Supplementary information

Microfluidic immuno-serology assay revealed a limited diversity of protection against COVID-19 in patients with altered immunity

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with two-tailed Mann-Whitney test. (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, **** $P < 0.0001$). ns, not significant.

ICU, Intensive Care Unit; ICU-Transfer, patients later transferred to the ICU; ICU-Admit, patients directly admitted to the ICU.

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(* *P* < 0.05, ** *P* < 0.01, *** *P* < 0.001, **** *P* < 0.0001). ns, not significant. Visit 1, two weeks after the first-dose vaccination; Visit 2, 0–3 days before the second-dose of vaccination; Visit 3, two weeks after the second-dose of vaccination.

**Figure S16.** Correlation matrices of functional protein groups and SARS-CoV-2 serology panel at Visit 1 and Visit 3 in each patient or donor group. (a) Correlations in healthy donors. (b) Correlations in Non-Heme cancer patients. (c) Correlations in autoimmune patients with B cell depletion therapy. Only significant correlations (<0.05) are represented as dots. Pearson’s correlation coefficients from comparisons of protein groups and IgG antibody concentrations across all the patients in specific group are visualized by color intensity. Protein groups and antibodies were listed as the original order. Visit 1, two weeks after the first-dose vaccination; Visit 3, two weeks after the second-dose of vaccination.
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Table S1. Basic demographics of patients/donors evaluated in this study.

| Subject | Heme COVID+ (n = 28) | Non-Heme Cancer COVID+ (n = 12) | Non-Heme Cancer pre- and post-Vax (n = 71) | Autoimmune (B cell depleted) pre- and post-Vax (n = 193) | Healthy Donor pre- and post-Vax (n = 64) |
|---------|----------------------|-------------------------------|---------------------------------|--------------------------------------------|-----------------------------|
|         | Mean age (SD), y     |                               |                                 |                                            |                             |
| Male    | 62 (15)              | 57 (16)                       | 47 (12)                        | 45 (14)                                   | 46 (20)                     |
| Female  | 62 (15)              | 57 (16)                       | 47 (12)                        | 45 (14)                                   | 46 (20)                     |
| Male    | 5 (42)               |                               | 4 (22)                         | 4 (25)                                    | 8 (53)                      |
| Female  | 5 (42)               |                               | 4 (22)                         | 4 (25)                                    | 8 (53)                      |
| Male    | 18 (69)              |                               | 14 (78)                        | 12 (75)                                   | 8 (47)                      |
| Female  | 8 (31)               |                               | 7 (56)                         | 12 (75)                                   | 9 (53)                      |

\(n\) represents the number of samples from each specific patient/donor group.
Table S2. The number of individuals with SARS-CoV-2 IgG antibody response larger than cut-off value in each patient/donor group.

| Subject                        | Home COVID+ (n ≥ 26) | Non-Home COVID+ (n ≤ 12) | Non-Home Cancer pre- and post-Vax (n ≥ 71) | Autoimmune (B cell depleted) pre- and post-Vax (n ≥ 193) | Healthy Donor pre- and post-Vax (n ≤ 64) |
|--------------------------------|----------------------|--------------------------|---------------------------------------------|----------------------------------------------------------|------------------------------------------|
|                                | Pre-Vax (n=26)       | Visit 1 (n=21)           | Visit 2 (n=21)                              | Visit 3 (n=21)                                            | Pre-Vax (n=10)                           |
|                                |                      |                         | Visit 1 (n=10)                              | Visit 2 (n=10)                                            | Visit 3 (n=10)                           |
|                                |                      |                         |                               |                                                          |                                          |
| Spike (wild type, BAU/ml)      | 10 (36)              | 7 (58)                  | 1 (8)                                      | 9 (50)                                                   | 12 (75)                                  |
|                                |                      |                         |                               |                                                          |                                          |
| RBD (wild type, µg/ml)         | 9 (19)               | 7 (58)                  | 0 (0)                                      | 1 (11)                                                   | 9 (66)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| Spike (B.1.1.7, µg/ml)         | 14 (54)              | 7 (58)                  | 4 (22)                                     | 2 (72)                                                   | 12 (75)                                  |
|                                |                      |                         |                               |                                                          |                                          |
| RBD (B.1.1.7, µg/ml)           | 5 (19)               | 6 (50)                  | 1 (6)                                      | 2 (11)                                                   | 5 (28)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| Spike (B.1.351, µg/ml)         | 14 (54)              | 8 (57)                  | 5 (33)                                     | 5 (28)                                                   | 8 (44)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| RBD (B.1.351, µg/ml)           | 0 (0)                | 6 (50)                  | 1 (6)                                      | 2 (11)                                                   | 3 (17)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| Spike (P.1, µg/ml)             | 9 (35)               | 8 (57)                  | 2 (11)                                     | 3 (16)                                                   | 6 (33)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| RBD (P.1, µg/ml)               | 3 (12)               | 6 (50)                  | 1 (6)                                      | 2 (11)                                                   | 4 (22)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| Spike (B.1.617.2, µg/ml)       | 14 (54)              | 7 (58)                  | 4 (22)                                     | 6 (33)                                                   | 12 (75)                                  |
|                                |                      |                         |                               |                                                          |                                          |
| RBD (B.1.617.2, µg/ml)         | 3 (12)               | 4 (33)                  | 1 (6)                                      | 1 (5)                                                    | 3 (17)                                   |
|                                |                      |                         |                               |                                                          |                                          |
| Nucleocapsid, BAU/ml           | 13 (50)              | 10 (83)                 | 0 (0)                                      | 0 (0)                                                    | 0 (0)                                    |
|                                |                      |                         |                               |                                                          |                                          |
| Response rate of SARS-CoV-2 IgG bAbs (> 83 µg/ml or > 50 BAU/ml), n (%) |

n represents the number of samples from each specific patient/donor group.

Table S5. The value of Kd and Bmax for each protein or antibody calculated using hyperbola equation in a non-linear regression model.

| Panel                  | B_{max} | K_{d}   | Panel                  | B_{max} | K_{d}   |
|------------------------|---------|---------|------------------------|---------|---------|
| Angiopoietin-2         | 14.13   | 0.4902  | IL-1b                  | 12.17   | 0.05796 |
| Follistatin            | 13.09   | 1.082   | IL-22                  | 15.75   | 2.859   |
| GMCSF                  | 12.79   | 0.3752  | IL-13                  | 16.84   | 5.301   |
| TNF-α                  | 12.93   | 1.026   | IL-21                  | 14.13   | 0.5607  |
| MIP-1b                 | 13.41   | 0.04363 | IL-32                  | 13.96   | 1.037   |
| IFN-γ                  | 15.4    | 0.5326  | IL-16                  | 14.31   | 0.0896  |
| PDGF-AB                | 19.57   | 1.312   | IL-7                   | 13.49   | 0.2333  |
| PDGF-BB                | 15.28   | 0.4169  | TGF-b1                 | 13.75   | 0.0686  |
| IL-6                   | 13.23   | 0.202   | TGF-b2                 | 16.5    | 0.1103  |
| IL-8                   | 12.7    | 0.05484 | GRZB                   | 14.41   | 0.4943  |
| IL-10                  | 12.09   | 1.952   | RANTES                 | 12.72   | 0.1119  |
| IL-17A                 | 13.74   | 1.115   | IL-15                  | 13.73   | 0.06644 |
| G-CSF                  | 14.13   | 0.05208 | IL-2                   | 12.36   | 0.9377  |
| Resistin               | 15.86   | 0.0702  | MCSF                   | 14.45   | 0.004836|
| Lipocalin-2            | 12.69   | 0.2125  | IL-12p70               | 18.73   | 8.724   |
| vWF                    | 13.59   | 0.1284  | MCP-1                  | 12.93   | 0.02396 |
| VEGF                   | 13.89   | 0.9005  | CD40L                  | 12.93   | 1.026   |
| IL-9                   | 12.12   | 2.245   | SARS-CoV-2 IgG Ab (µg/ml) | 10.55  | 0.00039 |
| Spike-IgG (BAU/ml)     | 10.92   | 0.06131 | Nucleocapsid-IgG (BAU/ml) | 11.29  | 0.02593 |