Table S1. PRISMA 2020 abstract checklist.

| Section and Topic | Item # | Checklist item                                                                 | Reported (Yes/No) |
|-------------------|--------|-------------------------------------------------------------------------------|-------------------|
| **TITLE**         |        |                                                                               |                   |
| Title             | 1      | Identify the report as a systematic review.                                  | Lines 4-6         |
| **BACKGROUND**    |        |                                                                               |                   |
| Objectives        | 2      | Provide an explicit statement of the main objective(s) or question(s) the review addresses. | Lines 4-6         |
| **METHODS**       |        |                                                                               |                   |
| Eligibility criteria | 3   | Specify the inclusion and exclusion criteria for the review.                  | Lines 8-10        |
| Information sources | 4   | Specify the information sources (eg, databases, registers) used to identify studies and the date when each was last searched. | Lines 7-8         |
| Risk of bias      | 5      | Specify the methods used to assess risk of bias in the included studies.       | Lines 11-13       |
| Synthesis of results | 6   | Specify the methods used to present and synthesise results.                   | Lines 11-14       |
| **RESULTS**       |        |                                                                               |                   |
| Included studies  | 7      | Give the total number of included studies and participants and summarize relevant characteristics of studies. | Lines 12-13       |
| Synthesis of results | 8   | Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (ie which group is favored). | Lines 13-18       |
| **DISCUSSION**    |        |                                                                               |                   |
| Limitations of evidence | 9   | Provide a brief summary of the limitations of the evidence included in the review (eg, study risk of bias, inconsistency and imprecision). | Lines 23-24       |
| Interpretation    | 10     | Provide a general interpretation of the results and important implications.    | Lines 21-23       |
| **OTHER**         |        |                                                                               |                   |
| Funding           | 11     | Specify the primary source of funding for the review.                        | Line 1            |
| Registration      | 12     | Provide the register name and registration number.                            | Line 7            |
| Section and Topic | Item # | Checklist item | Location where item is reported |
|-------------------|--------|----------------|----------------------------------|
| **TITLE**         |        |                |                                  |
| Title             | 1      | Identify the report as a systematic review. | Lines 48-49 and in Methods |
| **ABSTRACT**      |        |                |                                  |
| Abstract          | 2      | See the PRISMA 2020 for Abstracts checklist. | Supplemental Materials |
| **INTRODUCTION**  |        |                |                                  |
| Rationale         | 3      | Describe the rationale for the review in the context of existing knowledge. | Introduction |
| Objectives        | 4      | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Introduction (Lines 48-51) and Methods section (Lines 75-81) |
| **METHODS**       |        |                |                                  |
| Eligibility criteria | 5  | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Methods section (Lines 60-73) |
| Information sources | 6  | Specify all databases, registers, websites, organizations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | Methods section (Lines 60-73) |
| Search strategy   | 7      | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Supplemental Table S1 |
| Selection process | 8      | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | Methods section (Lines 60-73) |
| Data collection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | Methods section (Lines 83-92) |
| Data items        | 10a    | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (eg, for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | Methods section (Lines 83-92 and Lines 60-73) |
|                   | 10b    | List and define all other variables for which data were sought (eg, participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | Methods section (Lines 83-92 and Lines 60-73) |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | Methods section (Lines 94-101) |
| Effect measures   | 12     | Specify for each outcome the effect measure(s) (eg, risk ratio, mean difference) used in the synthesis or presentation of results. | Methods section (Lines 109-124) |
| Section and Topic             | Item # | Checklist item                                                                 | Location where item is reported                                      |
|------------------------------|--------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Synthesis methods            | 13a    | Describe the processes used to decide which studies were eligible for each synthesis (e.g., tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | Methods section (Lines 109-124)                                      |
|                              | 13b    | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Methods section (Lines 109-124)                                      |
|                              | 13c    | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | Methods section (Lines 109-124)                                      |
|                              | 13d    | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | Methods section (Lines 109-124)                                      |
|                              | 13e    | Describe any methods used to explore possible causes of heterogeneity among study results (e.g., subgroup analysis, meta-regression). | Methods section (Lines 109-124)                                      |
|                              | 13f    | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | Methods section (Lines 101-102)                                      |
| Reporting bias assessment    | 14     | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | Methods section (Lines 101-102)                                      |
| Certainty assessment         | 15     | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | Methods section (Lines 104-108)                                      |

**RESULTS**

| Study selection              | 16a    | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | Figure S1 and Results section (Lines 129-134)                             |
|                              | 16b    | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | Results section (Lines 129-134)                                          |
| Study characteristics        | 17     | Cite each included study and present its characteristics. | Table 1 and Results section (Lines 127-155)                                |
| Risk of bias in studies      | 18     | Present assessments of risk of bias for each included study. | Table S2 and Table S3                                                   |
| Results of individual studies| 19     | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g., confidence/credible interval), ideally using structured tables or plots. | Lines 148-257                                                            |
| Results of syntheses         | 20a    | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | Lines 266-270                                                            |
|                              | 20b    | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g., confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | Lines 148-257                                                            |
|                              | 20c    | Present results of all investigations of possible causes of heterogeneity among study results. | Lines 148-160 and Figure S2                                             |
| Section and Topic | Item # | Checklist item | Location where item is reported |
|------------------|--------|----------------|---------------------------------|
|                  | 20d    | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | Lines 269-270 and Figure S5 |
|                  | 21     | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | Lines 268-269 and Figure S4 |
|                  | 22     | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | Lines 272-275 and Table S4 |
| DISCUSSION       | 23a    | Provide a general interpretation of the results in the context of other evidence. | Lines 278-411 |
|                  | 23b    | Discuss any limitations of the evidence included in the review. | Lines 395-404 |
|                  | 23c    | Discuss any limitations of the review processes used. | Lines 395-404 |
|                  | 23d    | Discuss implications of the results for practice, policy, and future research. | Lines 278-411 |
| OTHER INFORMATION| 24a    | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | Results (Line 55) |
|                  | 24b    | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | Results (Line 55) |
|                  | 24c    | Describe and explain any amendments to information provided at registration or in the protocol. | N/A |
|                  | 25     | Describe sources of financial or nonfinancial support for the review, and the role of the funders or sponsors in the review. | Title page |
|                  | 26     | Declare any competing interests of review authors. | Title page |
|                  | 27     | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | N/A |
Table S3. Search strategy of Medline, Embase, and CENTRAL designed by a librarian specialising in systematic searches of the literature (Risa Shorr, The Ottawa Hospital).

| Search Strategy                                                                 | Count |
|---------------------------------------------------------------------------------|-------|
| Embase Classic+Embase <1947 to 2021 December 02>                                 |       |
| Ovid MEDLINE(R) ALL <1946 to December 02, 2021>                                 |       |
| EBM Reviews - Cochrane Central Register of Controlled Trials <October 2021>     |       |
| 1 COVID-19 Vaccines/ 14142                                                      |       |
| 2 ((2019 novel coronavirus or 2019 ncov or 2019-ncov or covid 19 or covid 19 virus or covid-19 or covid-19 virus or covid19 or covid19 virus or coronavirus disease 19 or coronavirus disease 2019 or coronavirus disease 2019 virus or coronavirus disease-19 or sars cov 2 or sars coronavirus 2 or sars-cov-2 or sars2) adj3 (vaccin* or immuni*)).tw,kf. 24095 |       |
| 3 ((mRNA or messenger RNA) adj3 vaccin*).tw,kf. 5025                             |       |
| 4 (BNT162b2 or BNT 162b2).tw,kf. 2409                                           |       |
| 5 pfizer vaccin*.tw,kf. 213                                                      |       |
| 6 moderna vaccin*.tw,kf. 246                                                     |       |
| 7 astra zeneca vaccin*.tw,kf. 9                                                 |       |
| 8 (AZD1222 or azd 1222).tw,kf. 450                                              |       |
| 9 johnson vaccin*.tw,kf. 51                                                      |       |
| 10 (mRNA-1273 or mRNA1273).tw,kf. 936                                           |       |
| 11 or/1-10 30561                                                               |       |
| 12 ((three or third) adj3 (dos* or injection* or vaccin*)).tw,kf. 121909        |       |
| 13 (3rd adj3 (dos* or injection* or vaccin*)).tw,kf. 2378                      |       |
| 14 Immunization, Secondary/ 9675                                                |       |
| 15 (booster* or secondary immuni?sation*).tw,kf. 34864                         |       |
| 16 or/12-15 161239                                                             |       |
| 17 11 and 16 1424                                                              |       |
| 18 exp Organ Transplantation/ 664929                                           |       |
| 19 exp Cell Transplantation/ 301673                                            |       |
| 20 transplant*.mp. 1904697                                                      |       |
| 21 Bone Marrow Transplantation/ 101940                                         |       |
| 22 (bmt or hsct or pbsct or sct).tw,kf. 109498                                 |       |
| 23 or/18-22 1928923                                                            |       |
| 24 17 and 23 131                                                               |       |
| 25 24 use medall 63                                                             |       |
| 26 exp SARS-CoV-2 vaccine/ 15226                                               |       |
| 27 ((2019 novel coronavirus or 2019 ncov or 2019-ncov or covid 19 or covid 19 virus or covid-19 or covid-19 virus or covid19 or covid19 virus or coronavirus disease 19 or coronavirus disease 2019 or coronavirus disease 2019 virus or coronavirus disease-19 or sars cov 2 or sars coronavirus 2 or sars-cov-2 or sars2) adj3 (vaccin* or immuni*)).tw. 23875 |       |
| 28 mRNA vaccin*.tw. 2782                                                        |       |
| 29 (BNT162b2 or BNT 162b2).tw. 2356                                             |       |
| 30 pfizer vaccin*.tw. 198                                                       |       |
| 31 moderna vaccin*.tw. 234                                                      |       |
|    | "bone marrow Transplantation"/ | 101940 |
|----|--------------------------------|--------|
| 72 | or/68-72                        | 1928871 |
| 73 | 67 and 73                       | 122    |
| 74 | 74 use ctr                      | 9      |
| 75 | 25 or 50 or 75                  | 127    |
| 76 | remove duplicates from 76       | 84     |
Table S4. Scoring distribution of quality assessment of studies according to the National Heart, Lung, and Blood Institute Quality Assessment Tool for Case Series Studies (https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools). Accessed October 14th, 2021. Y = Yes, N = No, NR = Not Reported. Full quality assessments (ie, answers to signaling questions) can be shared by contacting the corresponding author.

| Study                                      | Was the study question or objective clearly stated? | Was the study population clearly and fully described, including a case definition? | Were the cases consecutive? | Were the subjects comparable? | Was the intervention clearly described? | Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants? | Was the length of follow-up adequate? | Were the statistical methods well-described? | Were the results well-described? |
|--------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------|-------------------------------|---------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------|-----------------------------------------|
| Benotmane et al, 2021                      | Y                                                  | Y                                                                                | Y                           | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Masset et al, 2021                         | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Del Bello et al, 2021                      | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Kamar et al, 2021                          | Y                                                  | Y                                                                                | Y                           | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Westhoff et al, 2021                       | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Hall et al, 2021 and Kumar et al 2021      | Y                                                  | Y                                                                                | Y                           | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| (intervention arms)                         |                                                   |                                    |                              |                               |                                        |                                                                                          |                                         |                                              |                                           |
| Redjoul et al, 2021                        | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Bertrand et al, 2021                       | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Peled et al, 2021                          | Y                                                  | Y                                                                                | NR                          | Y                             | Y                                     | Y                                                                                        | Y                                       | Y                                           | Y                                        |
| Study                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-----------------------|---|---|---|---|---|---|---|---|---|
| Chavarot et al, 2021  | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Massa et al, 2021     | Y | Y | Y | Y | Y | Y | Y | Y | Y |
Table S5. Summary of the risk of bias assessments. N.B. The same rating was reached for all outcomes across studies. Green circles with a plus represent low risk of bias, yellow circles with a question mark represent some concerns for bias, and red circles with a minus represent high risk of bias. Full risk of bias assessments (i.e., answers to signaling questions) can be shared by contacting the corresponding author.

| Study                              | Risk of Bias Arising from the Randomization Process | Risk of Bias due to Deviations from the Intended Interventions (effect of assignment to intervention) | Risk of Bias due to Deviations from the Intended Interventions (effect of adhering to intervention) | Risk of Bias due to Missing Outcome Data | Risk of Bias in Measurement of the Outcome | Risk of Bias in Selection of the Reported Result | Overall Risk of Bias |
|-----------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------|------------------------------------------------|---------------------|
| Hall et al, 2021 and Kumar et al 2021 | ●                                                   | ●                                                                                             | ●                                                                                             | ●                                      | ●                                        | ●                                              | ●                   |
Table S6. GRADE assessment of outcomes. Please contact corresponding author for individual assessments.

| Number of Studies (Study Design) | Risk of Bias | Inconsistency | Indirectness | Imprecision | Other Considerations | Reasons to increase level of evidence | Quality | N | Prevalence/Effect | Importance |
|---------------------------------|--------------|----------------|--------------|-------------|----------------------|--------------------------------------|---------|---|-----------------|------------|
| Prevalence of humoral response after 3 doses |
| 7 Observational | No serious risk of bias | Not serious | Serious | Not serious | Unable to assess funnel plot asymmetry | None | Moderate | 801 | 66.1% (62.8%-69.4%) | Critical |
| Prevalence of humoral response after 3 doses according to transplant type |
| 7 Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 141 Kidney 96 Heart | Kidney 61.7% (53.7%-69.7%) vs Heart 66.7% (57.2%-76.1%) (P=0.56) | Critical |
| Prevalence of humoral response after 3 doses according to mRNA vaccine |
| 7 Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 741 BNT162b2 60 mRNA-1273 | BNT162b2 66.9% (63.5%-70.3%) vs mRNA-1273 55.0% (42.4%-67.6%) (P=0.07) | Critical |
| Prevalence of humoral response after humoral nonresponse to 2 doses |
| 9 Observational | No serious risk of bias | Not serious | Serious | Not serious | Not serious | None | Moderate | 789 | 45.9% (42.3%-49.4%) | Critical |
| Prevalence of humoral response after humoral nonresponse to 2 doses according to transplant type |
| Study Type | Bias | Risk of Bias | Response | Bias | Risk of Bias | Response | Bias | Risk of Bias | Response | Bias | Risk of Bias | Response |
|------------|------|--------------|----------|------|--------------|----------|------|--------------|----------|------|--------------|----------|
| 9 Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 253 | Kidney 70 | Heart 42 | aHSCT | Kidney 43.2% (33.6%-52.9%) vs Heart 54.3% (42.6%-66.0%) vs aHSCT 47.6% (32.5%-62.7%) (P=0.48) |
| 1 RCT | No serious risk of bias | Not serious | Not Serious | Serious | Unable to assess funnel plot asymmetry | Large Effect | High | 60E 57C | RR 3.1 (1.7-5.8) |
| Prevalence of humoral response after humoral nonresponse to 2 doses according to mRNA vaccine |
| 9 Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 567 | BNT162b2 222 mRNA-1273 | BNT162b2 44.3% (39.7%-49.0%) vs mRNA-1273 49.6% (43.0%-56.1%) (P=0.616) |
| Prevalence of humoral response after humoral nonresponse to 2 doses according to study threshold |
| 9 Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 567 | BNT162b2 222 mRNA-1273 | BNT162b2 44.3% (39.7%-49.0%) vs mRNA-1273 49.6% (43.0%-56.1%) (P=0.616) |
| Prevalence of cellular response to 3 doses |
|   | Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 139 | 75.3% (66.6%-83.9%) | Critical |
|---|---------------|------------------------|------------|--------|--------|----------------------------------------|------|-----|-----|---------------------|----------|
| 4 | Prevalence of cellular response to 2 doses |                       |            |        |        |                                        |      |     |     |                     |          |
| 2 | Observational | No serious risk of bias | Not serious | Serious | Serious | Unable to assess funnel plot asymmetry | None | Low | 99  | 49.3% (39.5%-59.1%) | Critical |
| 3 | Prevalence of cellular response after cellular nonresponse to 2 doses |                       |            |        |        |                                        |      |     |     |                     |          |
| 2 | Observational | No serious risk of bias | Not serious | Serious | Not serious | Unable to assess funnel plot asymmetry | None | Low | 156 | 60.9% (53.2%-68.6%) | Critical |

*E=Experimental group. C=Control group.*
Figure S1. PRISMA flow diagram for study selection process. Other sources of records included manual searches through reference lists of included articles or captured review articles.

127 Records identified through database searching

0 Additional records identified through other sources

84 Records after duplicates removed

84 Records screened

63 Records excluded

21 Full-text articles assessed for eligibility

9 Full-text articles excluded
  3 Second-dose
  2 Non-mRNA vaccine
  1 Commentary
  1 Reported double and triple vaccinated patients in a single cohort
  1 Inconsistent thresholds/data reporting
  1 Incomplete description of study population

12 Studies included in qualitative synthesis

0 Studies excluded

12 Studies included in quantitative synthesis (meta-analysis)
**Figure S2.** Prevalence of humoral response after 3 doses of any mRNA SARS-CoV-2 vaccine in transplant recipients, with outlier study included.

### Studies
- Bertrand et al, 2021
- Hall et al, 2021
- Kamar et al, 2021
- Del Bello et al, 2021
- Masset et al, 2021
- Peled et al, 2021
- Chavarot et al, 2021
- Massa et al, 2021

### Estimate (95% C.I.)
- Bertrand et al, 2021: 0.613 (0.506, 0.719)
- Hall et al, 2021: 0.550 (0.424, 0.676)
- Kamar et al, 2021: 0.677 (0.585, 0.769)
- Del Bello et al, 2021: 0.680 (0.625, 0.736)
- Masset et al, 2021: 0.661 (0.614, 0.769)
- Peled et al, 2021: 0.667 (0.572, 0.761)
- Chavarot et al, 2021: 0.065 (0.003, 0.126)
- Massa et al, 2021: 0.623 (0.501, 0.745)

### Weight
- Bertrand et al, 2021: 12.4%
- Hall et al, 2021: 12.2%
- Kamar et al, 2021: 12.5%
- Del Bello et al, 2021: 12.6%
- Masset et al, 2021: 12.5%
- Peled et al, 2021: 12.7%
- Chavarot et al, 2021: 12.2%

### Overall (I²=97.6 %, P< 0.001)
- Estimate (95% C.I.): 0.570 (0.379, 0.761)

### Weighted Proportion

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**Test for subgroup differences:** $\chi^2 = 4.92$, df = 5, $P = 0.43$, $I^2 = 0$

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**Figure S3.** Prevalence of humoral response after 3 doses of any mRNA SARS-CoV-2 vaccine in transplant recipients (A, top panel), according to threshold for humoral response, and response after 3 doses of any mRNA SARS-CoV-2 vaccine in in transplant recipients that did not display a humoral response to 2 doses of an mRNA SARS-CoV-2 vaccine (B, bottom panel), according to threshold for humoral response.

### Studies
- Bertrand et al, 2021
- Massa et al, 2021
- Subgroup >50 AU/mL (I²=55.5% , P=0.106)
- Hall et al, 2021
- Subgroup >100 U/mL (I²=NA , P=NA)
- Kamar et al, 2021
- Del Bello et al, 2021
- Subgroup >250 UI/L (I²=NA , P=NA)
- Peled et al, 2021
- Subgroup Geometric titer>12.6 (I²=NA , P=NA)

### Estimate (95% C.I.)
- Bertrand et al, 2021: 0.491 (0.413, 0.568)
- Massa et al, 2021: 0.481 (0.348, 0.615)
- Subgroup >50 AU/mL: 0.415 (0.311, 0.519)
- Subgroup >100 U/mL: 0.600 (0.296, 0.904)
- Subgroup >250 UI/L: 0.600 (0.296, 0.904)
- Subgroup Geometric titer>12.6: 0.543 (0.426, 0.660)

### Weight
- Bertrand et al, 2021: 19.9%
- Massa et al, 2021: 12.3%
- Subgroup >50 AU/mL: 13.3%
- Subgroup >100 U/mL: 12.3%
- Subgroup >250 UI/L: 12.3%
- Subgroup Geometric titer>12.6: 10.1%

### Overall (I²=1313 %, P=0.325)
- Estimate (95% C.I.): 0.491 (0.356, 0.625)

### Weighted Proportion

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**Test for subgroup differences:** $\chi^2 = 5.27$, df = 4, $P = 0.43$, $I^2 = 24.2$

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**Figure S4.** Prevalence of humoral response after three doses according to humoral correlates of protection for the wild type, alpha variant, and delta variant.

| Studies               | Estimate (95% C.I.) | Ev/Ttr | Weight |
|-----------------------|---------------------|--------|--------|
| Betrand et al, 2021   | 0.463 (0.353, 0.572) | 37/80  | 10.4%  |
| Hall et al, 2021      | 0.550 (0.424, 0.676) | 33/60  | 8.5%   |
| Kamar et al, 2021     | 0.444 (0.347, 0.542) | 44/99  | 12.0%  |
| Westhoff et al, 2021  | 0.500 (0.410, 0.610) | 5/10   | 1.8%   |
| Subgroup Wild Type (I²=0 % , P=0.614) | 0.478 (0.416, 0.540) | 119/249 | 32.7%  |
| Betrand et al, 2021 Alpha | 0.450 (0.341, 0.559) | 36/80  | 10.4%  |
| Hall et al, 2021 Alpha | 0.550 (0.424, 0.676) | 33/60  | 8.5%   |
| Kamar et al, 2021 Alpha | 0.424 (0.327, 0.522) | 42/99  | 12.2%  |
| Westhoff et al, 2021 Alpha | 0.500 (0.190, 0.810) | 5/10   | 1.8%   |
| Subgroup Alpha (I²=0 % , P=0.467) | 0.466 (0.404, 0.527) | 116/249 | 32.9%  |
| Betrand et al, 2021 Delta | 0.350 (0.245, 0.455) | 28/80  | 11.0%  |
| Hall et al, 2021 Delta | 0.450 (0.324, 0.576) | 27/60  | 8.5%   |
| Kamar et al, 2021 Delta | 0.333 (0.240, 0.426) | 33/99  | 12.8%  |
| Westhoff et al, 2021 Delta | 0.300 (0.261, 0.584) | 3/10   | 2.1%   |
| Subgroup Delta (I²=0 % , P=0.480) | 0.363 (0.304, 0.423) | 91/249 | 34.4%  |

Test for Subgroup Difference (I²=27.7%, P=0.173)

**Figure S4.** Funnel plot of the prevalence of humoral response after three doses of any mRNA SARS-CoV-2 vaccine in transplant recipients who did not display a humoral response to two doses.
Figure S5. Forest plot demonstrating the prevalence of humoral response after 3 doses of any mRNA SARS-CoV-2 vaccine in transplant recipients, with the poor-quality study included.

| Studies            | Estimate (95% C.I.) | Ev/Trt | Weight |
|--------------------|---------------------|--------|--------|
| Marlet et al, 2021 | 0.469 (0.391, 0.546) | 75/160 | 13.9%  |
| Bertrand et al, 2021 | 0.613 (0.506, 0.719) | 49/80  | 11.4%  |
| Hall et al, 2021   | 0.550 (0.424, 0.676) | 33/60  | 10.0%  |
| Kamar et al, 2021  | 0.677 (0.585, 0.769) | 67/99  | 12.6%  |
| Del Bello et al, 2021 | 0.680 (0.625, 0.736) | 183/269 | 15.5%  |
| Masset et al, 2021 | 0.691 (0.614, 0.769) | 94/136 | 13.8%  |
| Peled et al, 2021  | 0.667 (0.572, 0.761) | 64/96  | 12.4%  |
| Massa et al, 2021  | 0.623 (0.501, 0.745) | 38/61  | 10.4%  |

Overall (P²=72.5%, P<0.001) 0.624 (0.564, 0.684) 603/961 100%
