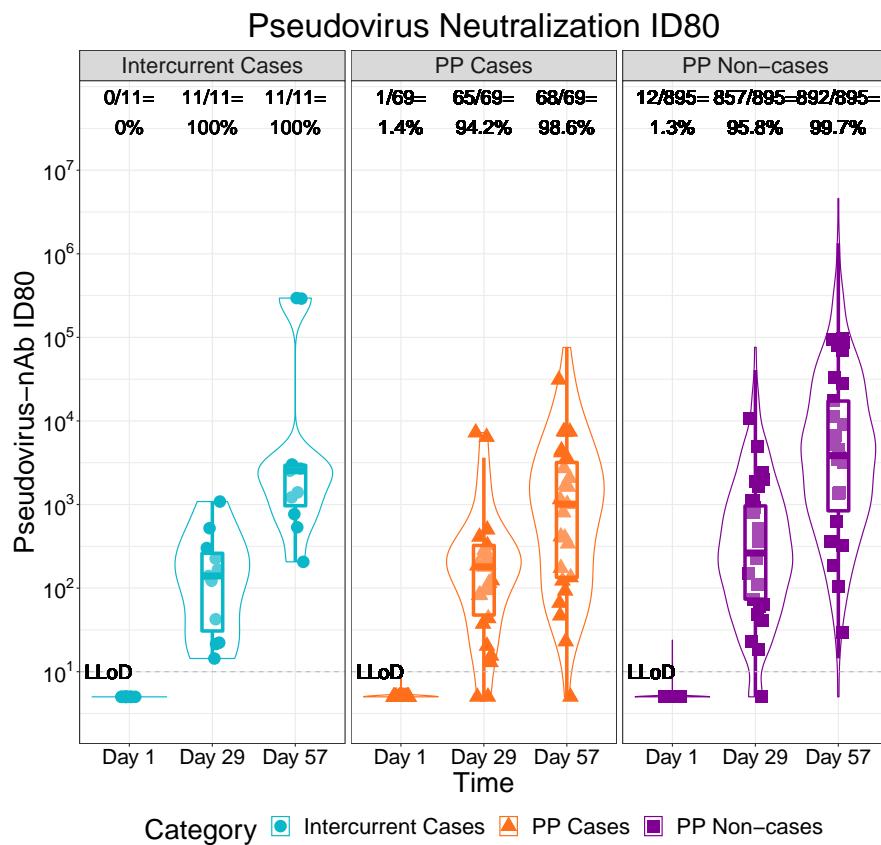


Figure 1.58: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm (3 timepoints)

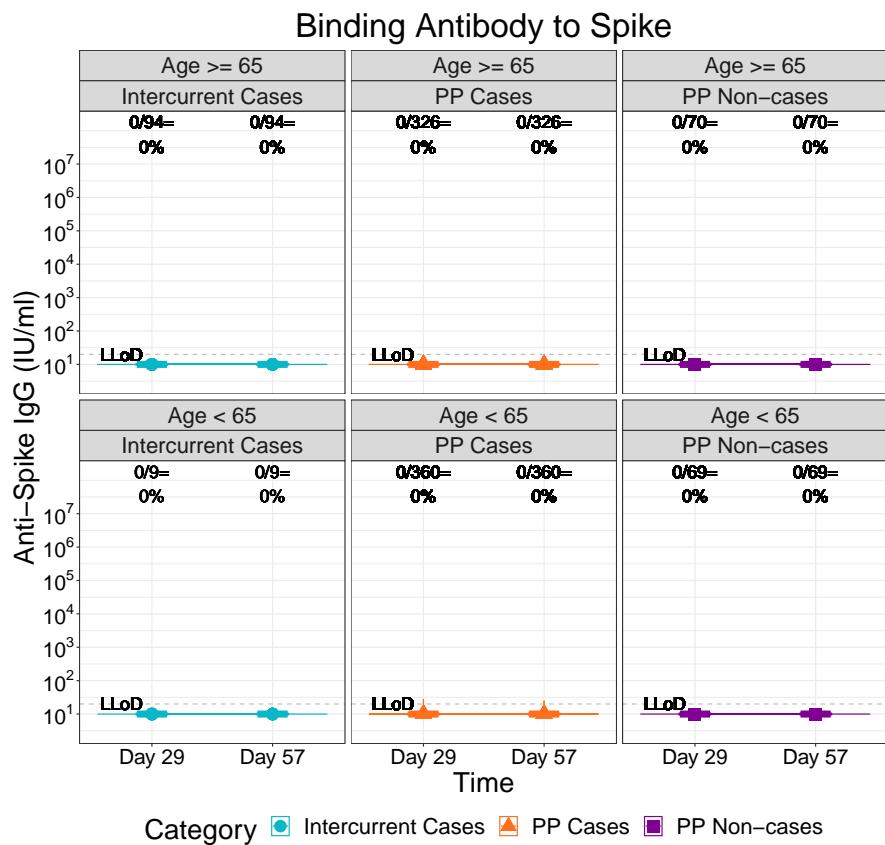


Figure 1.59: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints)

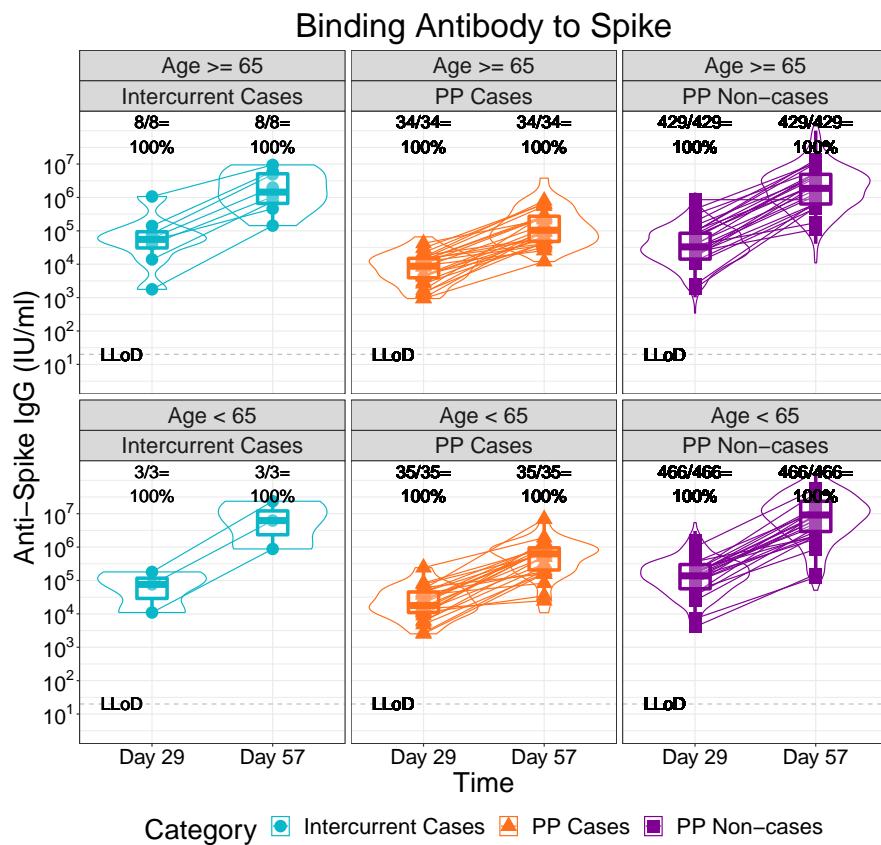


Figure 1.60: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints)

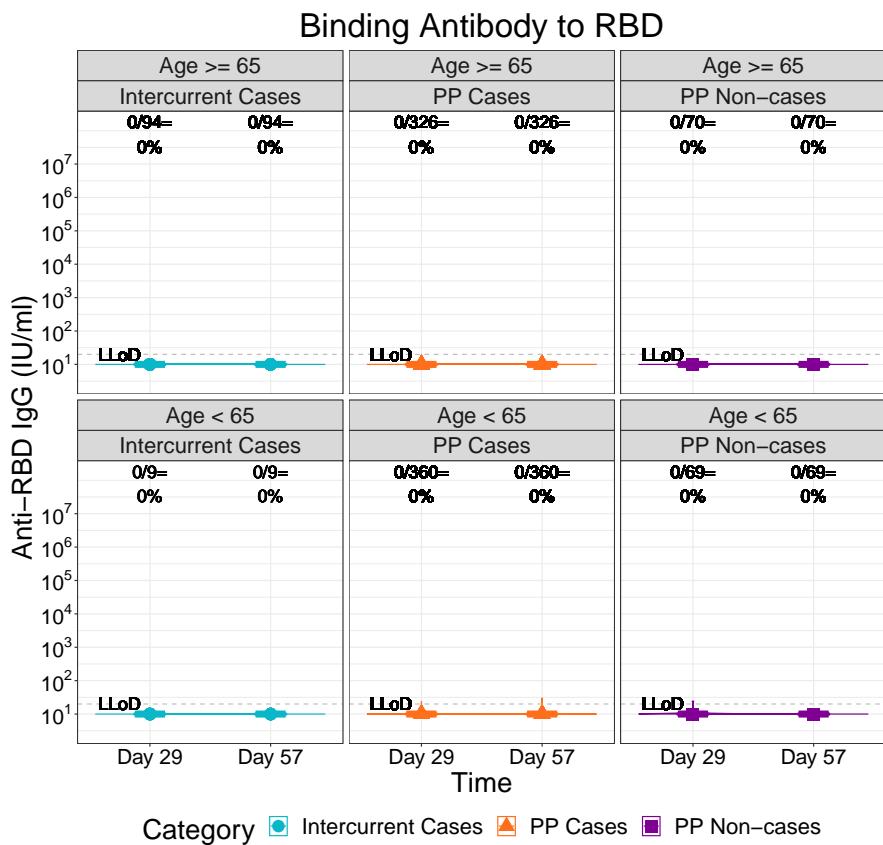


Figure 1.61: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints)

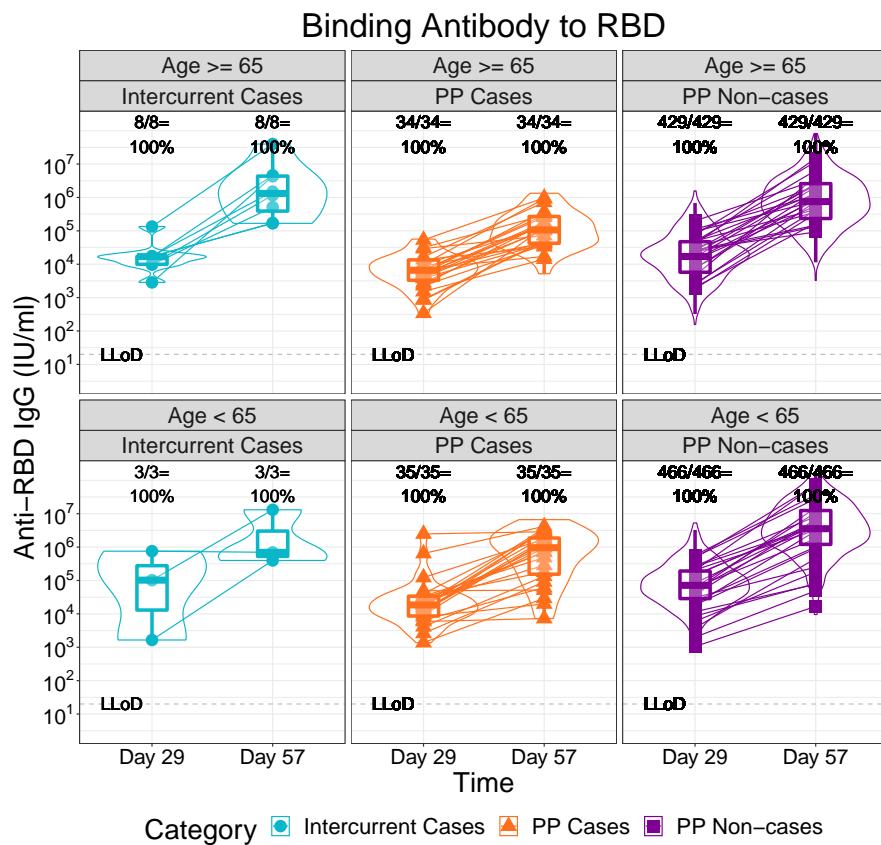


Figure 1.62: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints)

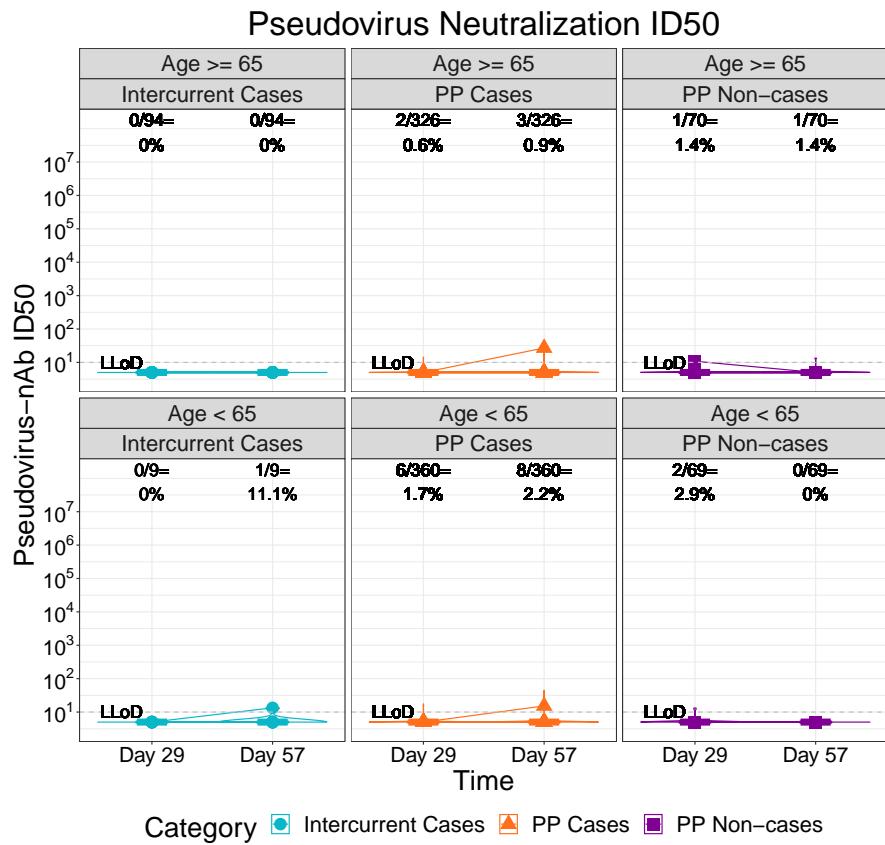


Figure 1.63: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints)

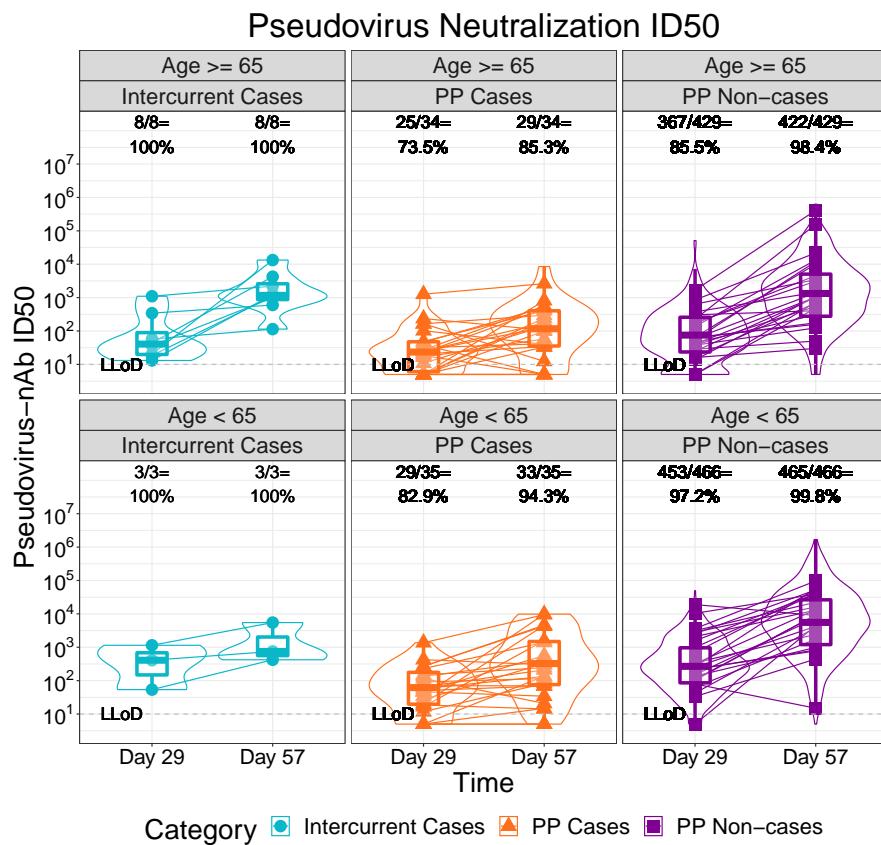


Figure 1.64: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (2 timepoints)

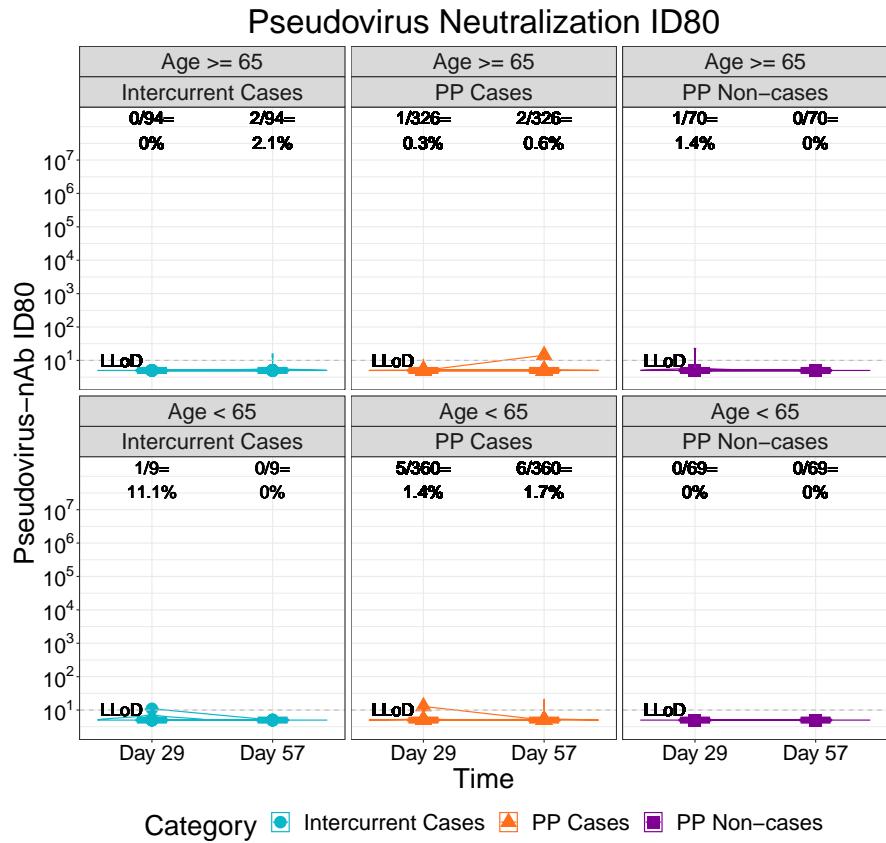


Figure 1.65: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints)

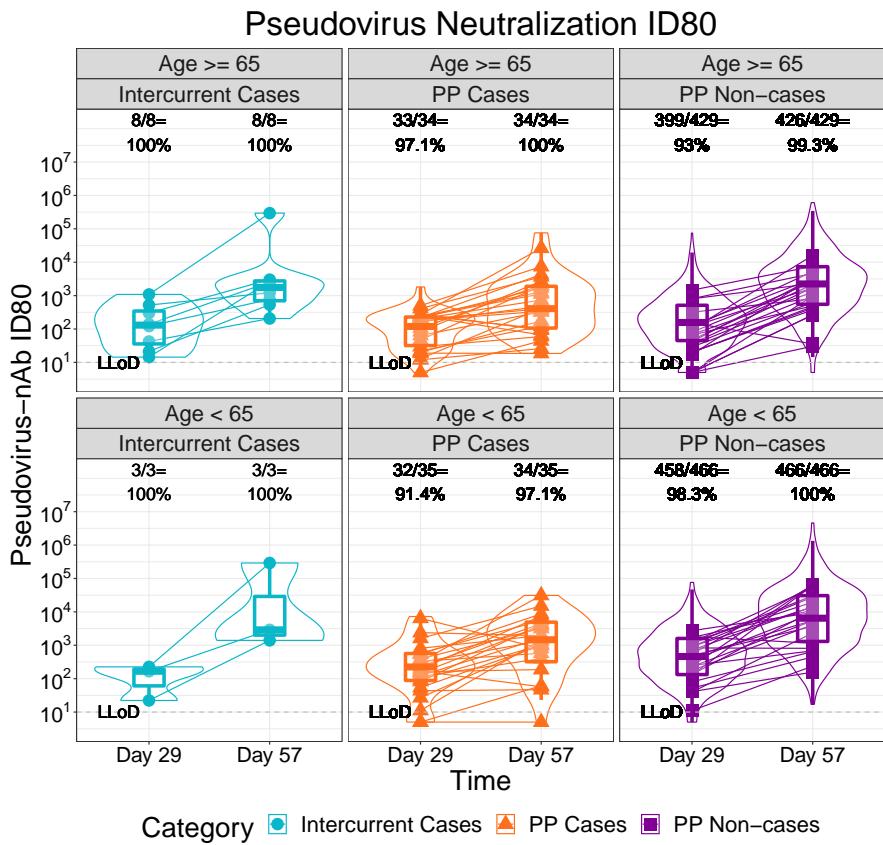


Figure 1.66: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints)

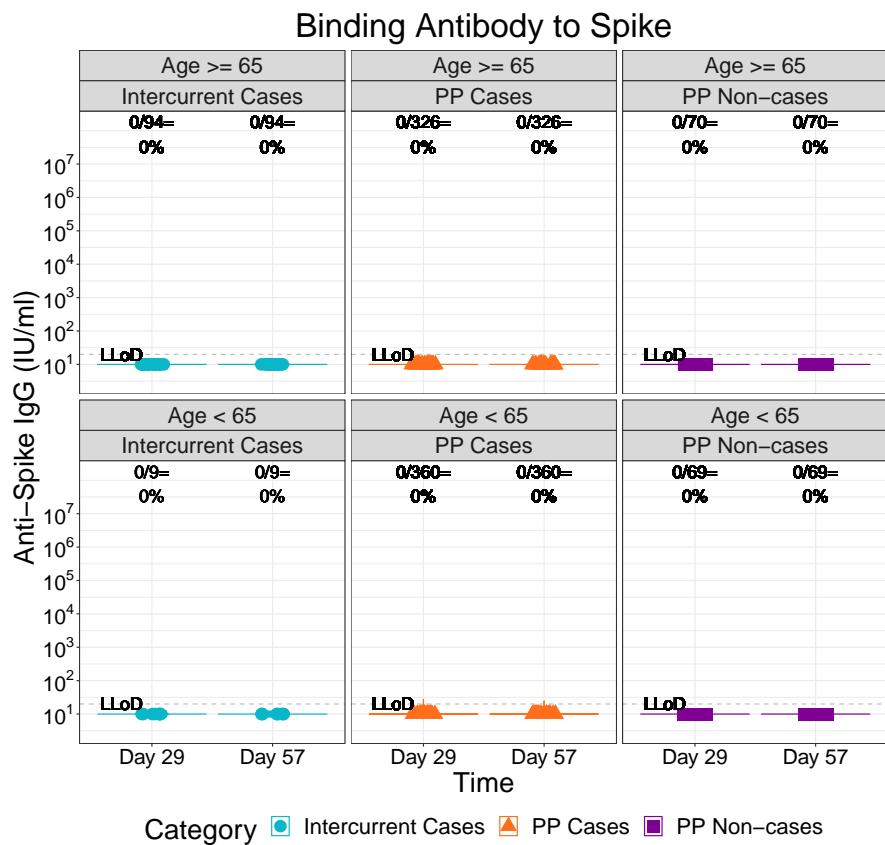


Figure 1.67: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (2 timepoints)

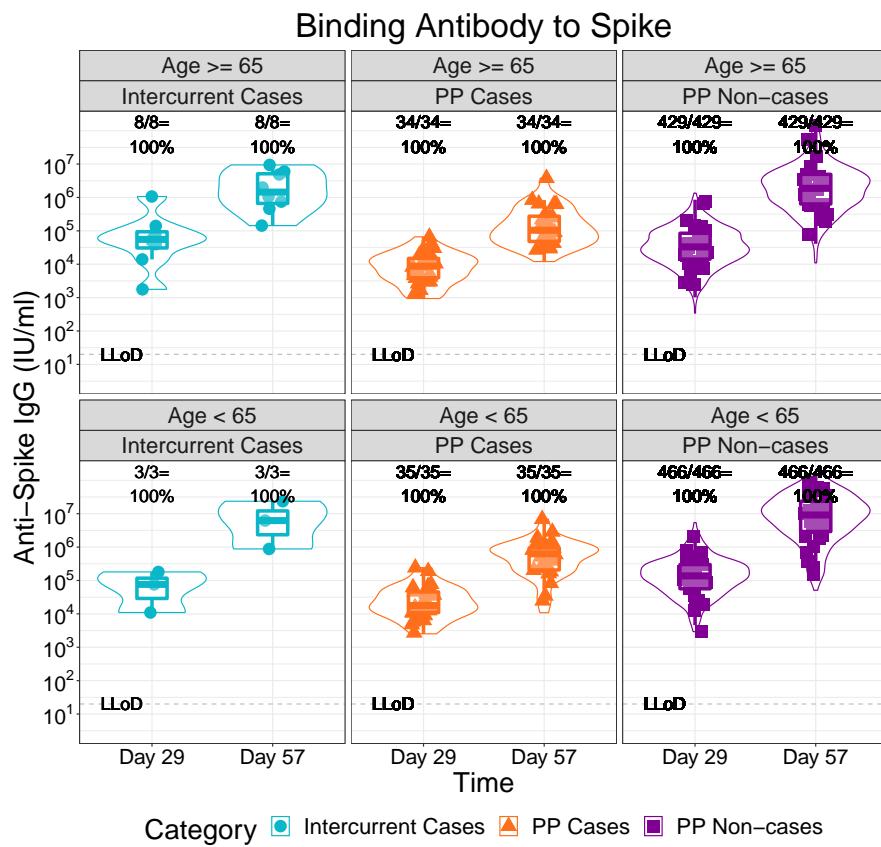


Figure 1.68: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (2 timepoints)

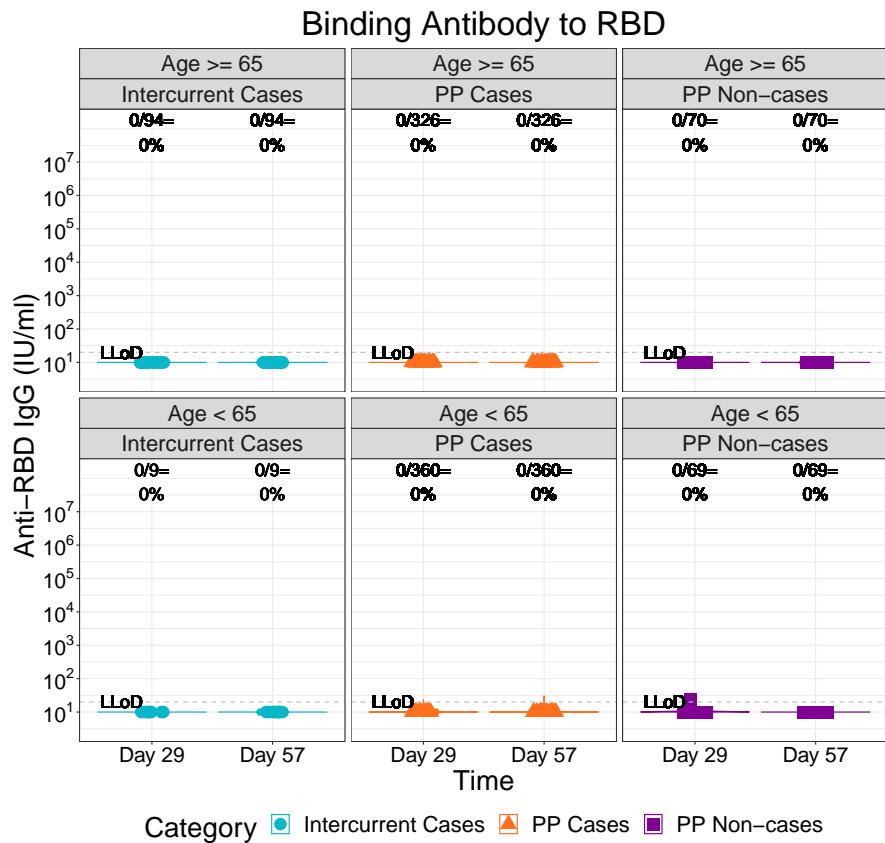


Figure 1.69: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (2 timepoints)

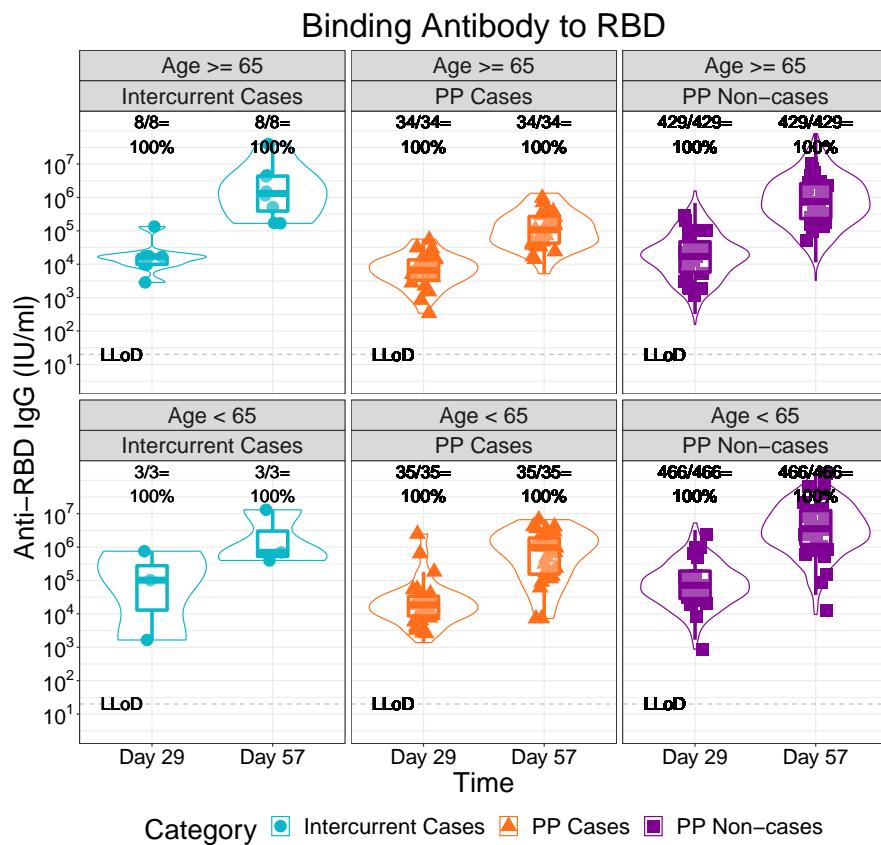


Figure 1.70: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (2 timepoints)

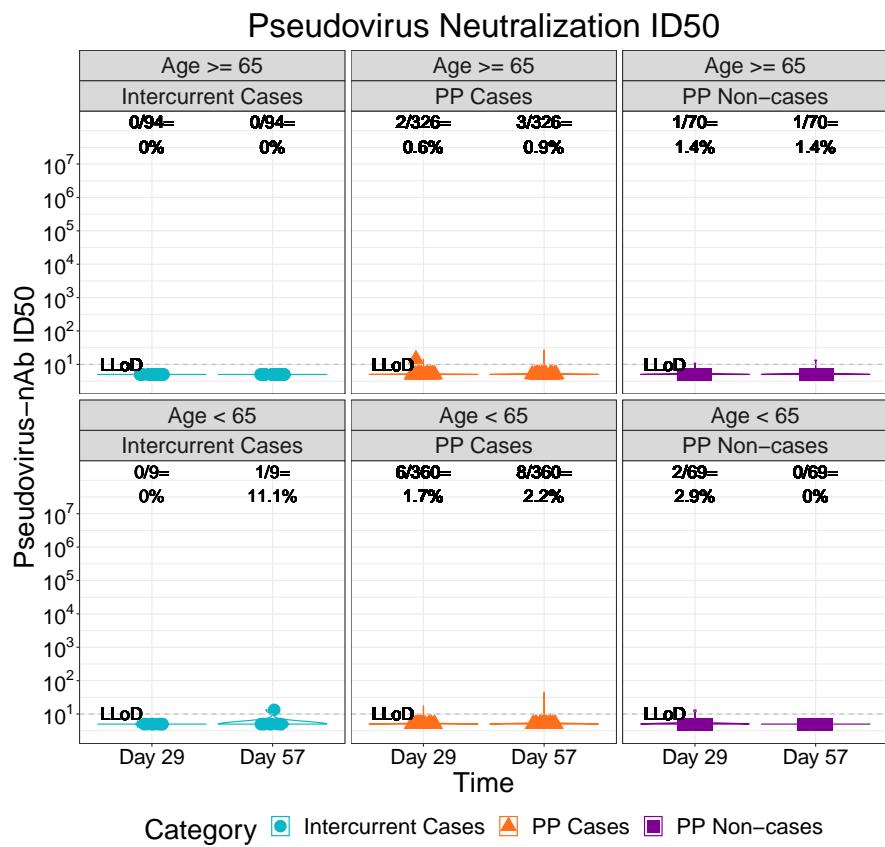


Figure 1.71: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (2 timepoints)

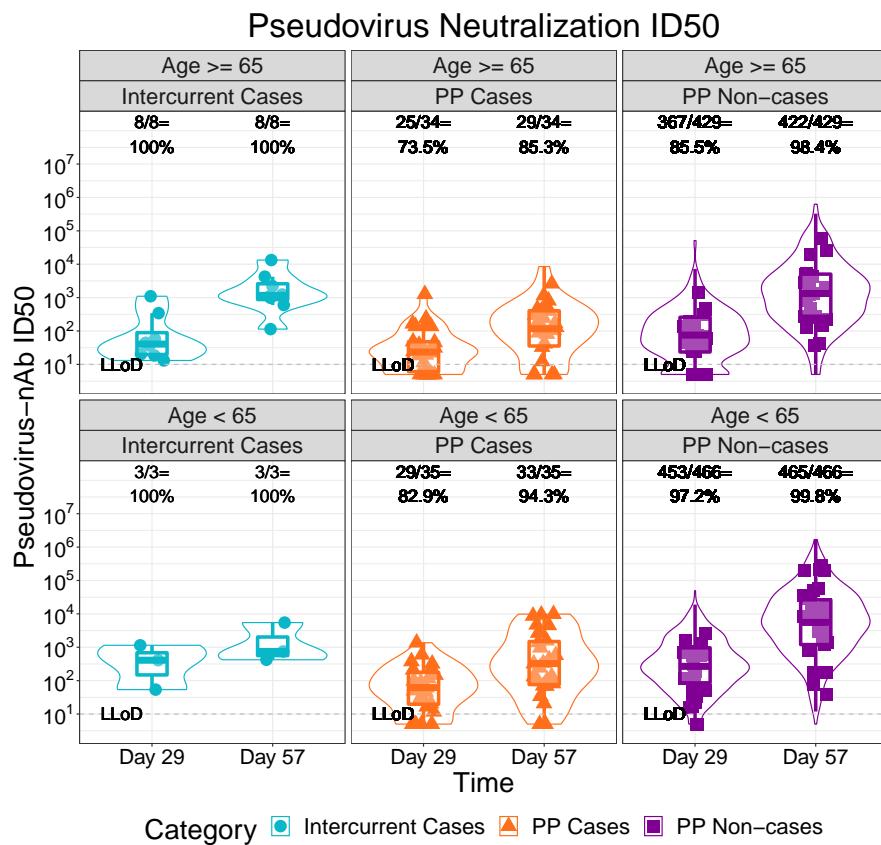


Figure 1.72: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (2 timepoints)

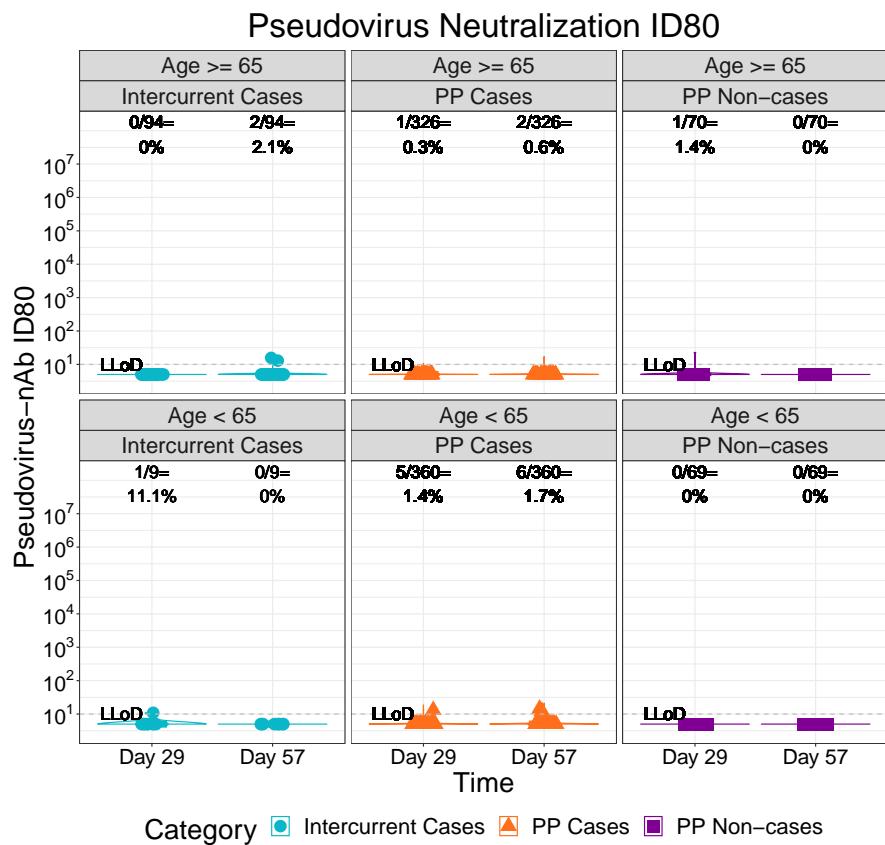


Figure 1.73: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (2 timepoints)

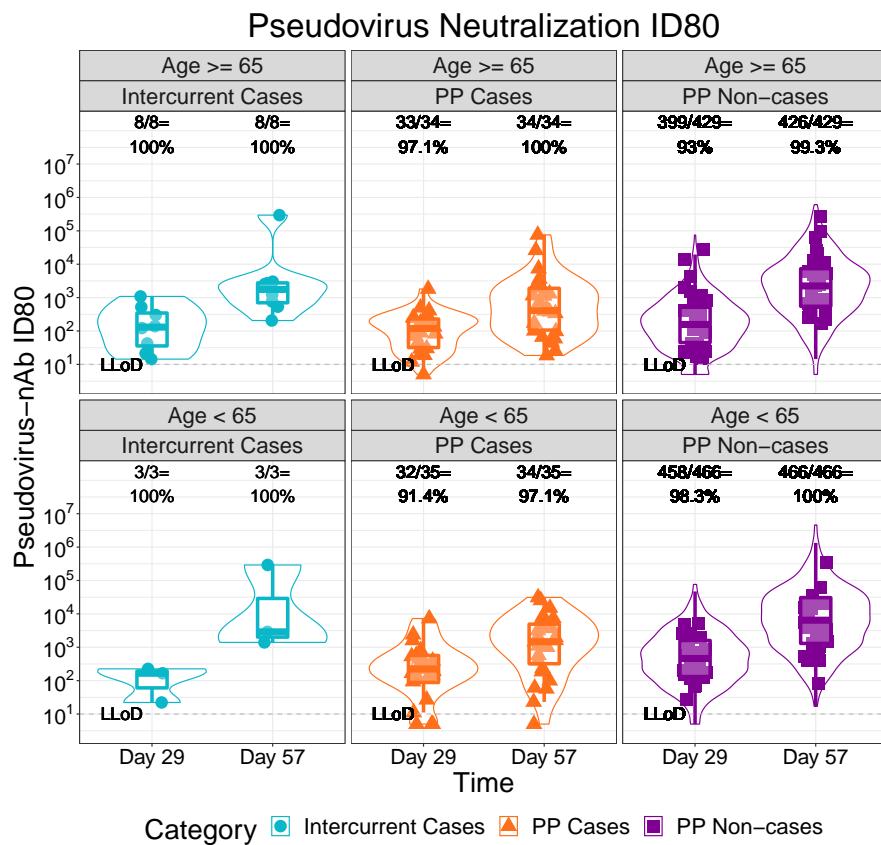


Figure 1.74: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (2 timepoints)

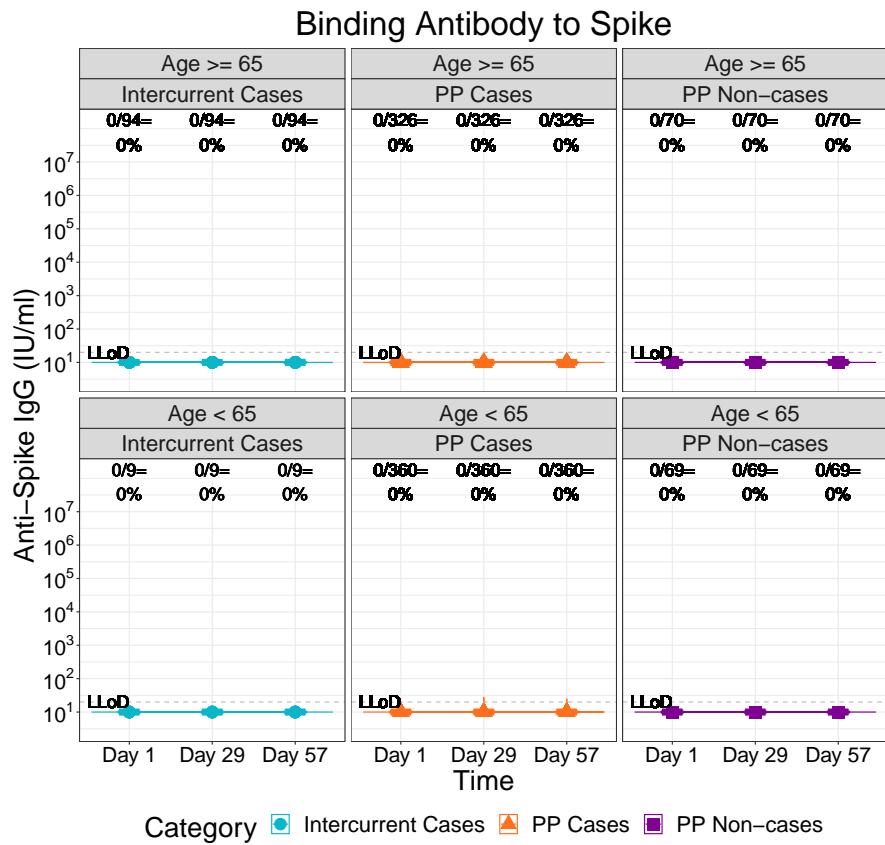


Figure 1.75: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints)

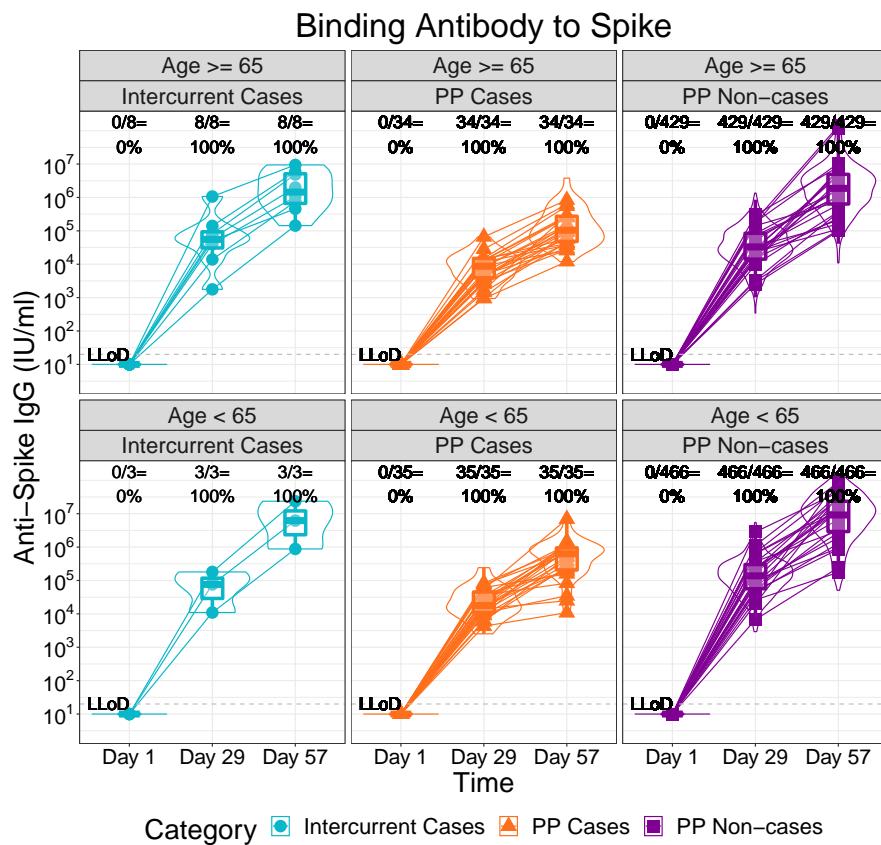


Figure 1.76: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints)

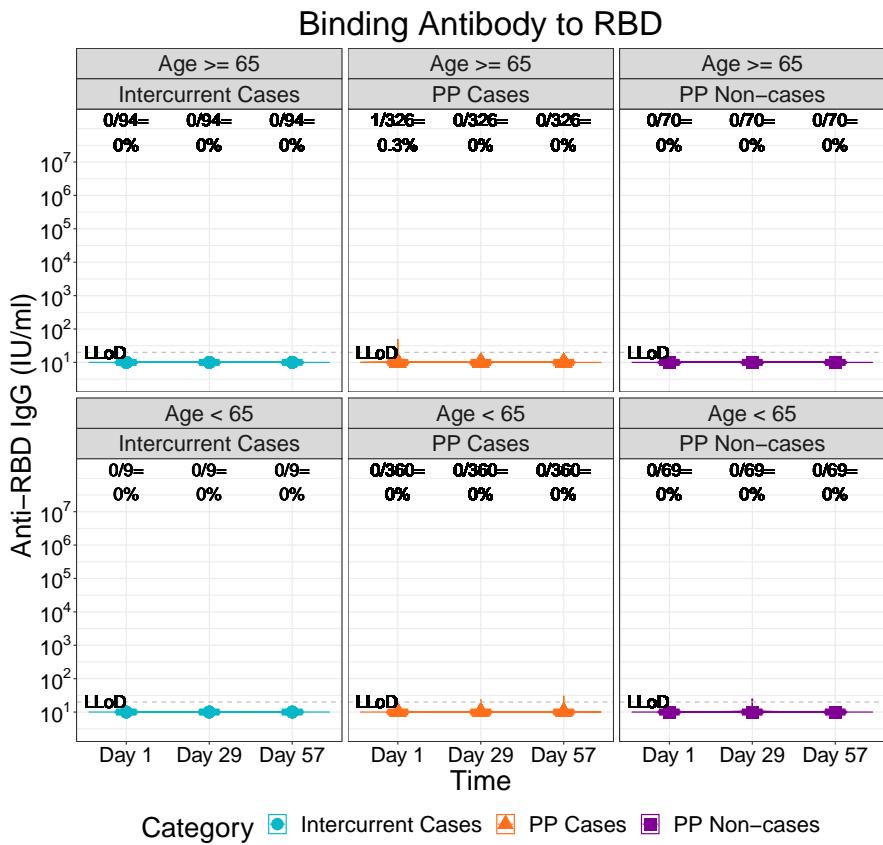


Figure 1.77: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints)

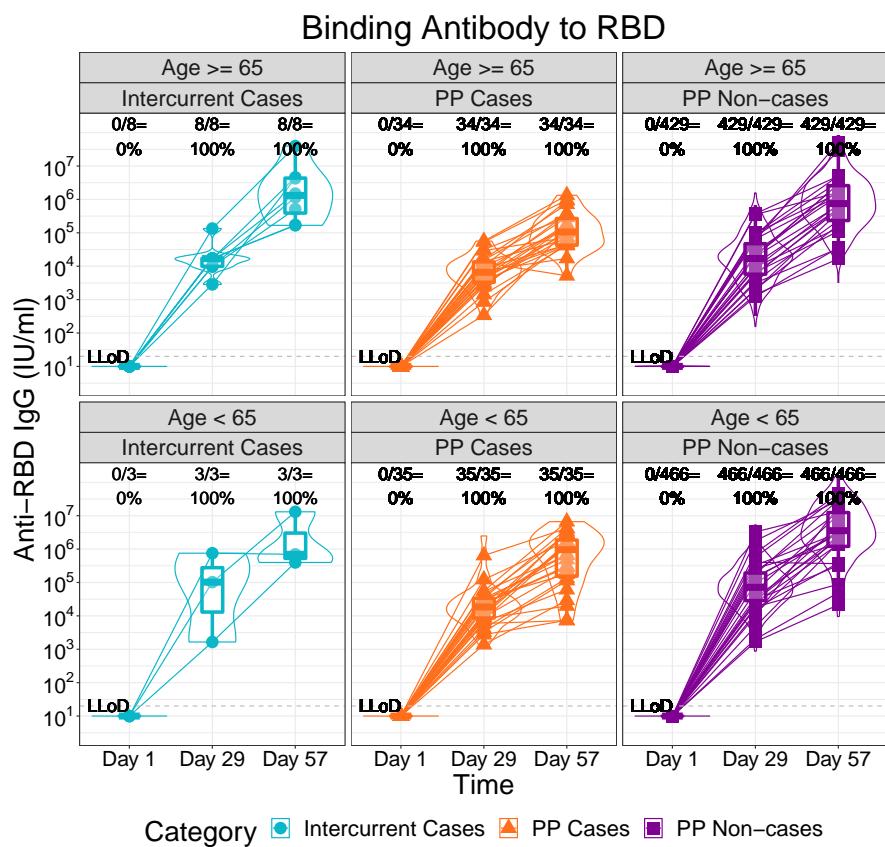


Figure 1.78: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints)

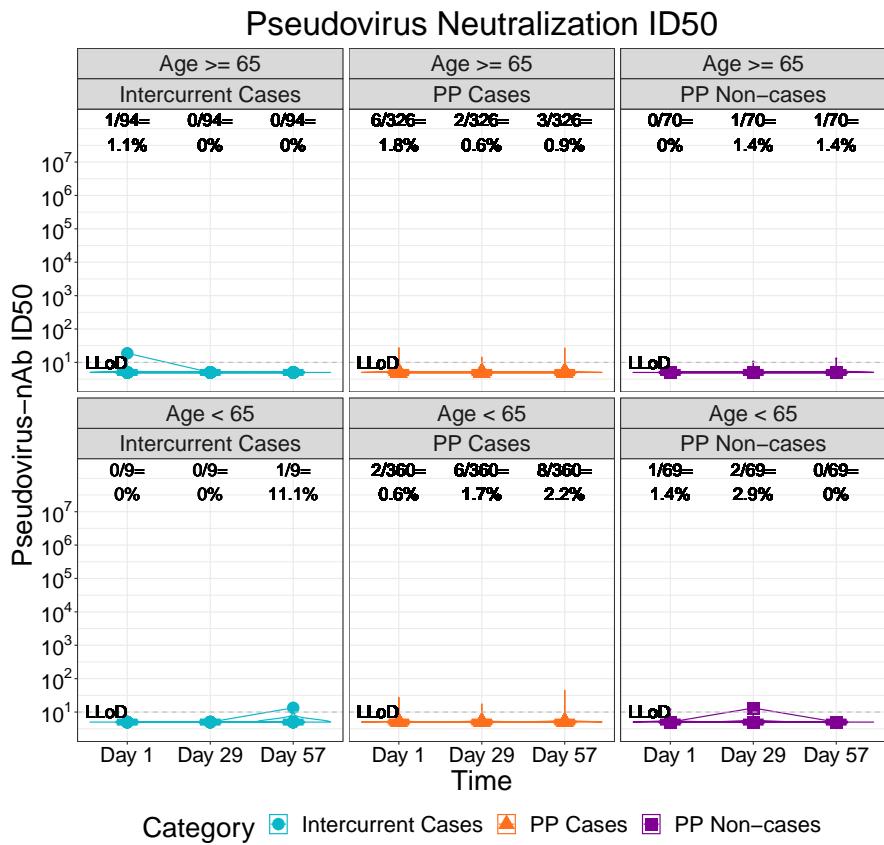


Figure 1.79: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints)

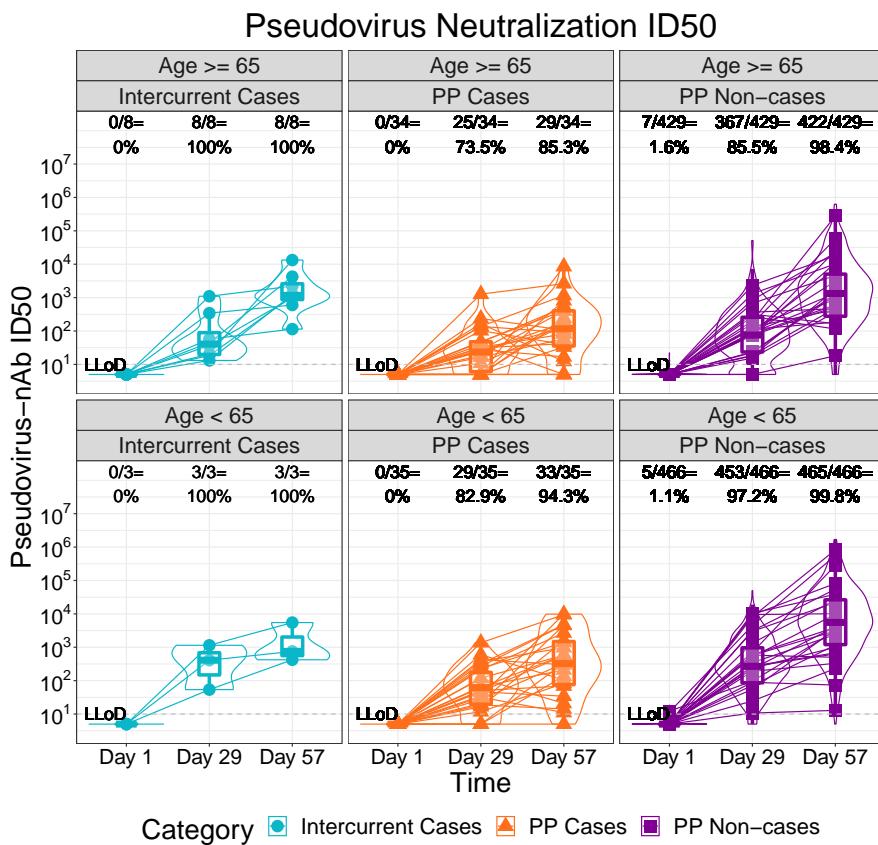


Figure 1.80: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints)

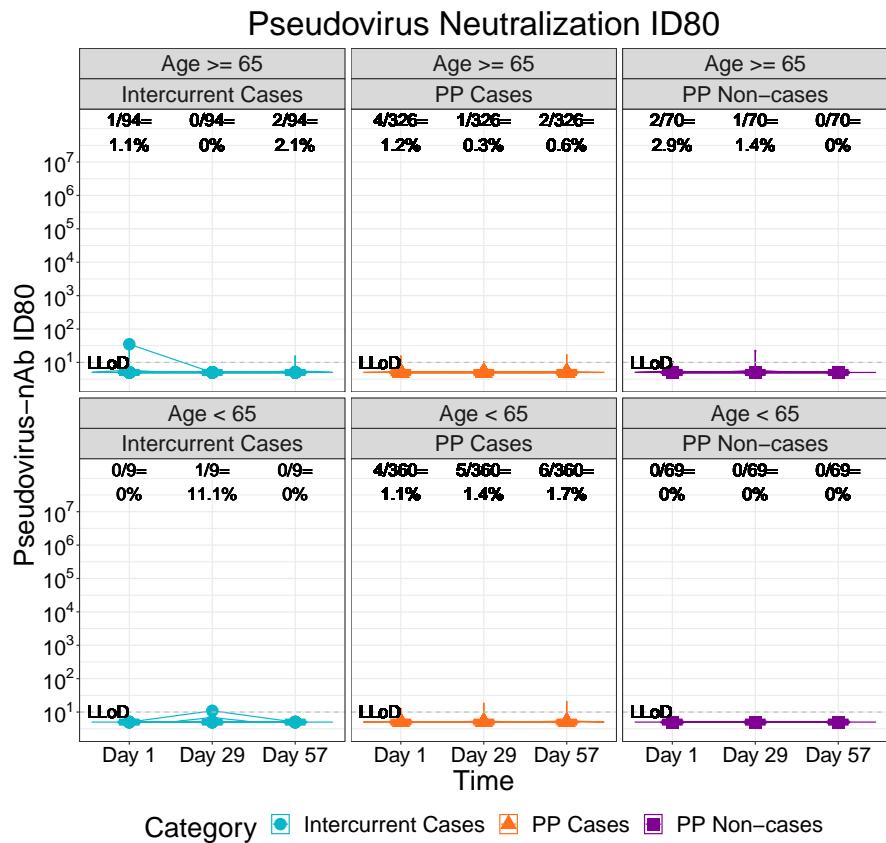


Figure 1.81: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints)

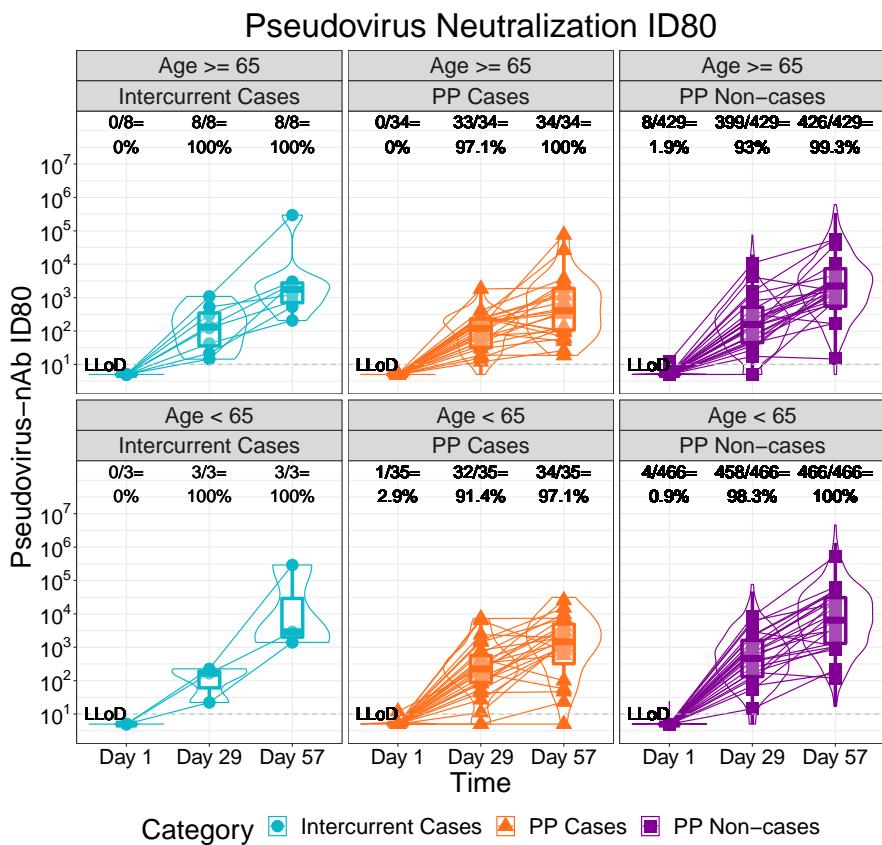


Figure 1.82: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints)

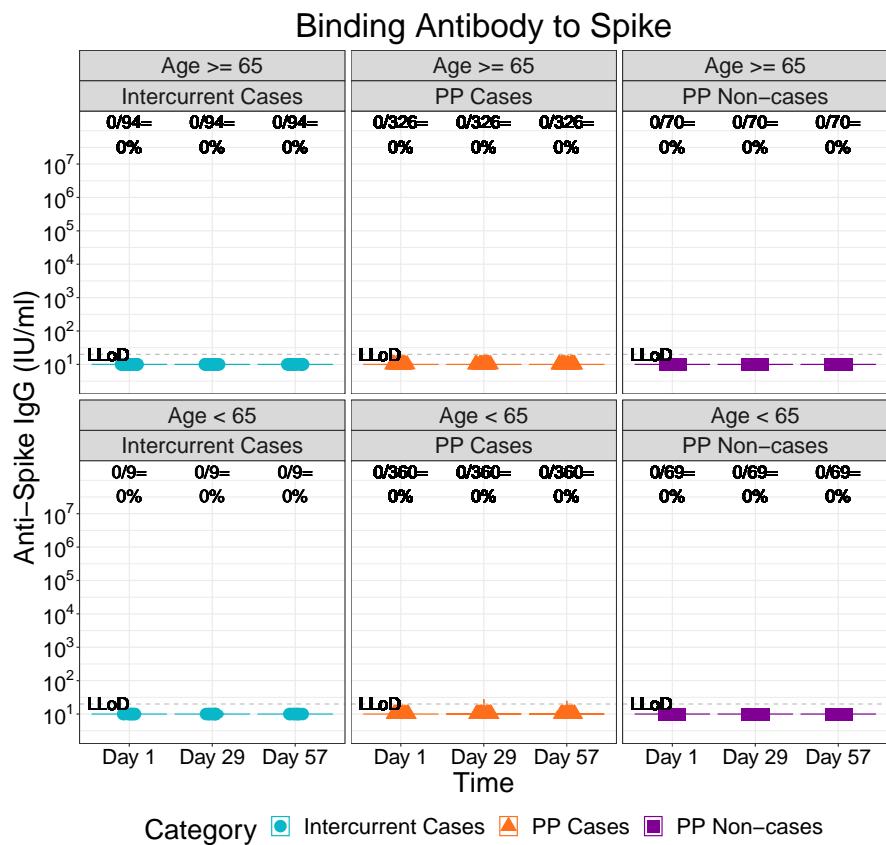


Figure 1.83: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age (3 timepoints)

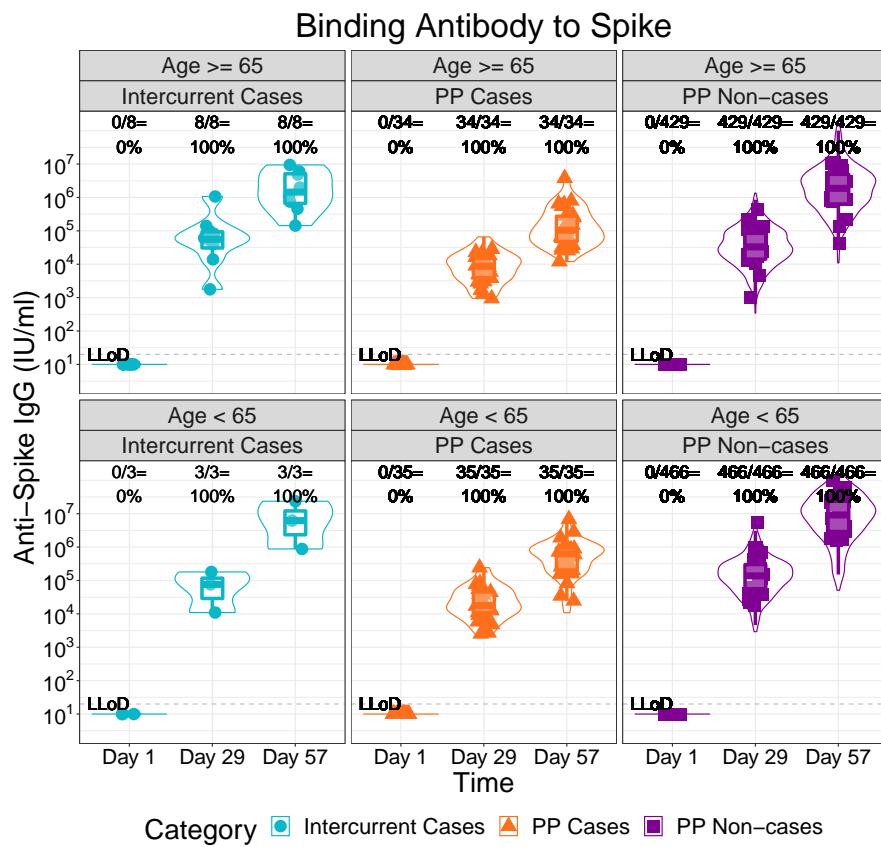


Figure 1.84: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age (3 timepoints)

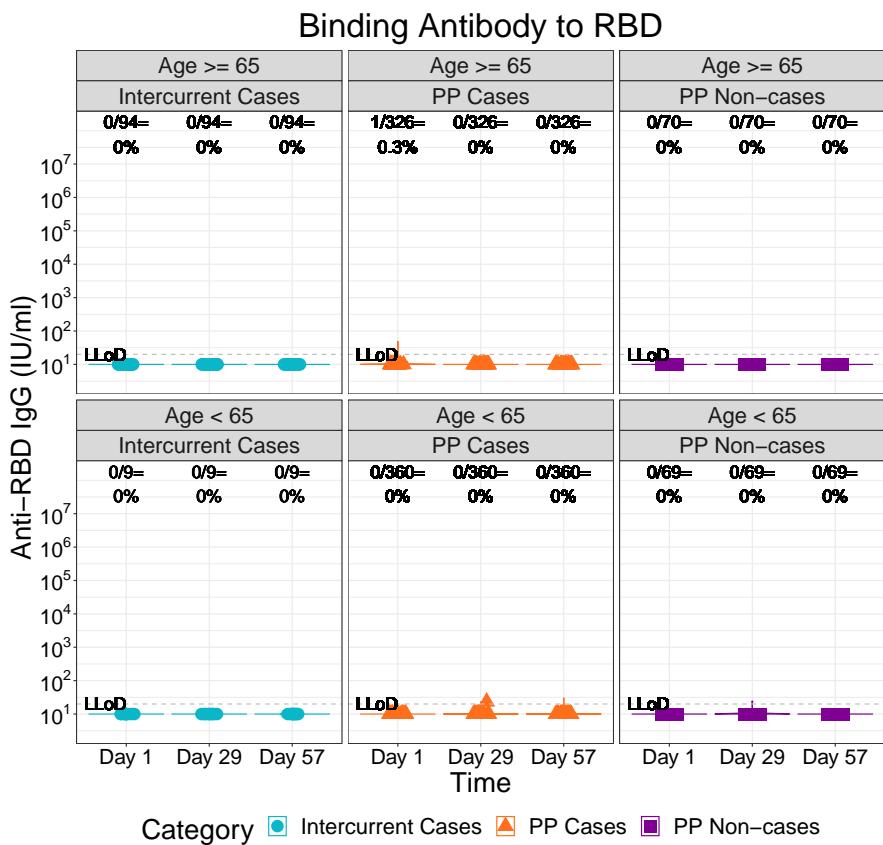


Figure 1.85: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age (3 timepoints)

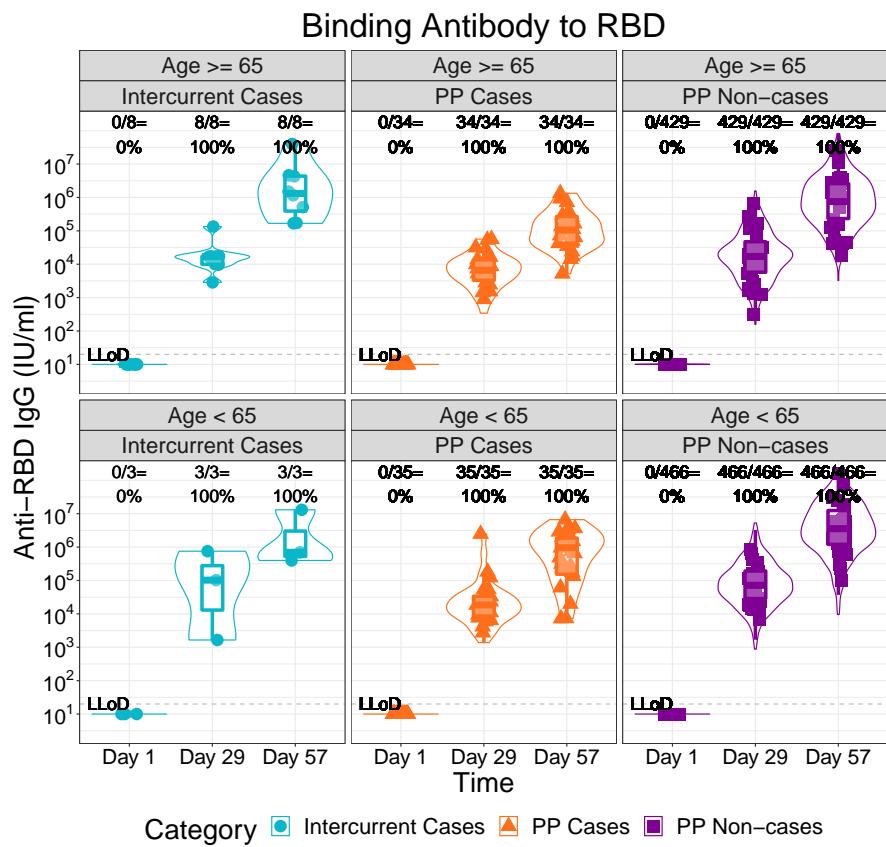


Figure 1.86: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age (3 timepoints)

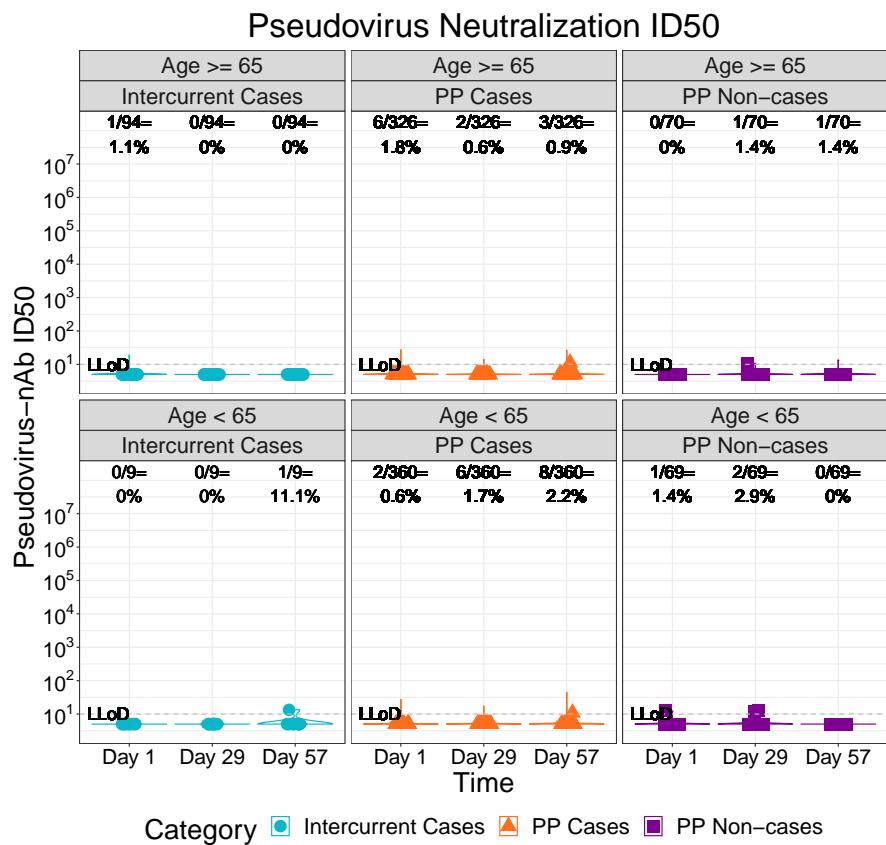


Figure 1.87: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age (3 timepoints)

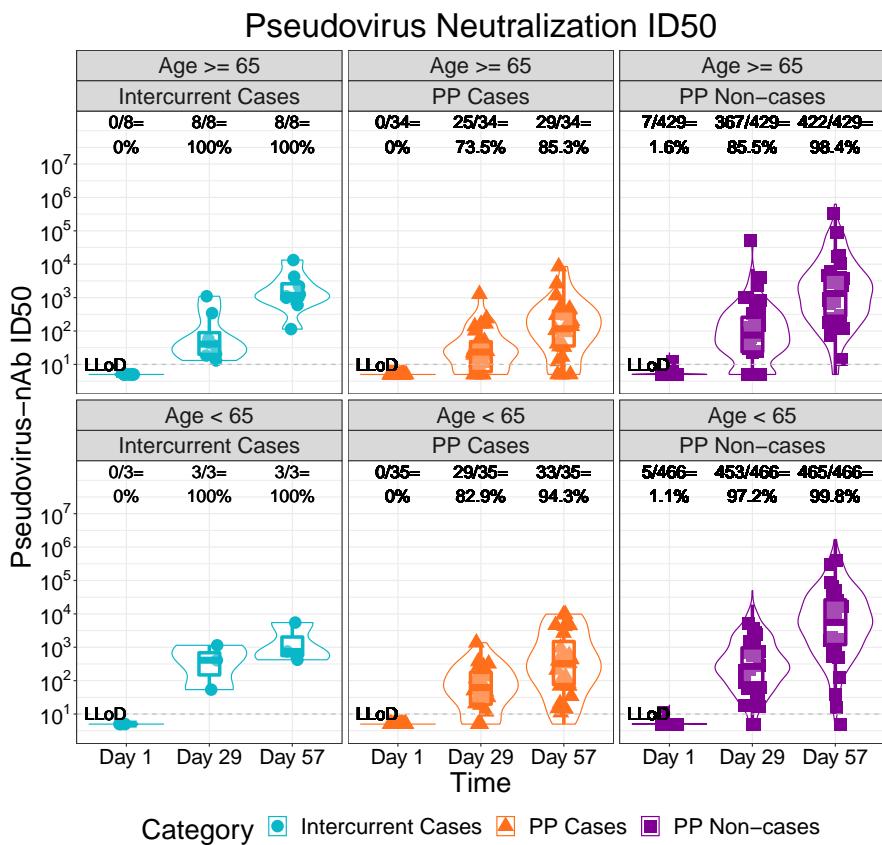


Figure 1.88: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age (3 timepoints)

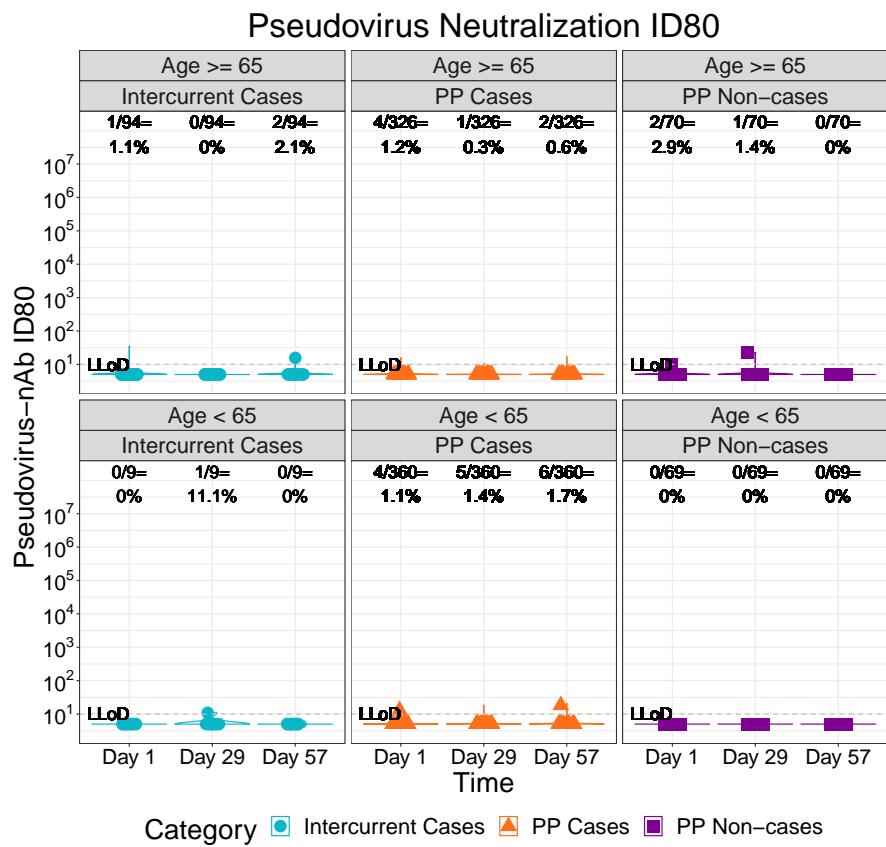


Figure 1.89: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age (3 timepoints)

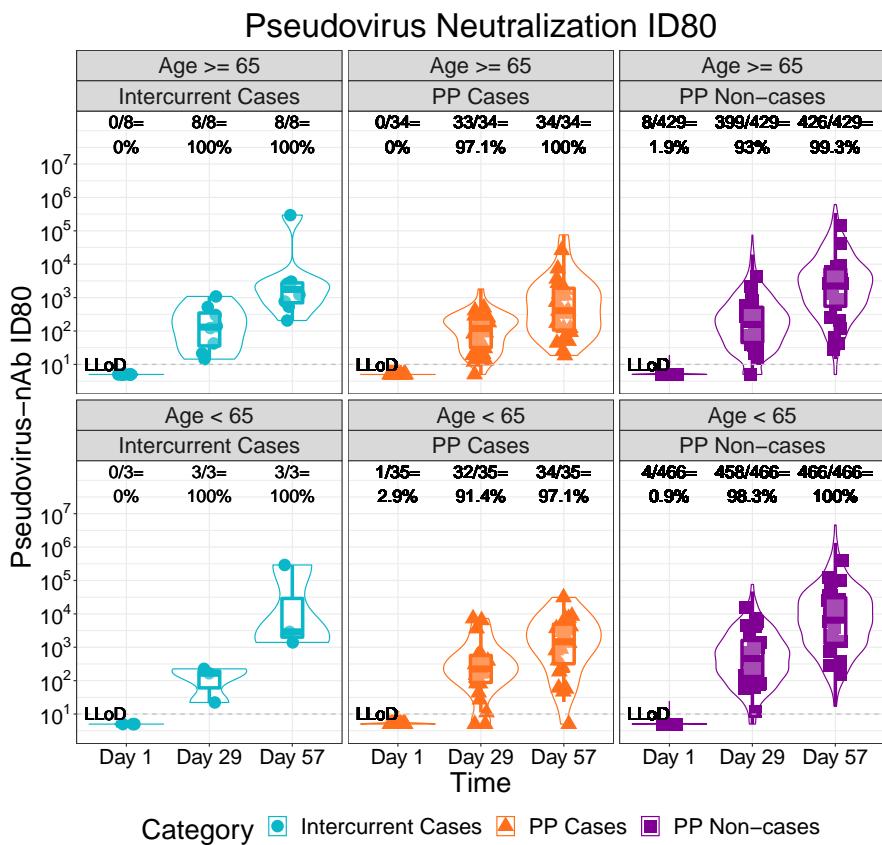


Figure 1.90: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age (3 timepoints)

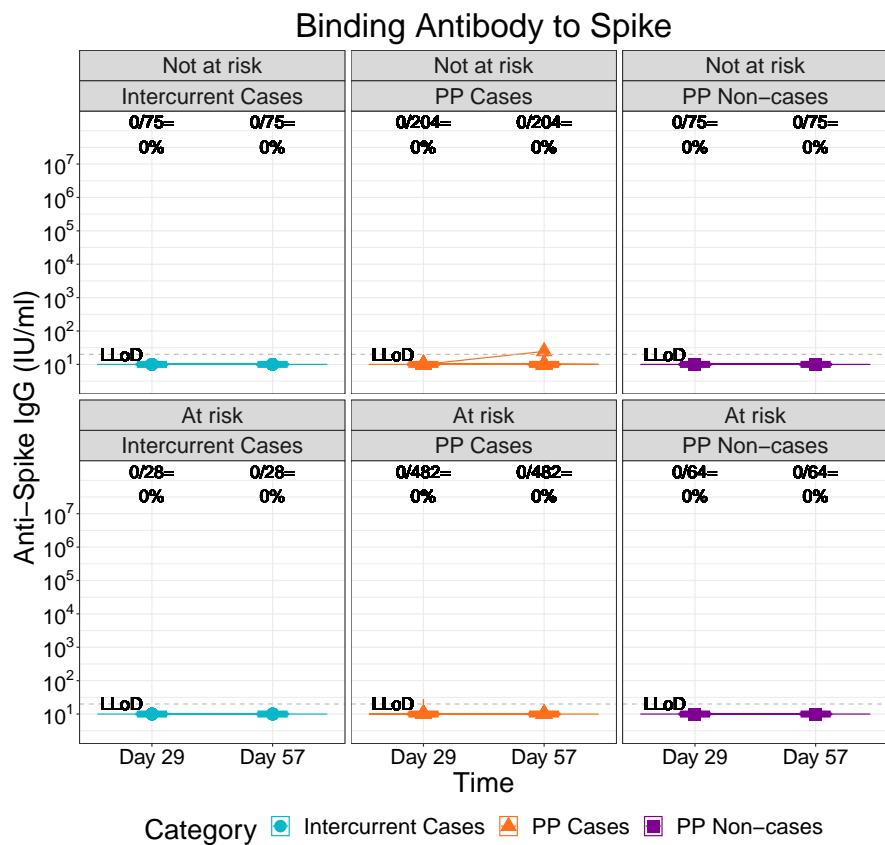


Figure 1.91: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints)

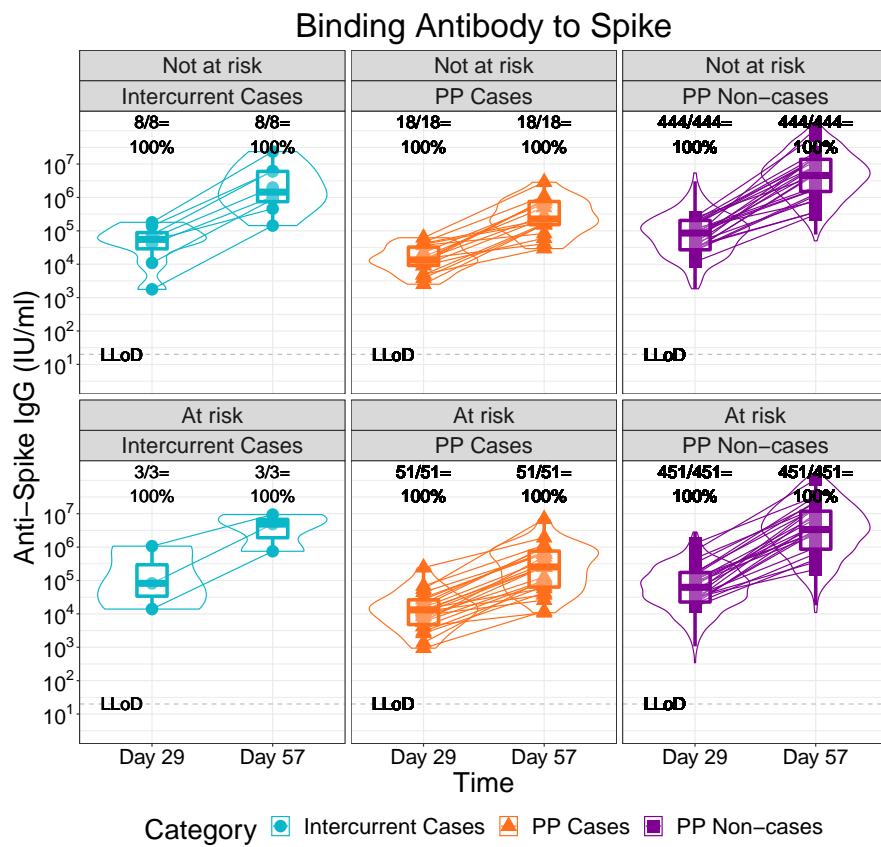


Figure 1.92: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints)

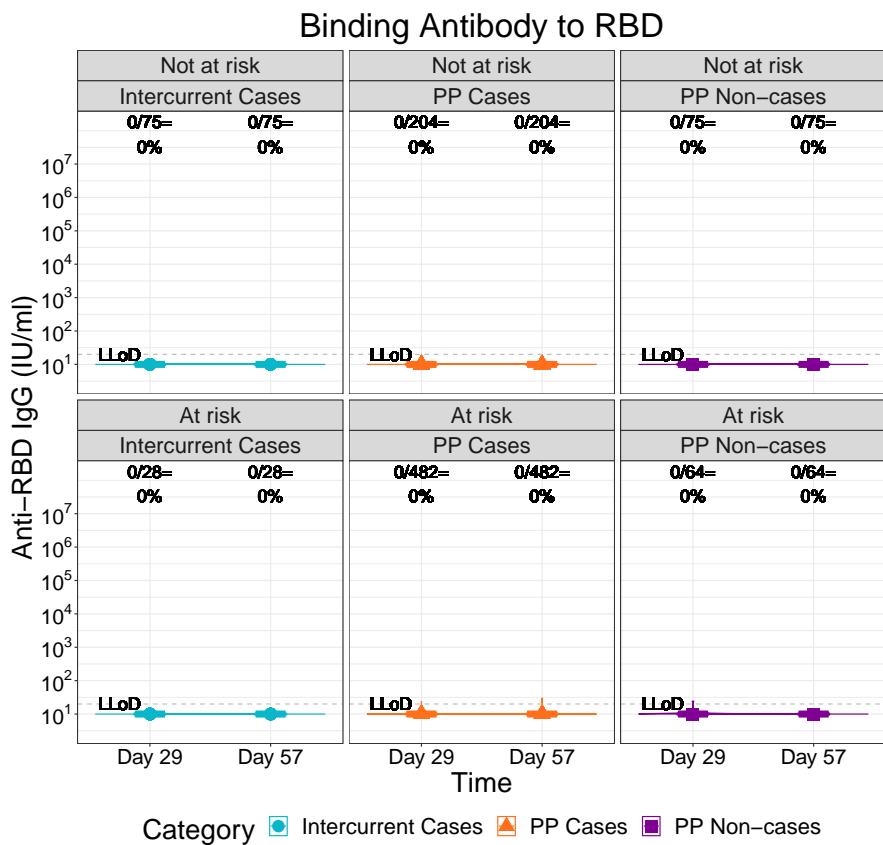


Figure 1.93: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints)

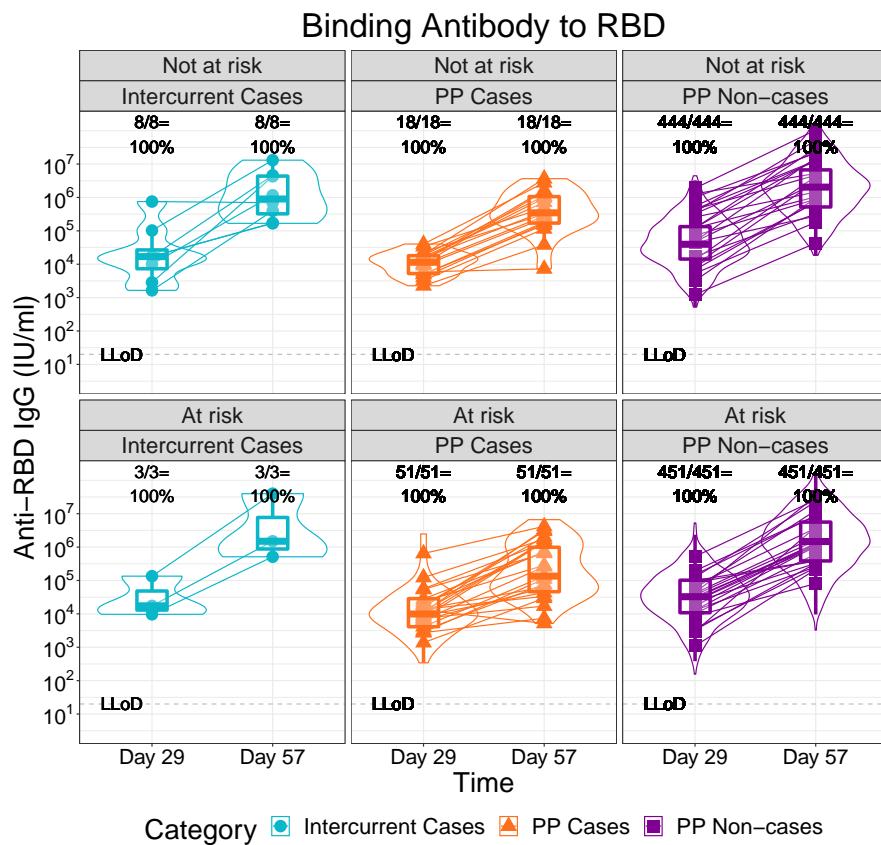


Figure 1.94: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints)

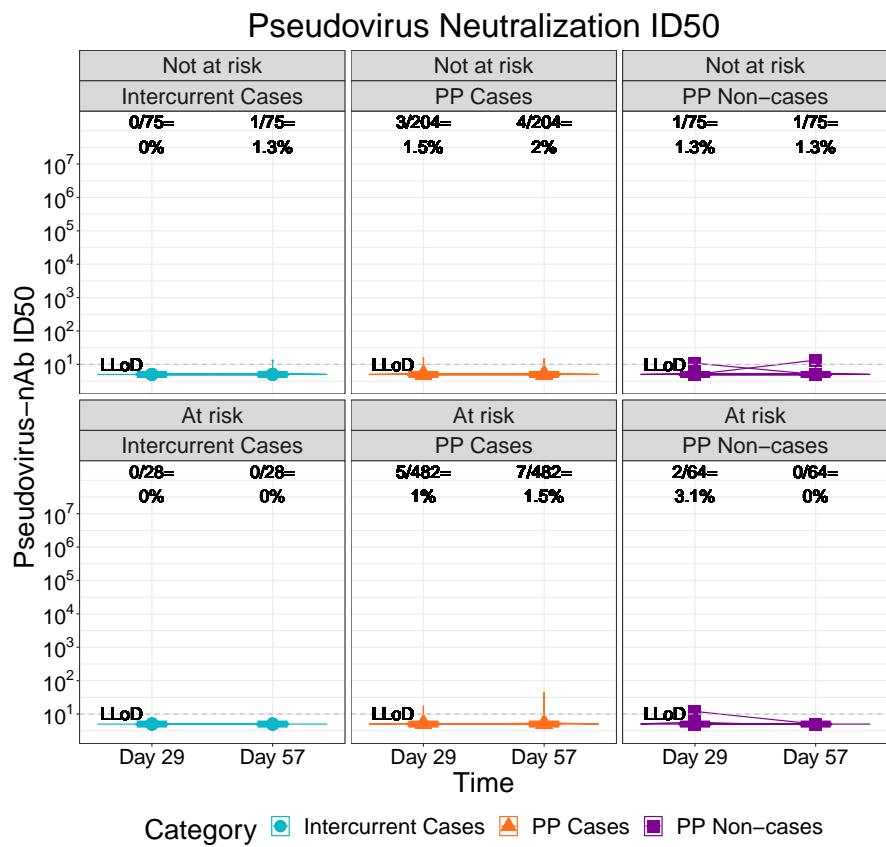


Figure 1.95: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints)

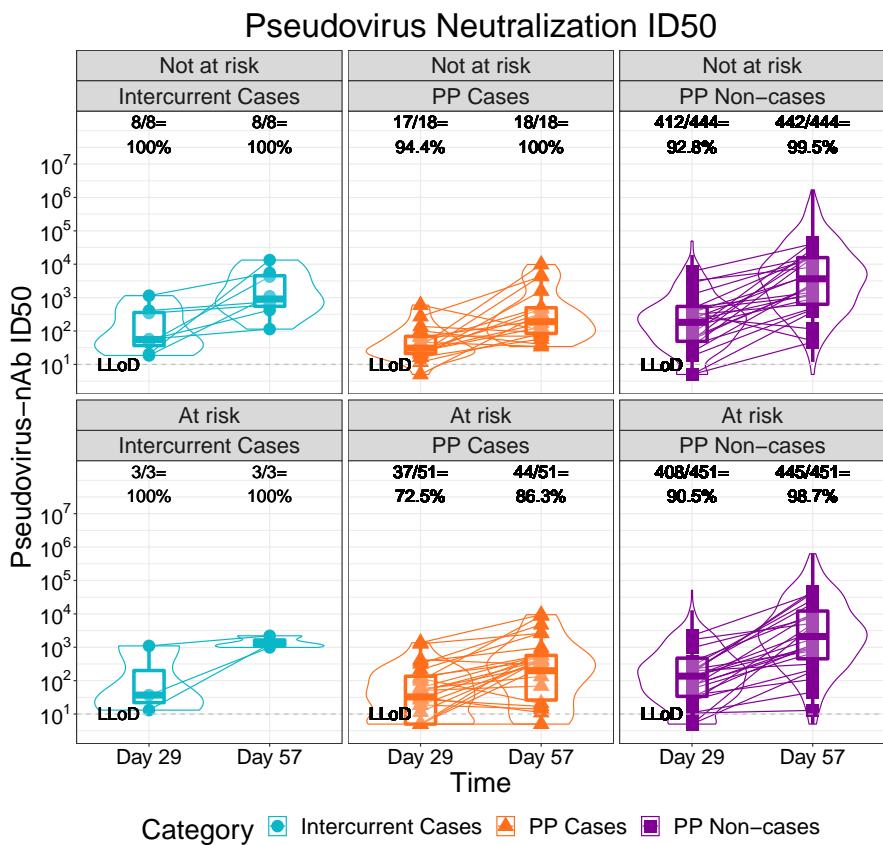


Figure 1.96: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints)

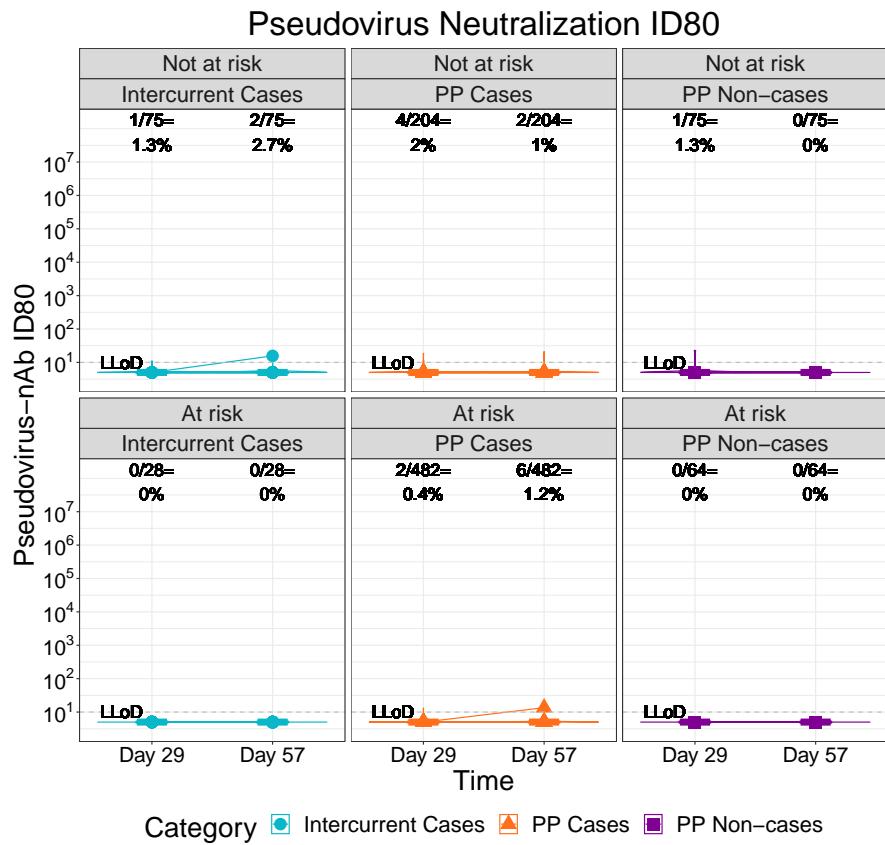


Figure 1.97: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints)

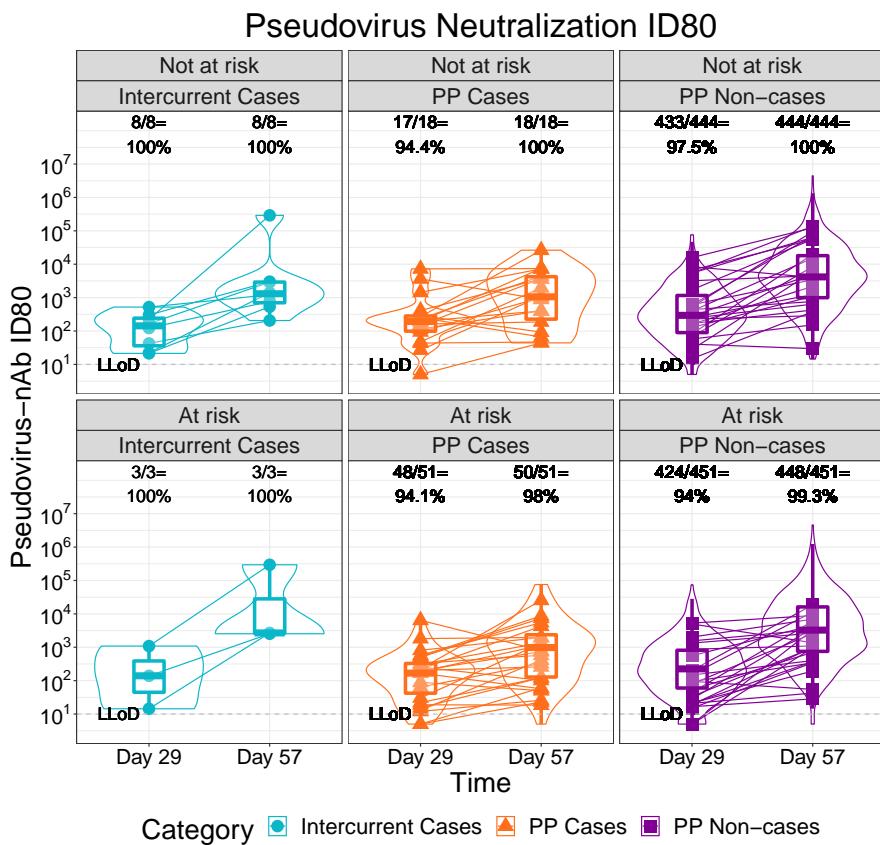


Figure 1.98: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints)

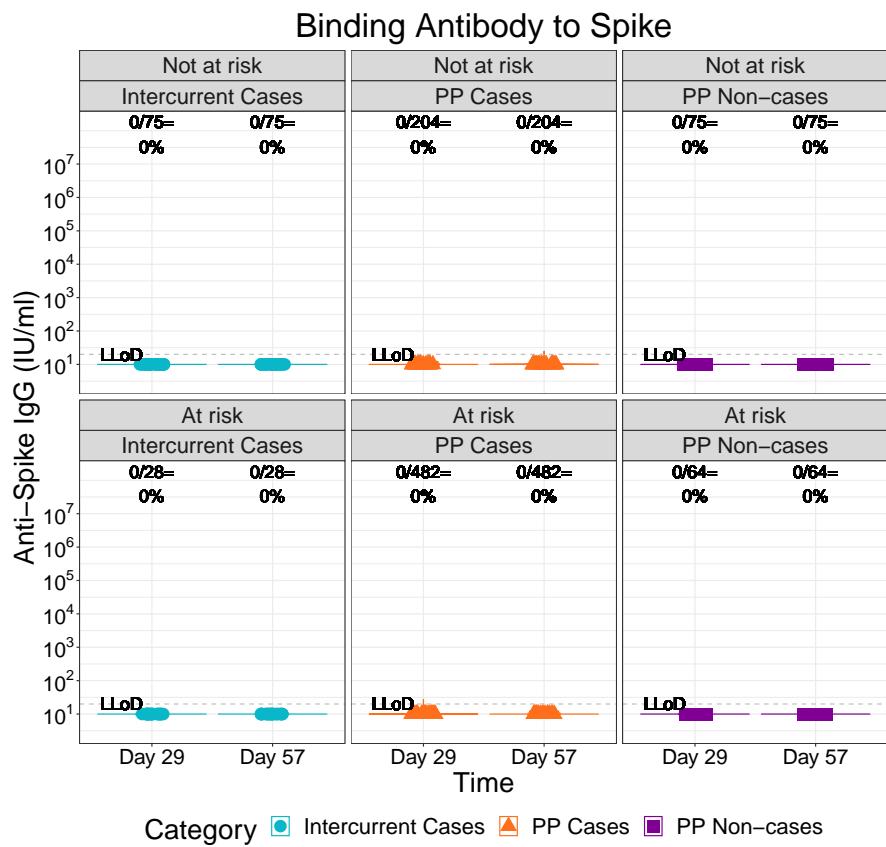


Figure 1.99: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (2 timepoints)

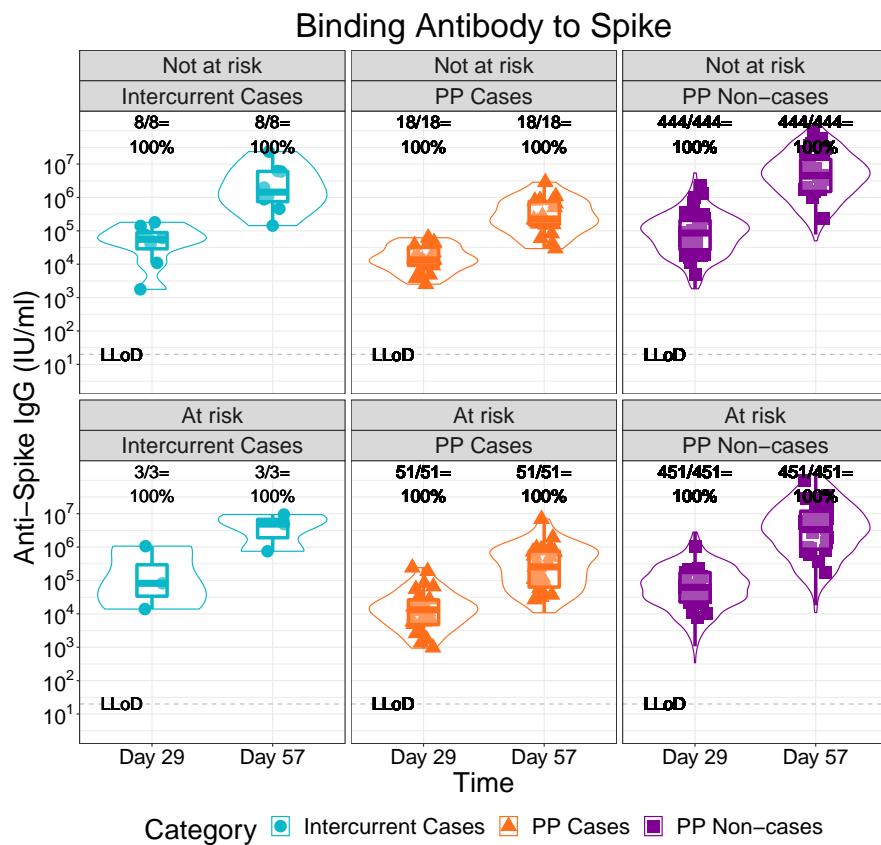


Figure 1.100: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (2 timepoints)

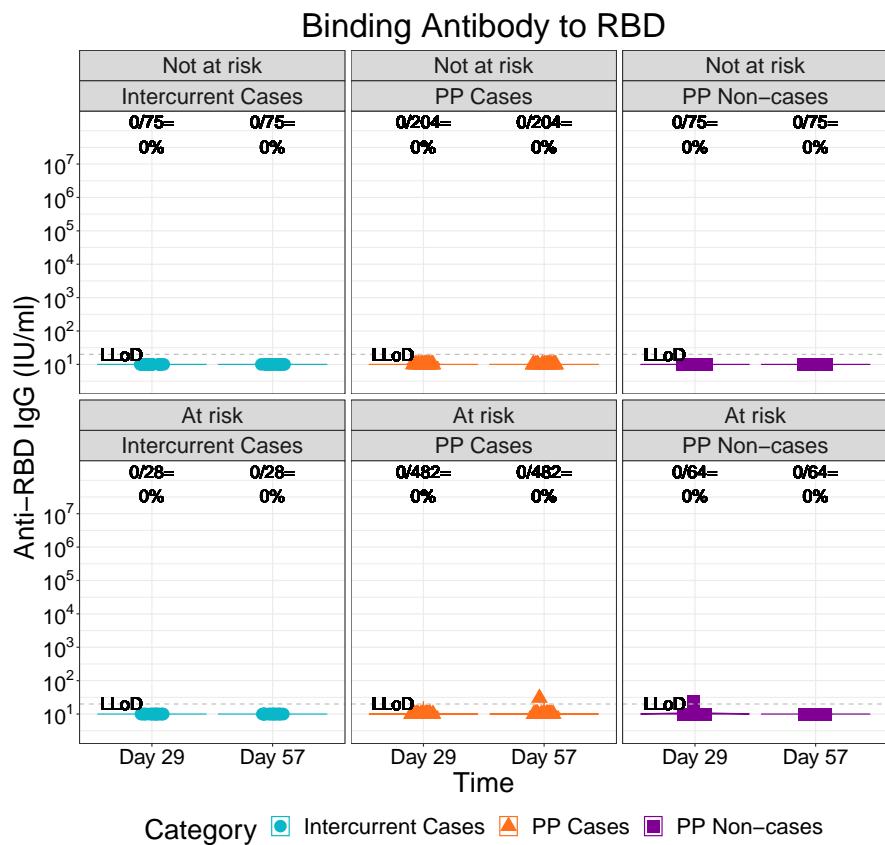


Figure 1.101: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (2 timepoints)

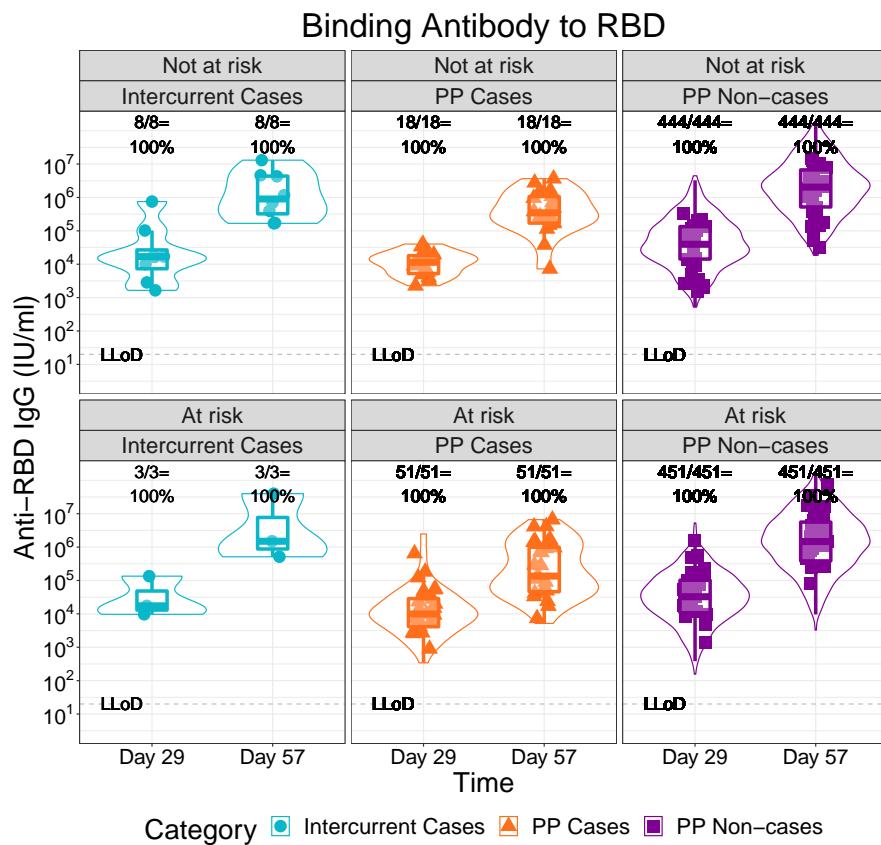


Figure 1.102: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (2 timepoints)

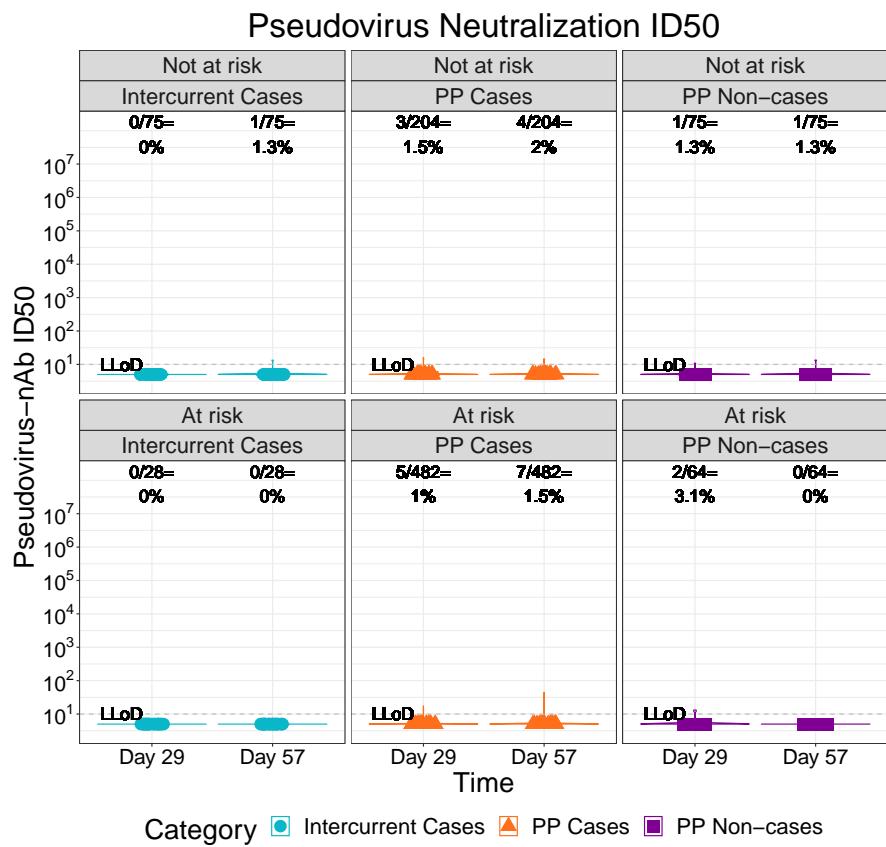


Figure 1.103: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (2 timepoints)

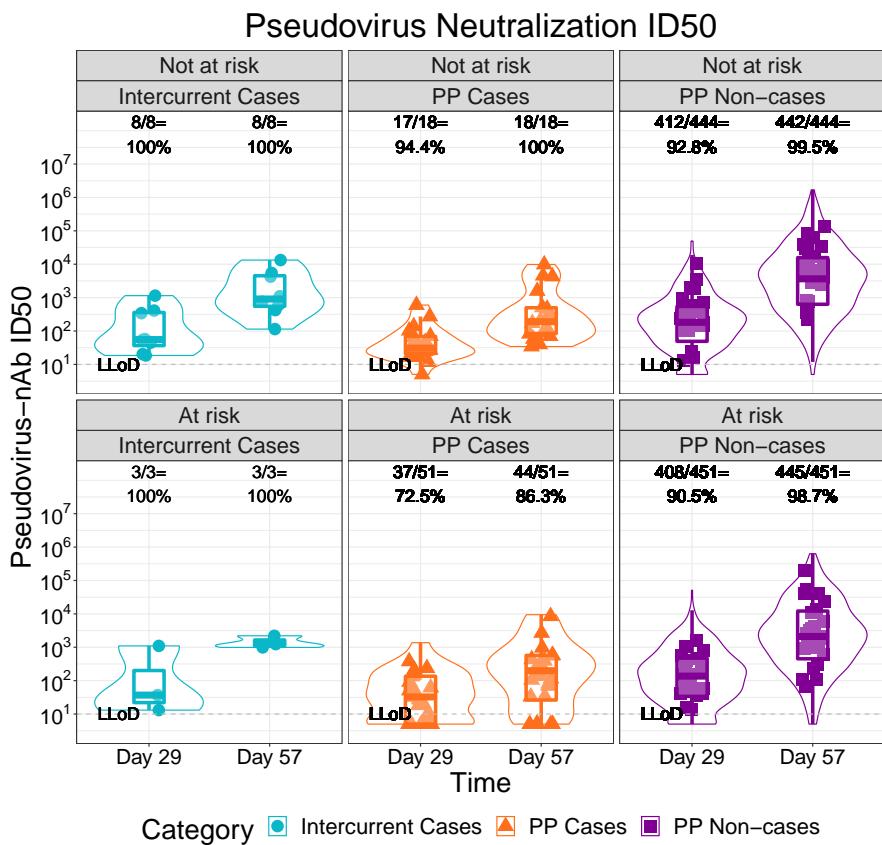


Figure 1.104: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (2 timepoints)

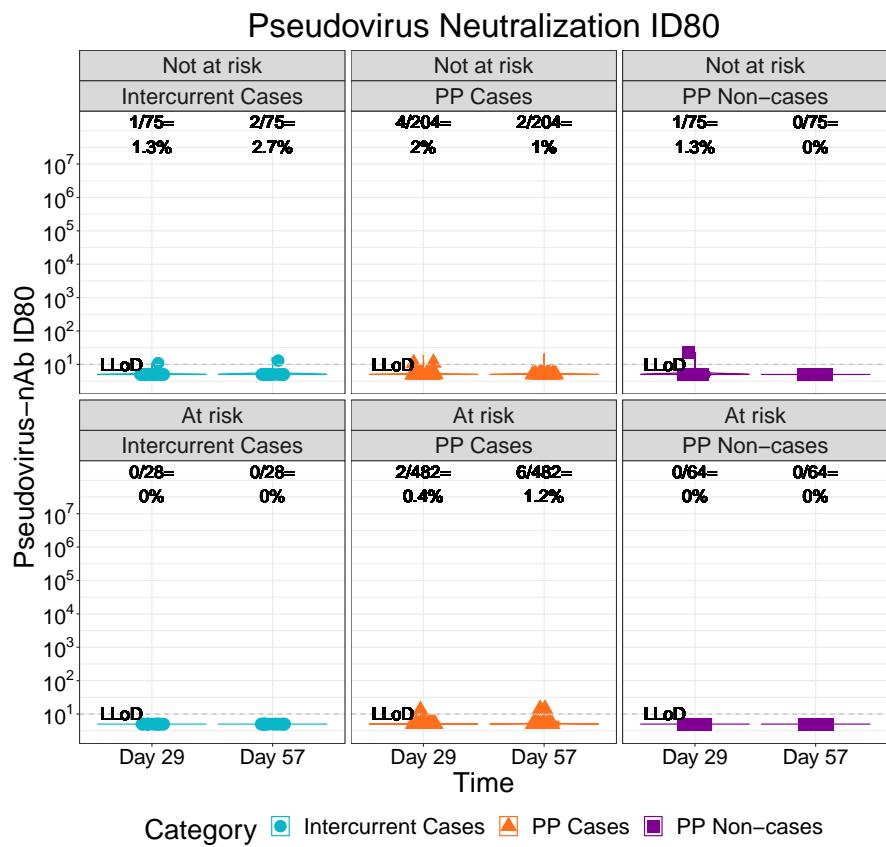


Figure 1.105: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (2 timepoints)

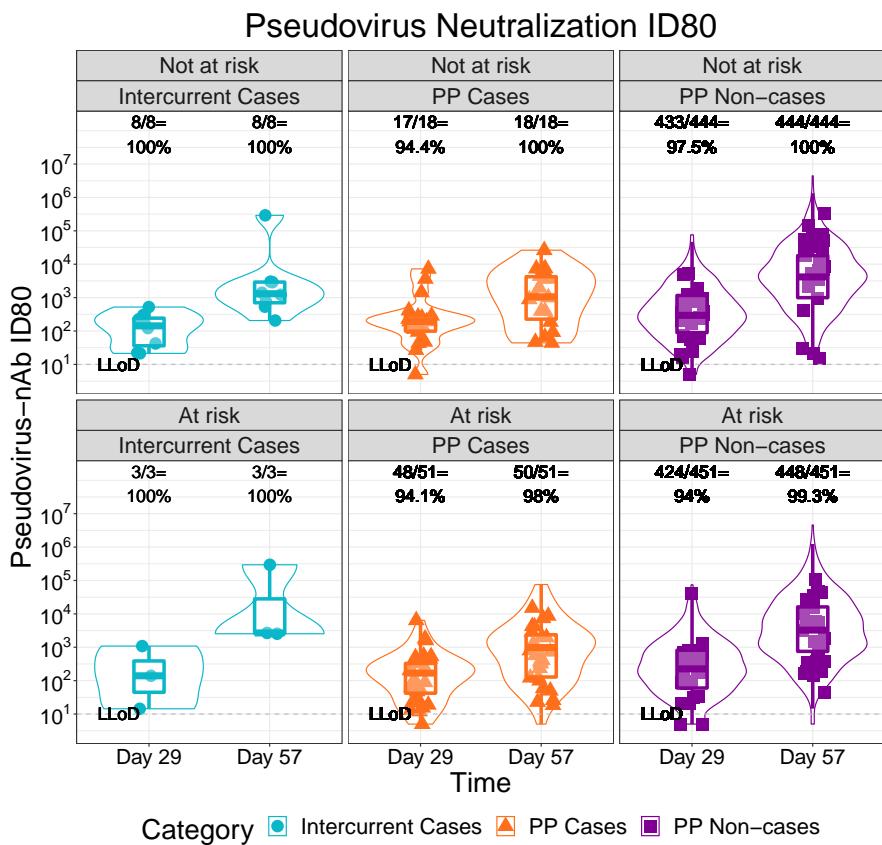


Figure 1.106: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (2 timepoints)

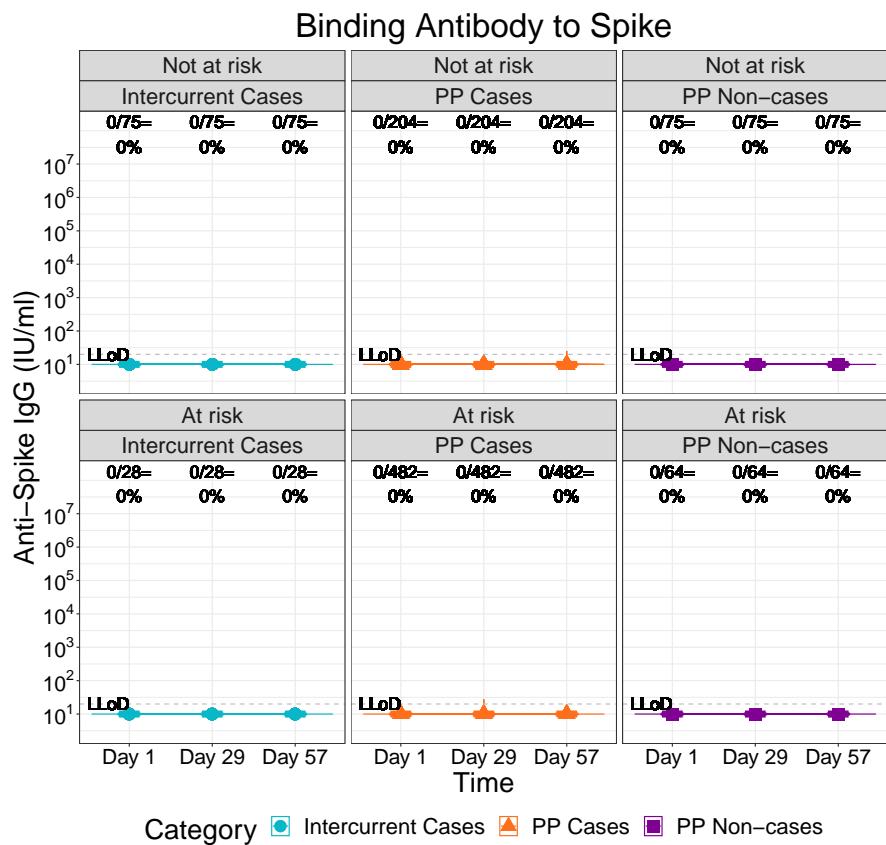


Figure 1.107: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints)

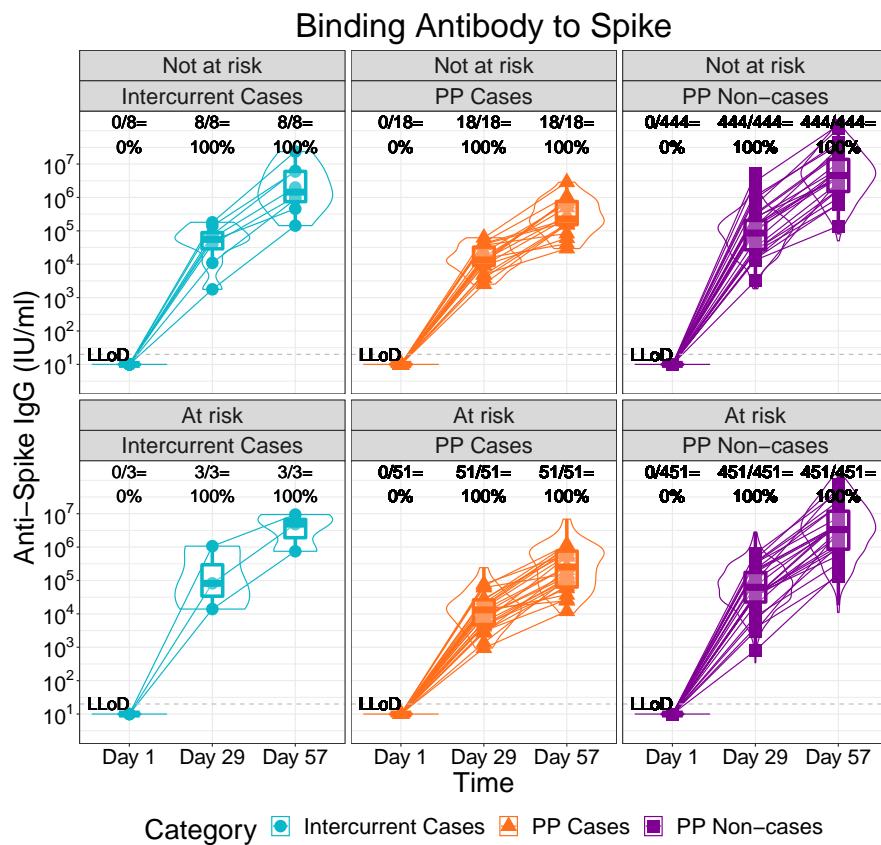


Figure 1.108: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints)

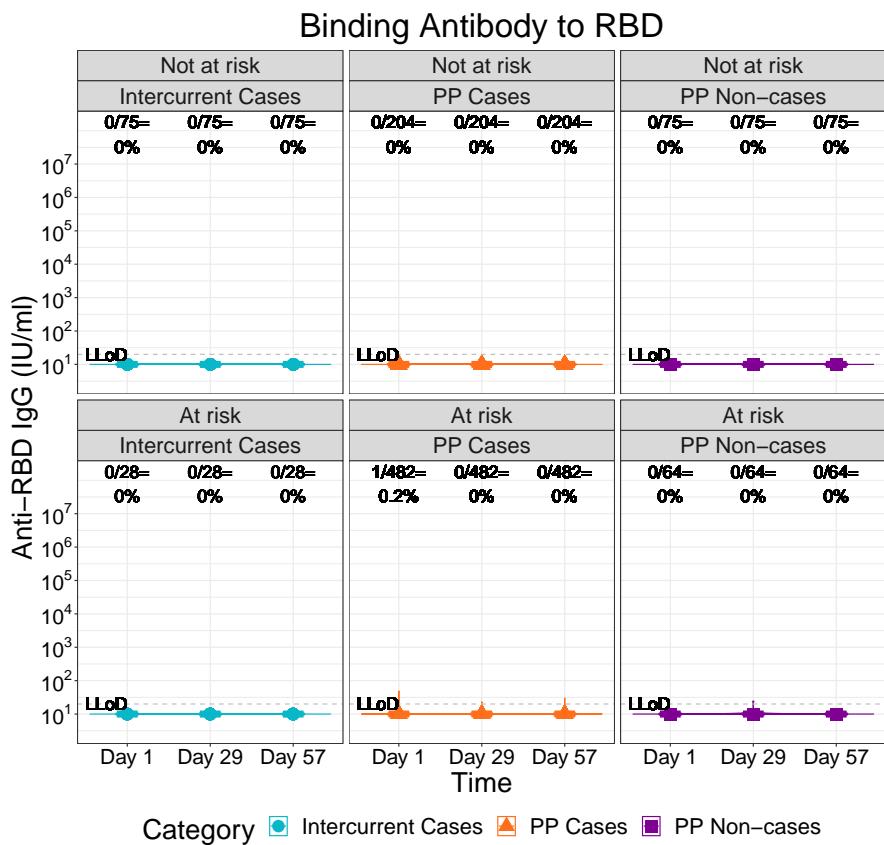


Figure 1.109: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints)

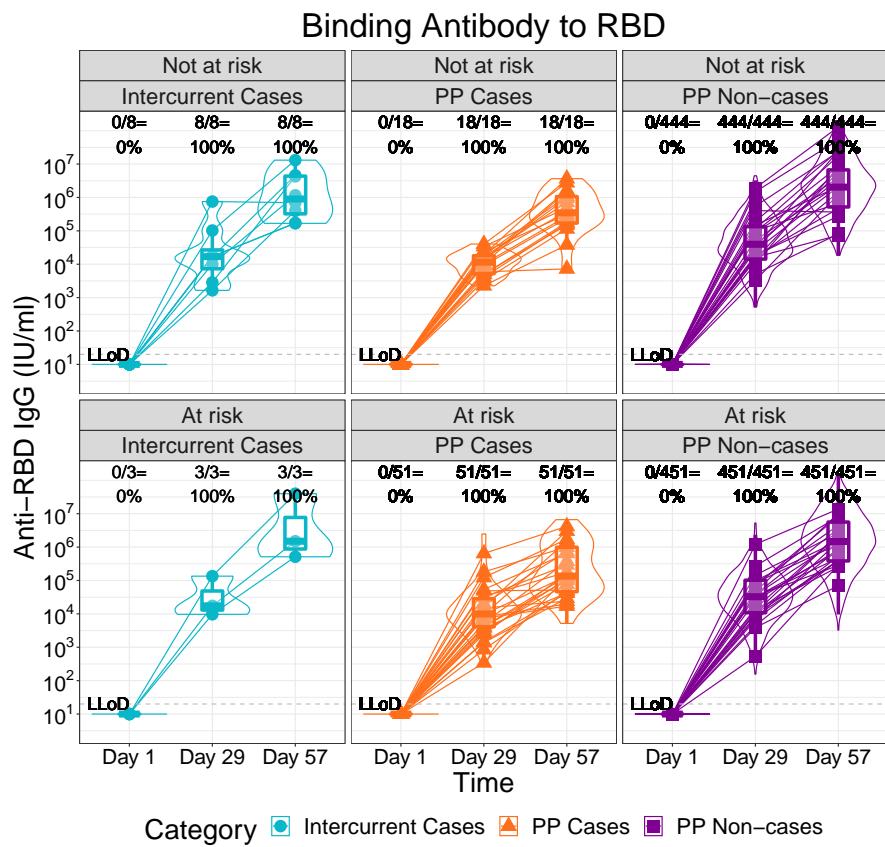


Figure 1.110: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints)

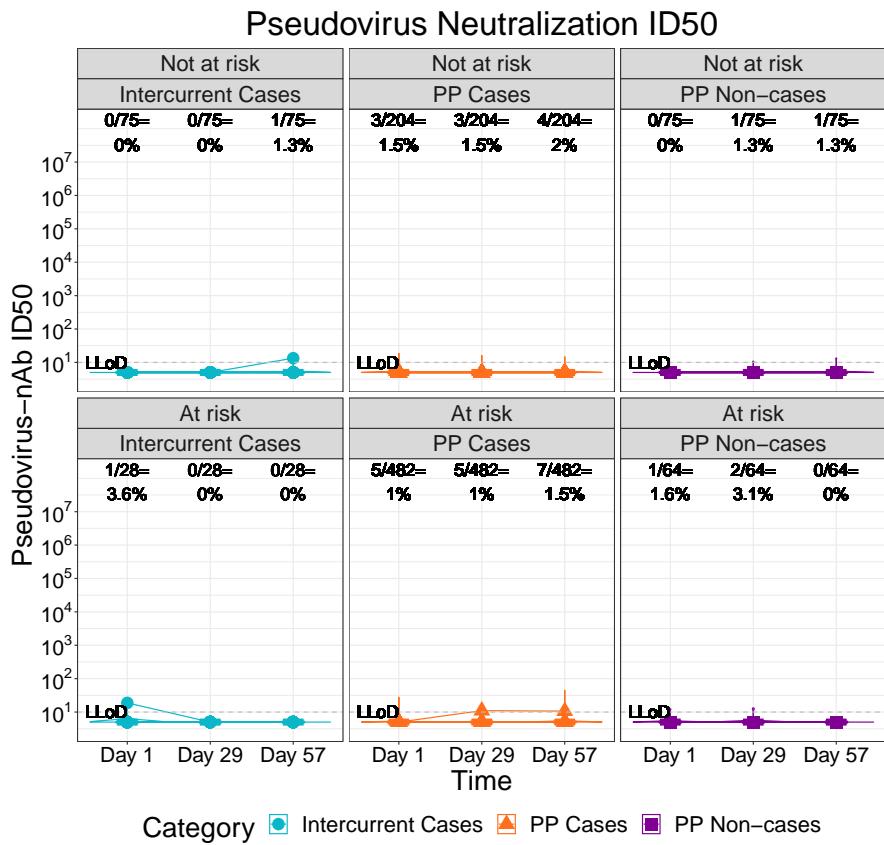


Figure 1.111: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints)

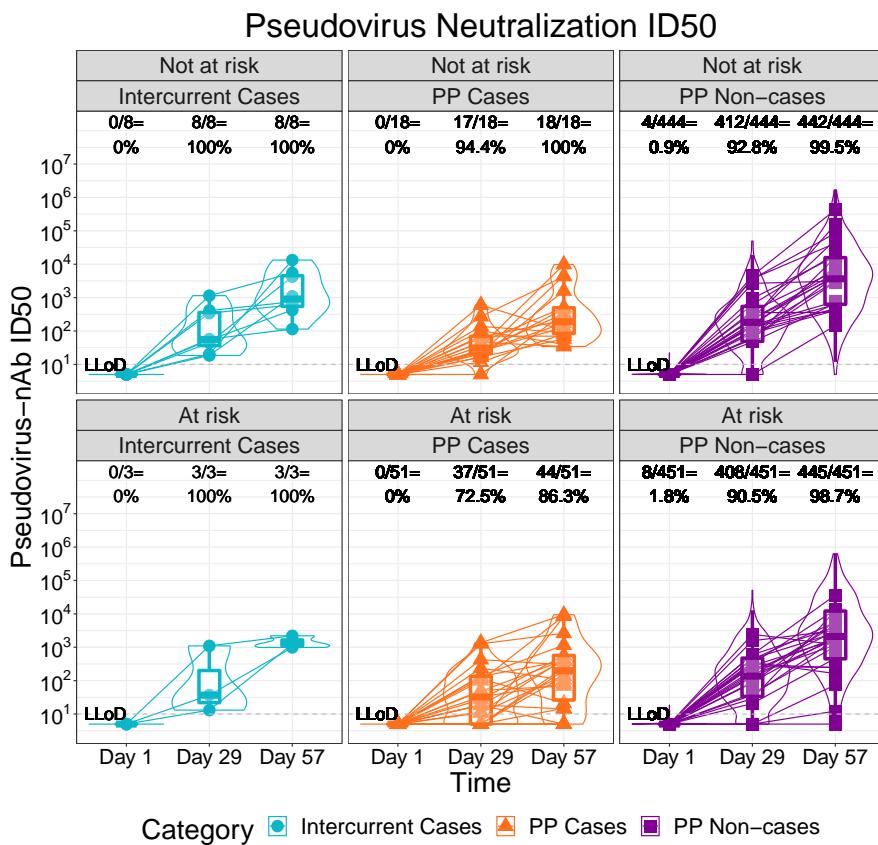


Figure 1.112: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints)

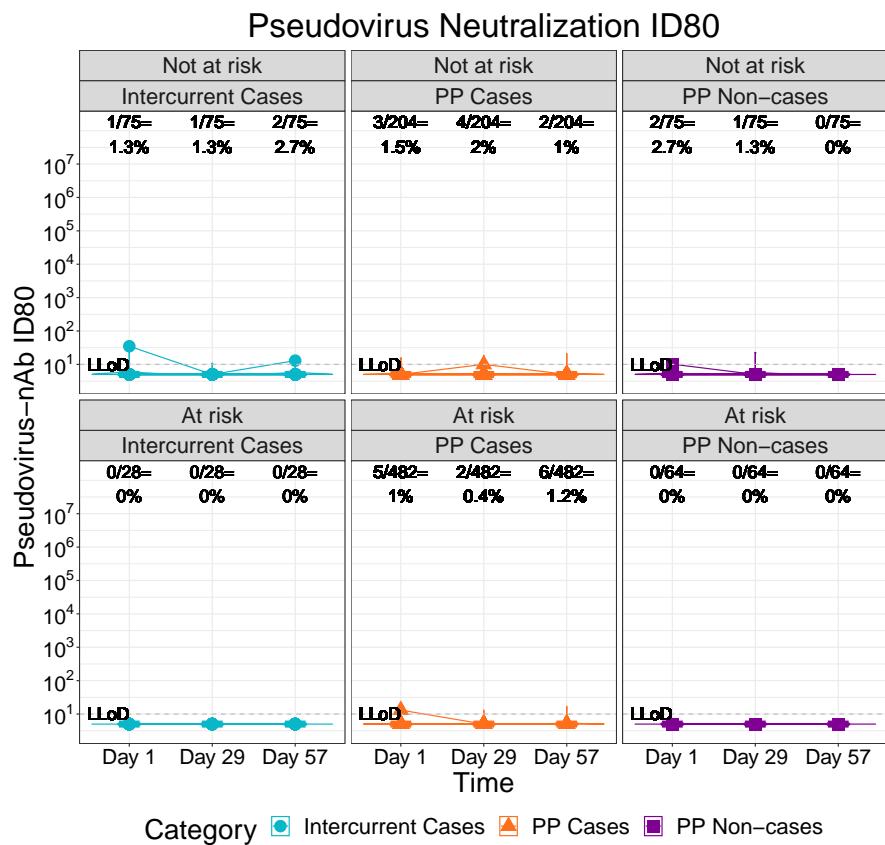


Figure 1.113: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints)

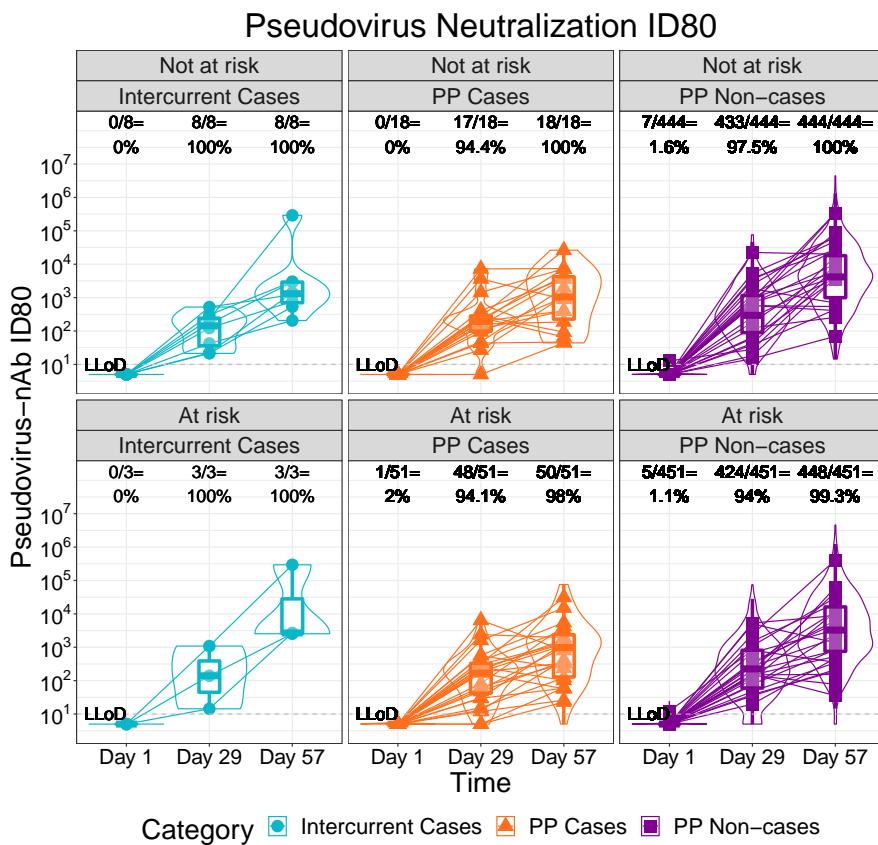


Figure 1.114: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints)

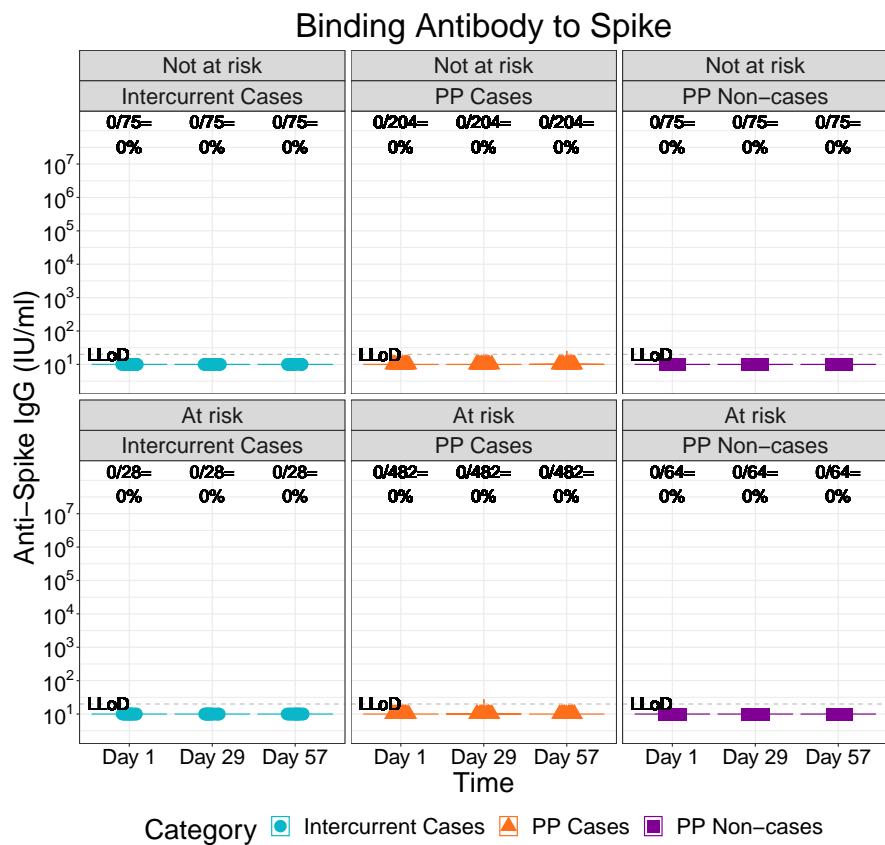


Figure 1.115: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by risk condition (3 timepoints)

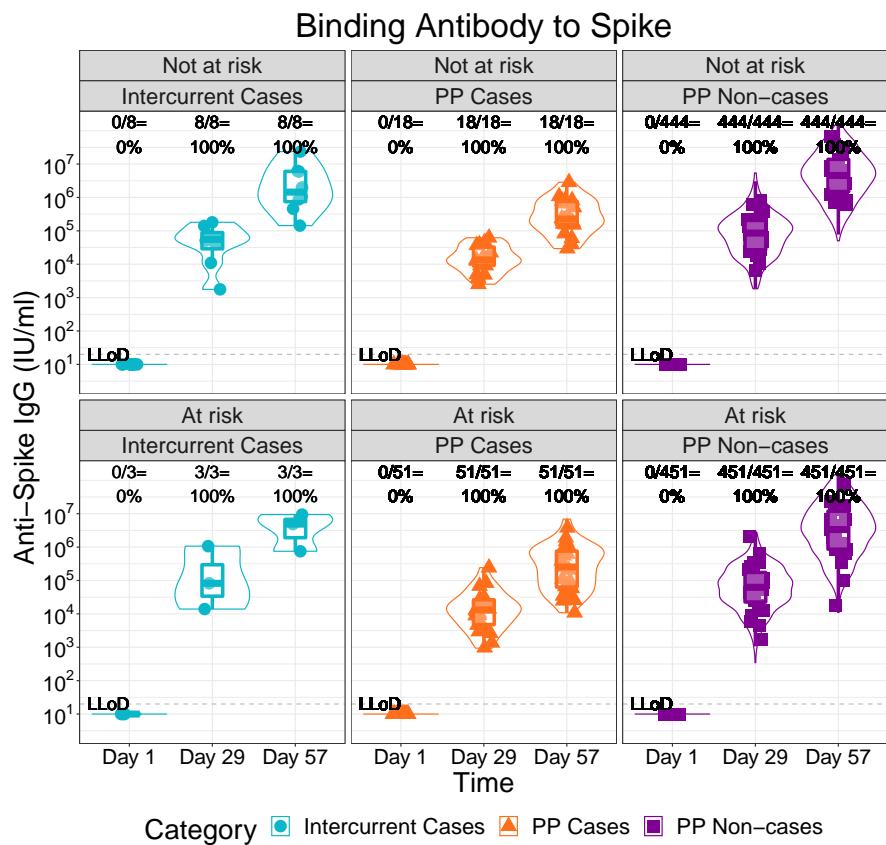


Figure 1.116: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by risk condition (3 timepoints)

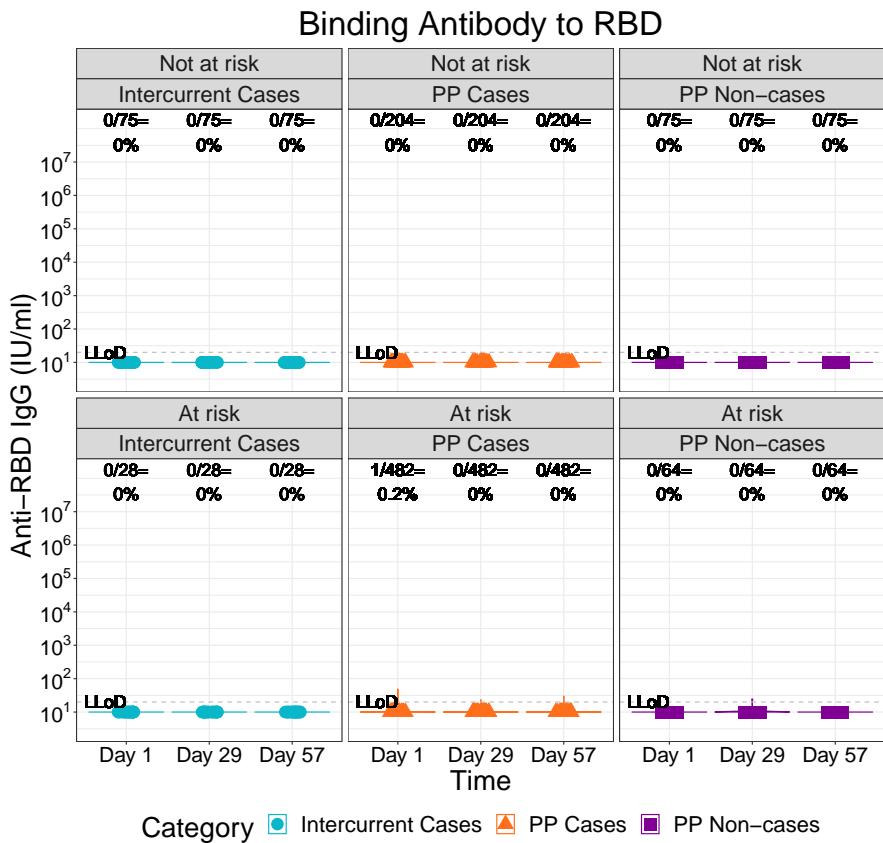


Figure 1.117: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by risk condition (3 timepoints)

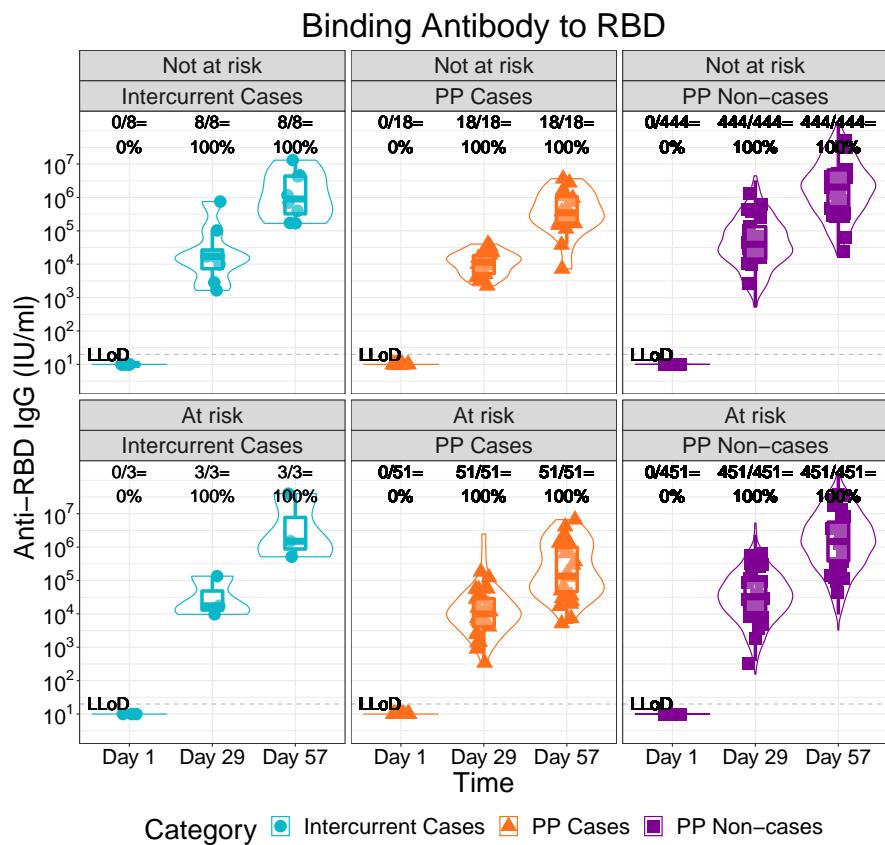


Figure 1.118: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by risk condition (3 timepoints)

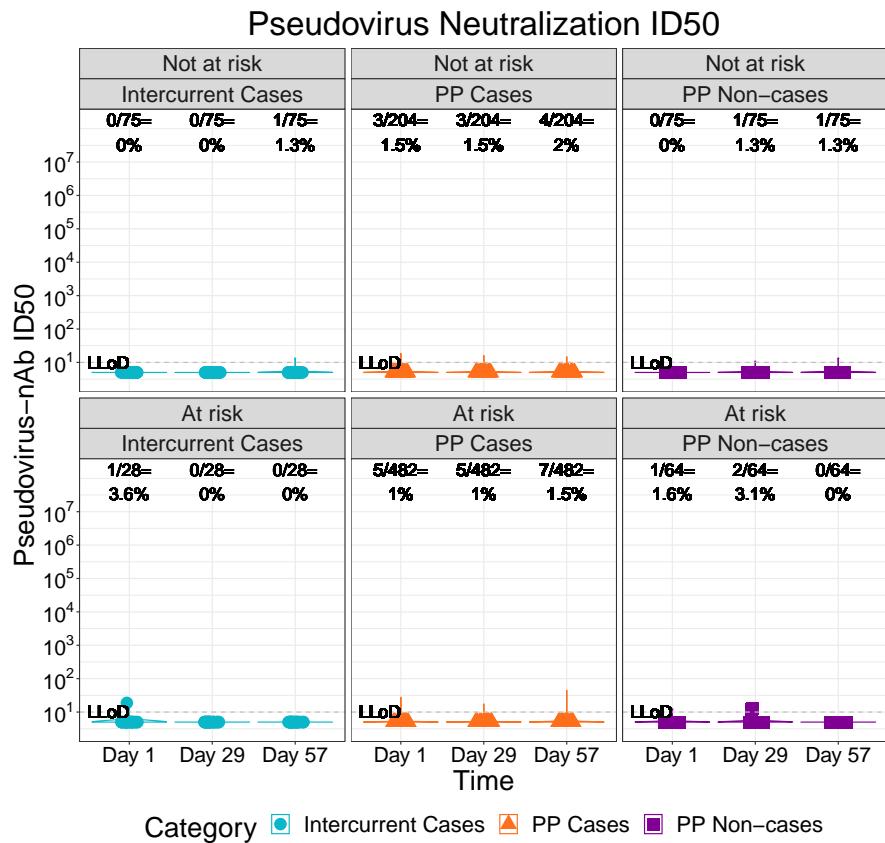


Figure 1.119: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by risk condition (3 timepoints)

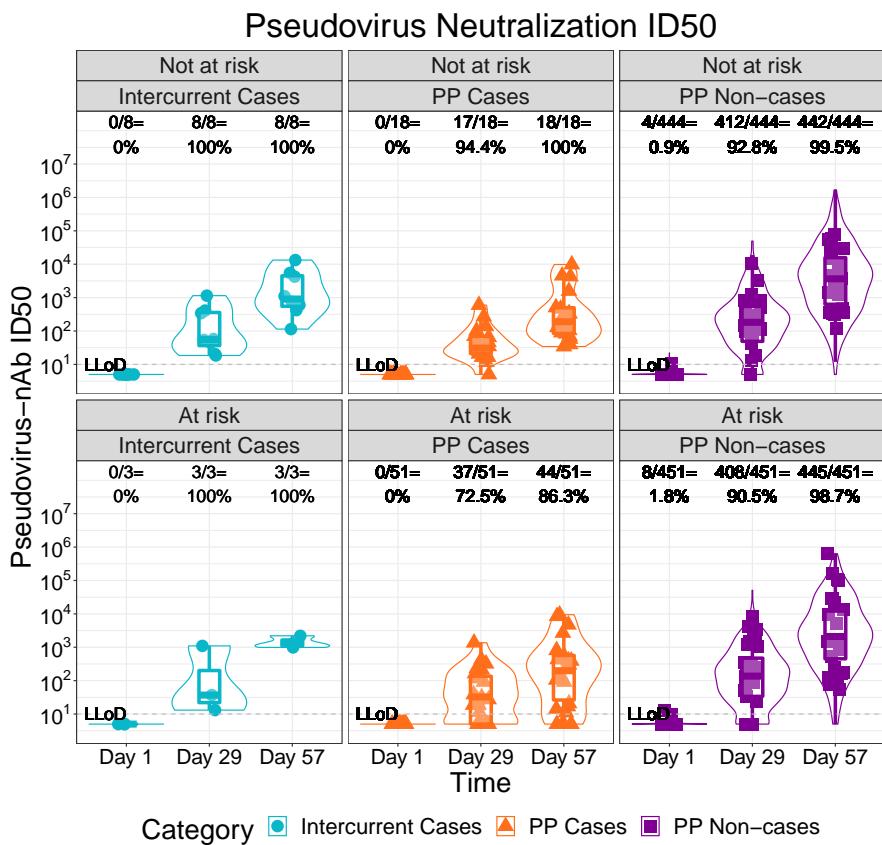


Figure 1.120: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by risk condition (3 timepoints)

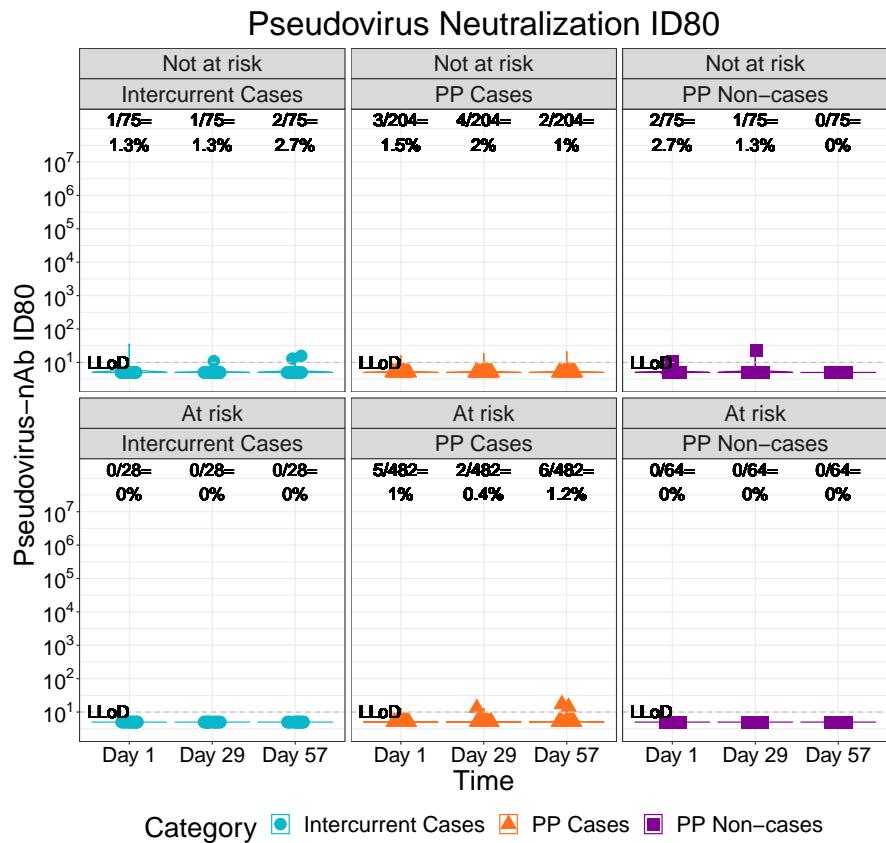


Figure 1.121: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by risk condition (3 timepoints)

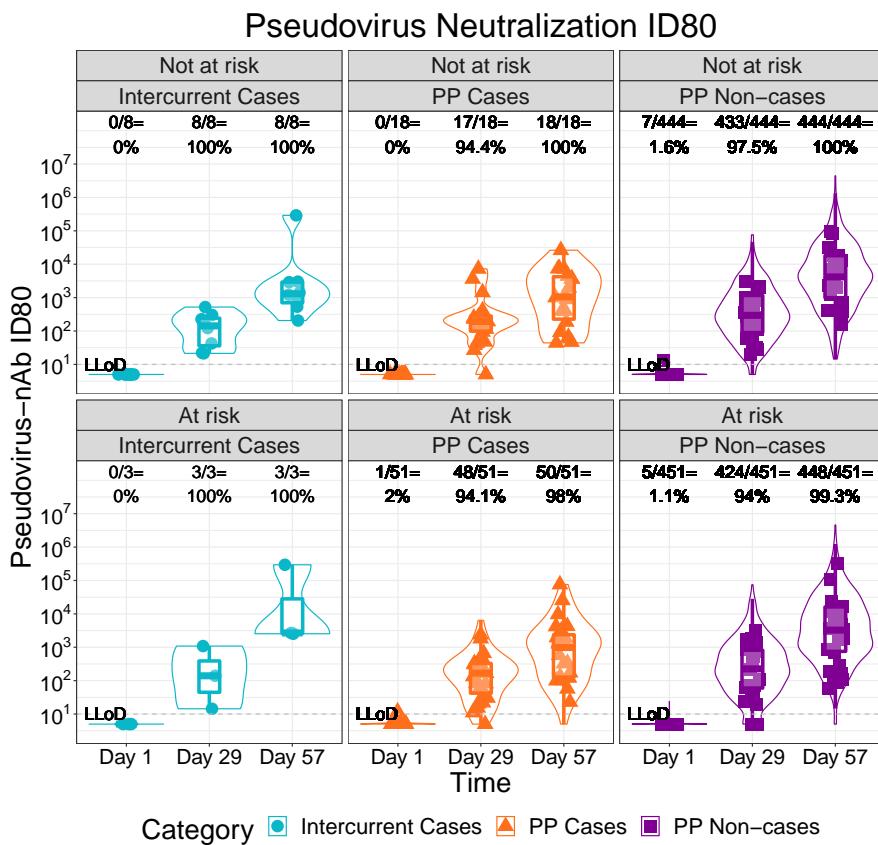


Figure 1.122: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by risk condition (3 timepoints)

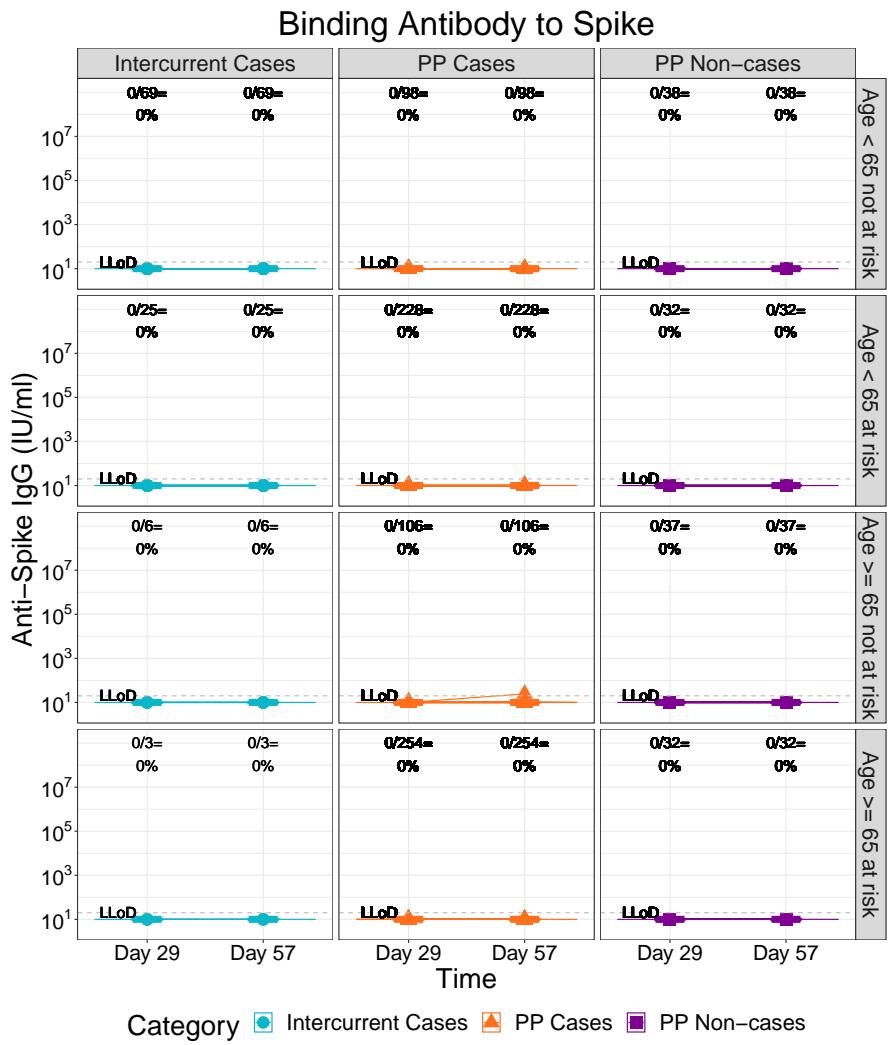


Figure 1.123: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints)

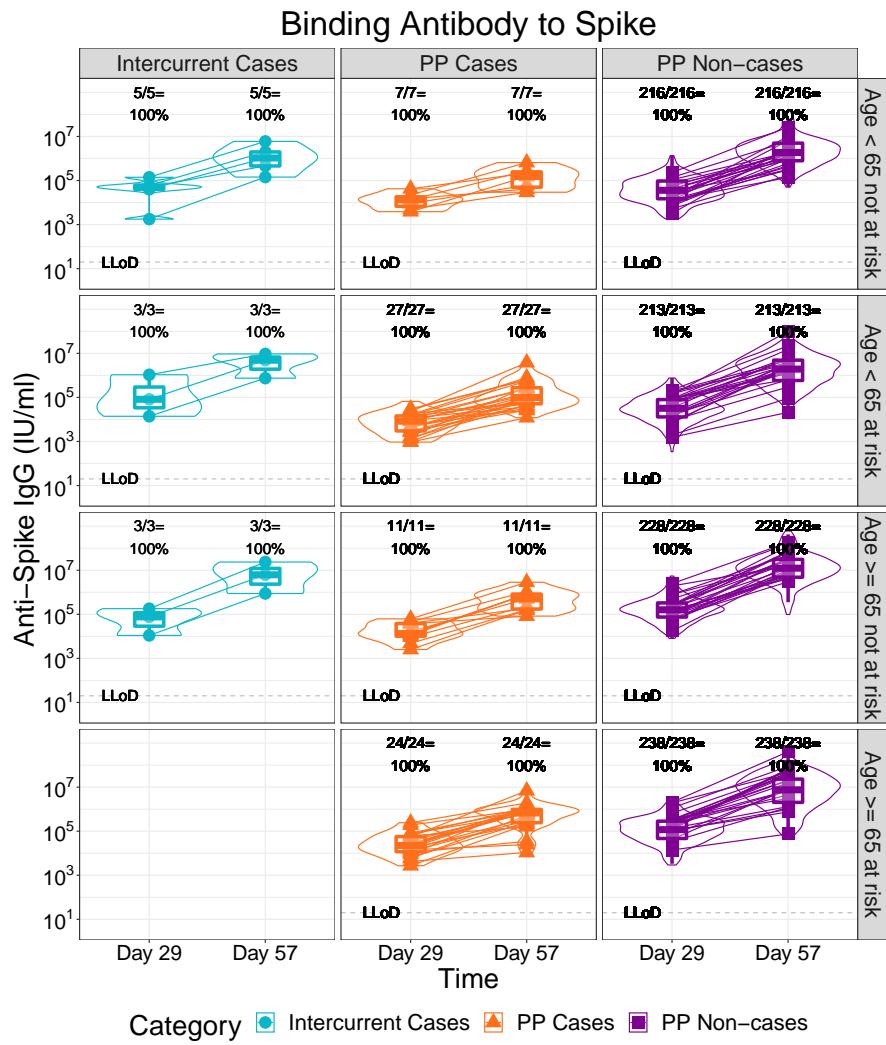


Figure 1.124: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints)

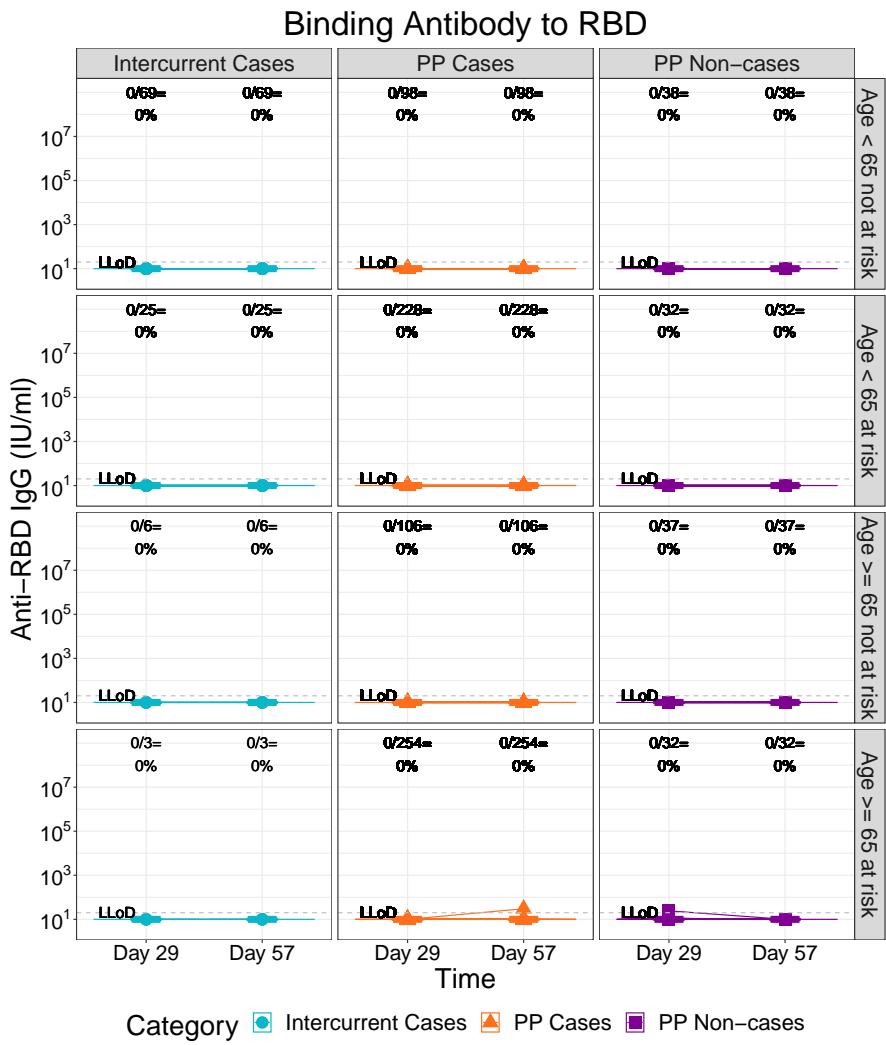


Figure 1.125: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints)

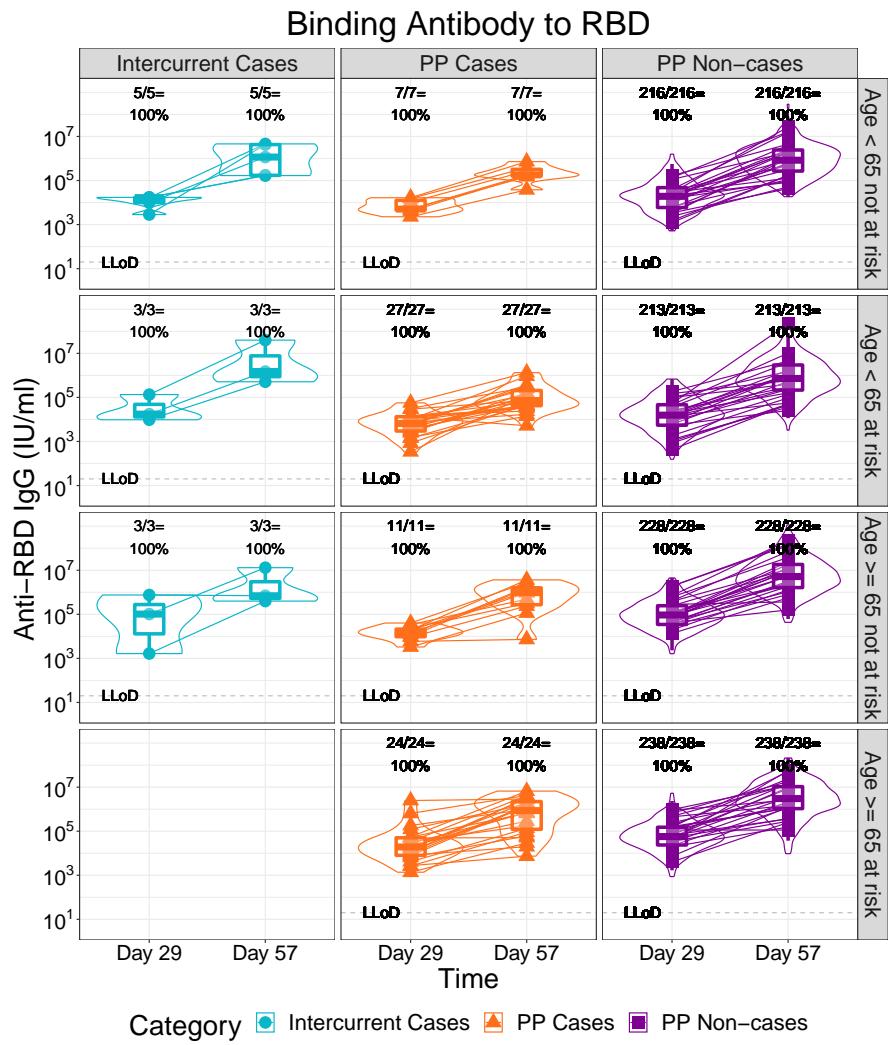


Figure 1.126: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints)

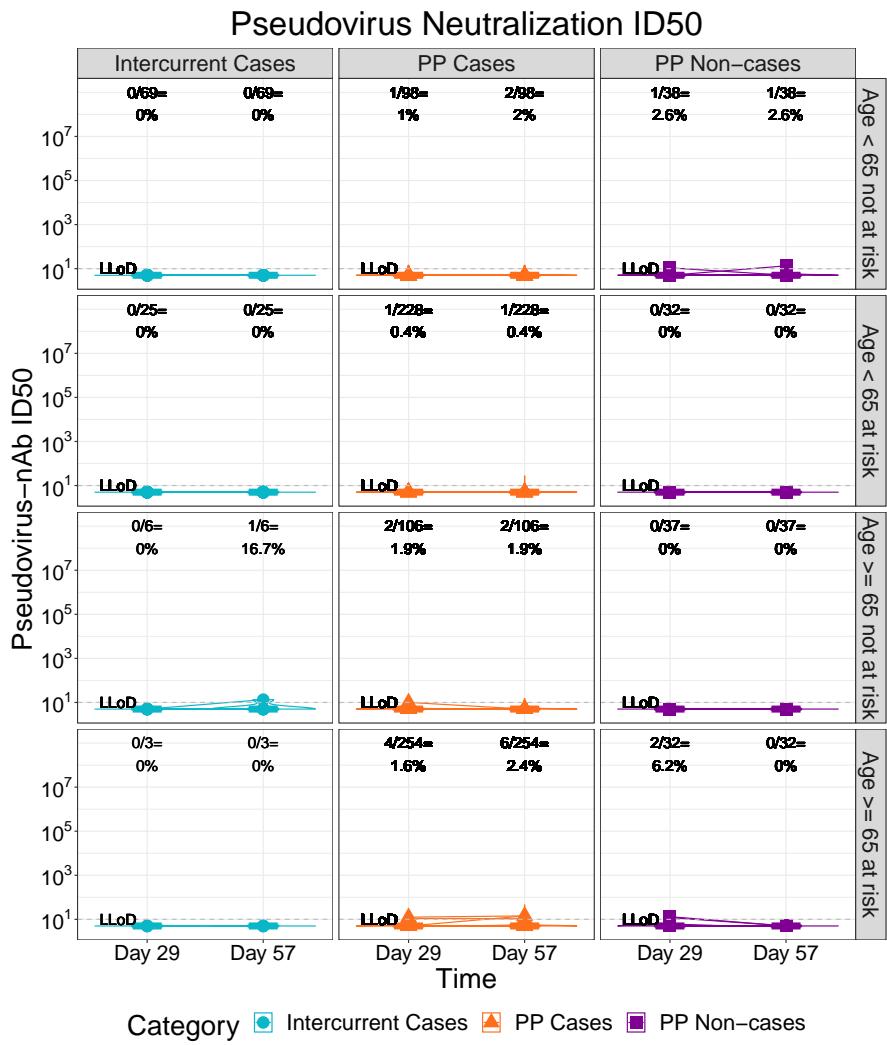


Figure 1.127: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints)

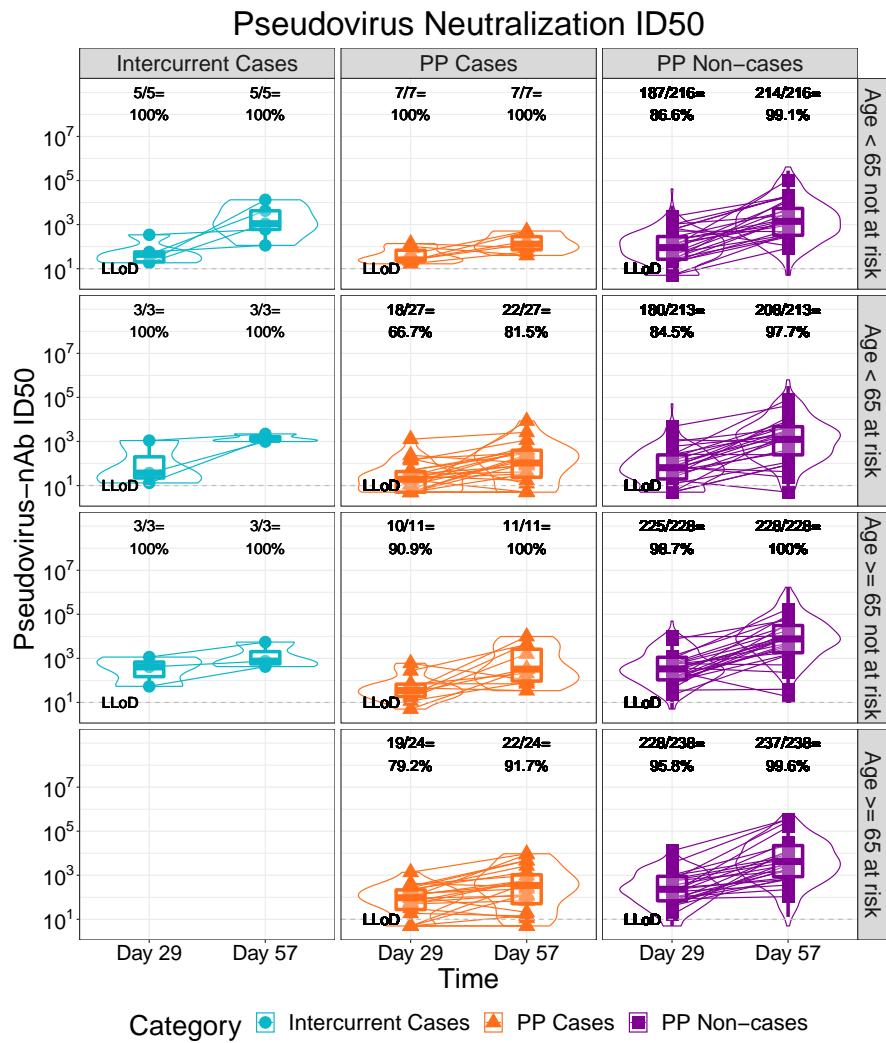


Figure 1.128: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints)

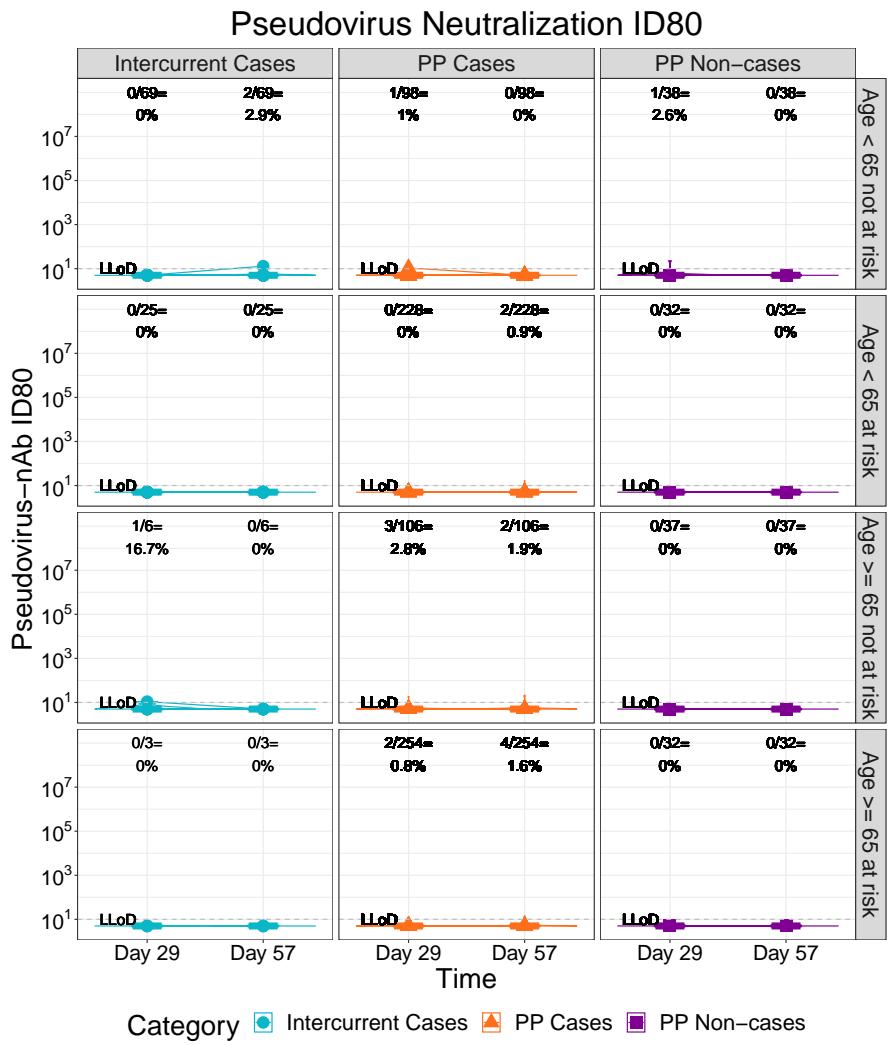


Figure 1.129: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints)

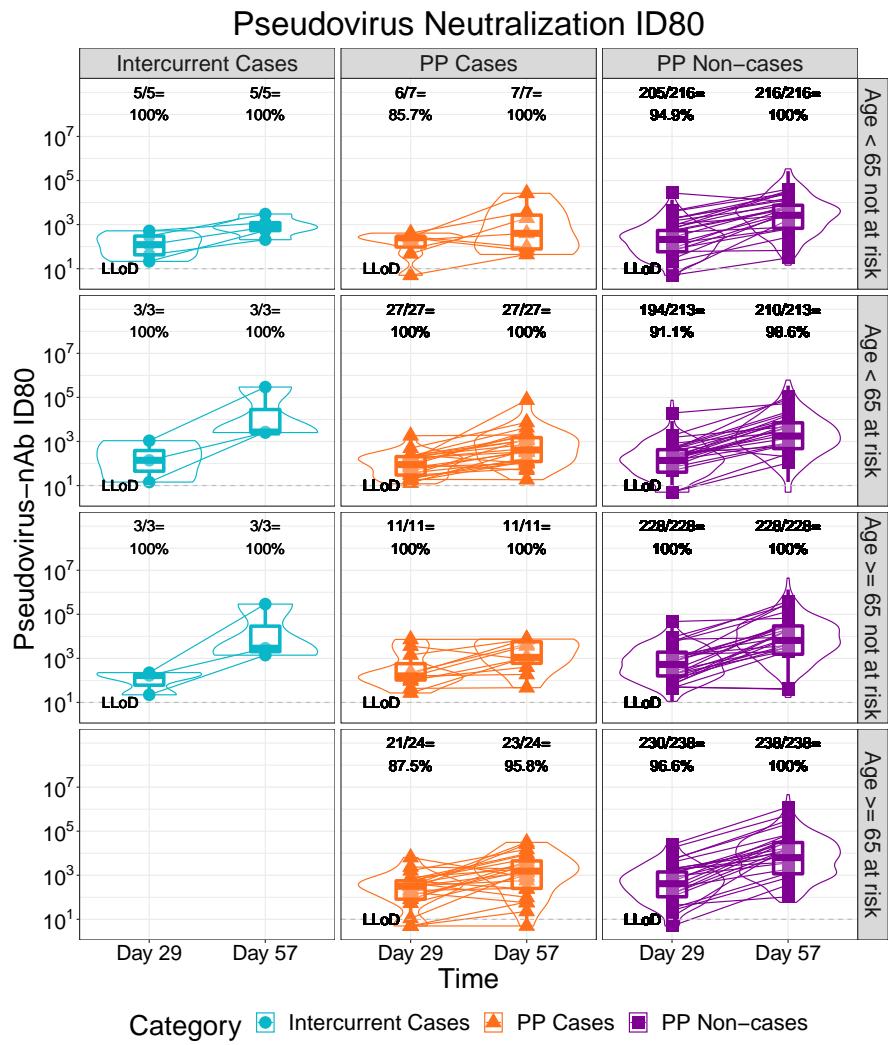


Figure 1.130: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints)

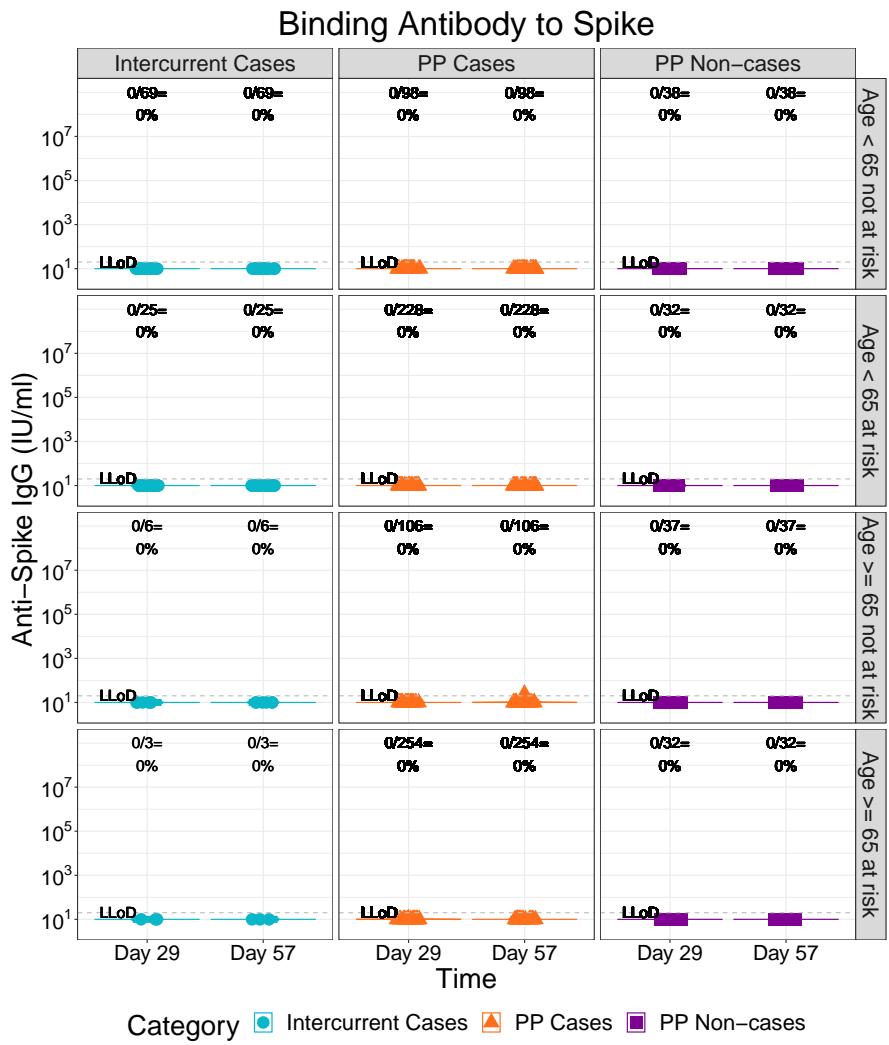


Figure 1.131: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (2 timepoints)

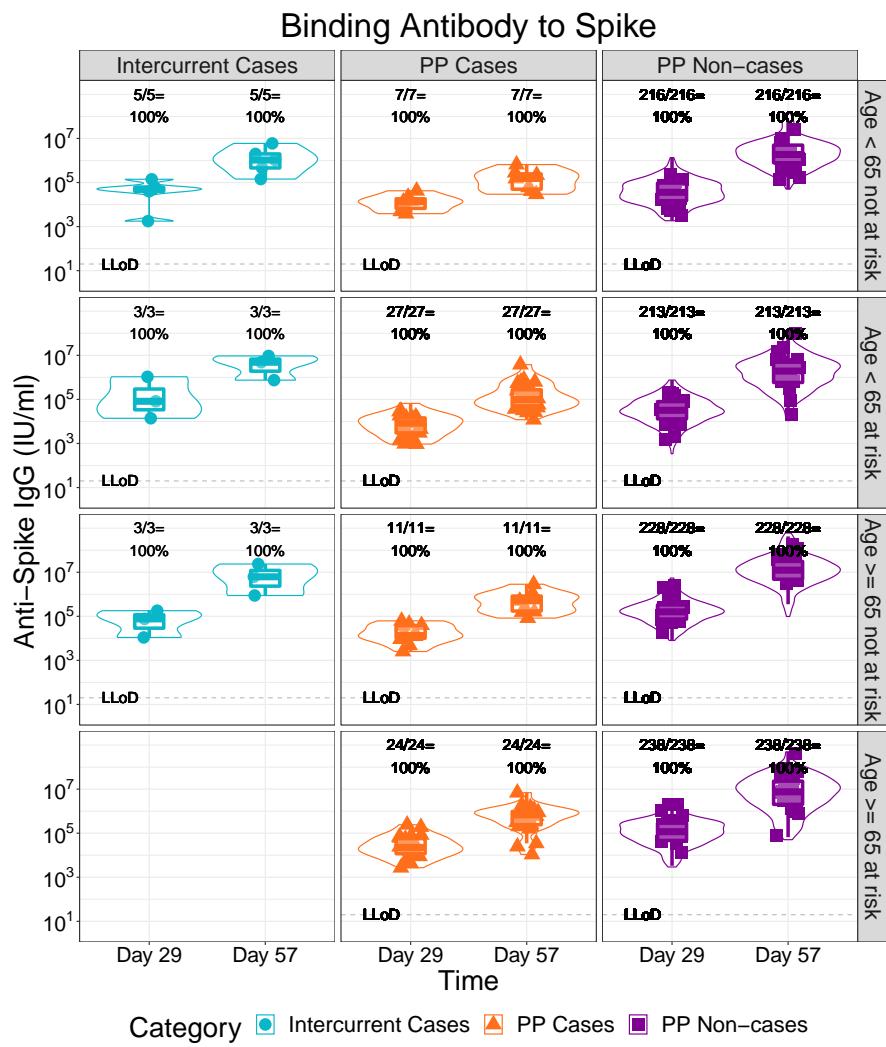


Figure 1.132: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (2 timepoints)

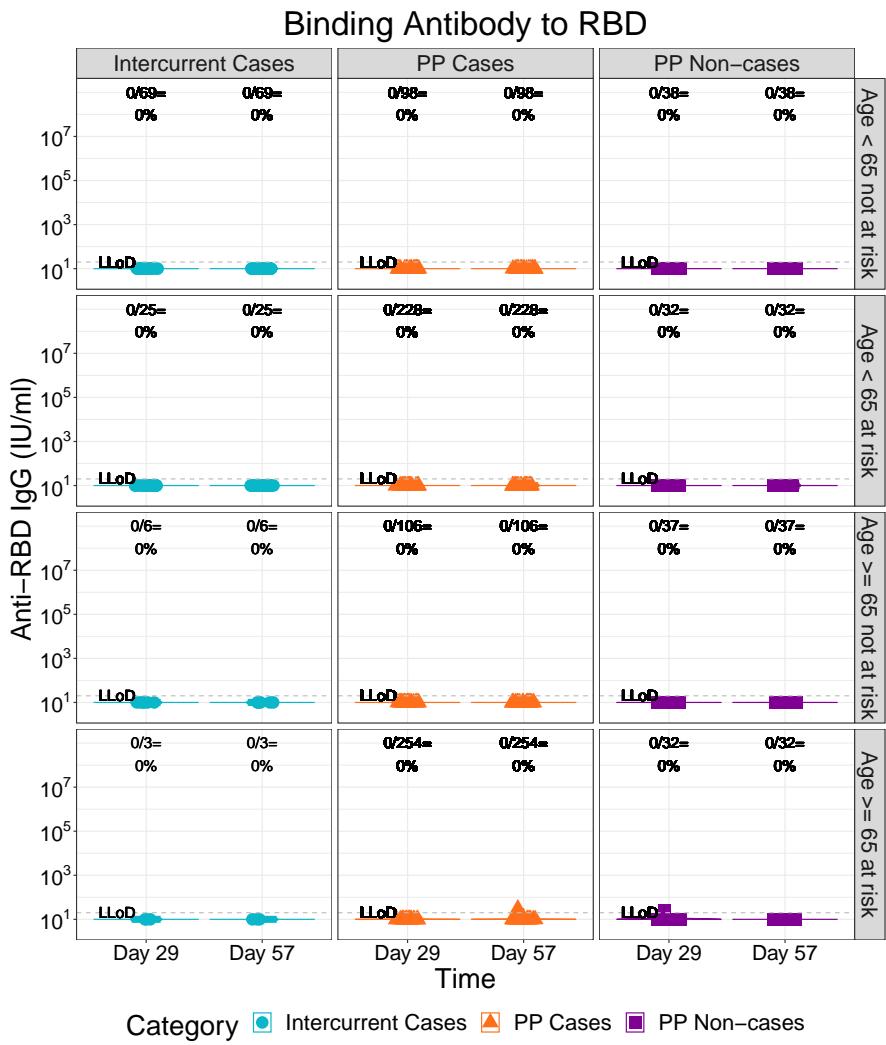


Figure 1.133: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (2 timepoints)

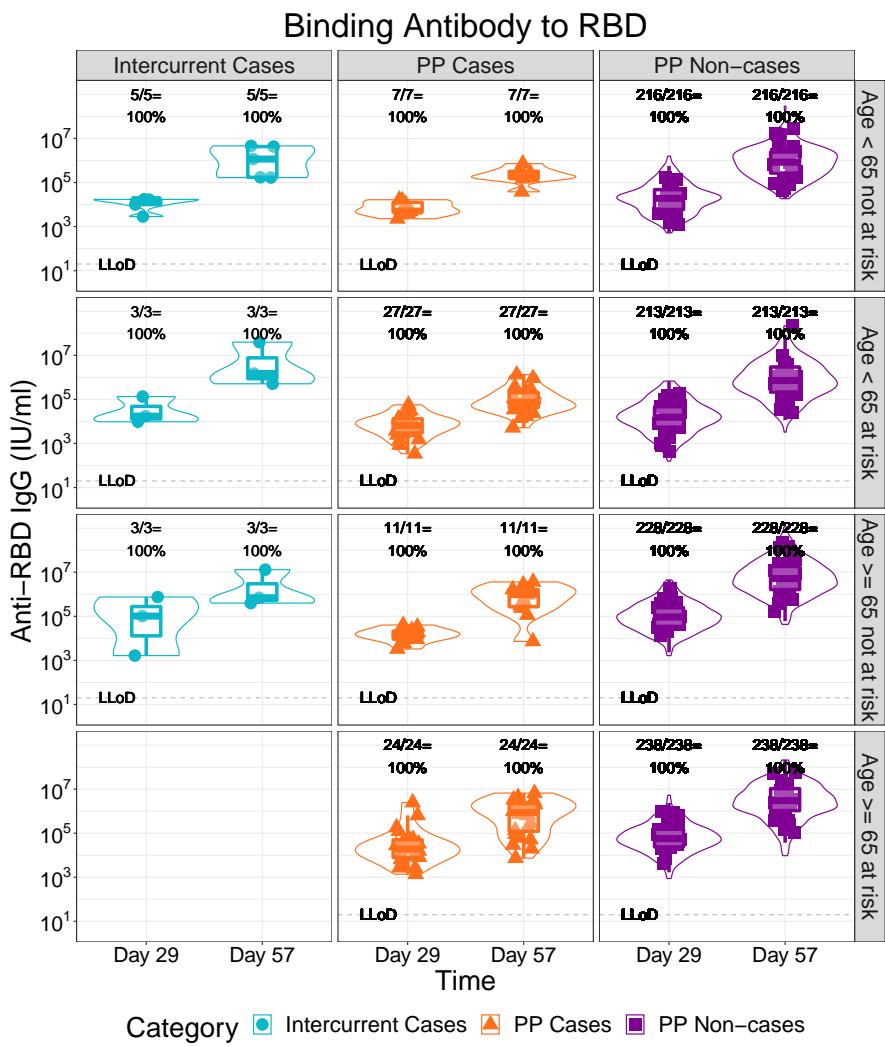


Figure 1.134: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (2 timepoints)

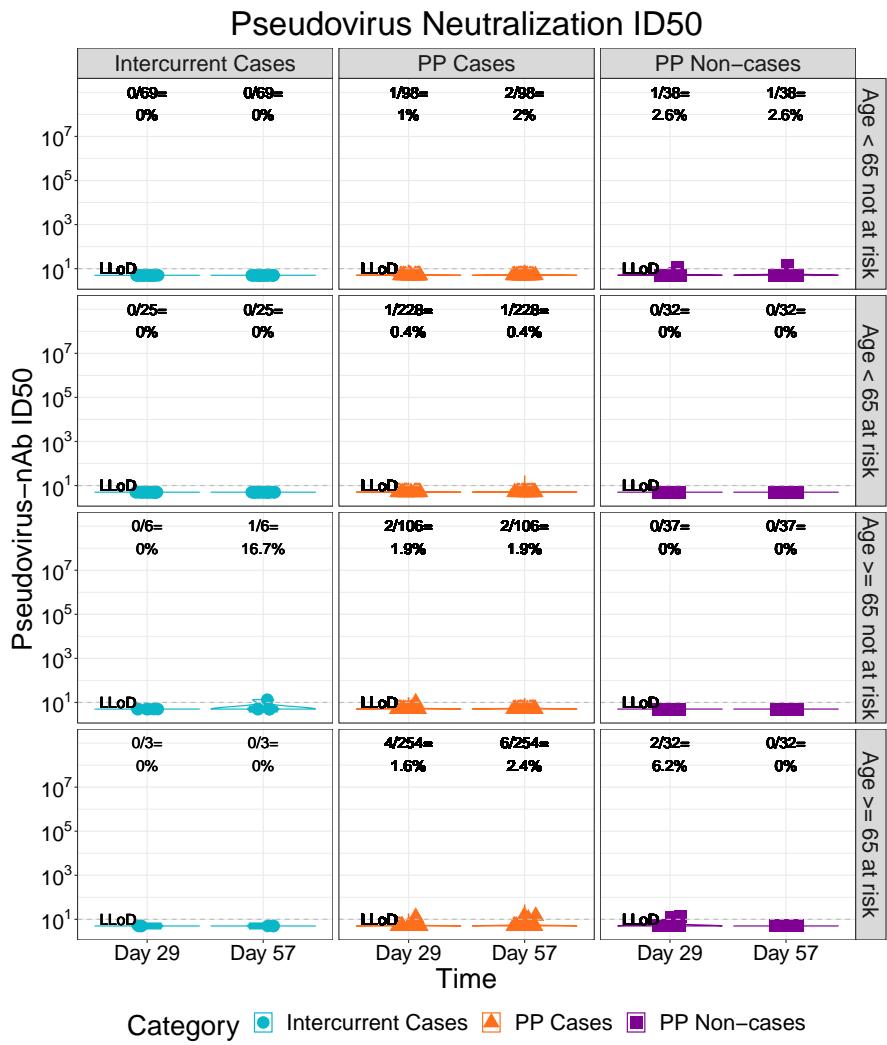


Figure 1.135: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (2 timepoints)

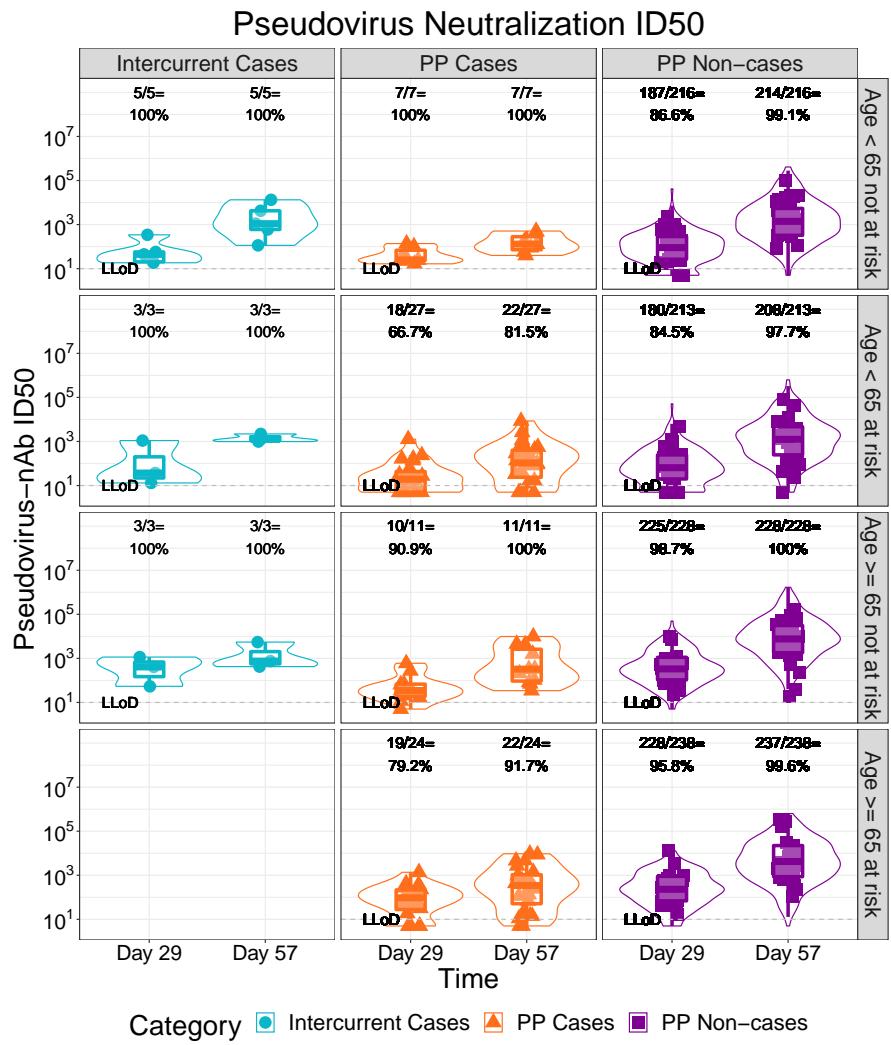


Figure 1.136: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (2 timepoints)

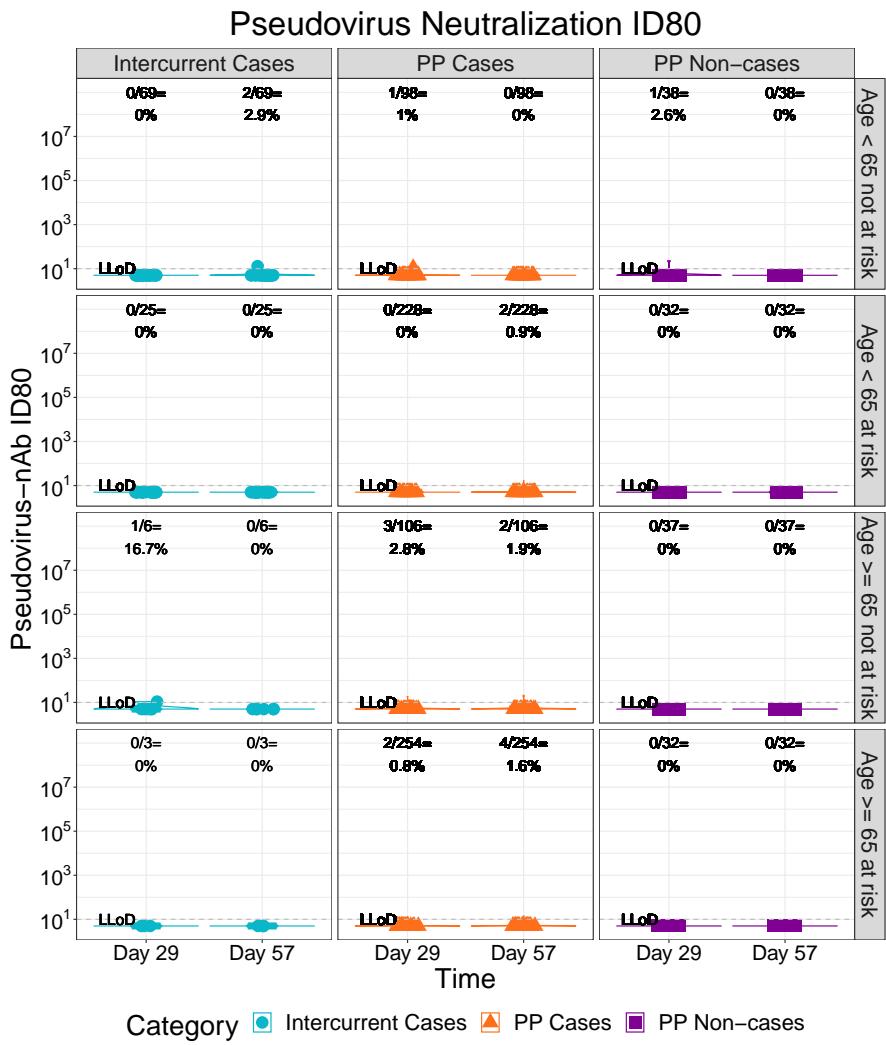


Figure 1.137: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (2 timepoints)

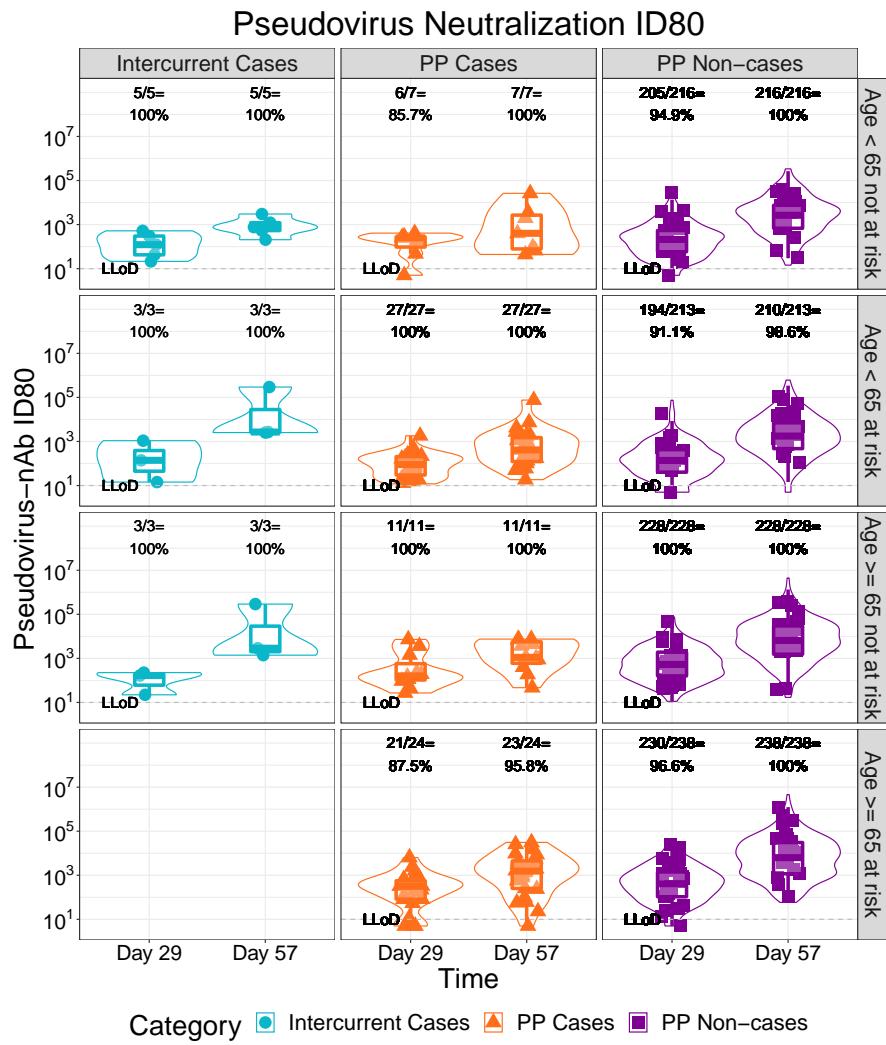


Figure 1.138: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (2 timepoints)

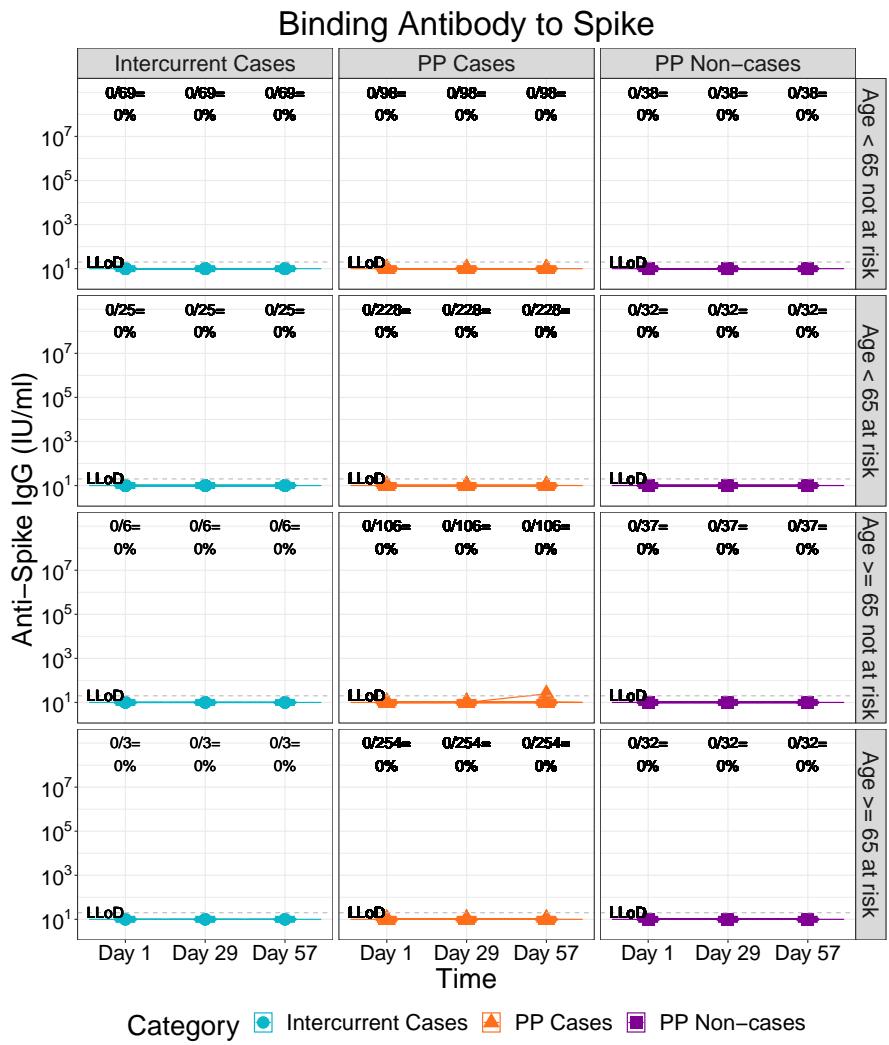


Figure 1.139: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints)

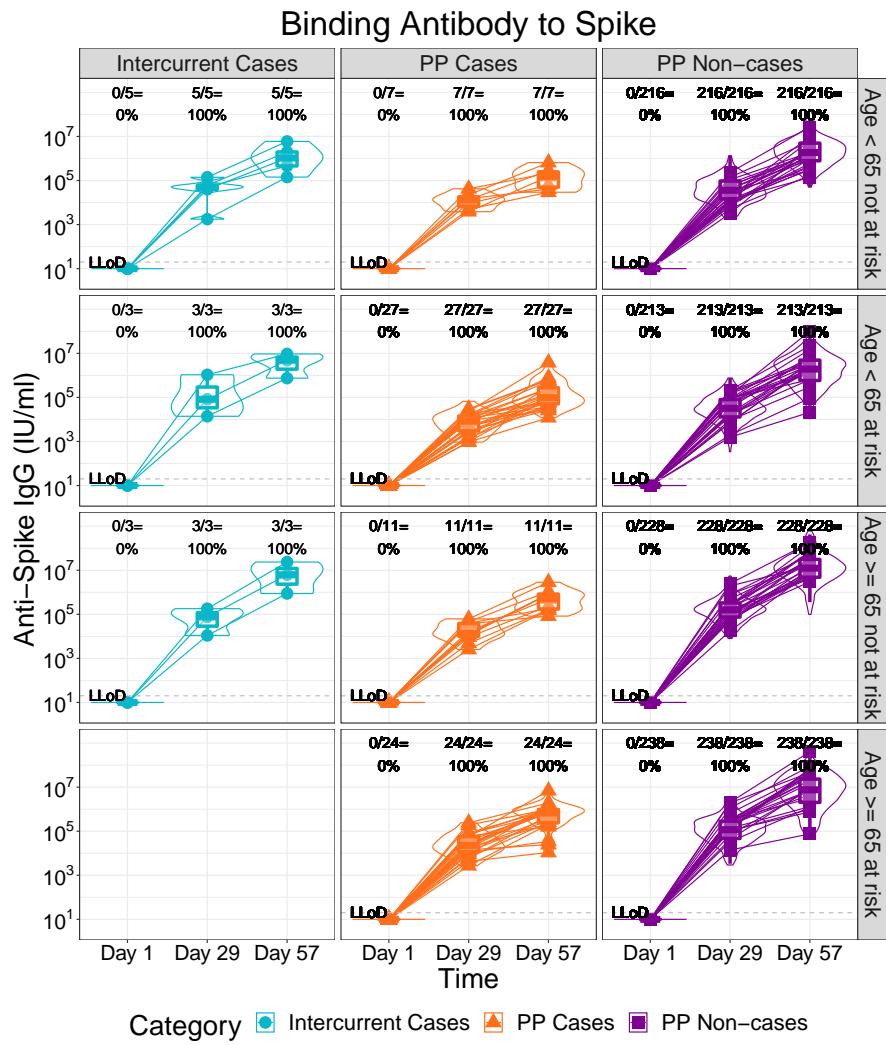


Figure 1.140: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints)

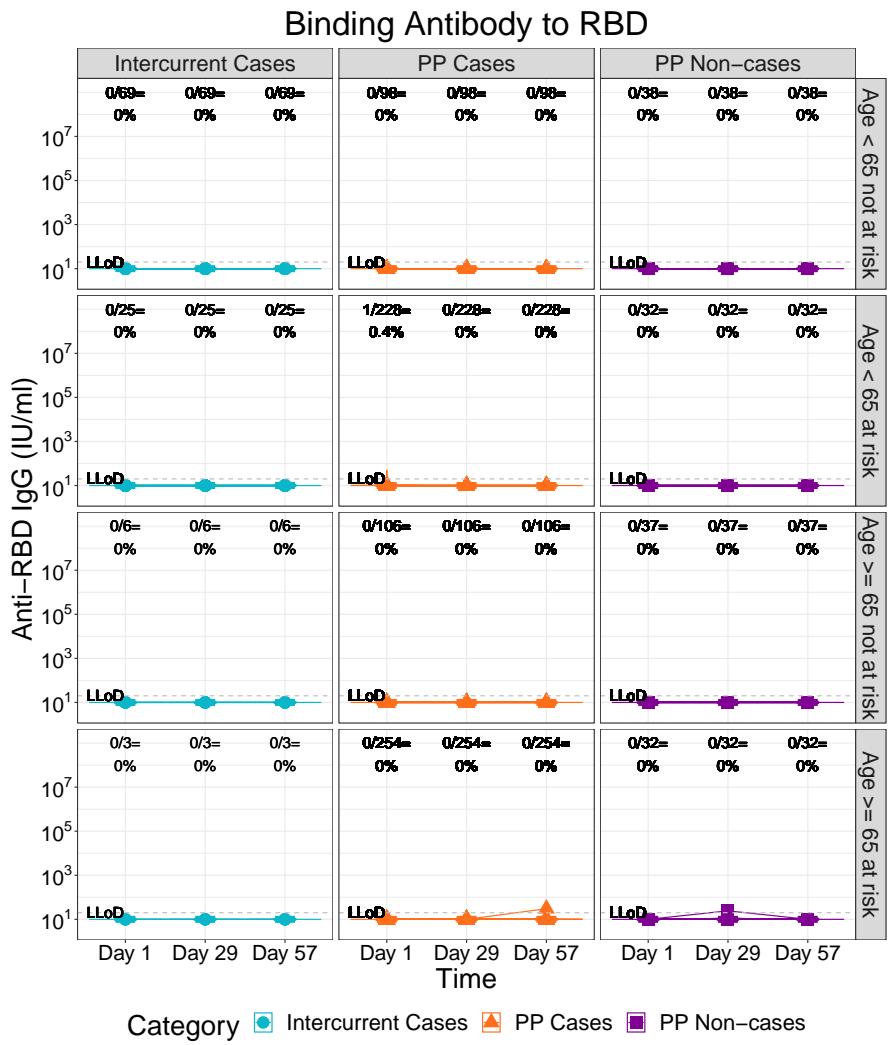


Figure 1.141: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints)

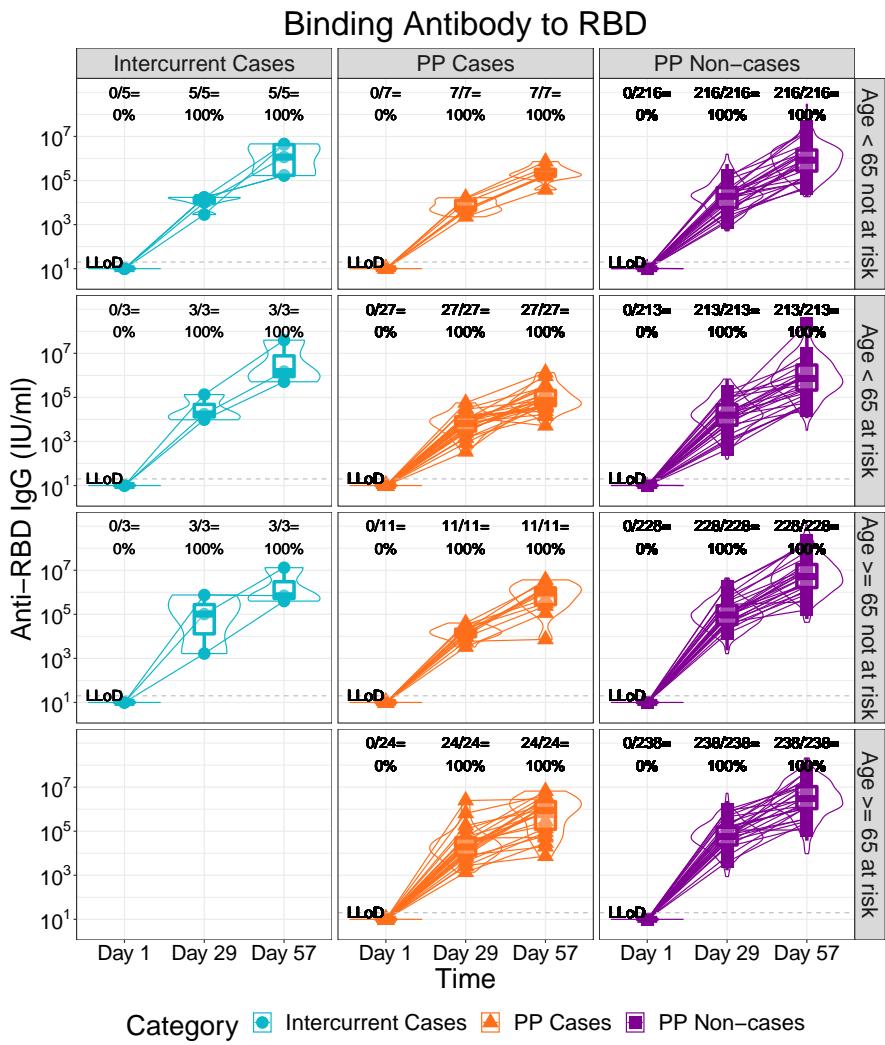


Figure 1.142: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints)

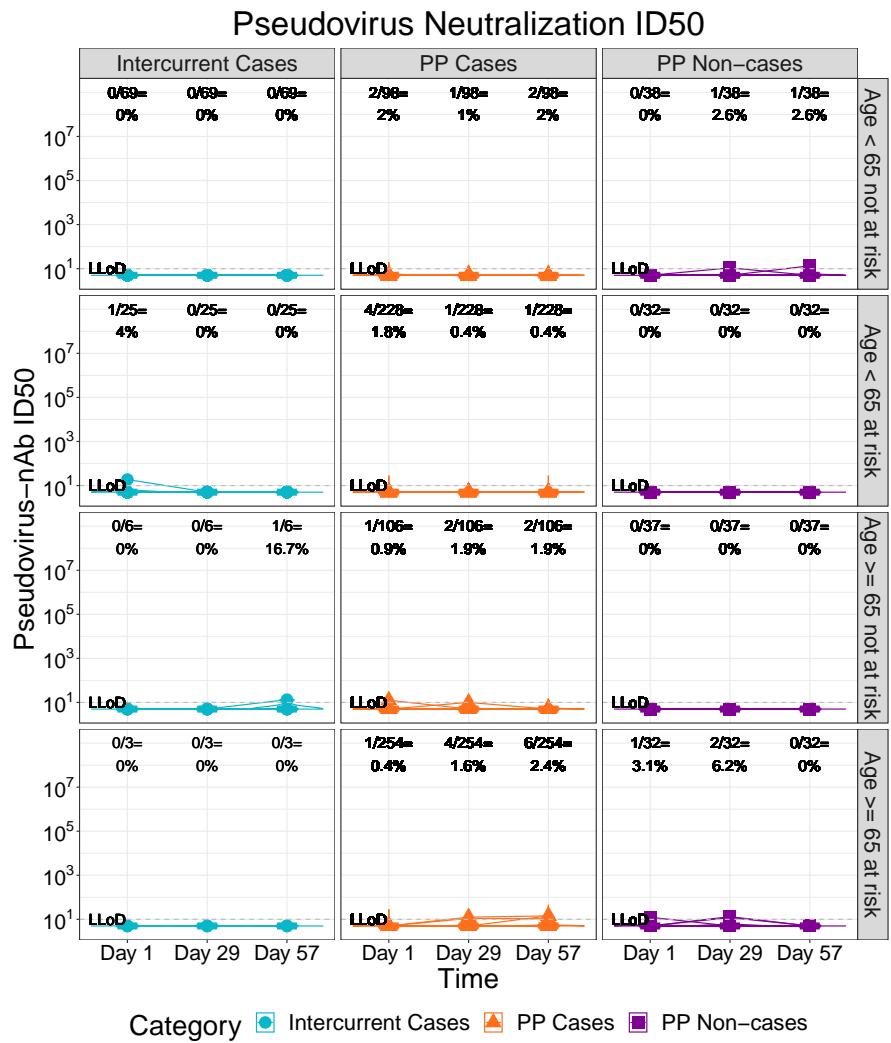


Figure 1.143: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints)

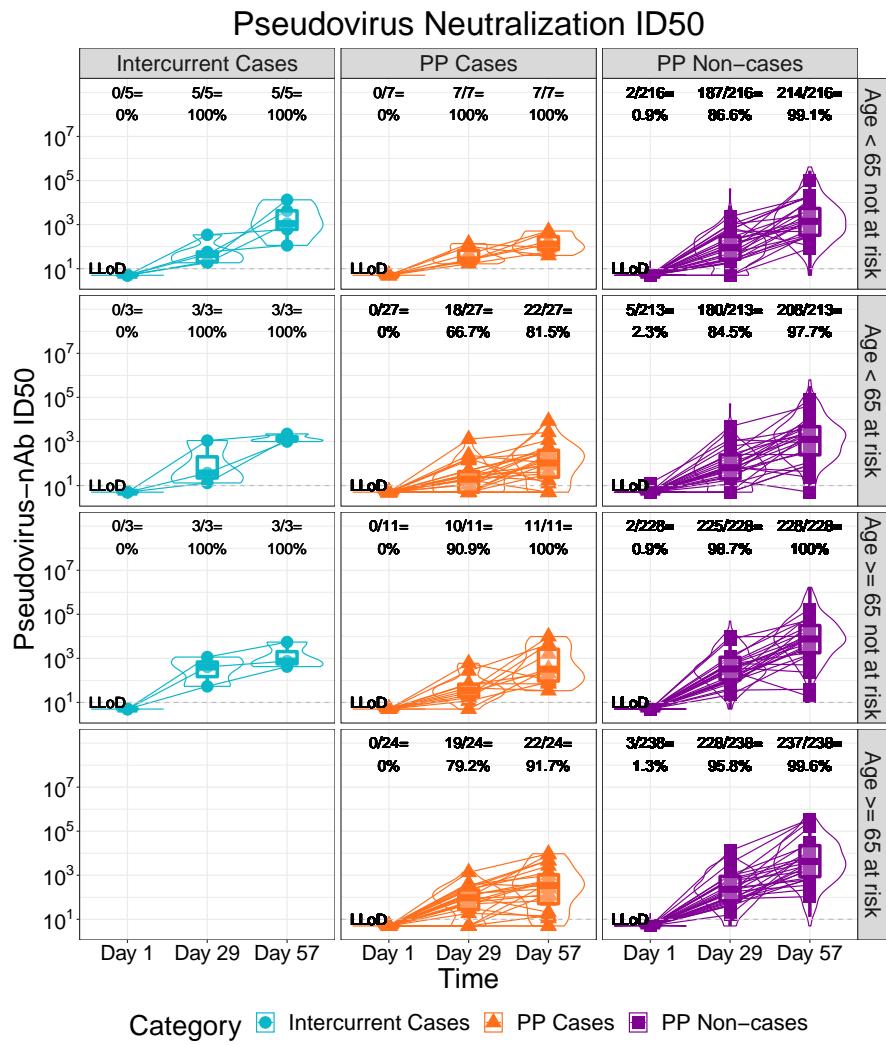


Figure 1.144: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints)

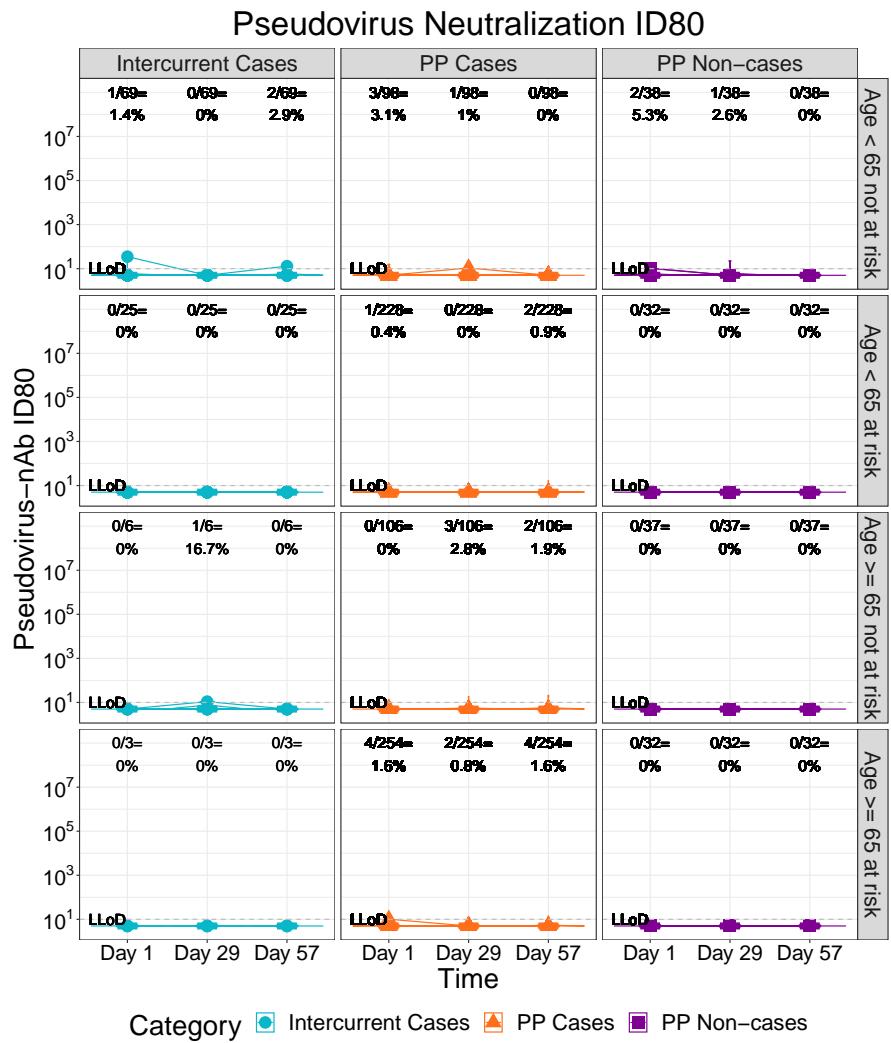


Figure 1.145: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints)

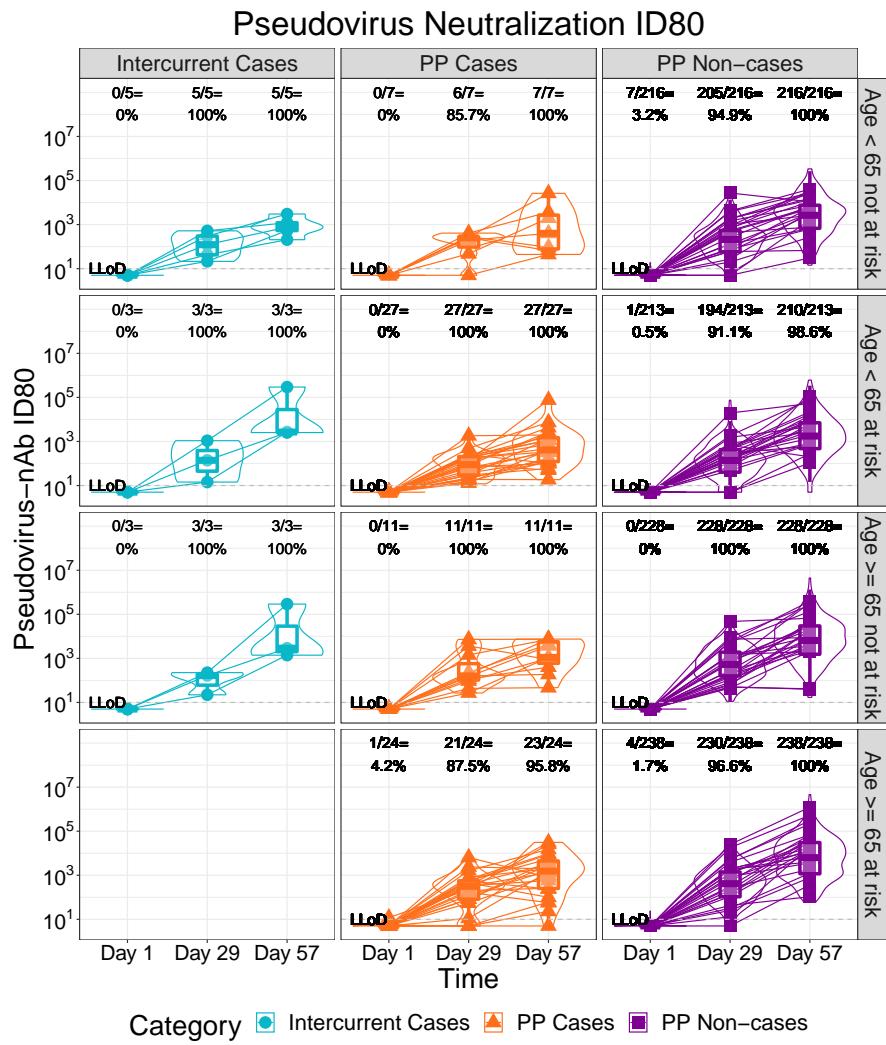


Figure 1.146: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints)

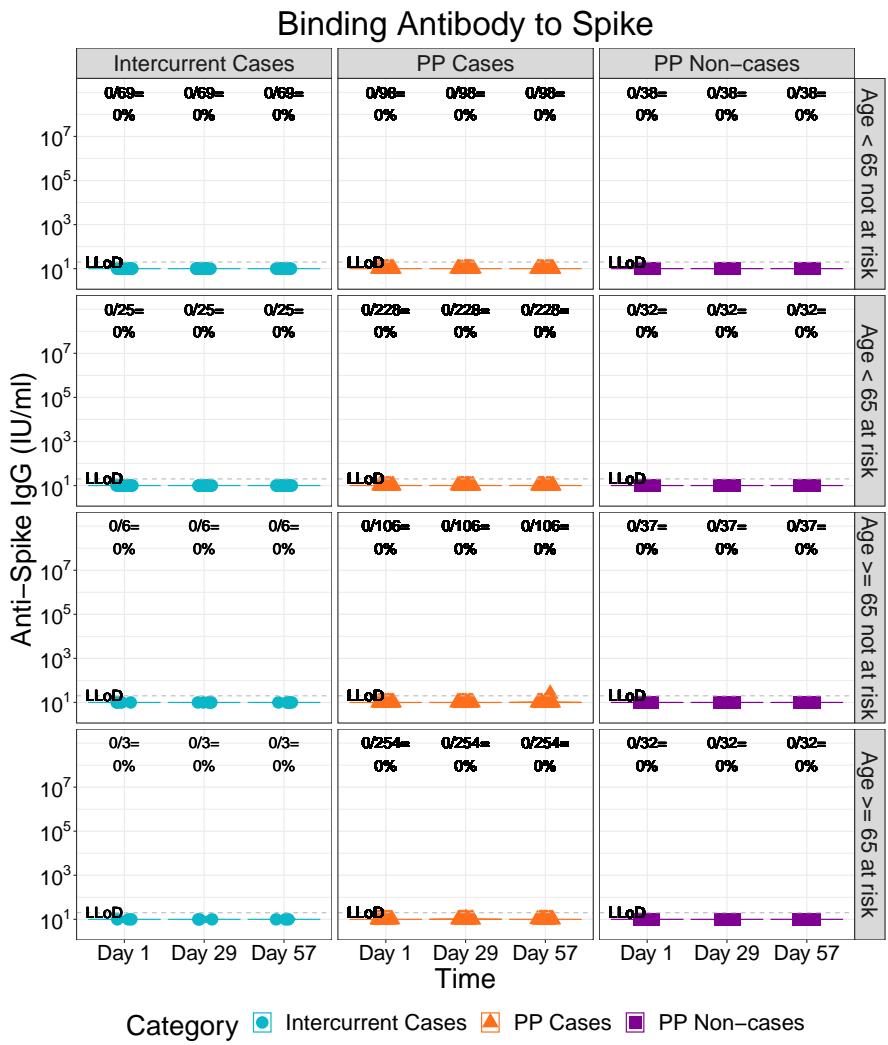


Figure 1.147: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by age and risk condition (3 timepoints)

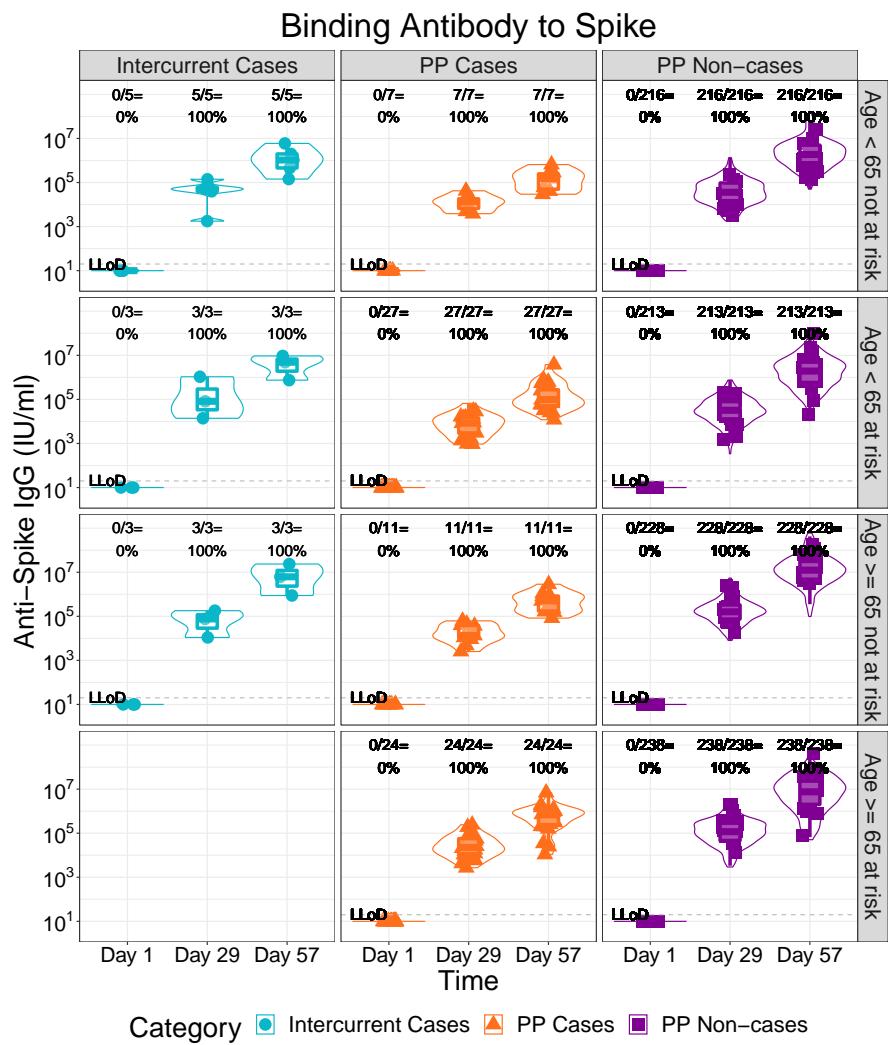


Figure 1.148: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by age and risk condition (3 timepoints)

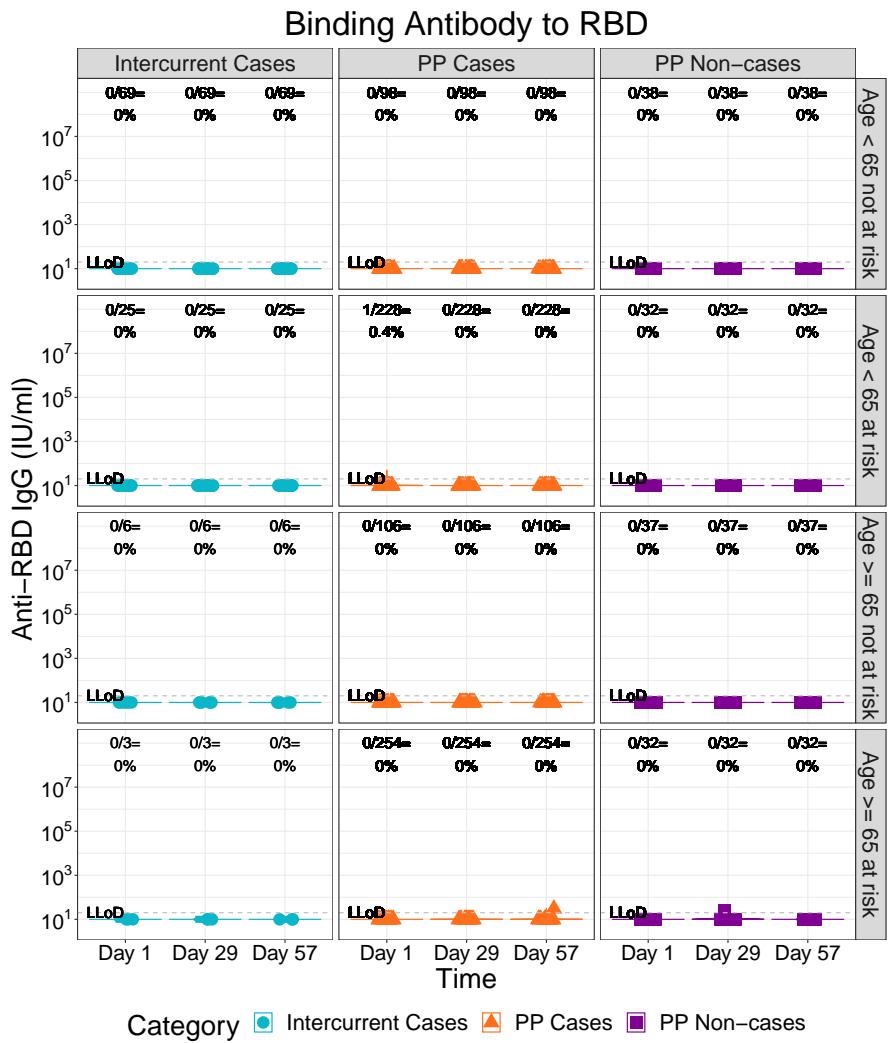


Figure 1.149: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by age and risk condition (3 timepoints)

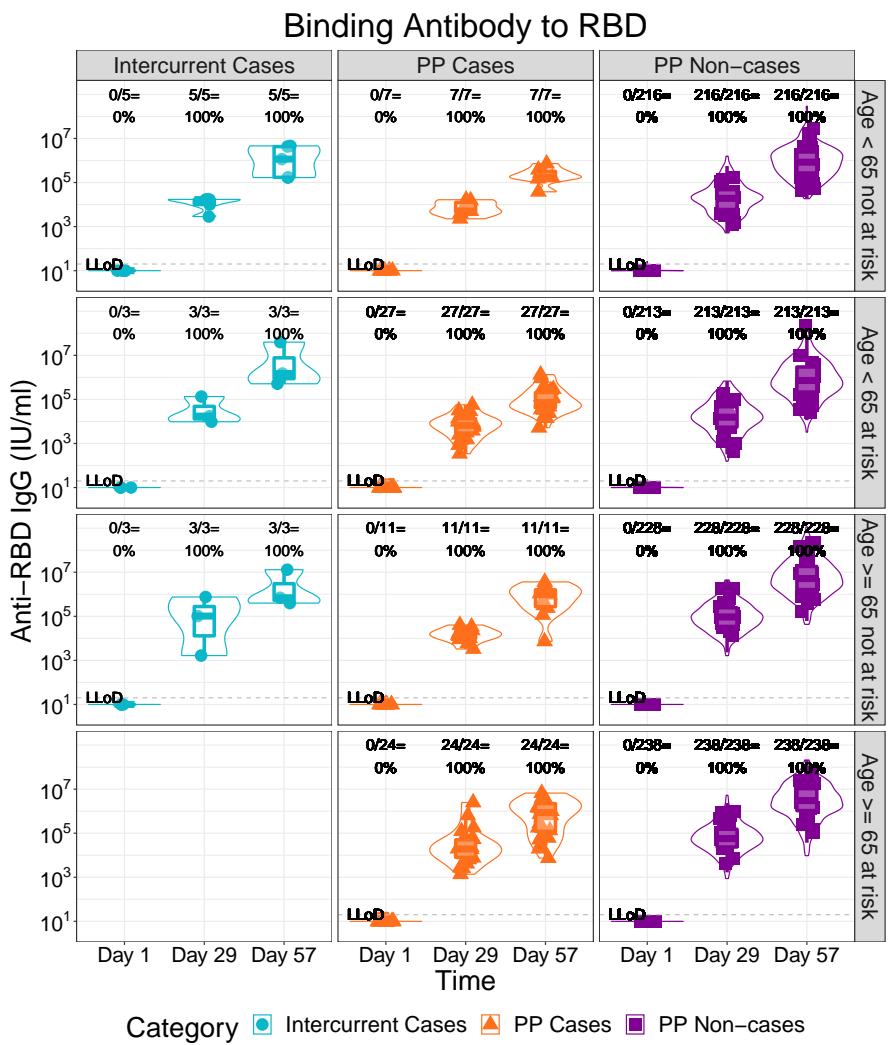


Figure 1.150: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by age and risk condition (3 timepoints)

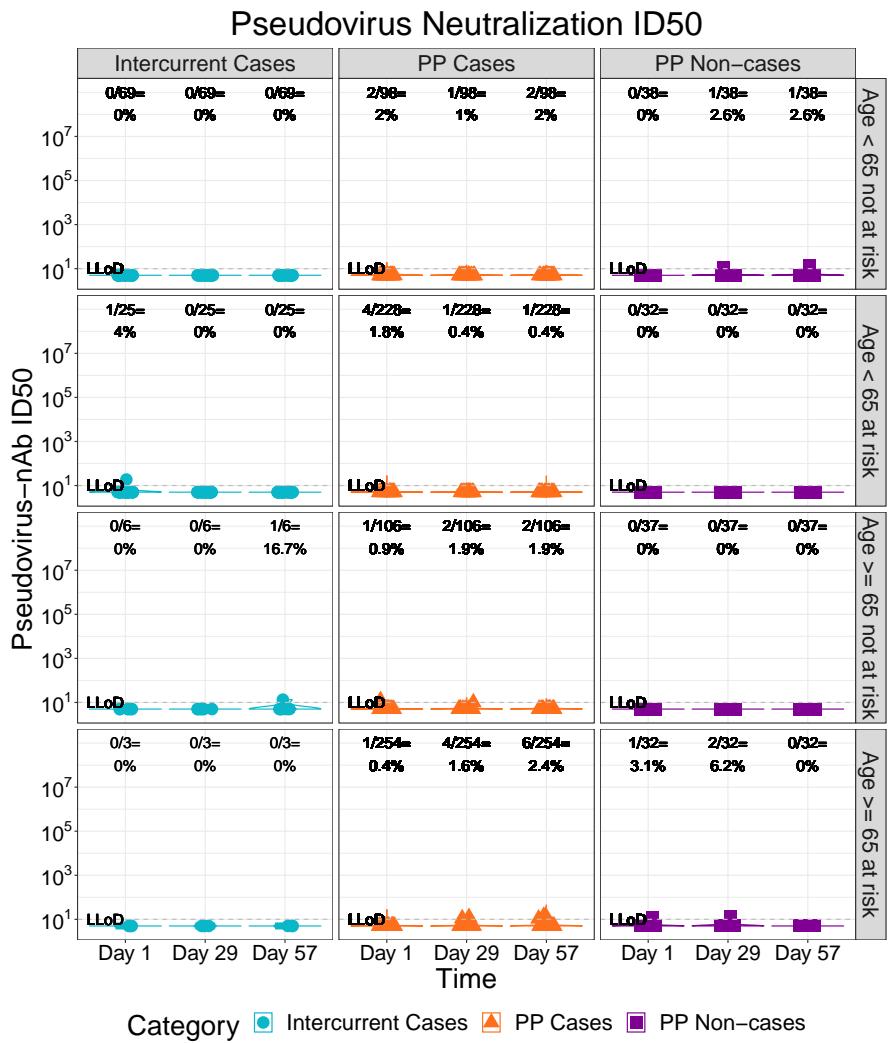


Figure 1.151: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by age and risk condition (3 timepoints)

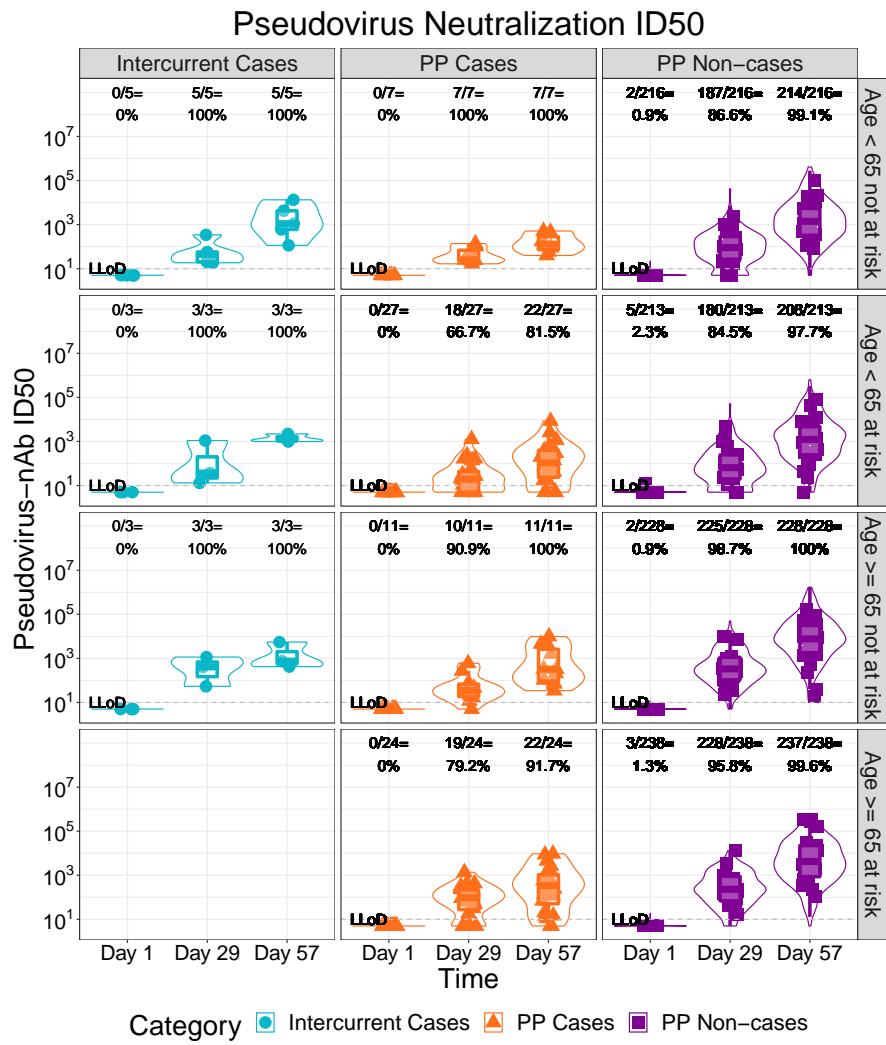


Figure 1.152: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by age and risk condition (3 timepoints)

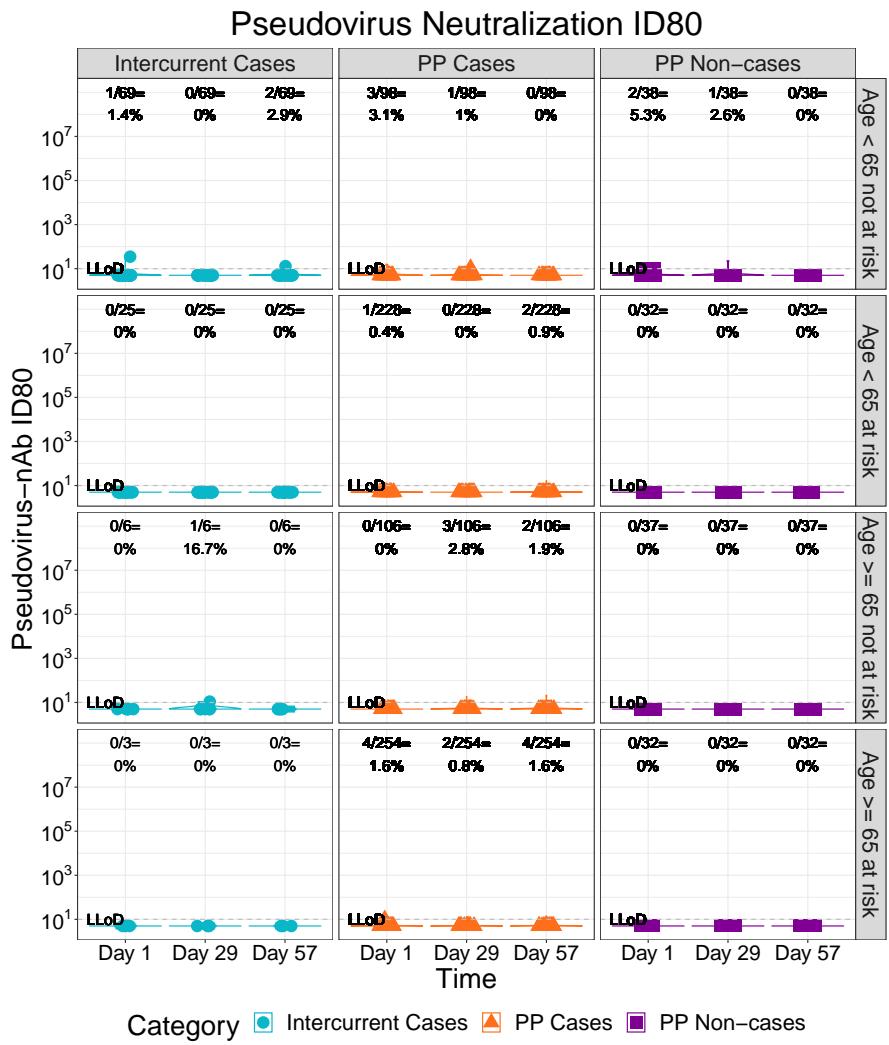


Figure 1.153: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by age and risk condition (3 timepoints)

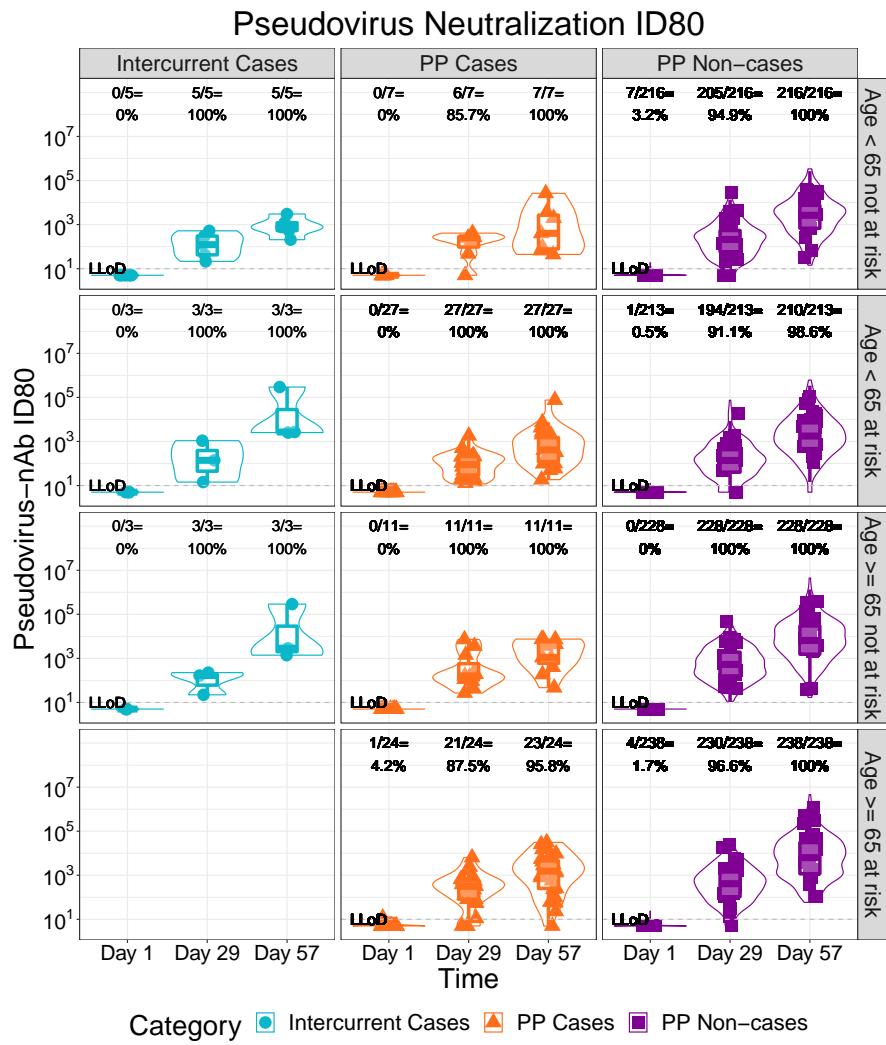


Figure 1.154: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by age and risk condition (3 timepoints)

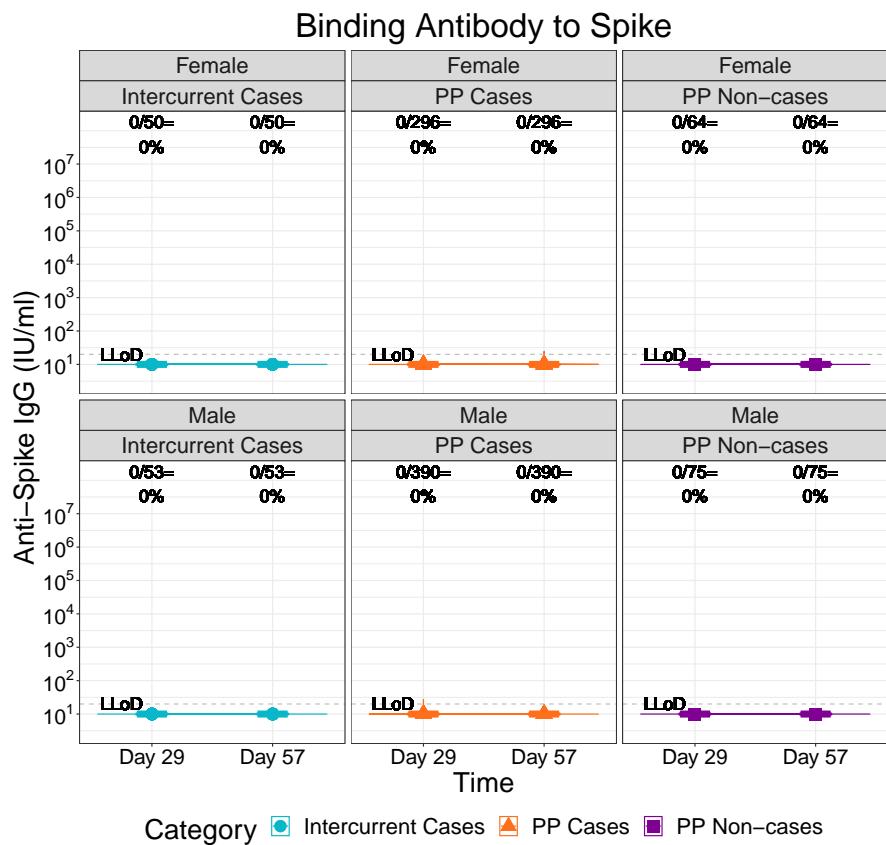


Figure 1.155: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints)

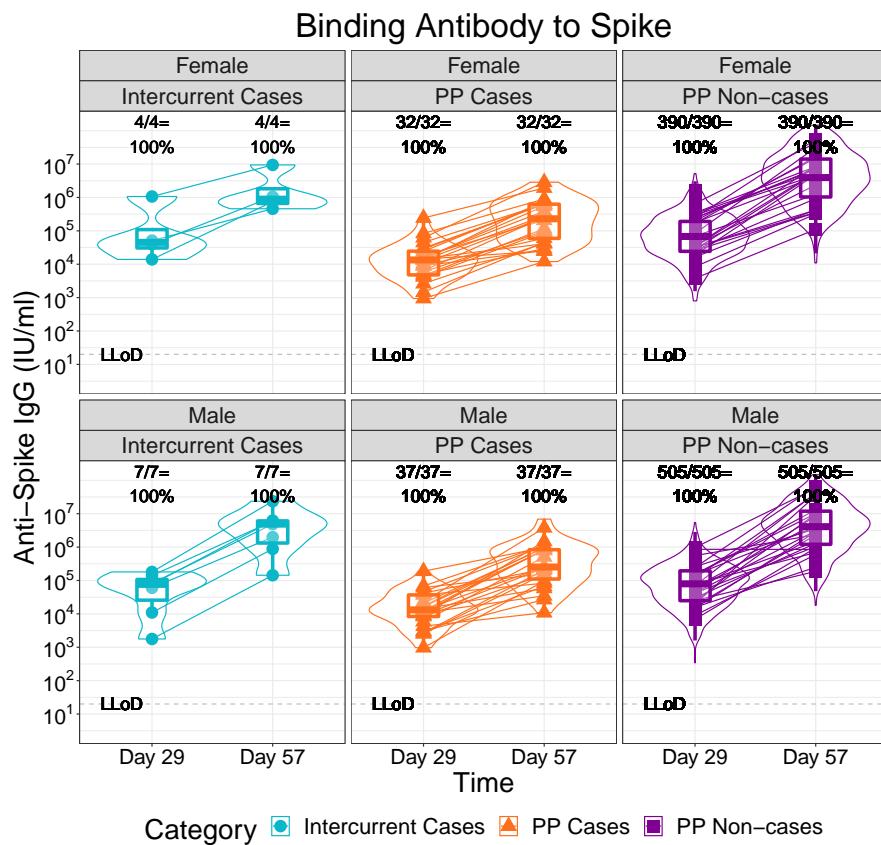


Figure 1.156: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

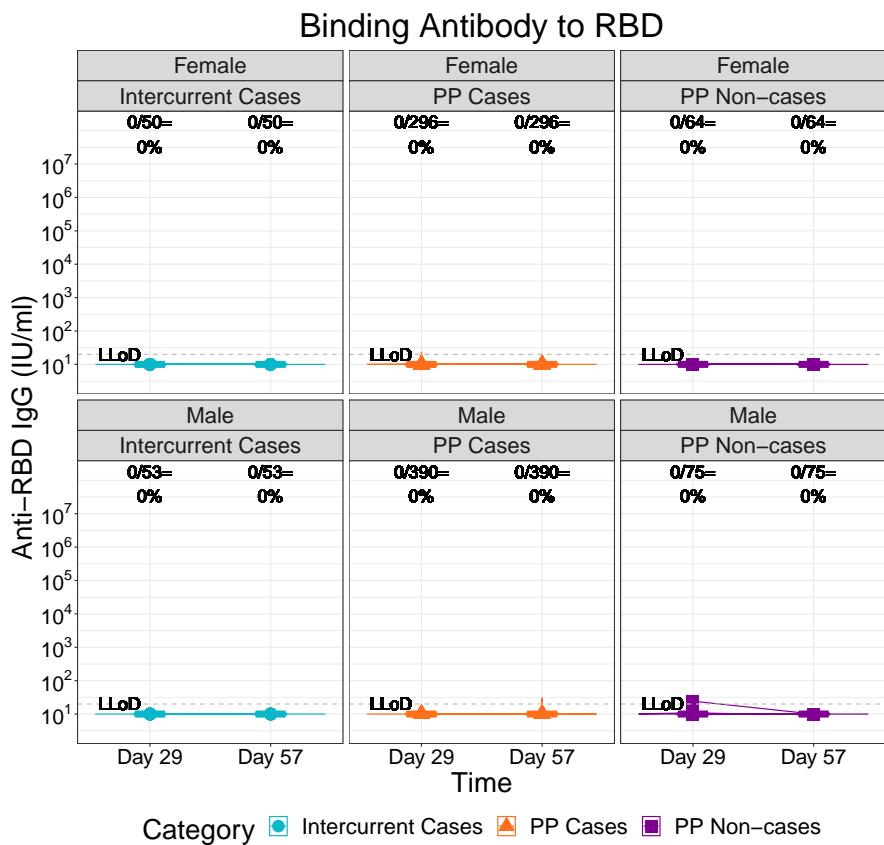


Figure 1.157: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints)

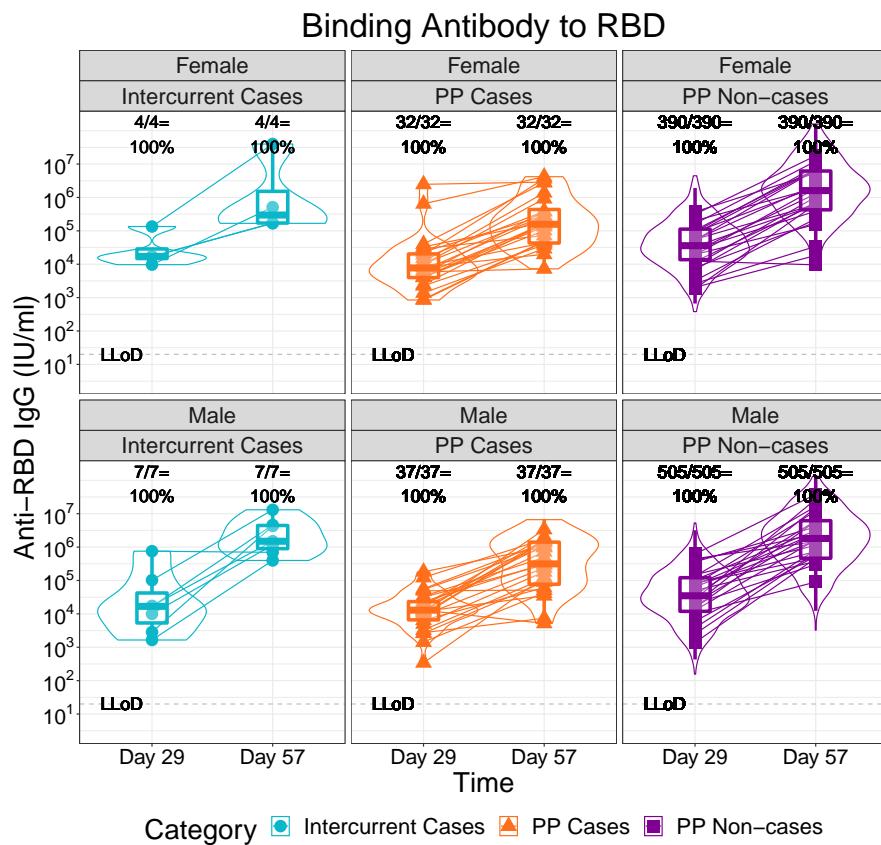


Figure 1.158: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

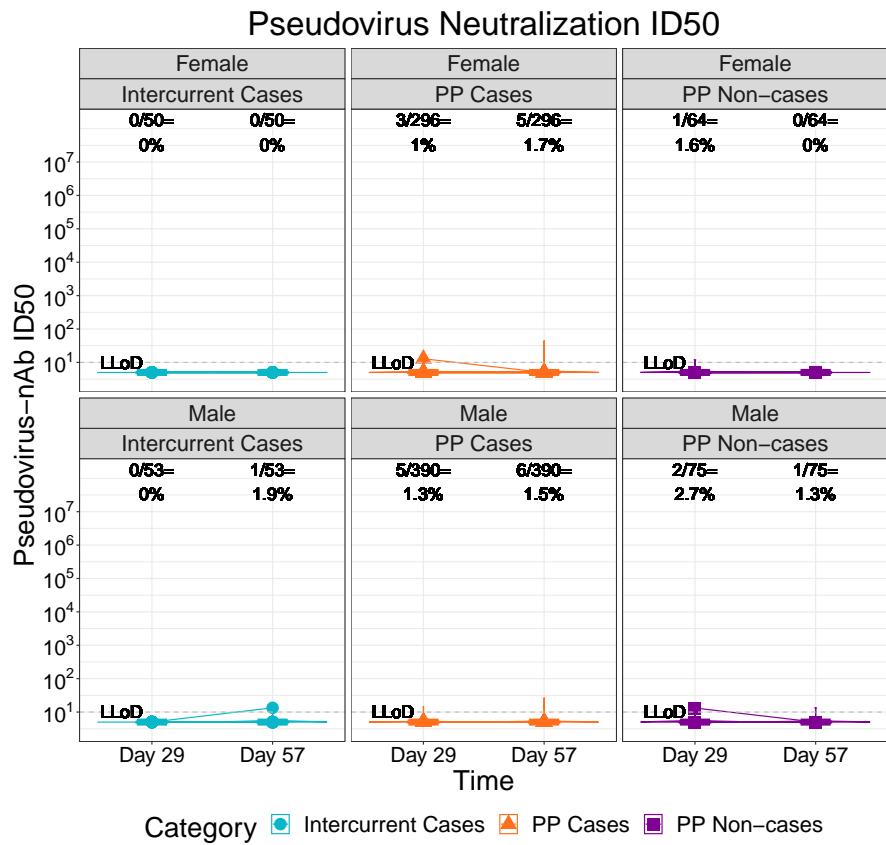


Figure 1.159: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints)

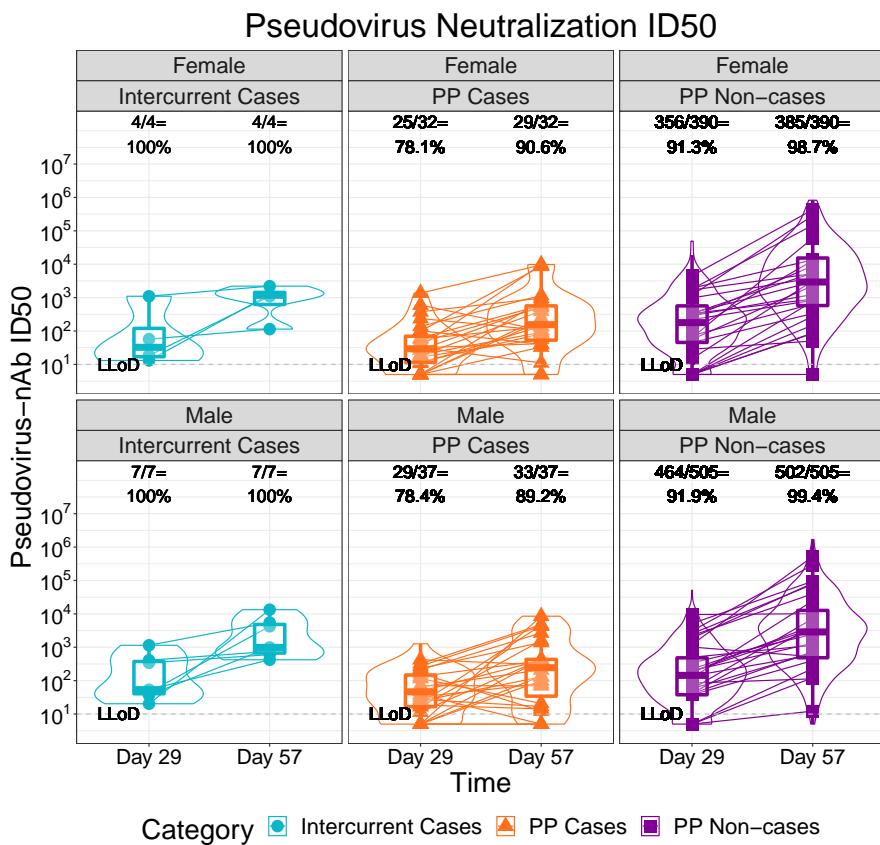


Figure 1.160: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

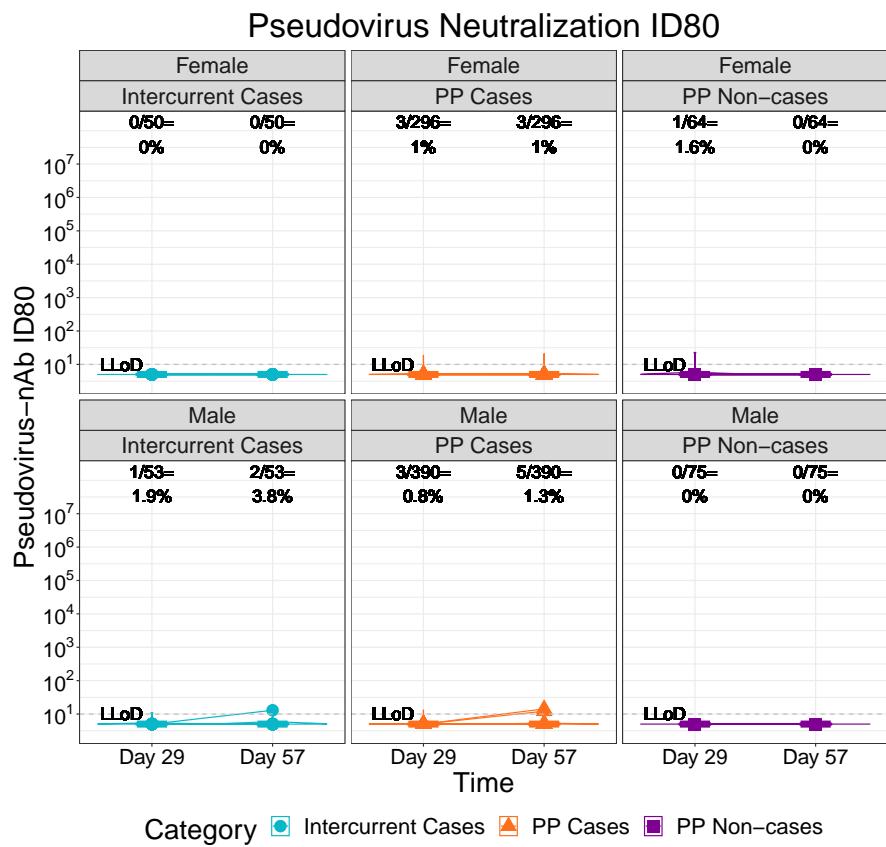


Figure 1.161: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints)

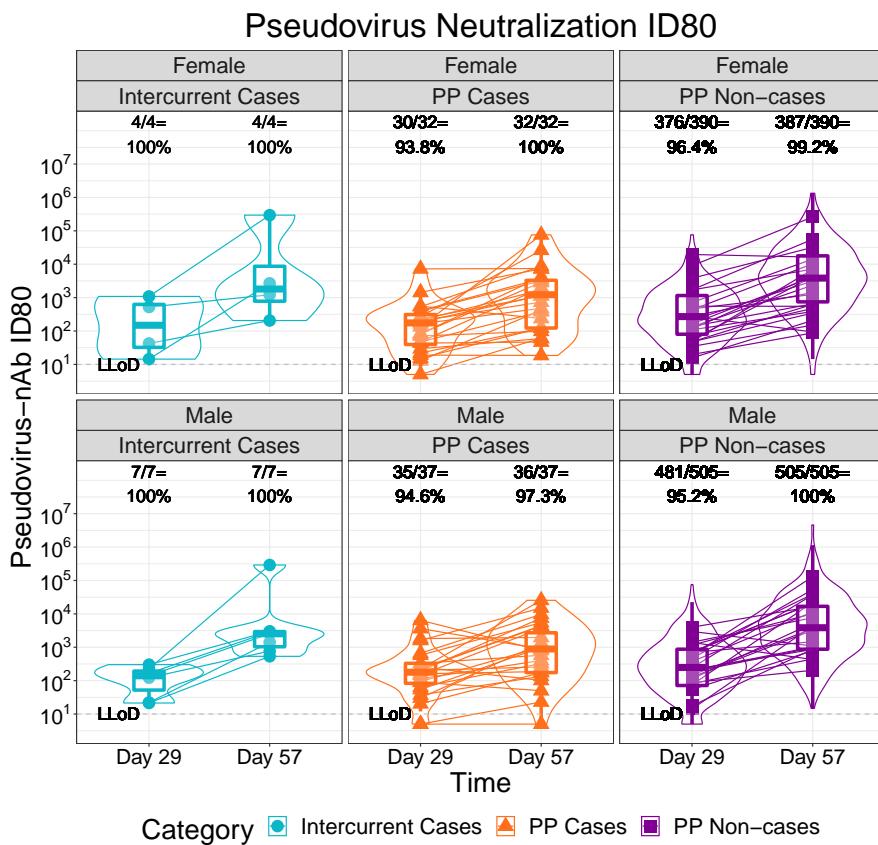


Figure 1.162: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

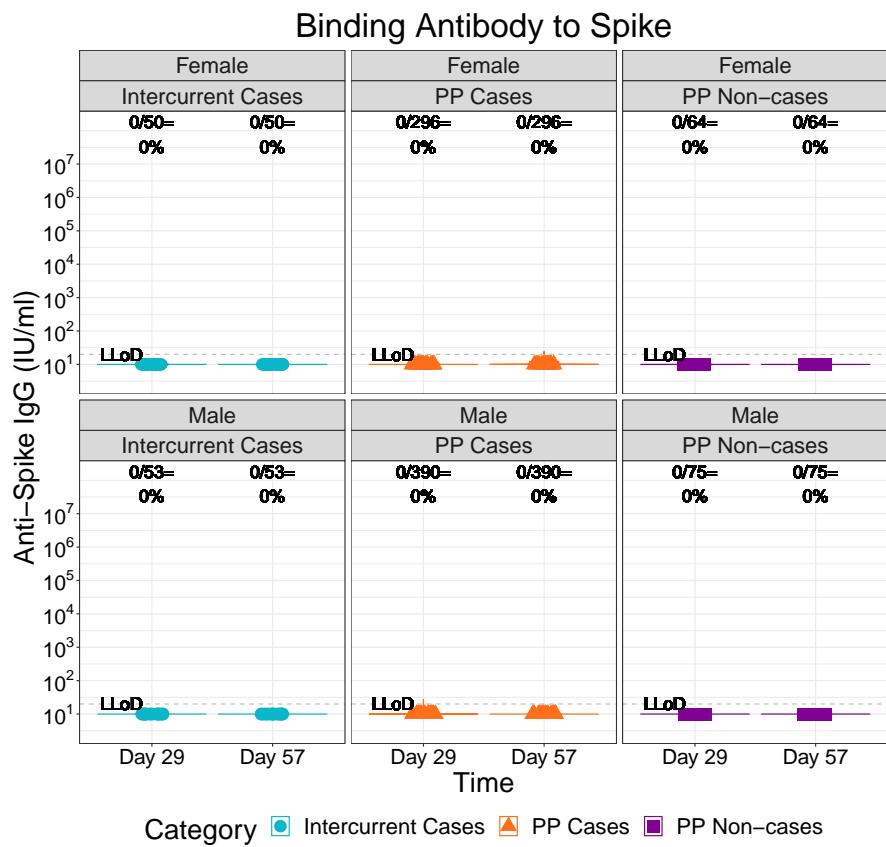


Figure 1.163: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (2 timepoints)

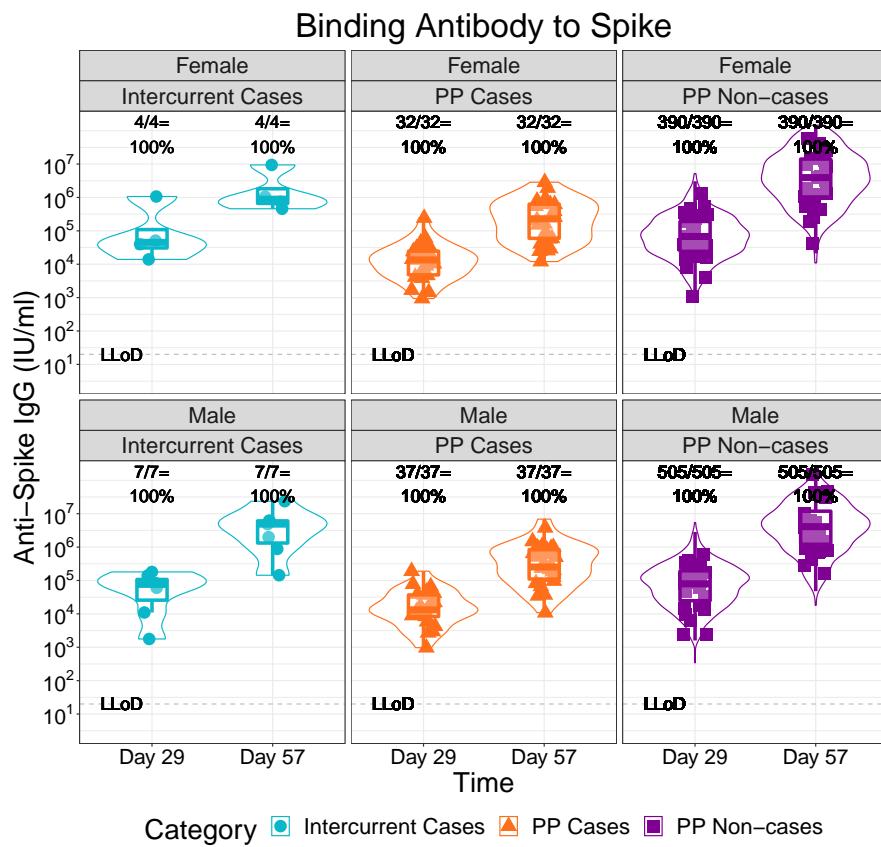


Figure 1.164: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

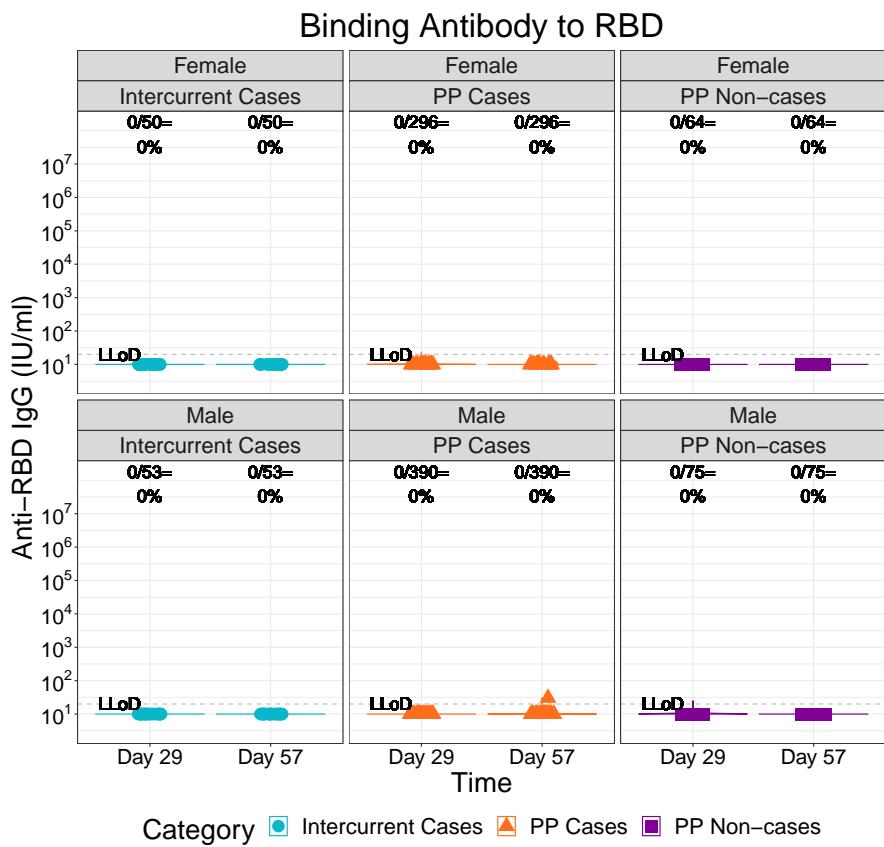


Figure 1.165: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (2 timepoints)

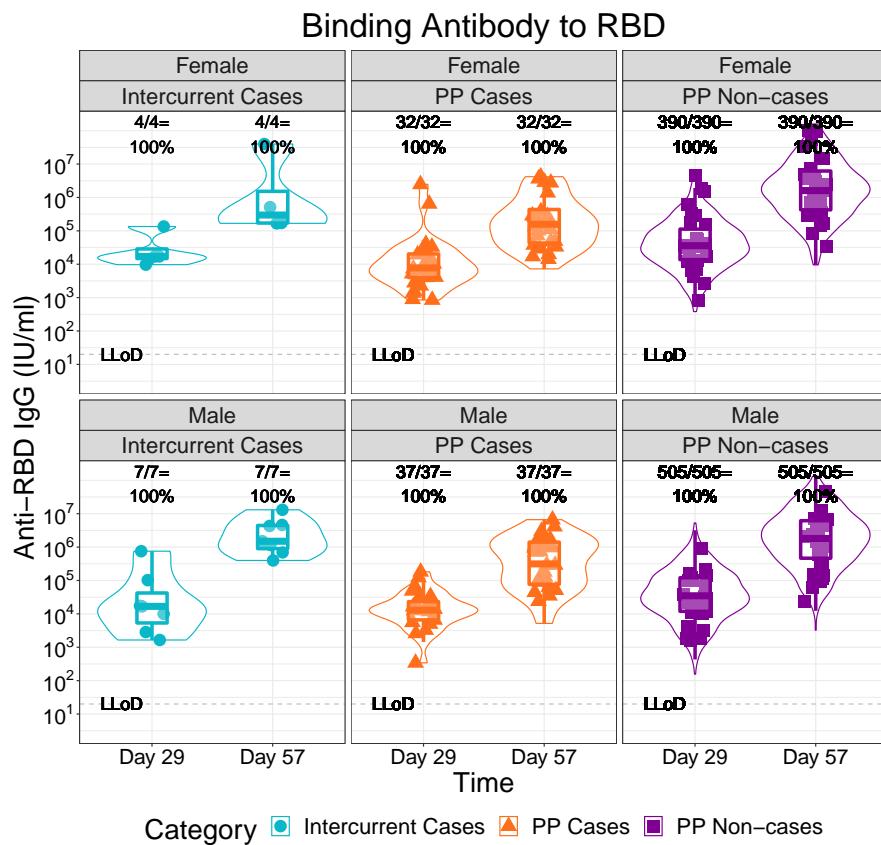


Figure 1.166: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

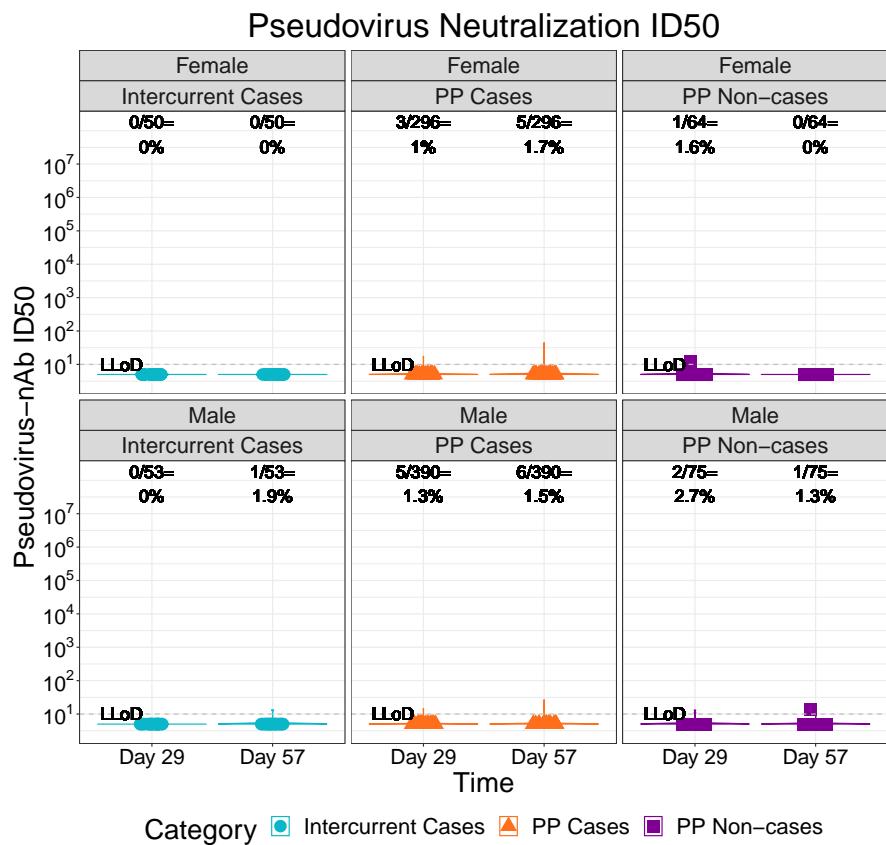


Figure 1.167: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (2 timepoints)

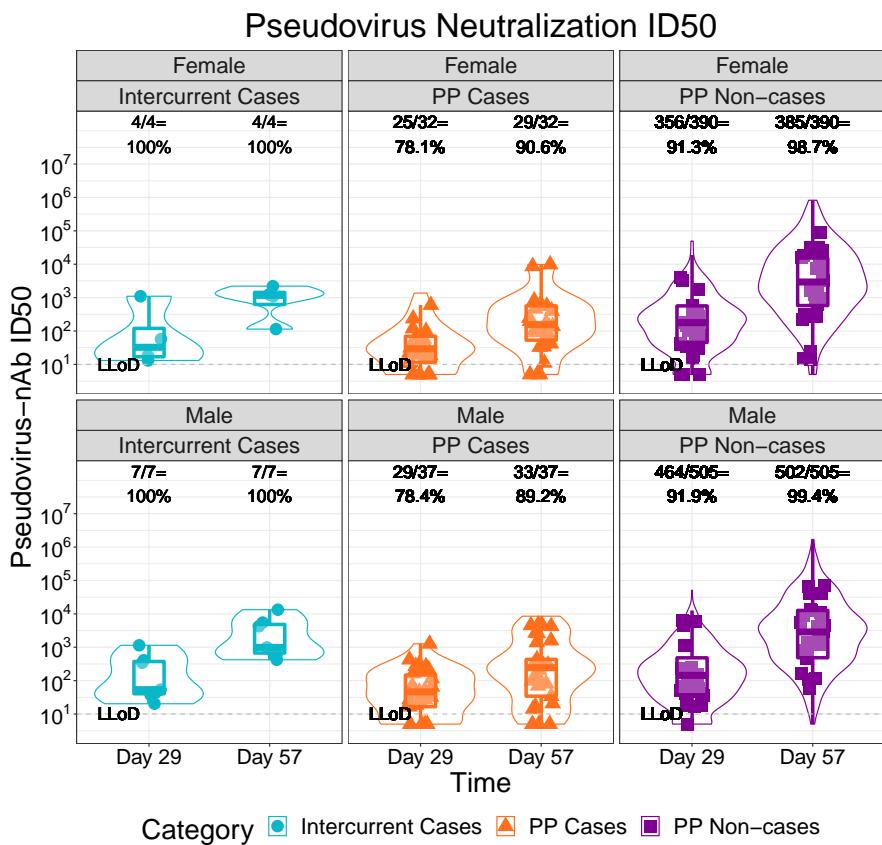


Figure 1.168: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

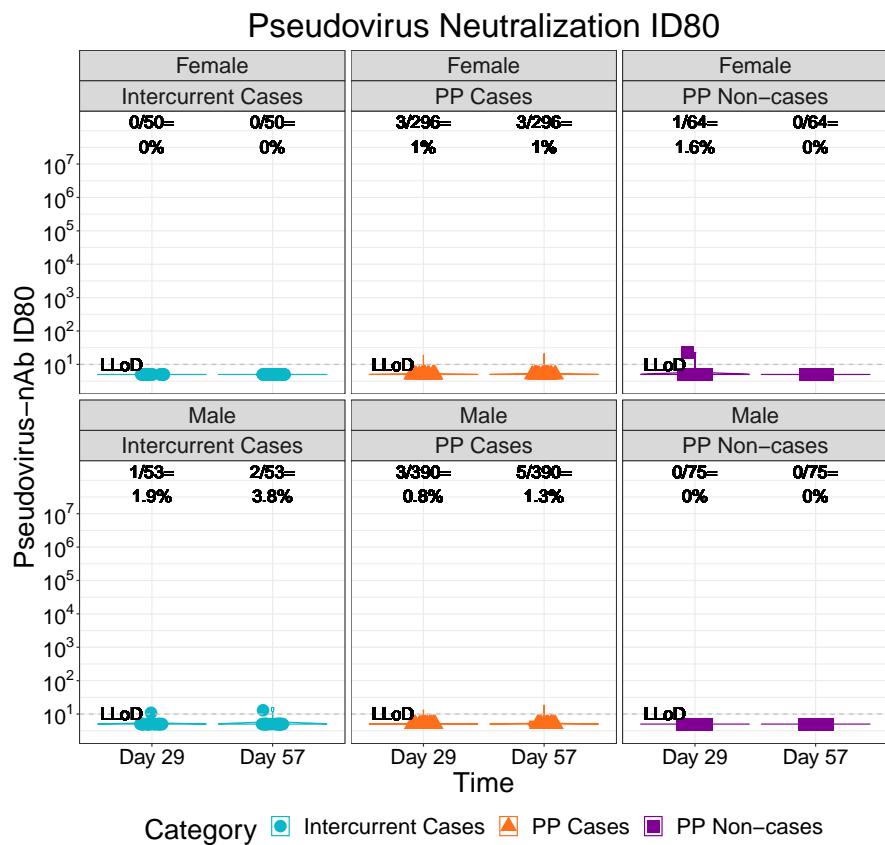


Figure 1.169: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (2 timepoints)

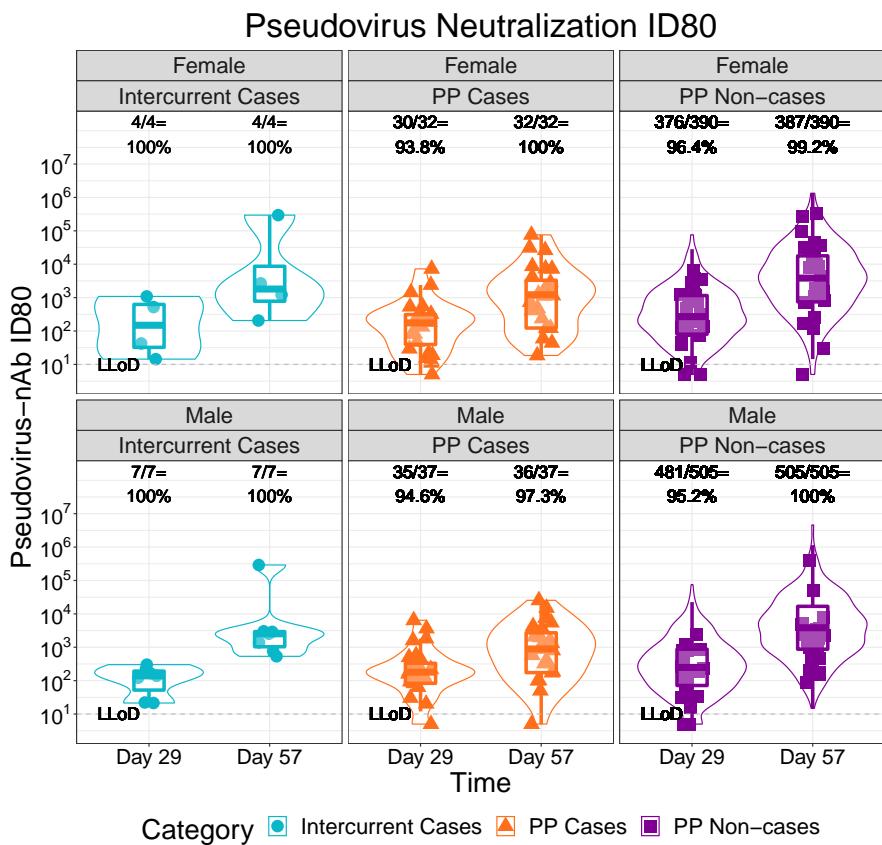


Figure 1.170: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (2 timepoints)

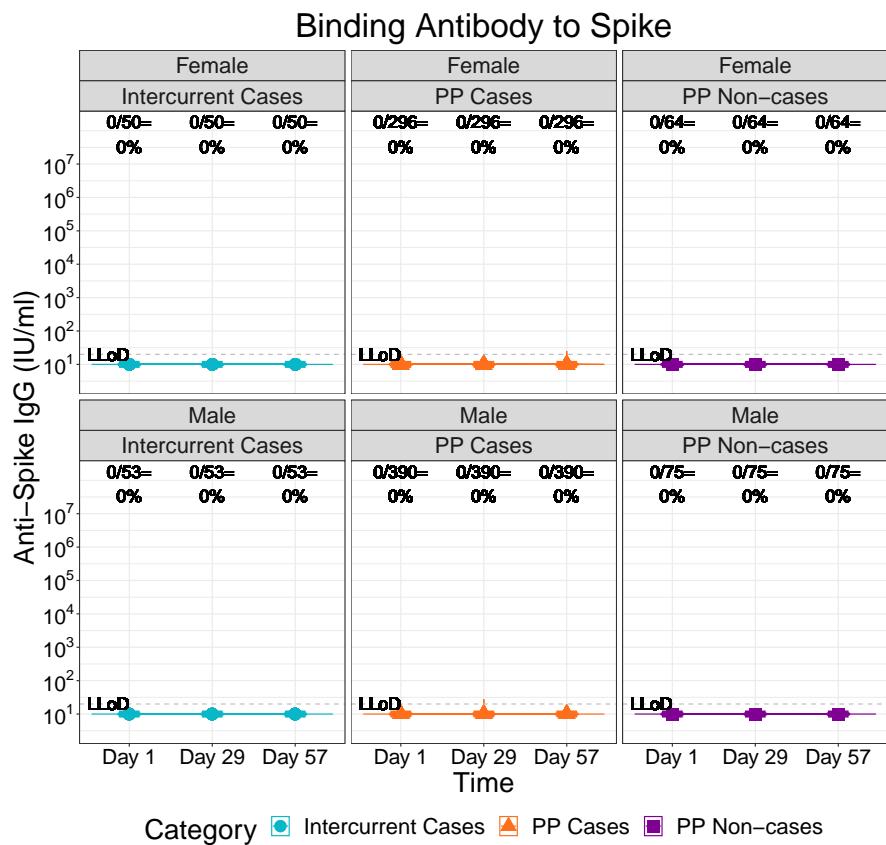


Figure 1.171: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints)

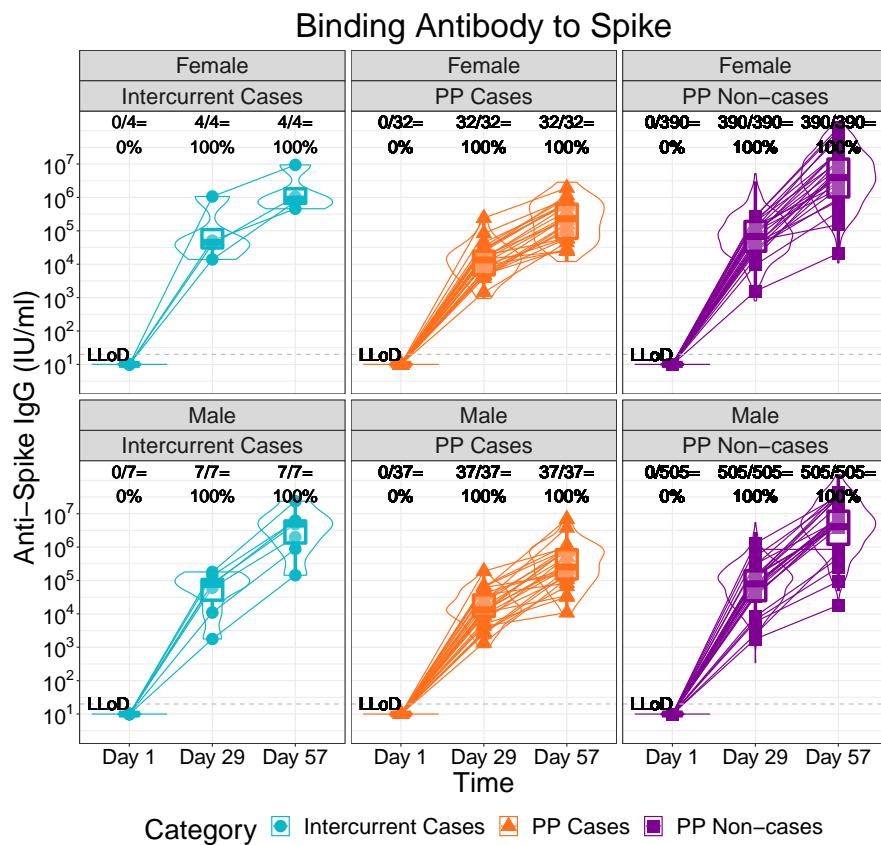


Figure 1.172: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

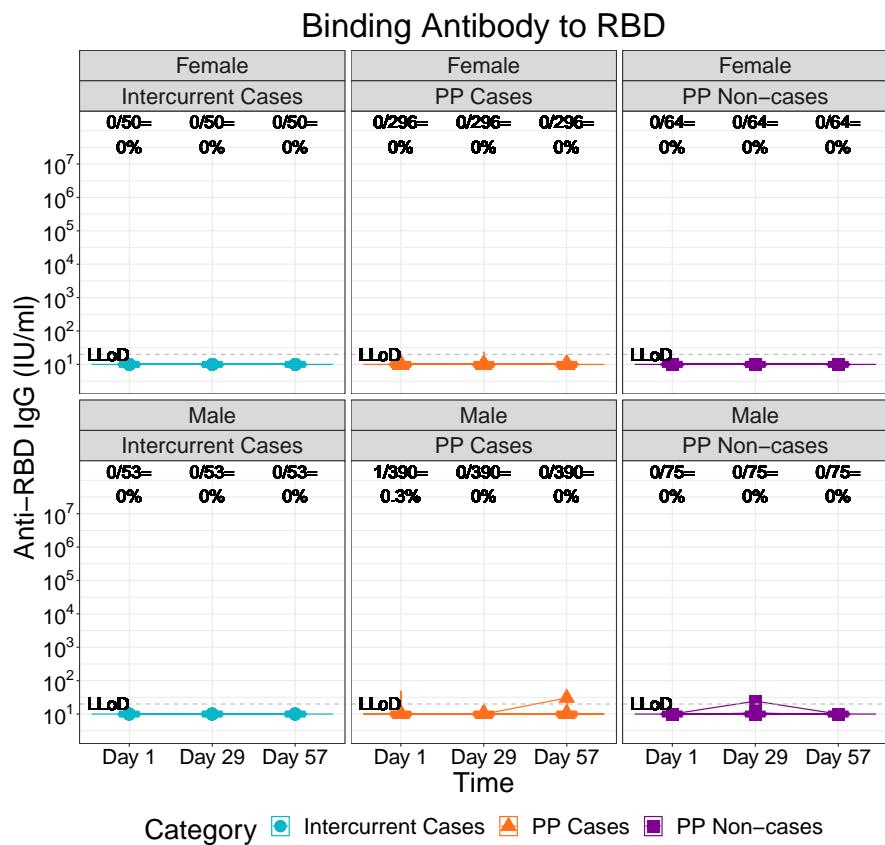


Figure 1.173: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints)

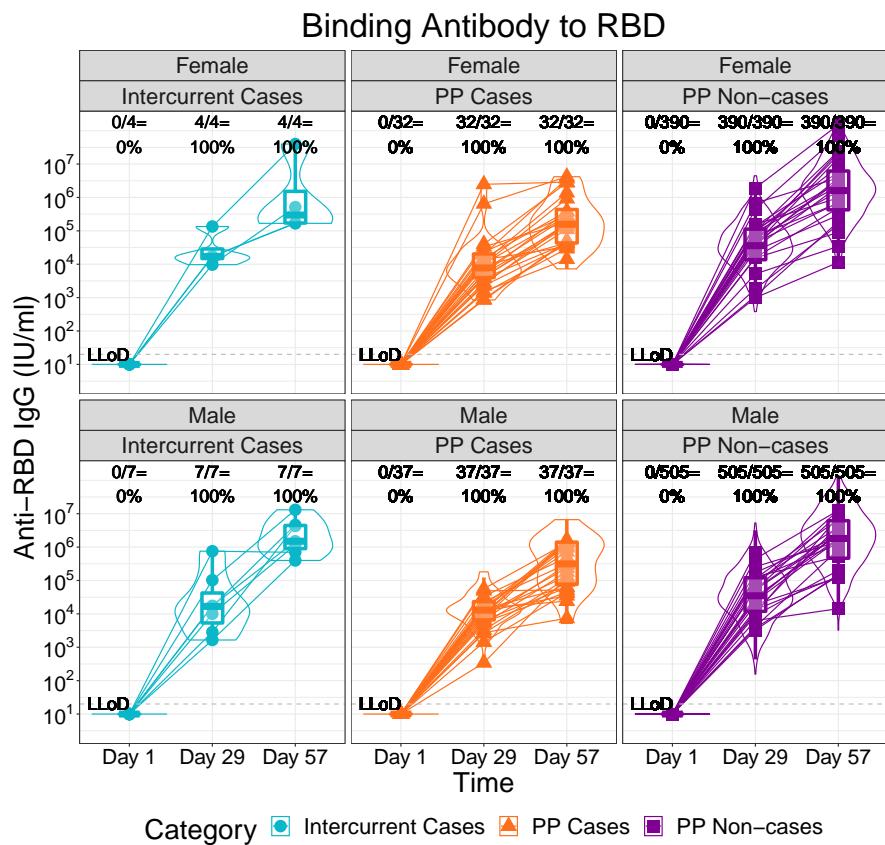


Figure 1.174: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

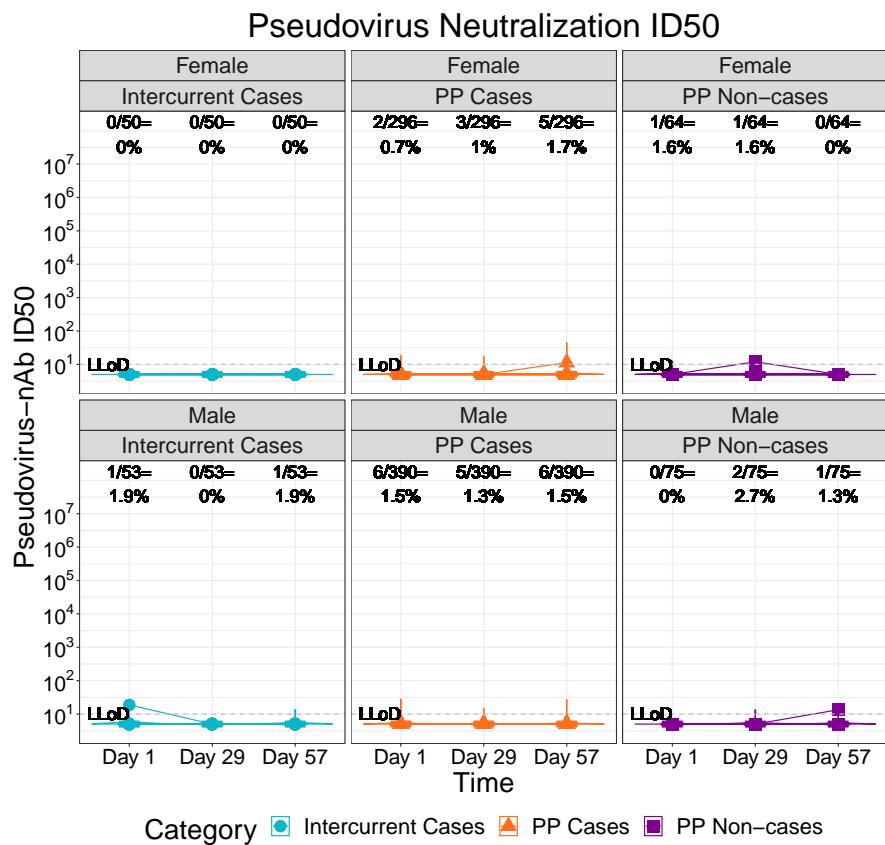


Figure 1.175: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints)

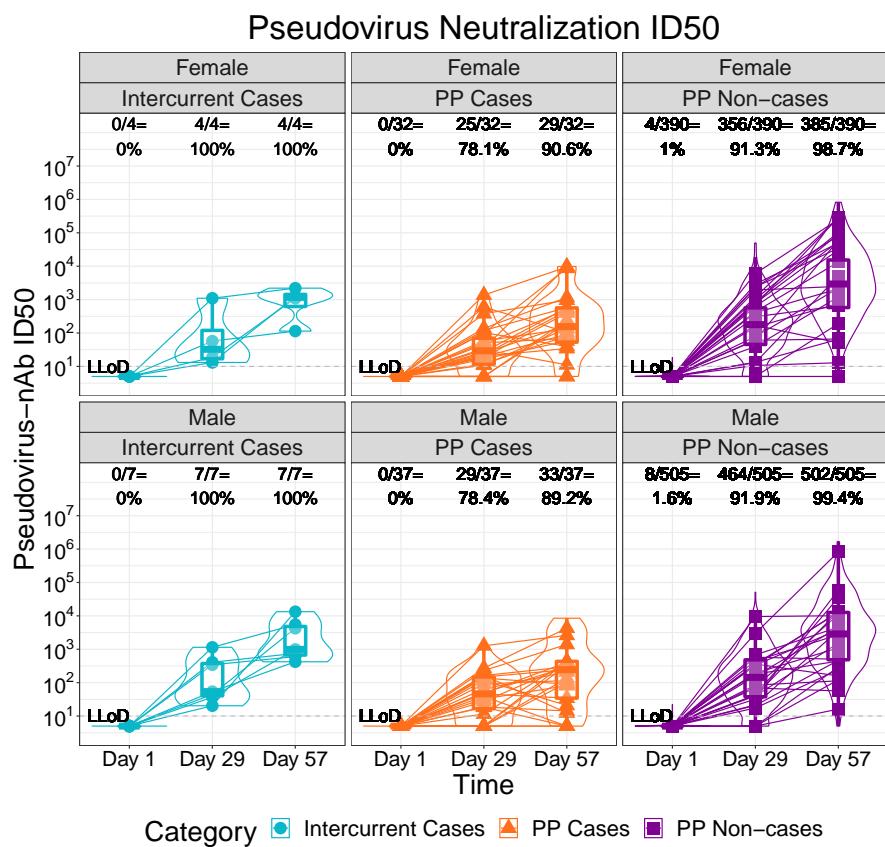


Figure 1.176: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

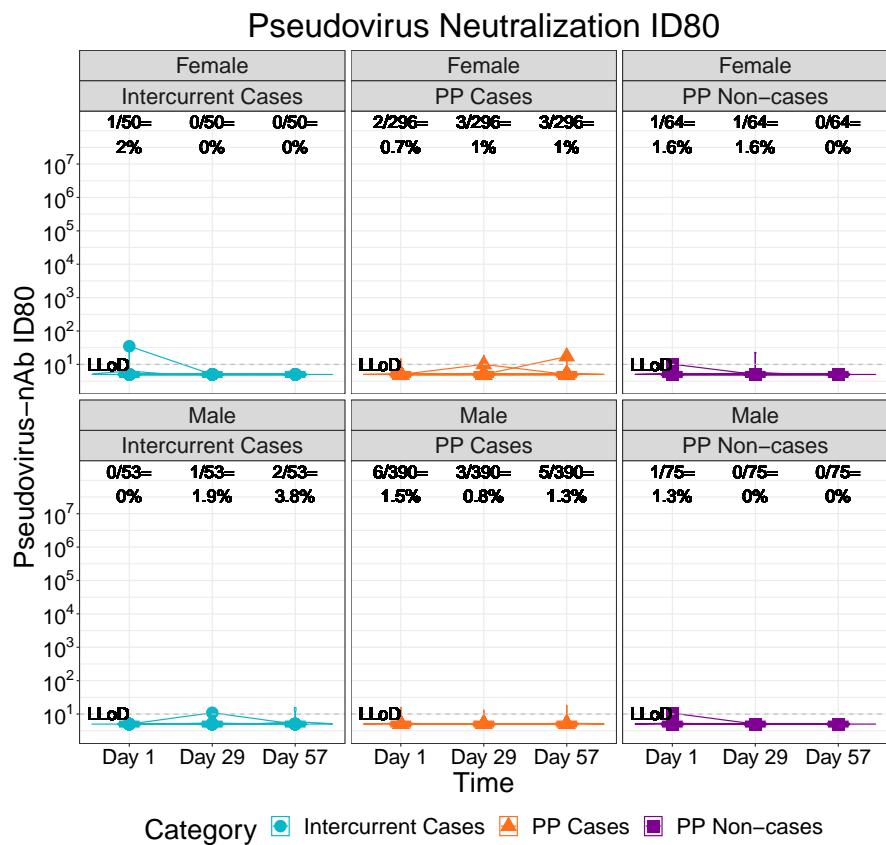


Figure 1.177: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints)

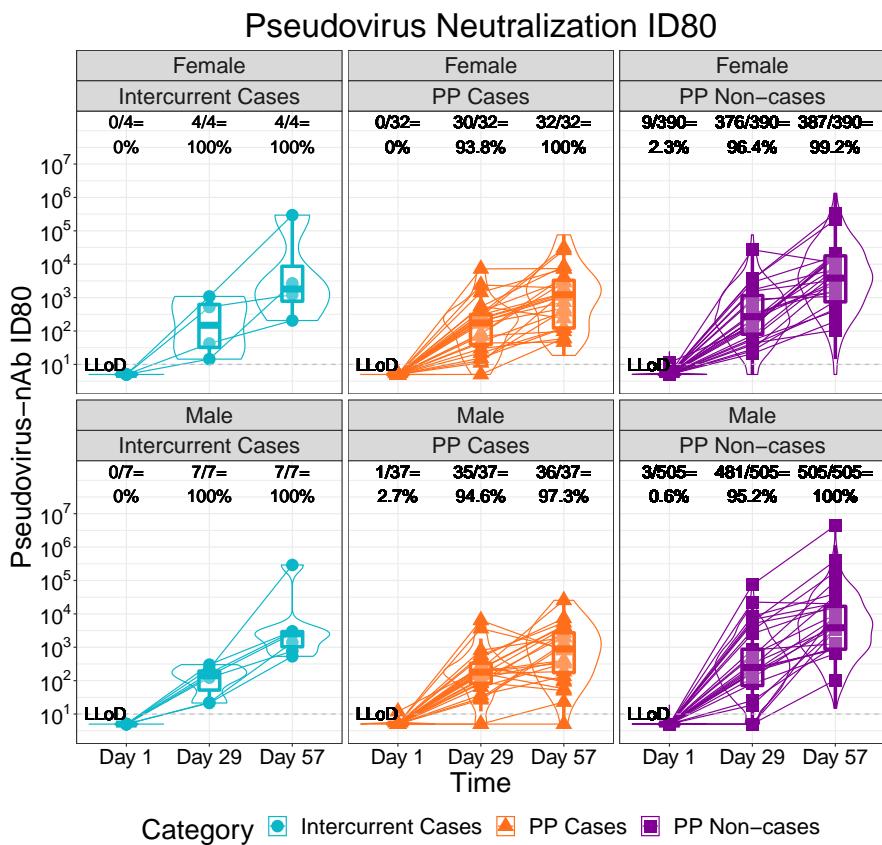


Figure 1.178: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

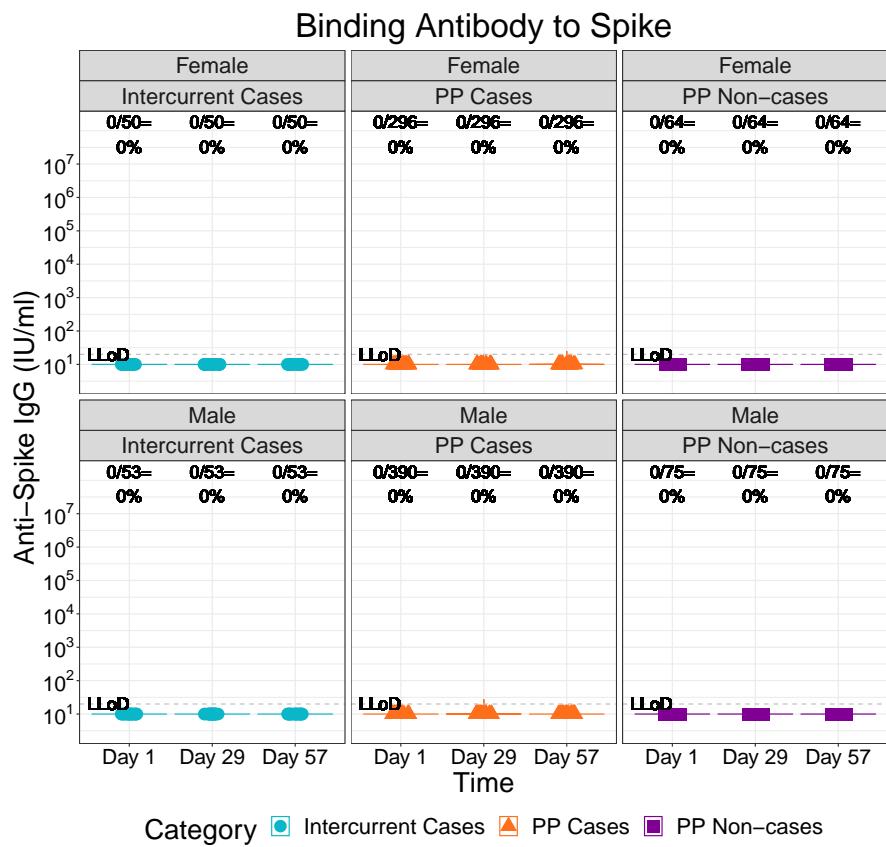


Figure 1.179: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by sex assigned at birth (3 timepoints)

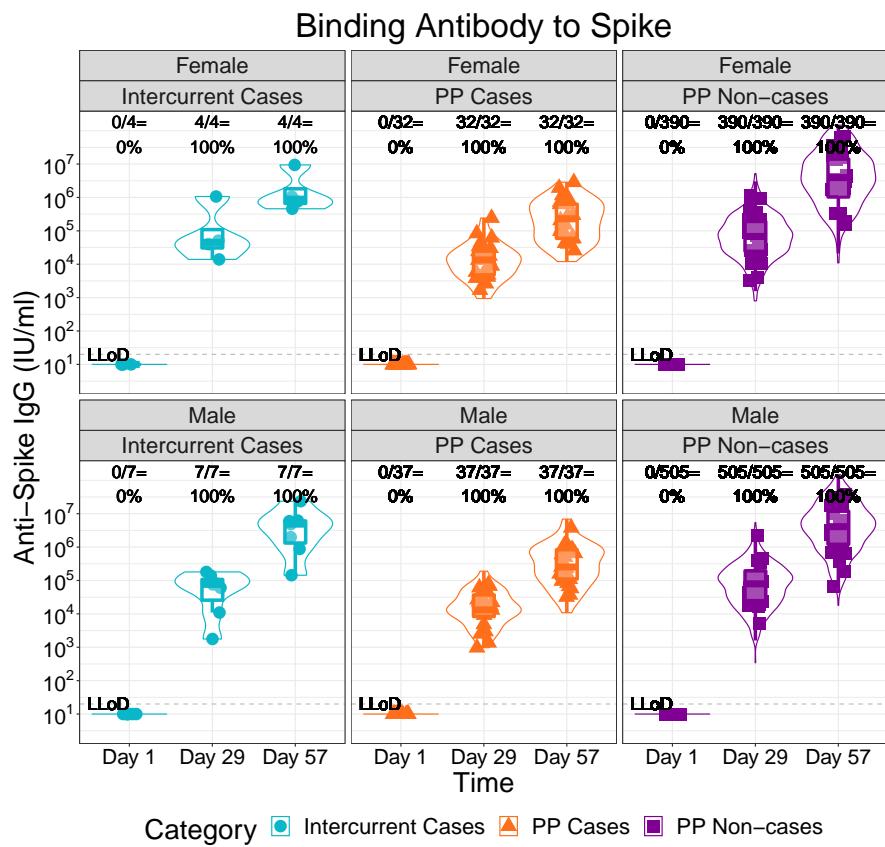


Figure 1.180: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

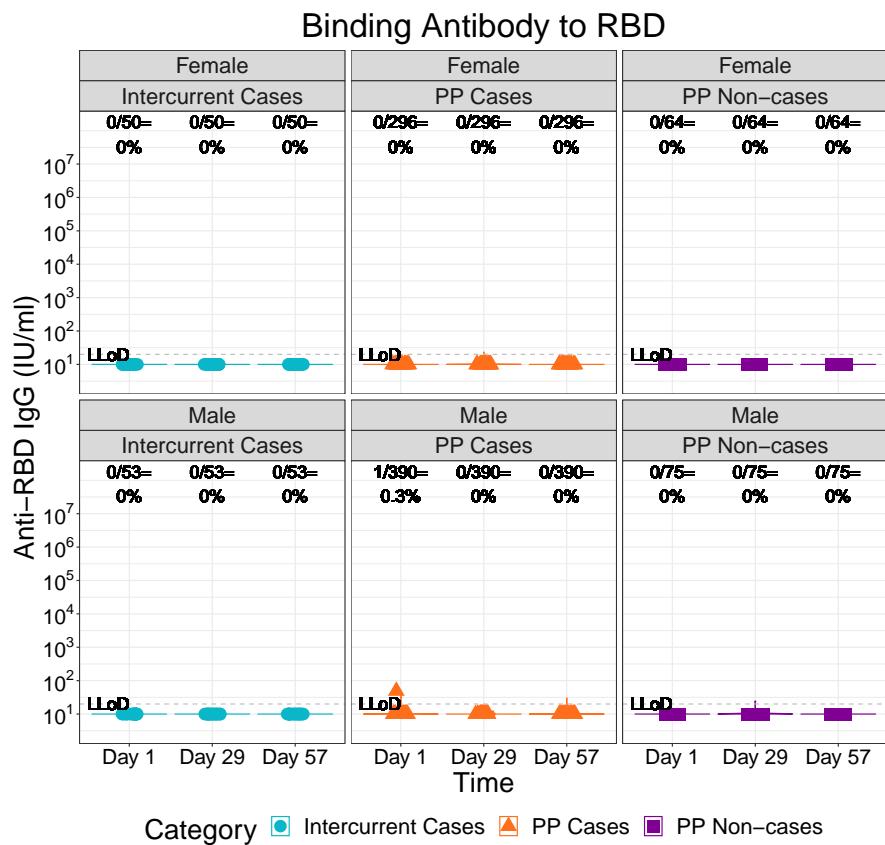


Figure 1.181: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by sex assigned at birth (3 timepoints)

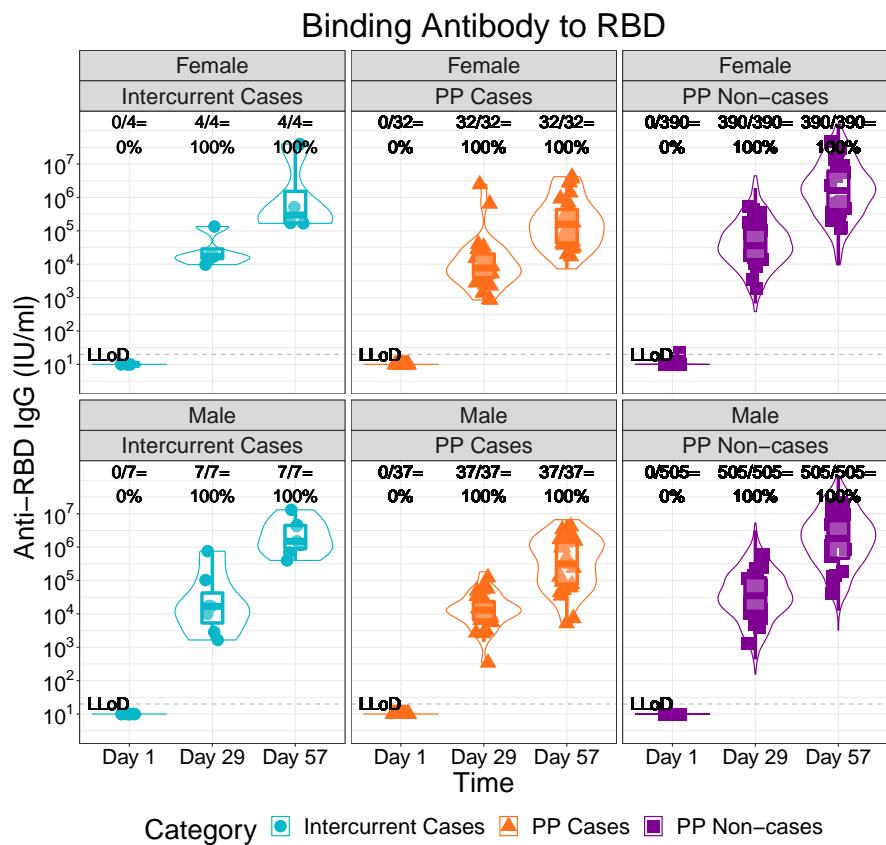


Figure 1.182: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

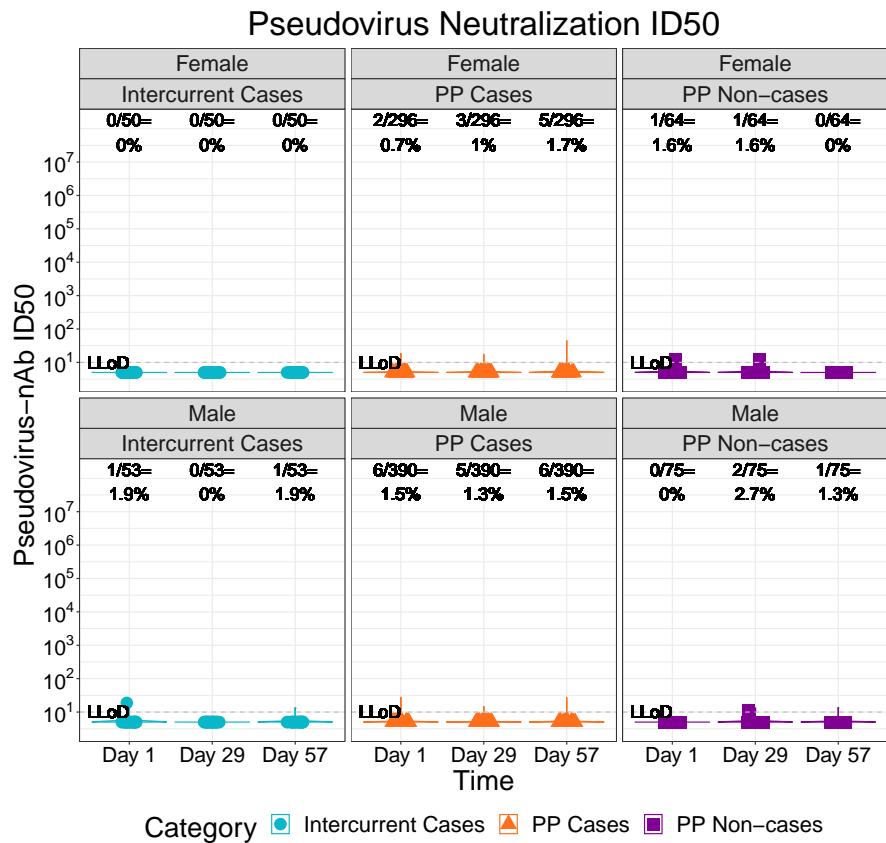


Figure 1.183: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by sex assigned at birth (3 timepoints)

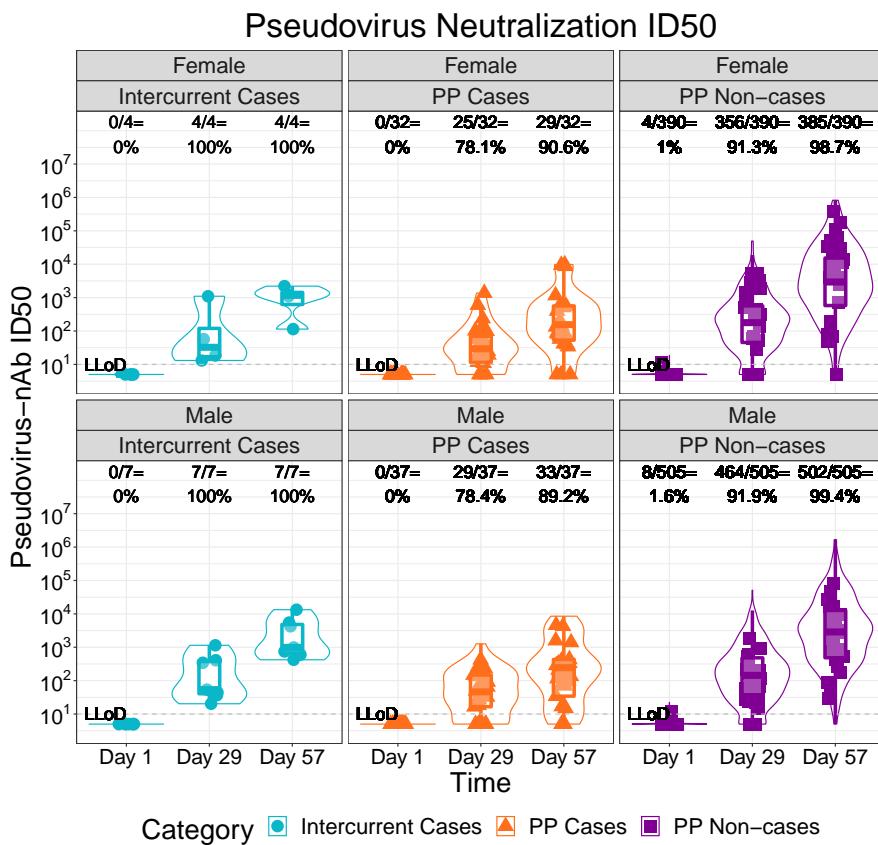


Figure 1.184: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

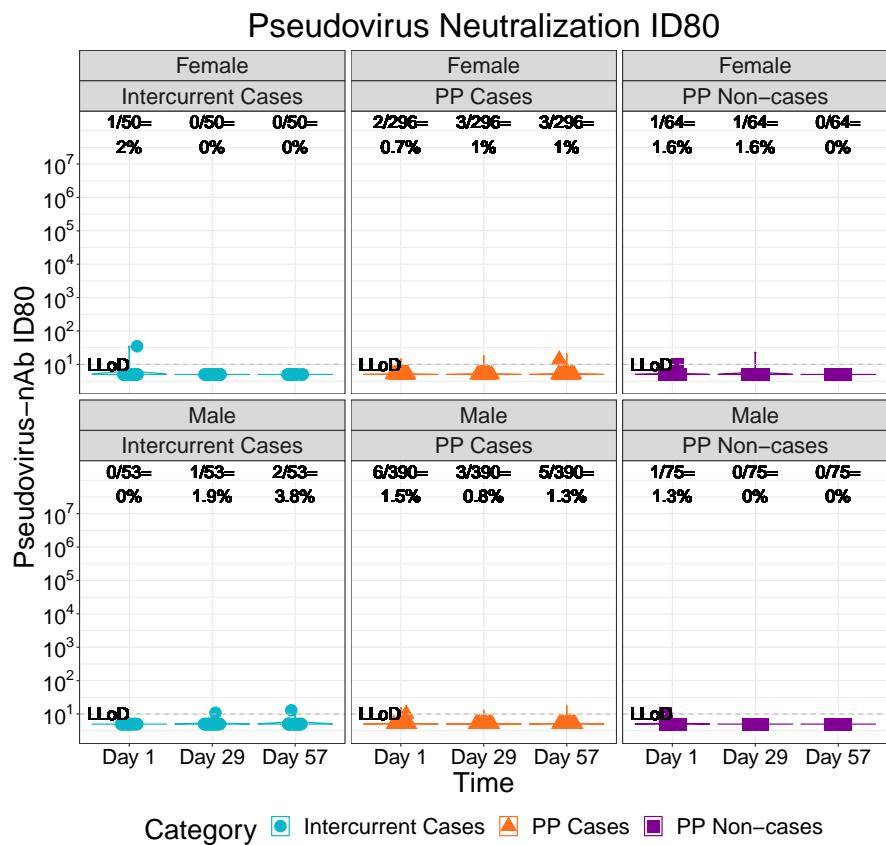


Figure 1.185: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by sex assigned at birth (3 timepoints)

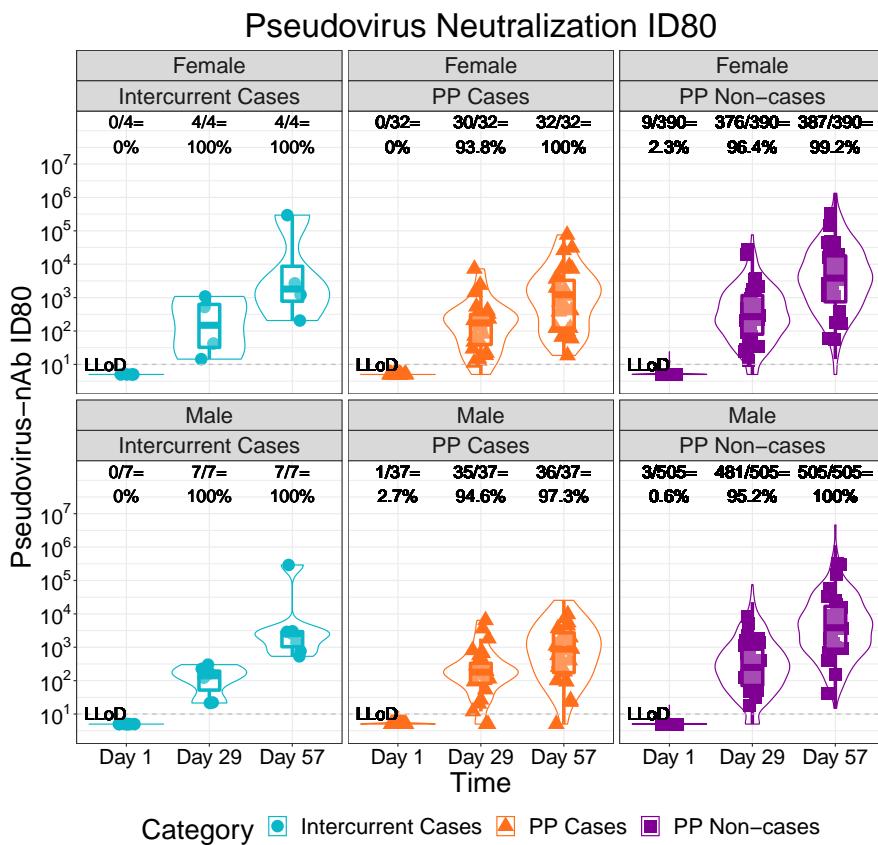


Figure 1.186: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by sex assigned at birth (3 timepoints)

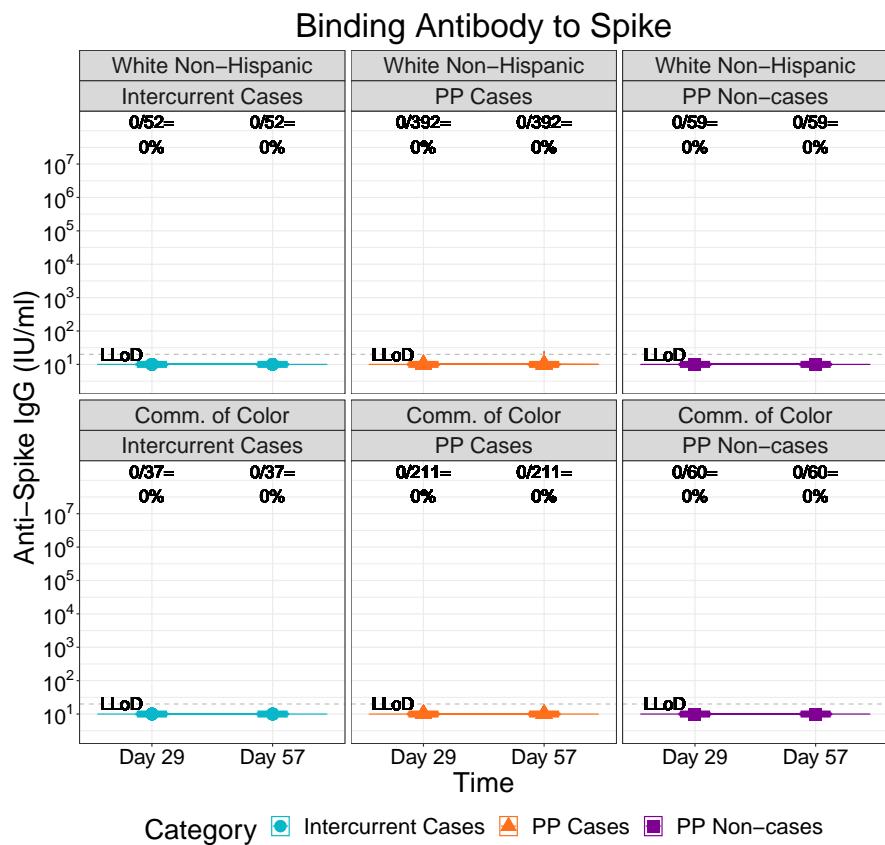


Figure 1.187: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints)

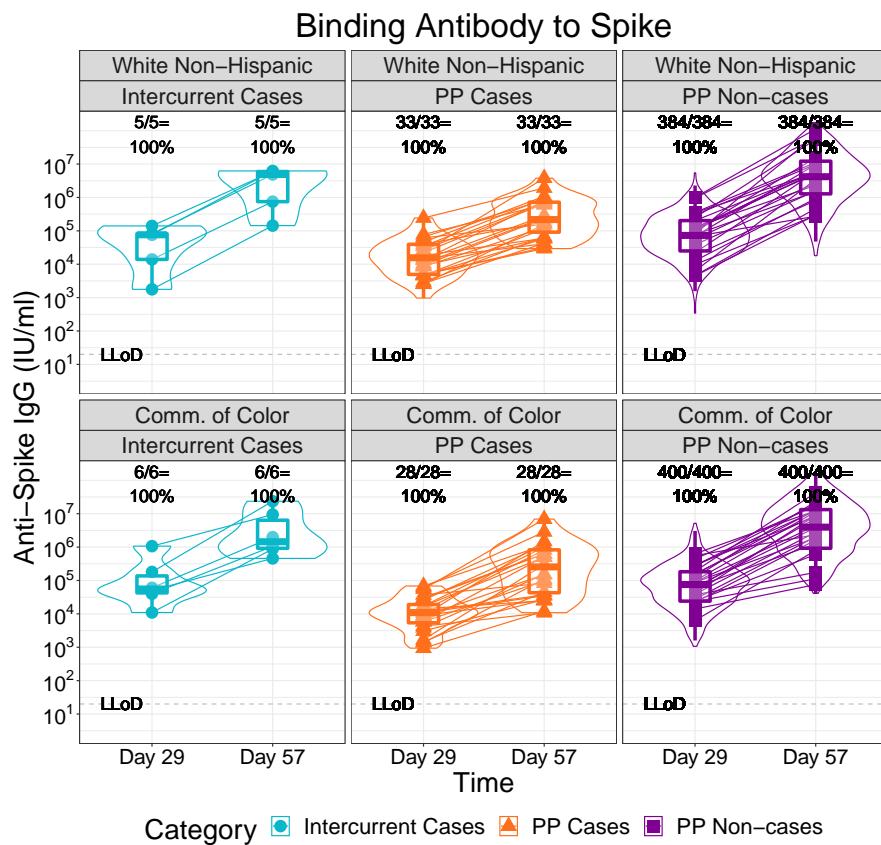


Figure 1.188: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints)

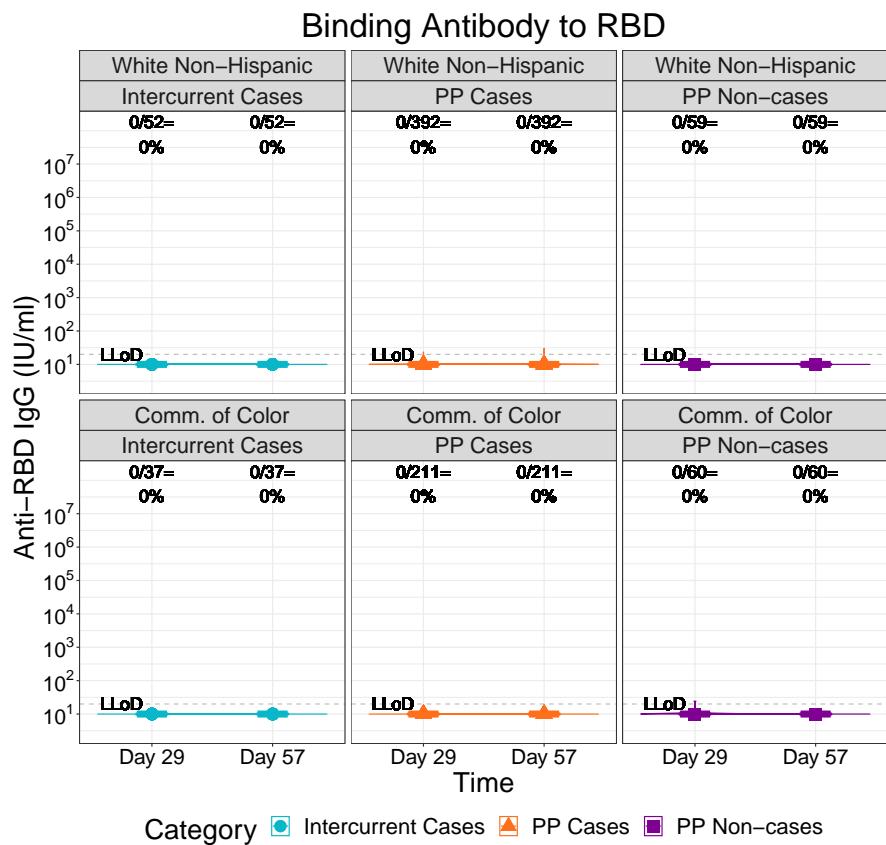


Figure 1.189: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints)

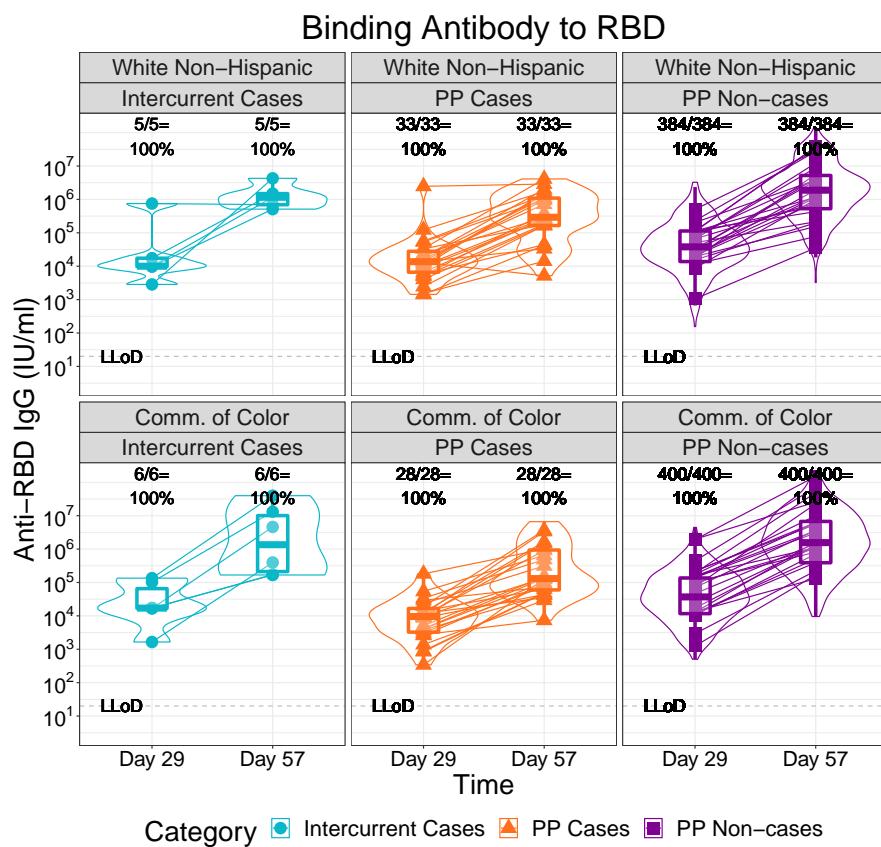


Figure 1.190: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints)

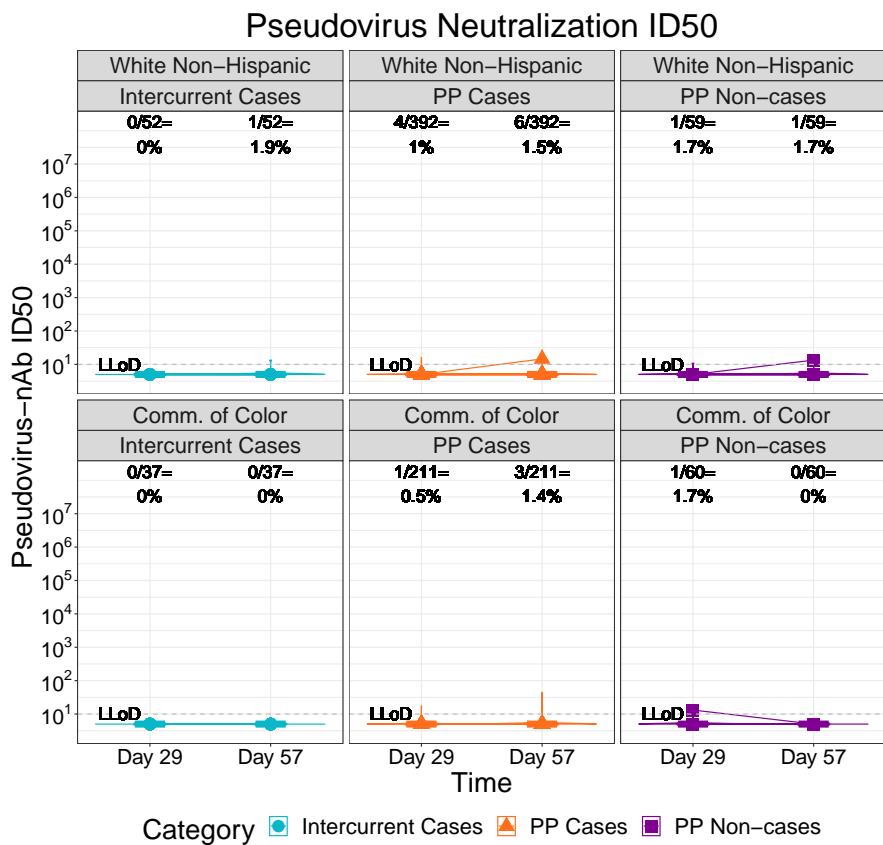


Figure 1.191: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints)

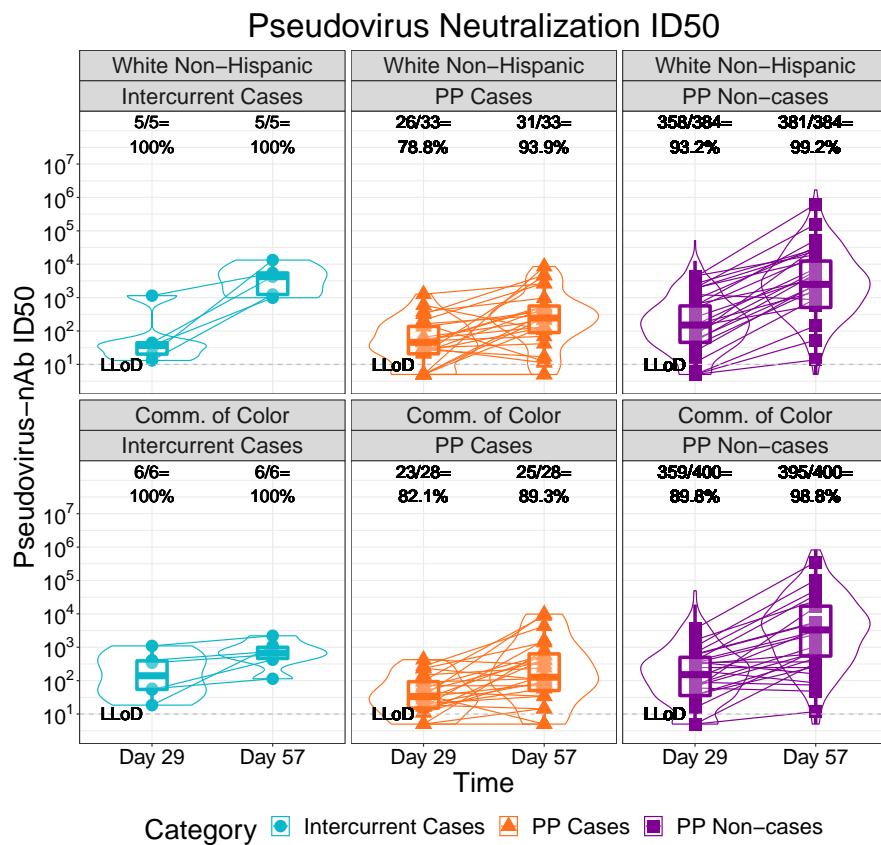


Figure 1.192: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints)

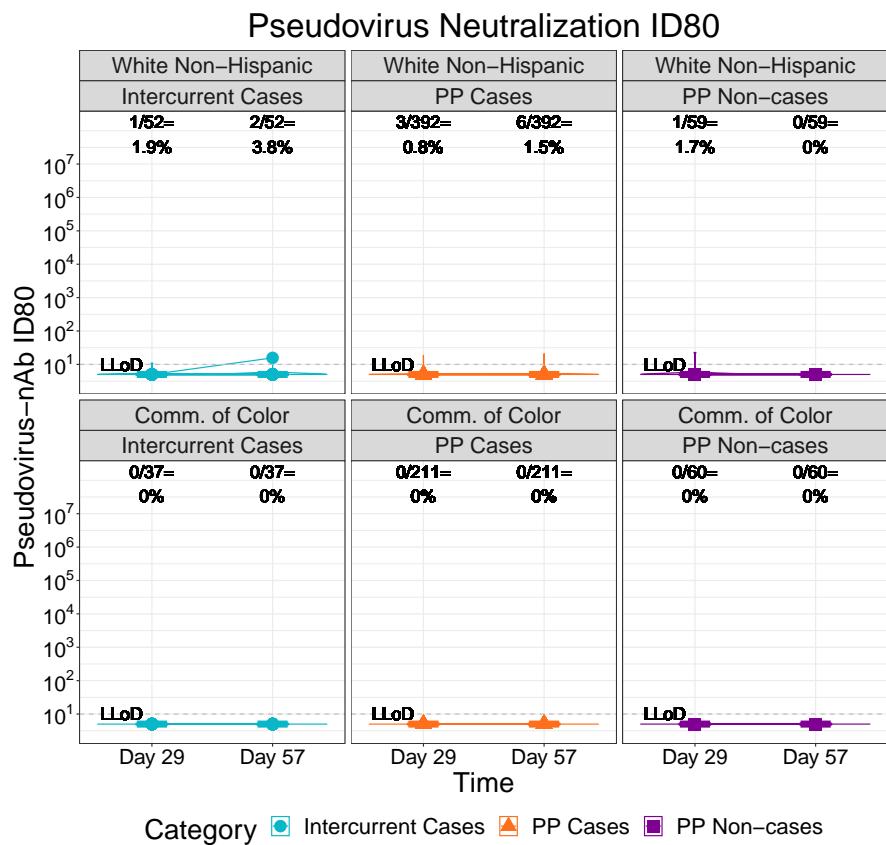


Figure 1.193: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints)

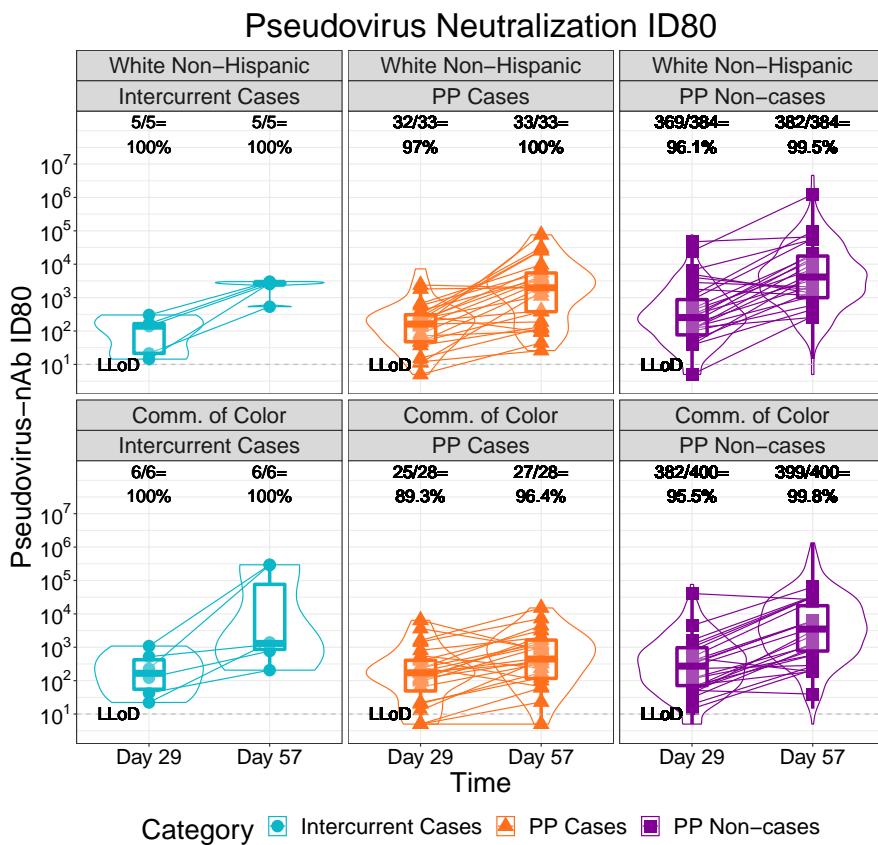


Figure 1.194: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints)

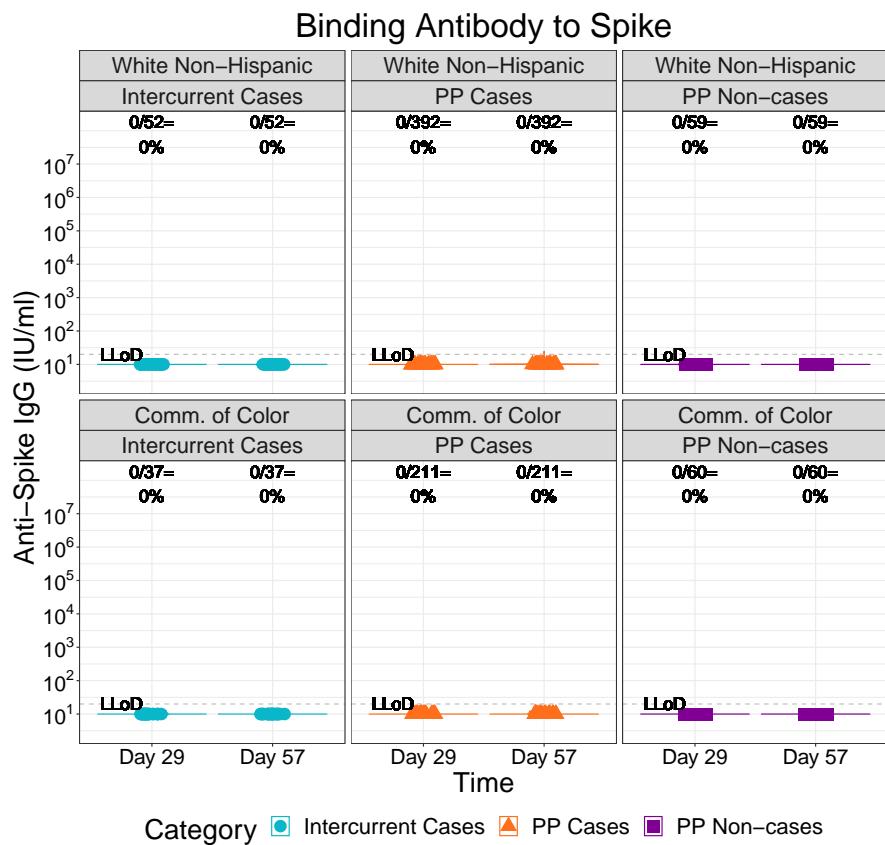


Figure 1.195: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (2 timepoints)

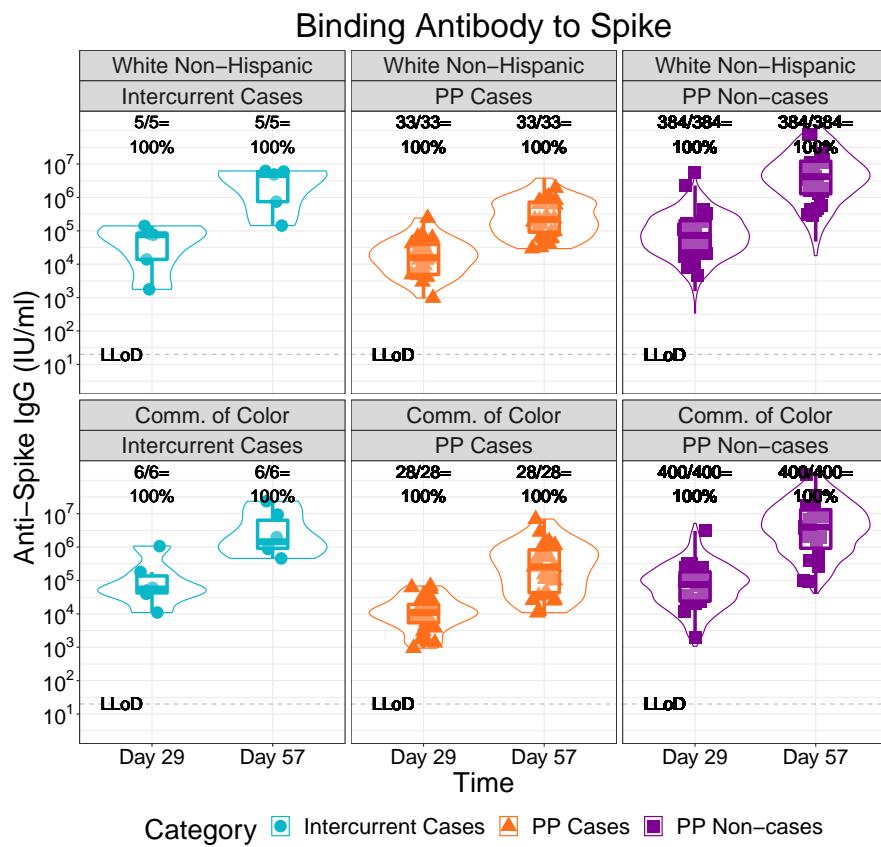


Figure 1.196: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (2 timepoints)

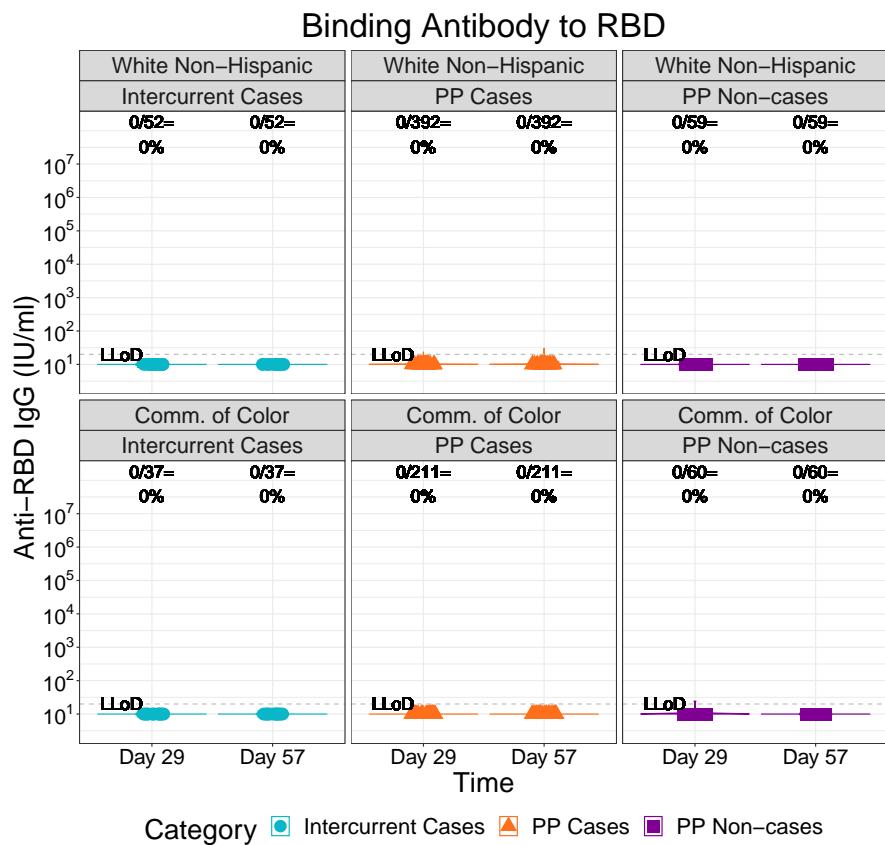


Figure 1.197: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (2 timepoints)

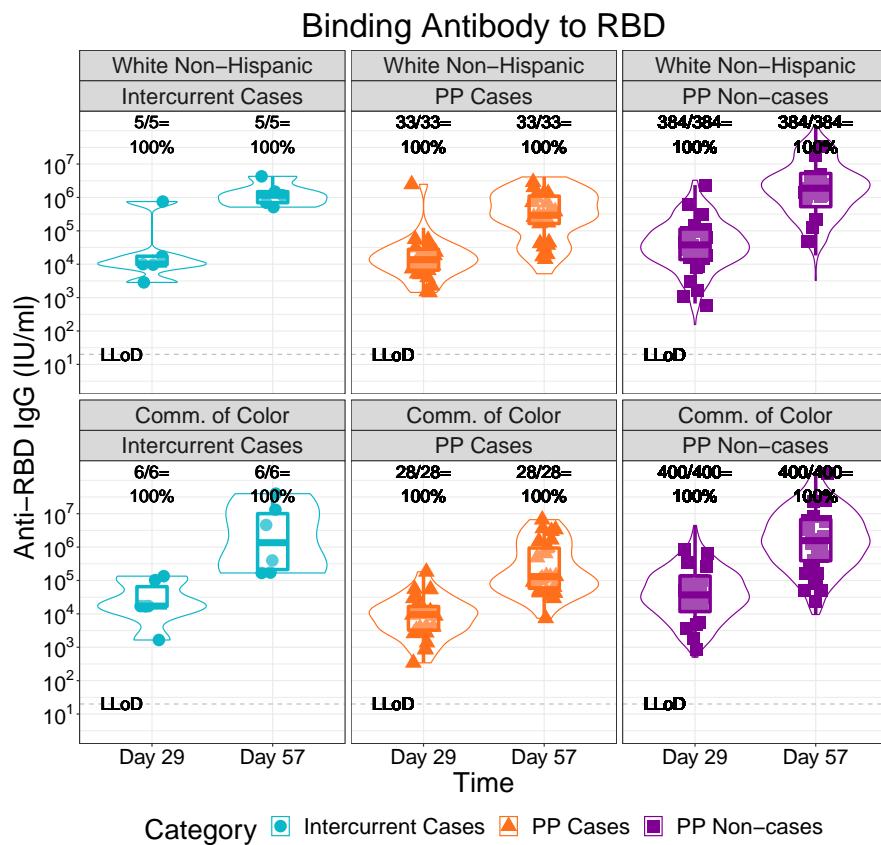


Figure 1.198: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (2 timepoints)

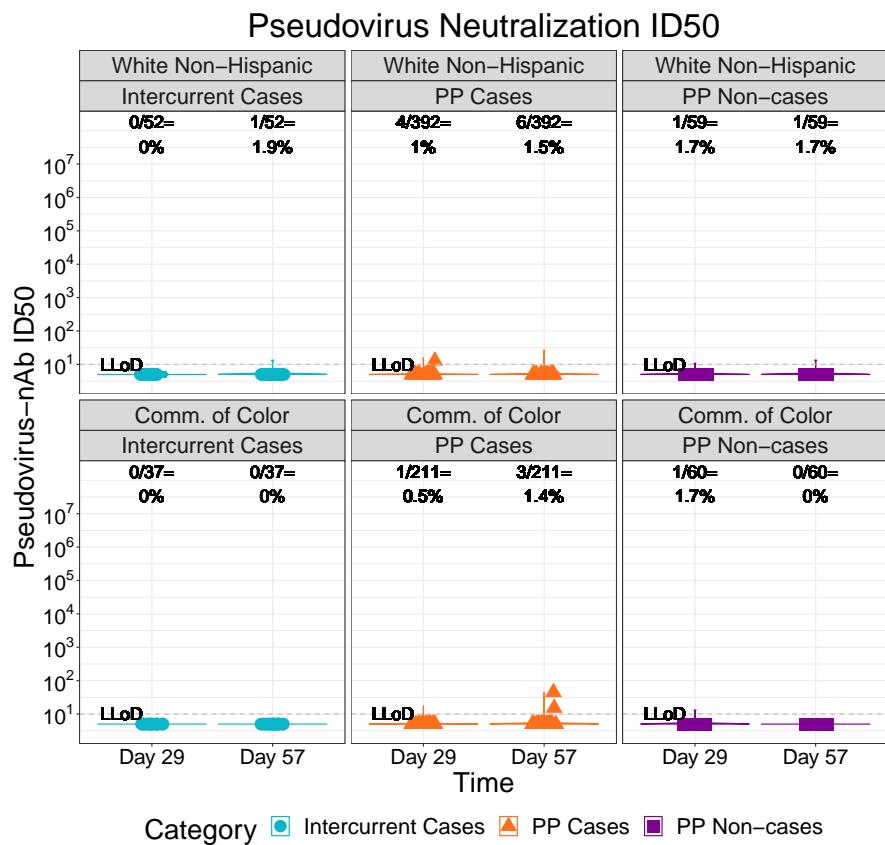


Figure 1.199: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (2 timepoints)

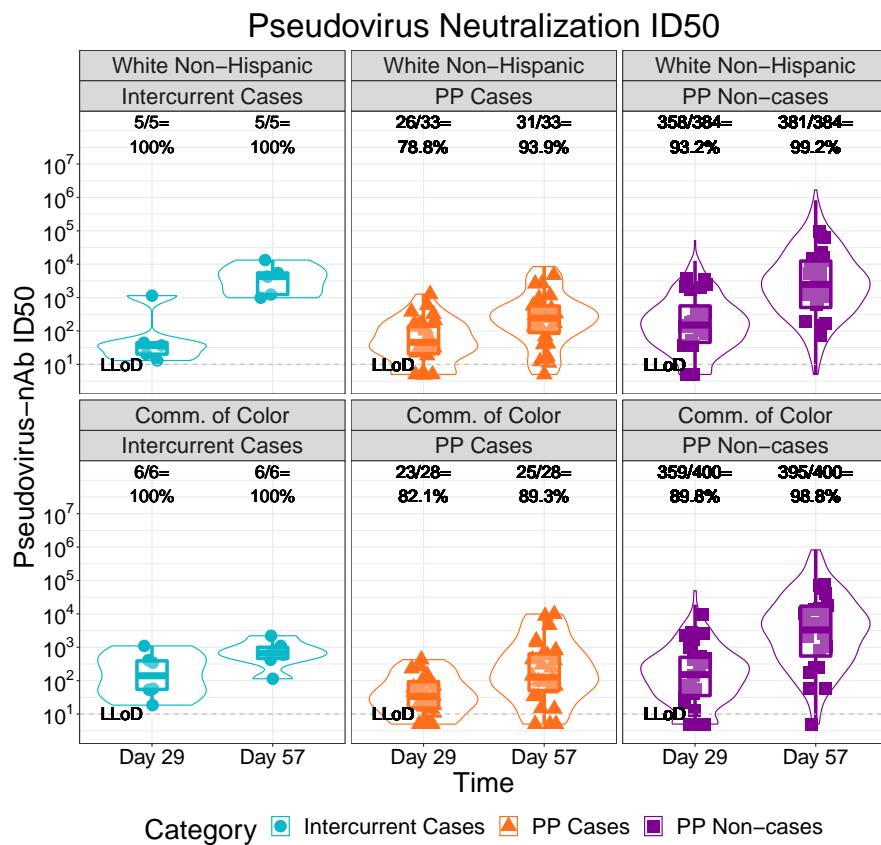


Figure 1.200: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (2 timepoints)

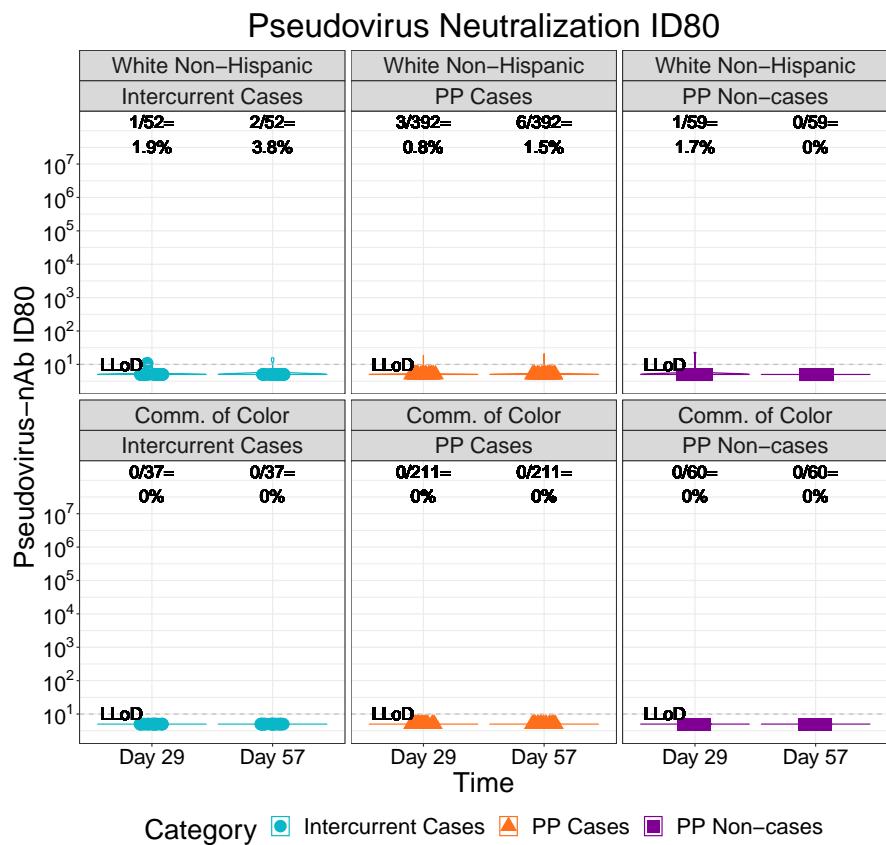


Figure 1.201: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (2 timepoints)

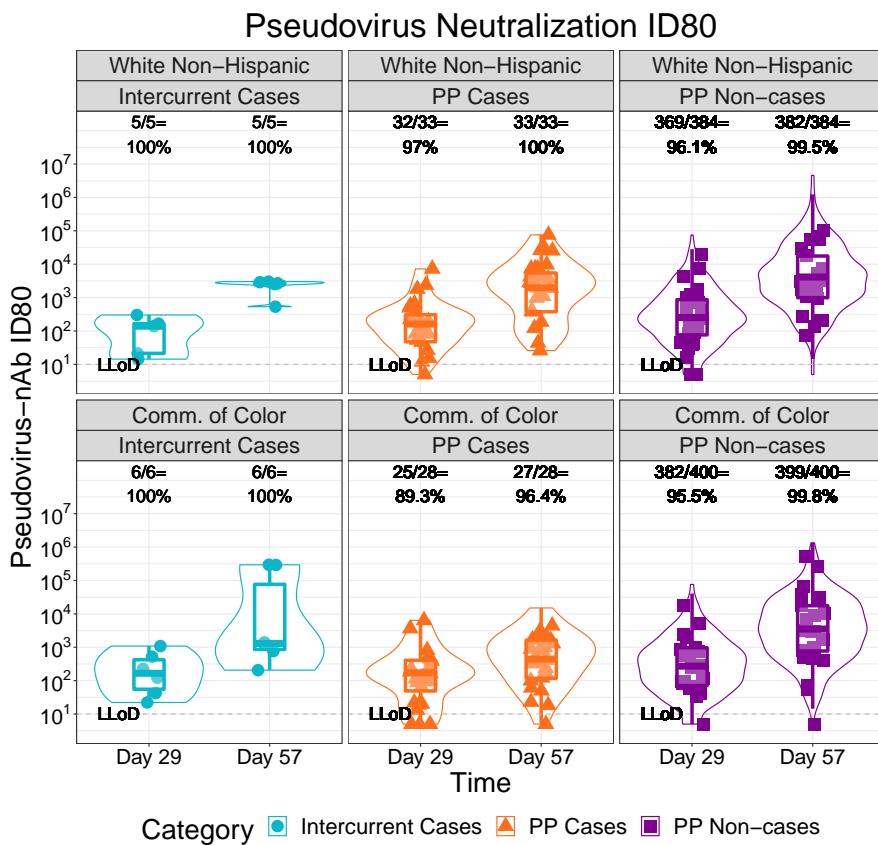


Figure 1.202: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (2 timepoints)

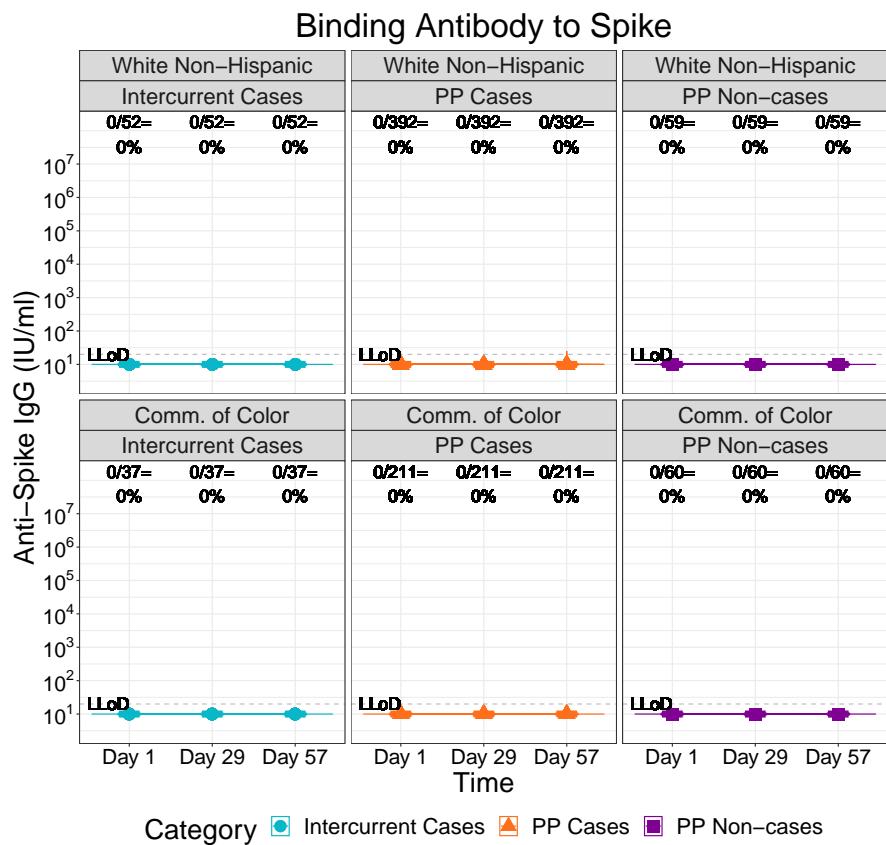


Figure 1.203: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints)

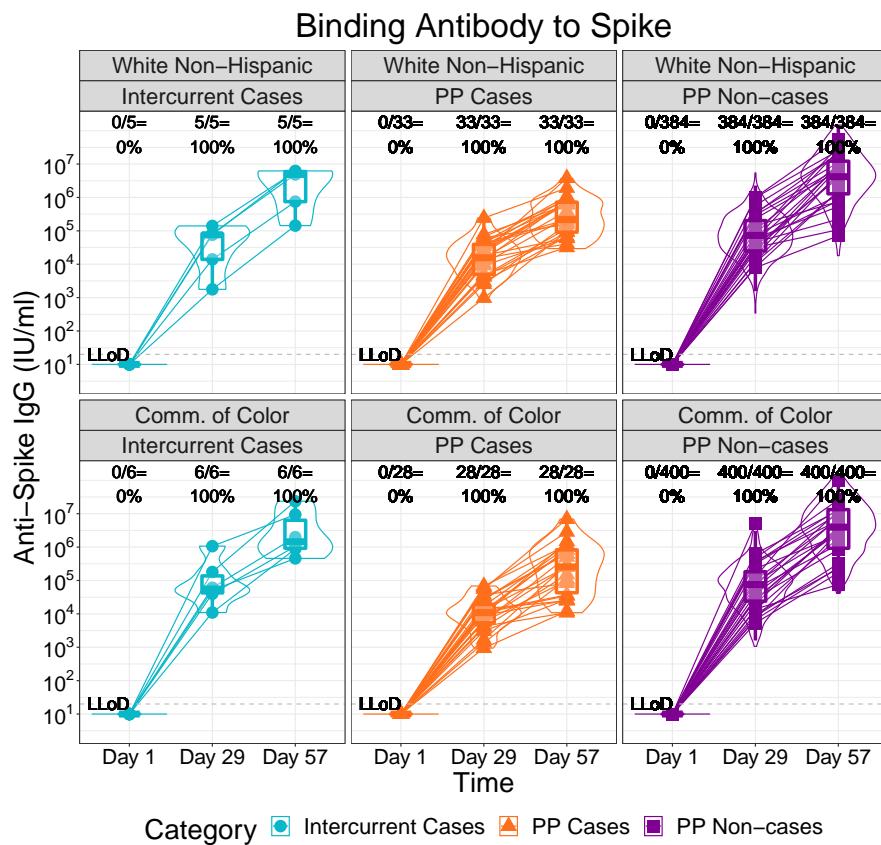


Figure 1.204: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints)

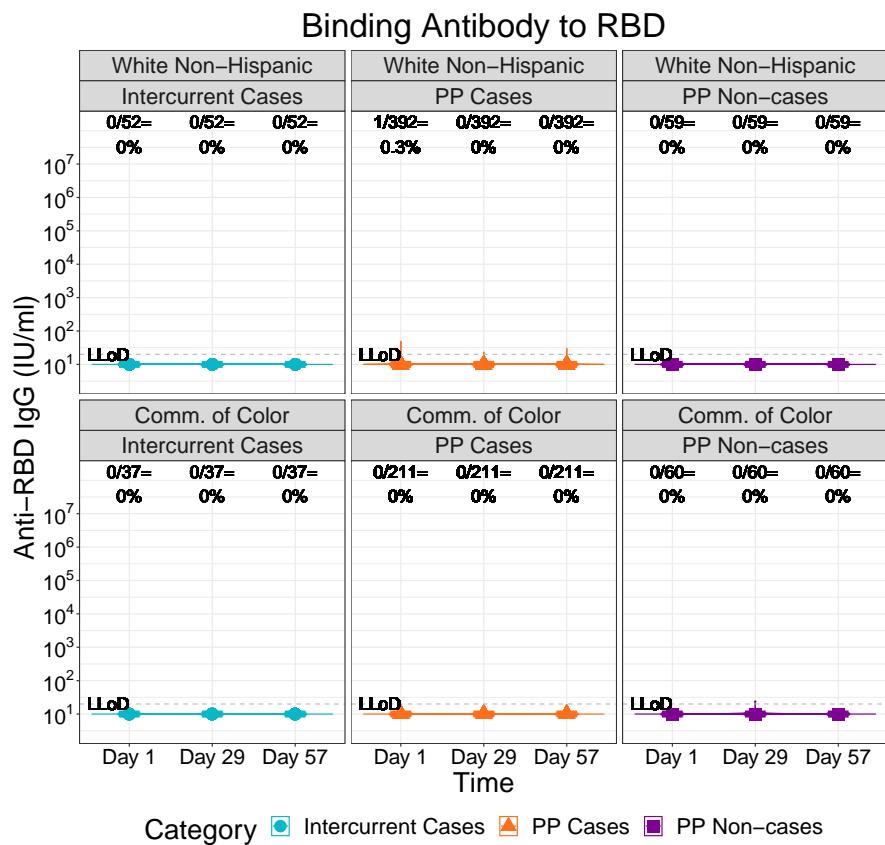


Figure 1.205: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints)

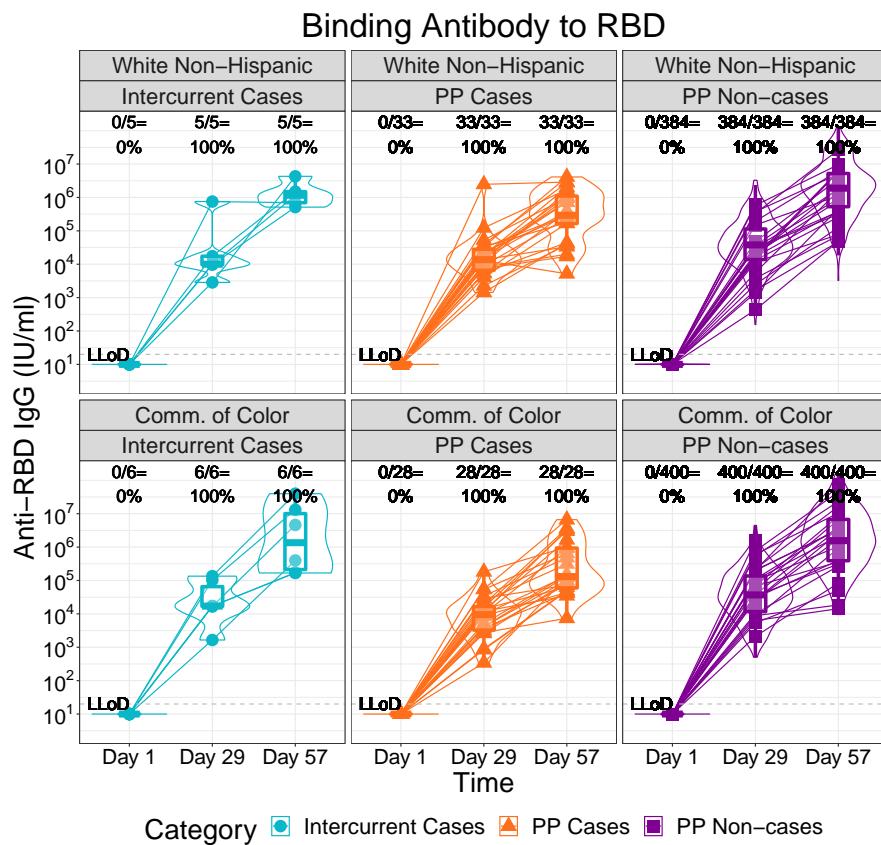


Figure 1.206: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints)

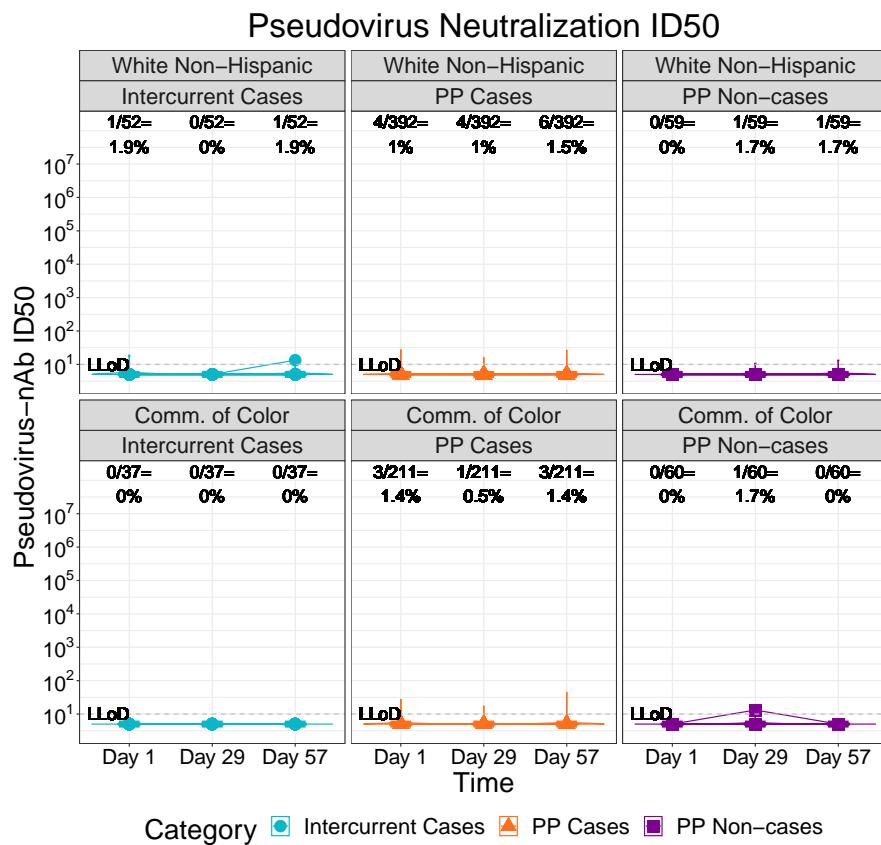


Figure 1.207: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints)

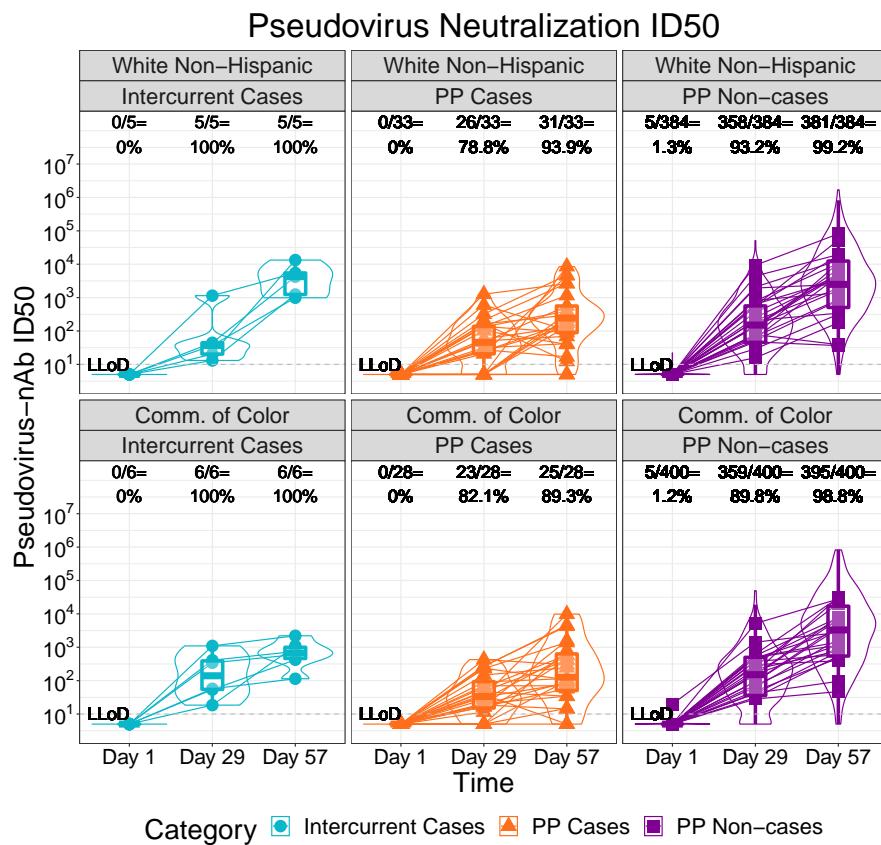


Figure 1.208: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints)

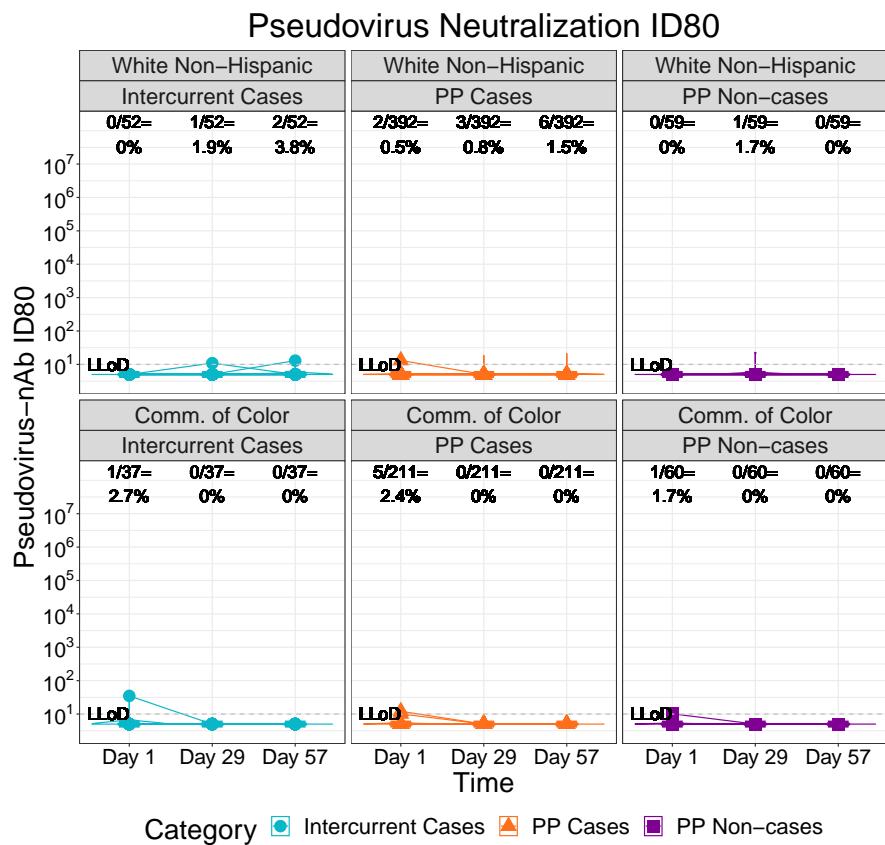


Figure 1.209: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints)

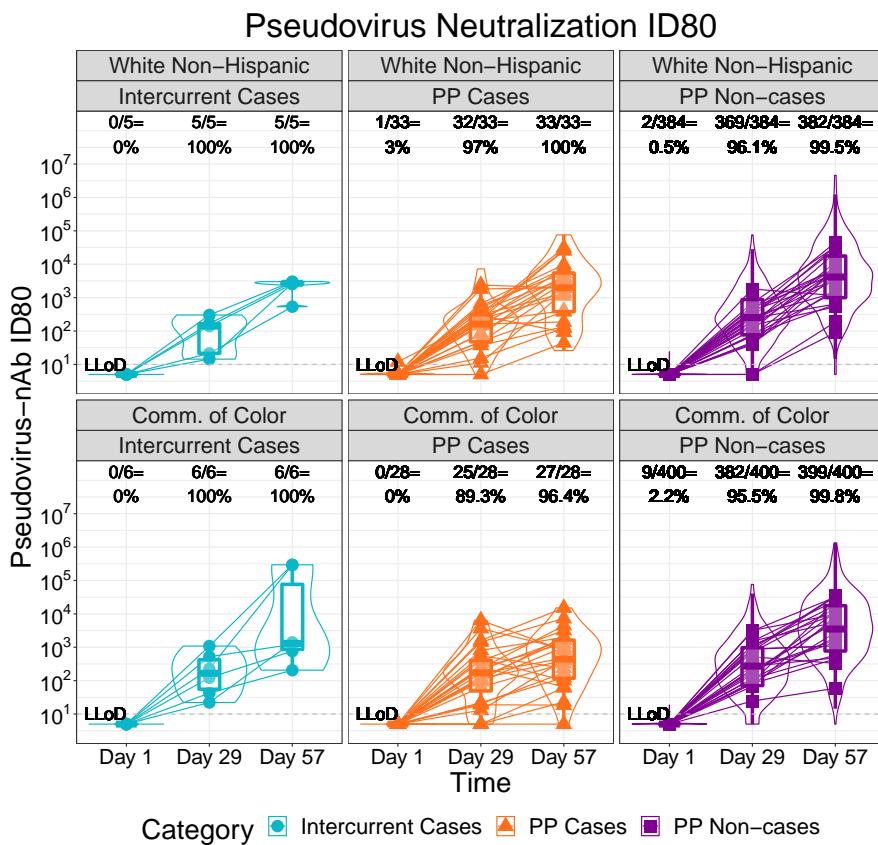


Figure 1.210: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints)

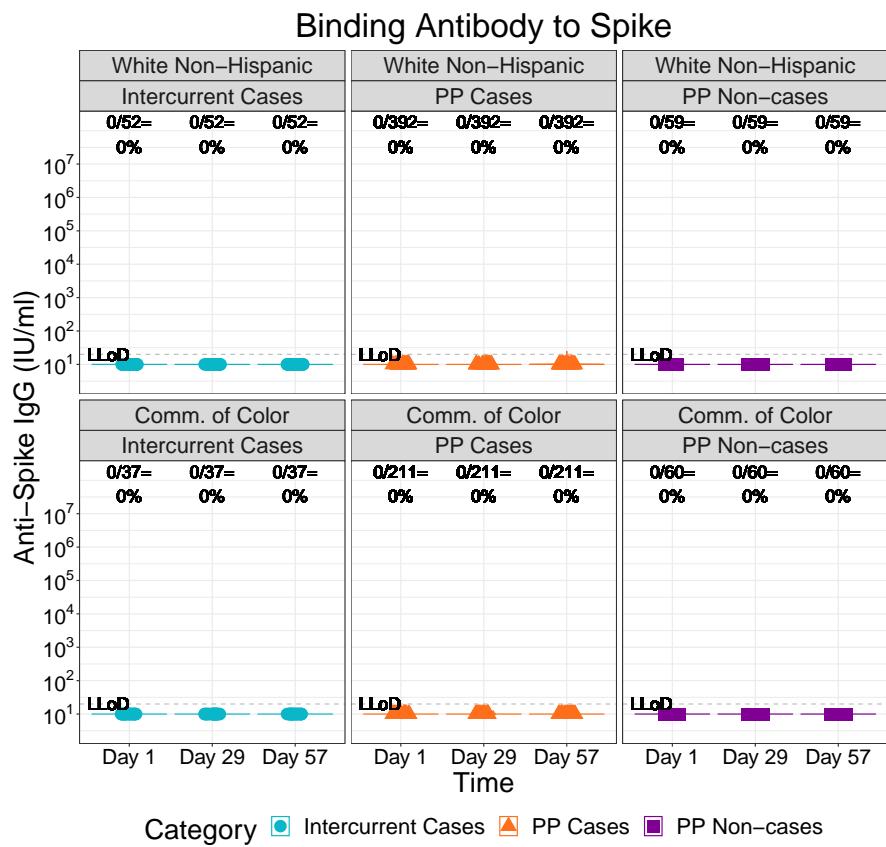


Figure 1.211: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by race and ethnic group (3 timepoints)

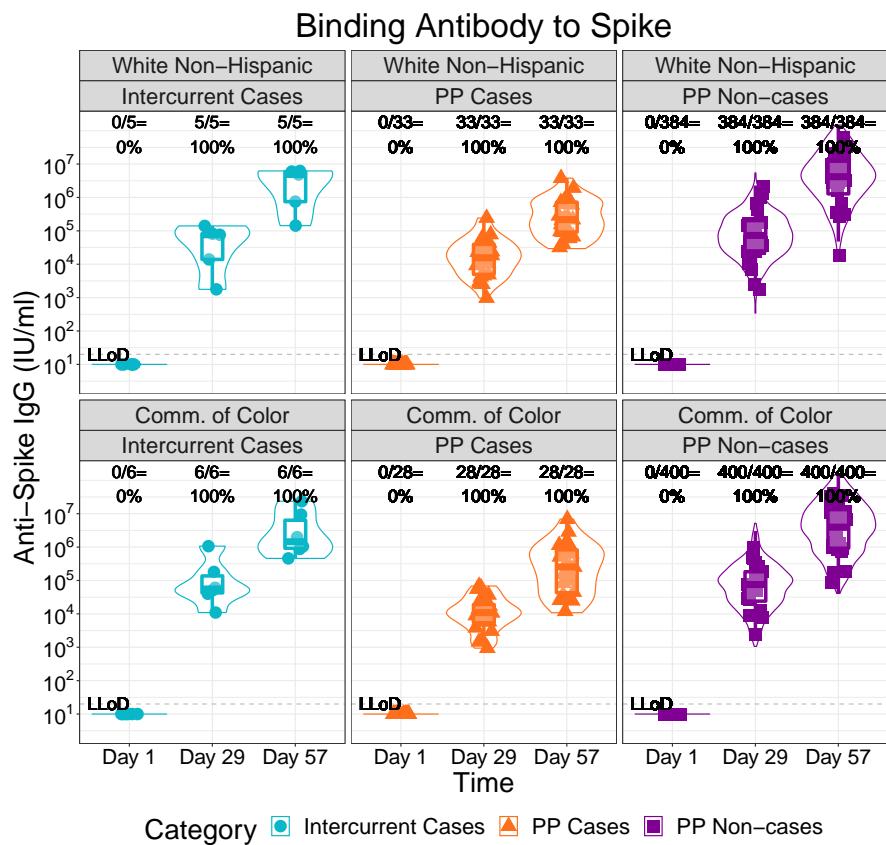


Figure 1.212: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by race and ethnic group (3 timepoints)

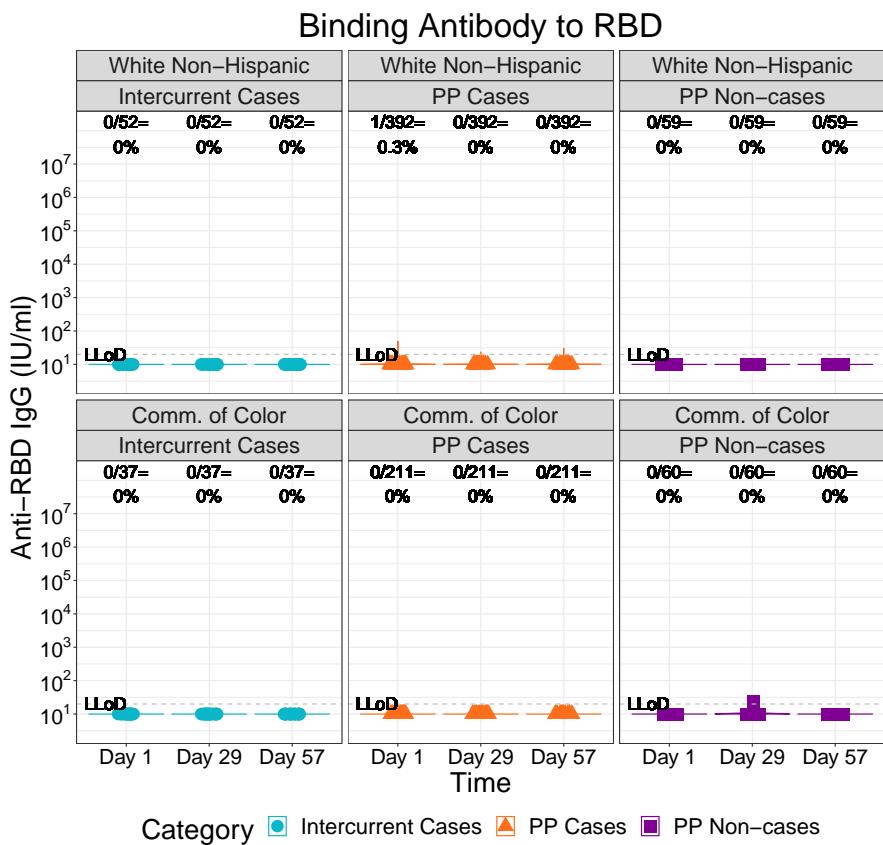


Figure 1.213: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by race and ethnic group (3 timepoints)

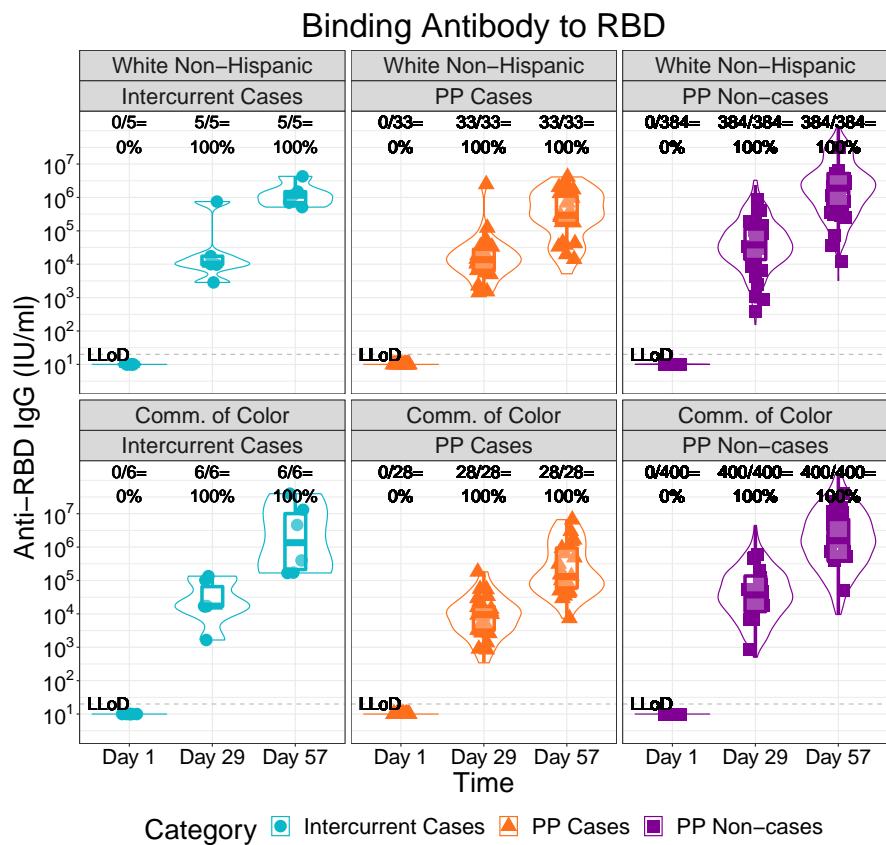


Figure 1.214: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by race and ethnic group (3 timepoints)

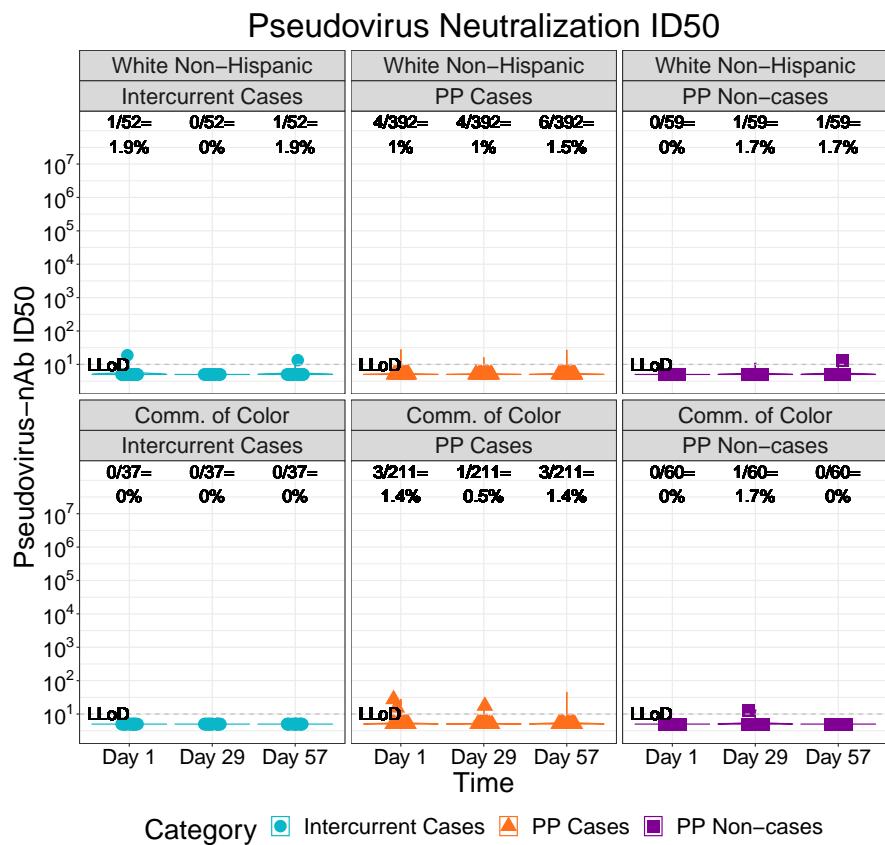


Figure 1.215: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by race and ethnic group (3 timepoints)

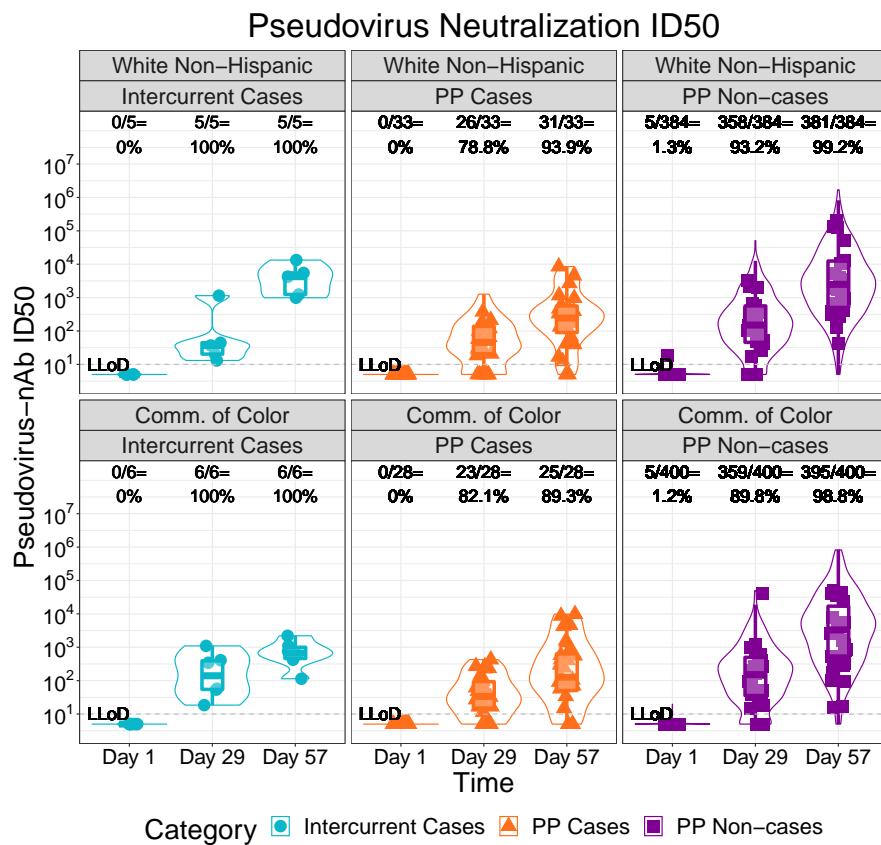


Figure 1.216: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by race and ethnic group (3 timepoints)

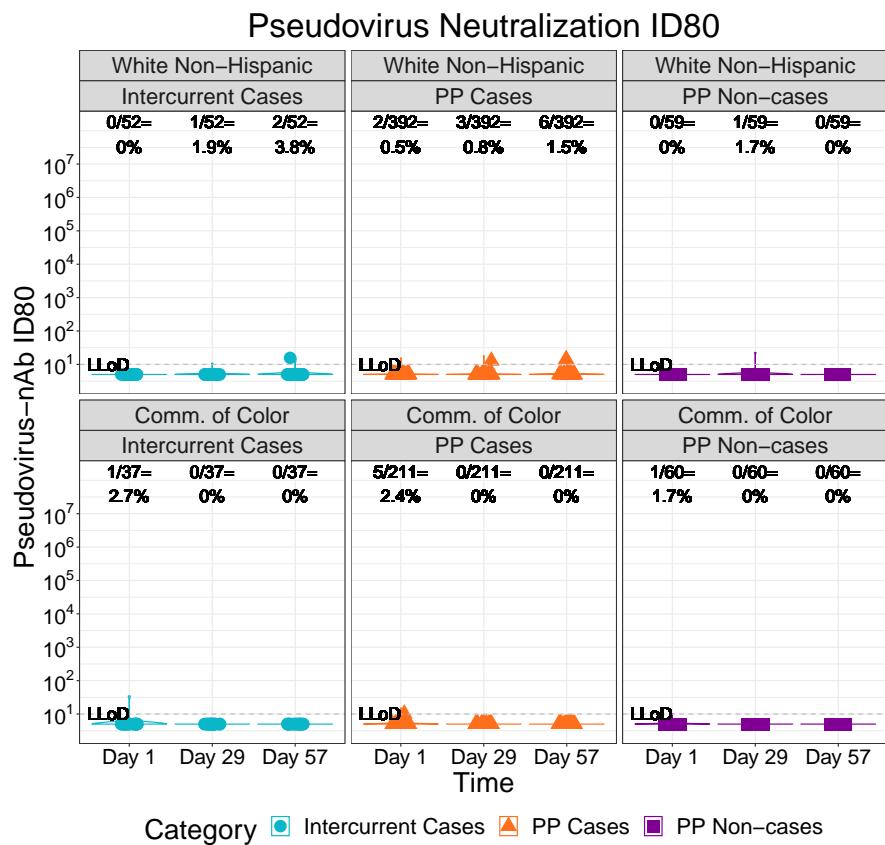


Figure 1.217: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by race and ethnic group (3 timepoints)

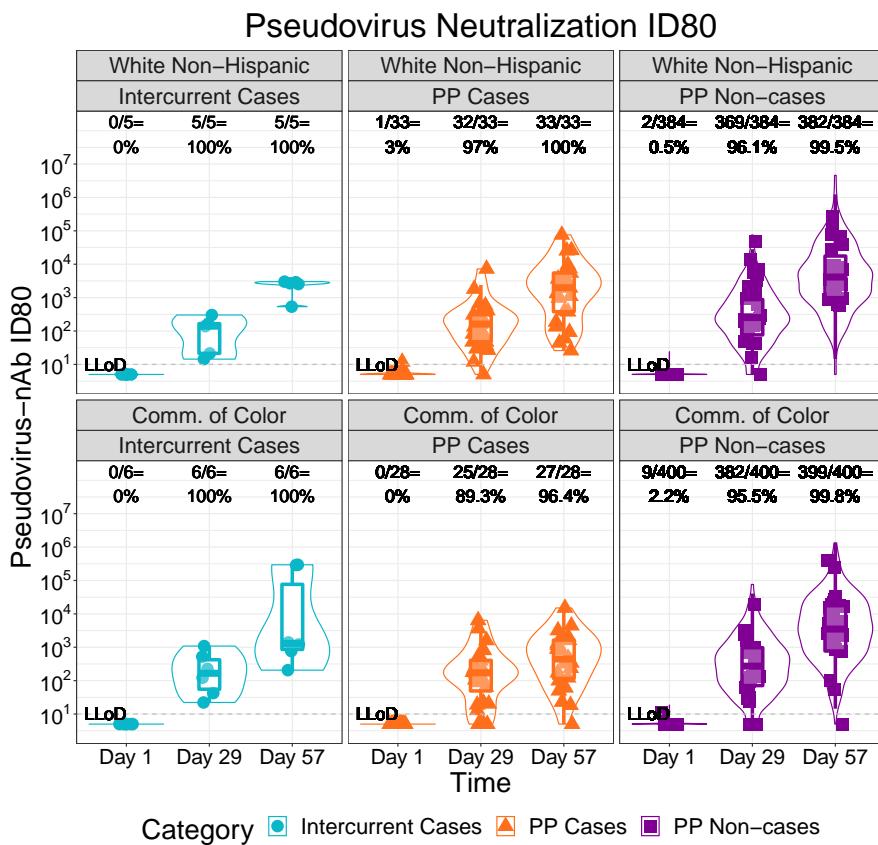


Figure 1.218: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by race and ethnic group (3 timepoints)

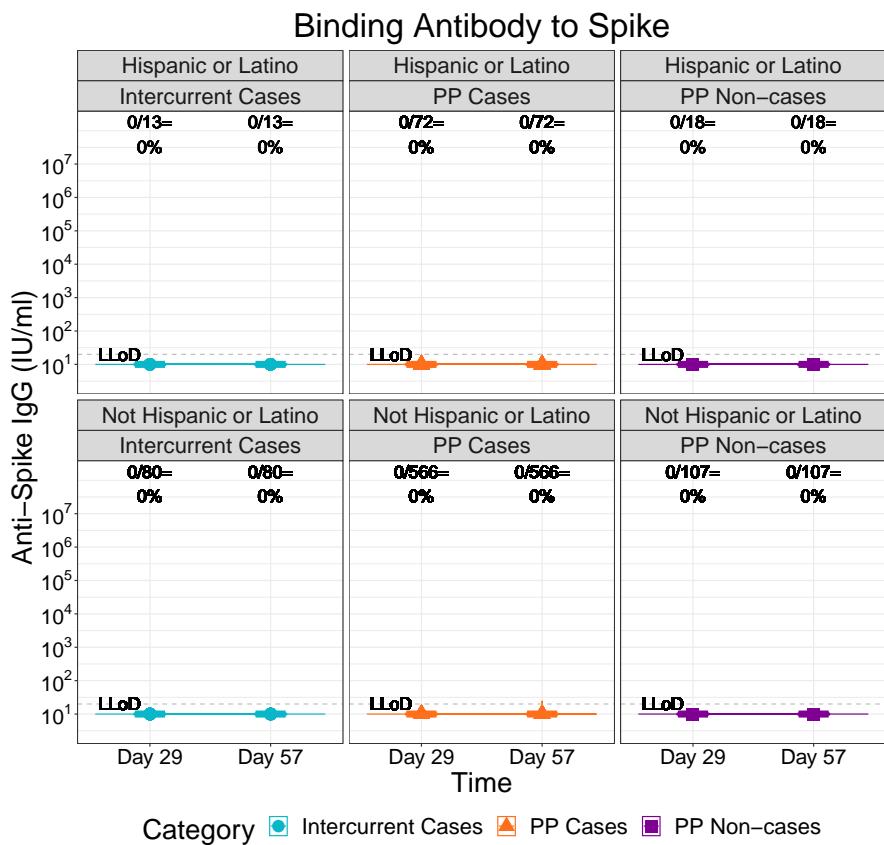


Figure 1.219: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

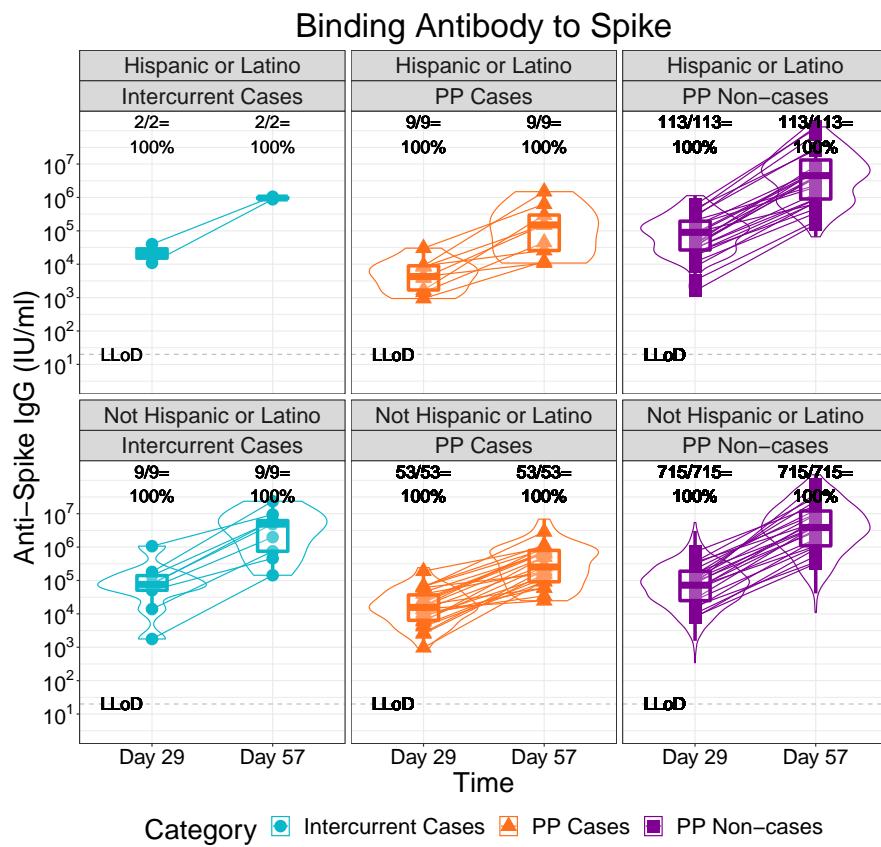


Figure 1.220: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

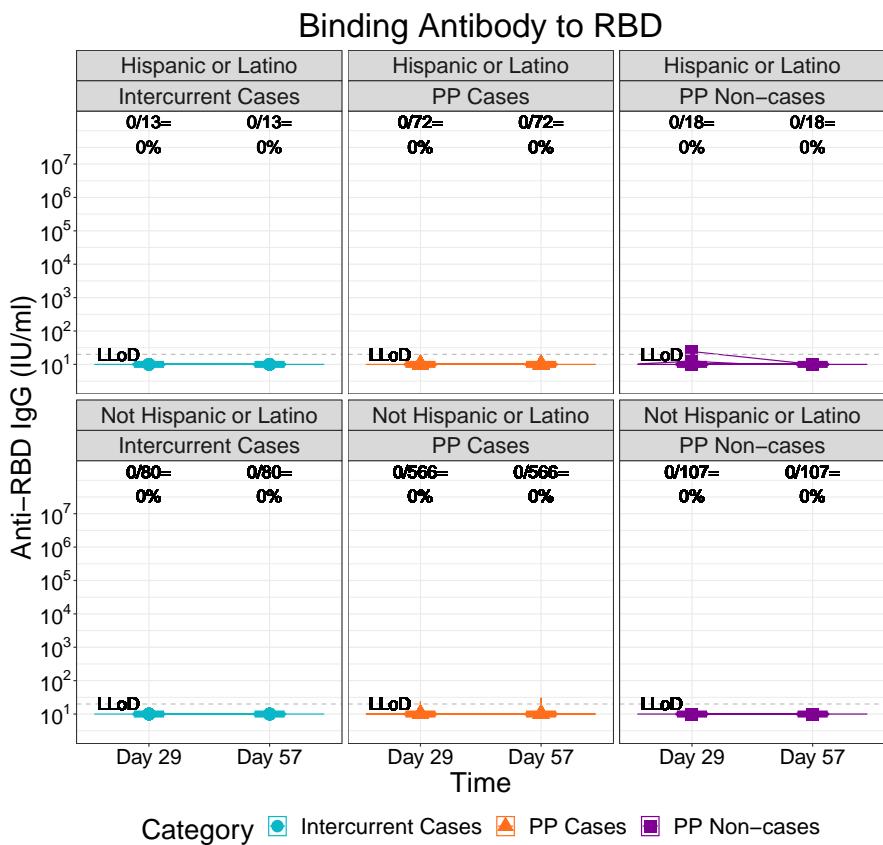


Figure 1.221: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

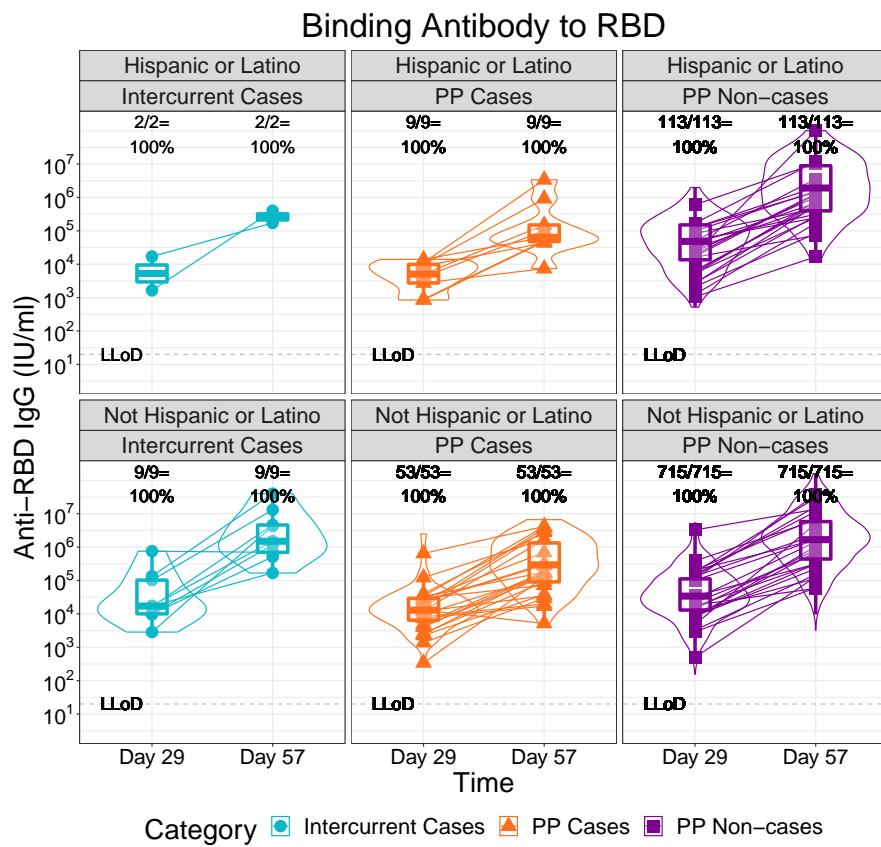


Figure 1.222: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

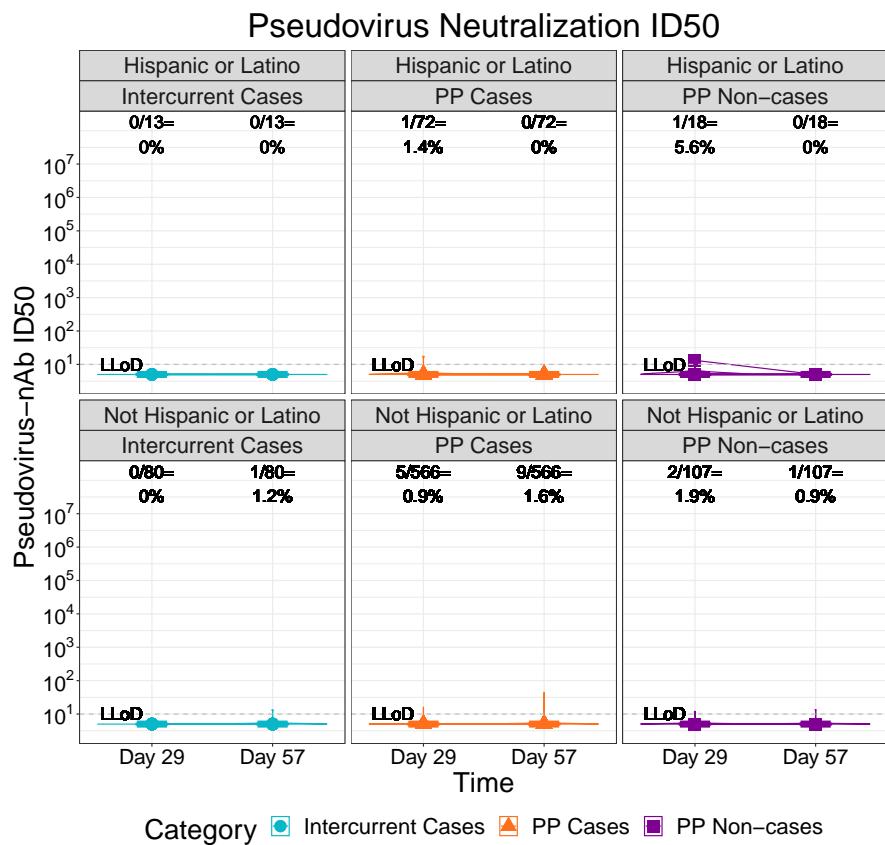


Figure 1.223: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

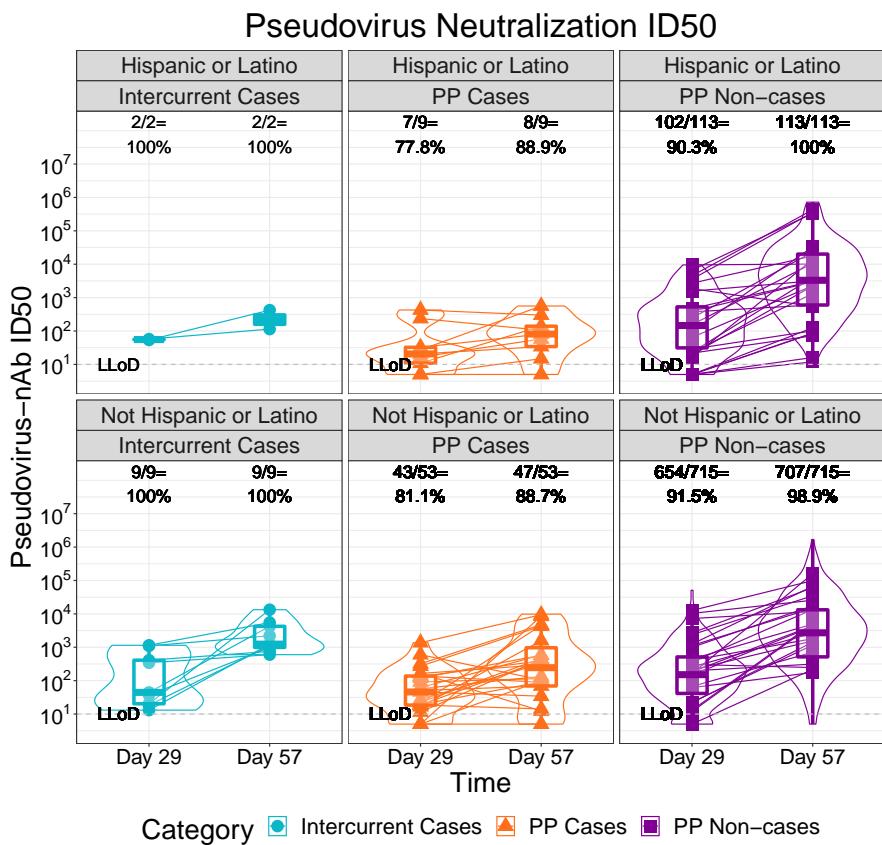


Figure 1.224: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

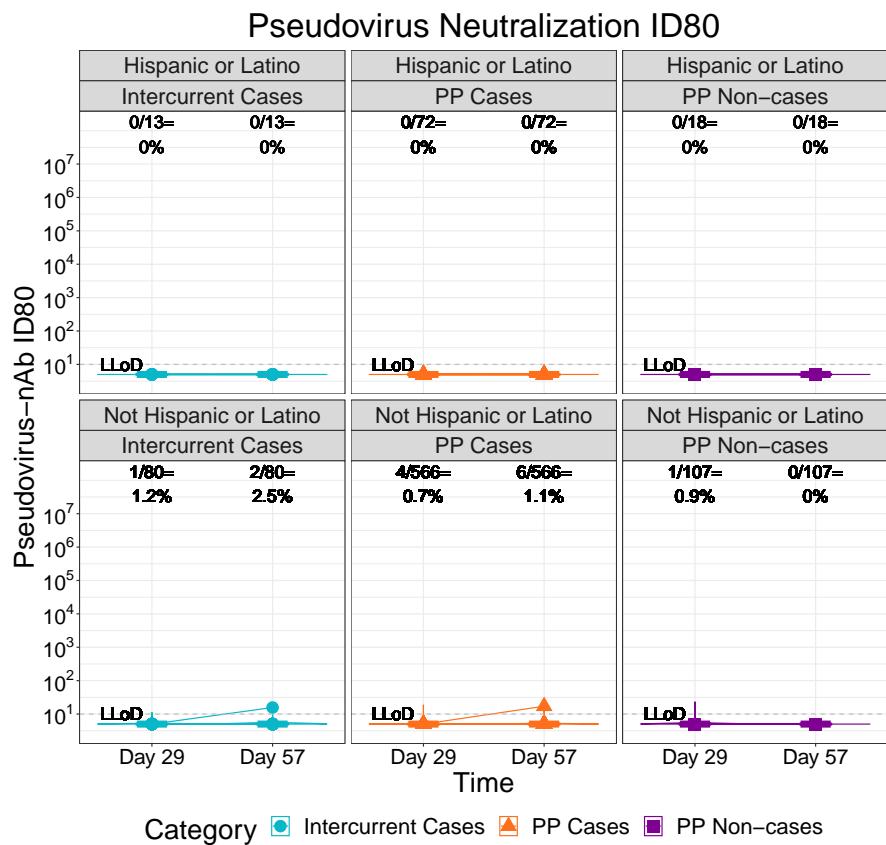


Figure 1.225: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

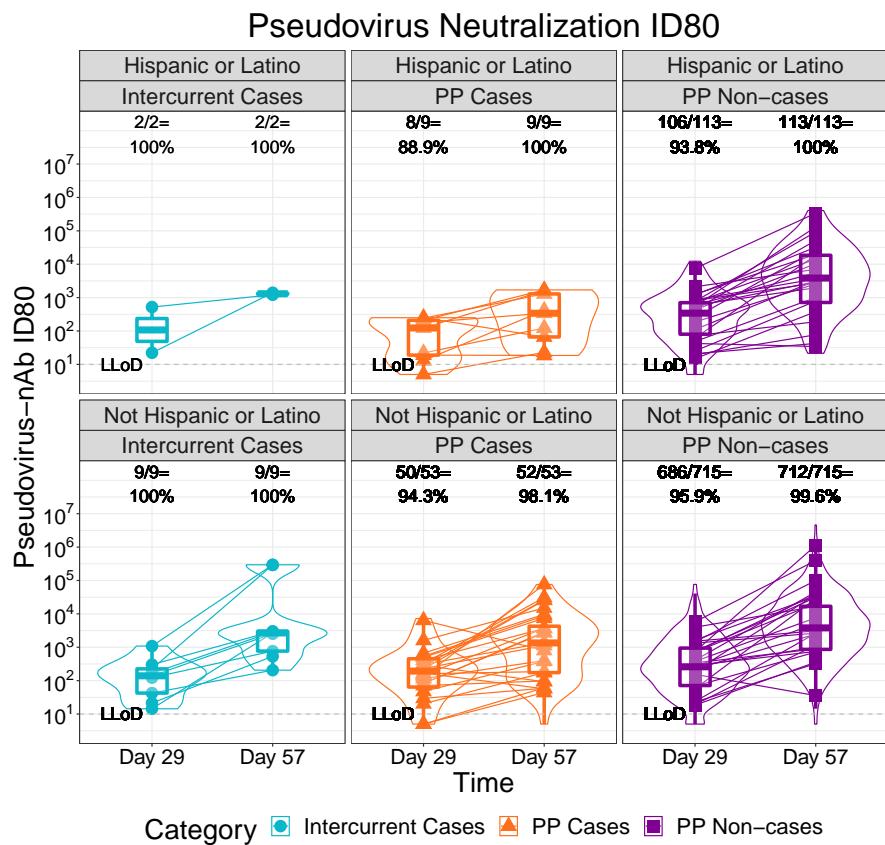


Figure 1.226: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

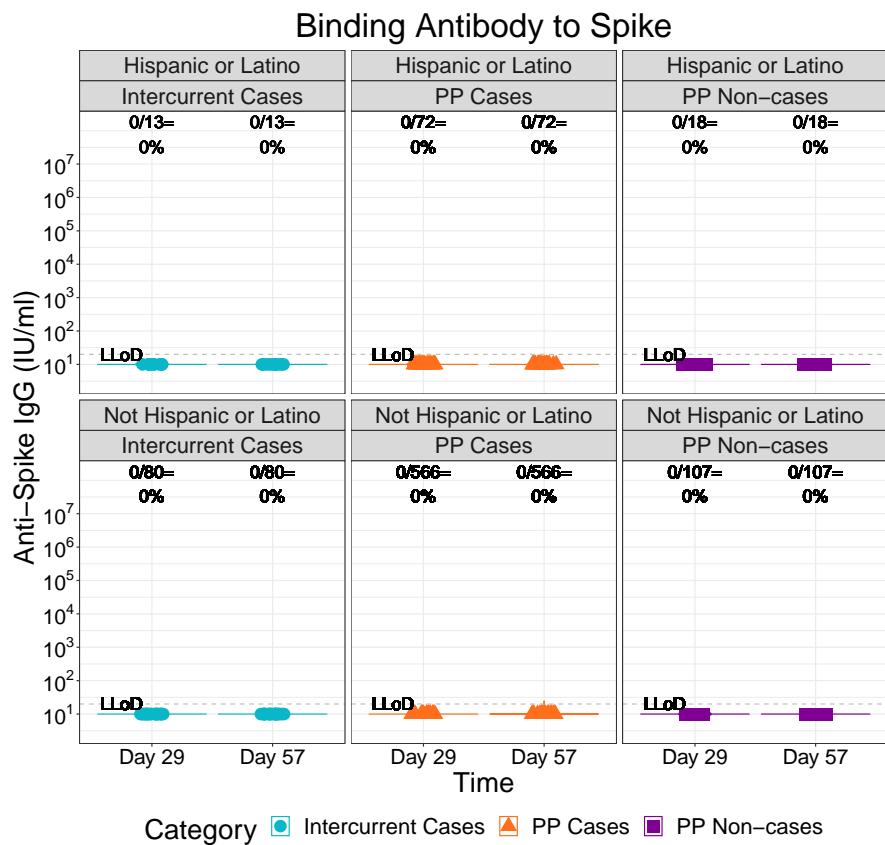


Figure 1.227: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

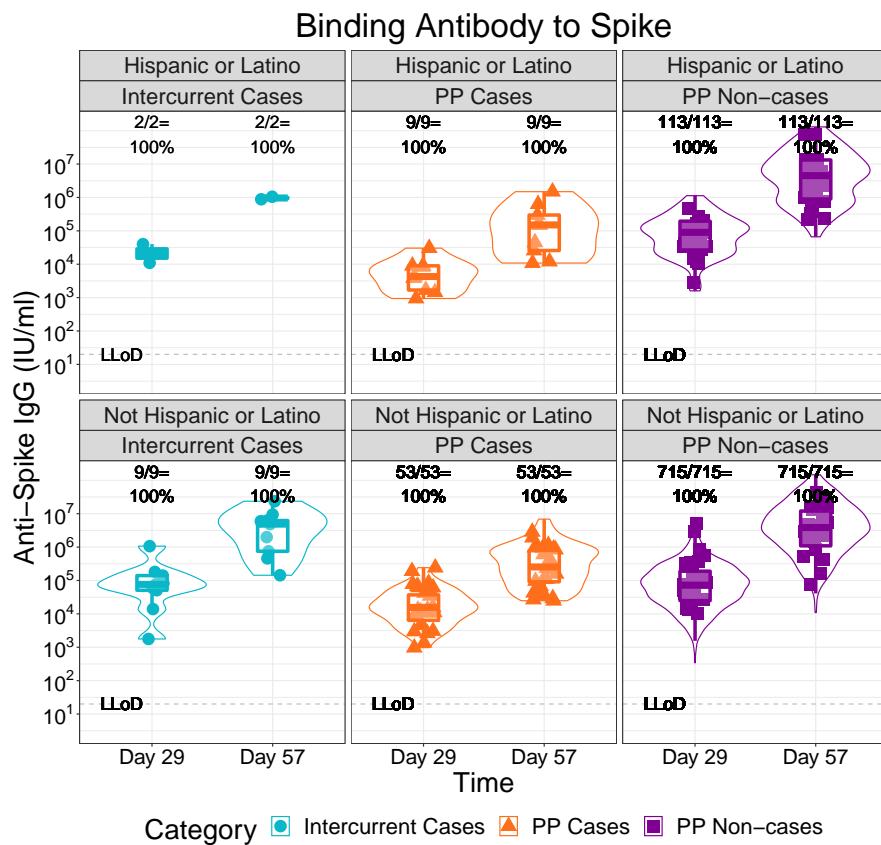


Figure 1.228: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

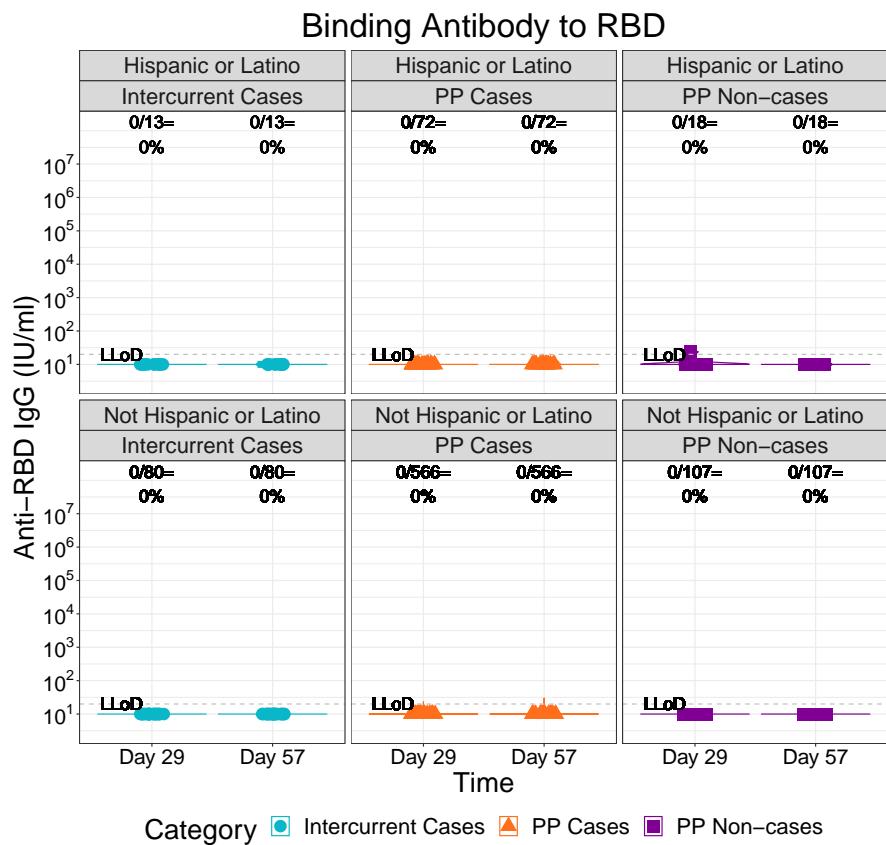


Figure 1.229: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

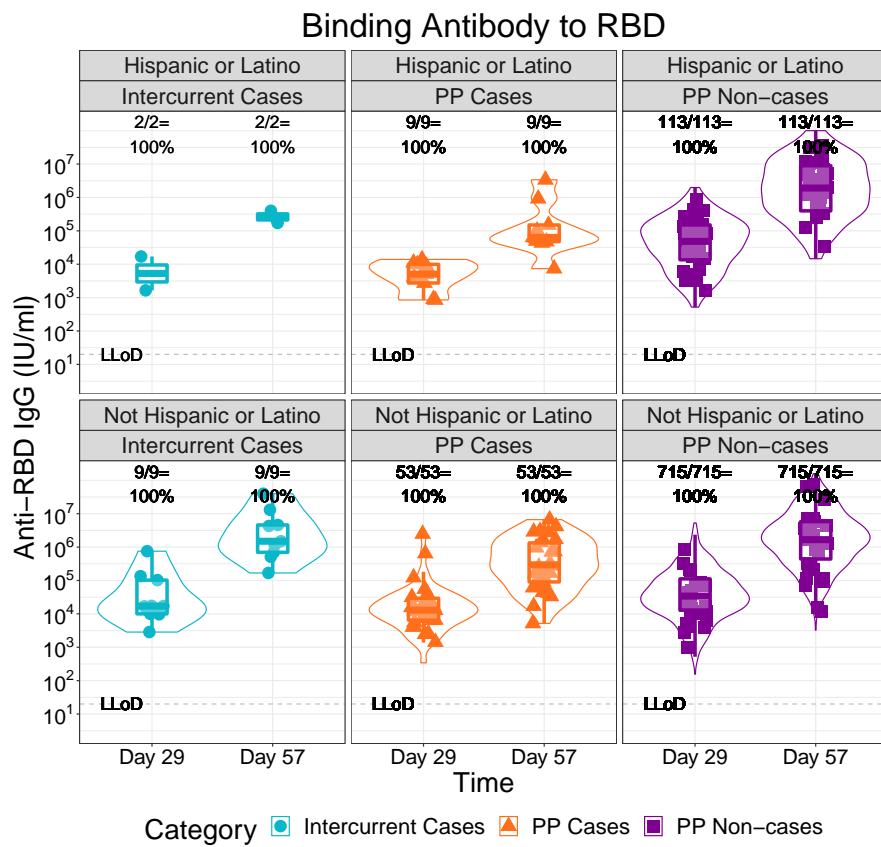


Figure 1.230: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

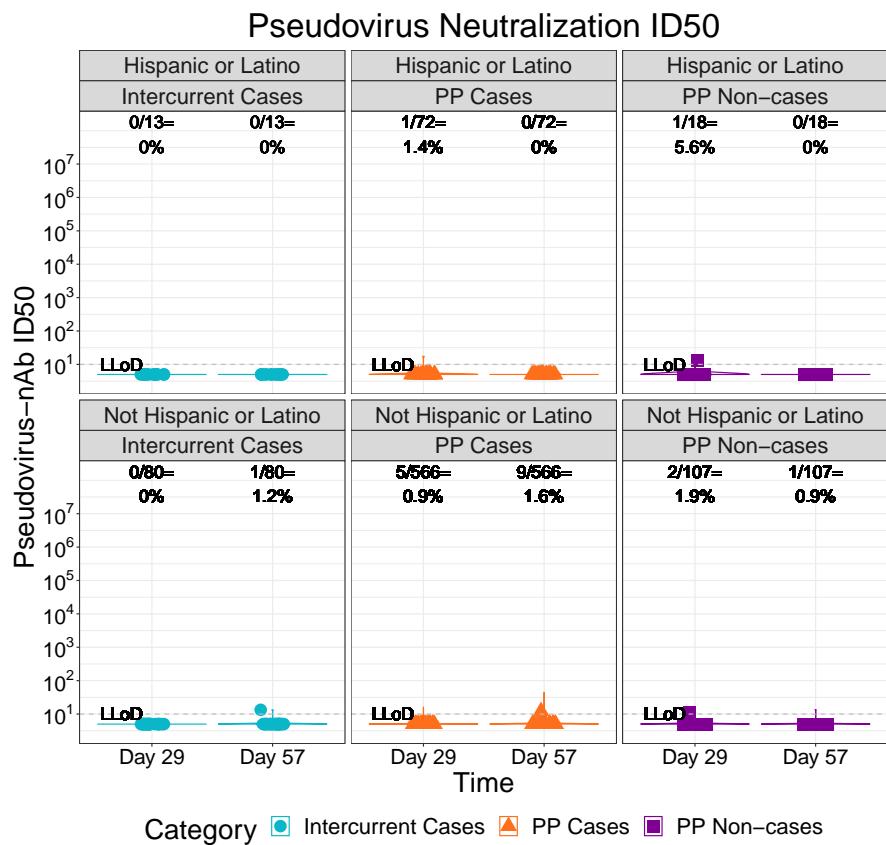


Figure 1.231: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

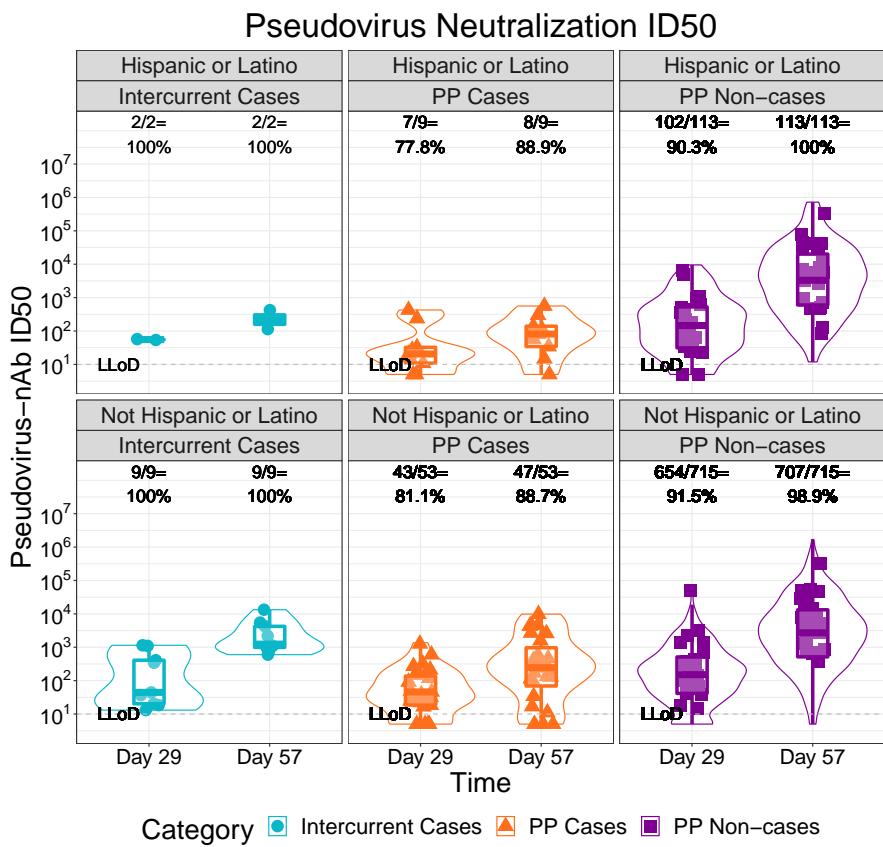


Figure 1.232: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

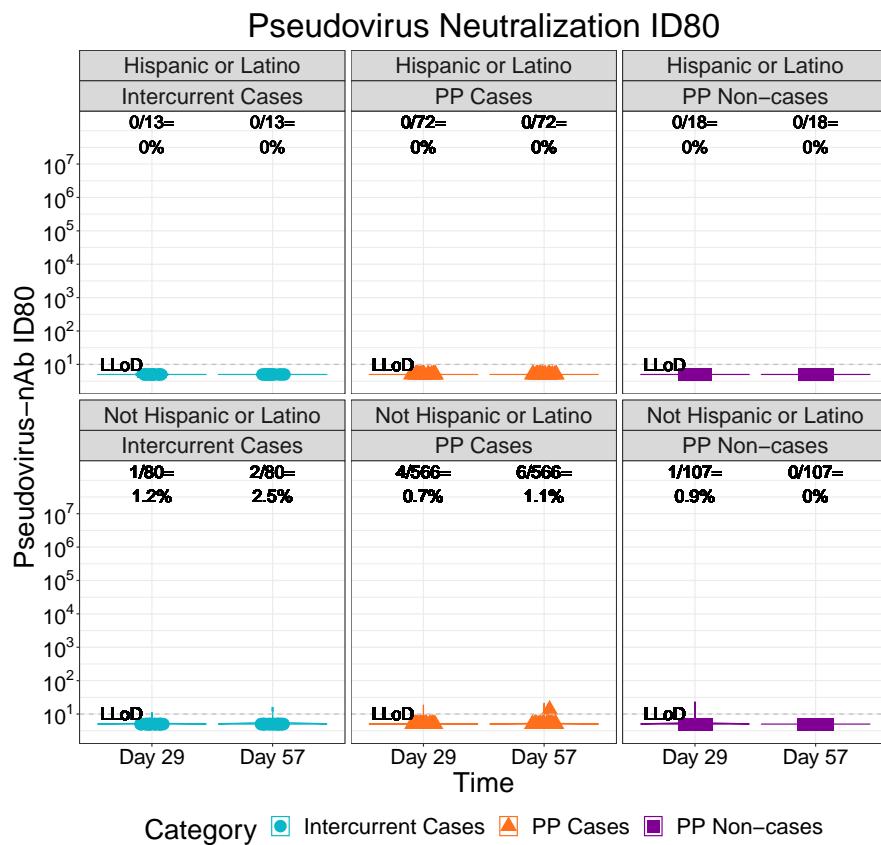


Figure 1.233: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (2 timepoints)

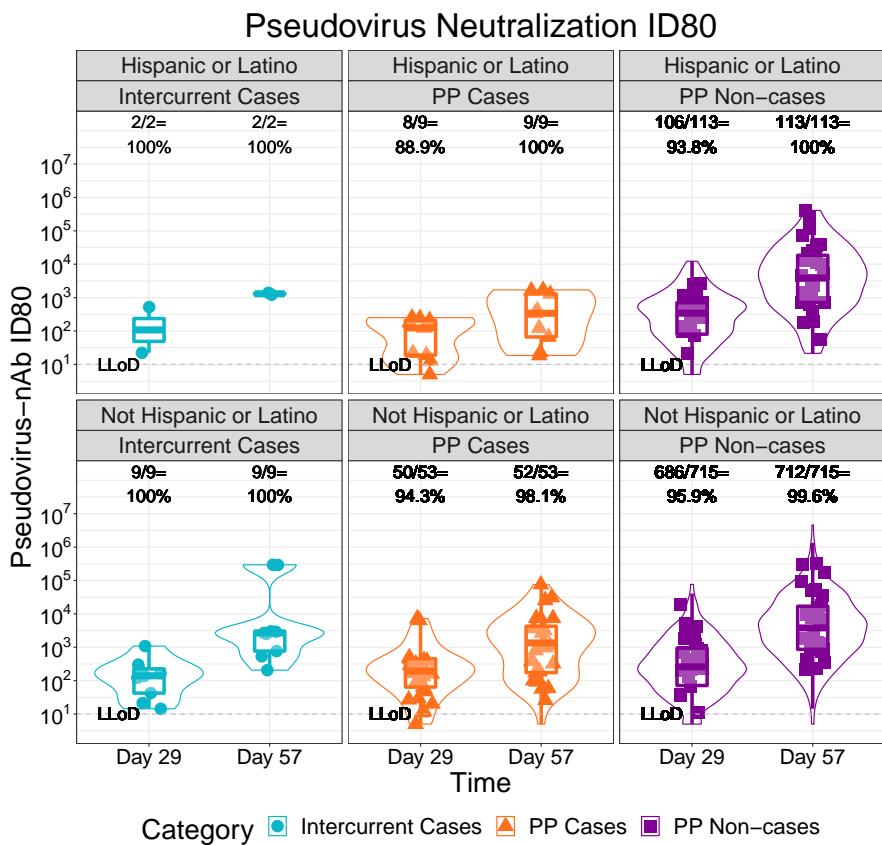


Figure 1.234: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (2 timepoints)

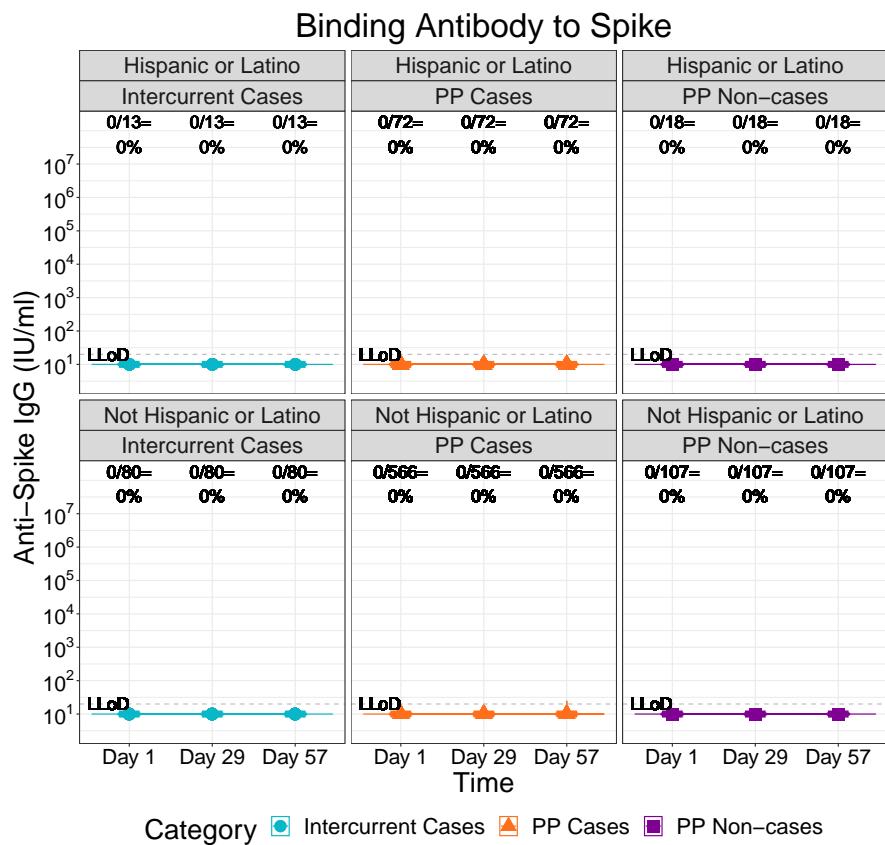


Figure 1.235: (Mock data) lineplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

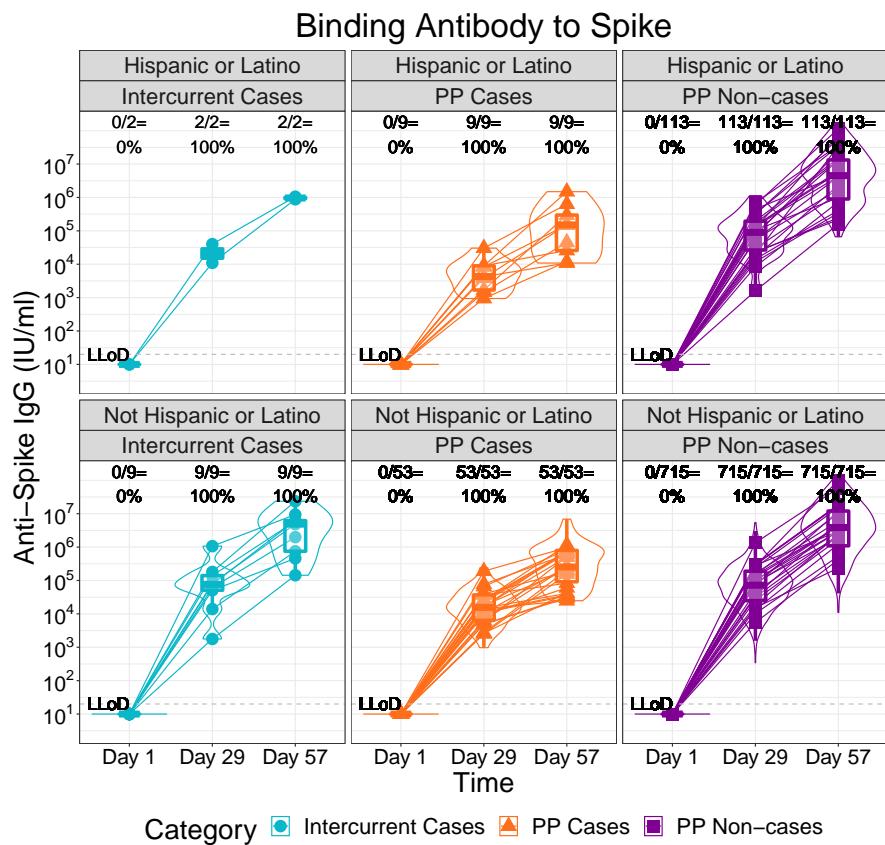


Figure 1.236: (Mock data) lineplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

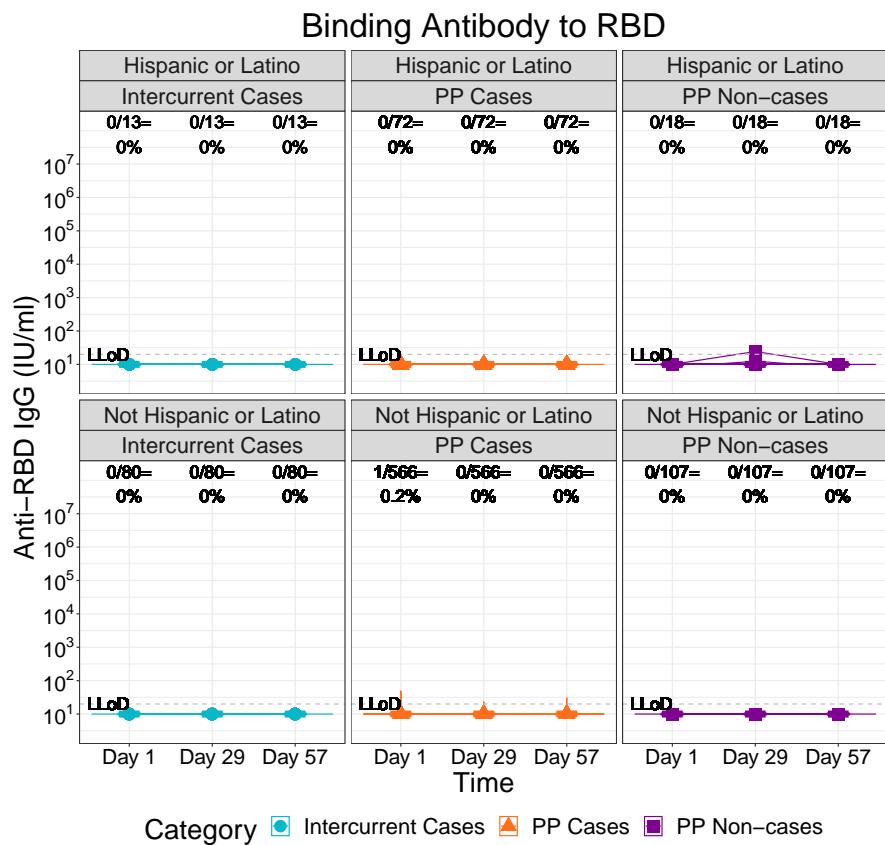


Figure 1.237: (Mock data) lineplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

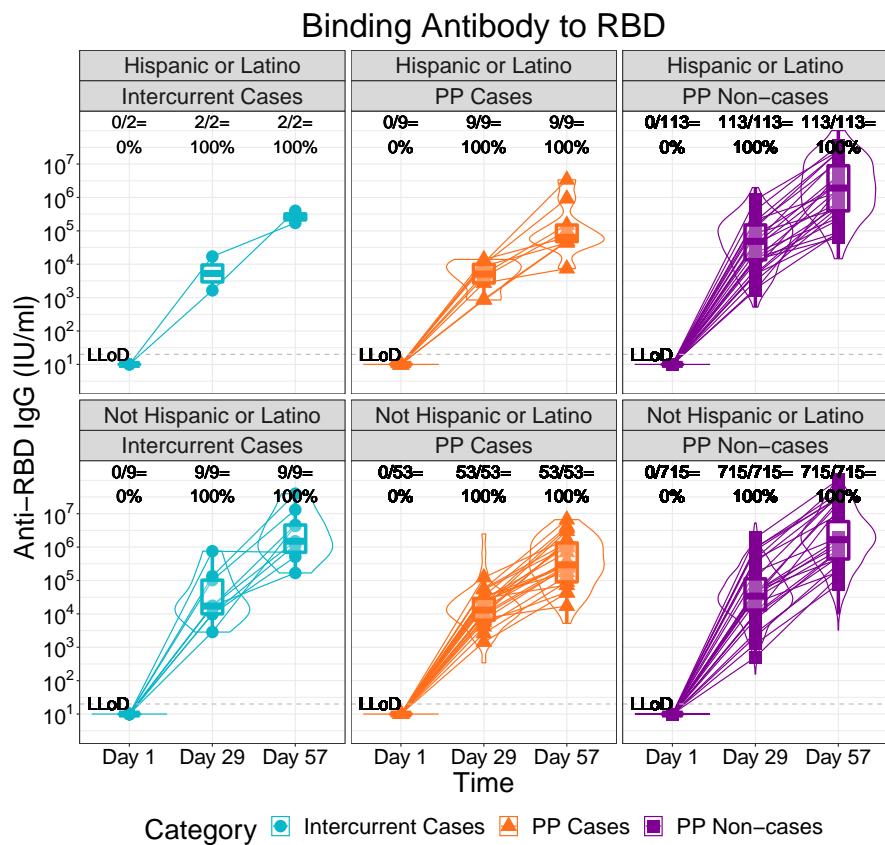


Figure 1.238: (Mock data) lineplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

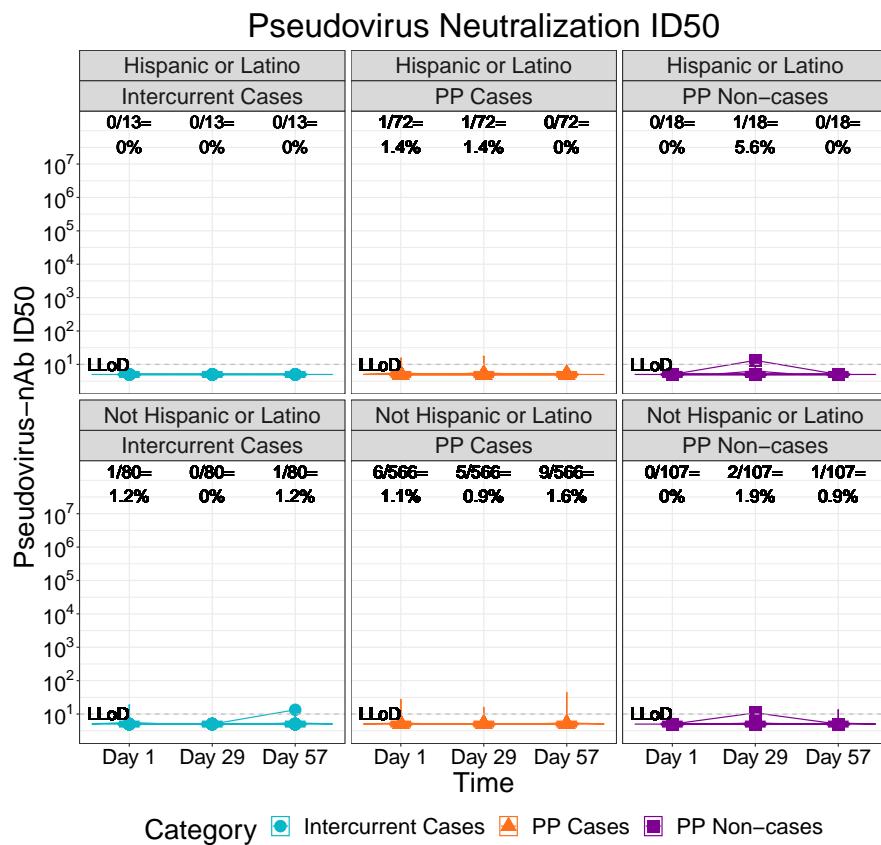


Figure 1.239: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

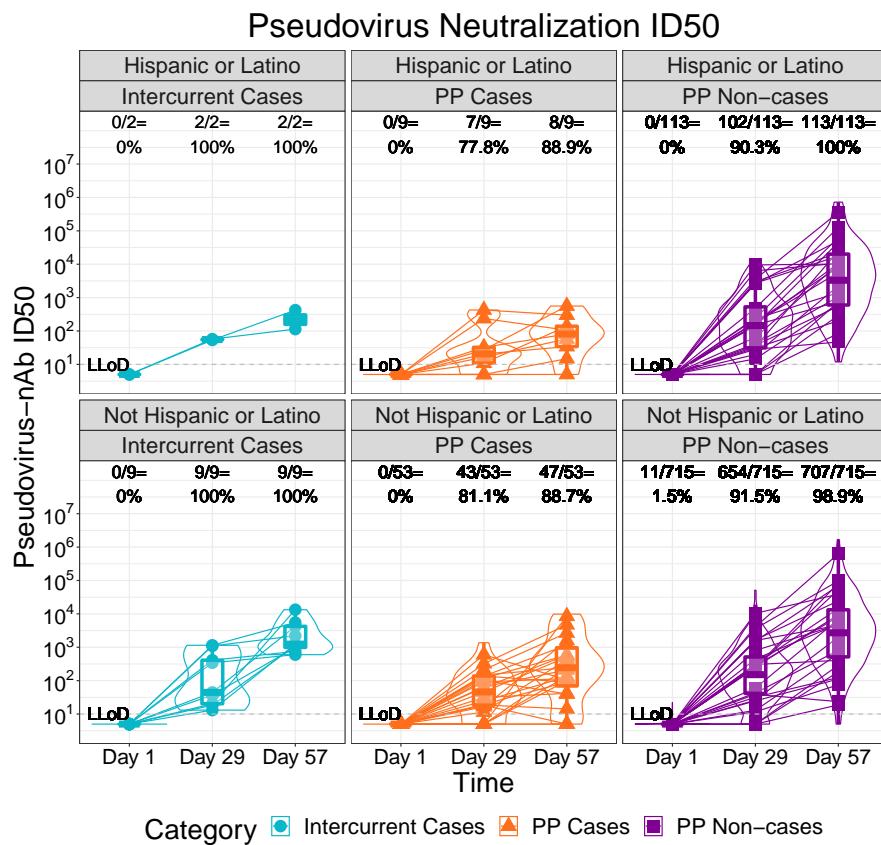


Figure 1.240: (Mock data) lineplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

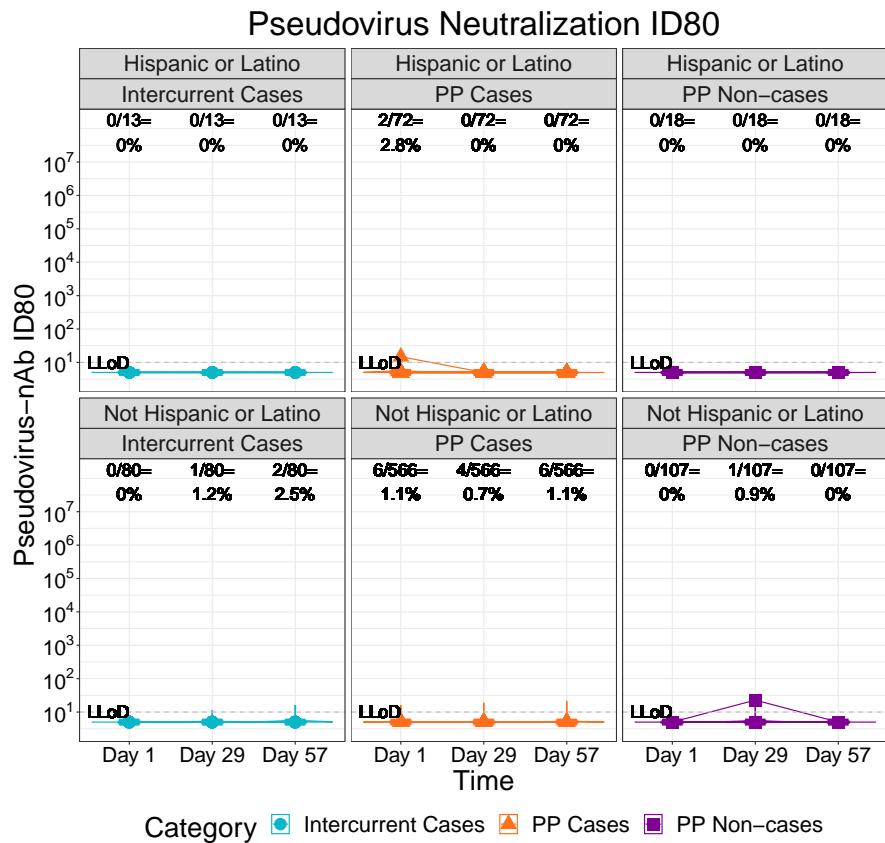


Figure 1.241: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

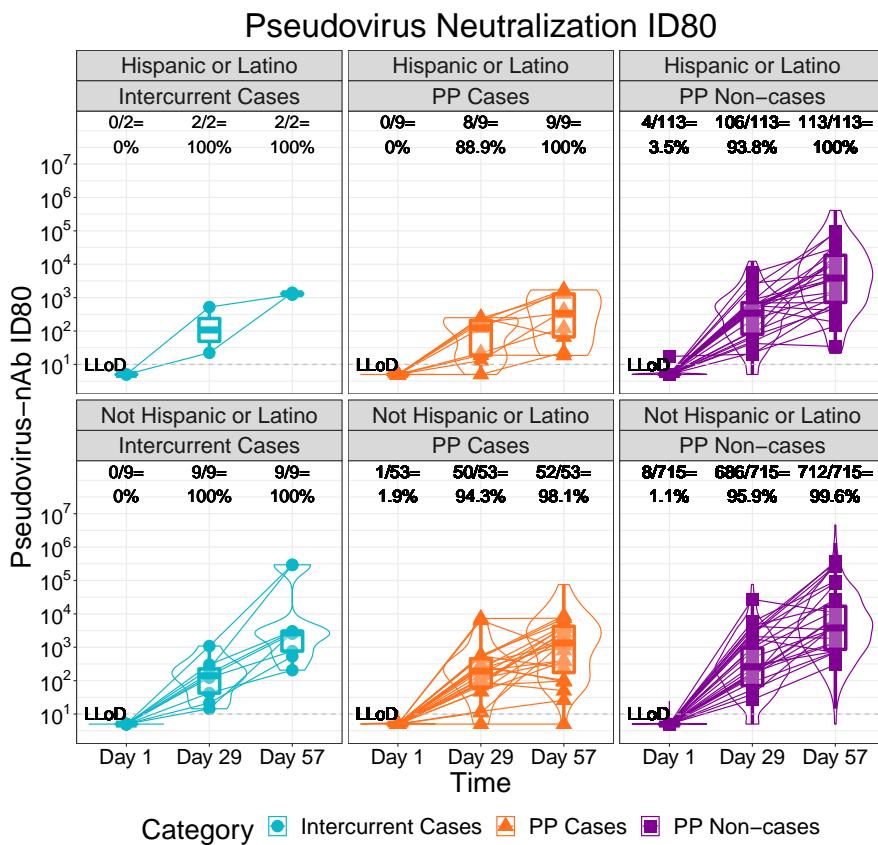


Figure 1.242: (Mock data) lineplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

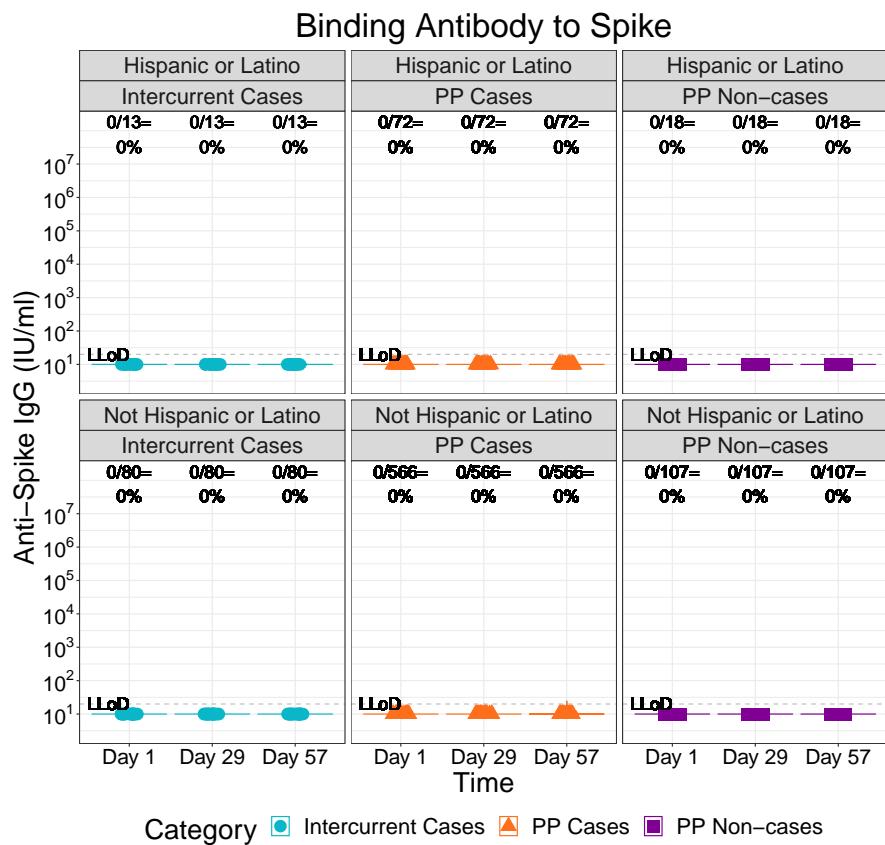


Figure 1.243: (Mock data) violinplots of Binding Antibody to Spike: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

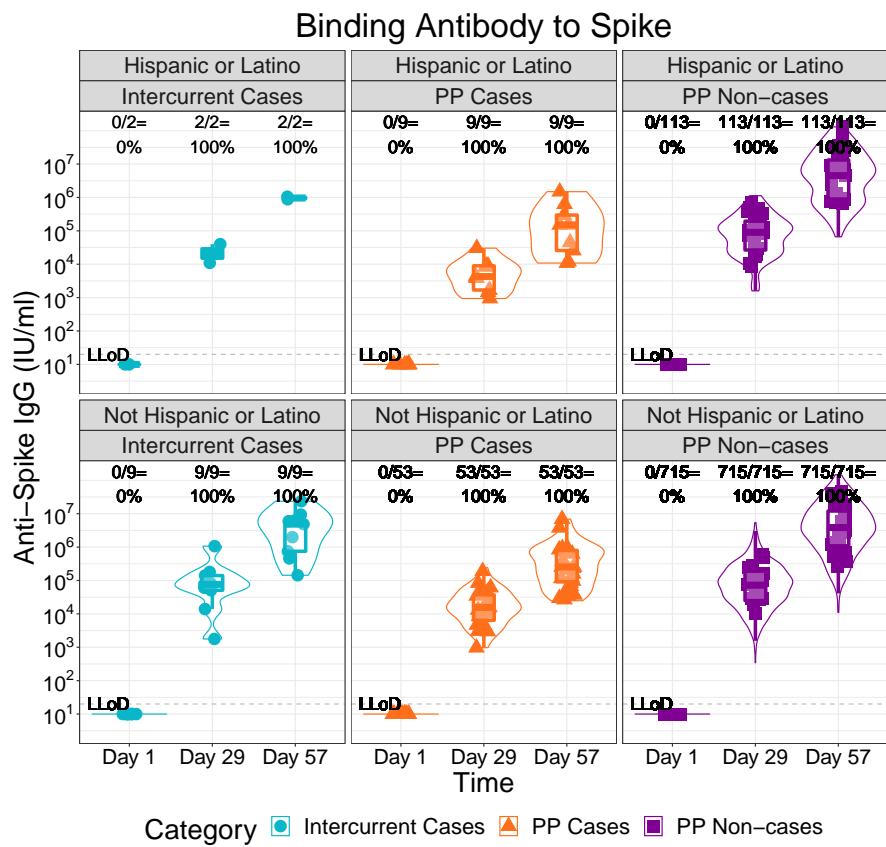


Figure 1.244: (Mock data) violinplots of Binding Antibody to Spike: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

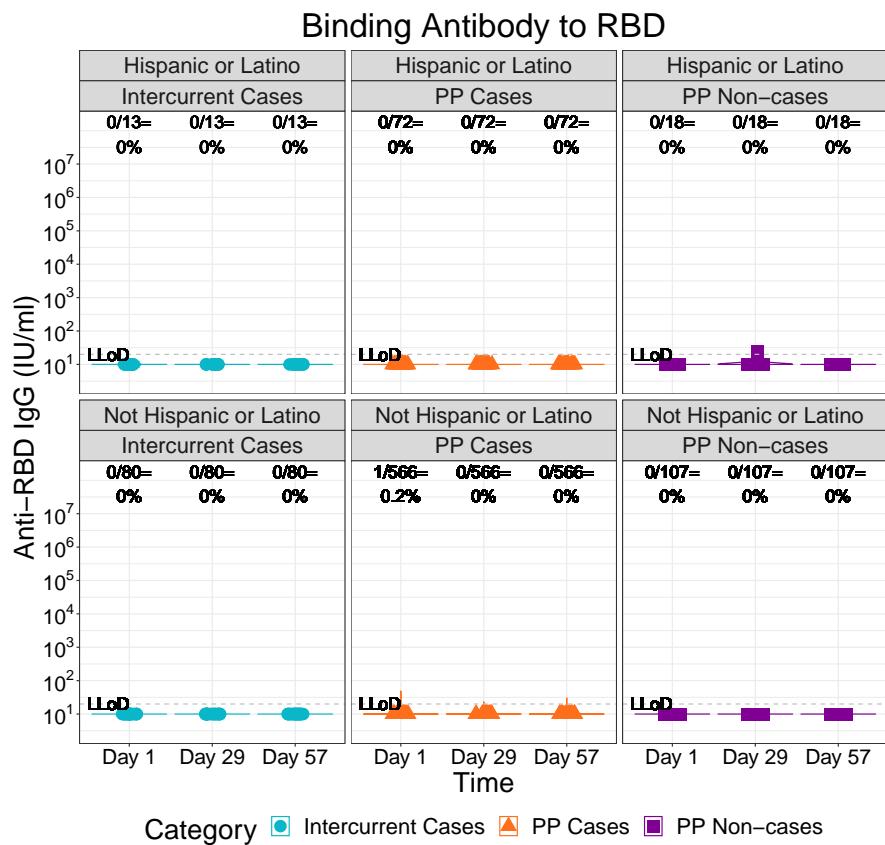


Figure 1.245: (Mock data) violinplots of Binding Antibody to RBD: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

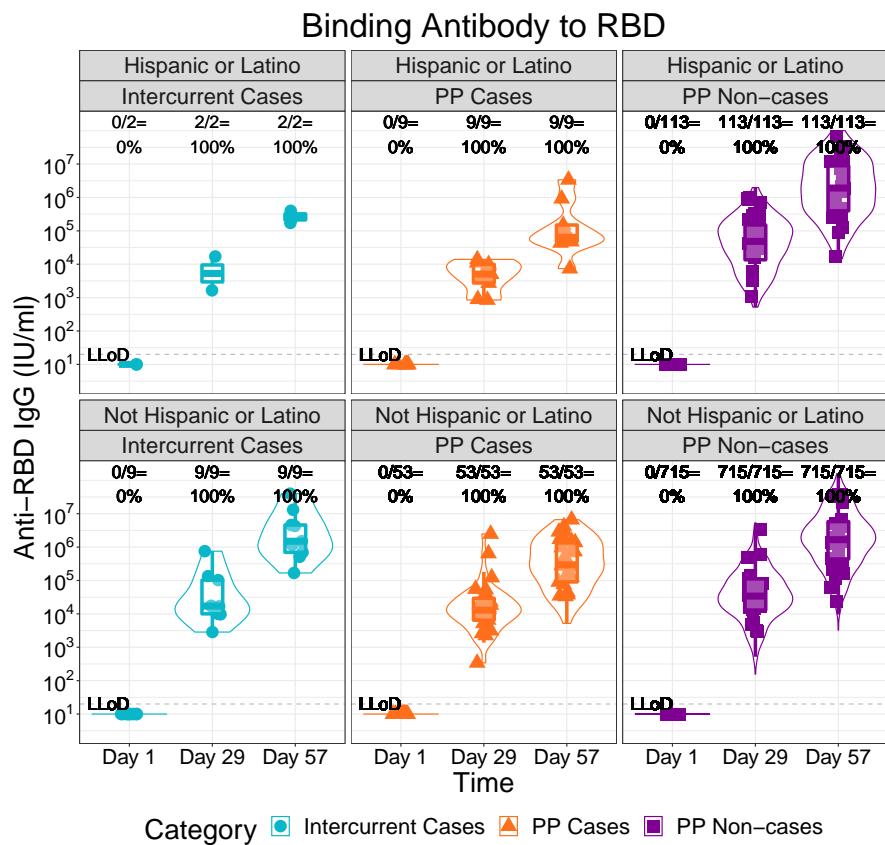


Figure 1.246: (Mock data) violinplots of Binding Antibody to RBD: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

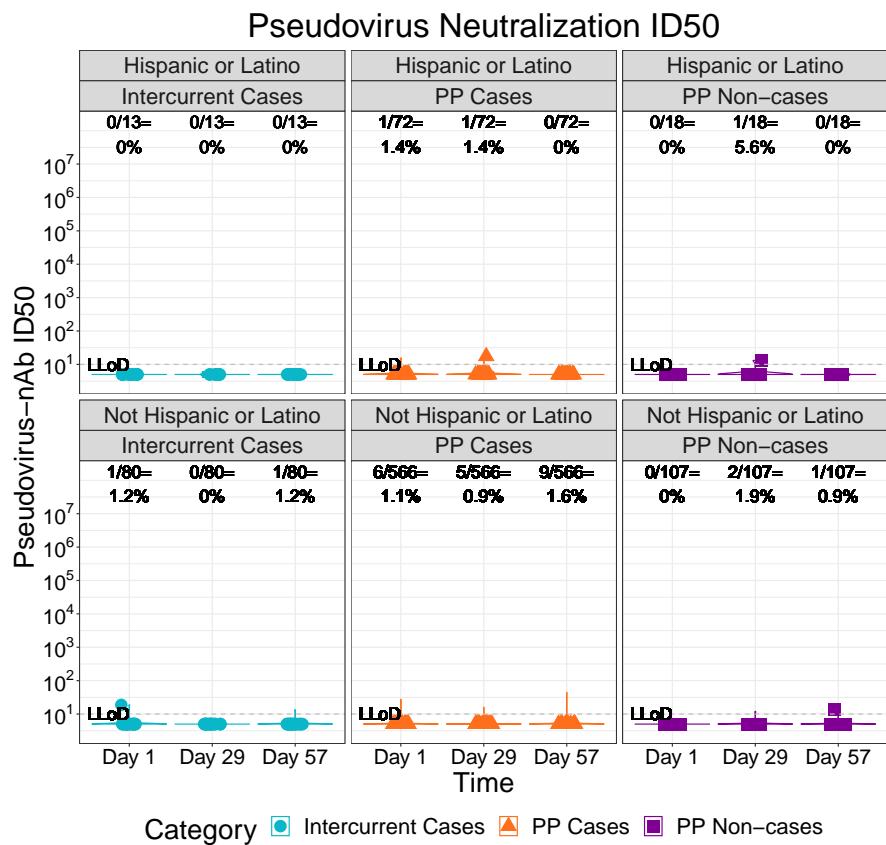


Figure 1.247: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

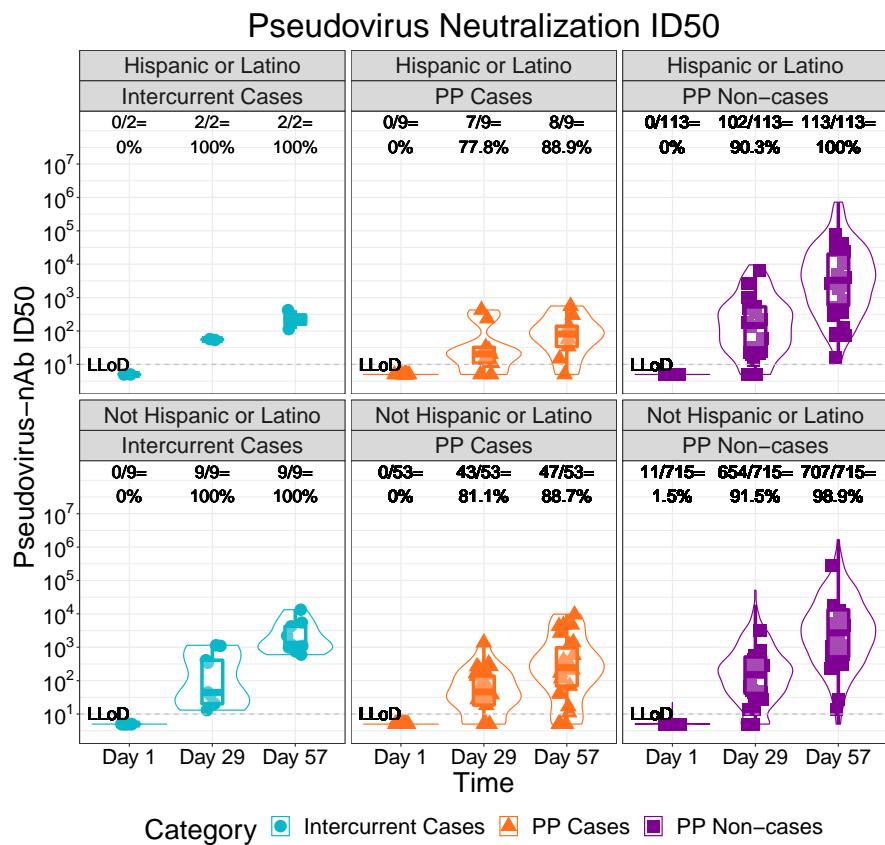


Figure 1.248: (Mock data) violinplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

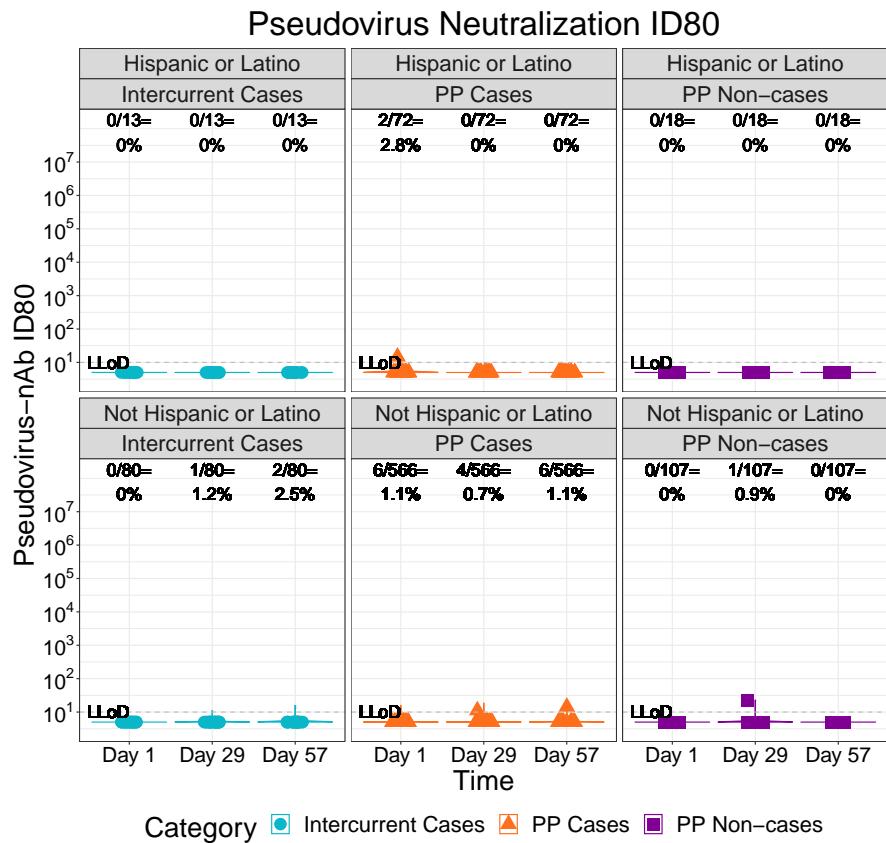


Figure 1.249: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative placebo arm by dichotomous classification of race and ethnic group (3 timepoints)

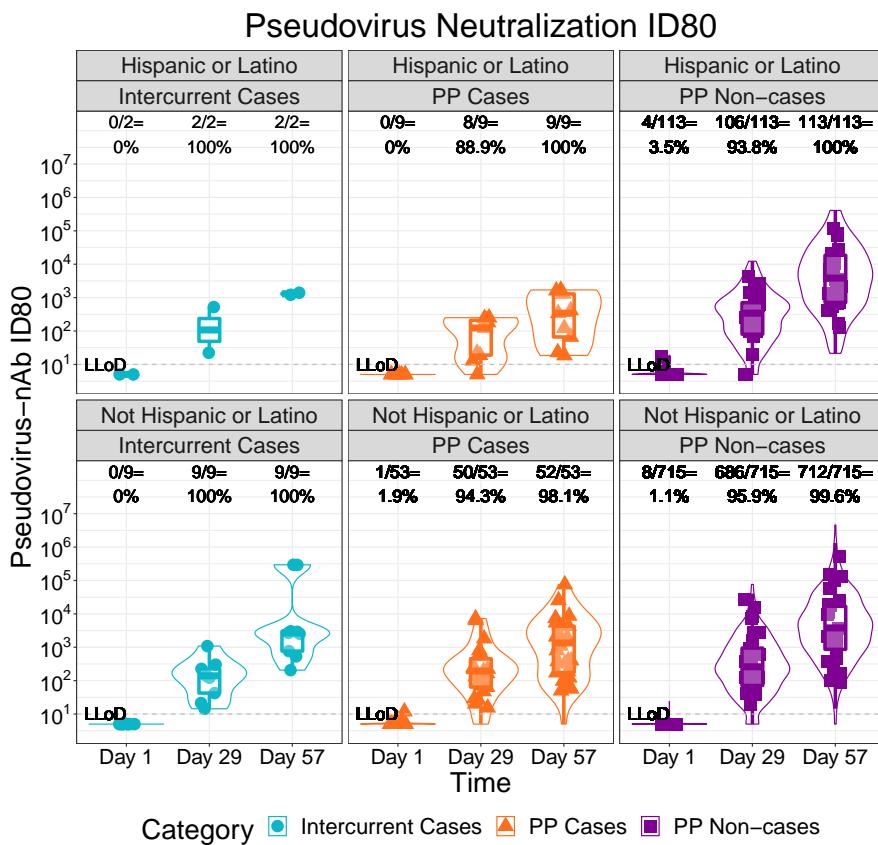


Figure 1.250: (Mock data) violinplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm by dichotomous classification of race and ethnic group (3 timepoints)

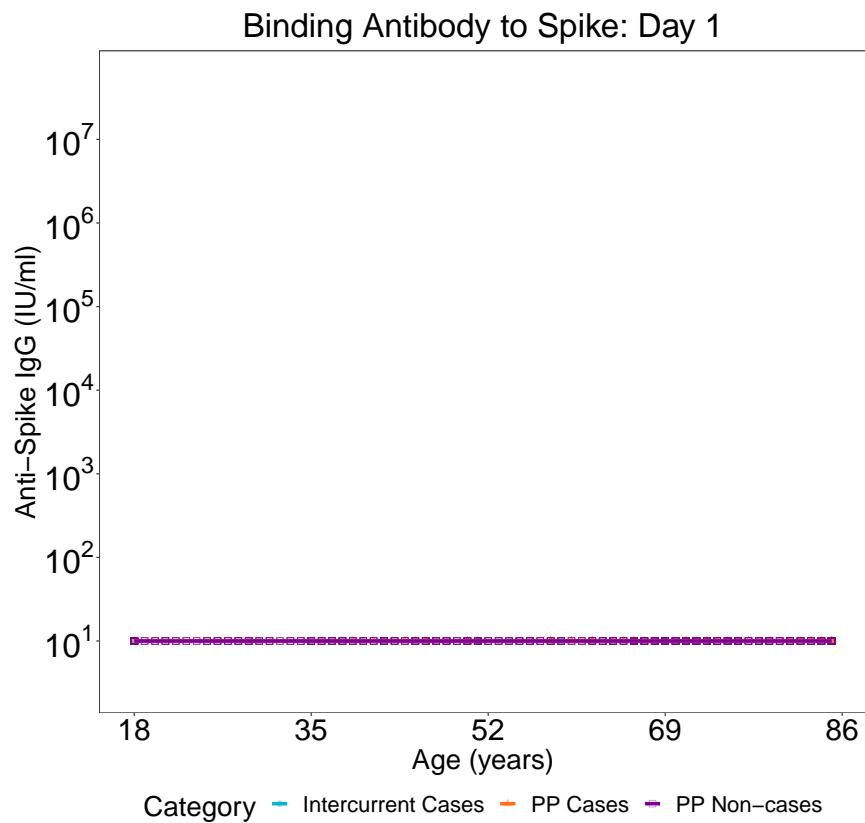


Figure 1.251: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 1

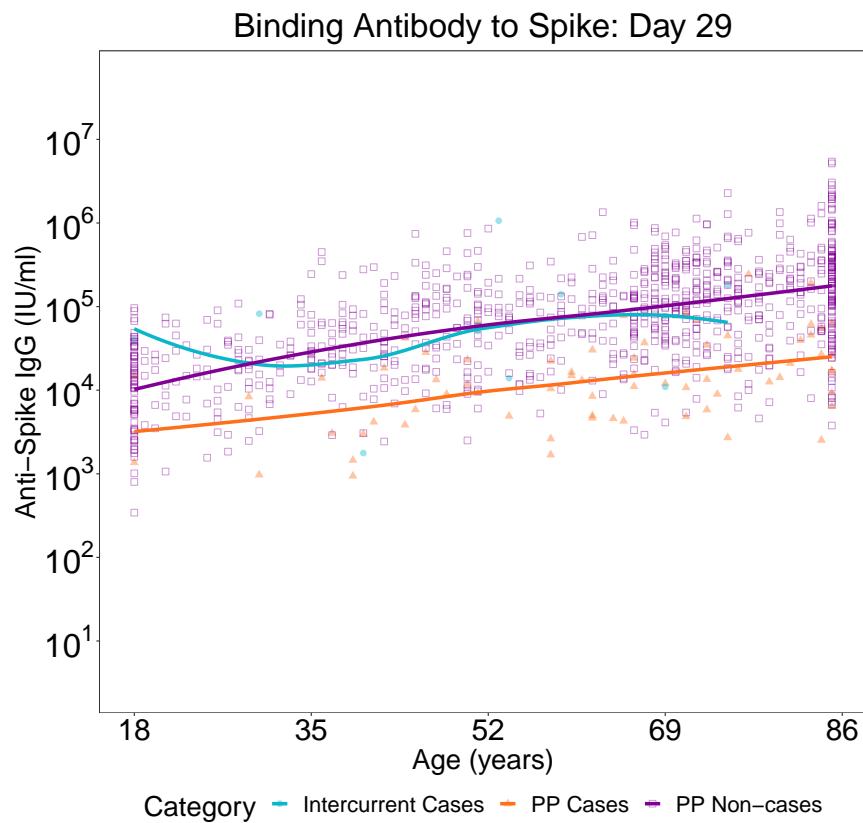


Figure 1.252: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 29

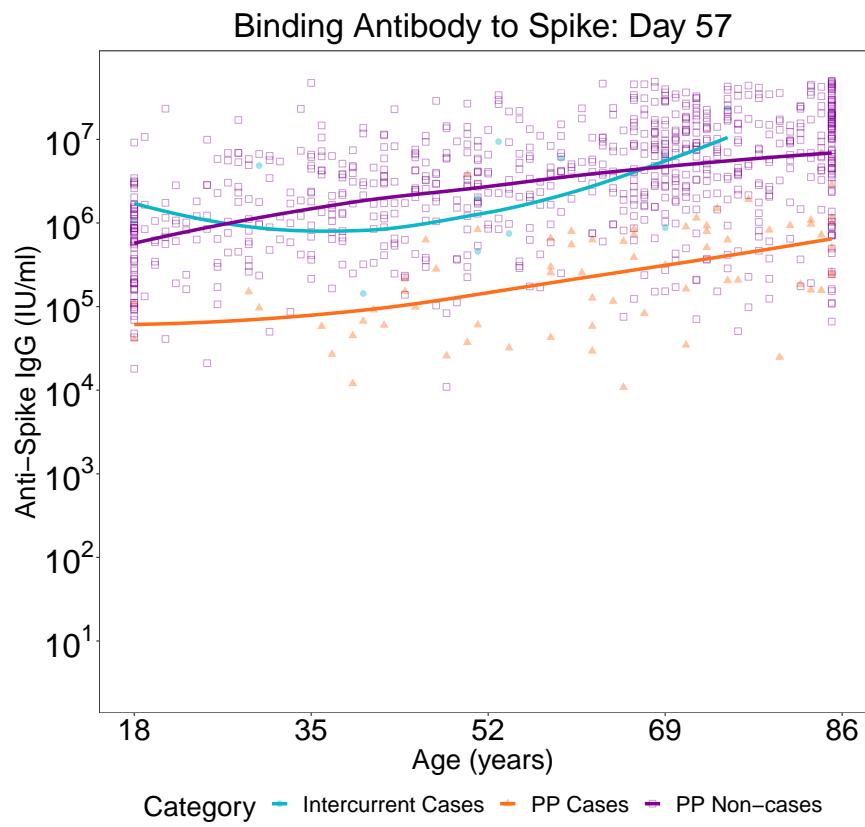


Figure 1.253: (Mock data) scatterplots of Binding Antibody to Spike: baseline negative vaccine arm at day 57

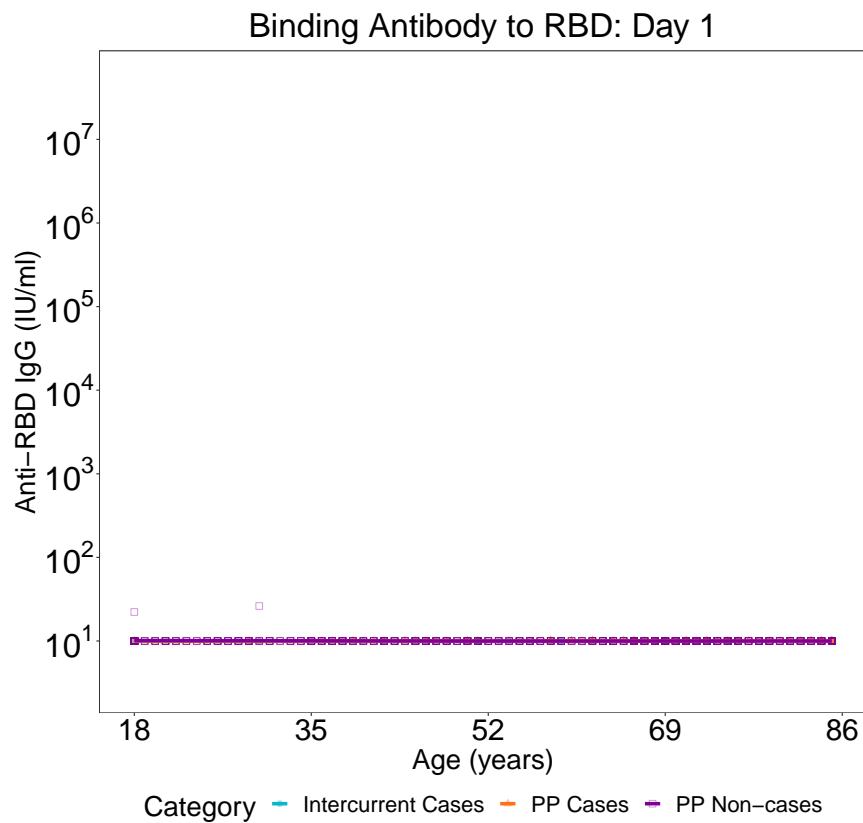


Figure 1.254: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 1

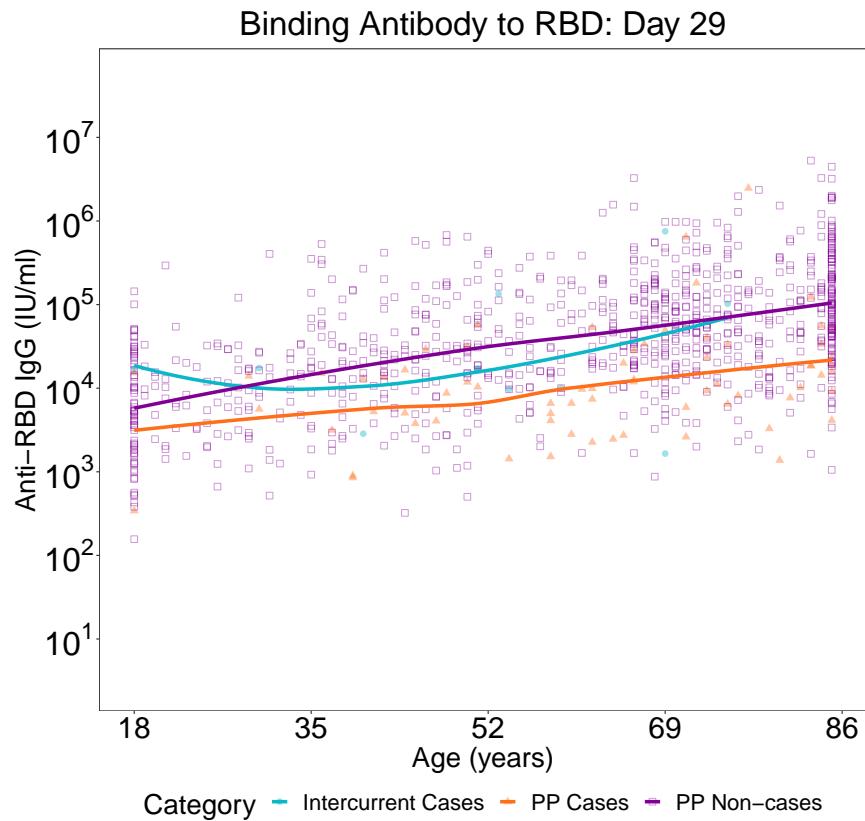


Figure 1.255: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 29

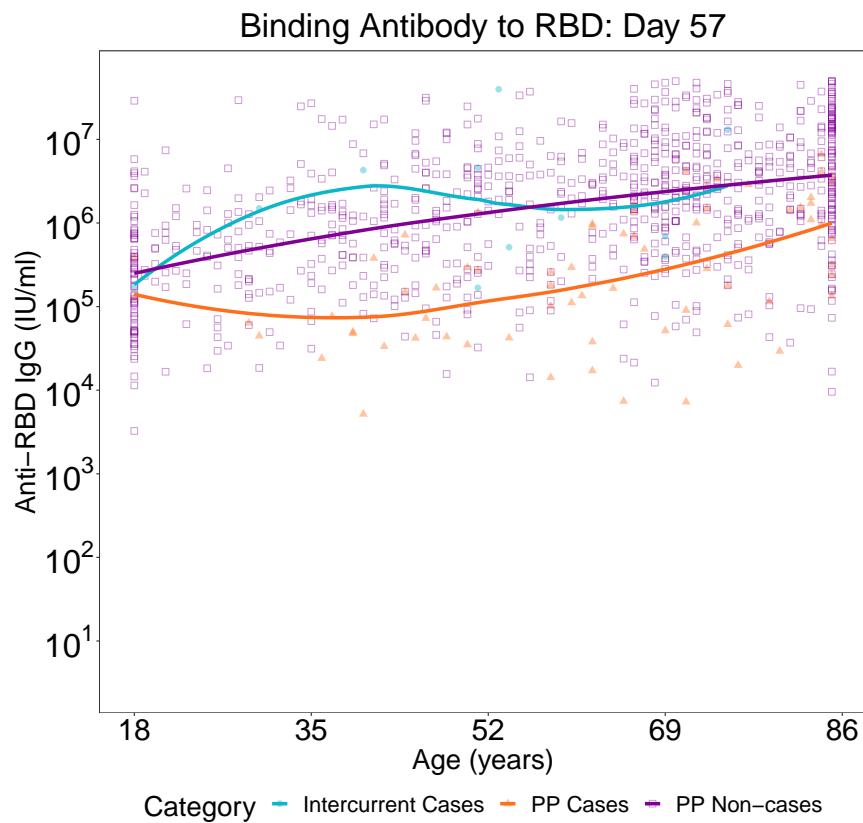


Figure 1.256: (Mock data) scatterplots of Binding Antibody to RBD: baseline negative vaccine arm at day 57

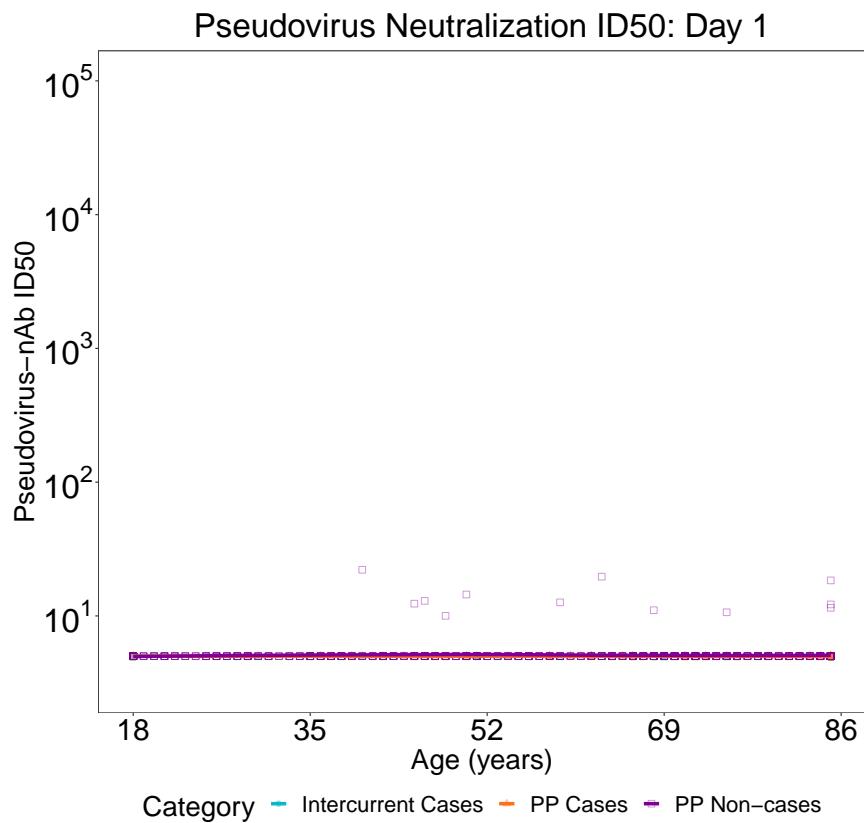


Figure 1.257: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 1

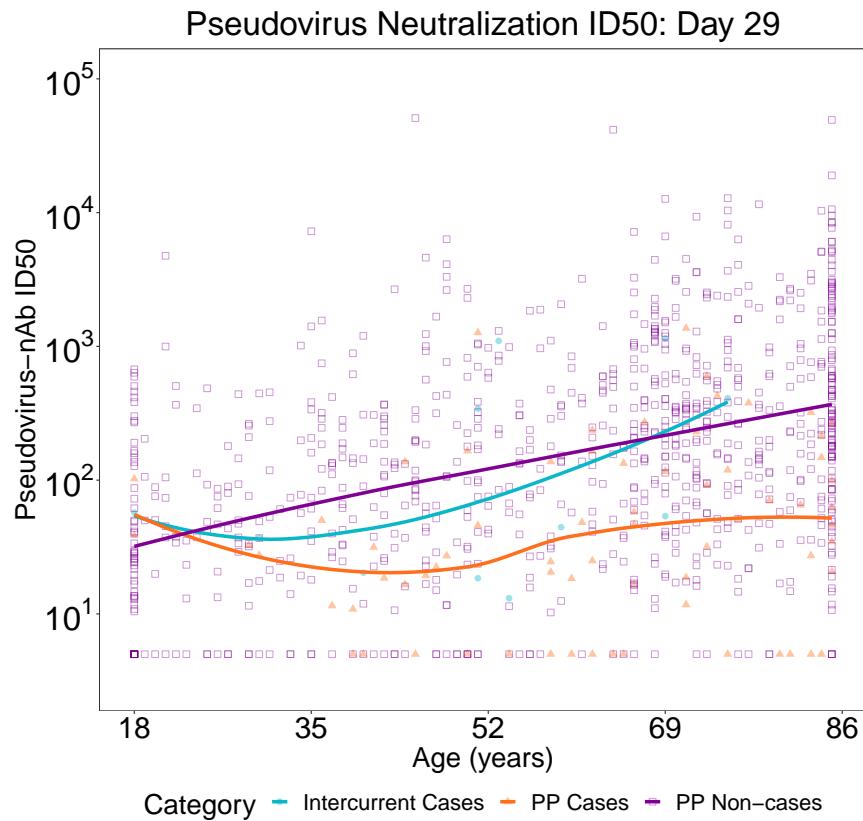


Figure 1.258: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 29

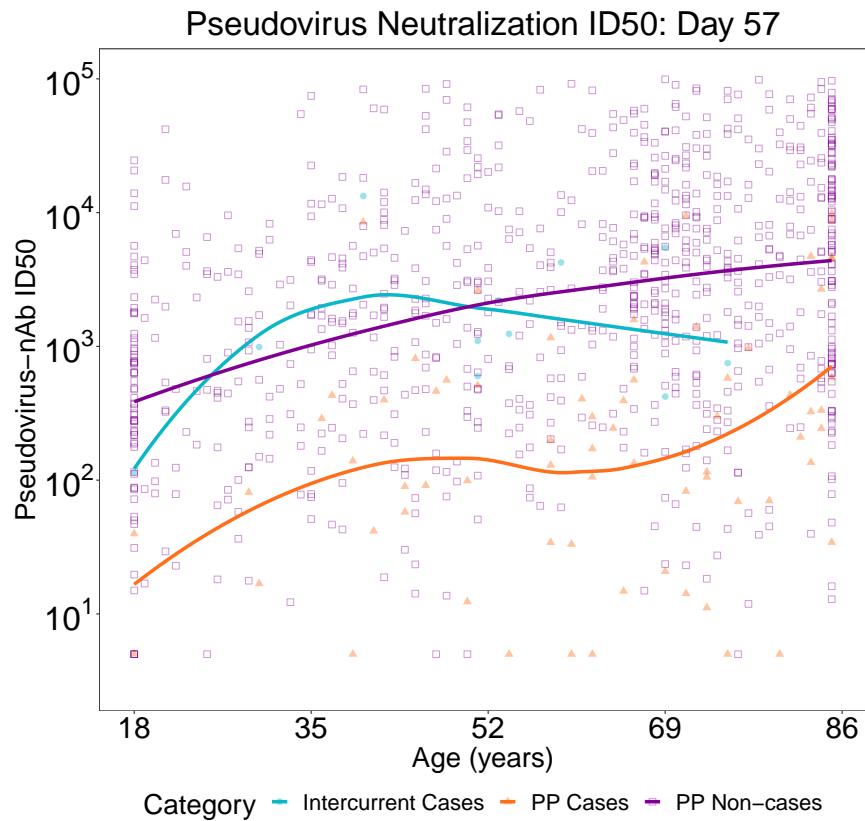


Figure 1.259: (Mock data) scatterplots of Pseudovirus Neutralization ID50: baseline negative vaccine arm at day 57

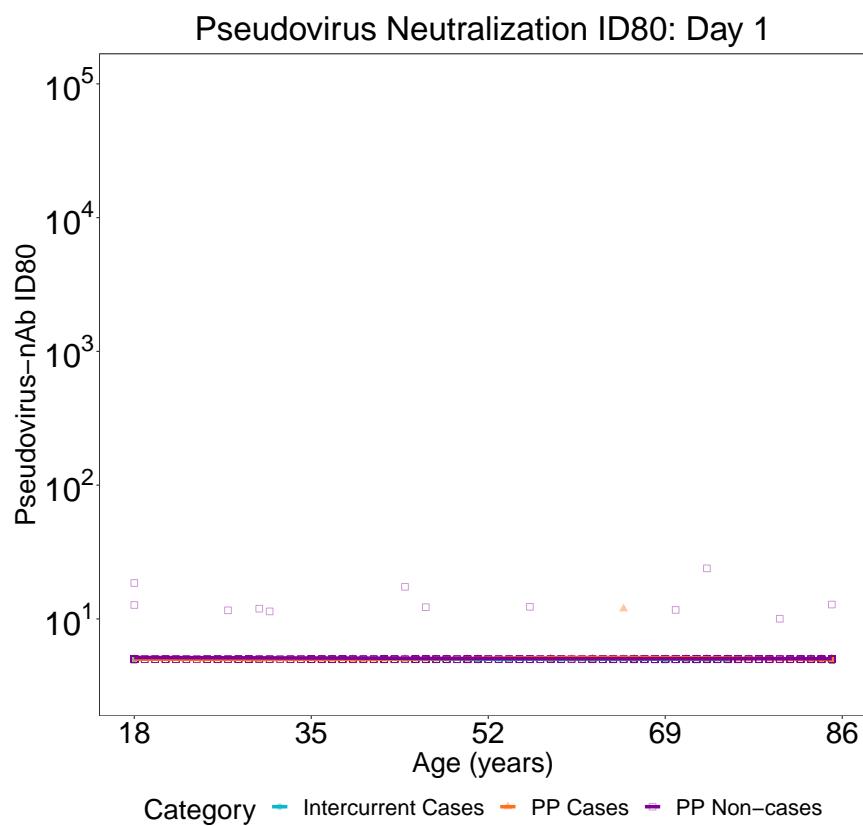


Figure 1.260: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 1

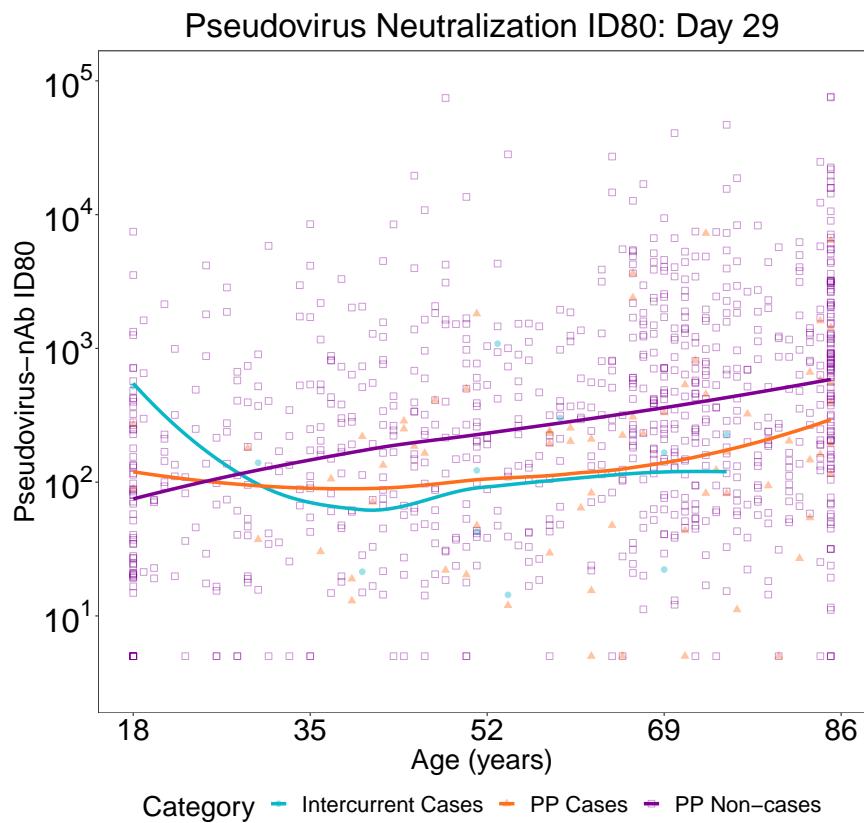


Figure 1.261: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 29

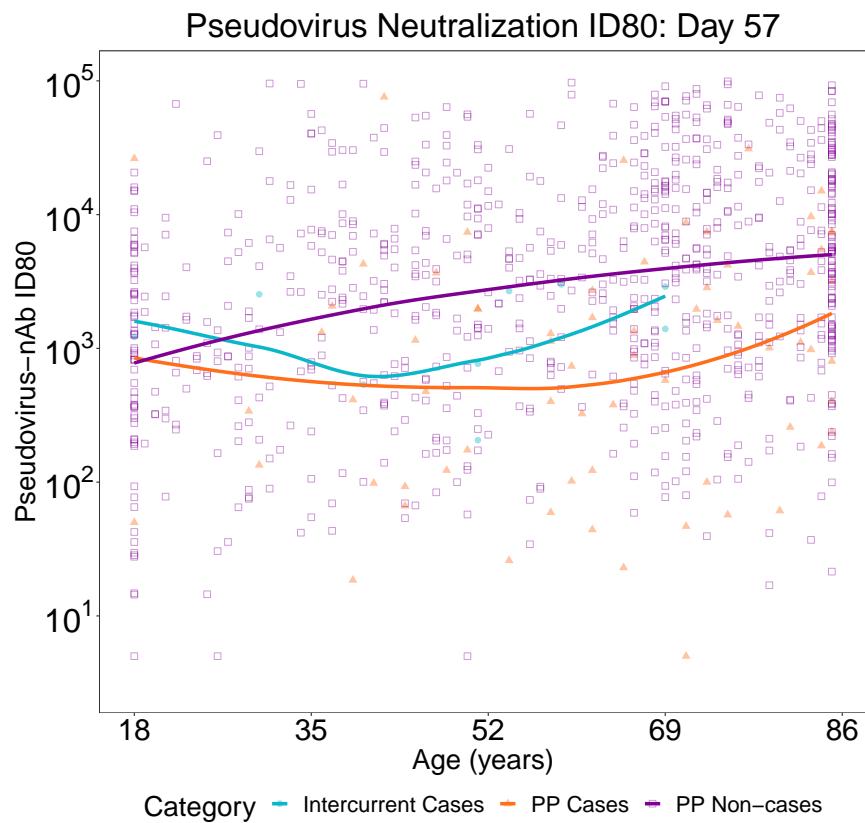


Figure 1.262: (Mock data) scatterplots of Pseudovirus Neutralization ID80: baseline negative vaccine arm at day 57

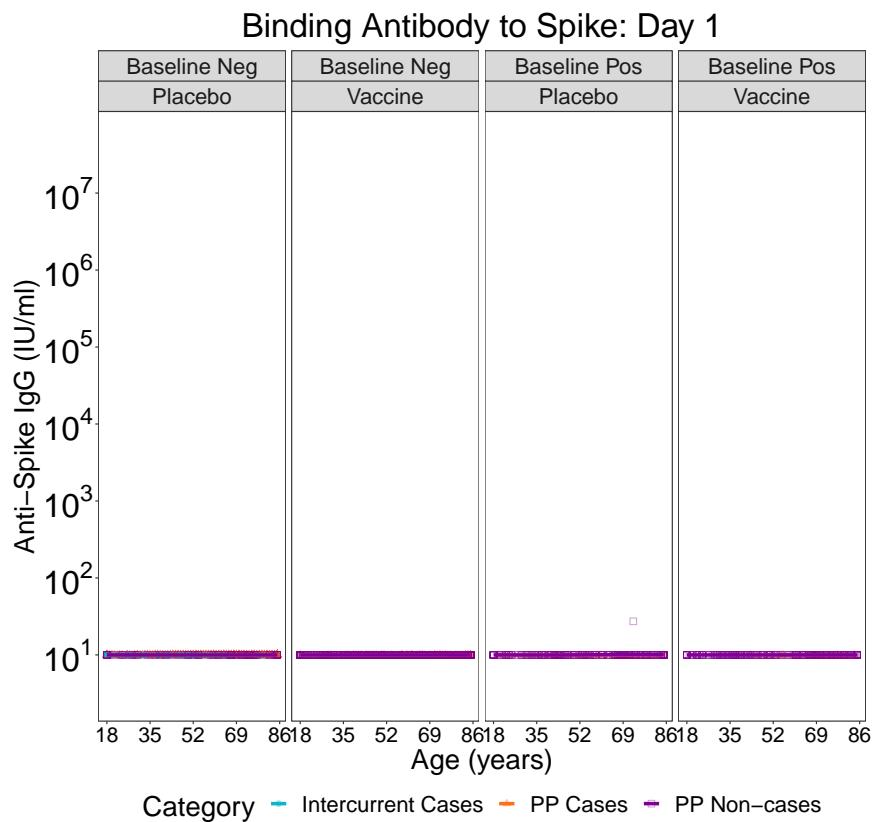


Figure 1.263: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 1

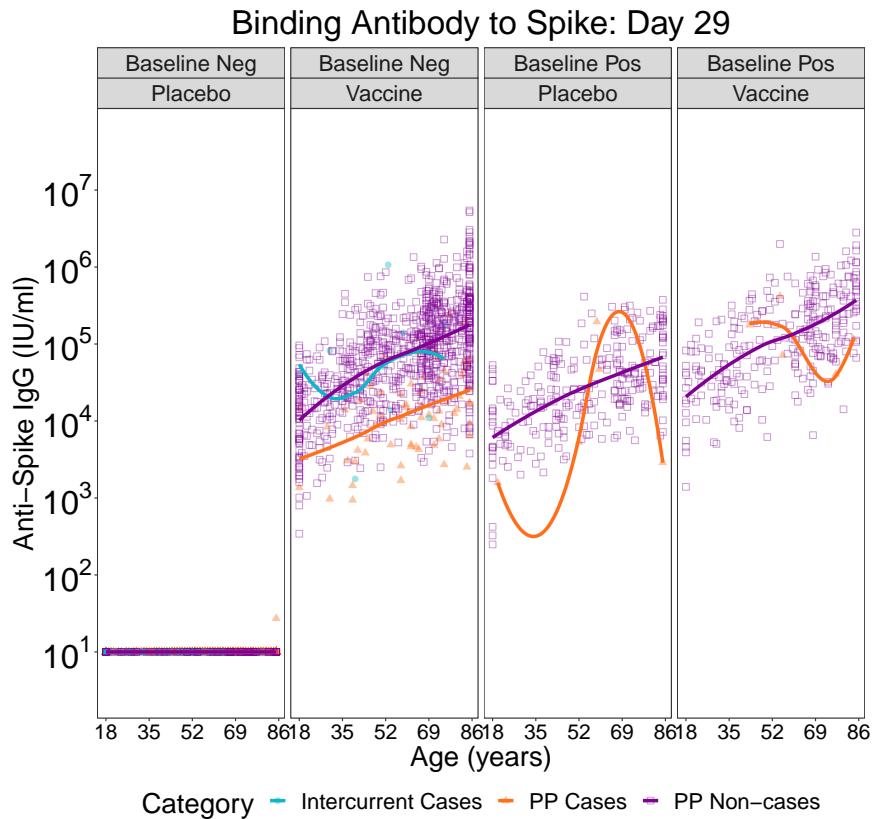


Figure 1.264: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 29

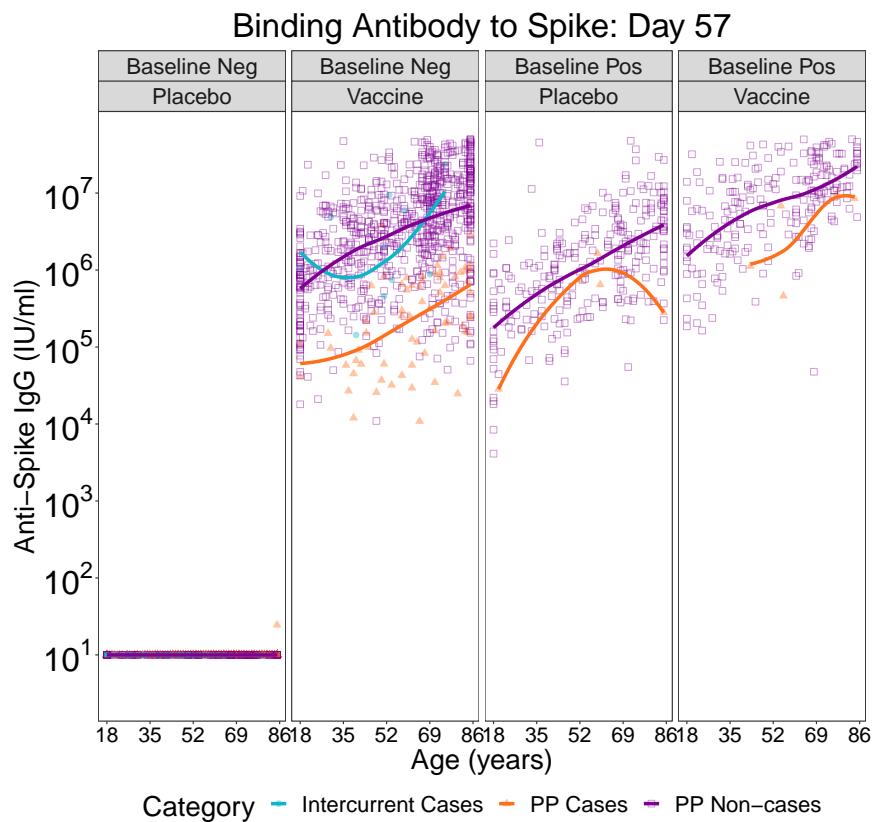


Figure 1.265: (Mock data) scatterplots of Binding Antibody to Spike: by arm at day 57

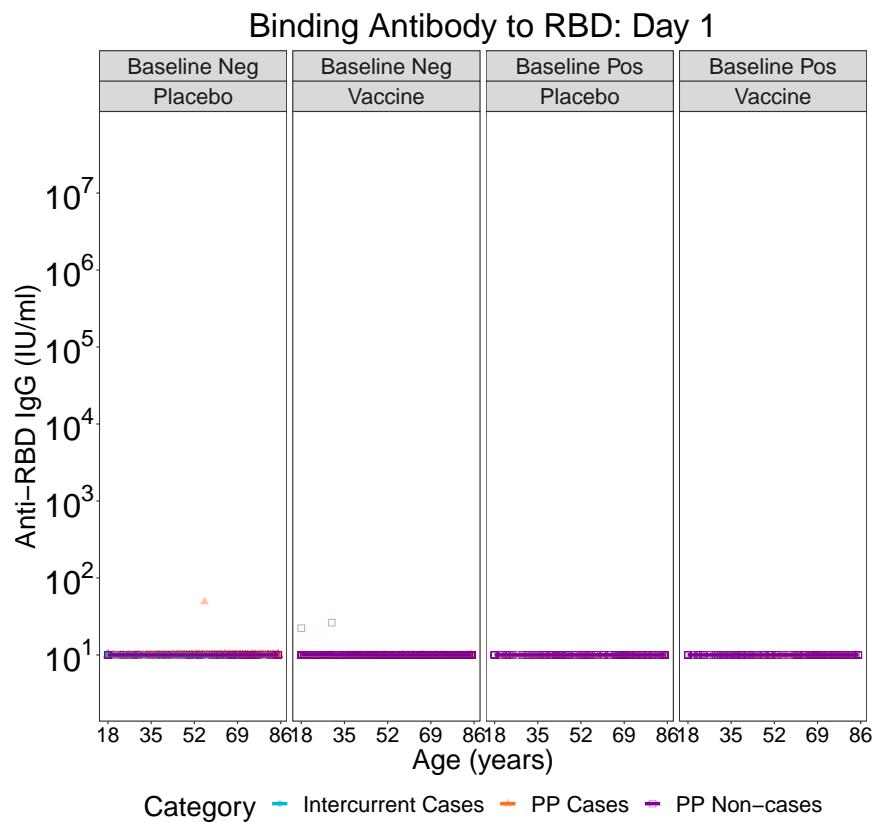


Figure 1.266: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 1

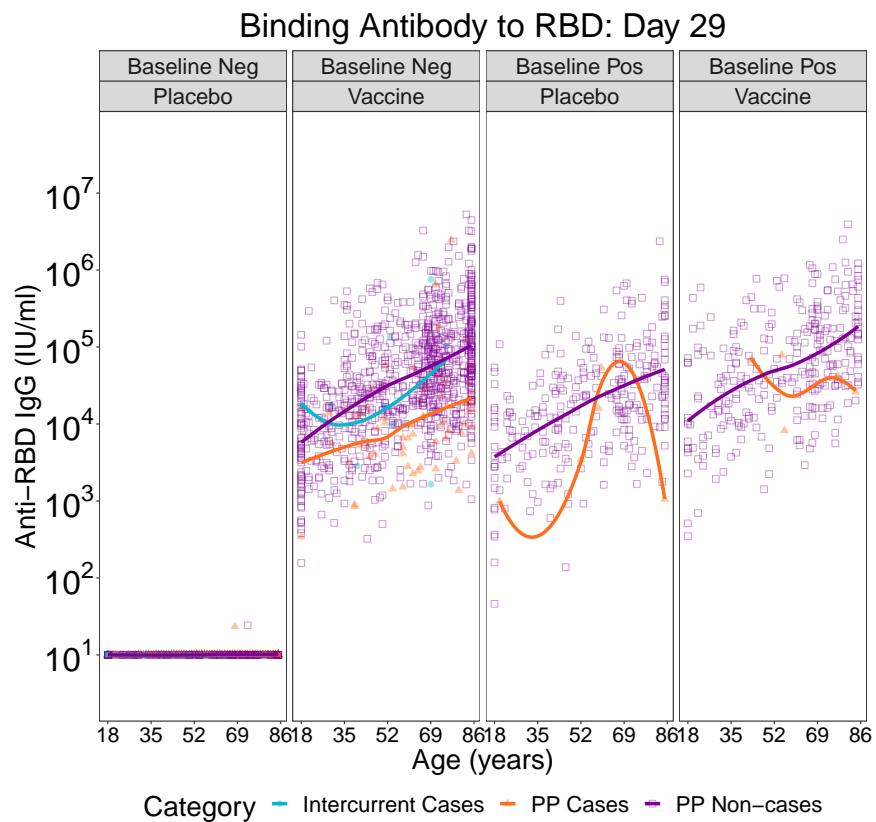


Figure 1.267: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 29

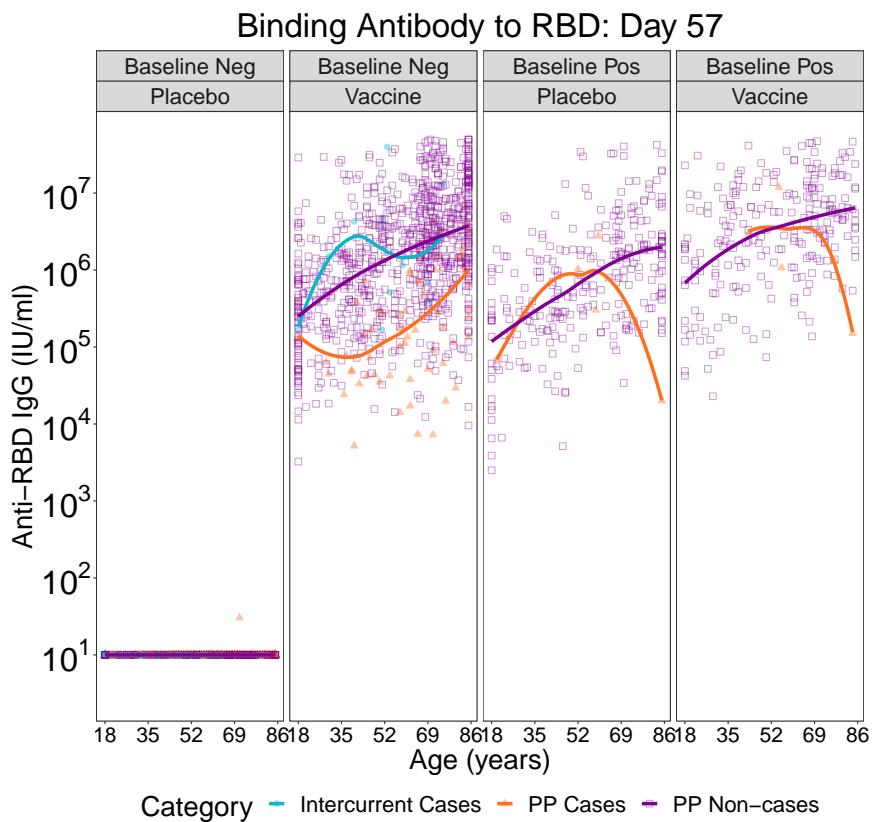


Figure 1.268: (Mock data) scatterplots of Binding Antibody to RBD: by arm at day 57

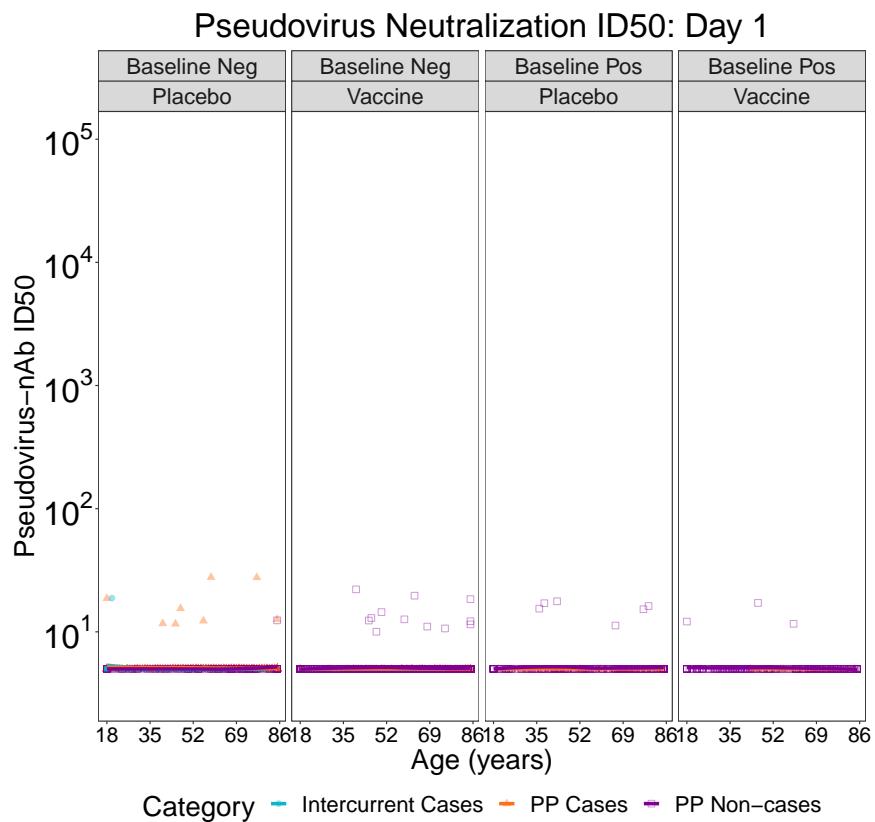


Figure 1.269: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 1

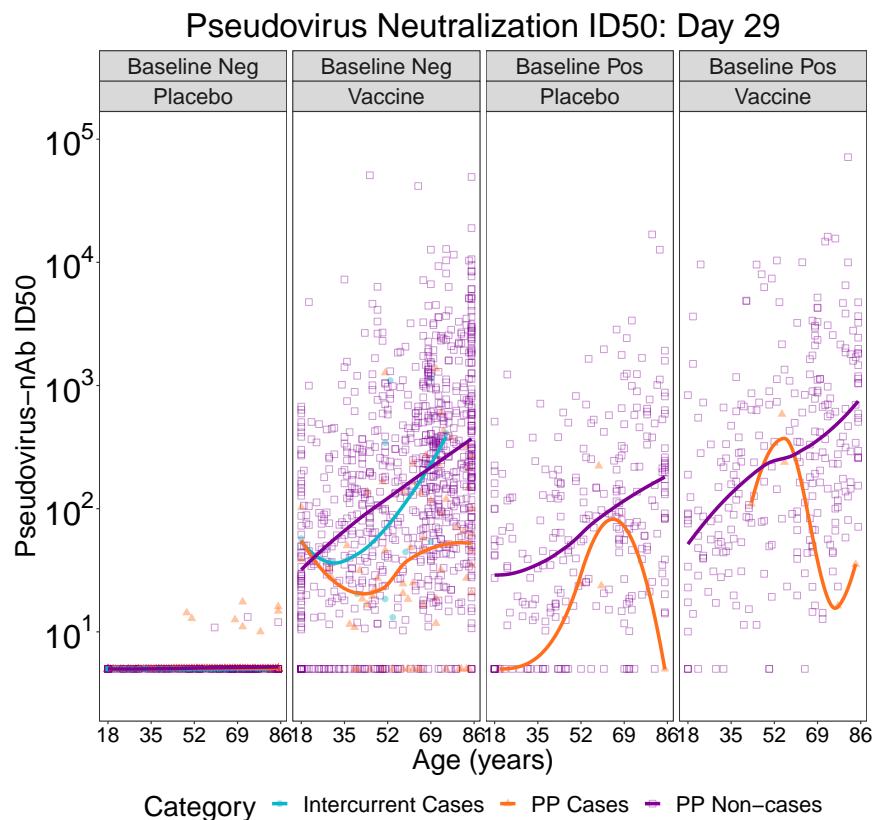


Figure 1.270: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 29

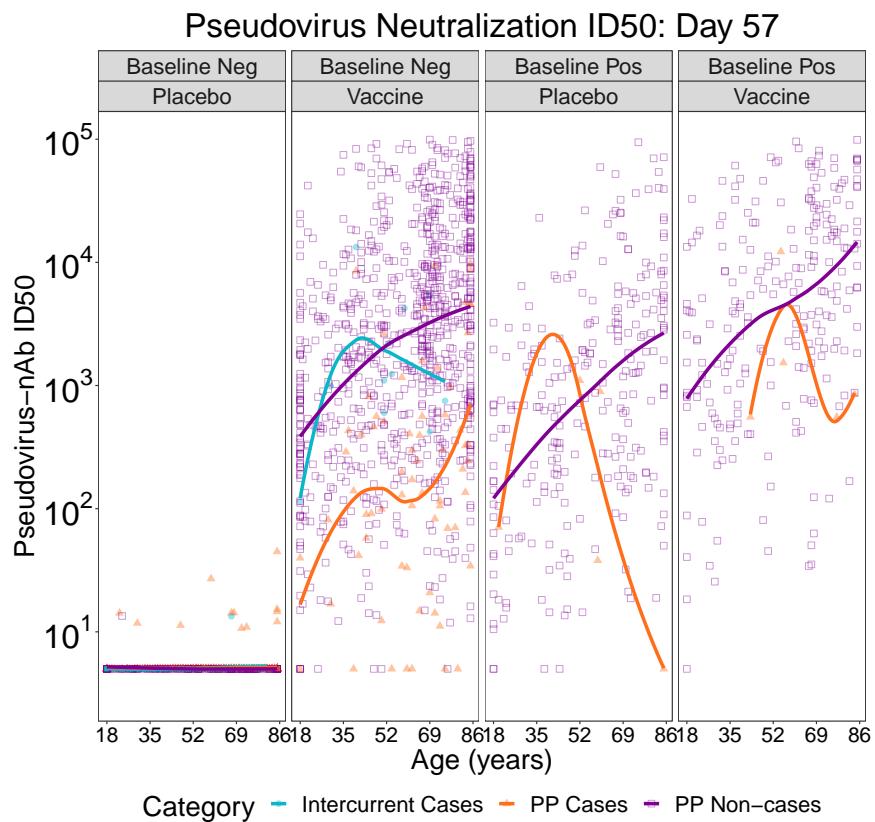


Figure 1.271: (Mock data) scatterplots of Pseudovirus Neutralization ID50: by arm at day 57

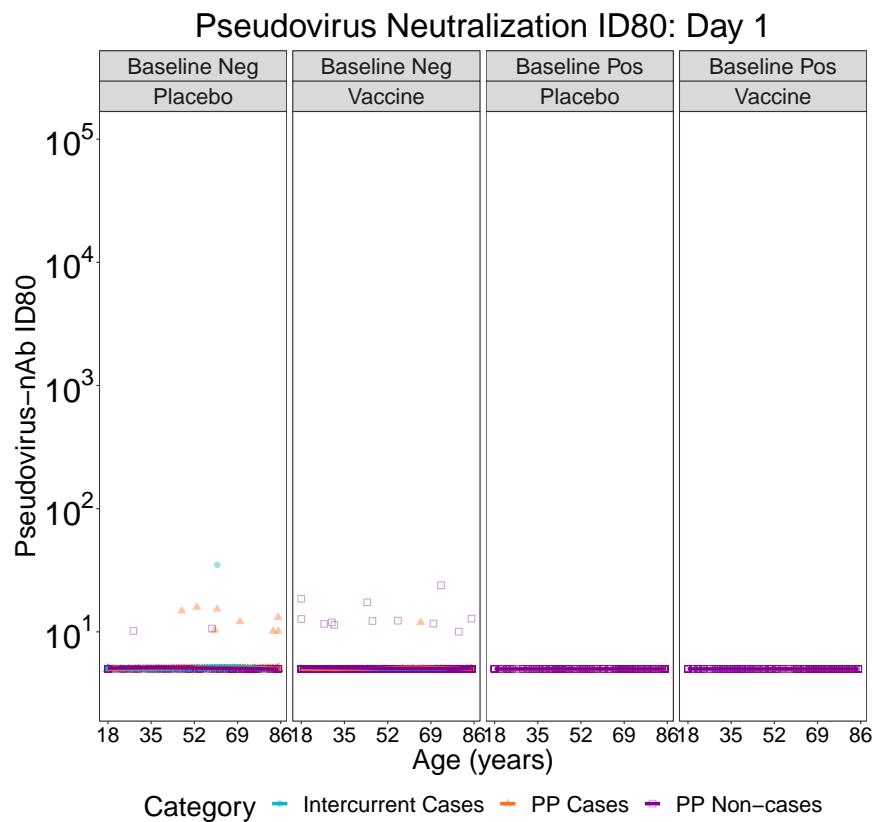


Figure 1.272: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 1

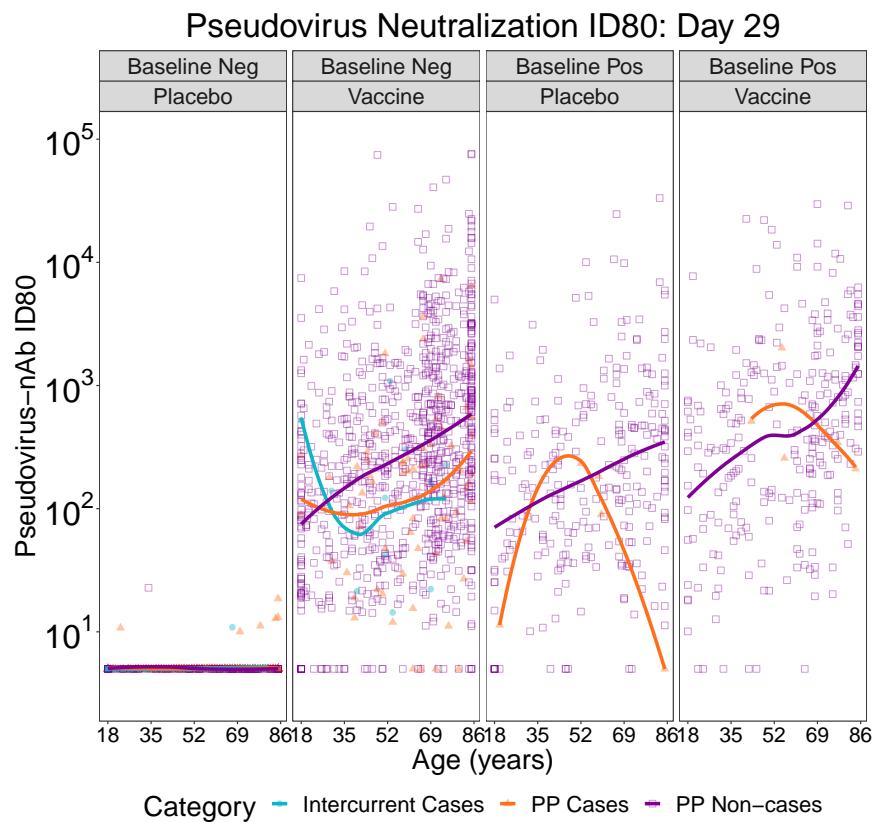


Figure 1.273: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 29

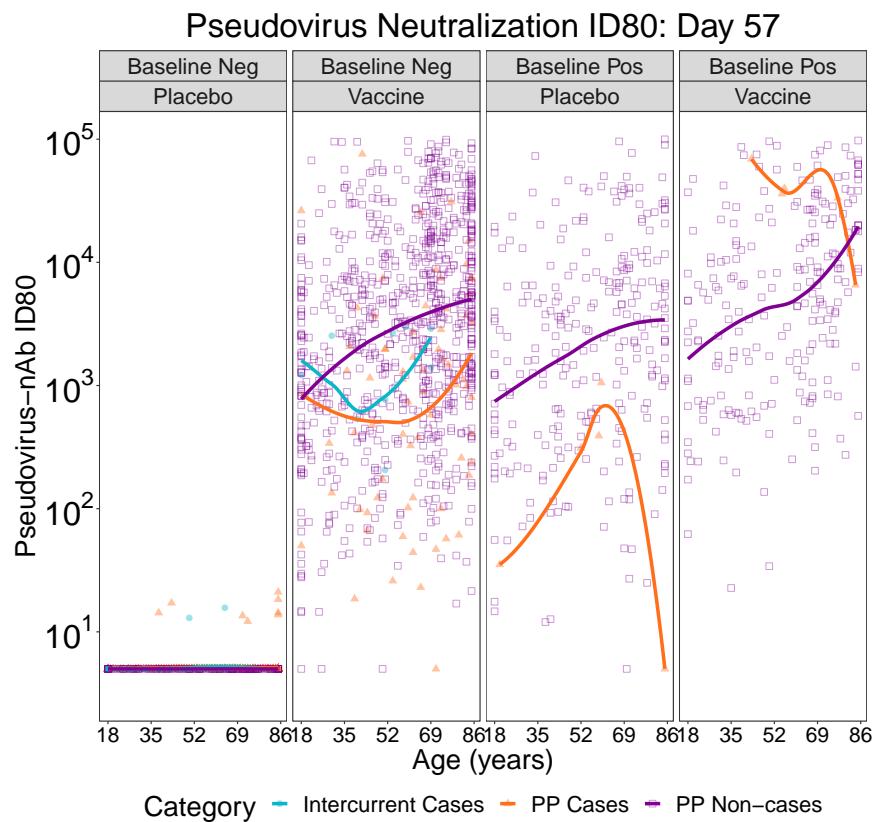


Figure 1.274: (Mock data) scatterplots of Pseudovirus Neutralization ID80: by arm at day 57



## Chapter 2

# Day 57 Univariate CoR: Cox Models of Risk

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

### 2.1 Hazard ratios

Table 2.1: Inference for Day 57 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group: Hazard ratios per 10-fold increment in the marker\*

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

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not \*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 57 visit; no. cases = number of this cohort with an observed COVID endpoints.

Table 2.2: Inference for Day 57 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group: Hazard ratios for Middle vs. Upper tertile vs. Lower tertile\*

Mock Immunologic Marker	Tertile	No. cases / No. at-risk**	Attack rate	Pt. Est.	Haz. Ratio 95% CI	P-value (2-sided)	Overall P-value***	Overall q-value	Overall FWER
Spike IgG (IU/ml)	Lower	67/4,425	0.0151	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	4/4,403	0.0009	0.04	(0.01-0.11)	<0.001			
	Upper	1/4,426	0.0002	0.00	(0.00-0.03)	<0.001			
RBD IgG (IU/ml)	Lower	45/4,437	0.0101	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	19/4,398	0.0043	0.24	(0.13-0.43)	<0.001			
	Upper	8/4,420	0.0018	0.05	(0.02-0.12)	<0.001			
PsV-nAb ID50	Lower	56/4,443	0.0126	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	9/4,382	0.0021	0.10	(0.05-0.22)	<0.001			
	Upper	6/4,429	0.0014	0.05	(0.02-0.11)	<0.001			
PsV-nAb ID80	Lower	40/4,434	0.0090	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	21/4,400	0.0048	0.43	(0.24-0.79)	0.006			
	Upper	11/4,420	0.0025	0.17	(0.08-0.34)	<0.001			
Placebo		713/13,271	0.0537						

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not . Average follow-up time 172 days, maximum follow-up time 185 days. Cutpoints: Spike IgG (IU/ml) [6.09, 6.7), RBD IgG (IU/ml) [5.68, 6.38), PsV-nAb ID50 [2.8, 3.66), PsV-nAb ID80 [3.08, 3.82) \*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 57 visit; no. cases = number of this cohort with an observed COVID endpoints.

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

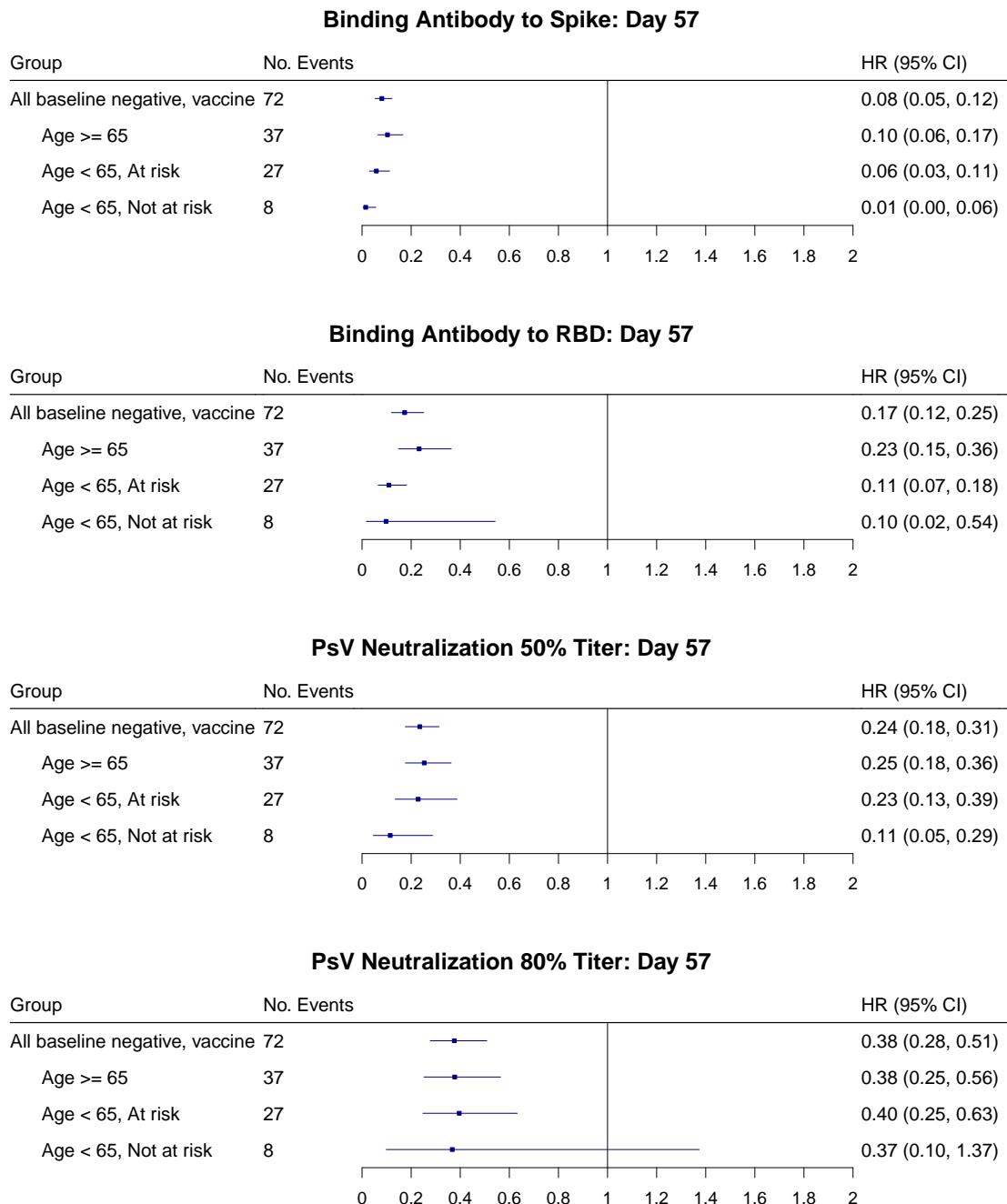


Figure 2.1: Forest plots of hazard ratios among baseline seronegative vaccine recipients and subgroups with 95% point-wise confidence intervals.

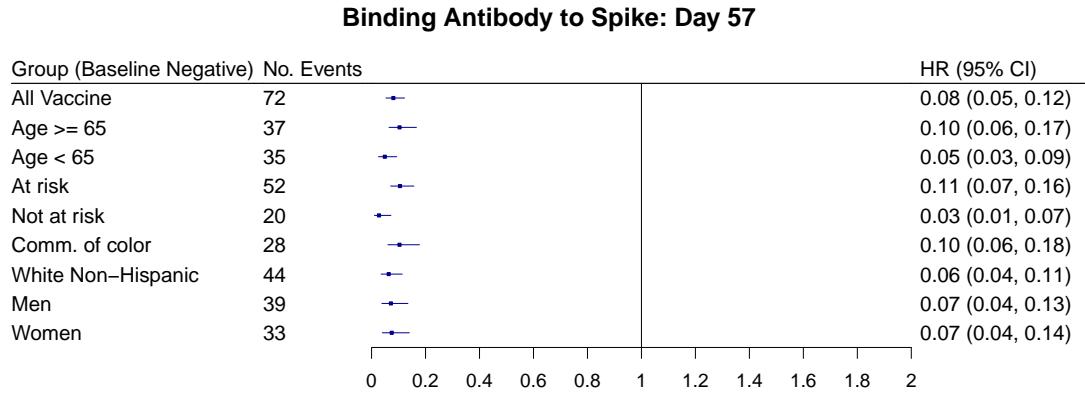


Figure 2.2: Forest plots of hazard ratios of Day 57 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

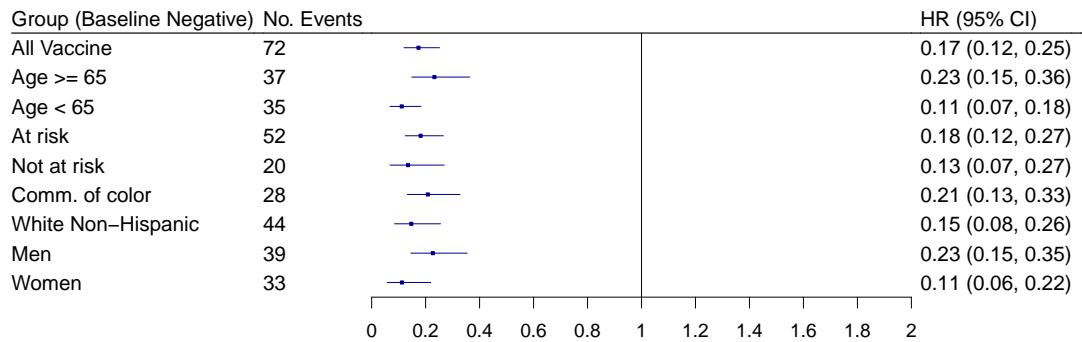
**Binding Antibody to RBD: Day 57**

Figure 2.3: Forest plots of hazard ratios of Day 57 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

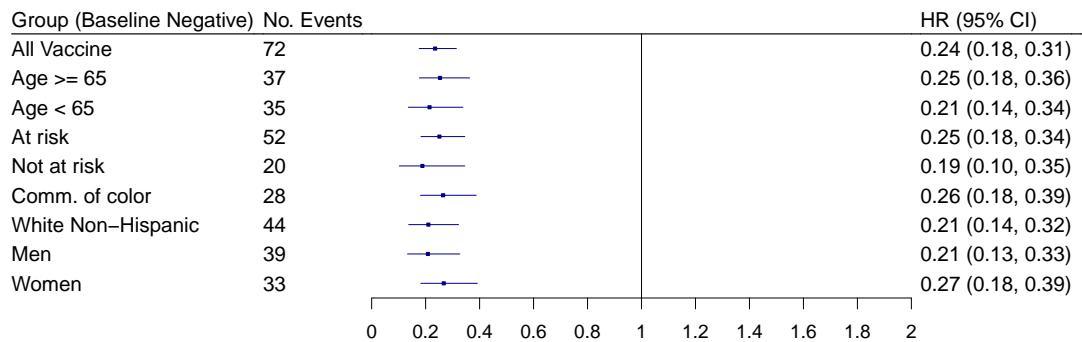
**PsV Neutralization 50% Titer: Day 57**

Figure 2.4: Forest plots of hazard ratios of Day 57 pseudo neut ID50 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

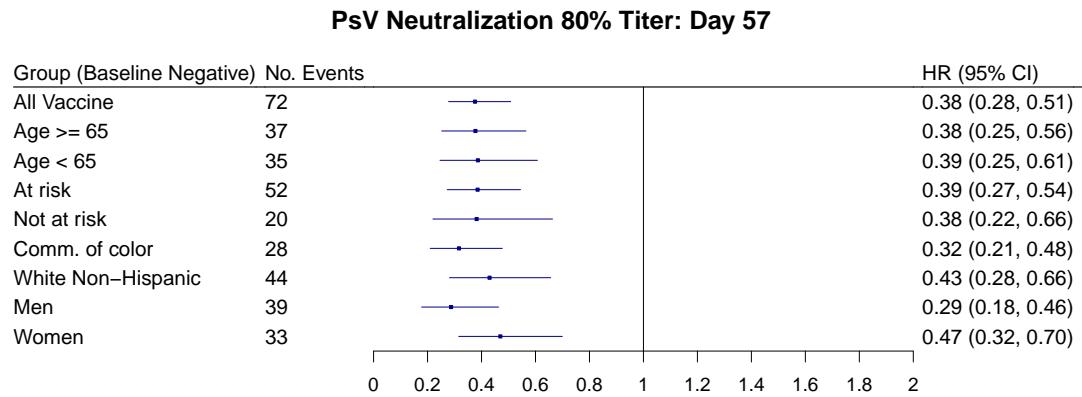


Figure 2.5: Forest plots of hazard ratios of Day 57 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

## 2.2 Marginalized risk and controlled vaccine efficacy plots

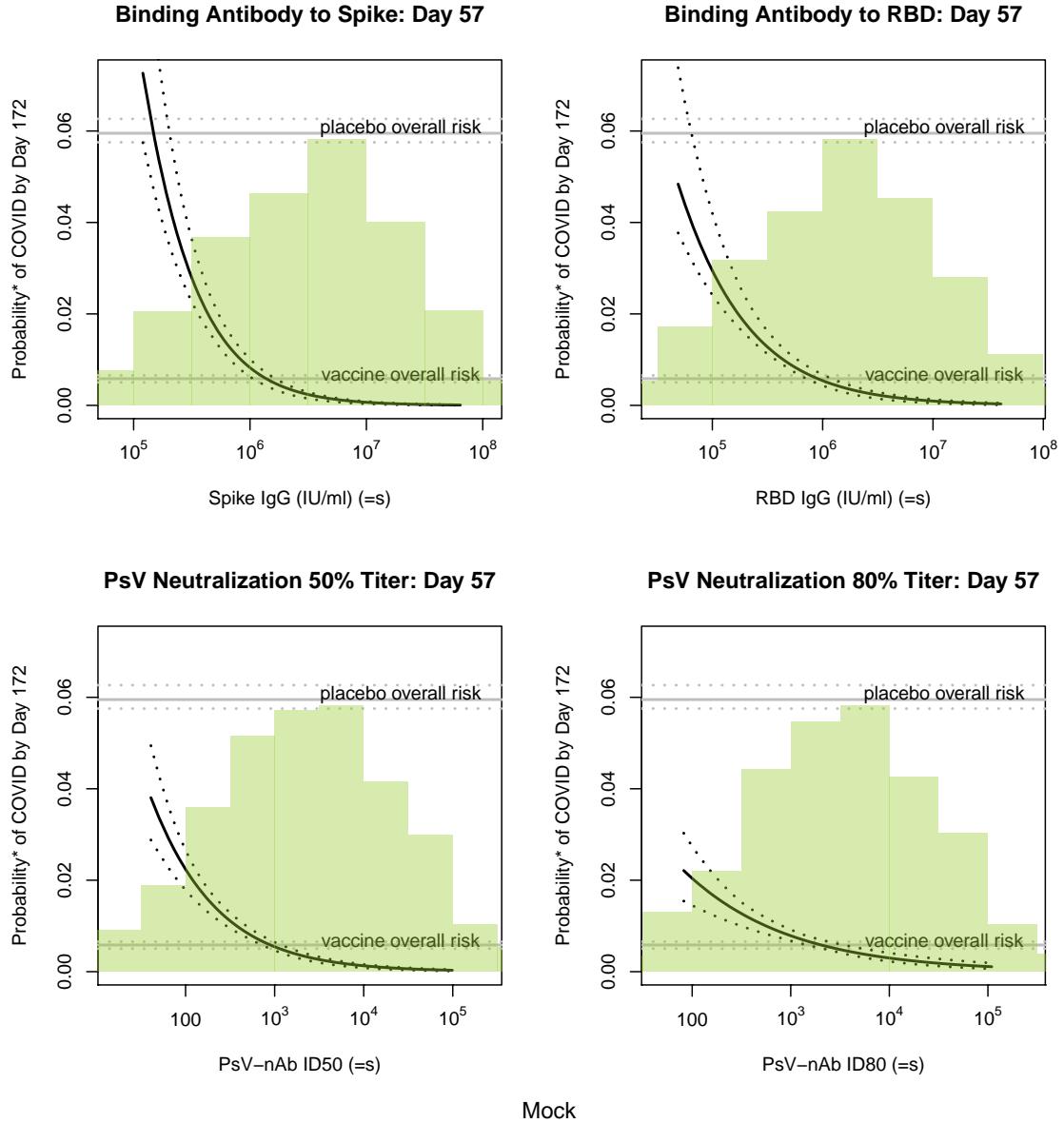


Figure 2.6: Marginalized cumulative risk by Day 172 as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 172 and its 95% point-wise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

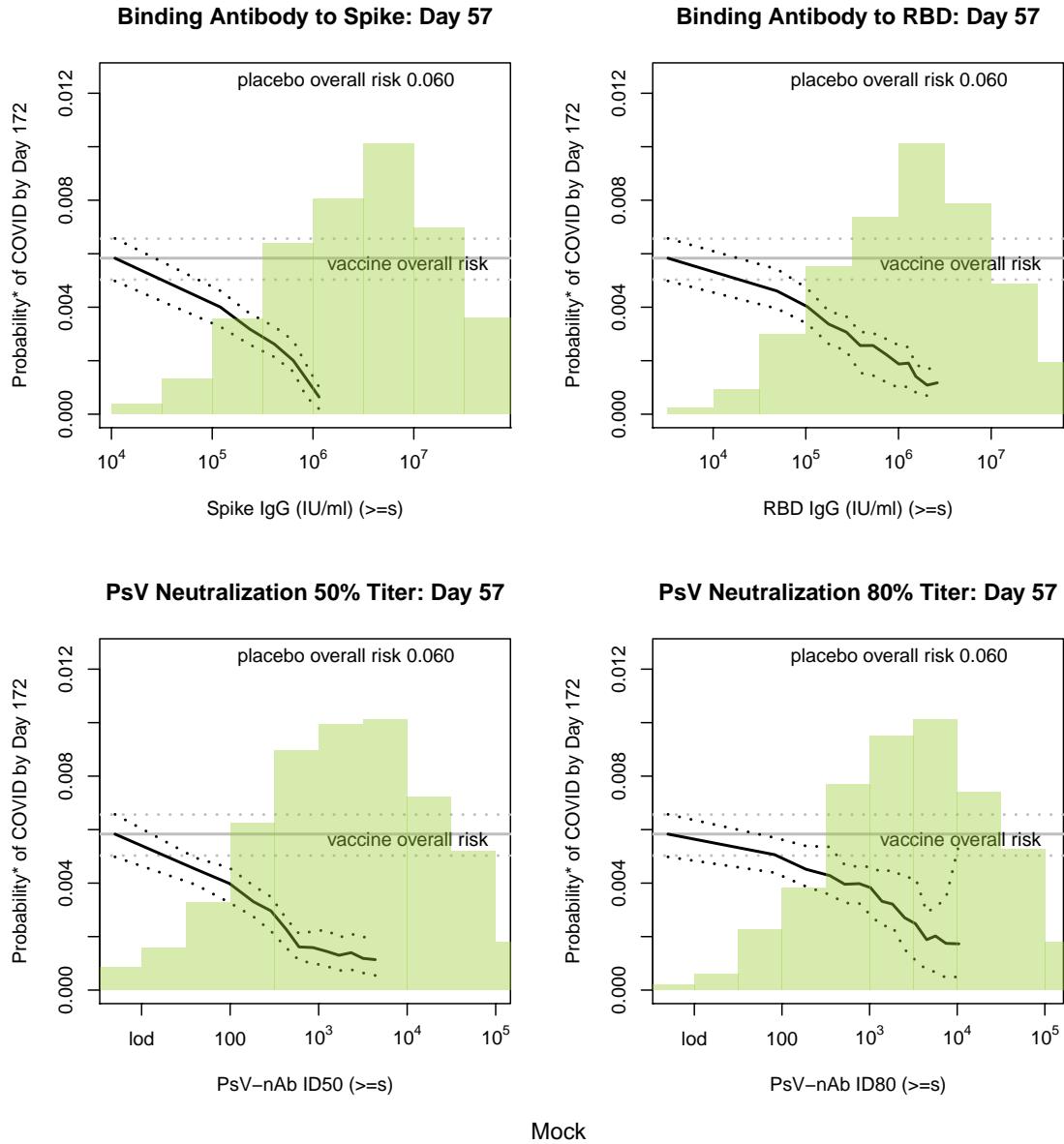


Figure 2.7: Marginalized cumulative risk by Day 57 as functions of Day 57 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of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

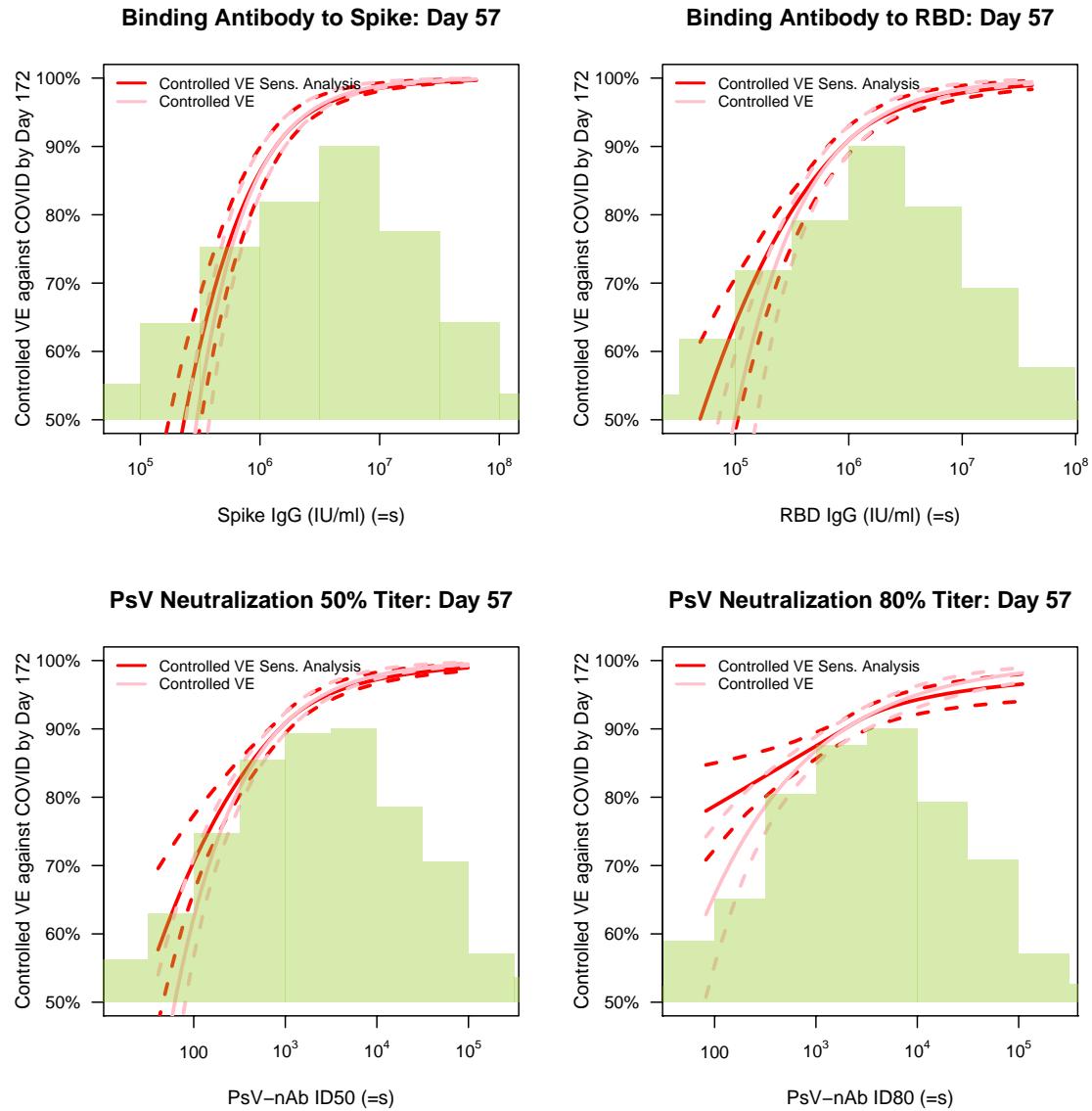


Figure 2.8: Controlled VE with sensitivity analysis as functions of Day 57 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

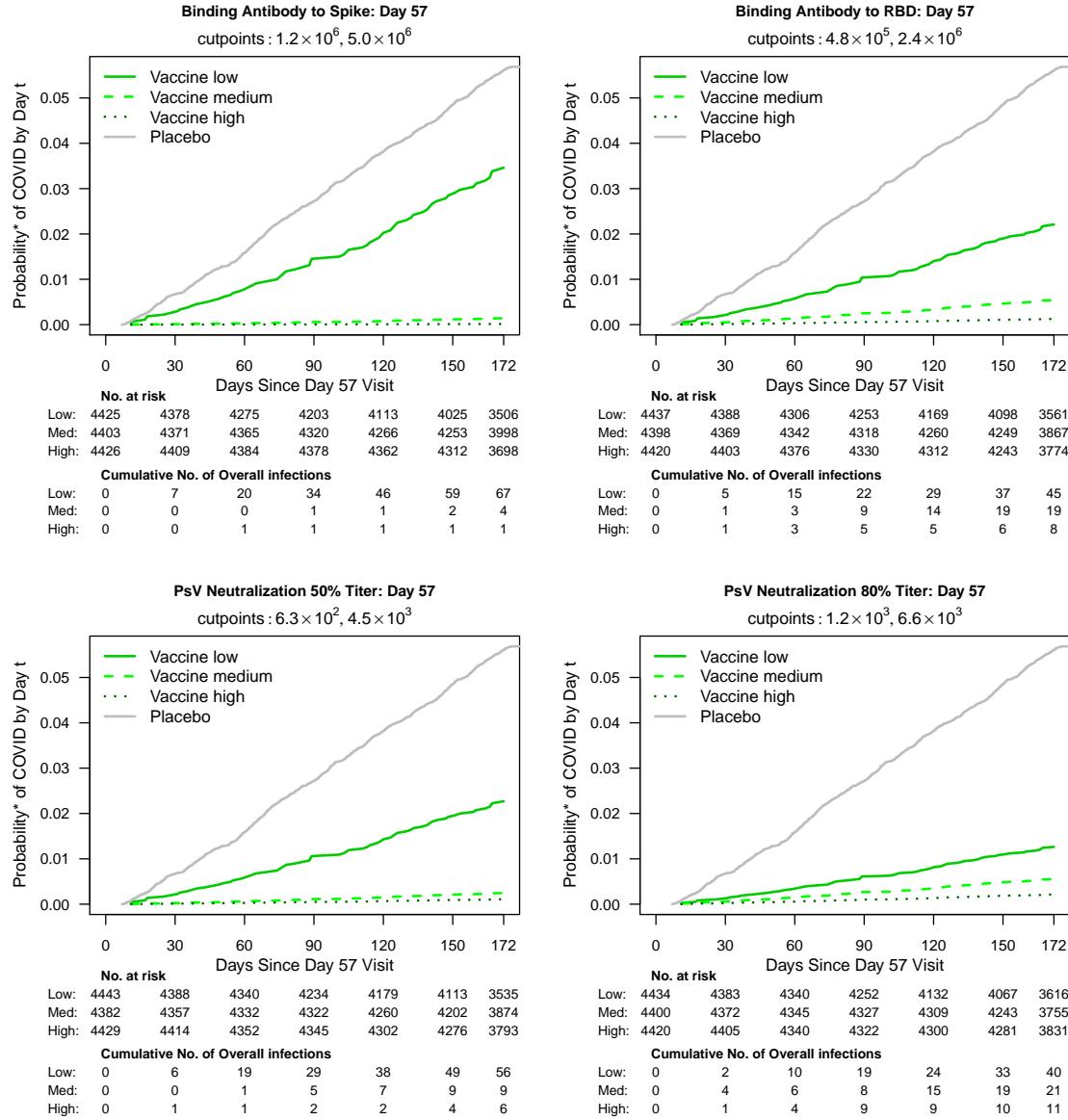


Figure 2.9: Marginalized cumulative incidence rate curves for trichotomized Day 57 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.



## Chapter 3

# Day 29 Univariate CoR: Cox Models of Risk

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

### 3.1 Hazard ratios

Table 3.1: Inference for Day 29 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group: Hazard ratios per 10-fold increment in the marker\*

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

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not \*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 29 visit; no. cases = number of this cohort with an observed COVID endpoints.

Table 3.2: Inference for Day 29 antibody marker covariate-adjusted correlates of risk of COVID in the vaccine group: Hazard ratios for Middle vs. Upper tertile vs. Lower tertile\*

Mock Immunologic Marker	Tertile	No. cases / No. at-risk**	Attack rate	Pt. Est.	Haz. Ratio 95% CI	P-value (2-sided)	Overall P-value***	Overall q-value	Overall FWER
Spike IgG (IU/ml)	Lower	54/4,422	0.0122	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	24/4,423	0.0054	0.20	(0.11-0.37)	<0.001			
	Upper	5/4,427	0.0011	0.02	(0.01-0.06)	<0.001			
RBD IgG (IU/ml)	Lower	46/4,419	0.0104	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	25/4,428	0.0056	0.30	(0.17-0.55)	<0.001			
	Upper	12/4,424	0.0027	0.08	(0.04-0.17)	<0.001			
PsV-nAb ID50	Lower	47/4,403	0.0107	1	N/A	N/A	<0.001	<0.001	<0.001
	Middle	24/4,420	0.0054	0.33	(0.19-0.59)	<0.001			
	Upper	12/4,448	0.0027	0.12	(0.06-0.25)	<0.001			
PsV-nAb ID80	Lower	30/4,416	0.0068	1	N/A	N/A	0.001	<0.001	<0.001
	Middle	36/4,429	0.0081	0.94	(0.55-1.62)	0.834			
	Upper	17/4,426	0.0038	0.33	(0.17-0.64)	0.001			
Placebo		821/13,299	0.0617						

\*Baseline covariates adjusted for: age in years, at risk or not, community of color or not . Average follow-up time 200 days, maximum follow-up time 213 days. Cutpoints: Spike IgG (IU/ml) [4.38, 4.94], RBD IgG (IU/ml) [4.11, 4.66], PsV-nAb ID50 [1.67, 2.38], PsV-nAb ID80 [1.97, 2.64] \*\*No. at-risk = number of per-protocol baseline negative vaccine recipients at-risk for COVID at 7 days post Day 29 visit; no. cases = number of this cohort with an observed COVID endpoints.

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

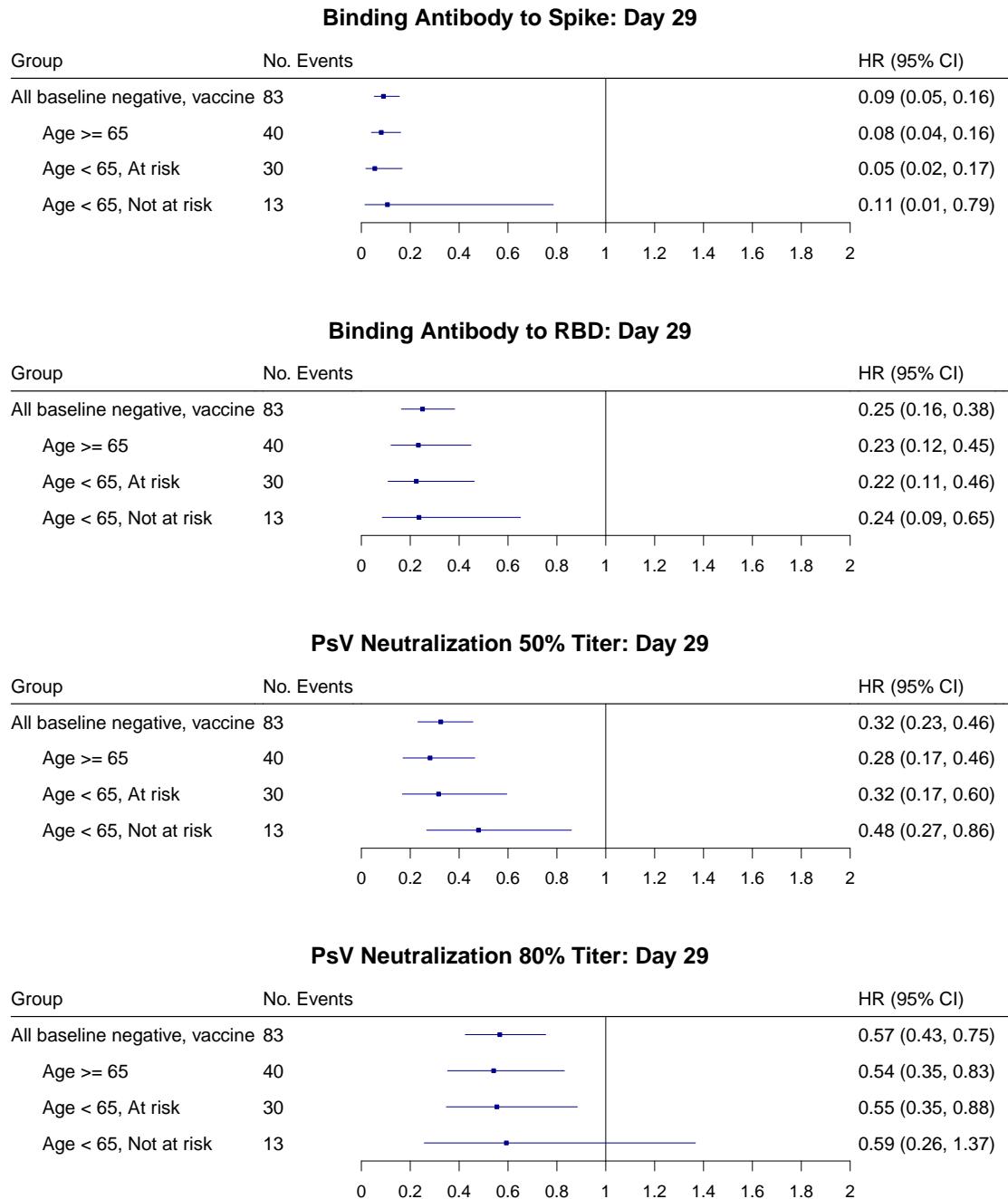


Figure 3.1: Forest plots of hazard ratios among baseline seronegative vaccine recipients and sub-groups with 95% point-wise confidence intervals.

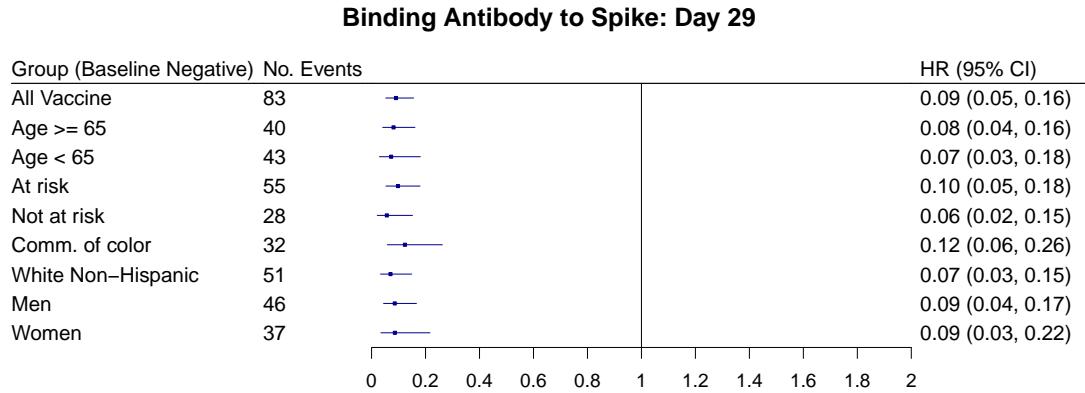


Figure 3.2: Forest plots of hazard ratios of Day 29 binding Ab to spike markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

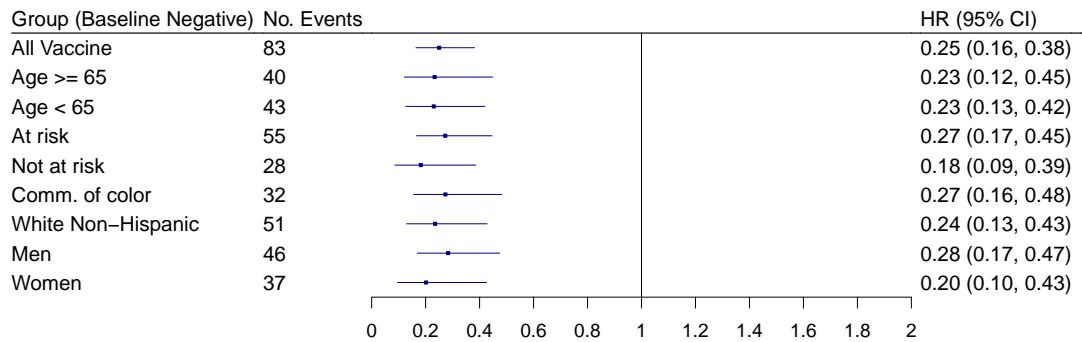
**Binding Antibody to RBD: Day 29**

Figure 3.3: Forest plots of hazard ratios of Day 29 binding Ab to RBD markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

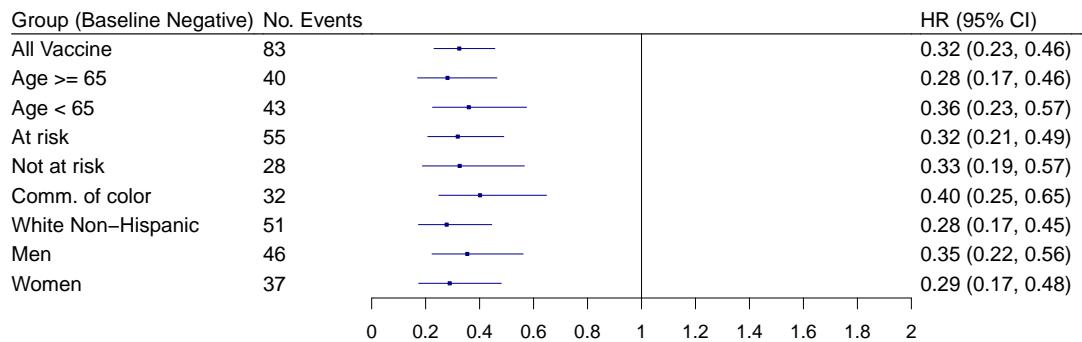
**PsV Neutralization 50% Titer: Day 29**

Figure 3.4: Forest plots of hazard ratios of Day 29 pseudo neut ID50 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

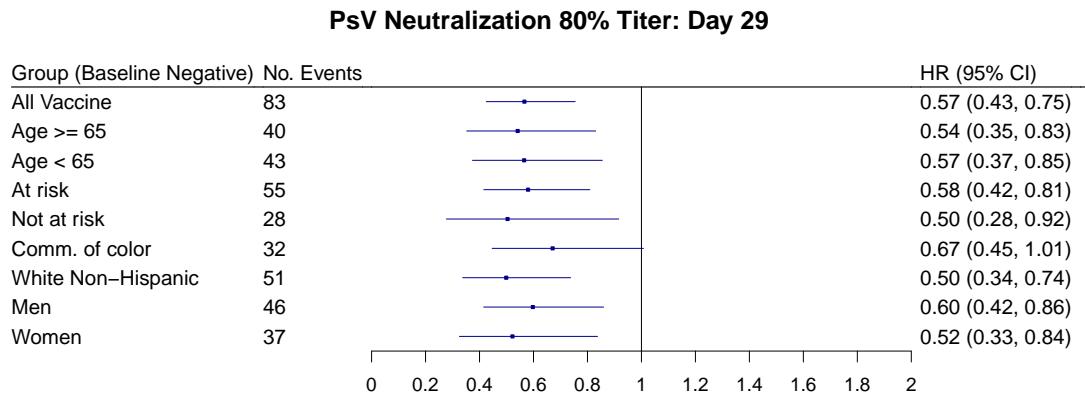


Figure 3.5: Forest plots of hazard ratios of Day 29 pseudo neut ID80 markers among baseline seronegative vaccine recipients (top row) and eight subpopulations (row 2-9) with 95% point-wise confidence intervals.

### 3.2 Marginalized risk and controlled vaccine efficacy plots

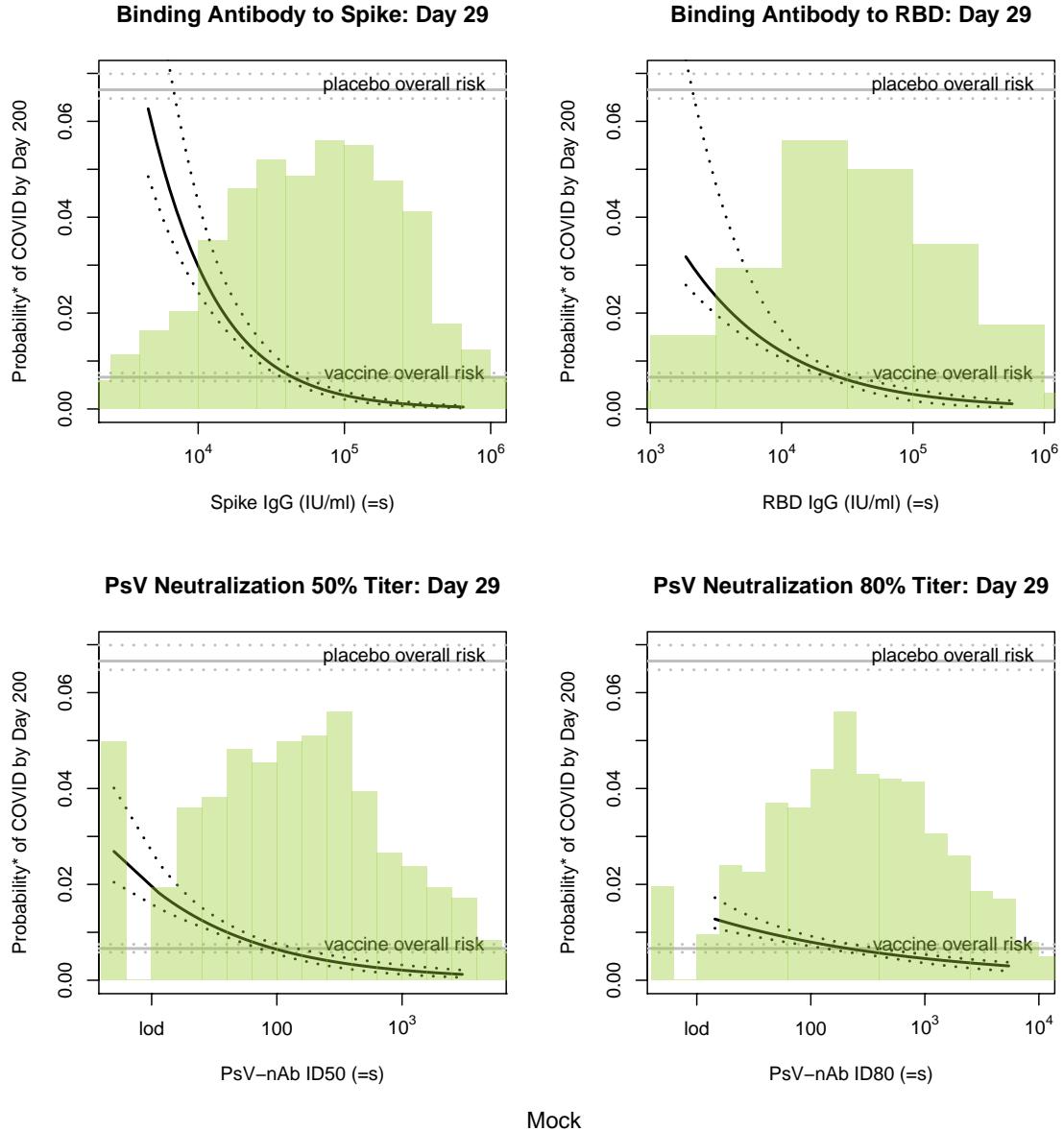


Figure 3.6: Marginalized cumulative risk by Day 200 as functions of Day 29 markers ( $=s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. The horizontal lines indicate the overall cumulative risk of the placebo and vaccine arms by Day 200 and its 95% point-wise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

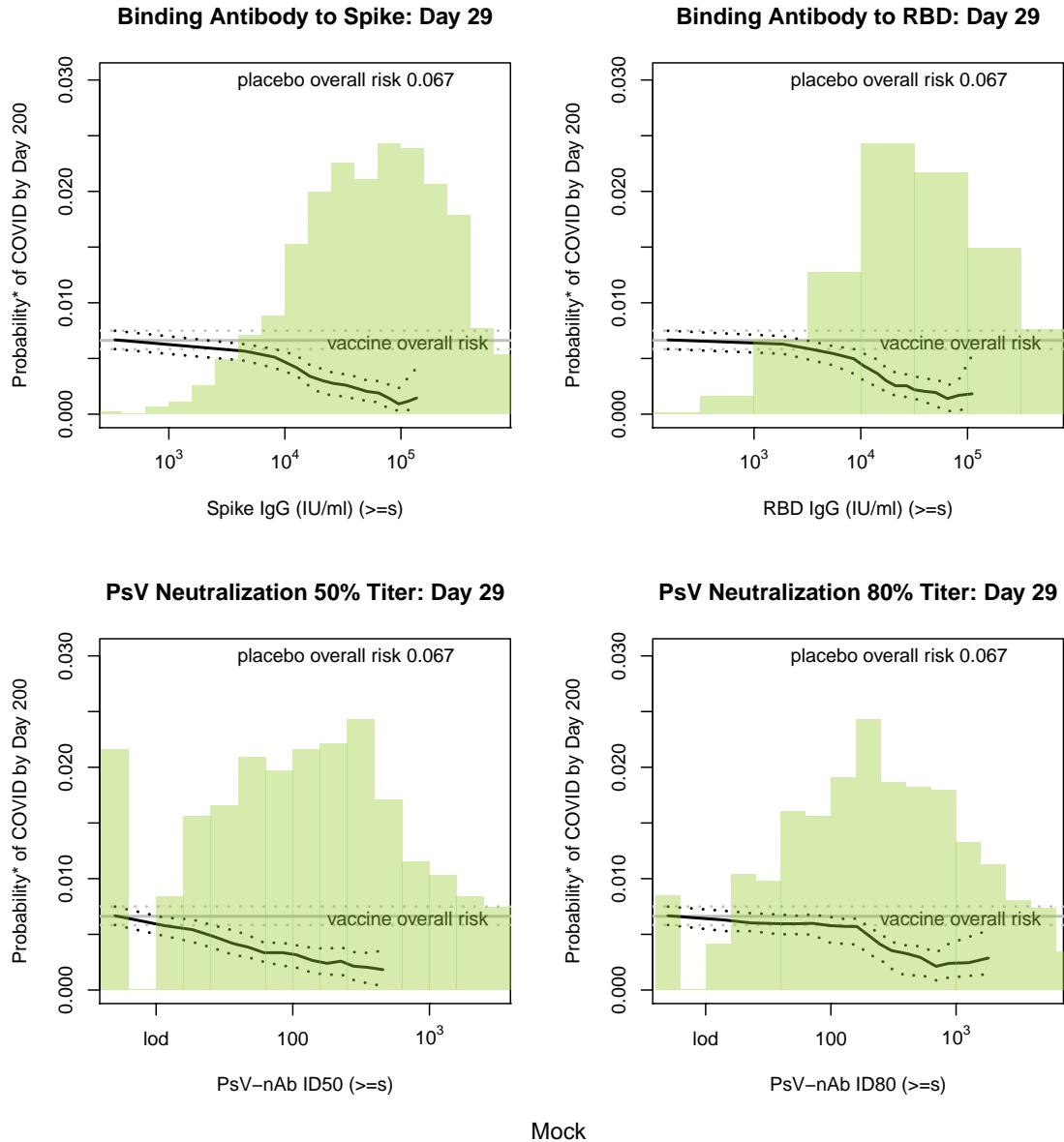


Figure 3.7: Marginalized cumulative risk by Day 29 as functions of Day 29 markers above a threshold ( $\geq s$ ) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands (at least 5 cases are required). The horizontal lines indicate the overall cumulative risk of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

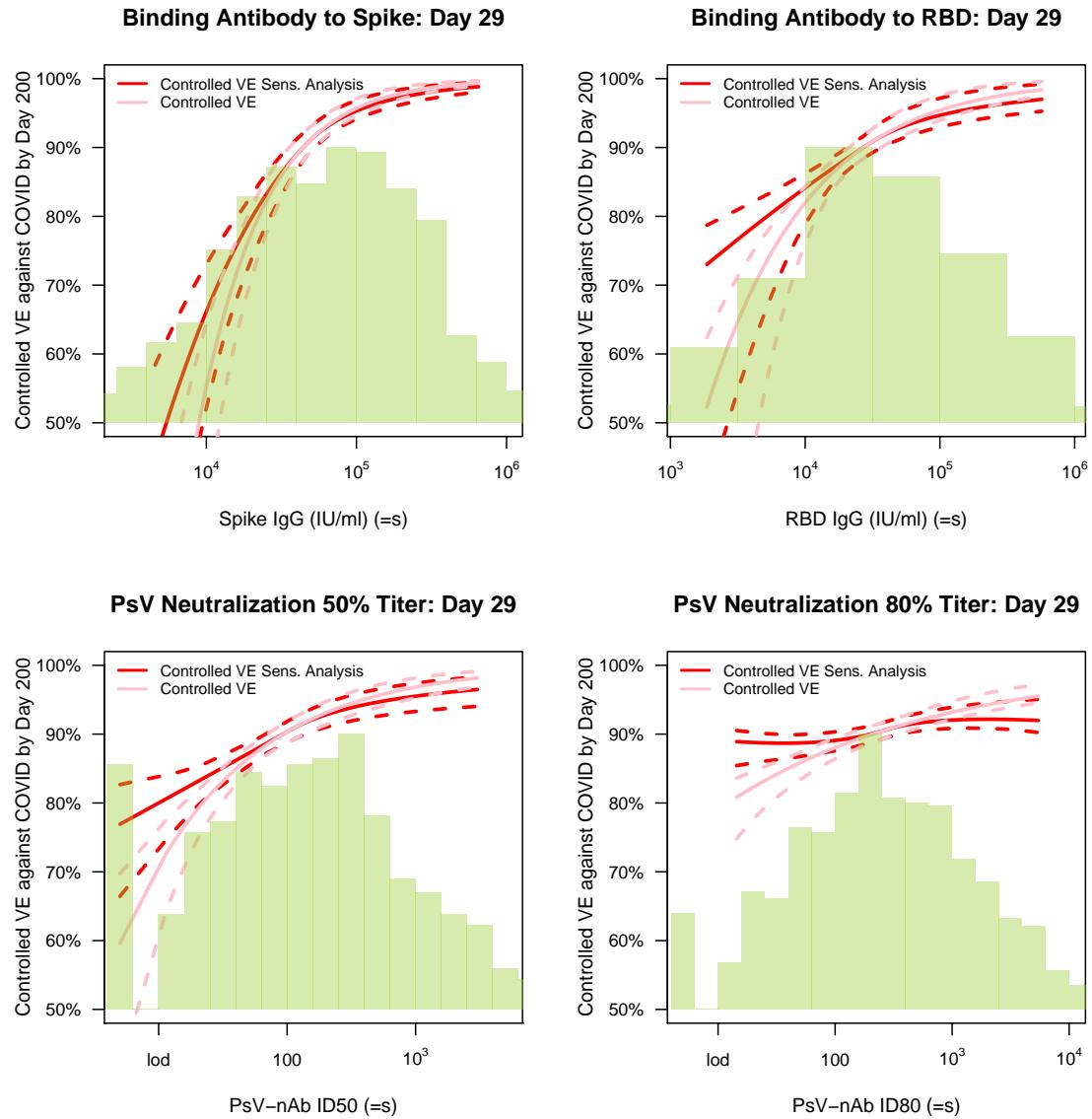


Figure 3.8: Controlled VE with sensitivity analysis as functions of Day 29 markers (=s) among baseline seronegative vaccine recipients with 95% bootstrap point-wise confidence bands. Histograms of the immunological markers in the vaccine arm are overlaid. lod: lower limit of detection.

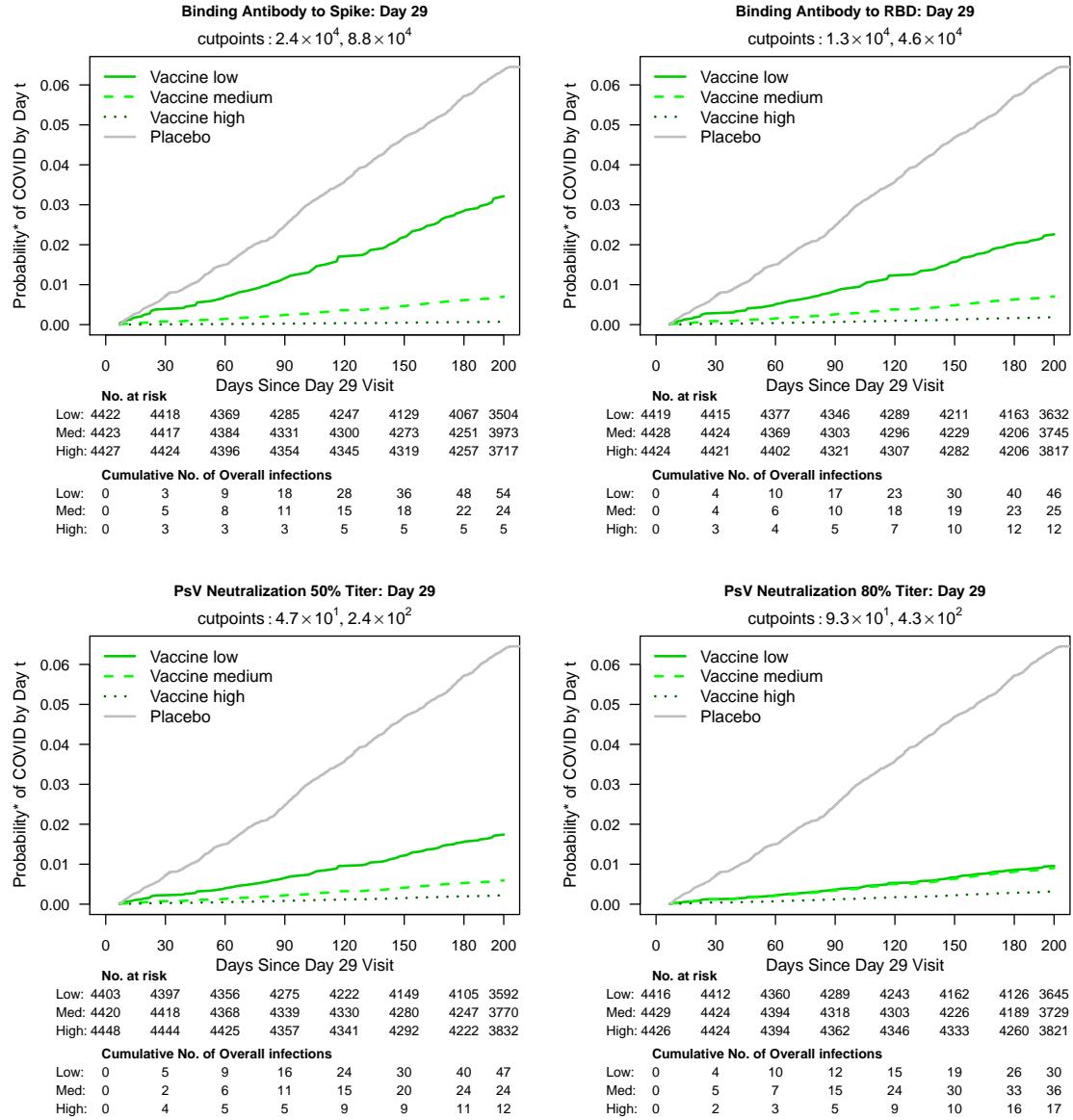


Figure 3.9: Marginalized cumulative incidence rate curves for trichotomized Day 29 markers among baseline seronegative vaccine recipients. The gray line is the overall cumulative incidence rate curve in the placebo arm.



## Chapter 4

# Univariate CoR: Nonparametric Threshold Modeling

An extension of the unadjusted nonparametric threshold-searching approach developed in (??), the covariate-adjusted TMLE-based approach developed by van der Laan, Zhang, Gilbert (in progress) is used to estimate the so-called threshold-response function  $E_X[E[Y|S \geq s, X, A = 1]|A = 1]$  for a range of thresholds  $s$ . Here,  $X$  is a set of baseline characteristics,  $A = 1$  represents the vaccine group,  $S$  is the biomarker/immune-response/correlate of interest, and  $Y$  is the indicator of COVID disease before some time point  $t_f$ . This parameter can be viewed as a causal version of the parameter  $P(Y = 1|S \geq s, A = 1)$ . Intuitively, the threshold-response at a given threshold is the expected probability of obtaining COVID disease if one experiences a marker/immune-response value above that threshold. The threshold-response function is estimated for each of the four Day 57 antibody markers, in each case adjusting for the baseline covariates: age, baseline risk score, high risk indicator, and underrepresented minority status. A parametric learner, selected via cross-validation, is used for the covariate adjustment. A number of plots and tables are reported: 1. A plot and table with risk estimates and point-wise 95% confidence intervals for the threshold-response at a grid of thresholds. 2. A plot and table with risk estimates and simultaneous 95% confidence bands for the threshold-response at a grid of thresholds.

A histogram of the marker values is superimposed on the threshold-response plots and a dashed red line is added to mark the threshold value after which no more events are observed.

#### 4.0.1 Day 57 Spike protein antibody

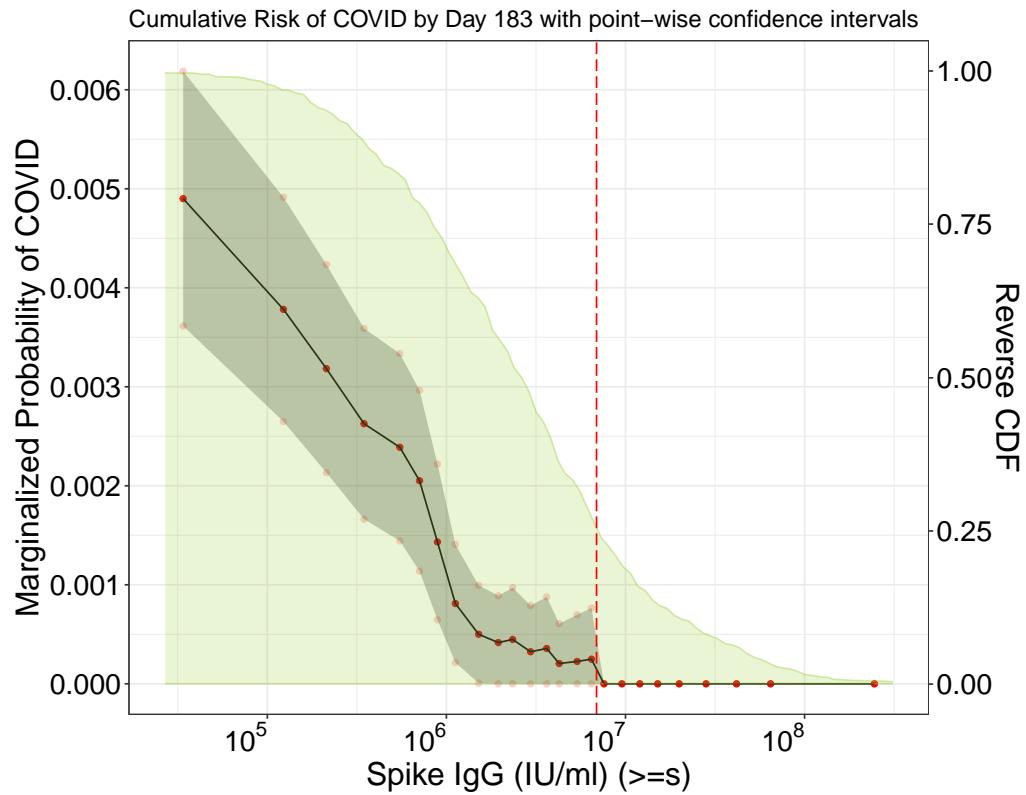


Figure 4.1: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

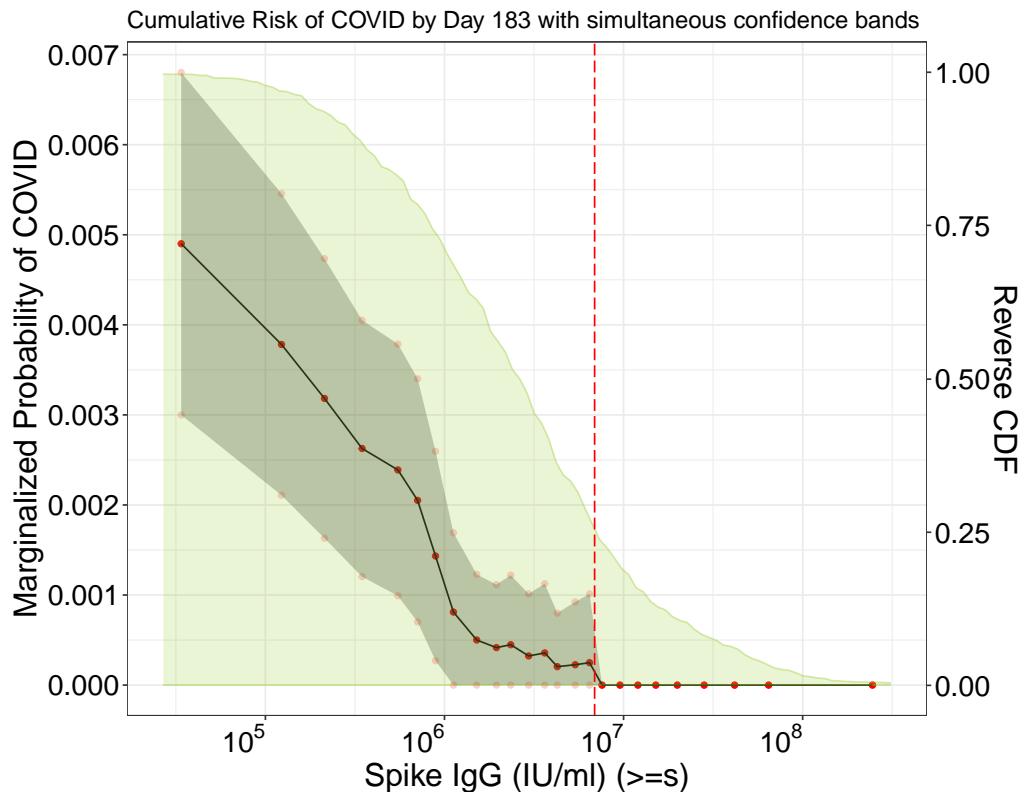


Figure 4.2: Adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

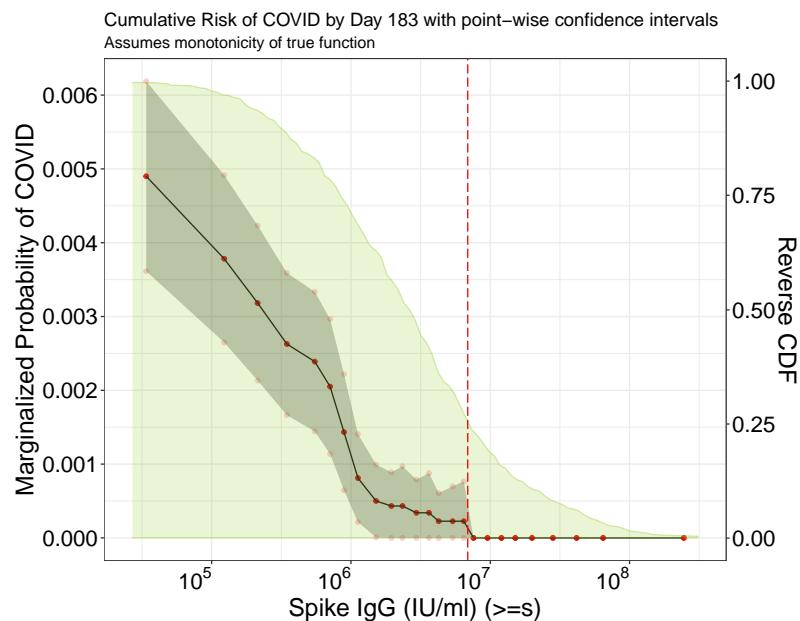


Figure 4.3: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold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

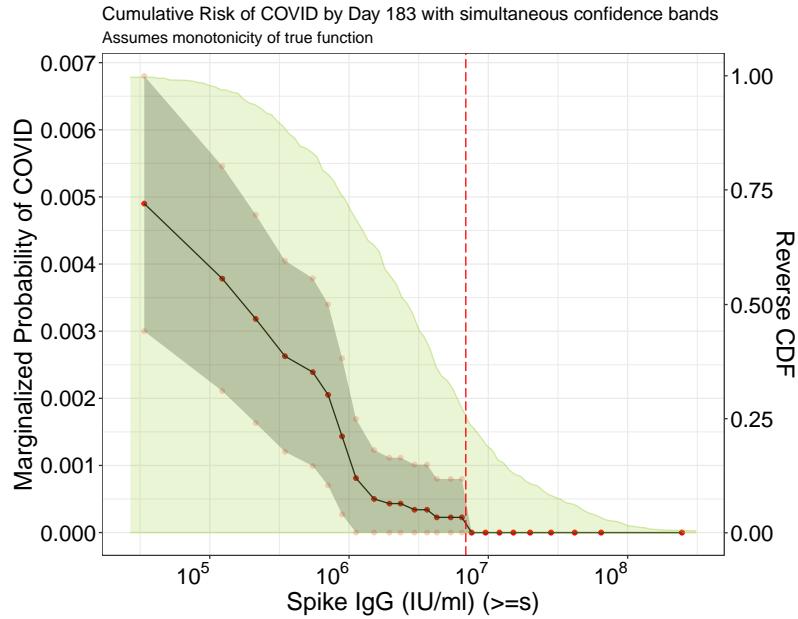


Figure 4.4: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold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

#### 4.0.2 Day 57 RBD binding antibody

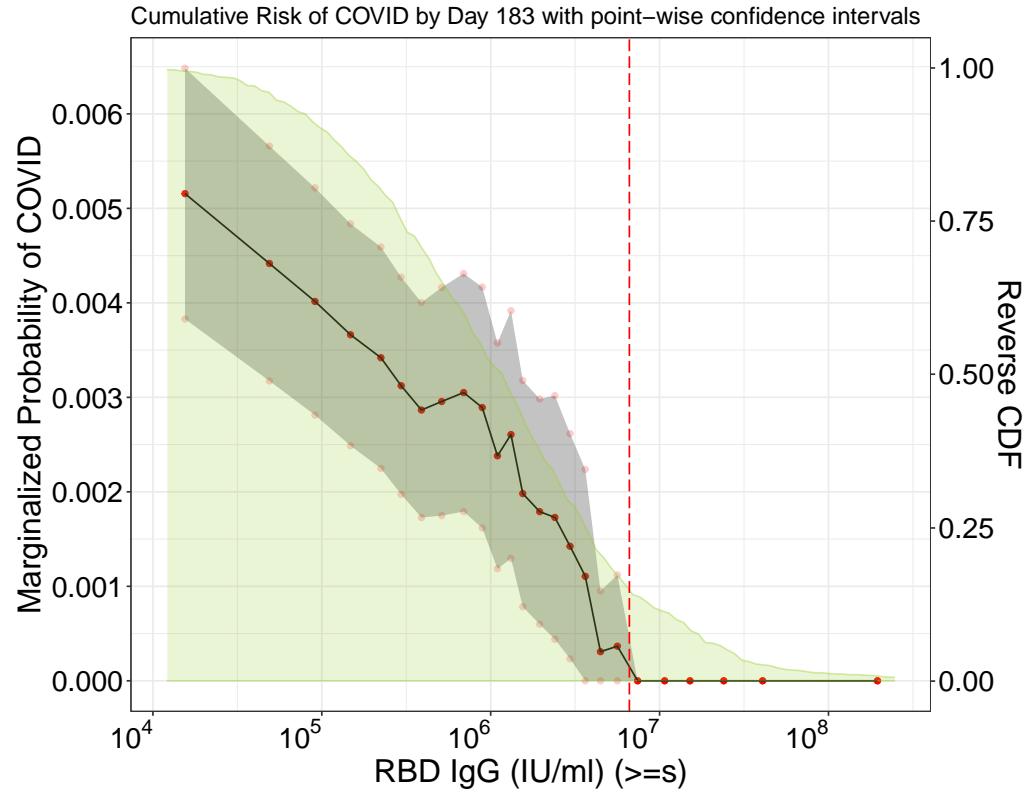


Figure 4.5: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

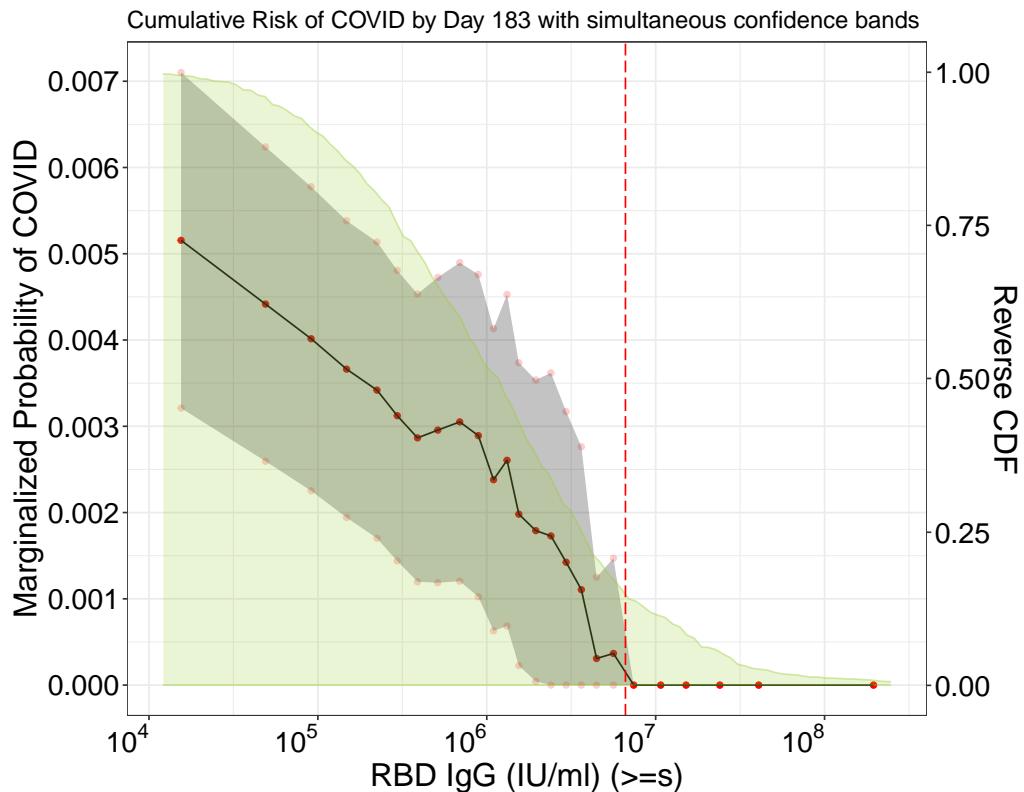


Figure 4.6: Adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

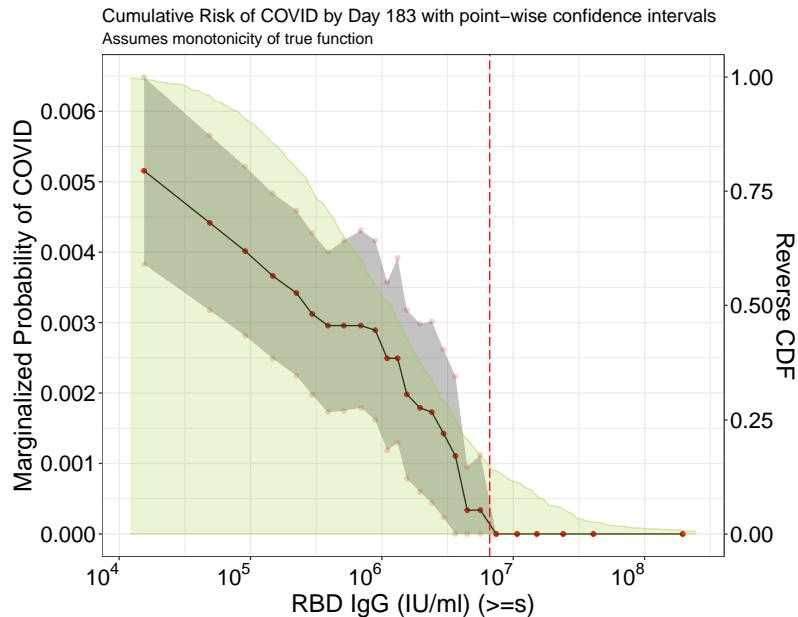


Figure 4.7: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold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

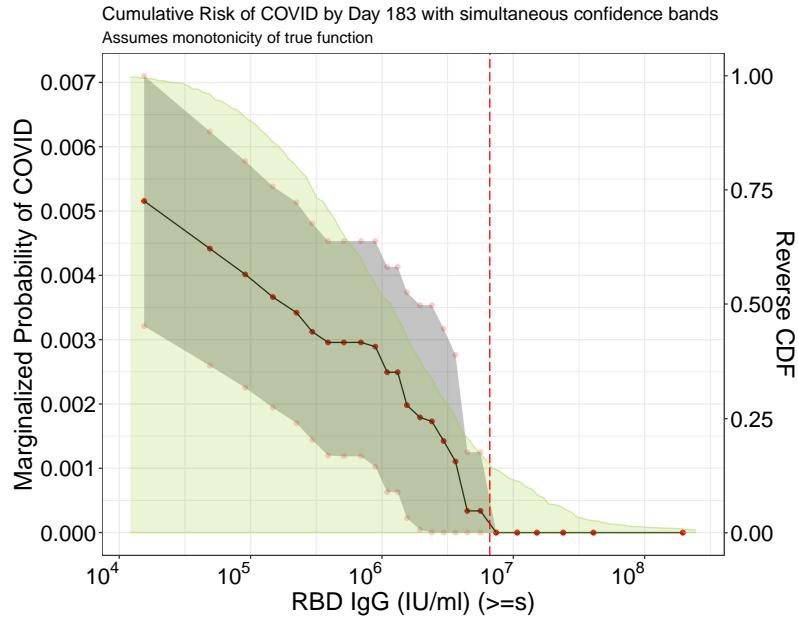


Figure 4.8: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold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

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

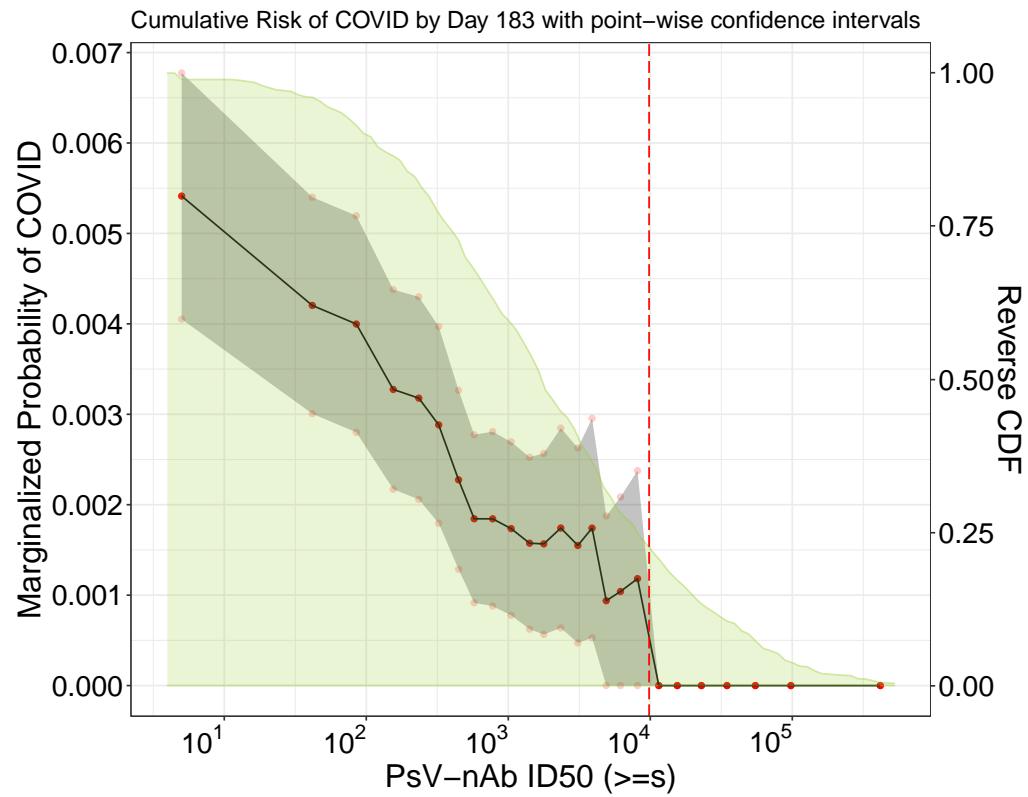


Figure 4.9: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

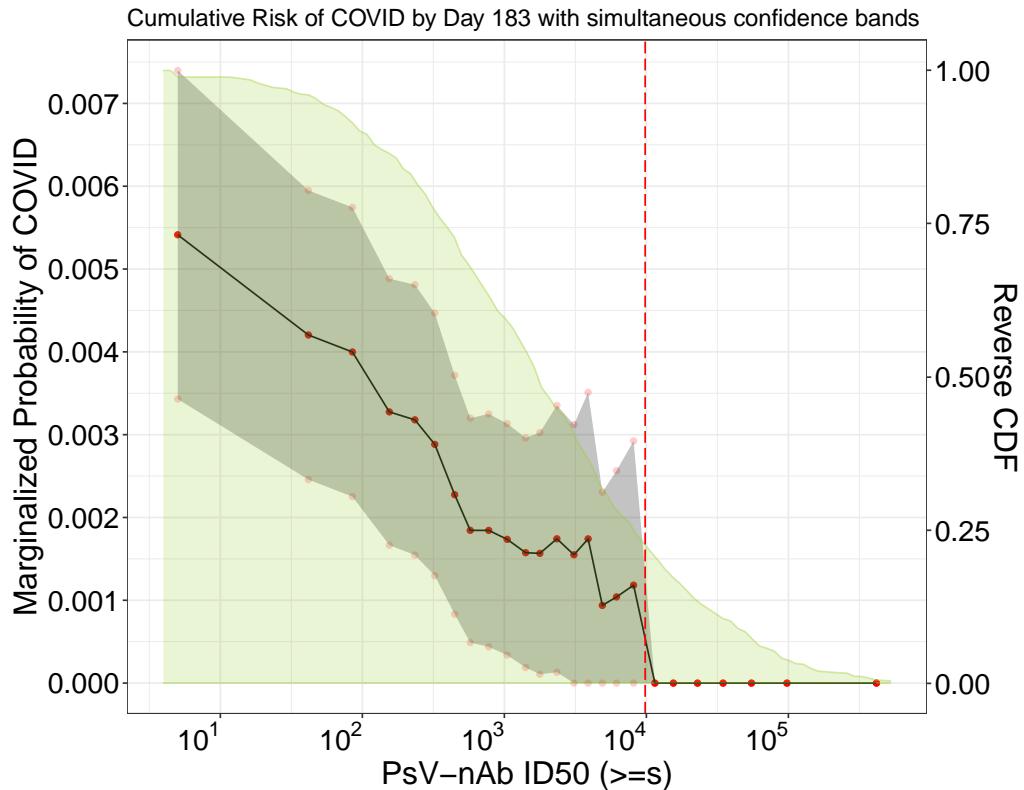


Figure 4.10: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

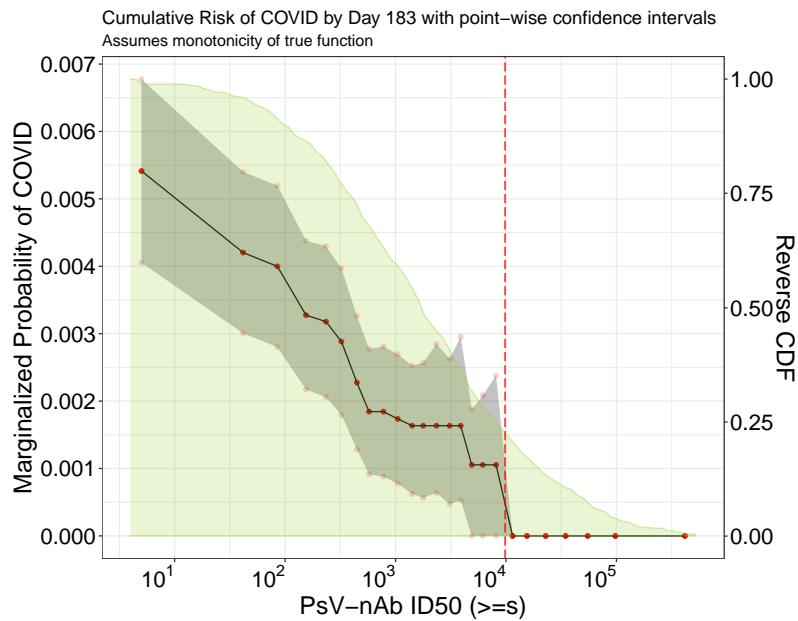


Figure 4.11: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed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

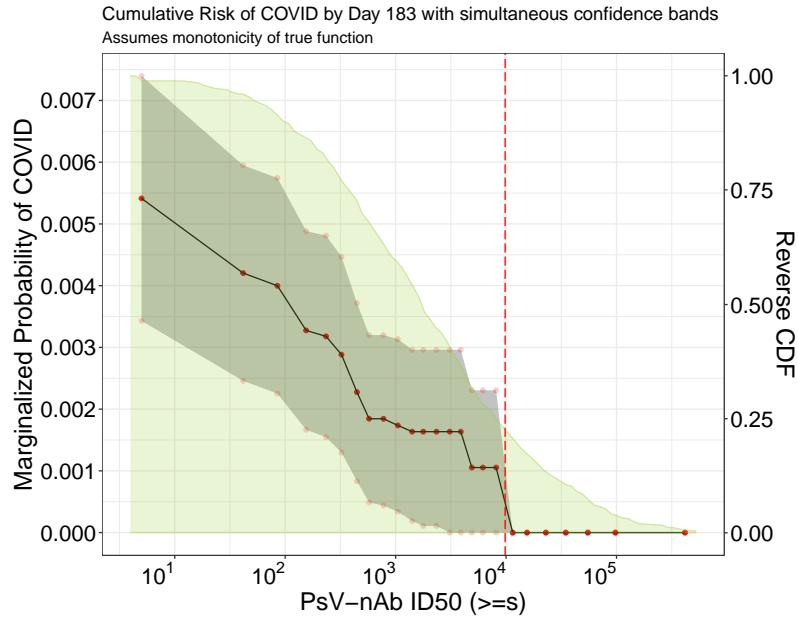


Figure 4.12: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed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

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

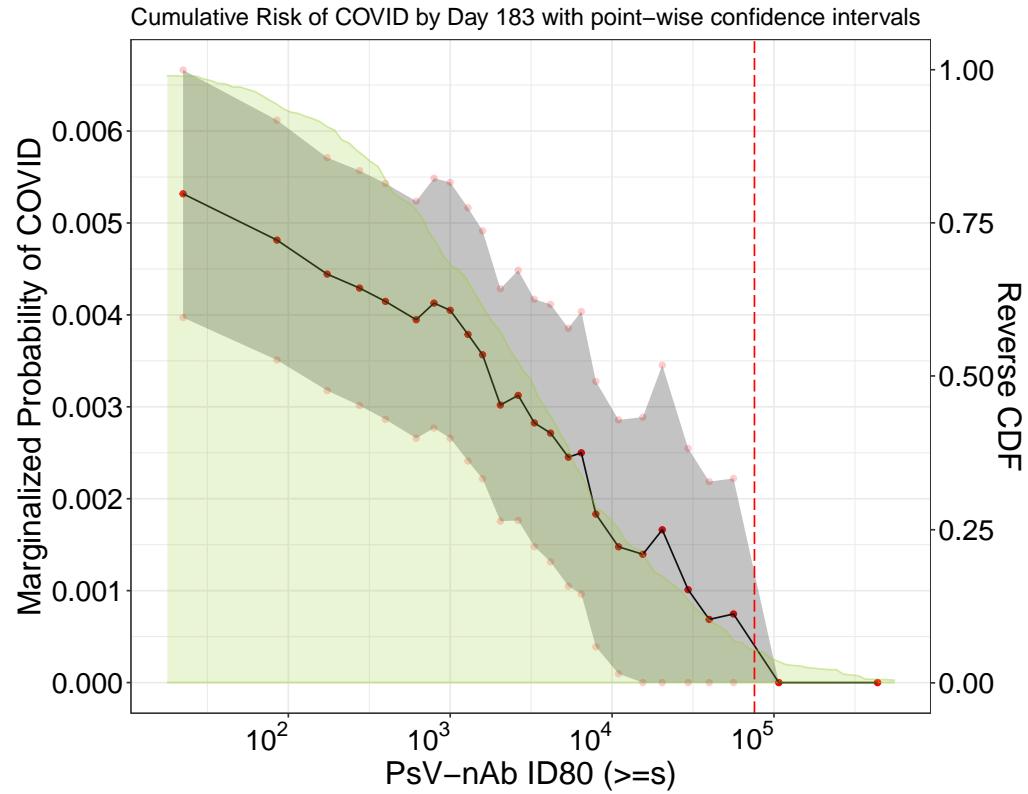


Figure 4.13: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

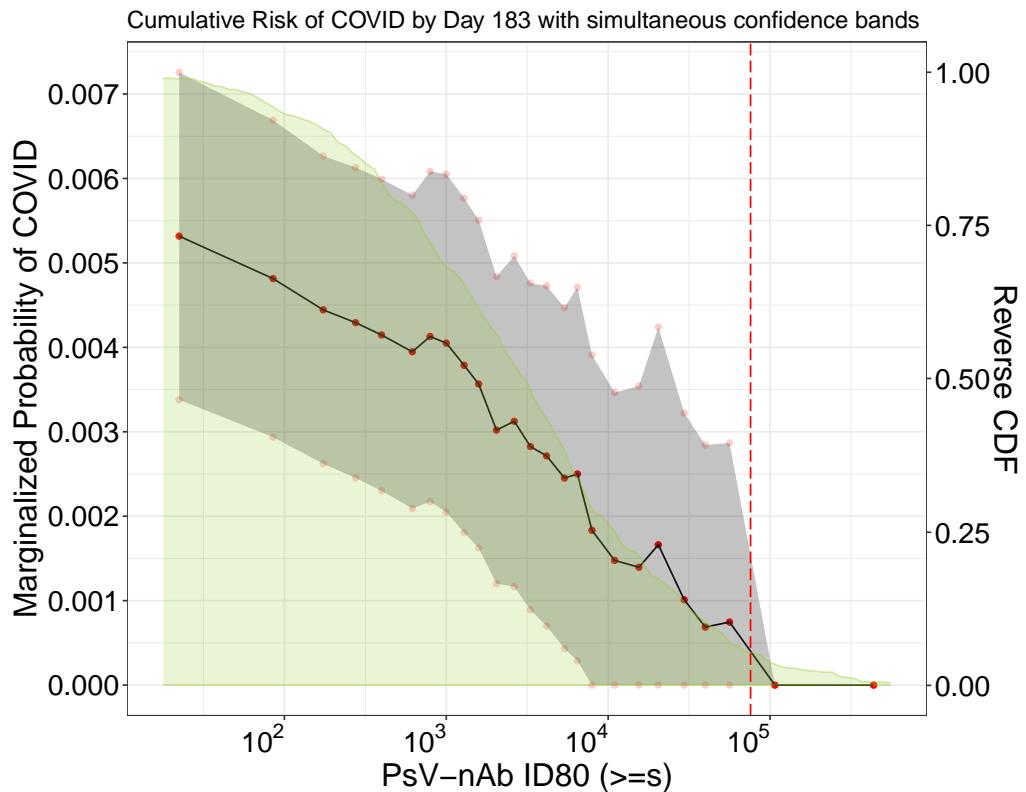


Figure 4.14: Adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

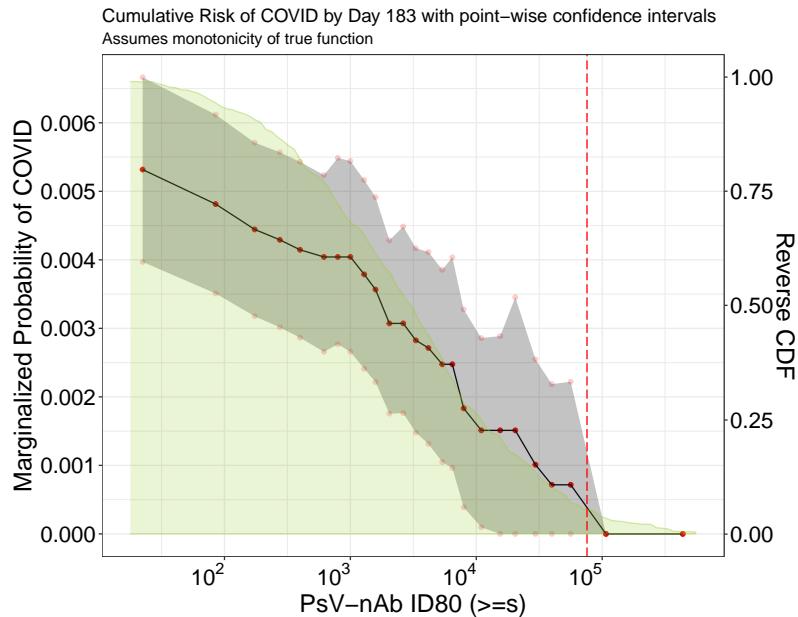


Figure 4.15: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed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

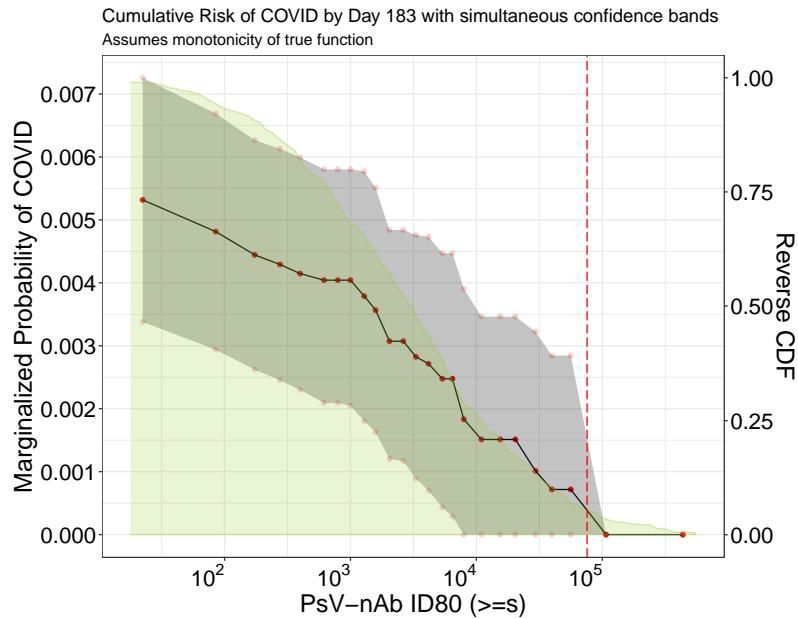


Figure 4.16: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 57 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed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

#### 4.0.5 Day 29 Spike protein antibody

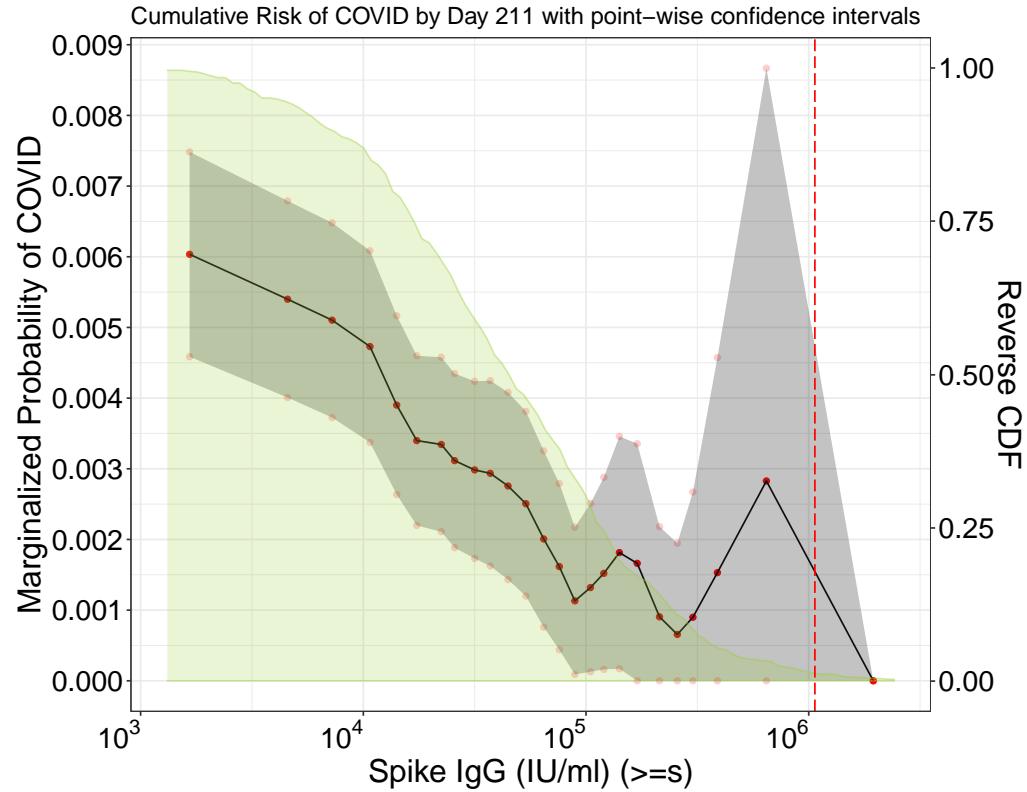


Figure 4.17: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

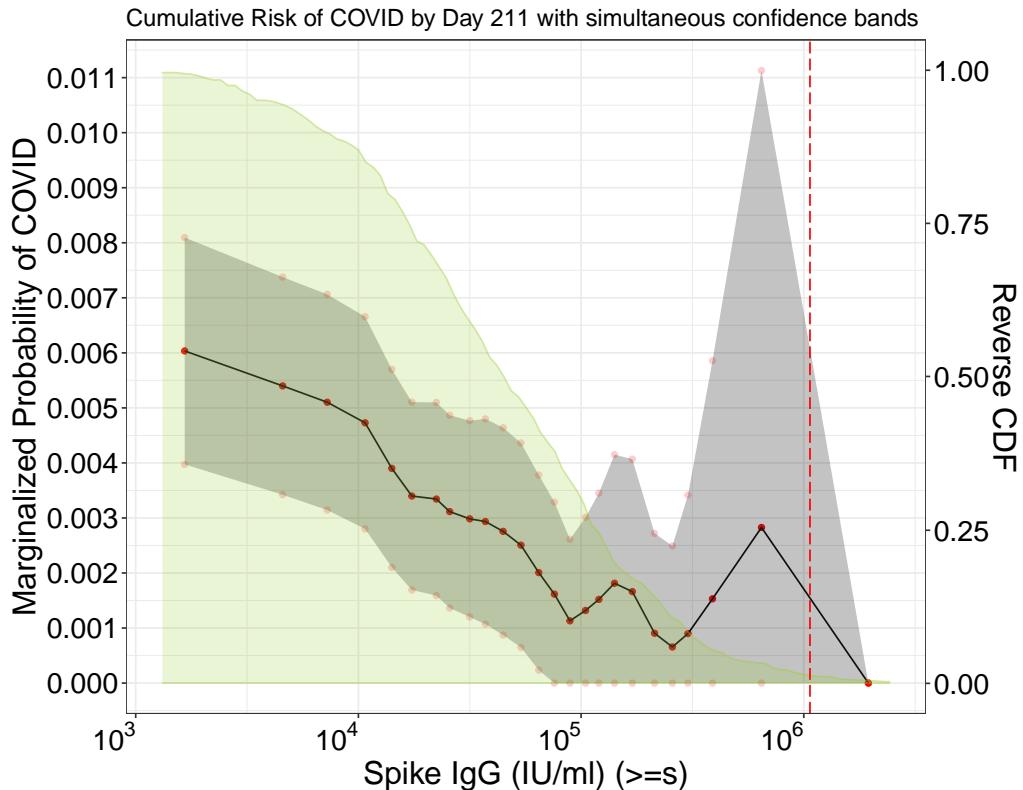


Figure 4.18: Adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

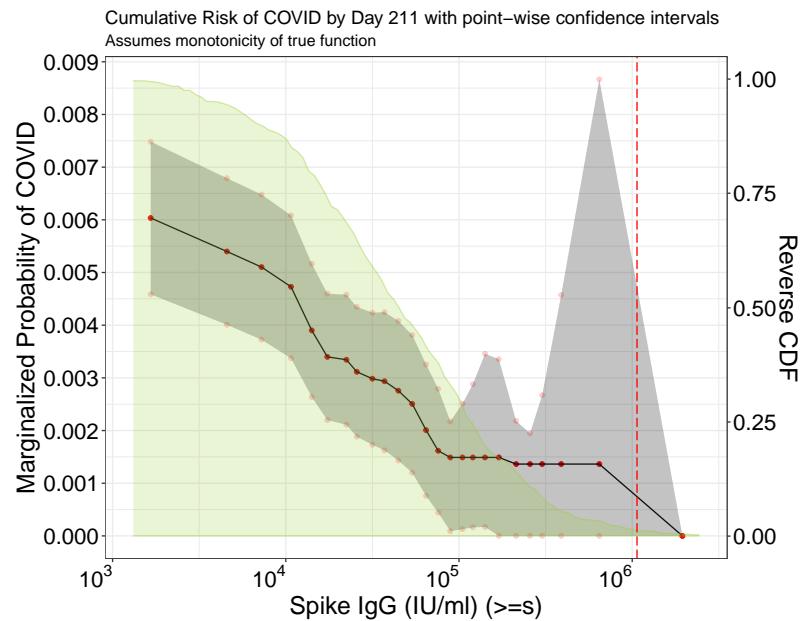


Figure 4.19: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold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

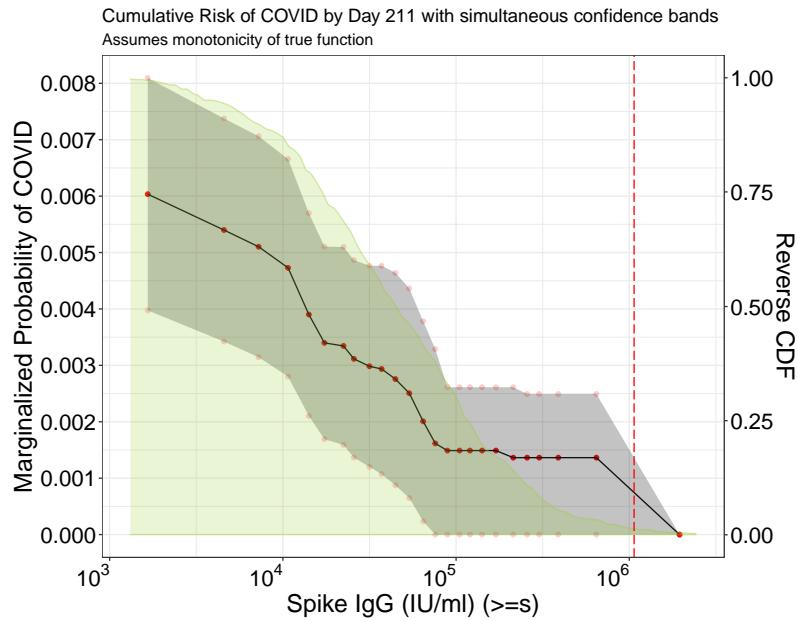


Figure 4.20: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Spike protein antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the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

#### 4.0.6 Day 29 RBD binding antibody

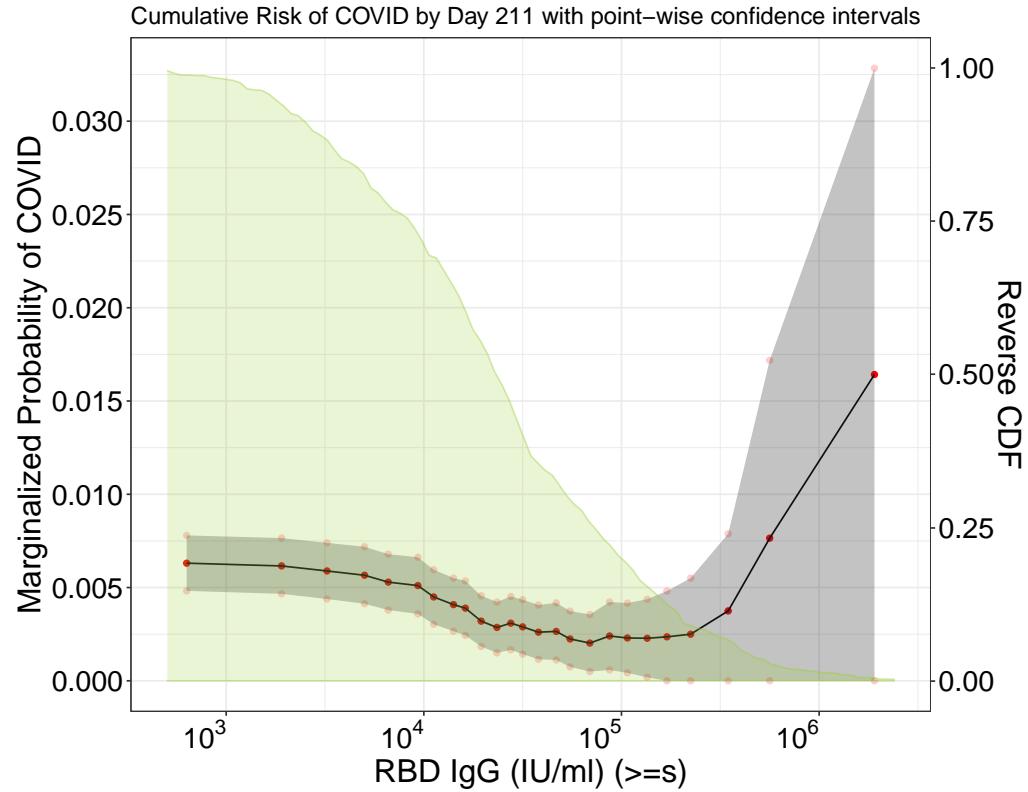


Figure 4.21: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

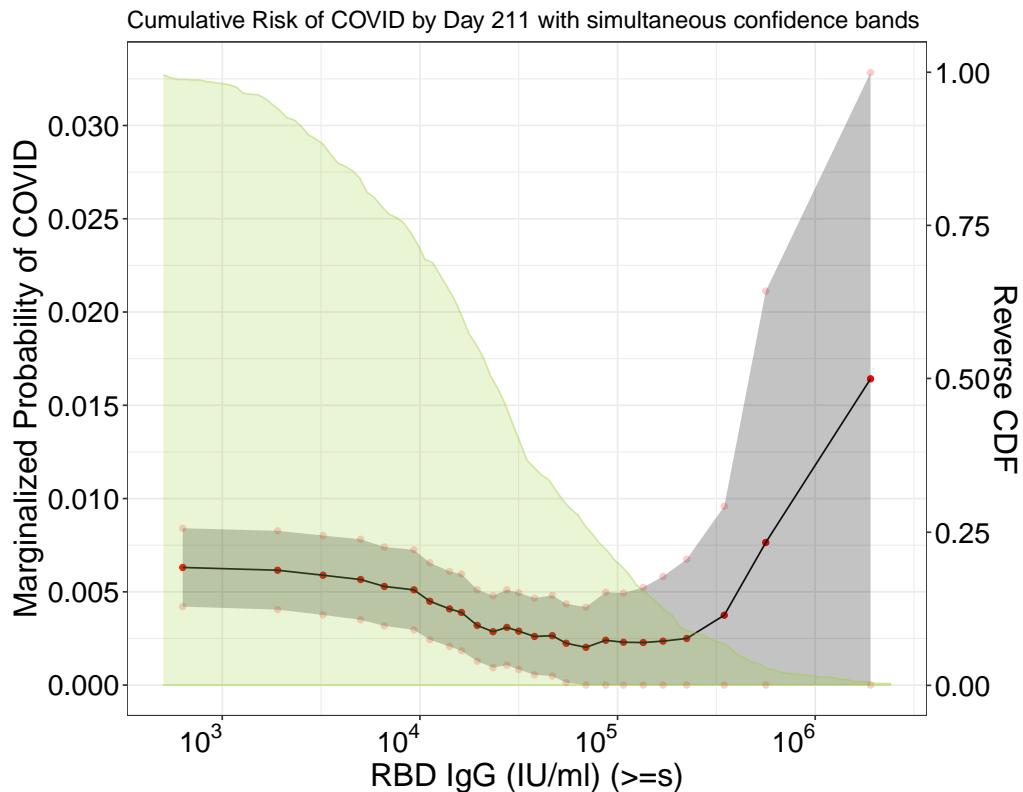


Figure 4.22: Adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

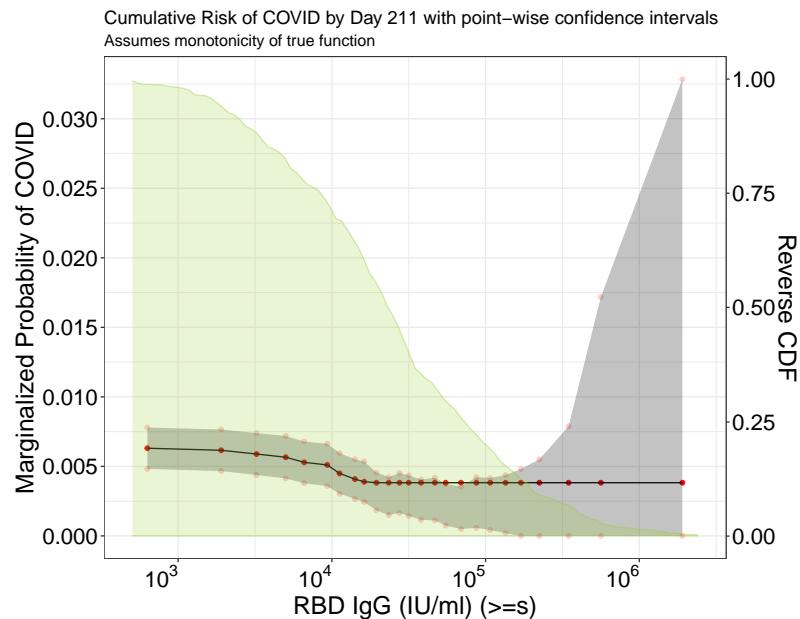


Figure 4.23: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold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

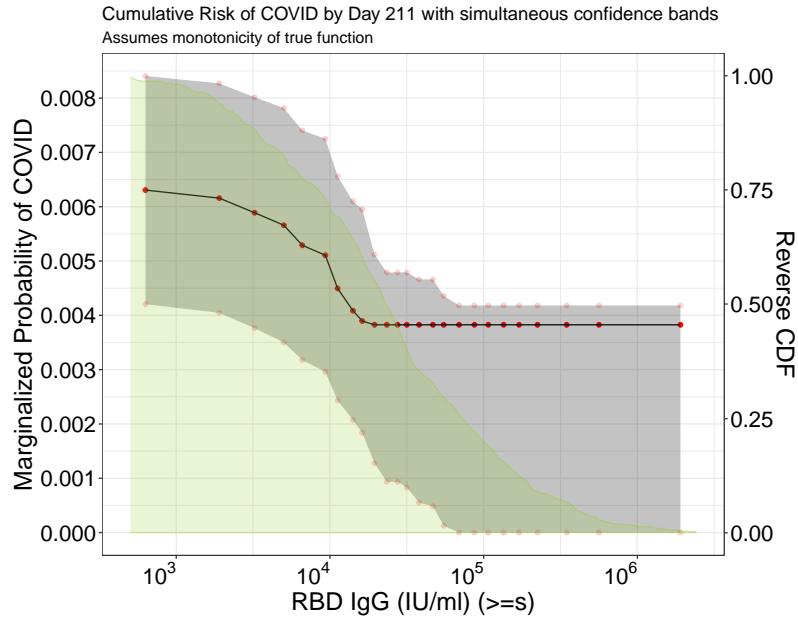


Figure 4.24: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 RBD binding antibody activity levels with simultaneous 95% confidence intervals. The dashed red line marks the threshold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

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

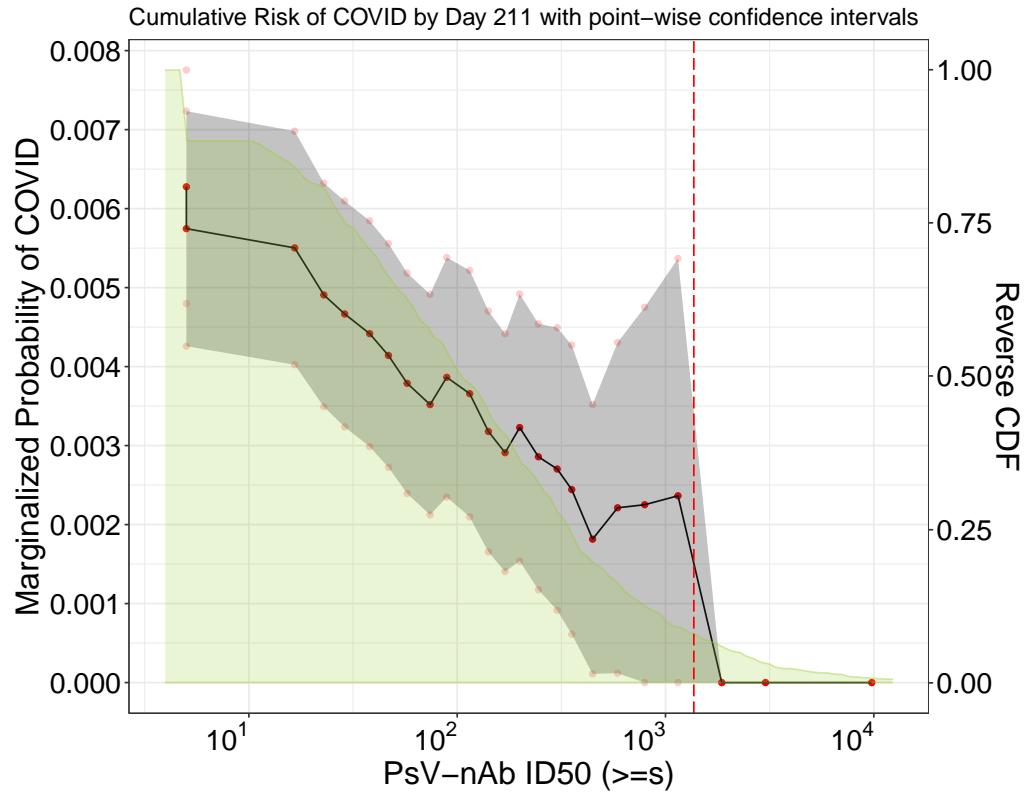


Figure 4.25: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

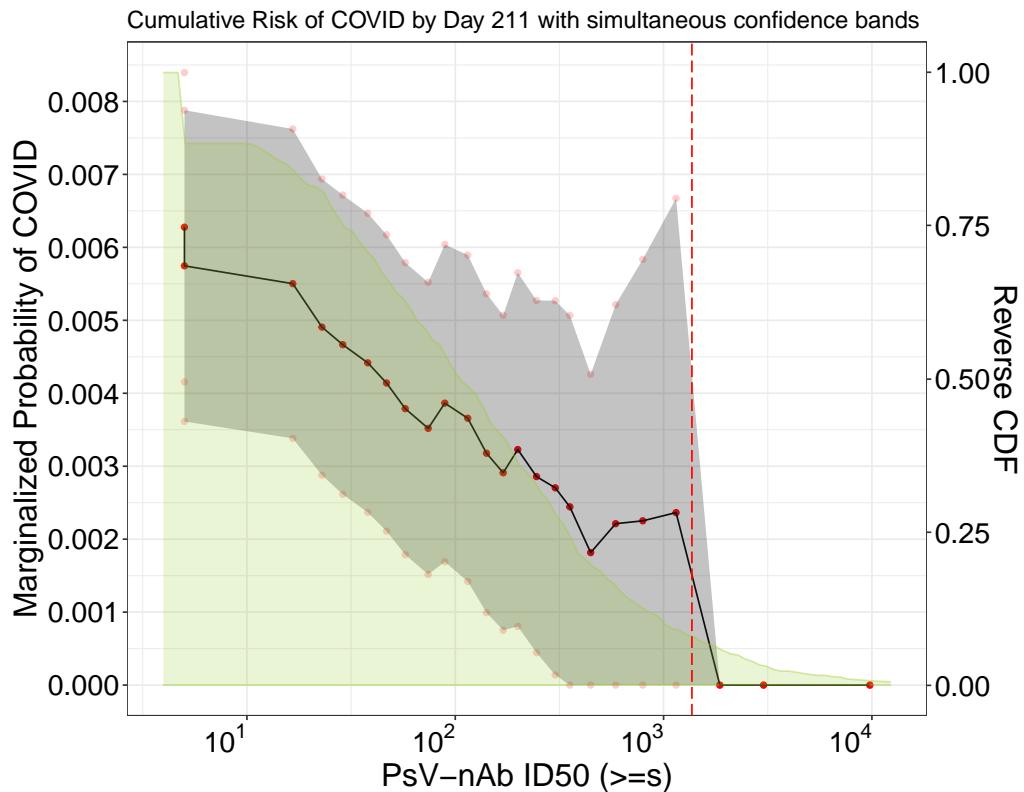


Figure 4.26: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

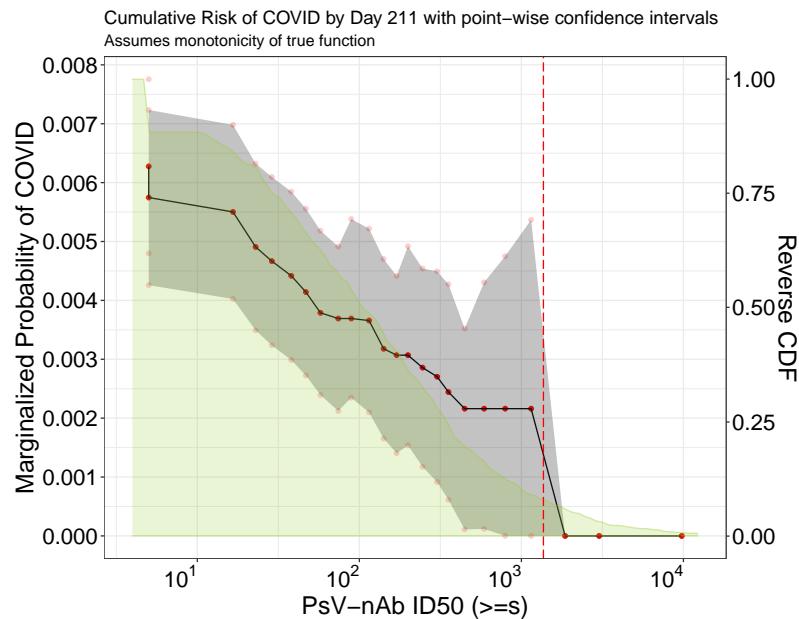


Figure 4.27: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with point-wise 95% confidence intervals. The dashed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

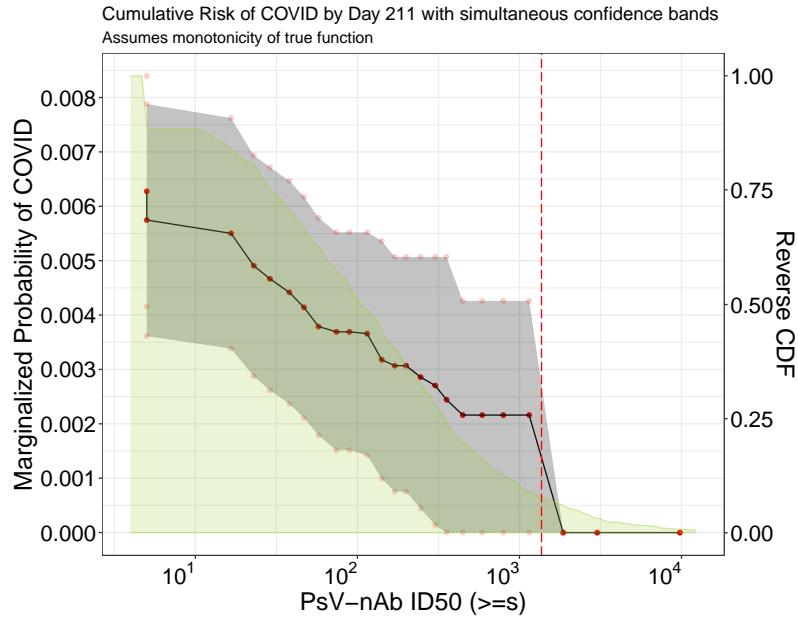


Figure 4.28: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (50% titer) activity levels with simultaneous 95% confidence intervals. The dashed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

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

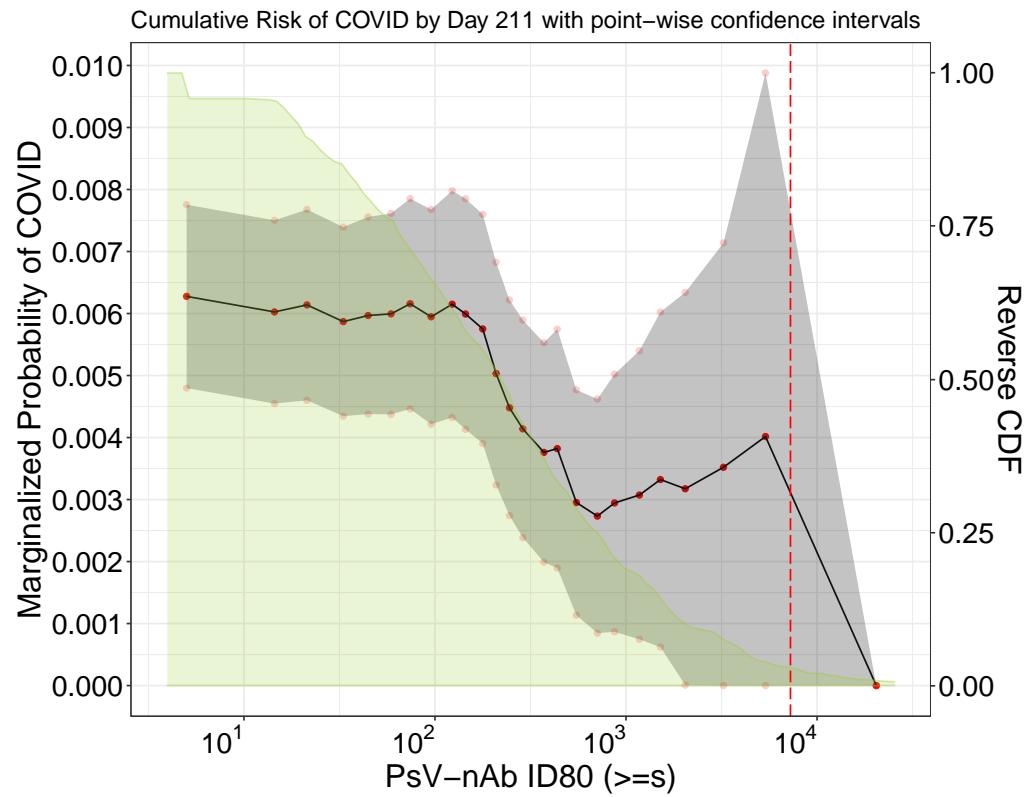


Figure 4.29: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

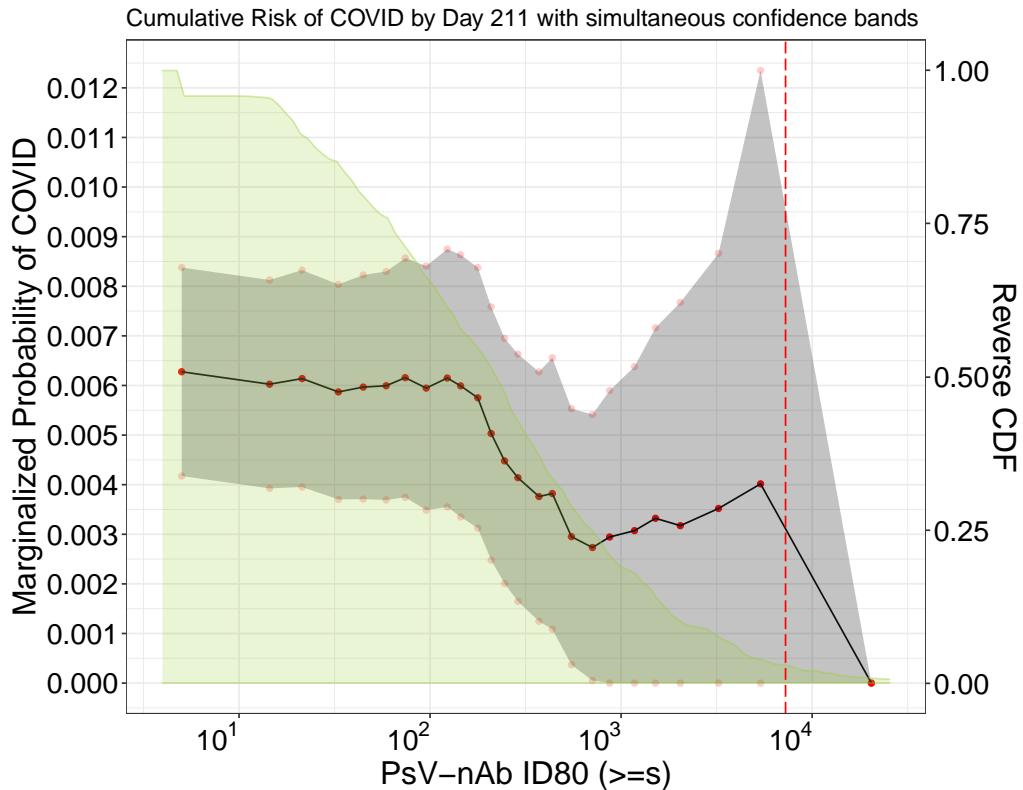


Figure 4.30: Adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence bands. The dashed red line marks the threshold after which no more COVID events are observed.

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

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

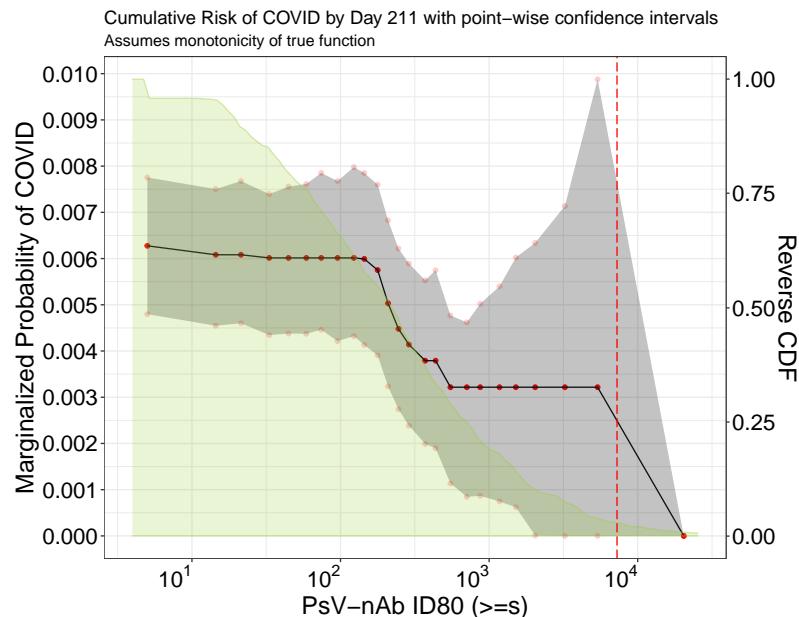


Figure 4.31: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with point-wise 95% confidence intervals. The dashed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

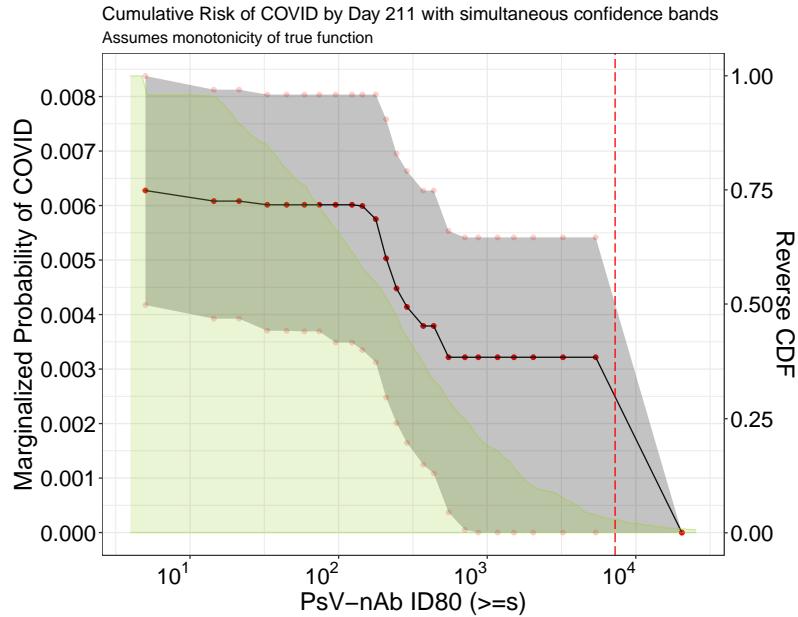


Figure 4.32: Assuming nonincreasing monotonicity of the true function, the plot shows the estimated (monotone) adjusted threshold-response function for a range of thresholds of the Day 29 Pseudo virus-neutralizing antibody (80% titer) activity levels with simultaneous 95% confidence intervals. The dashed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