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Vaccination Status, Knowledge Levels, and Influencing Factors Among Hemodialysis Patients: A Study from Istanbul

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ABSTRACT

Background: This study aimed to evaluate the vaccination rates, knowledge levels, and the influence of demographic, socioeconomic, and health perception factors on the uptake of influenza, pneumococcal, hepatitis B, and COVID-19 vaccines among patients undergoing hemodialysis (HD).
Methods: Between February and March 2024, a structured questionnaire was administered to 224 patients from 3 HD centers (3 private, 1 public) in Istanbul. The survey collected data on demographic characteristics, vaccination status, attitudes toward vaccines, and sources of vaccine-related information. Data were analyzed using SPSS, version 22.0.
Results: The vaccination rates were 77.2% for influenza, 56.1% for pneumococci, 85.7% for COVID-19, and 90.5% for hepatitis B. However, only 32.6% of participants had received all 4 recommended vaccines. Vaccination status was significantly associated with age, gender, education level, marital status, type of health insurance, and dialysis duration. The most commonly cited reasons for non-vaccination were "not perceiving vaccination as necessary" and "lack of adequate information." Nephrologists were identified as the most trusted source of vaccine information by 95.5% of participants.
Conclusion: Vaccination rates—particularly for pneumococcal disease—were higher than those reported in previous studies, potentially due to increased post-pandemic health awareness and active recommendations by healthcare professionals. Enhancing vaccine uptake in the HD population requires a comprehensive approach that addresses not only informational barriers but also perceived risk, healthcare access, and social support. These findings underscore the need for targeted educational efforts and policy-level strategies to improve vaccination coverage in this high-risk group.
Keywords: COVID-19, hemodialysis, influenza, pneumococcal vaccine, vaccination

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INTRODUCTION

Chronic kidney disease (CKD) is a major public health problem affecting approximately 10%-15% of the adult population globally. In the United States, more than 30 million adults have CKD, and the incidence of end-stage kidney disease (ESKD) is on the rise each year. In 2016, 124 675 new ESKD cases were reported in the US, bringing the total number of patients to 726 331.[1] In Türkiye, the Ministry of Health's 2018-2023 Kidney Diseases Prevention and Control Program reported that CKD is 15.7%. This indicates that 1 out of every 6-7 adults has kidney disease.[2] The Turkish Society of Nephrology's 2023 data reports the ESKD incidence as 159.8 per million population.[3]

Patients undergoing hemodialysis (HD) treatment are at a significantly increased risk for vaccine-preventable infections. Infections are the second leading cause of mortality in this group, accounting for 30%-36% of deaths.[4] This vulnerability stems from complex immunological disorders associated with uremia and the dialysis process itself. Mechanisms such as reduced T-cell

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function, slowed lymphocyte proliferation, and inadequate antigen presentation weaken both the cellular and humoral immune systems, increasing susceptibility to infections.[5]

In addition to immune response disorders, the structural characteristics of HD treatment also elevate the risk of infection. Hemodialysis patients encounter infectious agents more frequently due to frequent visits to healthcare facilities, recurrent vascular access procedures, invasive interventions, and shared dialysis equipment. Pneumonia caused by *Streptococcus pneumoniae* is a significant cause of mortality in this population, with a 14-16 times higher risk of pneumonia-related death compared to the general population.[6] The COVID-19 pandemic further revealed the fragility of HD patients, who experienced high mortality rates.[7] Seasonal influenza can lead to serious outcomes for these patients.[8]

Hepatitis B virus remains more prevalent in HD patients than in the general population despite its overall decline.[9]

Vaccination is an effective and economical strategy for protecting HD patients from infections. Although immune responses may be reduced in this population, vaccines remain safe and beneficial. Influenza, pneumococcal, and HBV vaccines are core recommendations in national and international guidelines,[10] and the COVID-19 pandemic has further underscored their importance. Vaccination reduces mortality, hospitalizations, and healthcare costs. However, coverage among HD patients remains suboptimal. The most commonly reported barrier is insufficient knowledge or awareness, with studies from multiple countries—including Nigeria and Türkiye—demonstrating a clear association between inadequate information and vaccine refusal.[11-13] Thus, the effectiveness of patient education and the role of healthcare professionals are critical for improving vaccine acceptance.

This study aims to assess HD patients' knowledge and behaviors related to vaccination and to examine how demographic, socioeconomic, lifestyle, and perceptual factors influence vaccine uptake. Building on gaps in the existing literature, it also offers several contributions. Conducted in the post–COVID-19 period—when vaccine attitudes and risk perceptions have shifted—it evaluates 4 major vaccines recommended for HD patients (influenza, pneumococcal, HBV, and COVID-19), unlike many prior studies that focus on only 1 or 2.

MAIN POINTS

- While hepatitis B (90.5%) and COVID-19 (85.7%) vaccination rates were relatively high, only 32.6% of hemodialysis patients were fully vaccinated against all 4 major infections, with pneumococcal coverage remaining the lowest (56.1%).
- Vaccination uptake was significantly associated with factors such as age, marital status, education level, dialysis duration, and health insurance type—highlighting the influence of both individual and systemic determinants.
- The most frequently cited barriers to vaccination were low perceived need, lack of information, and concerns about vaccine safety and efficacy, especially for COVID-19 and pneumococcal vaccines.
- Contrary to expectations, lower perceived risk from influenza or its side effects was associated with higher vaccination rates, indicating a complex relationship between risk perception and vaccine behavior.
- Improving vaccination rates requires more than provider-based education; targeted public health strategies must address social, cognitive, and structural factors to effectively support preventive care in this high-risk population.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional study was conducted between February 1 and March 31, 2024, among HD patients attending 1 public and 2 private dialysis centers in Istanbul.

Participants

Inclusion criteria were age ≥18 years, receiving maintenance HD for at least 3 months, attending one of the participating centers during the study period, and having the cognitive ability to provide informed consent and complete the questionnaire.

Exclusion criteria included HD duration <3 months, the presence of acute illness at the time of data collection, cognitive impairment preventing reliable participation, severe communication limitations, hospitalization during the study period, and refusal to participate.

A total of 250 patients were eligible during the study period. Twenty-six patients were excluded due to acute illness (n = 8), HD duration <3 months (n = 10), cognitive impairment (n = 4), or refusal to participate (n = 4). Ultimately, 224 patients were included in the analysis, yielding a participation rate of 89.6%.

Questionnaire Development and Data Collection

A structured questionnaire was developed based on a literature review to assess vaccination status for influenza, pneumococcal, hepatitis B, and COVID-19 vaccines, as well as factors influencing vaccination behavior. The first section included sociodemographic variables; the second assessed vaccine uptake and reasons for nonvaccination; the third asked about sources of vaccine information.

The questionnaire was pre-tested in a group of HD patients (n = 10), and minor wording adjustments were made. Although no formal validation study was conducted, pilot testing supported the clarity and acceptability of the instrument. Questionnaires were administered under supervision, and researchers assisted illiterate participants through face-to-face interviews.

Sample Size Considerations

Because the aim of the study was to include all eligible HD patients from the participating centers, no a priori power calculation was performed. The high participation rate demonstrates that the sample reflects nearly the entire dialysis population of these centers.

Ethical Approval

Approval for the study was obtained from the Clinical Research Ethics Committee of İstanbul Medeniyet University Göztepe Training and Research Hospital with protocol number 2023/0899 dated December 20, 2023. Written informed consent was obtained from all participants.

Data Analysis

The data was analyzed using SPSS 22.0 software (IBM SPSS Corp.; Armonk, NY, USA), and the statistical significance level was set at $P < .05$. Continuous variables are expressed as mean ± standard deviation or median, depending on their distribution characteristics. Categorical variables were described using frequencies and percentages (%). The chi-square test was used to assess differences between categorical variables; Fisher's exact test was preferred for inappropriate cell distributions.

To assess independent predictors of completing all recommended vaccinations, a multivariate logistic regression model was constructed. Clinically relevant variables were included in the multivariate model to examine independent associations. Results are presented as odds ratios (OR) with 95% CI.

RESULTS

A total of 224 HD patients were included in the analysis. Demographic characteristics are presented in Table 1. The mean age was 63 ± 137 years, and 68.3% were male. The mean duration of dialysis was 83 ± 71.9 months. Educational status, causes of ESKD, and vaccination knowledge levels are shown in Table 2. The majority of participants were primary or secondary school graduates, while 16.1% had university education. Hypertension (48.7%), diabetes mellitus (17.4%), and polycystic kidney disease (10.3%) were the most common causes of ESKD. Most patients perceived their influenza-related risk as low or moderate.

Awareness of vaccination was high (96.8%, n = 217). Vaccination rates were 77.2% for influenza, 56.1% for pneumococcal, 85.7% for COVID-19, and 90.5% for hepatitis B. A total of 73 patients (32.6%) had completed all 4 recommended vaccines.

Table 1. Sociodemographic Characteristics of the Study Population (n = 224)

		Number	%
Sex	Female	71	31.7
	Male	153	68.3
Age groups	≤59 years	74	33.0
	60-69 years	74	33.0
	70≥ years	76	33.9
Marital status	Married	168	75.0
	Single	24	10.7
	Widowed	32	14.3
Chronic illnes	Yes	187	83.9
	No	36	16.1
Education level	Illiterate	19	8.5
	Literate	17	7.6
	Primary school	90	40.2
	Middle school	26	11.6
	High school	36	16.1
	University/Master/PhD	36	16.1
Employment status	Employed	33	14.7
	Unemployed/retired	191	85.3
Health insurance	Employment-based health insurance	216	96.4
	Government-subsidized health insurance	8	3.6
Smoking status	Never smoked	101	45.1
	Ex-smoker	92	41.1
	Current smoker	31	13.8
Alcohol use	Never used	166	74.4
	Former user	46	20.6
	Current user	11	4.9
Type of chronic illness	Hypertension	160	85.5
	Diabetes	56	29.9
	Coronary artery disease	37	19.7
	Asthma	13	6.9
	Heart failure	22	11.7
	Hypothyroidism	4	2.1
Self-rated health status	Very good/good	106	47.3
	Moderate	110	49.1
	Very poor/poor	8	3.6

Associations Between Participant Characteristics and Vaccination Status

Age: Age was significantly associated with influenza vaccination ($P < .001$) and with completion of all 4 vaccines ($P < .05$). No significant associations were observed for COVID-19, pneumococcal, or hepatitis B vaccination ($P > .05$).

Gender: COVID-19 vaccination differed by gender ($P = .040$), with higher uptake among women. No significant associations were found for other vaccines or for completion of all 4 vaccines ($P > .05$).

Table 2. Demographics, Immunization Knowledge, Vaccine Behavior, and Perceived Influenza-Related Risks in Patients

		N	%
Duration of dialysis treatment (years)	≤5	128	57.1
	5>	96	42.9
Primary cause of ESKD (End Stage Kidney Disease)	Diabetes mellitus	39	17.4
	Hypertension	109	48.7
	Postrenal causes	3	1.3
	Glomerulonephritis	11	4.9
	Polycystic kidney disease	23	10.3
	Unknown	11	4.9
	Other	28	12.5
Awareness that patients on dialysis should be vaccinated	Yes	217	96.9
	No	7	3.1
Receiving information about immunization after starting dialysis	Yes	214	96.4
	No	8	3.6
Trusted sources of information about vaccines (512)	Nephrologist	214	41.8
	Family physician	133	26.0
	Medical journals	4	0.8
	Popular magazine sor newspapers	0	
	Internet	3	0.6
	Family/friends	6	1.1
	Other	152	29.6
Influenza vaccination in the 2023-2024 season	Yes	142	63.4
	No	82	36.6
Intention to receive influenza vaccine in the 2024-2025 season	Yes	151	67.7
	Undecided	34	15.2
	No	38	17.0
Perceived risk of contracting influenza (n = 224)	Very high/high	70	31.3
	Moderate	86	38.4
	Very low/low	68	30.4
Perceived risk of experiencing side effects from influenza vaccine (n = 223)	Very high/high	58	25.9
	Moderate	93	41.5
	Very low/low	73	32.6
Perceived risk of dying from influenza (n = 223)	Very high/high	7	3.1
	Moderate	50	22.3
	Very low/low	167	74.6

Marital Status: Marital status was associated with influenza vaccination (P = .017) and with completing all vaccinations (χ^2 = 7.654, P = .022), with married individuals showing higher rates. No significant associations were found for other vaccines.

Education Level: Education level was significantly associated with influenza vaccination (P = .017). Among individuals aged ≥70 years, education level was significantly related to influenza vaccination (likelihood ratio P = .042). A linear association between education level and influenza vaccination was found in those aged ≤59 years (P = .012). No significant association was detected in the 60-69 age group.

Employment Status: No significant associations were found between employment status and any of the vaccinations or completion of all 4 vaccines (P > .05)

Health Insurance Type: Significant associations were found between health insurance type and COVID-19 (P = .003) and pneumococcal vaccination (P = .011). No significant associations were identified for influenza, hepatitis B vaccination, or completion of all 4 vaccines (P > .05).

Smoking Status: No significant associations were found between smoking and any vaccine (P > .05).

Alcohol Consumption: Alcohol consumption was associated with influenza vaccination (P = .037) but not with other vaccines or completion of all 4 vaccines.

General Health Perception: No statistically significant associations were found between general health perception and vaccination status for any vaccine or completion of all 4 vaccines (P > .05).

Dialysis Duration: Dialysis duration showed significant associations with influenza (P < .001), COVID-19 (P < .001), and pneumococcal vaccination (P < .001). No significant association was found between dialysis duration, hepatitis B, and completion of all 4 vaccines (P > .05).

Risk Perception: Perceived risk of influenza infection was significantly associated with influenza vaccination (P < .05). Perceived risk of influenza-related adverse effects was also significantly associated with vaccination (P < .001). No significant association was found between perceived risk of influenza-related death and vaccination status (P = .170) (Table 3).

In the multivariate logistic regression model including age group, gender, education level, marital status, employment status, health insurance type, smoking status, alcohol use, self-rated health perception, and dialysis duration, only marital status and dialysis duration were identified as independent predictors of completing all recommended vaccinations.

Being single was significantly associated with lower odds of full vaccination compared with being married (OR = 0.098, P = .016). Longer dialysis duration increased the likelihood of completing all 4 vaccines (OR = 1.007 per month, P = .003). No other variables retained significance (P > .05).

Table 3. *P* values for Associations Between Participant Charactteristics and Vaccination Status

Variable	Influenza	Pneumococcal	COVID-19	Hepatitis B	Total Number of Vaccines
Age group	**<.001**	>.05	>.05	>.05	**.02**
Gender	>.05	>.05	**.040**	>.05	>.05
Marital status	**.017**	>.05	>.05	>.05	**.02**
Education level	**.017**	>.05	>.05	>.05	>.05
Aged ≥70 years	**.042***	>.05	>.05	>.05	>.05
Aged ≤59 years (linear)	**.012***	>.05	>.05	>.05	>.05
Employment status	>.05	>.05	>.05	>.05	>.05
Health insurance type	>.05	**.011**	**.003**	>.05	>.05
Smoking status	>.05	>.05	>.05	>.05	>.05
Alcohol consumption	**.037**	>.05	>.05	>.05	>.05
General health perception	>.05	>.05	>.05	>.05	>.05
Dialysis duration	**<.001**	**<.001**	**<.001**	>.05	>.05
Risk perception of influenza-infection	**<.05**	—	—	—	—
Risk perception of influenza adverse effects	**<.001**	—	—	—	—
Risk perception of influenza-death	.170	—	—	—	—

Values in bold and marked with asterisks (*) indicate statistical significance at the level.

Reasons for Non-Vaccination and Sources of Information

Across all 4 vaccines, the most common reason for non-vaccination was perceiving the vaccine as unnecessary. Lack of awareness was frequently reported for pneumococcal and hepatitis B vaccines. Concerns regarding safety and effectiveness were more commonly noted among individuals who were unvaccinated for COVID-19. Details of non-vaccination reasons are shown in Table 4.

Table 4 provides a detailed breakdown of the specific reasons for non-vaccination across all vaccine types.

For influenza, the most commonly reported reasons were not seeing the vaccine as necessary (29.0%), relying on alternative prevention methods (10.7%), and concerns about previous or potential side effects (7.5% and 9.6%). For pneumococcal vaccination, the leading reasons were lack of awareness (31.0%) and perceiving vaccination as unnecessary (34.0%). Other reasons were infrequent.

For COVID-19, concerns about vaccine effectiveness or safety (22.2%), pharmaceutical industry conspiracy beliefs (11.1%), and perceptions of low necessity (30.5%) were more prominent. For hepatitis B, the most common reason was perceiving vaccination as unnecessary (57.1%), followed by lack of information (9.5%) and safety concerns (4.8%). Additional reasons—such as logistical difficulties, fear of pain, or low perceived risk—were reported less often. Full distributions are shown in Table 4.

Table 5 summarizes information sources. Nephrologists were the primary source (95.5%). Other reported sources included family physicians (26.0%), other healthcare staff (29.6%), family/friends (1.1%), medical journals (0.8%), and the internet (0.6%).

DISCUSSION

This study evaluated influenza, pneumococcal, hepatitis B, and COVID-19 vaccination among 224 HD patients from 3 centers in Istanbul. By integrating demographic, socioeconomic, behavioral, and risk-perception variables into a unified analytical framework, the study provides a more comprehensive understanding of determinants of vaccination and supports the development of targeted strategies to improve coverage in this high-risk population.Vaccination rates of 77.2% for influenza, 56.1% for pneumococcal, 85.7% for COVID-19, and 90.5% for hepatitis B were found. Notably, pneumococcal vaccination rates were substantially higher than those reported in earlier HD studies, in which coverage often ranged from 14% to 23%.[12-14]

Several key factors may explain this difference. Istanbul, as a large metropolitan area, provides easier access to healthcare and more frequent patient–provider interactions. In addition, the post–COVID-19 period likely increased general vaccine awareness, contributing to improved uptake of both influenza and pneumococcal vaccines. Despite these relatively higher rates, influenza vaccination in the cohort only slightly exceeded the World Health Organization target of 75%.[15]

Table 4. Vaccination Status and Reasons for Non-Vaccination Among Hemodialysis Patients for Influenza, Pneumococcus, COVID-19, and Hepatitis B

	Influenza	Pneumococcus	COVID-19	Hepatitis B (n = 222)
Vaccination status				
Vaccinated, n (%)	173 (77.2)	125 (56.1)	192 (85.7)	201 (90.5)
Not vaccinated, n (%)	51 (22.8)	98 (43.9)	32 (14.3)	21 (9.5)
Reason for not being vaccinated	n = 93	n = 103	n = 36	n = 21
Unaware of vaccine recommendation	7 (7.5)	32 (31.0)	5 (13.8)	1 (4.8)
Doesn't see it as necessary	27 (29)	35 (34.0)	11(30.5)	12 (57.1)
Not enough information	4 (4.3)	1 (0.9)	1 (2.8)	2 (9.5)
Conspiracy of the pharmaceutical industry	1 (1)	0	4 (11.1)	0
Doesn't find it effective or safe	9 (9.6)	2 (1.9)	8 (22.2)	1 (4.8)
Fears side effects experienced before	7 (7.5)	1 (0.9)	1 (2.8)	0
Fears possible side effects of the vaccine	9 (9.6)	2 (1.9)	2 (5.6)	1 (4.8)
Finds the vaccine expensive	1 (1)	0	0	0
Because an extra doctor's appointment is needed	0	1 (0.9)	0	0
Fears pain during vaccination	3 (3.2)	2 (1.9)	1 (2.8)	0
Didn't get vaccinated because there was no vaccine when they went	1 (1)	0	0	0
Can be protected by other methods	10 (10.7)	5 (4.9)	0	0
Doesn't see themselves at risk for this disease	1 (1)	5 (4.9)	1 (2.8)	1 (4.8)
Thinks they wil easily overcome the illness if they get sick	12 (13)	5 (4.9)	0	0
Other	1 (1)	12 (11.7)	2 (5.6)	3 (14.3)

When examining the factors influencing vaccination rates, dialysis duration, education level, marital status, health insurance status, age, and gender emerged as prominent. Dialysis duration emerged as an important determinant: patients on HD for more than 5 years had significantly higher pneumococcal and COVID-19 vaccination rates, whereas influenza vaccination was more common among those with shorter dialysis duration. The higher uptake among long-term HD patients may reflect more sustained exposure to healthcare guidance, while the pattern observed for influenza warrants further investigation.

Table 5. Distribution of Vaccination Information Sources Other than Nephrologists

Information Source	n	%
Nephrologist	214	41.8
Family physician	133	26.0
Medical journals	4	0.8
Internet	3	0.6
Family/friends	6	1.1
Other	152	29.6

A significant association was found between education level and influenza vaccination (P = .017). Primary school graduates—largely older adults—were more frequently vaccinated. Older age groups may engage more with routine medical care and receive more consistent recommendations from family physicians. However, the relationship between education and vaccination is complex and context-dependent, as some international studies suggest that higher education may correlate with greater vaccine hesitancy in certain sociocultural settings.[16]

Gender differences in the study were modest, with women showing slightly higher vaccination rates for some vaccines, although overall uptake did not differ substantially. Previous studies in HD populations have reported inconsistent findings regarding gender, suggesting that its influence varies across regions and health-system contexts.[17,18] In metropolitan settings such as Istanbul, improved healthcare access and preventive health engagement among women may contribute to this pattern.

Marital status was another influential factor, with married individuals exhibiting higher influenza vaccination rates and greater completion of all 4 recommended vaccines. This likely reflects the supportive role of family structures in shaping preventive

health behaviors. Health insurance status also contributed to differences in uptake, particularly for COVID-19 and pneumococcal vaccines, underscoring the role of financial and structural access to healthcare

Lifestyle factors—including smoking, alcohol use, and employment status—were not consistently associated with vaccination behavior, suggesting that clinical and system-level interactions may play a more important role than individual habits. HBV vaccination showed the highest coverage (90.5%), reflecting the effectiveness of standardized institutional protocols. This finding indicates that similar structured approaches could improve uptake of influenza and pneumococcal vaccines.

An important aspect of this study was the evaluation of patients who had completed all 4 recommended vaccines. Preliminary comparisons showed that older age, being married, and longer dialysis duration were more common among fully vaccinated patients. These factors were subsequently evaluated in a multivariate logistic regression model, which identified dialysis duration as the only independent. These variables were subsequently entered into a multivariate logistic regression model, which identified dialysis duration as the only independent predictor of full vaccination. This suggests that longer engagement in dialysis care—and the accompanying frequent provider contact—may play a key role in sustaining adherence to vaccination recommendations.

Health and risk perceptions also influenced vaccination behavior. Self-rated general health was not associated with vaccine uptake, but patients who perceived lower risk of influenza infection or side effects were more likely to be vaccinated. This pattern likely reflects a bidirectional relationship in which vaccination reduces perceived risk, or lower concern about side effects increases willingness to be vaccinated. No association was found between perceived risk of influenza-related death and vaccination, suggesting that immediate concerns may be more influential than perceptions of severe outcomes.

Despite 95.5% of participants identifying nephrologists as their primary source of vaccine information, substantial gaps in awareness remained—particularly for pneumococcal and COVID-19 vaccines. This suggests that, although nephrologists play a central role in counseling, the information provided may not always be fully understood or retained. The most commonly reported reasons for hesitancy—perceiving vaccination as unnecessary, insufficient information, fear of side effects, and distrust—mirror patterns described in the broader literature. These findings suggest that vaccine hesitancy stems not only from inadequate information but also from individual beliefs, attitudes, and trust-related issues, as highlighted in a previous study.[19]

This study has several limitations. Being conducted in Istanbul limits generalizability to other regions. The cross-sectional design precludes causal inference, and reliance on self-reported data introduces potential recall or desirability bias. The questionnaire, although pilot-tested, lacked formal validation. Additionally, the study did not fully assess external influences such as media exposure or social networks, which may shape vaccination attitudes. Finally, participation was limited to 3 centers and did not include all HD units in the region.

CONCLUSION

Vaccination behavior among HD patients is shaped by a combination of demographic, socioeconomic, clinical, and perceptual factors. Enhancing provider-based education is necessary but insufficient on its own. A more comprehensive approach—addressing social support, health-system access, standardized vaccination protocols, and targeted educational strategies—is essential for improving vaccine uptake, particularly for influenza and pneumococcal vaccines. Understanding these multifactorial determinants is critical to strengthening preventive healthcare in this vulnerable population.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: The authors declared that no Artificial Intelligence tool was used in the preparation of the manuscript.

Ethics Committee Approval: Ethical committee approval was received from the Clinical Research Ethics Committee of İstanbul Medeniyet University Göztepe Training and Research Hospital (Approval no: 2023/0899, Date: 20.12.2023).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in this study.

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REFERENCES

1. Saran R, Robinson B, Abbott KC, et al. US renal data system 2018 annual data report: epidemiology of kidney disease in the United States. *Am J Kidney Dis*. 2019 (3)(suppl 1):A7-A8. [CrossRef]
2. Sağlık Bakanlığı TC. Republic of Turkey Ministry of Health, General Directorate of Public Health. Turkey Kidney Diseases Prevention

and Control Program (2018-2023). Ankara: Ministry of Health; 2018.
3. Turkish Society of Nephrology. Registry of nephrology, dialysis and transplantation in Turkey 2023. *Turk J Nephrol*. 2024;33(suppl 1):1-210.
4. Reddy S, Chitturi C, Yee J. Vaccination in chronic kidney disease. *Adv Chronic Kidney Dis*. 2019 26(1):72-78. [CrossRef]
5. Slinin Y, Foley RN, Collins AJ. Clinical epidemiology of pneumonia in hemodialysis patients: the USRDS waves 1, 3, and 4 study. *Kidney Int*. 2006 70(6):1135-1141. [CrossRef]
6. Sarnak MJ, Jaber BL. Pulmonary infectious mortality among patients with end-stage renal disease. *Chest*. 2001 120(6):1883-1887. [CrossRef]
7. Moore LR, Al-Jaddou N, Wodeyar H, et al. SARS-CoV-2 in dialysis patients and the impact of vaccination. *BMC Nephrol*. 2022 23(1):317. [CrossRef]
8. Chang YT, Guo CY, Tsai MS, et al. Poor immune response to a standard single dose non-adjuvanted vaccination against 2009 pandemic H1N1 influenza virus A in the adult and elder hemodialysis patients. *Vaccine*. 2012 30(33):5009-5018. [CrossRef]
9. Finelli L, Miller JT, Tokars JI, Alter MJ, Arduino MJ. National surveillance of dialysis-associated diseases in the United States, 2002. *Semin Dial*. 2005 18(1):52-61. [CrossRef]
10. Krueger KM, Ison MG, Ghossein C. Practical guide to vaccination in all stages of CKD, including patients treated by dialysis or kidney transplantation. *Am J Kidney Dis*. 2020 (3):417-425. [CrossRef]
11. Akinbodewa AA, Gbadegesin BA, Adejumo OA, et al. A multicentre study of awareness and practice of vaccination against infectious diseases among haemodialysis subjects in Nigeria. *West Afr J Med*. 2019;36(3):239-245.
12. Mutlu A, Şengül E, Boz G. A cross-sectional survey study on influenza and pneumococcal vaccination rates and the factors affecting vaccination rates in hemodialysis patients in Kocaeli Province of Turkey. *Ther Apher Dial*. 2022 26(3):640-648. [CrossRef]
13. Battistella C, Quattrin R, Celotto D, et al. Factors predicting influenza vaccination adherence among patients in dialysis: an Italian survey. *Hum Vaccin Immunother*. 2019;15(10):2434-2439. [CrossRef]
14. Wilmore SM, Philip KE, Cambiano V, et al. Influenza and pneumococcal vaccinations in dialysis patients in a London district general hospital. *Clin Kidney J*. 2014 7(1):27-32. [CrossRef]
15. World Health Organization. Influenza (seasonal). Available at: https://www.euro.who.int/en/health-topics/communicable-diseases/influenza. Accessed June 10, 2025.
16. Trepanowski R, Drążkowski D. The vaccine-education paradox in a cross-country analysis: education predicts higher and lower vaccination rates. *Sage Open*. 2024;14(2). [CrossRef]
17. Arı Yılmaz Y, Aydemir N, Kayadibi H, Boyacı H, Yılmaz B, Yılmaz A. Çorum ili hemodiyaliz hastalarında influenza ve pnömokok aşılarına yaklaşım [Approach to influenza and pneumococcal vaccines in hemodialysis patients in Çorum province]. *Turk Hij Den Biyol Derg*. 2023;80(4):455-462. [CrossRef]
18. Selen T, Merhametsiz Ö, Öneç K, et al. Factors affecting influenza and pneumococcal vaccination rates in hemodialysis patients: A multicenter study. *Risk Manag Healthc Policy*. 2025 18:19-32. [CrossRef]
19. Sayan Kaya FB, Doğruyol AR, Öztürk H, Canbaz S, Ören Çelik MM. Vaccine hesitancy and acceptance among hemodialysis patients: a cross-sectional study in Turkey. *BMC Public Health*. 2025;25(1):1037. [CrossRef]