Taylor & Francis
Taylor & Francis Group

Expert Review of Vaccines

ISSN: 1476-0584 (Print) 1744-8395 (Online) Journal homepage: www.tandfonline.com/journals/ierv20

The impact of a pneumococcal vaccination on disease activity in children and adolescents with inflammatory bowel disease: a 2-year prospective study

Magdalena Neścioruk , Kinga Kowalska-Duplaga , Urszula Grzybowska-Chlebowczyk , Agnieszka Sieczkowska & Aleksandra Banaszkiewicz

To cite this article: Magdalena Neścioruk , Kinga Kowalska-Duplaga , Urszula Grzybowska-Chlebowczyk , Agnieszka Sieczkowska & Aleksandra Banaszkiewicz (2026) The impact of a pneumococcal vaccination on disease activity in children and adolescents with inflammatory bowel disease: a 2-year prospective study, Expert Review of Vaccines, 25:1, 2652921, DOI: 10.1080/14760584.2026.2652921

To link to this article: https://doi.org/10.1080/14760584.2026.2652921

EXPERT REVIEW OF VACCINES
2026, VOL. 25, NO. 1, 2652921
https://doi.org/10.1080/14760584.2026.2652921

Taylor & Francis
Taylor & Francis Group

ORIGINAL RESEARCH

OPEN ACCESS Check for updates

The impact of a pneumococcal vaccination on disease activity in children and adolescents with inflammatory bowel disease: a 2-year prospective study

Magdalena Neścioruk[a], Kinga Kowalska-Duplaga[b], Urszula Grzybowska-Chlebowczyk[c], Agnieszka Sieczkowska[d] and Aleksandra Banaszkiewicz[a]

[a]Department of Pediatric Gastroenterology and Nutrition, Medical University of Warsaw, Warsaw, Poland; [b]Department of Pediatrics, Gastroenterology and Nutrition, Jagiellonian University Medical College, Cracow, Poland; [c]Upper Silesian Children`s Health Center, Department of Gastroenterology and Pediatrics, Katowice, Poland; [d]Department of Pediatrics, St. Adalbert Hospital, Copernicus PL Ltd., Gdansk, Poland

ABSTRACT

Background: Infectious diseases are known triggers for inflammatory bowel disease (IBD) exacerbations. Although vaccines can prevent many such infections, hesitancy persists among pediatric IBD patients and their caregivers due to concerns about vaccine-induced disease flare-ups. The aim of the study was to evaluate the impact of the 13-valent pneumococcal conjugate vaccine (PCV13) on disease activity in children and adolescents with IBD over a 24-month period post-vaccination.

Research design and methods: This prospective, multicenter cohort study included IBD patients aged 4–18 years. Participants were assigned to a vaccinated group (single PCV13 dose) or an unvaccinated control group. Disease activity was monitored using PUCAI/PCDAI scores, and exacerbation rates were recorded at 6, 12, 18, and 24 months.

Results: A total of 279 patients (52.3% male; median age, 167 months) were enrolled, of whom 93 (33.3%) received PCV13. The control group showed higher, but not statistically significant, disease activity at any time point ($p = 0.06, 0.10, 0.64, 0.36$) and exacerbation rates ($p = 0.47, 0.17, 0.82, 0.75$).

Conclusion: A single dose of PCV13 does not increase disease activity in pediatric IBD patients during the 24 months following vaccination.

ARTICLE HISTORY
Received 26 July 2025
Accepted 23 March 2026

KEYWORDS
Crohn's disease; flare; PCV; safety; ulcerative colitis

1. Introduction

Inflammatory bowel diseases (IBD), comprising Crohn's disease (CD) and ulcerative colitis (UC), constitute a group of gastrointestinal disorders characterized by chronic inflammation and a clinical course marked by alternating periods of exacerbation and remission [1].

Currently, the reliable prediction of disease flares in individual patients remains challenging. Among the many factors suspected to trigger exacerbations, infectious diseases are frequently implicated. Due to the nature of their underlying condition, comorbidities, malnutrition, immunosuppressive therapy, surgical procedures, frequent hospitalizations and contact with healthcare facilities, patients with IBD exhibit greater susceptibility to infections and increased infection severity. Therefore, national and international IBD-focused societies emphasize comprehensive infection prevention and management protocols for this vulnerable patient population. Key recommendations include minimizing pathogen exposure through avoidance of infected individuals and deferral of travel to endemic regions [2]. Vaccination represents one of the most efficacious strategies for infectious disease prophylaxis [3]. However, vaccination rates among patients with IBD remain significantly lower compared to the healthy population [4–6]. One of the main concerns cited by IBD patients or by parents of pediatric patients is the potential for vaccination to trigger a disease flare [7,8].

Few studies have prospectively assessed the impact of vaccination on IBD activity. Most existing studies focus on evaluating vaccine immunogenicity, with observation typically limited to a short period, most often 4 weeks after vaccination [4,9,10]. These studies have involved various vaccines, different patient populations, and a range of treatment regimens, with disease activity assessed using different scoring systems.

Mamula et al. conducted the only study in a pediatric population, assessing the impact of the trivalent influenza vaccine on disease activity in 80 pediatric patients with IBD [11]. In adult IBD populations, researchers have evaluated the effects of influenza A/H1N1 vaccination and pneumococcal vaccination – using both the 13-valent conjugate vaccine (PCV13) and the 23-valent polysaccharide vaccine (PPV23) – on IBD activity [12–15]. Across these studies, patients were monitored for several weeks, with no statistically significant vaccination-related worsening of disease course observed.

Regarding long-term follow-up, Launay et al. conducted the sole investigation on the impact of vaccination on IBD activity [16]. Their study assessed the influence of the influenza vaccine on IBD course in 225 adult patients over a 2-year

CONTACT Kinga Kowalska-Duplaga kinga.kowalska-duplaga@uj.edu.pl Department of Pediatrics, Gastroenterology and Nutrition, Jagiellonian University Medical College, Cracow ul. Wielicka 265, Kraków 30-663, Poland

Supplemental data for this article can be accessed online at https://doi.org/10.1080/14760584.2026.2652921

follow-up period. Disease exacerbation occurred in only two of 92 patients with CD who were receiving biological therapy.

Despite the important clinical implications of vaccine safety in pediatric IBD patients, no studies have assessed long-term effects. Our study aims to evaluate the impact of PCV13 on disease activity in children and adolescents with IBD over a 24-month period following vaccination.

2. Methods

2.1. Study design and population

This multicenter, prospective cohort study was conducted between 2015 and 2019 at four specialized pediatrics IBD centers in Poland (Warsaw, Krakow, Katowice, and Gdansk).

Participants included patients aged 4 to 18 years with IBD diagnosed according to the revised Porto criteria, including clinical, endoscopic, and histopathological assessment [17]. Newly diagnosed IBD was defined as a disease with a duration ≤ of 3 months from diagnosis. Two cohorts were established: (A) the study group, consisting of IBD patients receiving a single dose of PCV13 with no prior pneumococcal vaccine; (B) the control group, comprising patients who had not received any pneumococcal vaccine.

Participants were excluded from the study group if they had previously received any pneumococcal vaccine other than a single dose of PCV13, and from the control group if they had received any pneumococcal vaccine. Additional exclusion criteria common to both groups included comorbid chronic autoimmune disease, lack of parental/guardian consent or lack of consent from patients >16 years of age comorbid chronic autoimmune disease; lack of parental/guardian consent or lack of consent from patients >16 years of age.

2.2. Disease assessment and treatment classification

Disease activity was assessed using the Pediatric Crohn's Disease Activity Index (PCDAI) for CD and the Pediatric Ulcerative Colitis Activity Index (PUCAI) for UC. Patients were stratified into four groups according to their treatment regimens: 5-ASA derivatives only; corticosteroids (20 mg/kg body weight/day for ≥2 weeks) and/or immunomodulators, including azathioprine (2.5–3 mg/kg body weight/day), 6-mercaptopurine (1.5 mg/kg body weight/day for ≥12 weeks), methotrexate, or cyclosporine; biologic therapy (infliximab [IFX] or adalimumab [ADA]); and combination therapy (concurrent immunomodulators and biologics).

2.3. Study procedures

After obtaining informed consent, participants' pneumococcal vaccination history was verified through Child Health Book entries and vaccination cards. Detailed medical histories regarding disease characteristics, severity, and treatment regimens were collected. All participants underwent prospective evaluations at 6, 12, 18, and 24 months, including disease activity assessment using appropriate indices and treatment analysis.

2.4. Sample size calculation

Sample size determination was based on existing data regarding long-term post-vaccination follow-up in pediatric patients with chronic autoimmune diseases, as data specific to IBD populations were lacking [18,19]. We planned to include 80 patients in the study group and 160 in the control group (total $n = 240$ patients).

2.5. Statistical analysis

For independent qualitative variables, differences between groups were analyzed using the Chi-square test with Yates' correction for small samples. For dependent variables, the McNemar Chi-square test (two groups) or the Cochran Q test (multiple groups) was applied. Continuous variables were compared using the Mann-Whitney test for independent samples and the Wilcoxon test (two groups) or the Friedman test (multiple groups) for dependent samples. Statistical significance was defined as $p < 0.05$. All analyses were performed using STATISTICA 12 (StatSoft).

3. Results

A total of 279 patients with IBD were included in the study (52.3% males), with a median age of 167 months (IQR: 138–189 months; range: 36–215 months). CD was diagnosed in 160 patients (57.3%). Newly diagnosed IBD (≤3 months from diagnosis) comprised 37% of all participants. The study group (PCV13-vaccinated) consisted of 93 patients (33.3%). Baseline characteristics of patients in both groups are summarized in Table 1. Treatment regimens administered during the study period are presented in Table 2.

3.1. 5-ASA- 5-aminosalicylic acid derivatives

No significant difference in disease activity, as measured by PUCAI/PCDAI scores, was observed between the study and control groups at 6-, 12-, 18-, and 24-months follow-up (Table S1, supplementary materials).

The frequency of exacerbations at all time points is presented in Table 3. During the entire 24 month observation period, at least one exacerbation occurred in 34.52% of vaccinated patients and in 39.16% of patients in the control group, and this difference was not statistically significant (p = NS). In addition, the distribution of patients with 0, 1, 2, 3, or 4 flares did not differ significantly between the two groups ($p = 0.93$).

The distribution of exacerbations according to treatment modality is detailed in Table S2 (supplementary materials).

4. Discussion

Our cohort study demonstrates that administration of a single dose of PCV13 had no discernible impact on IBD activity throughout the two-year observation period. Although the control group experienced numerically more exacerbations at all time points compared to the vaccinated group, these differences were not statistically significant.

Table 1. Clinical characteristics of patients at enrollment.

	PCV13 vaccinated $n = 93$ (33.3%)	PCV13 non-vaccinated $n = 186$ (66.7%)	*p*-value
Age at diagnosis of IBD (months) (median (IQR))	139 (97–162)	154 (111–180)	0.01
Age (months) (median (IQR))	166 (144–185)	167.5 (135–190)	0.90
Patients aged ≤10 years	16 (17%)	43 (23%)	0.41
Patients aged 11–14 years	43 (46%)	73 (39%)	
Patients aged≥15 years	34 (35,5%)	70 (38%)	
Males (n (%))	56 (60%)	90 (48%)	0.06
Crohn disease (n (%))	64 (69%)	96 (52%)	0.01
PUCAI/PCDAI (median (IQR))	5 (0–12.5)	10 (5–30)	0.06
Patients with newly diagnosed IBD	17 (18%)	86 (46%)	0.00
Treatment at the time of enrollment in the study:			0.00
5-ASA	15 (16%)	52 (28%)	
Immunosuppressive drugs	58 (62%)	117 (63%)	
Biologic drugs	2 (2%)	5 (3%)	
Combination therapy	18 (19%)	12 (6%)	
Number of flare-ups at the time of study enrollment	30 (32%)	78 (42%)	0.12

Abbreviations: IQR – first and third quartile; IBD – inflammatory bowel disease; PUCAI (Pediatric Ulcerative Colitis Activity Index) / PCDAI (Pediatric Crohn Disease Activity Index) – disease activity scales for ulcerative colitis (UC) / Crohn's disease (CD); 5-ASA – 5-aminosalicylic acid derivatives.

Table 2. Treatment of the study groups.

Observation period	Group	5-ASA	Immunosuppressive drugs	Biologic therapy	Combination therapy	p-value
Enrollment	PCV13 vaccinated	15 (16%)	58 (62%)	2 (2%)	18 (19%)	0.00
	PCV13 non-vaccinated	52 (28%)	117 (63%)	5 (3%)	12 (6%)	
At 6 months	PCV13 vaccinated	14 (15%)	51 (55%)	1 (1%)	27 (29%)	0.04
	PCV13 non-vaccinated	43 (23%)	110 (59%)	4 (2%)	29 (16%)	
At 12 months	PCV13 vaccinated	13 (14%)	54 (58%)	1 (1%)	25 (27%)	0.07
	PCV13 non-vaccinated	44 (25%)	96 (55%)	5 (3%)	31 (18%)	
At 18 months	PCV13 vaccinated	12 (13%)	53 (60%)	1 (1%)	23 (26%)	0.07
	PCV13 non-vaccinated	39 (25%)	85 (54%0	6 (4%)	28 (18%)	
At 24 months	PCV13 vaccinated	13 (15%)	48 (57%)	0 (0%)	23 (27%)	0.04
	PCV13 non-vaccinated	35 (24%)	75 (52%)	7 (5%)	26 (18%)	

5-ASA- 5-aminosalicylic acid derivatives.

Table 3. Number of IBD flares.

	Number of flares				
	At the enrollment	At 6 months	At 12 months	At 18 months	At 24 months
PCV13 vaccinated	30 (32%)	28 (30%)	15 (16%)	22 (25%)	15 (18%)
PCV13 non-vaccinated	78 (42%)	64 (34%)	41 (23%)	37 (23%)	28 (20%)
p-value	0.12	0.47	0.17	0.82	0.75

4.1. Impact of vaccination on IBD activity in long-term follow-up

To our knowledge, this represents the first study evaluating the impact of pneumococcal vaccination on IBD activity in pediatric and adolescent patients with extended follow-up (≥12 weeks). Comparable studies have not been conducted in adult IBD cohorts. Currently, the literature contains only one study assessing vaccination effects on IBD activity with long-term follow-up. Launay et al., while primarily investigating the immunogenicity of the influenza vaccine in adult IBD patients, concurrently evaluated its impact on underlying disease activity [13]. The investigators reported no changes in disease activity throughout the study duration, with disease exacerbation occurring in only two of 92 CD patients receiving biologic therapy. Despite methodological differences, including the use of a different vaccine formulation, the absence of a control group, an adult population, and alternative activity indices, their results are consistent with our findings, supporting the conclusion that vaccination does not adversely affect IBD clinical course.

Patients with rheumatoid diseases constitute another population with autoimmune conditions for whom pneumococcal and influenza vaccination is strongly indicate [20]. Therapeutic similarities between IBD and rheumatoid diseases allow for comparative analyses, thereby enhancing the statistical power of individual studies evaluating the impact of immunosuppressive regimens on disease activity. Within rheumatologic literature, only one retrospective study by Fischer et al. has examined the long-term effects of single dose of PPV23 on disease activity [21]. Collectively, both our findings and those reported by Fischer et al. provide evidence that pneumococcal vaccination, although with different types of vaccines, does not negatively influence autoimmune disease activity.

4.2. Impact of vaccination on IBD activity in short-term follow-up

Most studies on pneumococcal vaccination have primarily focused on evaluating the post-vaccination immunological response rather than changes in disease activity. These investigations typically encompass short-term periods of 4 to 8 weeks post-vaccination with limited specification regarding changes in disease activity metrics. While the pediatric IBD literature demonstrates a lack of vaccination impact studies, some investigations have been conducted in adult IBD cohorts. Pittet et al., observed patients during the 8 weeks after vaccination with PCV13 [10]. Fiorino et al., evaluating PPV23 immunogenicity in 96 adult IBD patients stratified by treatment regimen, reported no significant clinical manifestations across all treatment groups during a mean follow-up of 58 days [11]. Similarly, Lee et al., investigating the effect of anti-TNF-alpha therapy on PPV23 response in 210 adult CD patients, documented only one case of disease flare according to clinical activity indices at 4 weeks post-vaccination [12]. These findings from adult IBD populations are consistent with our results and collectively indicate that pneumococcal vaccination does not adversely affect IBD activity.

The literature assessing the impact of pneumococcal vaccination on the activity of other autoimmune diseases is similarly limited in systemic lupus erythematosus (SLE) patients [22]. These findings from adult IBD and rheumatic populations are consistent with our results and collectively indicate that pneumococcal vaccination does not adversely affect disease activity.

Several studies have examined the impact of non-pneumococcal vaccines on IBD activity during short-term observation periods. In pediatric populations, data are limited to a single investigation by Mamula et al., who studied 80 children and adolescents aged 9 to 17 years [8]. No statistically significant disease exacerbation was observed following vaccination.

Rahier et al. evaluated A/H1N1 influenza vaccination safety in a big cohort of IBD patients [12]. The authors observed an increase in disease activity in 2.3% CD patients and in 4.4% UC patients. In rheumatic diseases, Puges et al. conducted a meta-analysis of 20 studies (3 pneumococcal, 17 influenza) evaluating vaccination effects on SLE activity [23]. No significant differences in SLEDAI-measured disease activity were observed at 3–8 weeks post-vaccination compared to baseline following either pneumococcal ($p = 0.63$) or influenza vaccination ($p = 0.02$). However, Kapetanovic et al. reported divergent findings [24]. In their study over 10% of patients reported an increase in joint pain, morning stiffness and increased fatigue.

Beyond clinical indices, researchers have evaluated vaccination impact on autoimmune diseases through disease-specific antibody profiles. Studies in rheumatic disease patients demonstrated an increase in antinuclear antibody (ANA) antibody titers following influenza vaccination, though this finding was limited to female participants and not observed across the entire study population [25]. Similarly, a transient increase of IgG anticardiolipin antibodies without concomitant increases in anti-β2-glycoprotein 1 antibodies was documented during the 12-week period post-influenza vaccination [26]. Conversely, other studies failed to demonstrate increased production of characteristic autoantibodies following vaccination against influenza or pneumococcus [27,28]. The absence of correlation between autoantibody titers and disease activity complicates the interpretation of these findings and their clinical relevance. The collective evidence regarding vaccination effects on rheumatic disease activity has informed the European League Against Rheumatism (EULAR) recommendations, which specifically advocate for vaccination against pneumococcus and influenza for patients with rheumatic diseases, analogous to patients with IBD [15].

In summary, the current literature examining the impact of vaccination on disease activity in IBD and rheumatic diseases remains limited, with most studies restricted to short-term post-vaccination observation periods. Despite methodological differences in disease activity assessment and predominant focus on adult populations, findings are generally consistent. Our study, in concordance with previous investigations, demonstrates the safety of killed or inactivated vaccines in IBD patients across all treatments used. However, there is a lack of data regarding the impact of live vaccines on the course of IBD.

4.3. Strengths and limitations

The present study represents the first prospective evaluation of the long-term impact of vaccination on IBD activity in pediatric patients. Our novel finding that a single dose of PCV13 does not increase disease activity provides important evidence-based counterarguments to anti-vaccine rhetoric regarding purported negative effects of vaccination on pediatric health, including effects on IBD and other chronic diseases. We hope that these results will enhance awareness among healthcare providers, contribute to the recommendation and implementation of vaccinations for IBD patients, and positively influence parental and patient attitudes regarding preventive vaccination strategies. However, our study has limitations. Most notably, complete 2-year follow-up was not achieved for all participants, primarily due to patients reaching 18 years of age and transitioning to adult IBD care centers. A main limitation of our study is the lack of systematic assessment of factors other than PCV13 vaccination that may influence IBD activity, such as diet, psychological stress, travel, and other environmental exposures. However, designing and conducting a study that comprehensively captures these variables would be highly challenging, given the large number of potential confounders and the fact that not all of them have been fully elucidated to date. Moreover, such an approach would require substantially larger study populations to ensure adequate statistical power and proper adjustment for multiple covariates. We also did not systematically record the number of patients excluded due to prior pneumococcal vaccination, which may affect the assessment of how representative our cohort is of the broader pediatric IBD population.

5. Conclusions

Administration of a single dose of PCV13 does not increase the number of exacerbations and does not increase IBD activity in children and adolescents compared to PCV13 unvaccinated children during the 24-month post-vaccination period.

Author contributions

CRediT: **Magdalena Neścioruk:** Data curation, Formal analysis, Writing – original draft; **Kinga Kowalska-Duplaga:** Conceptualization, Data curation, Formal analysis, Writing – review & editing; **Urszula Grzybowska-Chlebowczyk:** Data curation, Formal analysis, Writing – review & editing; **Agnieszka Sieczkowska:** Data curation, Formal analysis, Writing – review & editing; **Aleksandra Banaszkiewicz:** Conceptualization, Data curation, Formal analysis, Writing – review & editing.

Funding

This paper was not funded.

Declaration of interests

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

Reviewer disclosures

A peer reviewer has disclosed that they have previously conducted research on the effects of the 10-valent pneumococcal vaccine in studies supported by GSK. Peer reviewers on this manuscript have no other relevant financial or other relationships to disclose.

Ethics statement

The study protocol was approved by the Bioethics Committee of the Medical University of Warsaw (approval number: KB/167/2014). Informed consent was obtained from parents/legal guardians or from patients>16 years of age.

Data availability statement

Data available on request from the authors. The data that support the findings of this study are available from the corresponding author, [KKD], upon reasonable request.

AI-based tools and technologies

During the preparation of this work the authors did not use Generative AI and AI-assisted technologies in the writing process.

References

1. Abraham C, Cho J. Inflammatory bowel disease. N Engl J Med. 2009;361(21):2066–2068. doi: 10.1056/NEJMra0804647
2. Rahier J, Magro F, Abreu C, et al. Second European evidence-based consensus on the prevention, diagnosis and management of opportunistic infections in inflammatory bowel disease. J Crohns Colitis. 2014;8(6):443–448. doi: 10.1016/j.crohns.2013.12.013
3. Kucharzik T, Ellul P, Greuter T, et al. ECCO guidelines on the prevention, diagnosis, and management of infections in inflammatory bowel disease. J Crohns Colitis. 2021;15(6):879–913. doi: 10.1093/ecco-jcc/jjab052
4. Gertosio C, Licari A, De Silvestri A, et al. Efficacy, immunogenicity, and safety of available vaccines in children on biologics: a systematic review and meta-analysis. Vaccine. 2022;40(19):2679–2695. doi: 10.1016/j.vaccine.2022.03.041
5. Nakafero G, Grainge MJ, Card T, et al. Uptake and safety of pneumococcal vaccination in adults with immune-mediated inflammatory diseases: a Uk wide observational study. Rheumatol (Oxford). 2025;64(3):962–968. doi: 10.1093/rheumatology/keae160
6. Shabir MS, Arif S, Yeoh D, et al. Suboptimal vaccination coverage and serological screening in western Australian children with inflammatory bowel disease receiving immunosuppressive therapy: an opportunity for improvement. Cureus. 2024;16:e73744. doi: 10.7759/cureus.73744
7. Banaszkiewicz A, Talarek E, Śliwka J, et al. Influenza and attitude toward influenza vaccination among medical students. Adv Exp Med Biol. 2016;934:83–88.
8. Chan W, Salazar E, Lim TG, et al. Vaccinations and inflammatory bowel disease - a systematic review. Dig Liver Dis. 2021;53(9):1079–1088. doi: 10.1016/j.dld.2021.04.015
9. Tsyruk O, Kaplan GG, Fortin PR, et al. On behalf of the succeed investigative team. How safe are COVID-19 vaccines in individuals with immune-mediated inflammatory diseases? The succeed study. Vaccines (Basel). 2024;12(9):1027. doi: 10.3390/vaccines12091027
10. Desalermos A, Pimienta M, Kalligeros M, et al. Safety of immunizations for the adult patient with inflammatory bowel disease—a systematic review and meta-analysis. Inflamm Bowel Dis. 2022;28(9):1430–1442. doi: 10.1093/ibd/izab266
11. Mamula P, Markowitz J, Piccoli D, et al. Immune response to influenza vaccine in pediatric patients with inflammatory bowel disease. Clin Gastroenterol Hepatol. 2007;5(7):851–856. doi: 10.1016/j.cgh.2007.02.035
12. Rahier J, Papay P, Salleron J, et al. H1N1 vaccines in a large observational cohort of patients with inflammatory bowel disease treated with immunomodulators and biological therapy. Gut. 2011;60(4):456–462. doi: 10.1136/gut.2010.233981
13. Pittet L, Verolet C, Michetti P, et al. High immunogenicity of the pneumococcal conjugated vaccine in immunocompromised adults with inflammatory bowel disease. Am J Gastroenterol. 2019;114(7):1130–1141. doi: 10.14309/ajg.0000000000000289
14. Fiorino G, Peyrin-Biroulet L, Naccarato P, et al. Effects of immunosuppression on immune response to pneumococcal vaccine in inflammatory bowel disease: a prospective study. Inflamm Bowel Dis. 2012;18(6):1042–1047. doi: 10.1002/ibd.21800
15. Lee C, Kim H, Ye B, et al. Korean association for the study of intestinal diseases (KASID) study. Patient's with Crohn's disease on antitumor necrosis factor therapy are at significant risk of inadequate response to the 23-valent pneumococcal polysaccharide vaccine. J Crohns Colitis. 2014;8(5):384–391. doi: 10.1016/j.crohns.2013.09.022
16. Launay O, Abitbol V, Krivine A, et al. Immunogenicity and safety of influenza vaccine in inflammatory bowel disease patients treated or not with immunomodulators and/or biologics: a two-year prospective study. J Crohns Colitis. 2015;9(12):1096–1107. doi: 10.1093/ecco-jcc/jjv152
17. Levine A, Koletzko S, Turner D, et al. ESPGHAN revised Porto criteria for the diagnosis of inflammatory bowel disease in children and adolescents. J Pediatr Gastroenterol Nutr. 2014;58(6):795–806. doi: 10.1097/MPG.0000000000000239
18. Toplak N, Subelj V, Kveder T. Safety and efficacy of influenza vaccination in a prospective longitudinal study of 31 children with juvenile idiopathic arthritis. Clin Exp Rheumatol. 2012;30(3):436–444.
19. Aikawa N, França I, Ribeiro A. Short and long-term immunogenicity and safety following the 23-valent polysaccharide pneumococcal vaccine in juvenile idiopathic arthritis patients under conventional DMARDs with or without anti-TNF therapy. Vaccine. 2015;33(5):604–609. doi: 10.1016/j.vaccine.2014.12.030
20. Jansen MH, Rondaan C, Legger G, et al. Efficacy, immunogenicity and safety of vaccination in pediatric patients with autoimmune inflammatory rheumatic diseases (pedAIIRD): a systematic literature review for the 2021 update of the EULAR/PRES recommendations. Front Pediatr. 2022;10:910026. doi: 10.3389/fped.2022.910026

21. Fischer L, Gerstel P, Poncet A, et al. Pneumococcal polysaccharide vaccination in adults undergoing immunosuppressive treatment for inflammatory diseases – a longitudinal study. Arthritis Res Ther. 2015;17(1):151. doi: 10.1186/s13075-015-0663-9
22. Pisoni C, Sarano J, Benchetrit G, et al. Antipneumoccocal vaccination in patient with systemic lupus erythematosus. Medicina (B Aires). 2003;63:388–392.
23. Puges M, Biscay P, Barnetche T, et al. Immunogenicity and impact on disease activity of influenza and pneumococcal vaccines in systematic literature review and meta-analysis. Rheumatology. 2016;66(9):1664–1672. doi: 10.1093/rheumatology/kew211
24. Kapetanovic M, Kristensen L, Saxne T, et al. Impact of anti-rheumatic treatment on immunogenicity of pandemic H1N1 influenza vaccine in patients with arthritis. Arthritis Res Ther. 2014;16(1):R2. doi: 10.1186/ar4427
25. Perdan-Pirkmajer K, Thallinger G, Snoj N, et al. Autoimmune response following influenza vaccination in patients with autoimmune inflammatory rheumatic disease. Lupus. 2012;21(2):175–183. doi: 10.1177/0961203311429817
26. Vista E, Crowe S, Thompson L, et al. Influenza vaccination can induce new-onset anticardiolipins but not β2-glycoprotein-I antibodies among patients with systemic lupus erythematosus. Lupus. 2012;21(2):168–174. doi: 10.1177/0961203311429554
27. Crowe R, Merrill J, Vista E, et al. Influenza vaccination responses in human systemic lupus erythematosus: impact of clinical and demographic features. Arthitis Rheum. 2011;63(8):2396–2406. doi: 10.1002/art.30388
28. Elkayam O, Paran D, Burke M, et al. Pneumococcal vaccination of patients with systemic lupus erythematosus: effects on generation of autoantibodies. Autoimmunity. 2005;38(7):493–496. doi: 10.1080/08916930500285725