Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

African) SARS-CoV-2 variant [preprint]. *bioRxiv*. https://doi.org/10.1101/2021.02.20.432046. Accessed June 30, 2021.
7. Khoury DS, Cromer D, Reynaldi A, et al. Neutralizing antibody levels are highly predictive of immune protection from symptomatic SARS-CoV-2 infection. *Nat Med*. 2021;27:1205–1211.
8. Mulligan MJ, Lyke KE, Kitchin N, et al. Phase I/II study of COVID-19 RNA vaccine BNT162b1 in adults. *Nature*. 2020;586:589–593.
9. Anft M, Blazquez-Navarro A, Paniskaki K, et al. SARS-CoV-2–reactive cellular and humoral immunity in hemodialysis population. *Kidney Int*. 2021;99:1489–1490.
10. Westhoff TH, Seibert FS, Anft M, et al. Correspondence on 'SARS-CoV-2 vaccination in rituximab-treated patients: evidence for impaired humoral but inducible cellular immune response' [e-pub ahead of print]. *Ann Rheum Dis*. https://doi.org/10.1136/annrheumdis-2021-220756. Accessed July 18, 2021.

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Neutralizing antibody response against variants of concern after vaccination of dialysis patients with BNT162b2

To the editor: We and others showed high seroconversion rates after BNT162b2 mRNA vaccination in patients on hemodialysis, but still significantly lower rates as compared to those of healthy controls.[1–3] Variants of concern (VOCs) such as B.1.351 (beta variant) or B.1.617.2 (delta variant) partially escape from neutralizing antibodies (NAbs) and will probably replace wild-type severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or the B.1.1.7 (alpha) variant with increasing immunity in the population, induced by natural infection or vaccination. Wall *et al.*[4] recently revealed a 4- to 6-fold reduction in vaccine-induced peak NAbs against VOCs B.1.351 and B.1.617.2 in healthy controls compared with wild-type SARS-CoV-2 and the B.1.1.7 variant. Immune-compromised populations such as dialysis patients mounting lower NAbs might become most sensitive to VOCs.

We investigated the neutralization of variants B.1.1.7 and B.1.351 in SARS-CoV-2 infection–based experiments on VeroE6 cells using sera taken 3 weeks after the second BNT162b2 dose in a dual-center cohort of 30 patients receiving maintenance hemodialysis and 18 healthy controls. Only individuals with seroconversion, defined as detectable anti-spike(S)1 antibodies and >30% inhibition in a surrogate neutralization test, were included.

Seropositivity rate was 24 of 30 (80%) in dialysis patients having a median age of 78 years (interquartile range [IQR]: 69–88 years; Supplementary Table S1). The median S1-IgG index was 6 (IQR: 1–19) and the median inhibition in the surrogate neutralization test was 55% (IQR: 32%–78%; Figure 1a and b). All 24 seropositive dialysis patients had NAbs against the B.1.1.7 strain with a median ID_{50} (i.e., serum dilution that inhibits 50% of the infectivity) of 160 (IQR: 50–320; Figure 1c). However, NAbs against the VOC B.1.351 were only detected in 15 of 24 patients (63%). With a median of 15 (IQR: 0–20), the ID_{50} was significantly lower as compared to that of the B.1.1.7 strain ($P < 0.001$; Figure 1c). In contrast, all 18 healthy controls showed neutralizing activity against both B.1.1.7 and B.1.351, with significantly higher ID_{50} values compared with those of dialysis patients, respectively (Figure 1c). The S1-IgG index of dialysis patients correlated well with the ID_{50} of both B.1.1.7 and B.1.351 (Figure 1d). Of note, even dialysis patients with low anti-S1–IgG antibody levels had detectable neutralization against B.1.1.7, whereas this was not the case for B.1.351 in the same patients (Figure 1d).

Overall, this study suggests that a large proportion of dialysis patients may not be adequately protected against VOCs with vaccination regimens currently applied in the healthy general population. Even if SARS-CoV-2–specific antibodies are detectable by commercially available tests, neutralization of VOCs may be insufficient to protect against infection. Further immunization strategies of dialysis patients seem to be urgently indicated, especially in regions with rapidly increasing VOC prevalence.

DATA AVAILABILITY STATEMENT

The data underlying this article will be shared on reasonable request to the corresponding author.

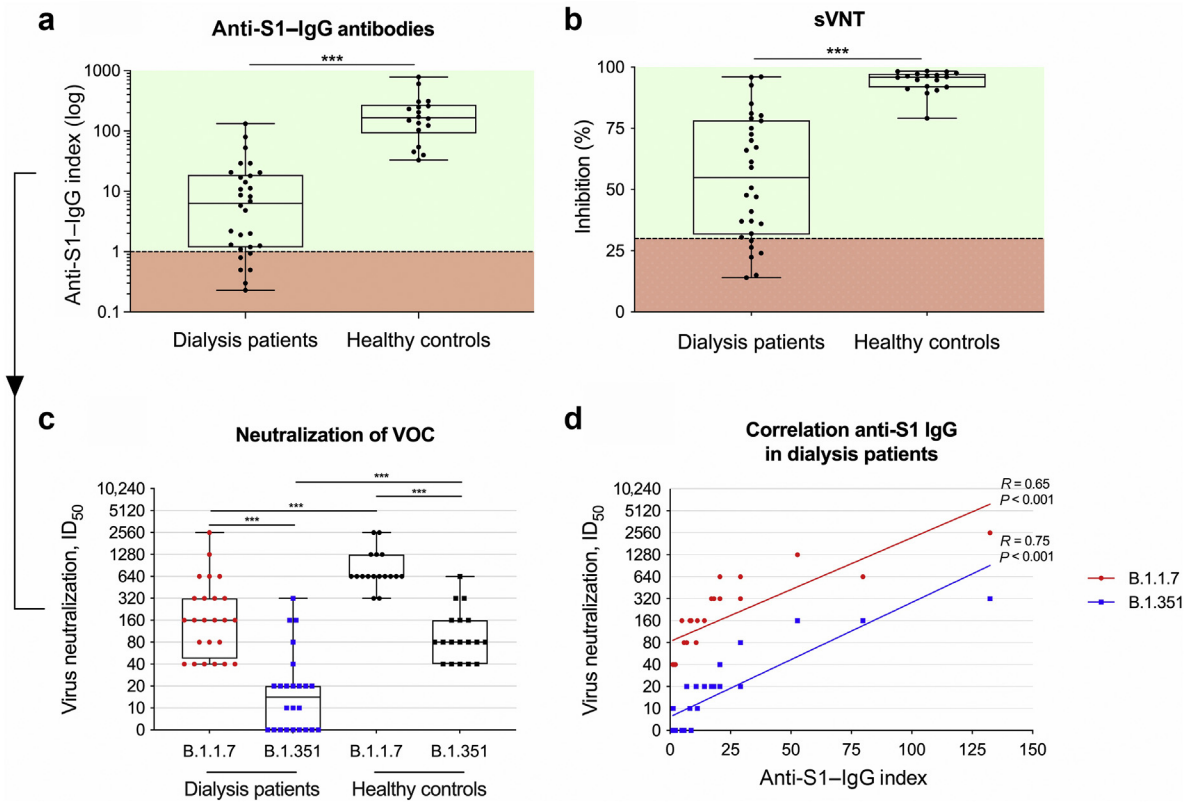

Figure 1 | Neutralization of B.1.1.7 and B.1.351 after BNT162b2 mRNA vaccination of dialysis patients and healthy controls. (**a**) Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) IgG antibody titers in dialysis patients and healthy controls were measured 3 weeks after the second BNT162b2 mRNA dose and are represented logarithmically as an anti-S1–IgG index. The dashed black line represents the cutoff for detection. A semiquantitative index of <1 was classified as negative, and a value of ≥ 1 as positive. (**b**) Antibody-mediated inhibition of the SARS-CoV-2 receptor-binding domain–angiotensin-converting enzyme 2 interaction in dialysis patients and healthy controls. Values were normalized to a negative control (see Supplementary Methods) and are given as percentages. A cutoff of $<30\%$ binding inhibition (dashed black line) indicates the limit of detection of this test. (**c**) Titers of neutralizing antibodies against the B.1.1.7 and B.1.351 variants were determined in a SARS-CoV-2 infection assay using VeroE6 target cells and serial 2-fold serum dilutions. Shown are only values obtained with sera from dialysis patients and healthy controls who exceeded the cutoffs of (**a**) and (**b**), respectively. Neutralization titers refer to the serum dilution that inhibits 50% of the infectivity (ID_{50}). Neutralization of different strains was assessed using the nonparametric *t* test with Well's correction or the Mann-Whitney *U* test. (**d**) The correlation between the anti-S1–IgG index and the neutralization of the respective SARS-CoV-2 strain was examined in dialysis patients using Spearman's correlation analysis. ***$P < 0.001$. sVNT, surrogate neutralization test; VOC, variant of concern.

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The results presented in this paper have not been published previously in whole or part.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Supplementary Study Design.
Supplementary Methods.
Table S1. Baseline characteristics of dialysis patients and healthy controls.
Supplementary References.

1. Ikizler TA, Coates PT, Rovin BH, Ronco P. Immune response to SARS-CoV-2 infection and vaccination in patients receiving kidney replacement therapy. *Kidney Int*. 2021;99:1275–1279.
2. Speer C, Göth D, Benning L, et al. Early humoral responses of hemodialysis patients after COVID-19 vaccination with BNT162b2. *Clin J Am Soc Nephrol*. 2021;16:1073–1082.
3. Yanay NB, Freiman S, Shapira M, et al. Experience with SARS-CoV-2 BNT162b2 mRNA vaccine in dialysis patients. *Kidney Int*. 2021;99:1496–1498.
4. Wall EC, Wu M, Harvey R, et al. Neutralising antibody activity against SARS-CoV-2 VOCs B.1.617.2 and B.1.351 by BNT162b2 vaccination. *Lancet*. 2021;397:2331–2333.

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Reasons for COVID-19 vaccination hesitancy in hemodialysis patients

To the editor: We read the excellent series of reports and editorial on the effectiveness of vaccination in patients on dialysis.[1] We would concur that although vaccination is less effective in these high-risk patients it remains critical to ensure our at-risk population remains as protected as possible. We would draw attention to the other significant challenge in such a population, namely hesitancy toward vaccination in patients on maintenance dialysis. Vaccine hesitancy is defined by the World Health Organization as a delay in acceptance or refusal of safe vaccines despite availability of vaccine services. We have completed vaccination of our large cohort of patients on renal replacement therapy and have found that while a substantial portion agreed to vaccination, hesitancy still exists in approximately 3% (12 of 378) of our patients. Various reasons for declining the vaccination by these patients are detailed in Table 1. Because others have reported even higher rates of unvaccinated patients on dialysis (and between 8% and 41% may display vaccine hesitancy, depending on ethnicity, sex, age, and deprivation[2]), this represents a significant risk to the remaining cohort of patients and staff as we approach considering booster vaccinations this winter to minimize further COVID-19 disease spikes. A mandatory vaccination is a potential solution for minimizing the risk but could be considered a controversial approach that may interfere with patients' autonomy and choice. The nephrology community needs to provide recommendations that involve a universal thoughtful process.

Table 1 | Reasons given by patients on hemodialysis for not being vaccinated with any of the available COVID-19 vaccines

No. of patients	Reason
2	"Their choice"—no faith in the COVID-19 vaccines.
1	Noncompliant with all treatments and did not wish additional treatment.
1	Refused to give reason for not accepting a COVID-19 vaccine.
1	Verbally aggressive to staff when offered and not prepared to give reasons.
1	Believes COVID-19 is just flu and so will not have it—does not take flu vaccine.
1	Refused to consider COVID-19 vaccine and does not want to be approached. Again a patient who has general noncompliance.
3	We are young and we believe the media reports that it is all overhyped and we are not convinced of the benefit.
1	Recovery from a recent long-term illness but may consider it.
1	Stated they are allergic to vaccines, but this is not substantiated.

COVID-19, coronavirus disease 2019.

1. Ikizler TA, Coates PT, Rovin BH, Ronco P. Immune response to SARS-CoV-2 infection and vaccination in patients receiving kidney replacement therapy. *Kidney Int*. 2021;99:1275–1279.
2. Razai M, Chaudhry UAR, Doerholt K, et al. COVID-19 vaccination hesitancy. *BMJ*. 2021;373:283–285.

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Humoral response after 3 doses of the BNT162b2 mRNA COVID-19 vaccine in patients on hemodialysis

To the editor: Dialysis patients are at increased risk of severe coronavirus disease 2019 (COVID-19) infections.[1] Therefore, they are considered as being a priority population for COVID-19 vaccination. Because immune responses against vaccines are considerably reduced in this population,[2] a vaccination strategy including 3 doses of vaccine has been recommended for dialysis patients. However, few data exist concerning humoral response to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccination with 3 doses of BNT162b2 (Pfizer–BioNTech) in patients on hemodialysis (HD). Moreover, about 90% of HD patients exhibit antibody positivity after 2