Προβληματισμοί σε σχέση με τους εμβολιασμούς στην Αιμοκάθαρση, στην Περιτοναϊκή Κάθαρση, όπως και πριν και μετά τη μεταμόσχευση.

Α. Ντούνι

Νεφρολόγος, Π. Γ. Ν. Ιωαννίνων

Concerns regarding vaccinations in dialysis patients, pre- and post-transplant.

- What is the ideal timing for vaccinations?
- Is there reduced efficacy of vaccinations?
- How can vaccine efficacy be improved?
- Is the assessment of vaccine response needed?
- Do vaccines confer improved outcomes and particularly a survival benefit?
- Does vaccination pre- or post-transplant increase the risk for rejection?
- How do we encourage vaccine uptake in our patients?

Recommended Standard Vaccinations for Patients With CKD *or* on Maintenance Dialysis *and* Those After Kidney Transplantation

Vaccine	Indication CKD	Indication post-transplant	Dose and Schedule
Influenza	all patients, annually	all patients, annually, starting 4 weeks after transplantation; no live vaccine	< 60 years: single injection standard vaccine; ≥ 60 years: single injection high dose vaccine
Pneumococcus	all patients ≥ 19 years	all patients ≥ 19 years, starting 6 months after transplantation	never vaccinated: one PCV injection; has received PPSV23: one PCV-booster >1 year after PPSV23
RSV	all patients ≥ 75 years, CKD 3+ and dialysis ≥ 60 years	all patients ≥ 60 years, starting 6 months after transplantation	single dose, no vaccine type preference
SARS-CoV-2	all patients, annual revaccination	all patients, annual revaccination, consider 6 month interval	single dose mRNA vaccine, most recent virus variant;
Hepatitis B	all patients CKD 3b – 5(d)	no specific recommendation	3-4 injections of regular or double dose vaccines (according to product label), serological monitoring and boostering
Herpes Zoster	patients ≥50 (ACIP), 60 (RKI) or 65 years (NHS) patients ≥19 years with therapeutic immunosuppression	all ≥19 years (except RKI: ≥50 years)	two injections of recombinant vaccine 2-6 months apart
Meningococcus	only patients with particular risk e.g. asplenia, complement inhibition, travel to endemic areas	only patients with particular risk e.g. asplenia, complement inhibition, travel to endemic areas	MenB oder MenAVWY depending on epidemiological situation; single dose. Evaluate need for additional antibiotic prophylaxis.
Human papilloma virus	Children 9-14 years, catch-up until 26 years	Children 9-14 years, catch-up until 26 years	Enhanced vaccination schedule (3 injections months 0, 2, 6)
Tetanus, Diphtheria, Pertussis	all patients every 5-10 years	all patients every 5-10 years	single injection combination vaccine

Journal Pre-proof

- *U.S. Centers for Disease Control and Prevention. ACIP Vaccine Recommendations and Guidelines: Vaccine-specific recommendations. https://www.cdc.gov/acip-recs/hcp/vaccinespecific/. Accessed September 15, 2025*
- *National Health Service. NHS vaccinations and when to have them. https://www.nhs.uk/vaccinations/nhs-vaccinations-and-when-to-have-them/. Accessed September 15, 2025.*
- *Robert Koch-Institut. Ständige Impfkommission: Empfehlungen der Ständigen Impfkommission (STIKO) beim Robert Koch-Institut 2025. Epidemiol. Bull. 2025;(04):1-75.*

Εθνικό Πρόγραμμα Εμβολιασμών Ενηλίκων, ανά νόσο ή άλλη ένδειξη, Οκτώβριος 2025

Εμβόλιο ▼	Κύηση ή λοχεία	Ανοσοκαταστολή (πλην HIV)	Λοίμωξη με HIV (CD4+ κύτταρα) <200	Λοίμωξη με HIV (CD4+ κύτταρα) ≥200	Ασπληνία, μόνιμη έλλειψη τελικών κλασμάτων συμπληρώματος	Νεφρική ανεπάρκεια τελικού σταδίου σε αιμοδιύλιση	Χρόνιες καρδιοπάθειες, πνευμονοπάθειες, βαρείς καπνιστές, χρόνιος αλκοολισμός	Χρόνιες παθήσεις του ήπατος	Σακχαρώδης διαβήτης	Υγειονομικό προσωπικό	MSM
[1] Γρίπης	1 δόση ετησίως										
[2] Tdap ή Tdap-IPV ή Td	1 δόση Tdap σε κάθε κύηση	Μία δόση Tdap ή Tdap-IPV και στη συνέχεια αναμνηστική δόση Td ή Tdap κάθε 10 χρόνια									
[3] MMR	Αντενδείκνυται				1-2 δόσεις βλέπε σχόλιο						
[4] VAR	Αντενδείκνυται				2 δόσεις						
[5] HZV (RZV)		2 δόσεις ≥ 18 ετών			2 δόσεις ≥ 60 ετών	2 δόσεις ≥18 ετών	2 δόσεις ≥ 60 ετών				
[6] HPV γυναίκες	βλέπε σχόλιο	3 δόσεις ≤ 45 ετών									
[6] HPV άνδρες		3 δόσεις ≤ 45 ετών									2 δόσεις ≤ 45 ετών
[7] PCV20		1 δόση PCV20 ≥ 18 ετών								1 δόση PCV20 ≥ 65 ετών	
[8] HepA	2 δόσεις		2 δόσεις		2 δόσεις			2 δόσεις	2 δόσεις		2 δόσεις
[9] HepB	3 δόσεις	3 ή 4 δόσεις	3 δόσεις		3 δόσεις	βλέπε σχόλιο	3 δόσεις	3 δόσεις			
[10] MenACWY	βλέπε σχόλιο	1 ή	περισσότερες δόσεις ανάλογα με τις ενδείξεις								
[11] MenB	βλέπε σχόλιο	2-3 δόσεις βλέπε σχόλιο			2-3 δόσεις βλέπε σχόλιο						
[12] Hib		1 δόση ή 3 δόσεις σε HSCT βλέπε σχόλιο			1 δόση						
[13] COVID-19		2 δόσεις			1 δόση	2 δόσεις	1 δόση				
[14] Αναπνευστικού συγκυτιακού ιού (RSV)	βλέπε σχόλιο	1 δόση βλέπε σχόλιο									

Συνιστώνται για ενήλικες που πληρούν το ηλικιακό κριτήριο ή δεν έχουν αποδεικτικό προηγούμενου εμβολιασμού ή νόσησης

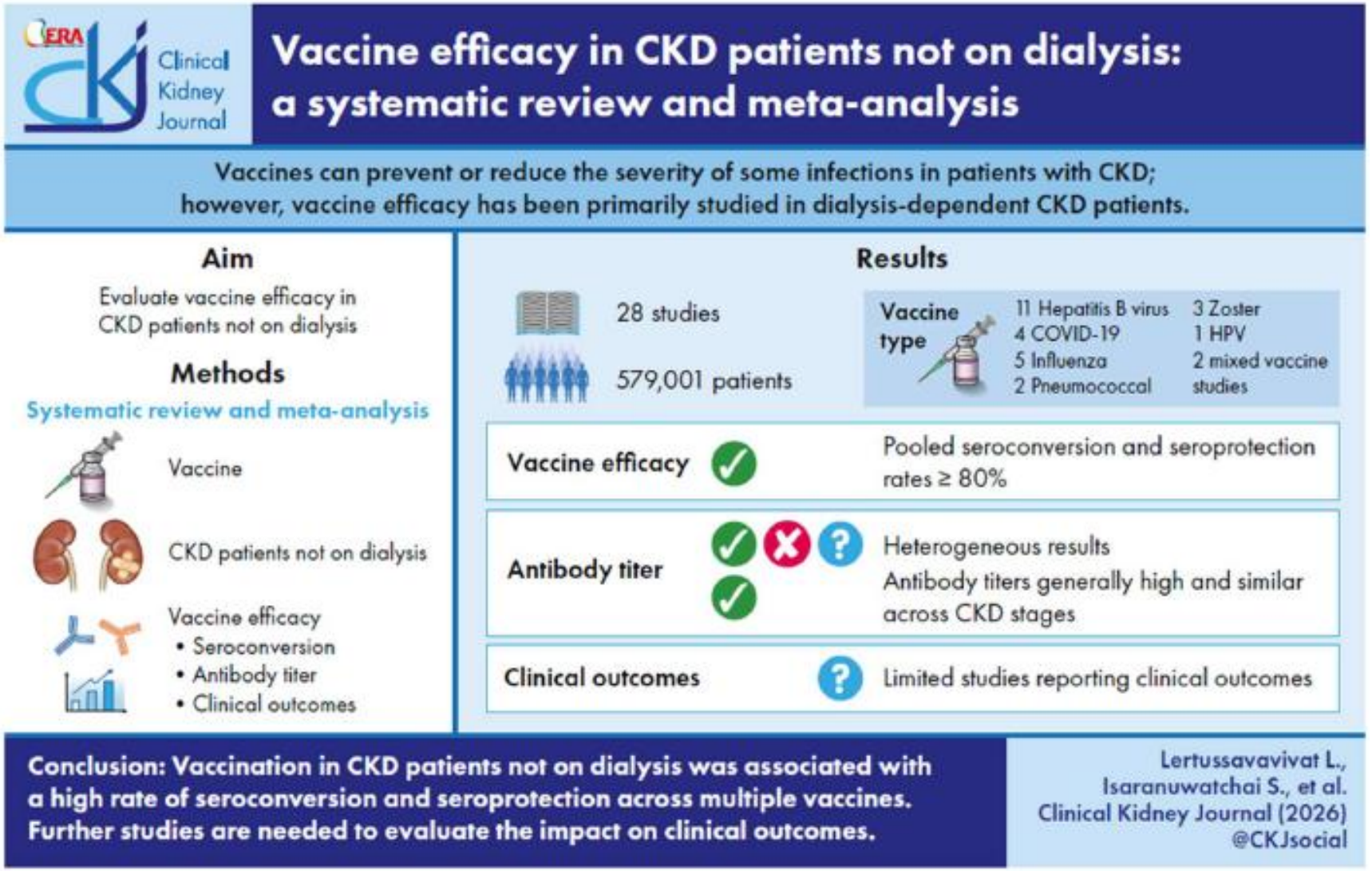
Συνιστώνται για ενήλικες με πρόσθετους παράγοντες κινδύνου ή άλλες ενδείξεις

Αντενδείκνυται

Δε συνιστώνται

What is the ideal timing for vaccinations?

There is no consensus on the stage of CKD that would be ideal for administering vaccines.

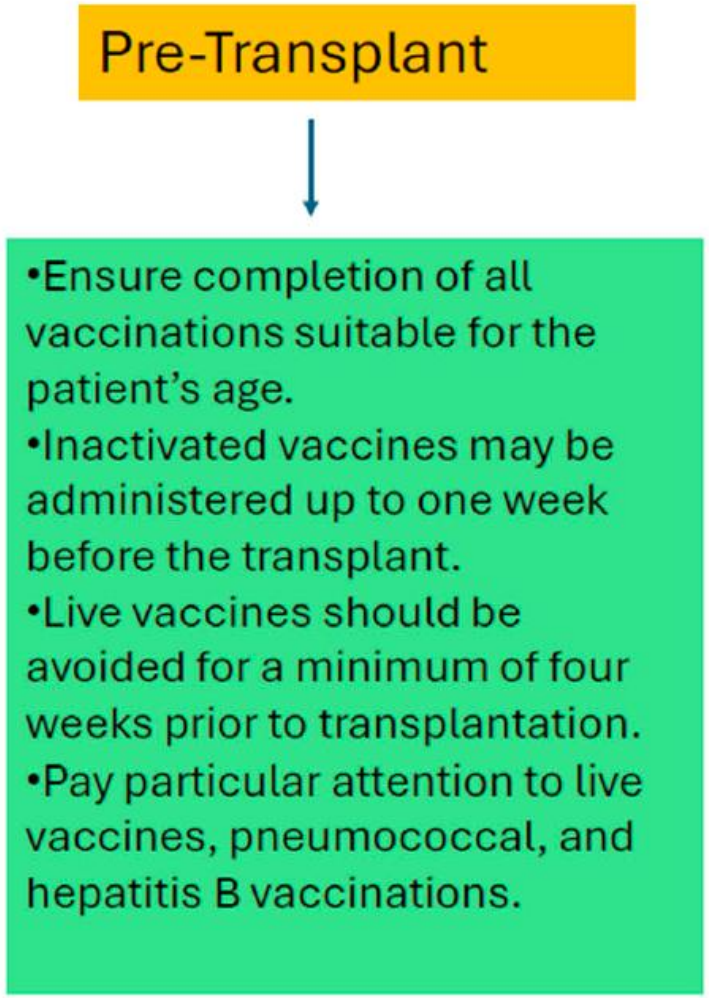


Pre-Transplant Vaccination Timing

Ideally, vaccination should be completed pre-transplant!

- ✓at least 2 weeks before organ transplantation for inactivated vaccines
- ✓at least 4 weeks prior to organ transplantation for live vaccinations

MMR, varicella, oral typhoid, oral polio, rotavirus, oral cholera, Yellow Fever, dengue, chikungunya, and Bacille Calmette-Guerin



Mour et al, Microorganisms 2026

Post-Transplant Vaccination Timing

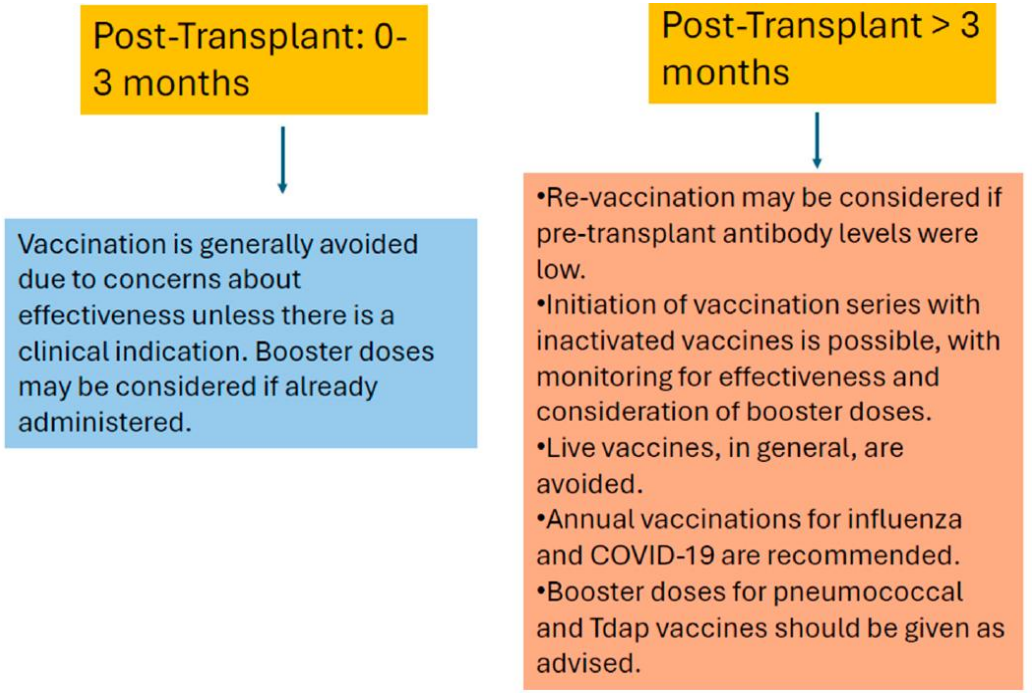
- **Variability across transplant centers regarding timing of vaccination post-transplantation**

✓Vaccinations should be avoided in the immediate post-transplant period

✓Inactivated vaccines starting at 3-6 months post-transplant or treatment for rejection

✓Live attenuated vaccines (LAVs), such as MMR, contraindicated post-transplant

✓ **The influenza vaccine may be given as early as 1 month posttransplant.**



Mour et al, Microorganisms 2026

Most transplant centers suggest vaccinating KTRs no sooner than 6 months after transplantation.

- *reduced efficacy during intense immunosuppression*
- *potential risks of triggering rejection*

- prospective cohort study
- 130 KTRs vaccinated within 6 months post Tx vs 668 KTRs vaccinated later

Variable	Early group	Late group	p	RR (95% CI)/β coefficient (95% CI)
Baseline seroprotection rate, *n* (%)				
A/(H1N1)pdm	60 (46.2)	226 (33.8)	0.007	1.36 (1.10, 1.68)
A/H3N2	51 (44.7)	166 (44.5)	0.947	1.15 (0.89, 1.47)
B	78 (68.4)	182 (52.0)	0.002	1.53 (1.27, 1.83)
Postvaccine seroprotection rate, *n* (%)				
A/(H1N1)pdm	95 (73.1)	507 (76.5)	0.494	0.96 (0.86, 1.07)
A/H3N2	77 (67.5)	277 (74.1)	0.172	0.99 (0.84, 1.16)
B	96 (84.2)	299 (85.2)	0.800	1.14 (1.01, 1.29)
Seroconversion rate, *n* (%)				
A/(H1N1)pdm	68 (52.3)	379 (56.7)	0.352	0.92 (0.77, 1.10)
A/H3N2	53 (46.5)	175 (46.9)	0.936	1.13 (0.89.1.44)
[illegible]	45 (39.5)	179 (51.1)	0.030	0.89 (0.69, 1.16)
GMT (95% CI)				
[illegible]				
Baseline	32.59 (23.59, 45.03)	31.93 (26.33, 38.73)	0.000	0.02 (0.01, 0.04)
After vaccination	117.32 (81.52, 168.83)	87.43 (72.87, 104.91)	0.287	0.008 (−0.007, 0.02)
A/H3N2 (95% CI)				
Baseline	34.59 (24.01, 49.82)	27.33 (22.92, 32.59)	0.109	0.01 (−0.004, 0.03)
After vaccination	120.45 (82.17, 176.57)	97.86 (81.34, 117.44)	0.140	0.01 (−0.005, 0.030)
B (95% CI)				
Baseline	54.19 (40.62, 72.28)	34.94 (29.54, 39.80)	0.002	0.03 (0.01, 0.06)
After vaccination	143.32 (103.46, 198.53)	145.54 (122.35, 174.24)	0.741	0.004 (−0.01, 0.02)
GMR (95% CI)				
A/(H1N1)pdm	3.59 (2.47, 5.23)	2.73 (2.23, 3.35)	0.051	−0.01 (−0.02, 0.00)
A/H3N2	3.48 (2.50, 4.84)	3.58 (2.90, 4.14)	0.921	−0.001 (−0.02, 0.01)
B	2.64 (1.82, 3.83)	4.16 (3.39, 5.10)	0.039	−0.02 (−0.04, −0.001)

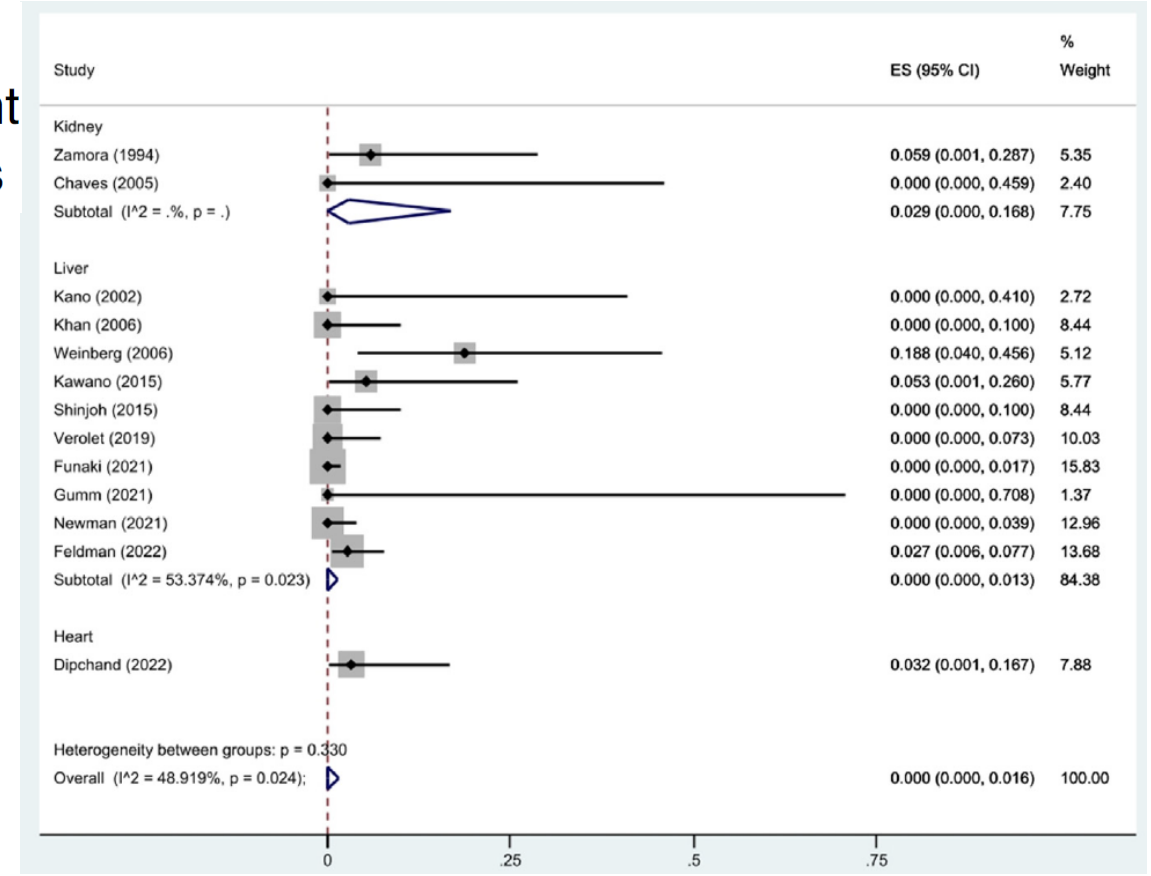
Pérez-Romero et al, Clin Microbiol Infect. 2015

Can live vaccines ever be safely administered post-transplant?

Safety and immunogenicity of the live-attenuated varicella vaccine in pediatric solid organ transplant recipients: A systematic review and meta-analysis

- 14 observational studies + 4 case reports
- 711 SOT recipients

✓ 88.2% seroconverted
✓ 0% vaccine-strain varicella
✓ 0.8% break-through varicella disease



Piche-Renaud et al, Am. J. Transplant 2023

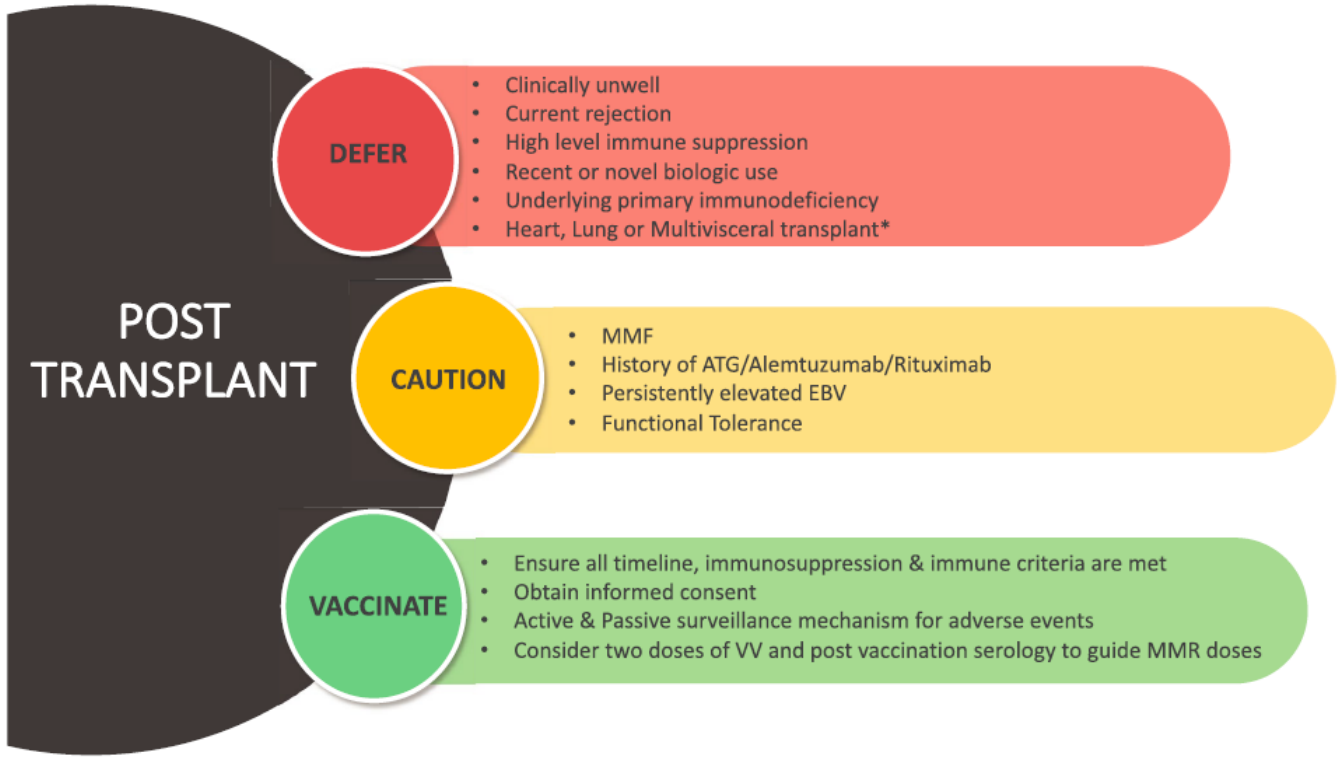
The science on live vaccination post-transplantation is evolving.

- **Increasing evidence on the safety of MMR and varicella vaccines**

Greater benefits than harms in children

- ➢ absence of primary vaccination
- ➢ higher immunogenicity

❖ **Polio, oral typhoid, and inhaled influenza vaccine contraindicated**



Group 1: Defer Vaccine	Patients in whom live vaccination post–solid organ transplant should be deferred	• Clinically unwell • Cardiac, lung, and multivisceral TR[a] • High-level immune suppression • Patients with current rejection • Use of novel biologic agents (other han those outlined in the table) • Use of the following agents: ATG <1 y prior Alemtuzumab <2 y prior Rituximab <1 y prior
Group 2: Proceed with Vaccine	Patients in whom live vaccination post-SOT is likely to be safe	Clinically well Do not meet criteria in yellow or red boxes and meet all 3 of the following criteria: 1. Timeline criteria: • 1 y post-transplant AND • 2 mo post–rejection episode *AND* 2. Intensity of Immunosuppression Criteria: • Steroids (prednisone equivalent) <2 mg/kg/d or total cumulative <20 mg/d • Tacrolimus <8 ng/mL for two consecutive readings • Cyclosporine <100 ng/mL for two consecutive readings *AND* 3. Minimum Immune Criteria: • ALC >1500 for children ≤6 y and >1000 cells/μL for children >6 y • CD4 >700 cells/μL for children ≤6 y and >500 cells/μL for children >6 y • Normal total serum IgG for age
Group 3: Vaccinate with Caution	Patient where evidence for safety and efficacy of live vaccination post-SOT is unclear. *Patients who meet these criteria may be eligible for live vaccination after more in-depth evaluation, and provided they meet the minimum timeline, immunosuppression and immunology criteria in Group 1*	• Patients who have received mycophenolate mofetil (MMF)/mycophenolate sodium • Patients who have received the following T cell–depleting agents: ATG—wait 1 y[b] Alemtuzumab—wait 2 y[b] • Use of rituximab—wait 1 y[b] • Patients with persistently elevated EBV viral loads. • Liver transplant recipients who are undergoing immune suppression withdrawal with the goal of cessation or those who are deemed to have "functional tolerance"

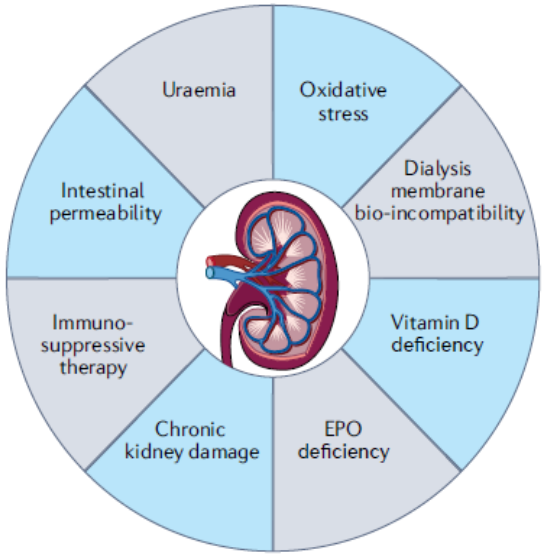
Suresh et al. PEDIATR TRANSPLANT 2019

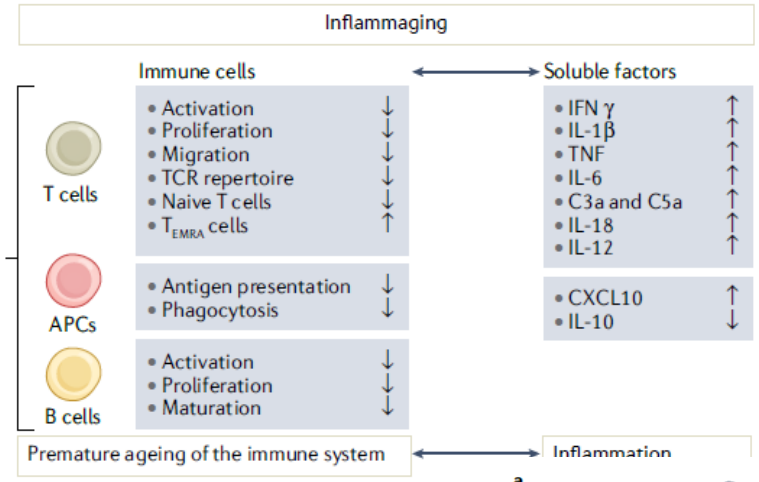
Is there reduced efficacy of vaccinations?

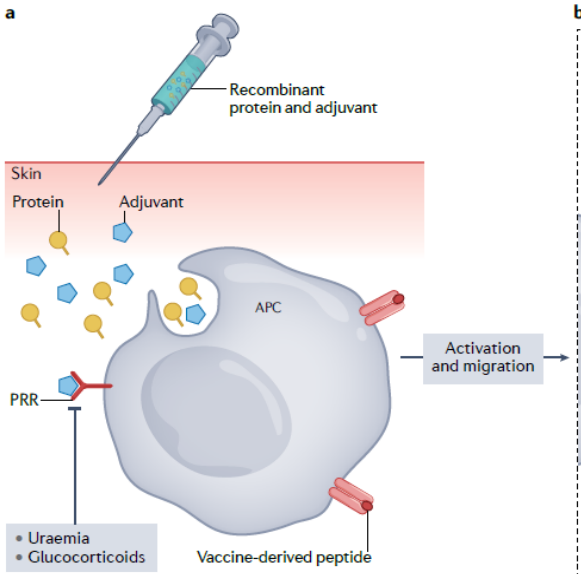
How can vaccine efficacy be improved?

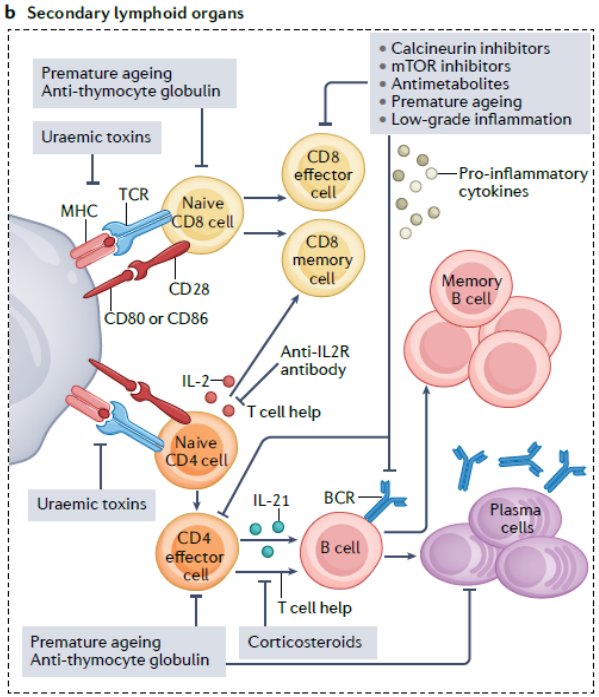
Is the assessment of vaccine response needed?

Inflammaging impairs vaccine responses kidney failure.





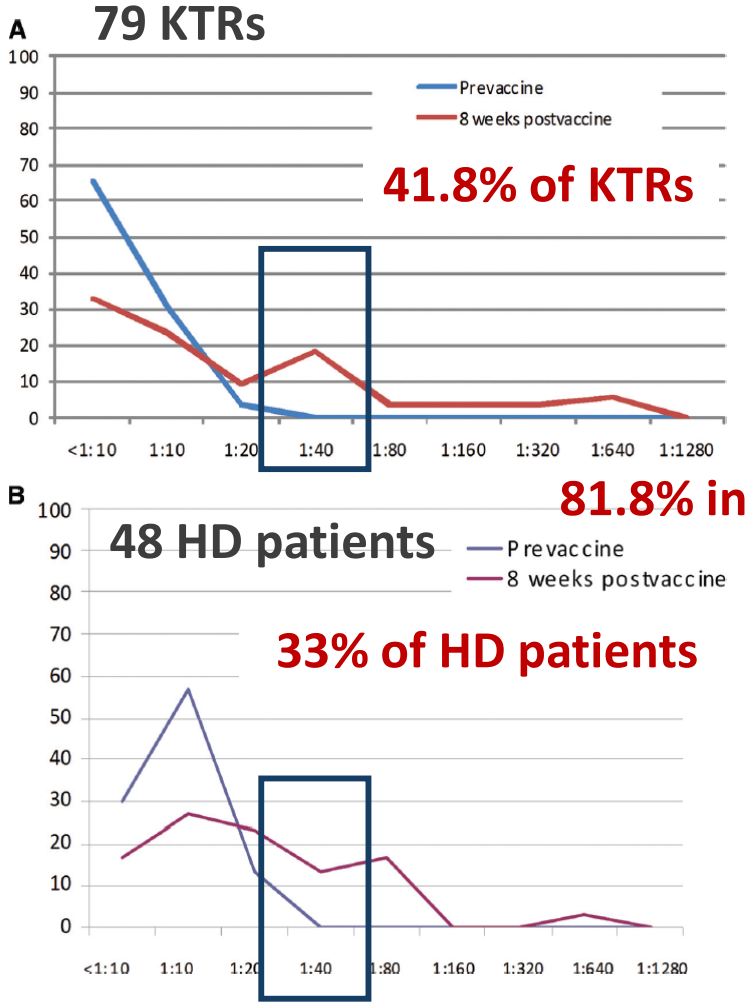




Babel et al, NATURE Reviews | NEPHROlOGY 2022

The immune response to influenza vaccines is less robust and more heterogenous in dialysis patients and SOTRs compared with healthy individuals.

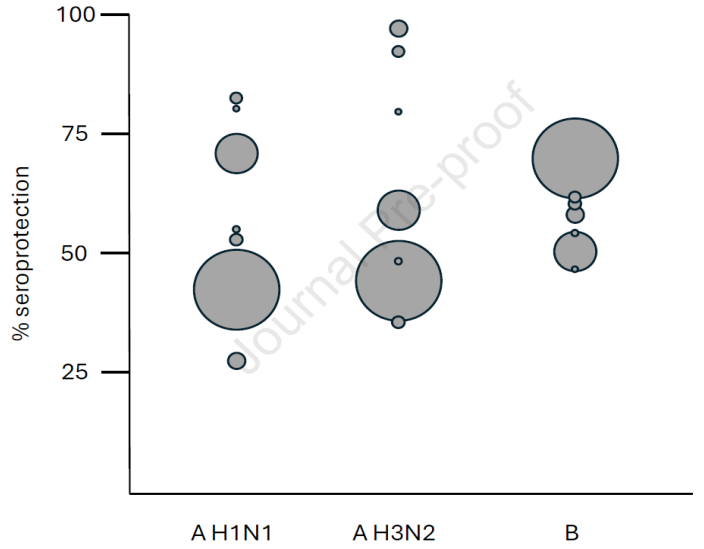
Influenza A H1N1/2009 Vaccine



81.8% in 15 healthy controls

Systematic review of 17 of standard and non-standard vaccination schemes:

- ✓ most studies are small
- ✓ protection rates vary



% of individuals with titers ≥1:40 after standard influenza vaccination in SOTRs.

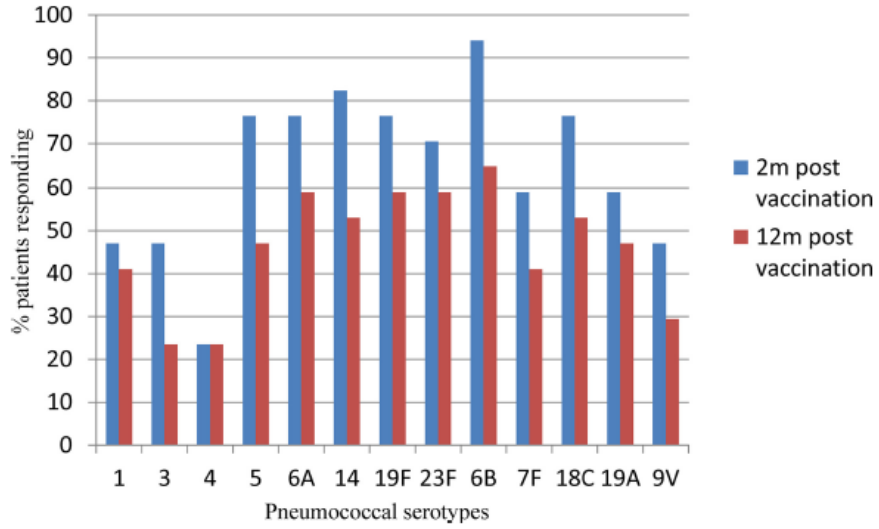
Crespo et al, Clin J Am Soc Nephrol. 2011
Chong et al, Clin Infect Dis 2018

There are limited data for pneumococcal vaccine effectiveness in the dialysis and KTRs populations.

Antibody titers undergo a significant decline during follow-up for almost all serotypes.

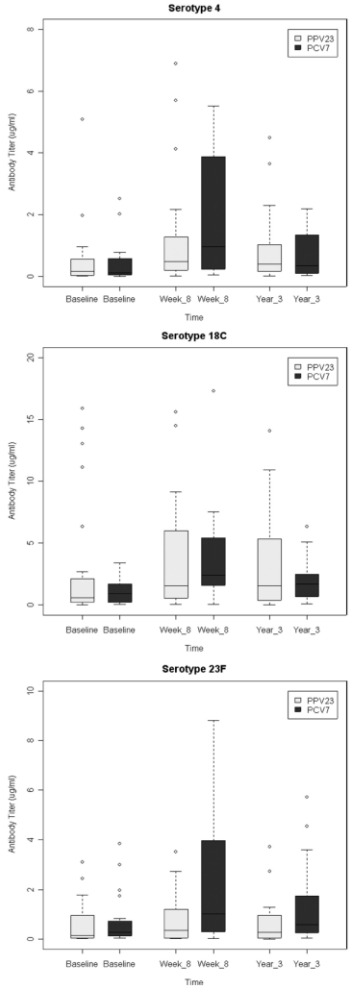
- 17 HD patients >50 years
- PCV13
- 12 months follow-up

✓ Seroprotection in 70% of patients.
✓ Baseline vaccine response to each serotype 23.5% - 94.1% .



Mitra et al, Clin Vaccine Immunol. 2016

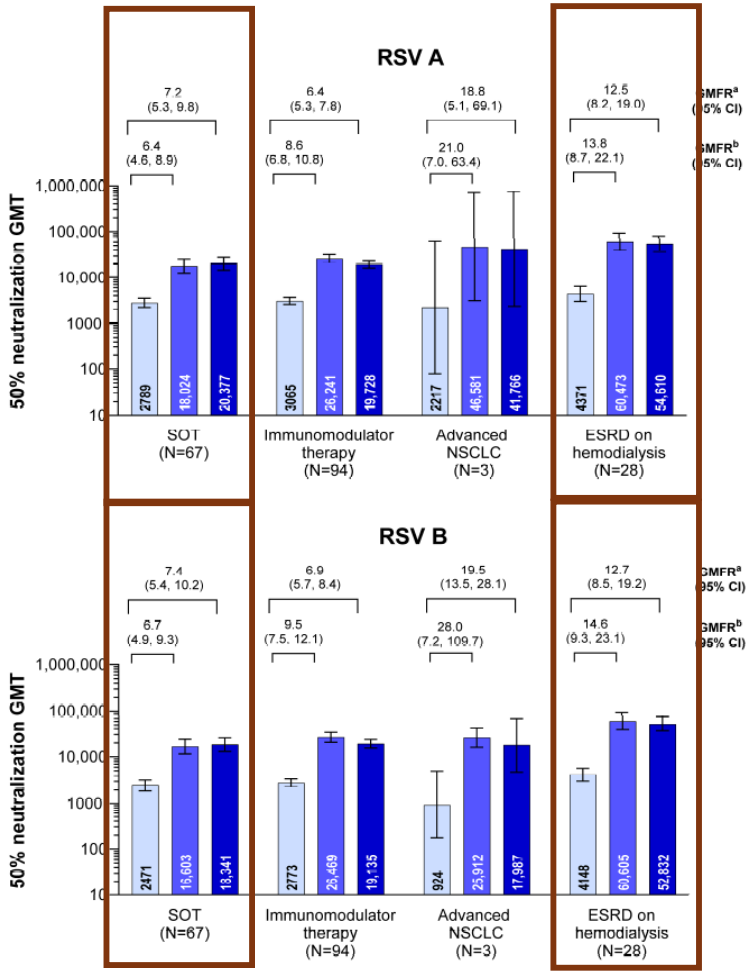
- 47 KTRs
- PCV7 vs PPV23
- 3-years follow-up

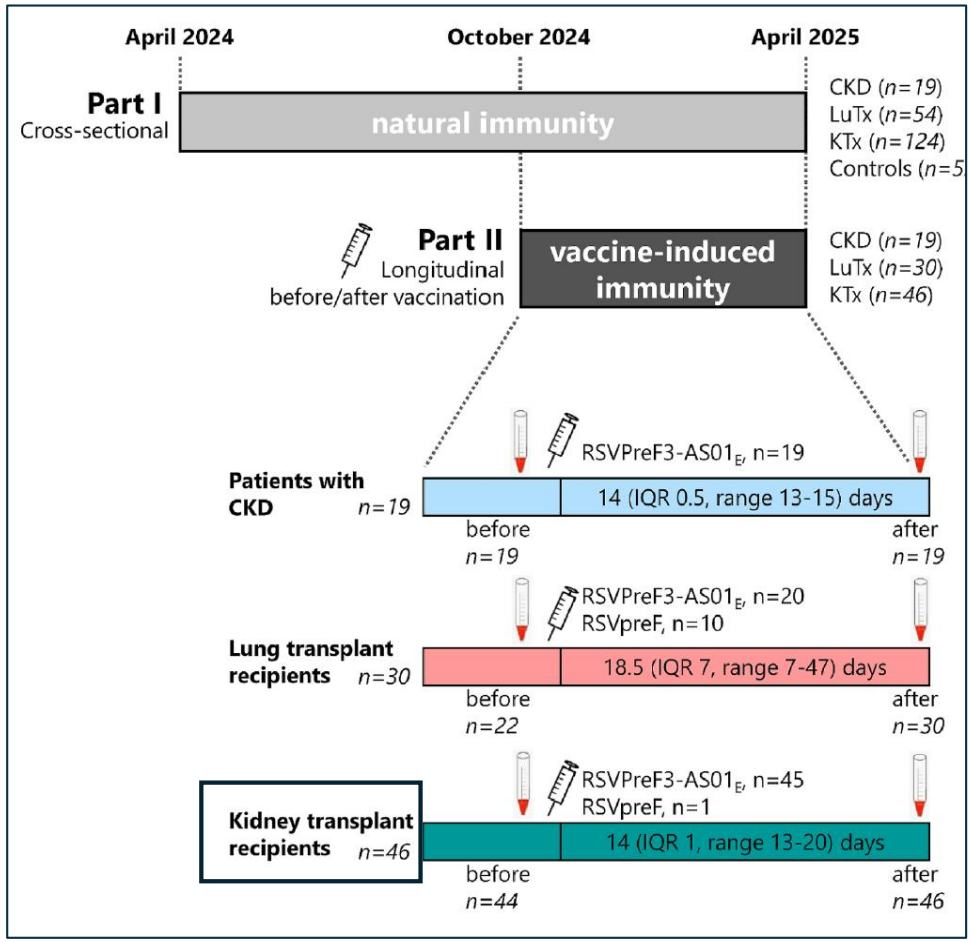


Kumar et al, Am J Transplant 2007

RSV vaccine induces strong IgG and CD4 T cell responses with RSV-A/B cross-reactivity in CKD patients and KTRs.

Vaccine efficacy in CKD = 66.4%





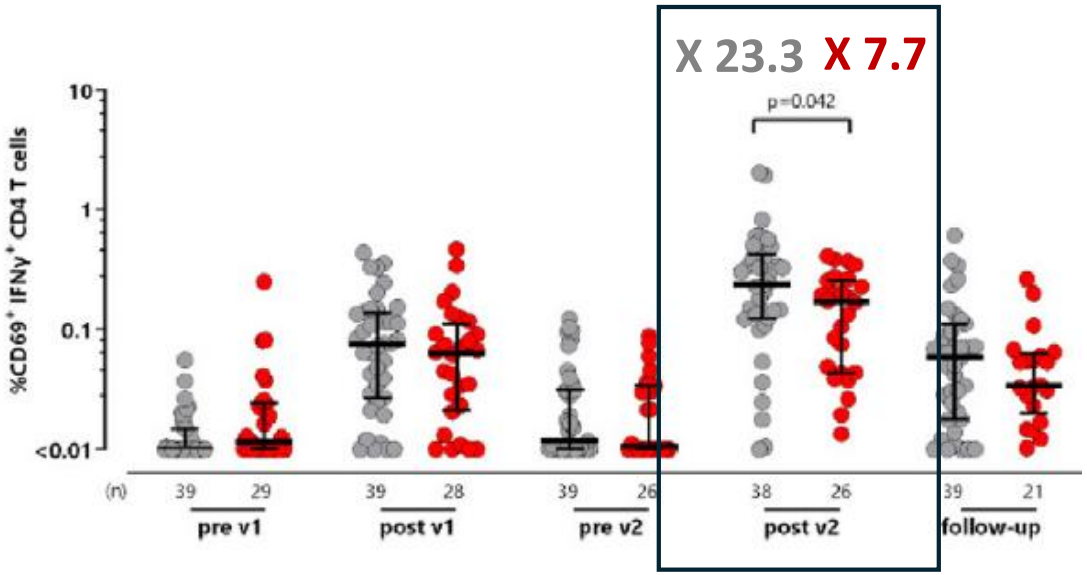
Almeida et al, Vaccines (Basel). 2025 Lassen et al, N Engl J Med. 2025 Bronder et al, Am J Transplant 2026; 26:499.

HZ/su vaccine is well tolerated and induces a multifunctional VZV-specific CD4 T-cell response in patients on dialysis and KTRs.

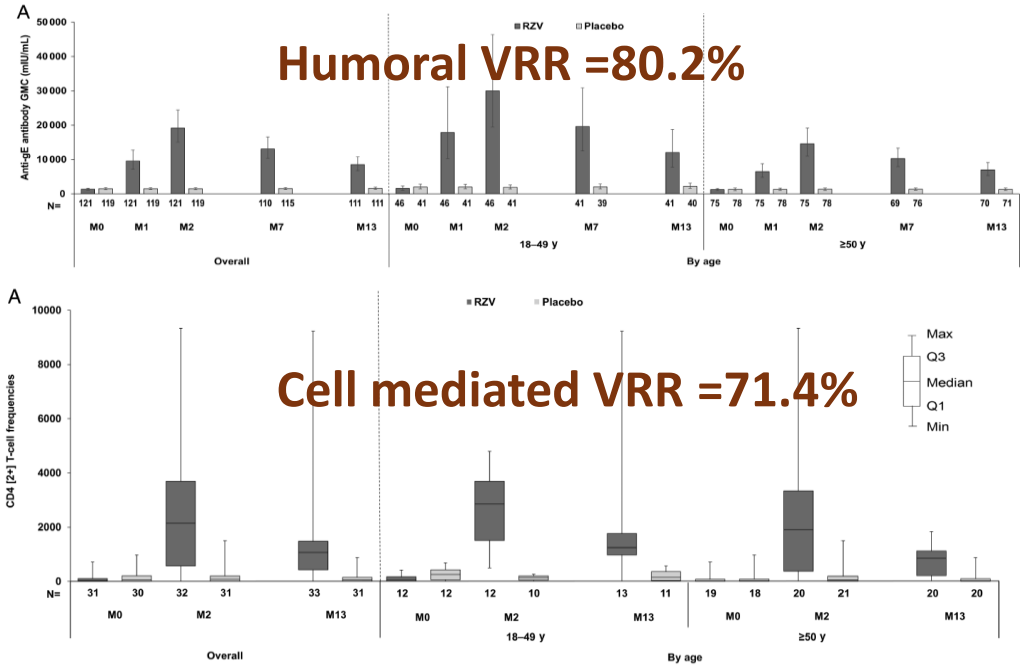
- **29 dialysis pts** and 39 healthy ctrls
- specific antibodies and CD4 T-cells lower in patients vs controls

- **264 KTRs**
- **multicenter RT**
- strong and long-lasting responses
- tolerable safety profile
- no severe kidney damage or rejection

VZV-specific CD4 T-cells

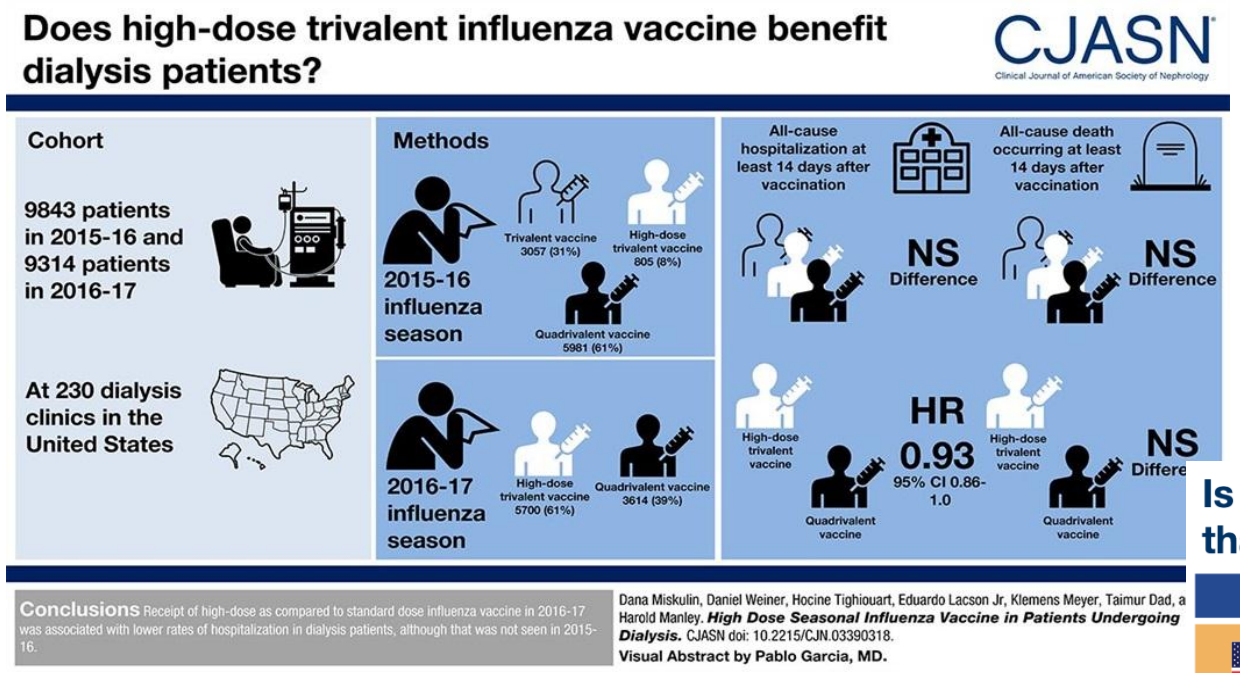


Hielscher et al, eBioMedicine 2024

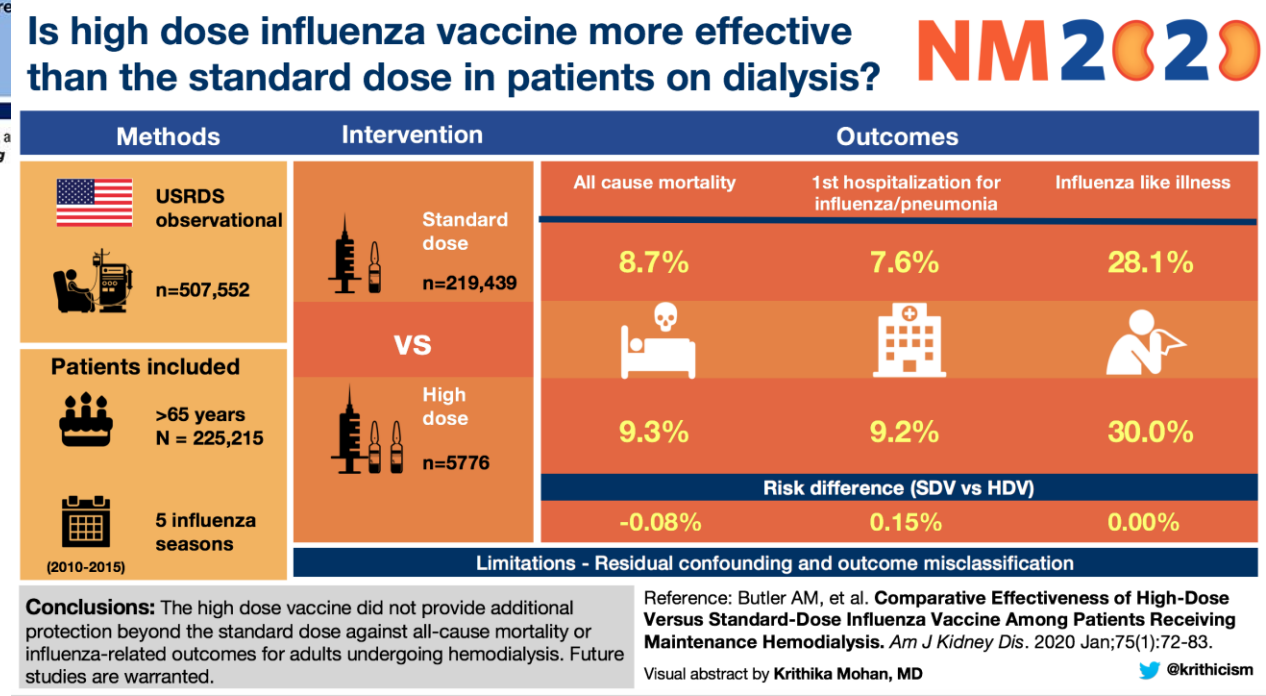


Vink et al, Clin Infect Dis. 2020

Adjuvanted or high-dose influenza vaccines intend to achieve better seroprotection.



- prospective evidence for the adjuvanted vaccine still lacking



Two Doses of Inactivated Influenza Vaccine Improve Immune Response in Solid Organ Transplant Recipients: Results of TRANSGRIPE 1–2, a Randomized Controlled Clinical Trial

Variable	Single-Dose Vaccination Group (n = 213)	Booster Dose Vaccination Group (n = 211)	OR (95% CI)/ β Coefficient (95% CI)	NNT (ARR, %) With Booster Dose
Short-term seroconversion rate				
A(H1N1)pdm	33 (32.7)	43 (46.7)	**1.81 (1.009–3.24)***	12 (14.1)
A(H3N2)	38 (30.2)	45 (39.1)	1.49 (.87–2.54)	8 (9)
Influenza B	53 (63.9)	63 (75.9)	1.78 (.91–3.50)	9 (12)
Long-term seroconversion rate				
A(H1N1)pdm	20 (19.8)	19 (20.7)	1.05 (.52–2.13)	…
A(H3N2)	57 (45.2)	47 (40.9)	0.84 (.50–1.40)	…
Influenza B	42 (50.6)	53 (63.9)	1.73 (.93–3.21)	
Short-term seroprotection rate				
A(H1N1)pdm	92 (43.2)	114 (54)	**1.54 (1.05–2.27)***	10 (10.8)
A(H3N2)	97 (45.5)	120 (56.9)	**1.58 (1.08–2.31)***	9 (11.3)
Influenza B	153 (71.8)	176 (83.4)	**1.97 (1.23–3.16)****	9 (11.6)

Cordero et al, Clin Infect Dis 2017

Immunogenicity of High-Dose vs. MF59-adjuvanted vs. Standard Influenza Vaccine in Solid Organ Transplant Recipients: The STOP-FLU trial

Mombelli et al, 2023 | *Clinical Infectious Diseases*

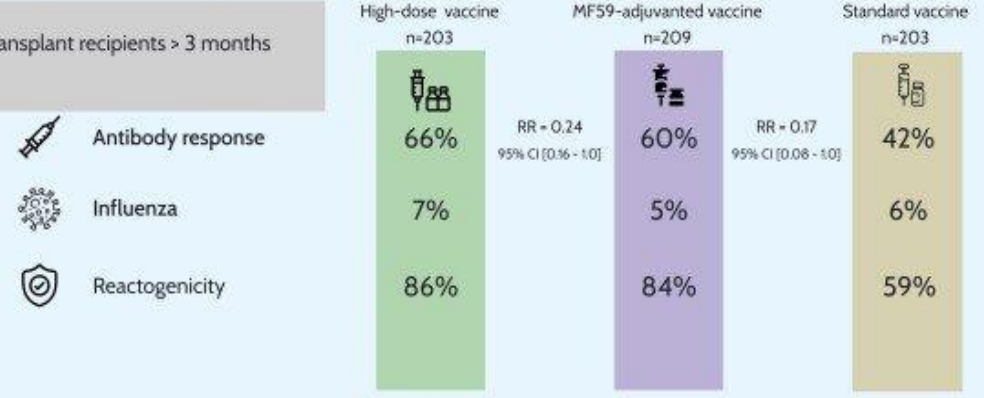
IDSA Infectious Diseases Society of America

BACKGROUND: Which is the best strategy for vaccinating solid-organ transplant recipients against influenza?

PARTICIPANTS: Solid-organ transplant recipients > 3 months after transplantation

METHODS

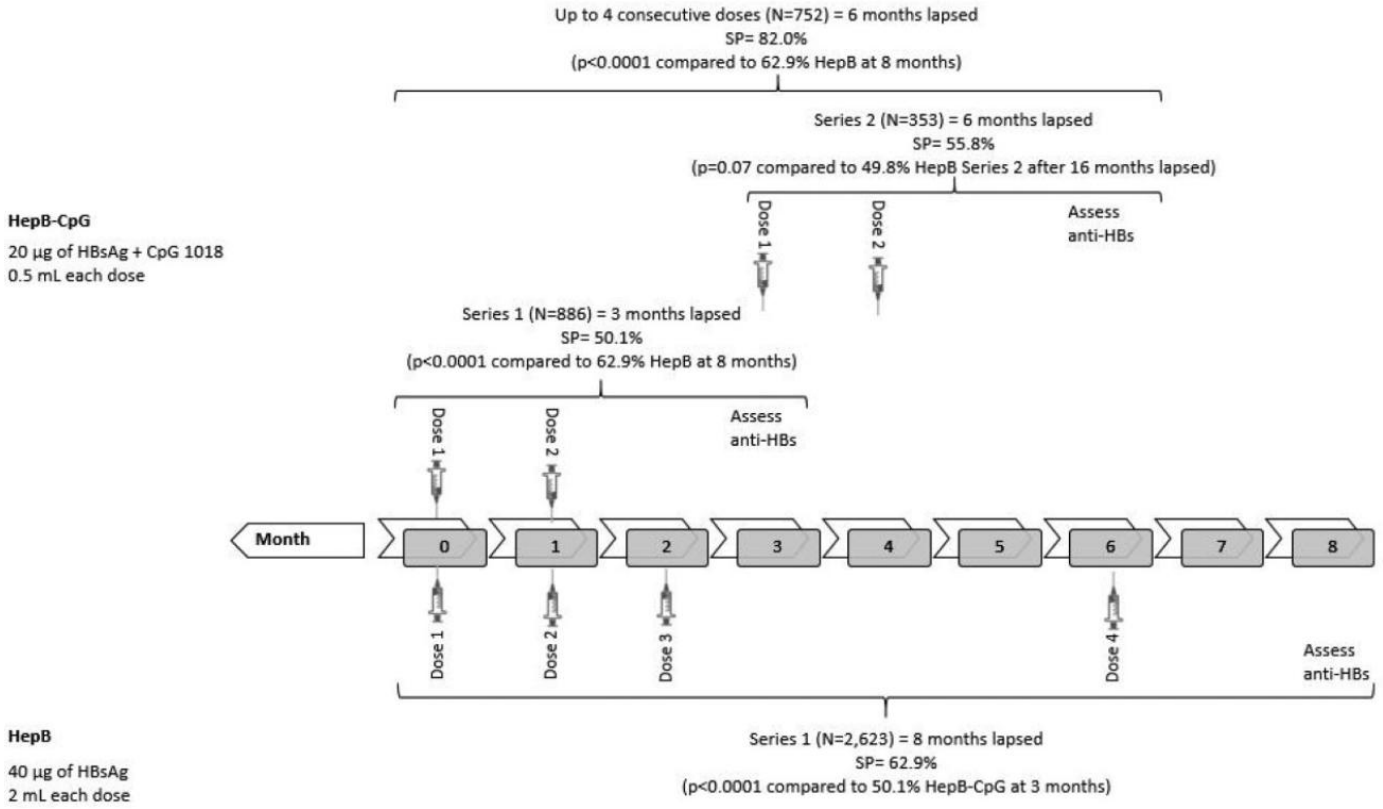
- 9 transplant clinics in Switzerland and Spain.
- Patients were randomized (1:1:1) to a MF59-adjuvanted or a high-dose influenza vaccine (intervention), or a standard influenza vaccine (control).



CONCLUSION: In solid-organ transplant recipients, use of an MF59-adjuvanted or a high-dose influenza vaccine was safe and resulted in a higher vaccine response rate.

Clinical Infectious Diseases https://doi.org/10.1093/cid/ciad477

A real world comparison of HepB (Engerix-B®) and HepB-CpG (Heplisav-B®) vaccine seroprotection in patients receiving maintenance dialysis



Seroprotection anti-HBs>10 mIU/ml

- 82.0% of pts that received 2–4 doses of HepB-CpG
- 62.9% of pts that received 4 doses of HepB

$P < 0.0001$

Manley et al, Nephrology Dialysis Transplantation 2023
Girndt et al, Hum Vaccin Immunother. 2022

Vaccination strategies are crucial for close contacts.

- ✓ family members
- ✓ health care workers
- ✓ pets

Diseases and vaccines potentially targeted by cocooning strategies for CKD patients.

	Household contacts		HCWs
	Children	*Adults*	
Vaccine			
Tdap	NA	Tdap one time (if not done) then Td every 10 years	Tdap one time (if not done) then Td every 10 years
Hepatitis B virus	Routine immunization	Testing and booster consideration	Testing and booster consideration
PCV13/PPV23	Routine immunization	PCV13 → PPV23 (8-week interval)	NA
Inactivated influenza vaccine	Annual administration	Annual administration	Annual administration
Measles–mumps–rubella	Routine immunization	Vaccination if non-immune	Vaccination if non-immune
Varicella	Routine immunization	Vaccination if non-immune	Vaccination if non-immune
Meningococcal	Routine immunization	NA	Recommended for HCWs routinely exposed to isolates

HCW: Healthcare workers; PCV13: 13-Valent conjugate pneumococcal vaccine; PPV23: 23-Valent pneumococcal polysaccharide vaccine.

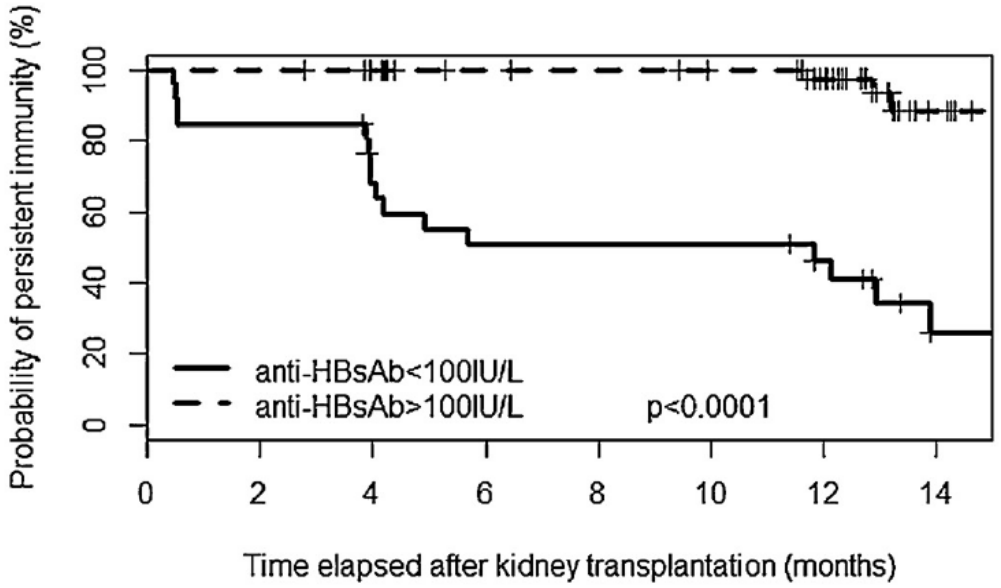
Bitsori et al, Expert Rev Vaccines. 2015

Not all vaccines require the monitoring of serologic response.

✓ **HAV, HBV, HiB, and rabies, varicella and MMR recommended for evaluation**

- Assessing the serologic response to vaccination should be a standard practice before transplantation
- Data on the post-transplant monitoring of serologic response remain a subject of debate.

To avoid false-positive results, serologic tests should not be used in patients who recently received blood or antibody-containing products.



- The initial vaccine response is a strong predictor of the duration of protective effects.

Moal et al, J. Clin. Virol. 2015

Do vaccines confer improved outcomes *and* particularly a survival benefit?

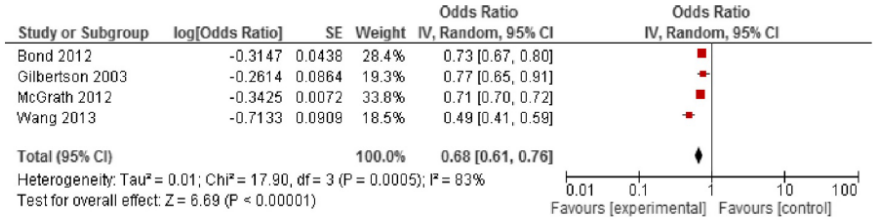
Prospective studies on the impact of influenza vaccination on hospitalization or mortality in CKD are lacking.

Systematic review of Influenza vaccine effectiveness in kidney failure.

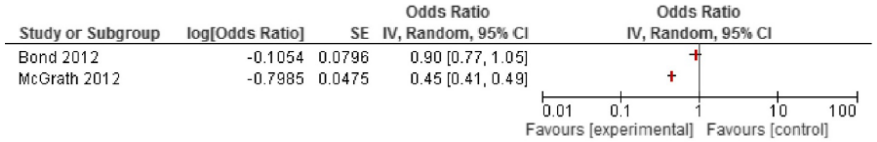
- 5 observational studies
- no randomized-controlled trial

✓ **32% reduction in mortality risk**

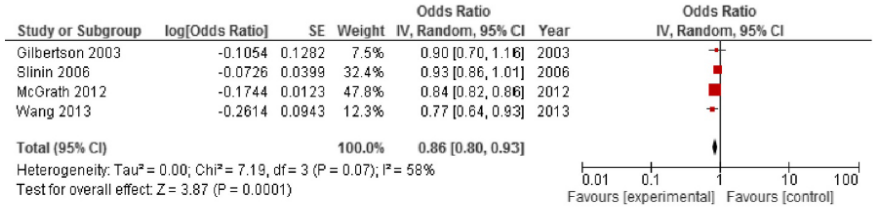
A All-cause mortality during influenza season.



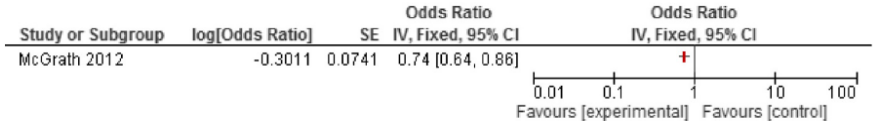
B All-cause mortality outside influenza seasons ("off-season").



C Hospitalization due to influenza or pneumonia during influenza season.



D Hospitalization due to influenza or pneumonia outside influenza seasons ("off-season").



Remschmidt, BMC MED 2014

Seasonal influenza vaccination is associated with reduced morbidity and mortality in peritoneal dialysis patients.

- 4608 incident PD patient

The incidence rate of mortality was 10/100 patient-years in vaccinated vs 16 in non-vaccinated pts.

Incident morbidities and mortality and associated Cox method measured HR for vaccinated PD patients compared with propensity score matched non-vaccinated patients.

Outcome	Non-vaccine			Vaccine			Crude HR (95% CI)	Adjusted HR (95% CI)[a]
	Event	PY	Rate	Event	PY	Rate		
Hospitalization	1088	1357	80.2	999	1459	68.5	0.86 (0.79,0.94)***	0.85 (0.78, 0.92)***
Pneumonia/influenza	154	1854	8.31	146	1927	7.58	0.91 (0.73, 1.14)	0.90 (0.72, 1.13)
Septicemia, bacteremia and viremia	224	1847	12.1	184	1929	9.54	0.79 (0.65, 0.96)*	0.79 (0.65, 0.96)*
Respiratory Failure	133	1886	7.05	113	1959	5.77	0.82 (0.64, 1.05)	0.83 (0.64, 1.06)
Stroke	109	1866	5.84	99	1938	5.11	0.88 (0.67, 1.15)	0.87 (0.66, 1.14)
Heart disease	287	1783	16.1	226	1873	12.1	0.75 (0.63, 0.90)**	0.74 (0.63, 0.89)***
Peritonitis	405	1719	23.6	356	1799	19.8	0.84 (0.73, 0.97)*	0.84 (0.73, 0.97)*
Intensive care unit	352	1802	19.5	314	1879	16.7	0.86 (0.74, 1.00)*	0.85 (0.73, 0.99)*
Mortality	302	1912	15.8	202	1979	10.2	0.65 (0.54, 0.77)***	0.66 (0.55, 0.78)***

PY, person-years; rate, incidence rate, per 100 person-years; crude HR, crude hazard ratio.
[a]Adjusted for age, sex, comorbidities, icodextrin use and calendar year.
*$P \leq 0.05$; **$P < 0.01$; ***$P < 0.001$.

Wang et al, Nephrol Dial Transplant 2016

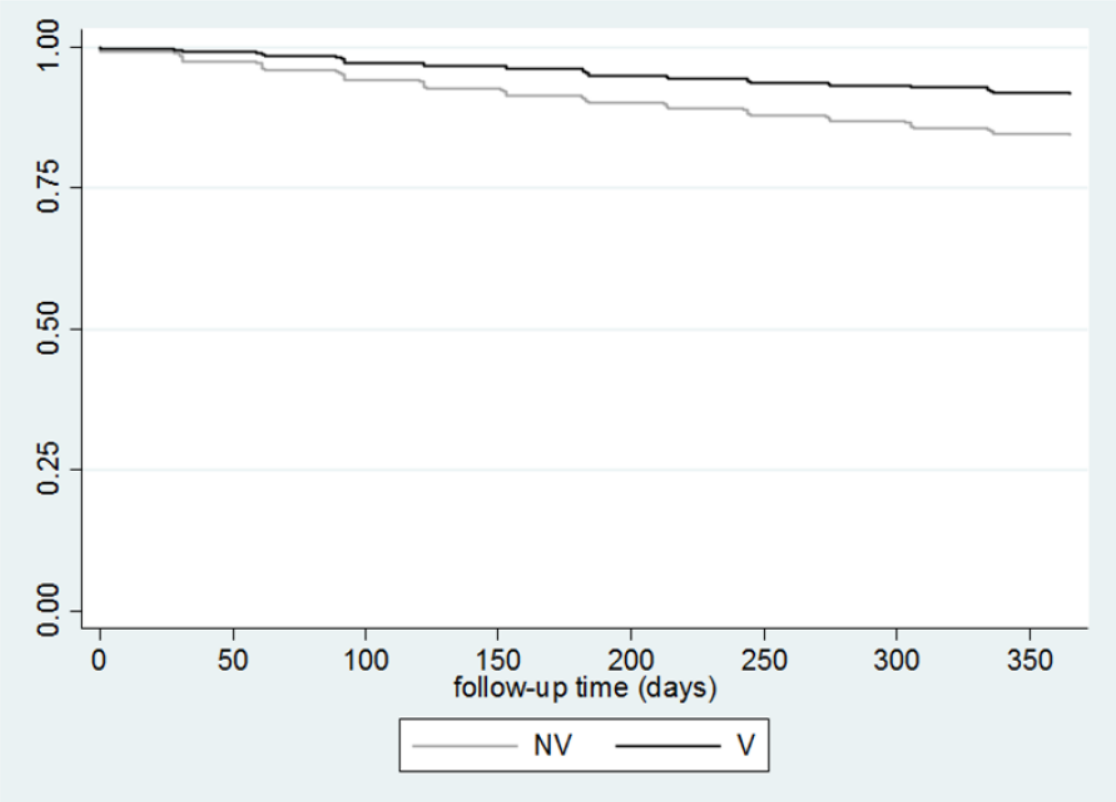
Prescription of at least one anti-pneumococcal conjugate vaccine is independently associated with survival in patients starting dialysis.

French dialysis registry

- 8294 incident dialysis patients
- 1849 vaccinated prior to or after dialysis start

✓ PCV13 + PPSV23
✓ PCV13 alone
✓ PPSV23 alone

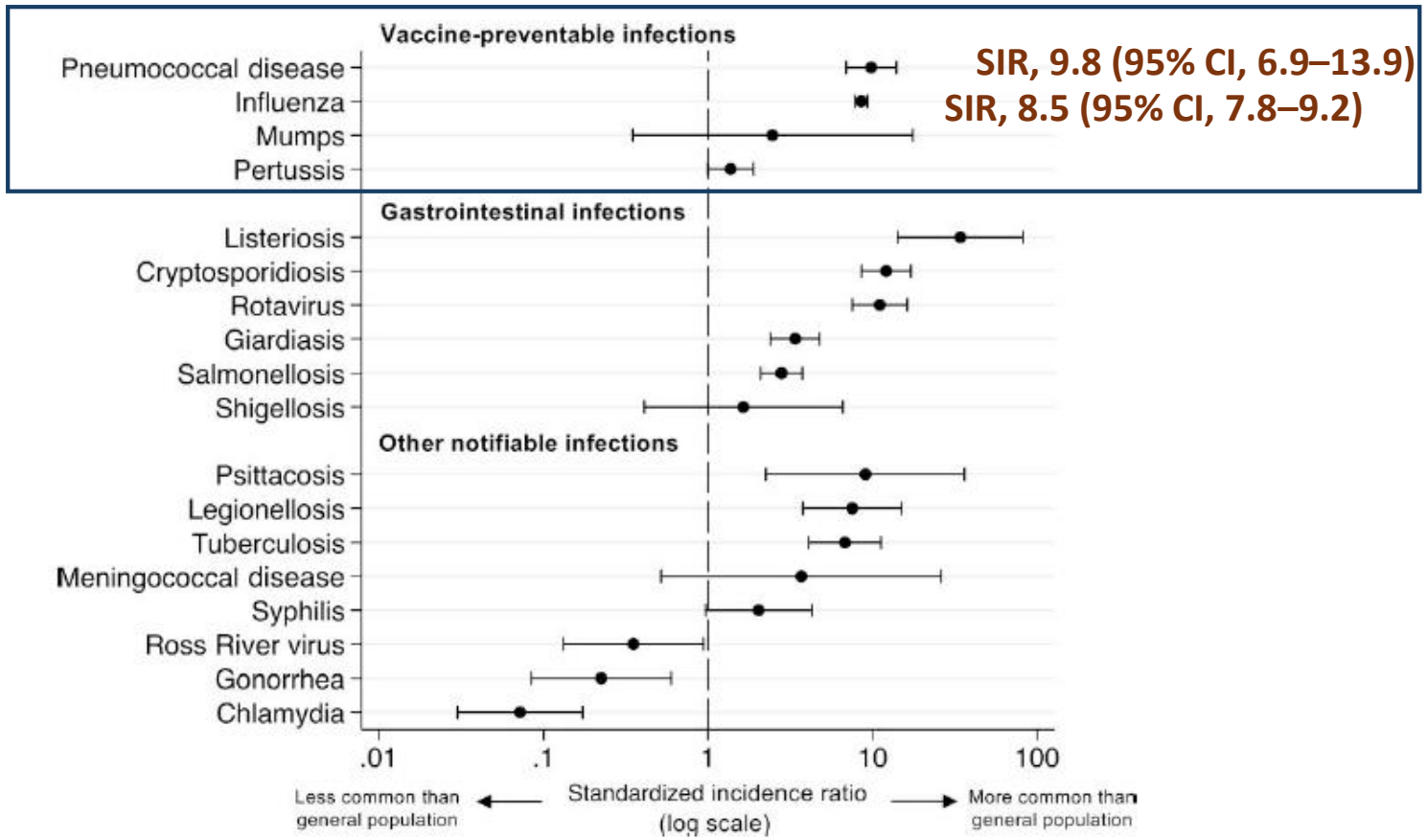
Vaccination reduced the risk of mortality by 49%.

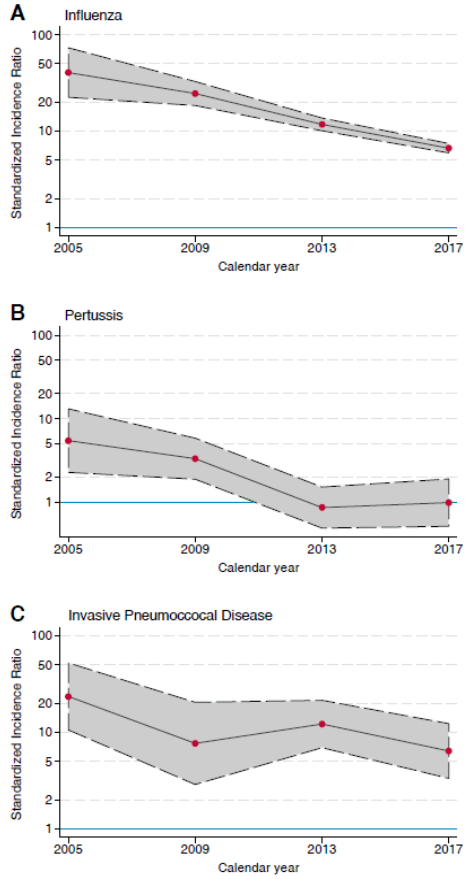


Pierre et al, Vaccine. 2023

The excess burden of influenza and IPD highlights the importance of vaccinations for transplant recipients.

- 4858 solid organ recipients followed for 39 183 person-years





Standardized incidence ratios with 95% CI of infections after transplant.

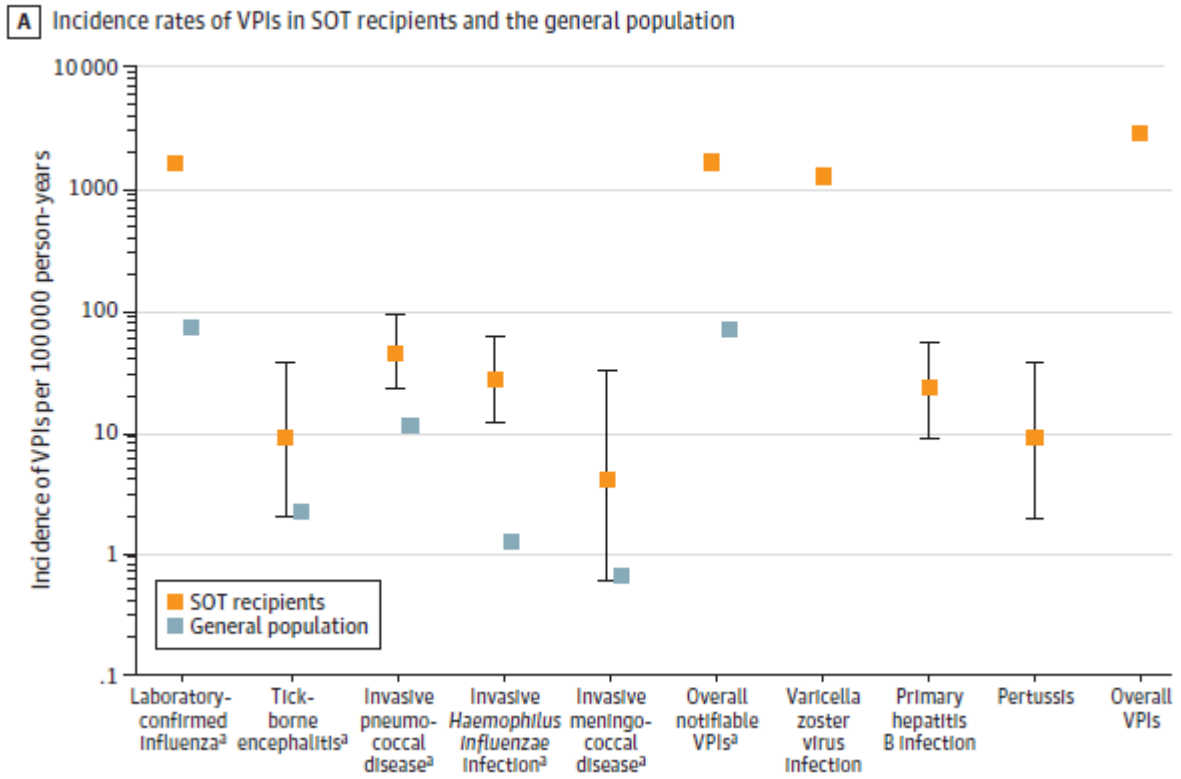
Waller et al, Open Forum Infect Dis. 2022

The occurrence of a VPI is associated with an increased risk for graft loss or death in SOT recipients.

- 4967 SOT recipients in Switzerland

HR = 2.44 for death and/or graft loss (95%CI, 1.50-3.99; P = 0.002)

Figure 2. Vaccine-Preventable Infections (VPIs) in Solid Organ Transplant (SOT) Recipients and the General Population



VPIs > X 27 higher in SOTR vs the general population

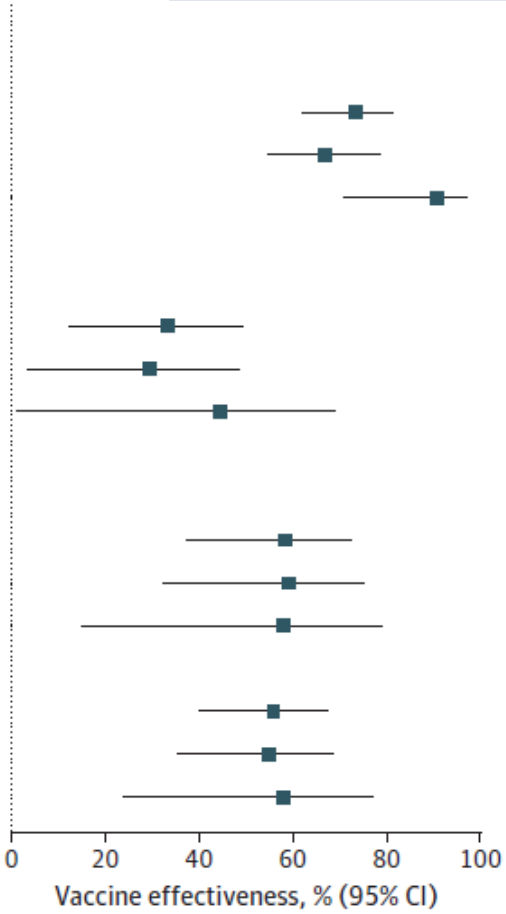
Walti et al, JAMA Netw Open. 2023

In SOTRs RSV vaccine effectiveness against ARI ranged from 50% to 69% and from 55% to 58% for ARI-associated hospitalization.

vaccine effectiveness = 75% among adults > 60 years

B Transplant recipients

Age group, y	No. of vaccinated cases/total No. (%)	No. of vaccinated controls/total No. (%)	Vaccine effectiveness, % (95% CI)
Solid organ transplant recipients			
ARI			
≥60	32/847 (3.8)	1492/11614 (12.8)	73.4 (61.9-81.4)
60-74	29/634 (4.6)	1068/8449 (12.6)	66.9 (54.6-78.4)
≥75	3/213 (1.4)	424/3165 (13.4)	90.8 (71.0-97.1)
Hematopoietic stem cell transplant recipients			
ARI			
≥60	62/626 (9.9)	650/4587 (14.2)	33.4 (12.3-49.4)
60-74	48/492 (9.8)	476/3584 (13.3)	29.4 (3.5-48.4)
≥75	14/134 (10.4)	174/1003 (17.3)	44.4 (1.0-68.8)
Transplant recipients			
ED/UC			
≥60	26/450 (5.8)	453/3528 (12.8)	58.4 (37.4-72.3)
60-74	17/328 (5.2)	309/2623 (11.8)	59.1 (32.4-75.2)
≥75	9/122 (7.4)	144/905 (15.9)	57.9 (15.1-79.1)
Hospitalization			
≥60	45/798 (5.6)	1186/9943 (11.9)	55.9 (40.0-67.5)
60-74	33/592 (5.6)	835/7213 (11.6)	54.9 (35.4-68.5)
≥75	12/206 (5.8)	351/2730 (12.9)	58.1 (24.1-76.8)



Fry et al, JAMA Network Open. 2025

Does vaccination pre- or post-transplant increase the risk for rejection?

Does vaccination in solid-organ transplant recipients result in adverse immunologic sequelae? A systematic review and meta-analysis

- 90 studies
- 15645 vaccinated patients
- 42924 control patients

Incidence of de novo DSA (14 studies)

↓

23 of 1244 patients (1.85%) at 21-94 days

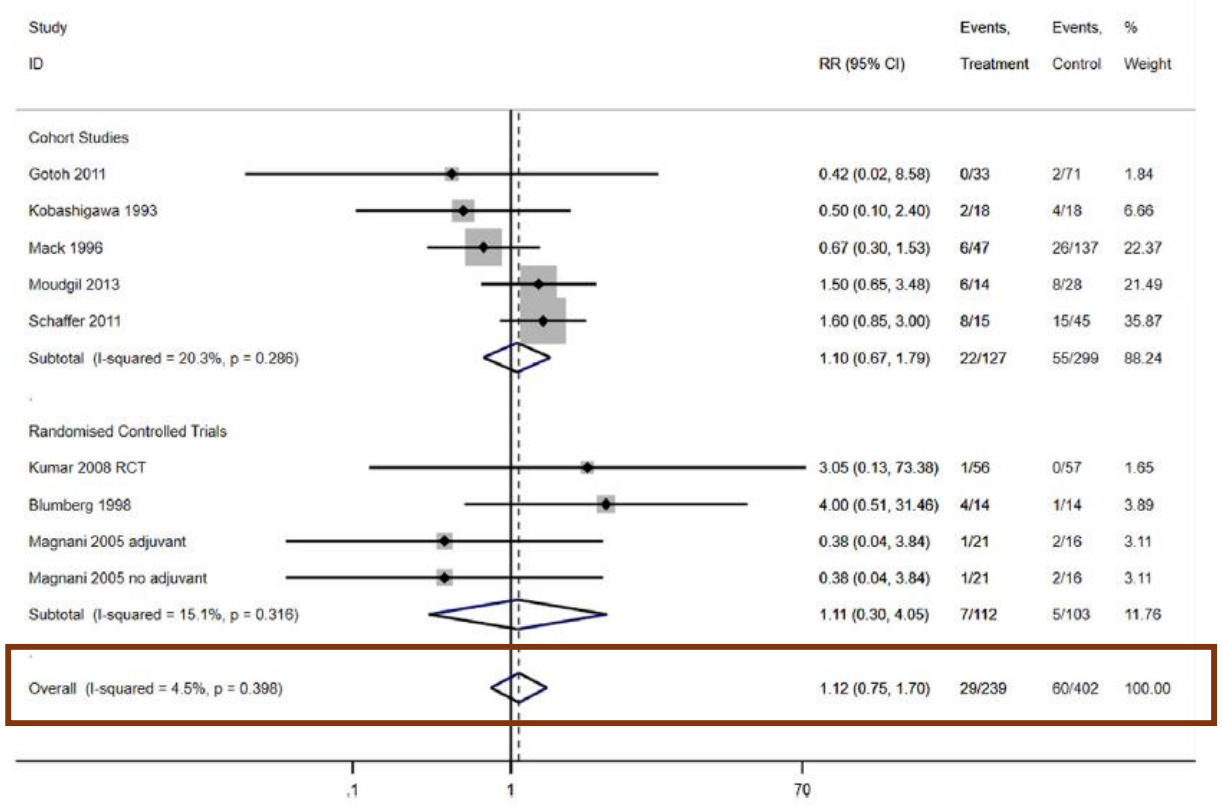
Incidence of rejection (83 studies)

↓

107 of 5116 patients (2.1%) at 0.7-6 months

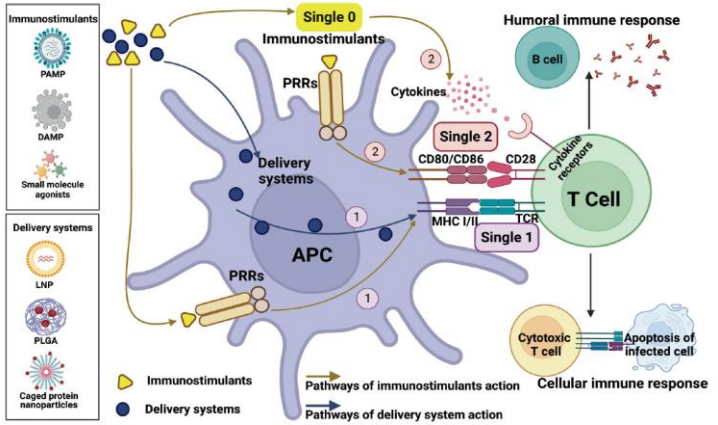
- **8 prospective controlled studies**

✓ **No increased rejection risk with vaccination vs no vaccination.**



Mulley et al, J Heart Lung Transplant 2018

Fears of altering immunotolerance of the transplanted organ when used after Tx



Vaccine Adjuvants in the Immunocompromised Host: Science, Safety, and Efficacy

Haya Hayek[1] | Lana Hasan[2] | Justin Z. Amarin[1,3] | Yasmeen Z. Qwaider[1] | Olla Hamdan[1] | Wanderson Rezende[1] | Kevin C. Dee[4] | James D. Chappell[1] | Natasha B. Halasa[1]

Transplant Infectious Disease, 2025

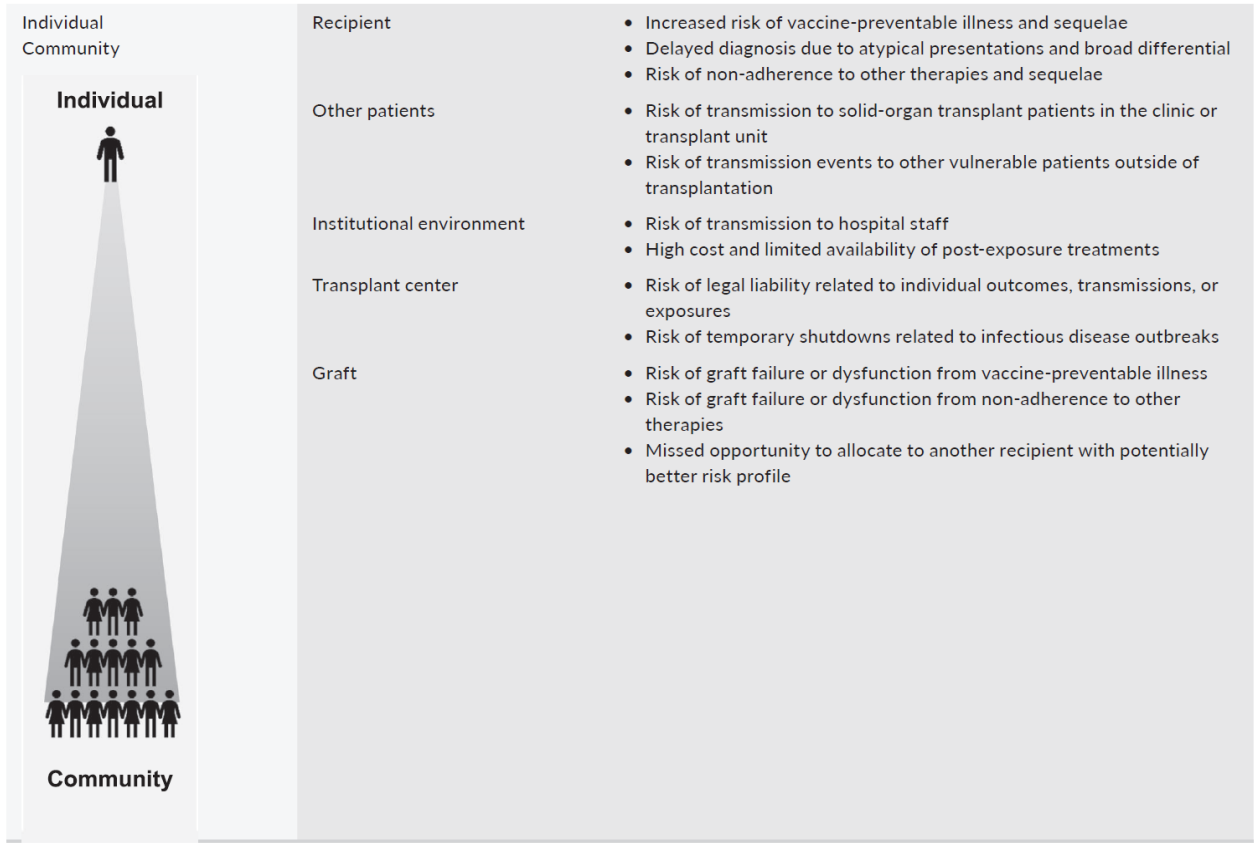
- ✓ **Aluminum salts**
- ✓ **CpG 1018**
- ✓ **MF59**
- ✓ **AS03**
- ✓ **AS01B**

- ○ AS04
- ○ AHQ-II
- ○ Virosomes
- ○ RC-529

How do we encourage vaccine uptake in our patients?

The limits of refusal: An ethical review of solid organ transplantation and vaccine hesitancy

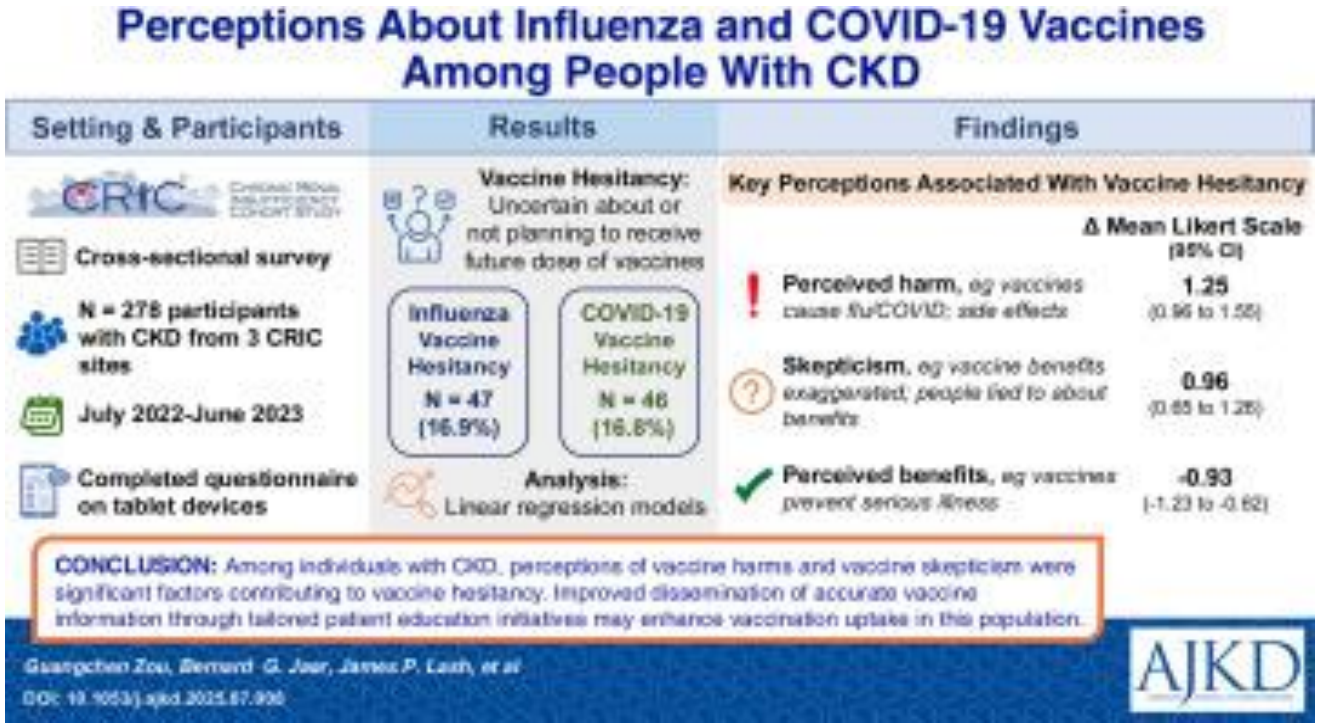
Olivia S. Kates[1,2] | Erica J. Stohs[3] | Steven A. Pergam[1,2] | Robert M. Rakita[1] | Marian G. Michaels[4] | Cameron R. Wolfe[5] | Lara Danziger-Isakov[6] | Michael G. Ison[7,8] | Emily A. Blumberg[9] | Raymund R. Razonable[10] | Elisa J. Gordon[8] | Douglas S. Diekema[11]



Am J Transplant. 2021;21:2637–2645.

Vaccines should be a Core Conversation in Nephrology.

- Nearly 50% of survey responders were uncertain or misinformed about vaccine efficacy and safety in CKD.



COMMUNICATION GAP BETWEEN PATIENTS AND PROVIDERS

Zou et al, Am J Kidney Dis. 2025
Subramanian et al, Am J Kidney Dis. 2025

Improving Vaccination in People With CKD: Report From a National Kidney Foundation Working Group

Susan F. Massengill, Kenneth A. Andreoni, Keith A. Bellovich, Cheryl Courtlandt, Vimal K. Derebail, David L. Feldman, Gia J. Oh, John W. Sleasman, and Kristina A. Bryant, on behalf of the Improving Vaccination in CKD Working Group

Training and Resources for Health Care Workers and Patients With CKD

The Working Group recommends that:

- Educational materials about evidence-based, CKD disease–specific vaccine recommendations be developed to support health care workers, patients, and families.
- Vaccine-specific discussion scripts using best practice phrasing, be developed by professional and patient organizations for clinicians to use to discuss vaccines more confidently with patients with CKD.
- Nephrology and primary care clinics should consider establishing vaccine champion(s) who lead and coordinate activities for patient vaccinations.

Training of Health Care Teams for Vaccination Discussions With Patients With CKD

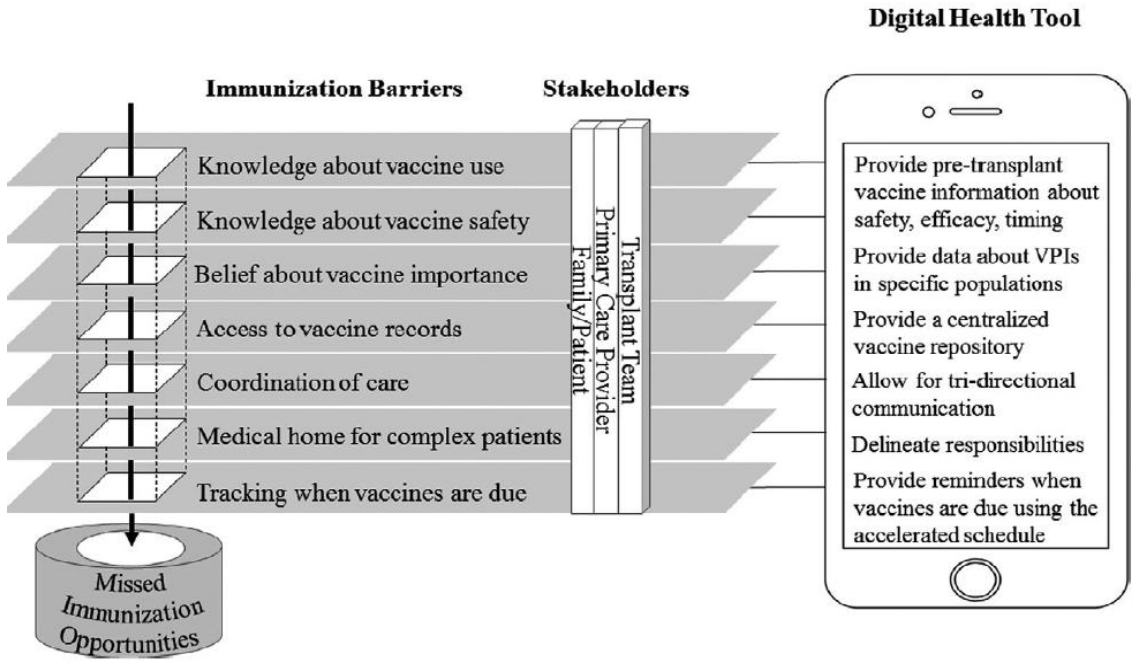
The Working Group recommends that:

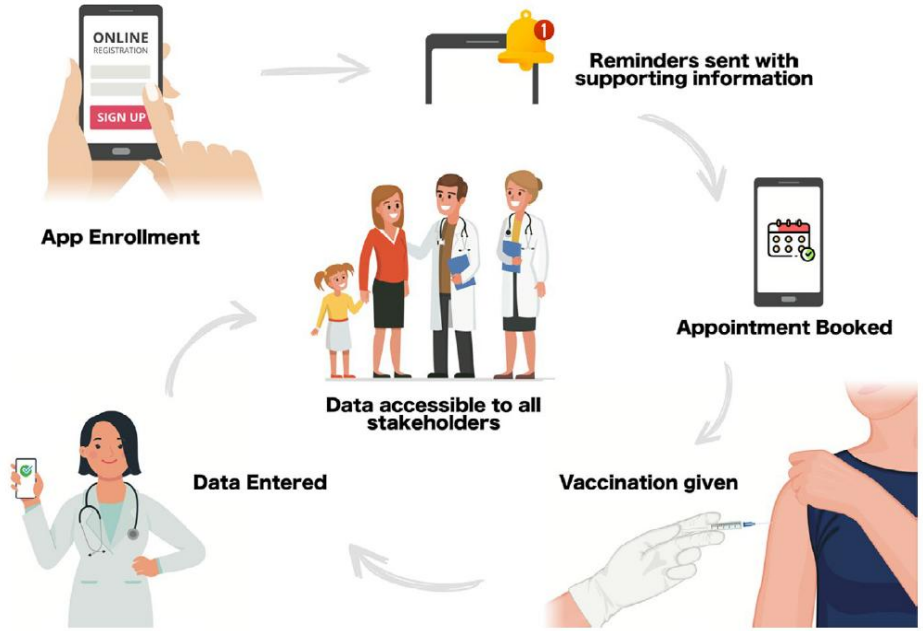
- Health care teams, including primary care and nephrology clinicians and staff, receive formal training on
  - The importance of vaccination in the early stages of CKD, given reduced vaccine efficacy with advancing CKD.
  - The delivery of evidence-based vaccine information to patients with CKD and their families while accounting for the patient's background and beliefs.
  - Communicating scientific information and addressing myths.

Massengill et al, Am J Kidney Dis 2025

Digital health technologies may offer a solution by addressing transplant-specific barriers.

- ✓ Technology be leveraged to accurately track and promote age-appropriate vaccines for people with CKD.
- ✓ **A national vaccine registry exists for all patients.**





Feldman et al, Am J Transplant. 2020
Massengill et al, Am J Kidney Dis 2025

Future directions

- Clinical trials to evaluate the safety and efficacy of vaccines should include people with CKD.
- How to monitor protection and then under what circumstances to administer a booster vaccine remain unclear.
- The available data on vaccine uptake clearly indicate a gap in care, which is systematic and present across all programs and geographic areas.
- There is also hope that vaccines will become available against pathogens that have been difficult to combat for years, such as CMV, HCV, malaria.

The development of a systematic approach tailored to the specifics of the individual programs improves the vaccination status after introducing a regular workup in all candidates.

- Immunization history
- Serological immunity at listing (ELISA for HAV, HBV, measles, VZV, tetanus toxoid, pneumococci).

- ✓ Vaccination records very rarely available (8%) despite years of follow-up.
- ✓ Vaccine serology readily identified patients with or without immunity againstVPIs.
- ✓ Vaccine history is less useful screening to identify patients requiring a booster dose *vs* serology.

Blanchard-Rohner et al, Am. J. Transplant 2019

There is a systematic gap in care, present across all programs and geographic areas.

- Rochester Epidemiology Project
- **468 adult SOT recipients (70% KTRs)**

Vaccination rates of:

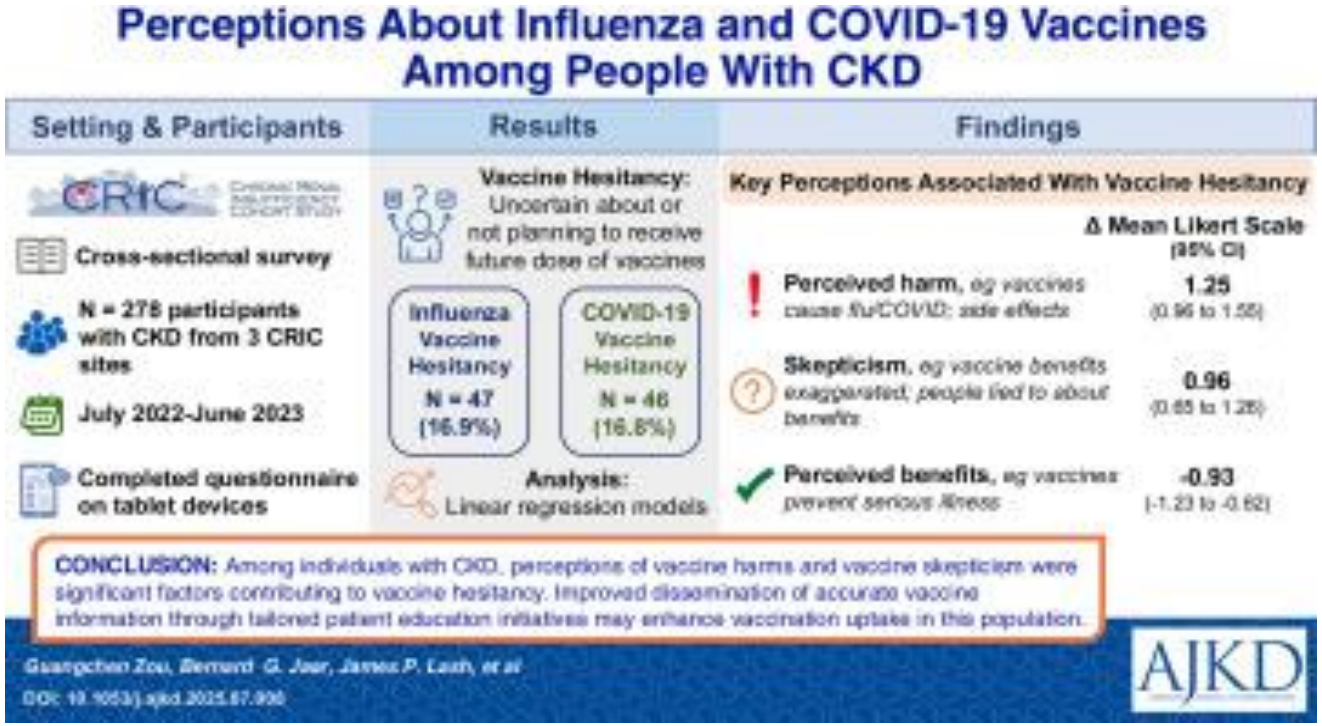
- ➢ **57% to 63% for influenza**
- ➢ **56% for pneumococcal vaccines**

- ✓ living outside urban centers
- ✓ lower socioeconomic status

Time transplant patients spent undervaccinated.

Felzer et al, Transpl Infect Dis. 2023

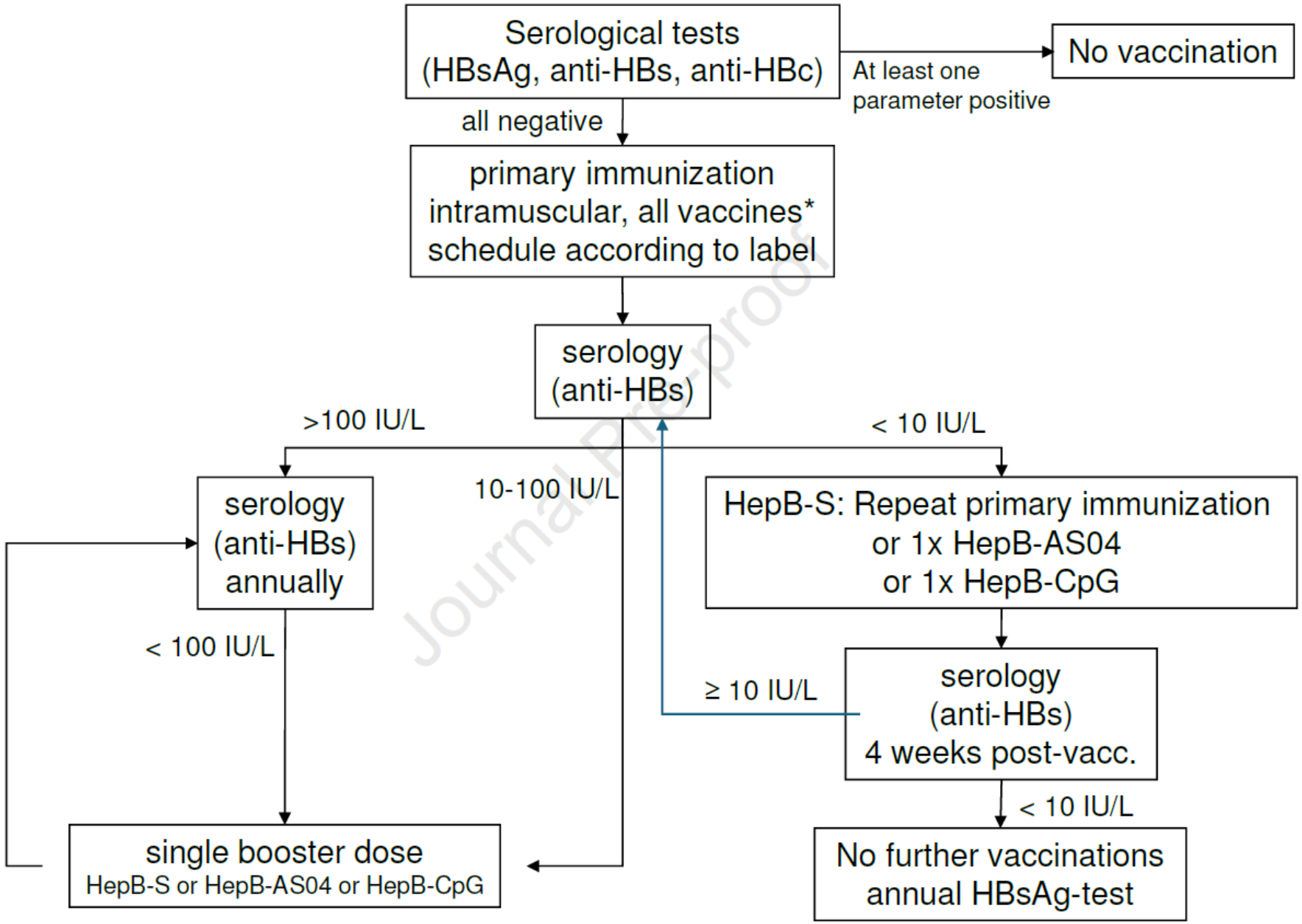
nearly 50% of survey responders were uncertain or misinformed about vaccine efficacy and safety in CKD



Strategies to Enhance Vaccine Uptake in Patients With CKD

- ✓ Presumptive campaign
- ✓ Motivational interviewing
- ✓ Acknowledge side effects and benefits
- ✓ Designate vaccine champions
- ✓ Tailored education materials
- ✓ Reminder and recall systems

Zou et al, Am J Kidney Dis. 2025
Subramanian et al, Am J Kidney Dis. 2025



Journal Pre-proof

Special Situations

Complement Inhibitors

- Meningococcal vaccination with booster dose
- Antibiotic prophylaxis during therapy and to continue 6 weeks post completion of therapy

Elderly

- Loss of vaccine efficacy
- May require booster dosing esp. Pneumococcal, Tdap
- Consider checking Hep B titers
- RSV and VZV vaccination
- Annual vaccination

Exposure to Live vaccination

- When possible, consider inactivated vaccines for close contacts
- Generally, live vaccines are safe; however, special caution is needed with Rotavirus and Oral Polio vaccines due to fecal shedding
- Proper hand hygiene and avoiding diaper changes are recommended

Travel

- Avoid travel first 12 months and 3 months post rejection therapy
- Visit Travel clinic specializing in transplant population
- Avoid high risk areas