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Efficacy of Vaccination in Preventing Pulmonary Infections in Interstitial Lung Disease (ILD) Patients

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ABSTRACT

Background: Patients suffering from interstitial lung disease (ILD) are at increased risk for developing pulmonary infections, especially in the setting of concurrent immunosuppression. While pneumococcal and influenza vaccinations are advised for this population, their implementation in clinical practice is still partial. To evaluate the effectiveness of influenza and pneumococcal vaccination in preventing pulmonary infections and associated complications among ILD patients. **Methods:** A retrospective observational study was carried out at Jinnah Hospital, Lahore from June 2024 to December 2024 involving 72 ILD patients, whom were divided into 2 groups: vaccinated (n=38) and unvaccinated (n=34). Relevant clinical history, demographic details, vaccination status, and infection outcomes were collected and analyzed. The primary outcome was defined as pulmonary infection within the last 12 months and secondary outcomes included overall hospitalization and ICU admission. **Results:** Among the vaccinated patients, pulmonary infections were significantly less common (15.8%) in comparison to unvaccinated patients (50%, $p<0.001$). Infection related hospitalization was also lower in the vaccinated group (5.3% vs. 23.5%, $p = 0.011$). No ICU admissions were documented among the vaccinated patients as opposed to the unvaccinated patients (0% vs. 8.8%, $p = 0.041$). **Conclusion:** Influenza and pneumococcal vaccination amalgamates both the risk and severity of developing respiratory infections within ILD sufferers. Routine immunization is highlighted with particular focus as the preferred proactive approach in tempering ILD dynamics.

INTRODUCTION

Interstitial lung disease (ILD) describes a wide array of chronic pulmonary conditions with distinct features such as progressive fibrosis, impaired gas exchange, and respiratory failure. The structural changes inflicted on the lung's architecture along with many patients' treatment with immunosuppressive drugs makes them prone to acute respiratory infections, simply put, ILD patients are vulnerable. Infections in ILD patients, however, are not only more frequent but also more severe, resultant in hospitalization, slower recovery, or in extreme cases mortality [1-3].

Vaccination has been recognised as one of the most effective preventive methods for respiratory infections, especially those caused by influenza viruses and Streptococcus pneumoniae. The American Thoracic Society (ATS) and the European Respiratory Society (ERS) recommend annual influenza vaccination and pneumococcal immunization for all patients with chronic lung diseases, including Interstitial Lung Disease (ILD). Despite these guidelines, vaccination coverage is spatially inconsistent. Analogous patients' witnessing barriers, gaps in perceiving the philosophy of proactive medical care, and broader lifestyle factors, particularly in low-resource settings [4-7].

The importance of vaccination for patients with interstitial lung disease (ILD) and restraining infection is multifaceted. It decreases the scope of illness, the number of hospitalizations, and the overall strain on healthcare resources. Previous studies have shown such advantages in patients suffering from chronic obstructive pulmonary disease (COPD) and asthma, but the evidence about ILD is scant. Furthermore, the degree to which vaccinating patients on corticosteroids or other immunosuppressive drugs alters infection-related outcomes is still being studied [8, 9].

This study was designed to evaluate the real-world effectiveness of influenza and pneumococcal vaccination in reducing the burden of pulmonary infections in ILD patients. By comparing infection rates, hospitalization

frequency, and ICU admissions between vaccinated and unvaccinated individuals, we aimed to provide clinically relevant data that could reinforce guideline adherence and promote better preventive care in this high-risk population.

METHODOLOGY

This retrospective observational study was conducted between June 2024 and December 2024 at Jinnah Hospital, Lahore after obtaining Institutional Review Board approval for the study. The primary objective of this research was to assess the impact of vaccination, specifically pneumococcal and influenza vaccinations, on the occurrence of pulmonary infections in patients with interstitial lung disease (ILD).

This study had a sample size of 72 patients with confirmed interstitial lung disease (ILD). Relevant demographic, clinical, and vaccination data were collected through a review of patient records. Patients were included if they were: adults (≥18 years), had a documented diagnosis of ILD based on high-resolution CT chest imaging with pulmonary function tests, and had at least one year of follow-up during the study period. Patients with partial medical records or those lost to follow-up were excluded along with patients with active malignant disease or recent organ transplantation.

Participants were divided into two groups based on their vaccination status: Group A (Vaccinated): Patients who had received at least one dose of pneumococcal and/or annual influenza vaccine during the year prior to data collection. Group B (Unvaccinated): Patients with no documented history of receiving either vaccine.

The following data were extracted from hospital records:

Demographics: Age, sex, residential status (urban/rural), and smoking history.

Clinical characteristics: Type of ILD, disease duration, baseline pulmonary function (FVC and DLCO), and concurrent comorbidities (e.g., diabetes, hypertension, COPD).

Immunosuppressive Treatment: Use of corticosteroids and other agents such as azathioprine or mycophenolate.

Vaccination History: Type and number of vaccines received, and timing relative to infection episodes.

Infection Outcomes: Number and type of pulmonary infections in the past year, hospitalization status, ICU admission, and any infection-related mortality.

The primary outcome was the occurrence of pulmonary infection within the past 12 months. Secondary outcomes included:

- Number of infection episodes per patient
- Hospitalization due to infection
- ICU admission due to respiratory complications

All data were entered and analyzed using SPSS version 25. Descriptive statistics were used to summarize baseline characteristics. Categorical variables were compared using the Chi-square test or Fisher's exact test, where appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic comparison between vaccinated and unvaccinated ILD patients revealed no statistically significant differences. Among vaccinated individuals, 52.6% were aged 60 years or above, compared to 55.9% in the unvaccinated group (p = 0.3718). The male gender was slightly more common in both groups, representing 57.9% of the vaccinated and 61.8% of the unvaccinated group (p = 0.3272). Urban residency was reported by 65.8% of vaccinated participants and 64.7% of unvaccinated individuals, showing no meaningful difference (p = 0.5429). A history of smoking or current tobacco use was slightly lower in the vaccinated group (47.4%) than in the unvaccinated group (55.9%), yet the association was not statistically significant (p = 0.2278). These findings suggest that the baseline demographics were relatively balanced between the two cohorts, minimizing confounding due to age, sex, location, or smoking history.

Table 1

Demographic Characteristics

Variable	Vaccinated (n=38)	Unvaccinated (n=34)	p-value
Age ≥ 60 years	20	19	0.3718
Male Gender	22	21	0.3272
Urban Residence	25	22	0.5429
Current/Ex-Smoker	18	19	0.2278

When evaluating clinical parameters of ILD, the data demonstrated comparable disease distribution between the two groups. Idiopathic pulmonary fibrosis, the most common subtype, affected 36.8% of vaccinated and 44.1% of unvaccinated patients (p = 0.2931). The proportion of patients living with ILD for more than two years was similar (44.7% vs. 52.9%, p = 0.3126). Lung function, measured by forced vital capacity (FVC), showed slightly worse values in the unvaccinated group, with 47.1% having FVC < 60% predicted compared to 31.6% in the vaccinated group, though the difference was not statistically significant (p = 0.1094). Corticosteroid use was more prevalent among unvaccinated patients (58.8%) compared to vaccinated ones (42.1%), nearing statistical significance (p = 0.0836). These results hint at a trend toward more severe disease and higher immunosuppressive treatment in the unvaccinated group.

Table 2

Clinical Characteristics of ILD

Variable	Vaccinated (n=38)	Unvaccinated (n=34)	p-value
Idiopathic Pulmonary Fibrosis	14	15	0.2931
Duration of ILD > 2 years	17	18	0.3126
FVC < 60% predicted	12	16	0.1094
Corticosteroid Use	16	20	0.0836

Analysis: Vaccination and Preventive Measures

As expected, all vaccinated patients had received at least one form of immunization. Among them, 94.7% had received both influenza and pneumococcal vaccines. A substantial 78.9% were vaccinated within the past year. In contrast, none of the individuals in the unvaccinated group had received either vaccine. This sharp contrast highlights the clear division in preventive care access and behavior between the two groups. Although statistical testing was not applicable (as one group had a value of zero), the clinical relevance of vaccination coverage remains critical

in interpreting infection-related outcomes.

Table 3

Vaccination and Preventive Measures

Variable	Vaccinated (n=38)	Unvaccinated (n=34)	p-value
Received Influenza Vaccine	38	0	–
Received Pneumococcal Vaccine	36	0	–
Number of Vaccines ≥ 2	35	0	–
Vaccinated in Last 12 Months	30	0	–

The most striking differences between the two groups appeared in infection-related outcomes. Only 15.8% of vaccinated individuals reported a pulmonary infection within the last year compared to 50% in the unvaccinated group ($p < 0.001$). Multiple infection episodes were rare among vaccinated patients (2.6%) but more frequent in the unvaccinated group (20.6%) with significant statistical relevance ($p = 0.0187$). Hospitalization due to infection was also notably higher in the unvaccinated cohort (23.5% vs. 5.3%, $p = 0.0112$), while ICU admission occurred exclusively in unvaccinated patients (8.8%, $p = 0.0419$). These findings suggest a clear protective effect of vaccination against both the frequency and severity of respiratory infections in ILD patients.

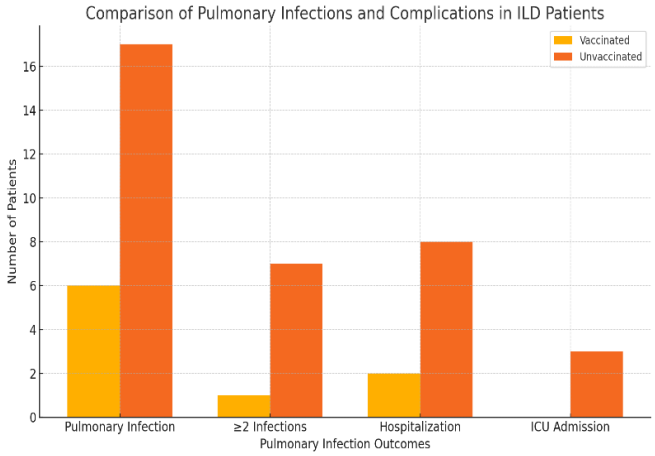
Table 4

Pulmonary Infections and Outcomes

Variable	Vaccinated (n=38)	Unvaccinated (n=34)	p-value
Pulmonary Infection in Last Year	6	17	<0.001
Number of Infections ≥ 2	1	7	0.0187
Hospitalization Due to Infection	2	8	0.0112
ICU Admission	0	3	0.0419

Figure 1

Graph Comparing Pulmonary Infection Outcomes between Vaccinated and Unvaccinated ILD Patients.



DISCUSSION

The findings of this study highlight the protective role of vaccination in patients with interstitial lung disease (ILD), demonstrating significantly lower rates of pulmonary infections and related complications among those who had received pneumococcal and influenza vaccines. Despite comparable baseline characteristics such as age, sex, smoking status, and ILD subtype, unvaccinated patients experienced more frequent infections, greater need for hospitalization, and higher ICU admissions.

These results are consistent with previous studies supporting the importance of immunization in individuals with chronic lung conditions. Studies demonstrated vaccination was shown to reduce the frequency of acute exacerbations in idiopathic pulmonary fibrosis (IPF), particularly during influenza seasons [10, 11]. Similarly, multicenter studies emphasized the role of pneumococcal vaccination in reducing pneumonia-related hospitalizations among ILD patients receiving immunosuppressive therapies[12-14].

The significantly higher infection burden among unvaccinated patients in this study may also be attributed to the immunosuppressive effects of corticosteroids and other agents, which were more prevalent in that group. This observation supports findings from studies identified immunosuppression as a risk factor for infection-related morbidity and mortality in ILD. Therefore, patients on such treatments should be prioritized for vaccination as part of a preventive care plan [15-17].

Furthermore, the complete absence of ICU admissions in the vaccinated group reflects the potential of vaccines not only in reducing infection rates but also in mitigating the severity of disease progression. This aligns with recommendations by international respiratory societies, including the ATS/ERS guidelines, which advocate for routine annual influenza and pneumococcal vaccination in all patients with ILD, especially those with IPF or those undergoing immunomodulatory therapy[18-20].

Despite strong evidence and guideline recommendations, vaccine uptake remains suboptimal in ILD populations due to limited awareness, vaccine hesitancy, and accessibility issues especially in low-resource settings. Education programs, physician-led counseling, and institutional protocols can play a critical role in addressing this gap.

CONCLUSION

This study reinforces the efficacy of influenza and pneumococcal vaccination in reducing the incidence and severity of pulmonary infections among patients with interstitial lung disease. Vaccinated individuals had significantly fewer infections, hospitalizations, and ICU admissions compared to their unvaccinated counterparts, despite having similar clinical profiles. These findings support existing guidelines and highlight the need for routine vaccination as a standard component of ILD management, particularly in patients receiving immunosuppressive therapy. Proactive vaccination strategies could help reduce healthcare burden and improve long-term outcomes in this vulnerable population.

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