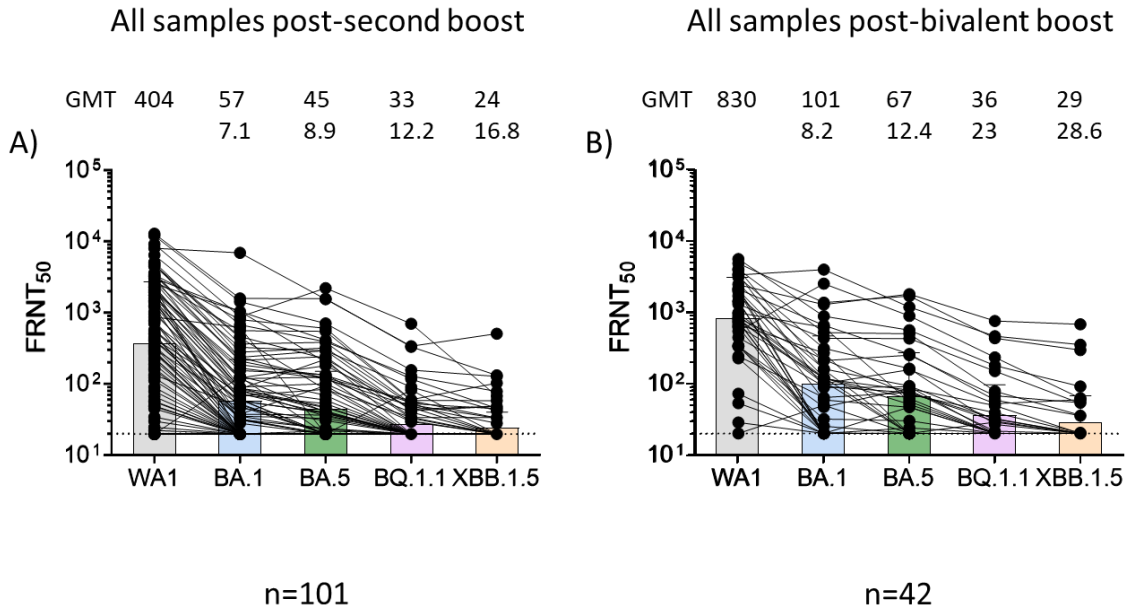
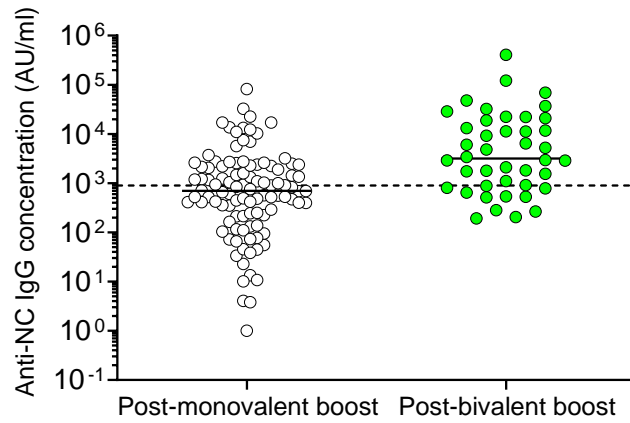


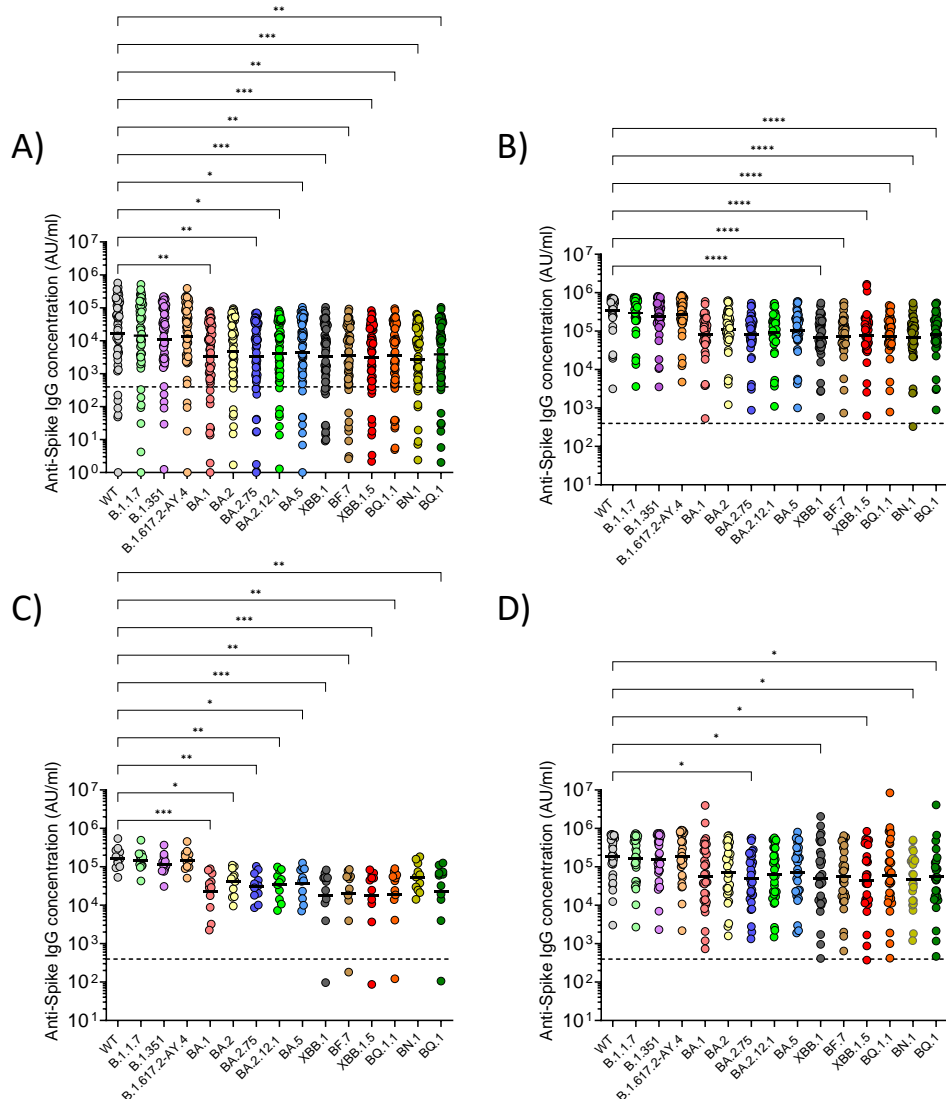
Supplementary Figure 1. Flowchart of study participants. Positive anti-nucleocapsid binding antibodies (anti-NC+). Negative anti-nucleocapsid binding antibodies (anti-NC-).



Supplementary Figure 2. Neutralizing Responses against the WA1 Strain and Omicron Subvariants. Neutralization activity against the WA1 strain and the Omicron subvariants BA.1, BA.5, BQ.1.1, and XBB.1.5 in MM patients that received a monovalent booster (Panel A) or a bivalent booster immunization (Panel B). The FRNT₅₀ geometric mean titer (GMT) of neutralizing antibodies against the WA1 strain and Omicron subvariants is shown at the top of each panel, along with the fold changes compared to WA1. The connecting lines between the variants represent matched serum samples. The horizontal dotted lines represent the limit of detection of the assay (FRNT₅₀ GMT 20), and the colored bars the FRNT₅₀ GMT.



Supplementary Figure 3. Natural exposure to SARS-CoV-2 infection was monitored by measuring nucleocapsid (NC)-specific IgG antibody titers by electrochemiluminescence assay. The horizontal dotted line represents the threshold for nucleocapsid positive signal (Anti-NC IgG concentration =900 AU/ml)¹. NC reactivity in patients who received monovalent booster immunization was 45.5%, and in the cohort of patients who received bivalent booster immunization was 73.8%.



Supplementary Figure 4. SARS-CoV-2 Spike-binding IgG antibody titers in MM patients that received a monovalent or bivalent booster immunization. A and B) Antibody titers after monovalent booster immunization that were previously unexposed to SARS-CoV-2 (Panel A) or previously exposed to SARS-CoV-2 (Panel B). C and D) Antibody titers after bivalent booster immunization that were previously unexposed to SARS-CoV-2 (Panel C) or previously exposed to SARS-CoV-2 (Panel D). Prepandemic plasma samples from healthy individuals were used to set the detection cutoff levels for SARS-CoV-2 Spike-specific IgG antibody titers. The differences between all groups were determined with the Kruskal–Wallis test with Dunn’s correction for multiple comparisons. * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, **** $p \leq 0.0001$.

Supplementary Table 1a: Univariate linear regression - Serum from WA1 Monovalent vaccinated participants tested against WA1 virus

| Covariate | Level | N | Log WA1 | |
|---------------------------|----------|----|---------------------|-----------------|
| | | | B (95% CI) | B P-value |
| Race | Black | 39 | 0.17 (-0.63-0.97) | 0.670 |
| | Other | 59 | - | - |
| Sex | Female | 47 | -0.44 (-1.22-0.34) | 0.272 |
| | Male | 51 | - | - |
| Age <=65 | Yes | 31 | 0.76 (-0.08-1.59) | 0.076 |
| | No | 66 | - | - |
| Prior LOT (>2) | Yes | 32 | -0.74 (-1.58-0.11) | 0.088 |
| | No | 60 | - | - |
| IgG <=400 | Yes | 21 | -0.19 (-1.14-0.77) | 0.703 |
| | No | 77 | - | - |
| antiCD38 | Yes | 20 | -0.98 (-1.93--0.03) | 0.044 |
| | No | 78 | - | - |
| Len maintenance | Yes | 28 | 0.84 (-0.01-1.69) | 0.054 |
| | No | 70 | - | - |
| antiBCMA | Yes | 3 | -3.03 (-5.23--0.83) | 0.007 |
| | No | 95 | - | - |
| Prior SARS CoV-2 exposure | Positive | 44 | 2.39 (1.76-3.02) | <.001 |
| | Negative | 54 | - | - |

Supplementary Table 1b: - Univariate linear regression - Serum from WA1/BA.5
Bivalent vaccinated participants tested against WA1 virus

| Covariate | Level | N | Log WA1 | |
|---------------------------|----------|----|---------------------|--------------|
| | | | B (95% CI) | B P-value |
| Race | Black | 19 | -0.48 (-1.35-0.38) | 0.271 |
| | Other | 18 | - | - |
| Sex | Female | 20 | 0.26 (-0.59-1.11) | 0.545 |
| | Male | 18 | - | - |
| Age <=65 | Yes | 8 | 0.67 (-0.36-1.69) | 0.202 |
| | No | 30 | - | - |
| Prior LOT (>2) | Yes | 9 | -0.61 (-1.60-0.38) | 0.225 |
| | No | 28 | - | - |
| IgG <=400 | Yes | 10 | 0.26 (-0.70-1.23) | 0.595 |
| | No | 28 | - | - |
| antiCD38 | Yes | 13 | -0.87 (-1.72--0.01) | 0.048 |
| | No | 25 | - | - |
| Len maintenance | Yes | 7 | 0.71 (-0.37-1.79) | 0.198 |
| | No | 31 | - | - |
| antiBCMA | Yes | 2 | 0.67 (-1.23-2.57) | 0.488 |
| | No | 36 | - | - |
| Prior SARS CoV-2 exposure | Positive | 28 | 0.22 (-0.75-1.18) | 0.661 |
| | Negative | 10 | - | - |

Supplementary Table 2a: Univariate logistic regression – Serum from WA1 Monovalent vaccinated participants tested against XBB.1.5 virus

| | | XBB_1_5=Positive | | |
|---------------------------|----------|------------------|------------------------|----------------|
| | | ----- | | |
| | | - | | |
| Covariate | Level | N | Odds Ratio (95% CI) | OR P- value |
| Race | Black | 39 | 2.56 (0.88-7.45) | 0.084 |
| | Other | 59 | - | - |
| Sex | Female | 47 | 0.39 (0.12-1.20) | 0.100 |
| | Male | 51 | - | - |
| Age <=65 | Yes | 31 | 1.63 (0.56-4.80) | 0.372 |
| | No | 66 | - | - |
| Prior LOT (>2) | Yes | 32 | 1.40 (0.48-4.12) | 0.541 |
| | No | 60 | - | - |
| IgG <=400 | Yes | 21 | 1.16 (0.33-4.01) | 0.816 |
| | No | 77 | - | - |
| antiCD38 | Yes | 20 | 0.20 (0.03-1.64) | 0.135 |
| | No | 78 | - | - |
| Len maintenance | Yes | 28 | 1.46 (0.48-4.43) | 0.501 |
| | No | 70 | - | - |
| antiBCMA | Yes | 3 | - | - |
| | No | 95 | - | - |
| Prior SARS CoV-2 exposure | Positive | 44 | - | - |
| | Negative | 54 | - | - |

Supplementary Table 2b: - Univariate logistic regression – Serum from WA1/BA.5 Bivalent vaccinated participants tested against XBB.1.5 virus

| | | XBB_1_5=Positive | | |
|---------------------------|--------------|-------------------------|--------------------------------|------------------------|
| | | ----- | | |
| | | - | | |
| Covariate | Level | N | Odds Ratio (95% CI) | OR P- value |
| Race | Black | 19 | 1.20 (0.29-4.94) | 0.800 |
| | Other | 18 | - | - |
| Sex | Female | 20 | 1.11 (0.27-4.55) | 0.880 |
| | Male | 18 | - | - |
| Age <=65 | Yes | 8 | 3.29 (0.65-16.67) | 0.151 |
| | No | 30 | - | - |
| Prior LOT (>2) | Yes | 9 | 0.60 (0.10-3.51) | 0.574 |
| | No | 28 | - | - |
| IgG <=400 | Yes | 10 | 1.07 (0.22-5.21) | 0.932 |
| | No | 28 | - | - |
| antiCD38 | Yes | 13 | 0.32 (0.06-1.79) | 0.196 |
| | No | 25 | - | - |
| Len maintenance | Yes | 7 | 4.57 (0.82-25.46) | 0.083 |
| | No | 31 | - | - |
| antiBCMA | Yes | 2 | - | - |
| | No | 36 | - | - |
| Prior SARS CoV-2 exposure | Positive | 28 | 5.00 (0.55-45.39) | 0.153 |
| | Negative | 10 | - | - |

Supplementary References

- 1 Chang, A. *et al.* Antibody binding and neutralization of live SARS-CoV-2 variants including BA.4/5 following booster vaccination of patients with B-cell malignancies. *Cancer Res Commun* **2**, 1684-1692, doi:10.1158/2767-9764.crc-22-0471 (2022).