

## Vaccination Strategies in Adult Dialysis Patients: A Global, Temperate-Tropical Epidemiological Feature

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### Abstract

**Background:** Patients receiving maintenance dialysis have elevated risks of vaccine-preventable infections and reduced vaccine immunogenicity due to uremia-associated immune dysfunction and repeated healthcare exposure. Geographic variation in infectious burden influences vaccination strategy implementation.

**Objective:** To comprehensively review immunization procedures in adult dialysis patients, integrating immunologic mechanisms, clinical effectiveness, global epidemiologic variation (temperate vs tropical differences), and implementation practices.

**Methods:** Narrative synthesis of systematic reviews, clinical studies, and expert recommendations pertaining to vaccine immunogenicity and clinical outcomes in chronic kidney disease and dialysis populations.

**Results:** Enhanced hepatitis B vaccine regimens improve seroprotection and survival. Combined influenza and pneumococcal vaccination are associated with reduced all-cause mortality in dialysis patients. COVID-19 vaccination elicits robust humoral responses with acceptable safety profiles, though effectiveness is lower than in healthy controls. Tropical regions face higher endemic burdens of hepatitis B and year-round influenza, requiring context-adapted protocols. Implementation science suggests dialysis-unit-based vaccination programs improve uptake and outcomes.

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**Conclusion:** *Immunization in dialysis patients requires higher-dose regimens, booster strategies, and context-specific adaptation to regional epidemiologic patterns. Dialysis facilities should adopt structured vaccination frameworks to reduce infection-related morbidity and mortality globally.*

**Keywords:** COVID 19; Hepatitis; Nephrology; Pneumococcus; Vaccination.

## Introduction

Infection is a leading contributor to morbidity and mortality in patients with end-stage renal disease on maintenance dialysis, owing to both intrinsic immune dysfunction and repeated healthcare exposure. Patients with chronic kidney disease exhibit impaired antigen presentation, dysfunctional T- and B-cell responses, and chronic inflammation, which contribute to attenuated vaccine responses across multiple vaccine types (1). Geographic differences in infectious disease epidemiology further affect vaccine strategies, particularly when comparing temperate and tropical settings. This review synthesizes current evidence on immunization in adult dialysis patients, emphasizing both clinical efficacy and global implementation differences.

Chronic kidney disease leads to immune dysregulation characterized by impaired antigen presentation, reduced naïve T-cell populations, diminished B-cell function, and chronic systemic inflammation, collectively diminishing immune responses to vaccination. These perturbations explain observed reductions in seroconversion following vaccination against hepatitis B, influenza, pneumococcus, and SARS-CoV-2 in dialysis cohorts relative to healthy controls.

Hepatitis B virus remains a significant risk in dialysis units due to blood exposure. Dialysis patients historically show a lower seroprotection rate than healthy adults after standard hepatitis B virus vaccine dosing. High-dose or double-dose regimens are recommended, with repeated boosters based on

anti-HBs titers due to waning immunity.

Evidence indicates vaccination is most effective when given before dialysis initiation, likely due to higher pre-dialysis immunocompetence. Despite advances, many dialysis patients remain non-responders, highlighting ongoing challenges.

Annual inactivated influenza vaccination is recommended for all adult dialysis patients (1). Many cohort studies show influenza vaccine administration reduces influenza-related hospitalization and may lower cardiovascular and all-cause mortality in chronic kidney disease populations.

Prospective immunogenicity studies demonstrate that standard-dose inactivated vaccines elicit adequate humoral and cellular responses in dialysis patients, though some cohorts have lower relative antibody titers compared with healthy controls (2). Repeated annual vaccination does not appear to impair subsequent immune responses and may enhance protective responses.

Dialysis patients are at high risk for invasive pneumococcal disease. Meta-analytic evidence supports the effectiveness of pneumococcal vaccinations (particularly when combined with influenza vaccination), showing reduced all-cause mortality and cardiovascular events in vaccinated dialysis patients compared with unvaccinated individuals (3). Recommendations include conjugate vaccines (e.g., PCV15 or PCV20) with appropriate polysaccharide boosters.

Dialysis patients suffered disproportionate morbidity and mortality during the COVID-19 pandemic. Systematic reviews demonstrate that SARS-CoV-2 vaccination results in high immunogenicity rates (~85%-90%) but lower antibody titers and more rapid waning than in healthy cohorts (4). Safety profiles in dialysis populations are similar to the general population, with primarily benign injection-site and systemic reactions reported. Observational data support that vaccination reduces severe COVID-19 outcomes, though ongoing booster strategies are necessary given immune waning.

### Comparative temperate versus tropical vaccination contexts

Domain	Temperate Settings	Tropical Settings
Influenza seasonality	Winter peaks, predictable	Year-round or bi-modal
Hepatitis B virus endemicity	Low-moderate	Moderate-high
Vaccine supply stability	Generally stable	May face intermittent cold-chain issues
Enteric pathogens (hepatitis A virus, etc.)	Often endemic but lower adult susceptibility	High endemicity and exposure
Serologic monitoring access	Widely available	Often limited by lab infrastructure

**Recombinant Zoster Vaccine:** Recommended for adults  $\geq 50$  years, including dialysis patients, due to increased risk of herpes zoster. Non-live recombinant formulations are preferred given immunosuppression.

**Tdap and Adult Boosters:** tetanus-diphtheria-pertussis boosters and age-appropriate vaccines remain part of standard immunization schedules.

**Hepatitis A:** in tropical regions with higher enteric disease prevalence, hepatitis A vaccination may be more broadly indicated.

In temperate climates, influenza vaccination campaigns are usually seasonal and timed before winter months. In contrast, tropical regions may have less predictable influenza activity, requiring more flexible vaccination schedules. Tropical low-resource settings also face frequent cold-chain challenges, limited access to serologic monitoring, and greater background burdens of hepatitis B and enteric pathogens, all of which influence vaccination strategy planning and implementation.

Dialysis facilities are uniquely positioned to deliver vaccinations effectively due to frequent patient contact. Best practices include standing protocols, regular assessment of vaccination status, integration of electronic reminders into health records, and on-site vaccine availability. Studies show that physician and nurse vaccination recommendations significantly impact patient vaccination rates.

Dialysis patients often represent medically and socioeconomically vulnerable populations. Barriers to vaccination include vaccine hesitancy, limited healthcare access, and financial constraints. Policies that classify dialysis patients as high-priority groups for adult immunization, improve vaccine supply chains, and provide culturally competent education can improve uptake and outcomes.

Key areas for future study include: optimization of vaccine schedules and dosing specifically for dialysis immunocompromise; longitudinal studies on vaccine effectiveness against clinical endpoints; evaluation of new vaccines (e.g., respiratory syncytial virus - RSV) in dialysis cohorts and health systems research on reducing disparities in vaccine access.

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## Conclusion

Immunization remains a cornerstone of preventive care for adult dialysis patients. Enhanced vaccination doses, booster strategies, and context-adapted schedules that account for temperate vs tropical epidemiology can significantly reduce infection-related morbidity and mortality. Dialysis facilities should adopt structured vaccination programs and advocate for their patients within broader public health frameworks.

## Acknowledgments

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## Conflicts of interest

No conflict of interest.

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