ORIGINAL ARTICLE

Vaccination recommendations for adults receiving biologics and oral therapies for psoriasis and psoriatic arthritis: Delphi consensus from the medical board of the National Psoriasis Foundation

Vipawee S. Chat, MD,[a] Christoph T. Ellebrecht, MD,[b] Paige Kingston, BS,[a] George Gondo, MA,[c] Stacie Bell, PhD,[c] Kelly M. Cordoro, MD,[d] Seemal R. Desai, MD,[e,f] Kristina C. Duffin, MD,[g] Steven R. Feldman, MD, PhD,[h] Amit Garg, MD,[i] Joel M. Gelfand, MD, MSCE,[b] Dafna Gladman, MD,[j] Lawrence J. Green, MD,[k] Johann Gudjonsson, MD, PhD,[l] George Han, MD, PhD,[i] Jason E. Hawkes, MD, MS,[m] Leon Kircik, MD,[n] John Koo, MD,[d] Richard Langley, MD,[o] Mark Lebwohl, MD,[p] G. Michael Lewitt, MD,[q] Wilson Liao, MD,[d] George Martin, MD,[r] Ana-Maria Orbai, MD,[s] Soumya M. Reddy, MD,[t] Veronica Richardson, MSN, CRNP, ANP-BC,[b] Christopher T. Ritchlin, MD, MPH,[u] Sergio Schwartzman, MD,[v] Evan L. Siegel, MD,[w] Abby S. Van Voorhees, MD,[x] Elizabeth B. Wallace, MD,[y] Jeffrey M. Weinberg, MD,[p] Kevin L. Winthrop, MD, MPH,[z] Paul Yamauchi, MD,[aa] and April W. Armstrong, MD, MPH[ab]

Background: For psoriatic patients who need to receive nonlive or live vaccines, evidence-based recommendations are needed regarding whether to pause or continue systemic therapies for psoriasis and/or psoriatic arthritis.

Objective: To evaluate literature regarding vaccine efficacy and safety and to generate consensus-based recommendations for adults receiving systemic therapies for psoriasis and/or psoriatic arthritis receiving nonlive or live vaccines.

From the Department of Dermatology, Keck School of Medicine at USC, Los Angeles, California[a]; Department of Dermatology, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania[b]; National Psoriasis Foundation, Portland, Oregon[c]; Department of Dermatology, University of California, San Francisco School of Medicine, San Francisco, California[d]; Department of Dermatology, The University of Texas Southwestern Medical Center, Dallas, Texas[e]; Innovative Dermatology, Plano, Texas[f]; Department of Dermatology, University of Utah, Salt Lake City, Utah[g]; Department of Dermatology, Wake Forest School of Medicine, Winston-Salem, North Carolina[h]; Department of Dermatology, Donald and Barbara Zucker School of Medicine, Hempstead, New York[i]; Schroeder Arthritis Institute, Krembil Research Institute, Toronto Western Hospital, Toronto, Ontario, Canada[j]; Aesthetic & Dermatology Center, Rockville, Maryland[k]; Department of Dermatology, University of Michigan, Ann Arbor, Michigan[l]; Department of Dermatology, University of California, Davis, Rocklin, California[m]; Physicians Skin Care, Louisville, Kentucky[n]; Division of Clinical Dermatology & Cutaneous Science, Dalhousie University, Halifax, Nova Scotia, Canada[o]; Department of Dermatology, Icahn School of Medicine at Mount Sinai, New York, New York[p]; Illinois Dermatology Institute, Chicago, Illinois[q]; Dr. George Martin Dermatology Associates, Kihei, Hawaii[r]; Division of Rheumatology, Johns Hopkins University School of Medicine, Baltimore, Maryland[s]; Division of Rheumatology, NYU Grossman School of Medicine, New York, New York[t]; Division of Allergy, Immunology, and Rheumatology, University of Rochester Medical Center, Rochester, New York[u]; Division of Rheumatology, Weill Cornell Medical Center, New York, New York[v]; Department of Rheumatology, Arthritis and Rheumatism Associates, Rockville, Maryland[w]; Department of Dermatology, Eastern Virginia Medical School, Norfolk, Virginia[x]; Department of Dermatology, University of Colorado Anschutz Medical Campus, Aurora, Colorado[y]; Division of Infectious Diseases, Oregon Health and Science University, Portland, Oregon[z]; Dermatology Institute & Skin Care Center, Santa Monica, California[aa]; and Division of Dermatology, University of California Los Angeles, Los Angeles, California.[ab]

Drs Chat, Ellebrecht, and Kingston contributed equally to this work.

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Correspondence to: April W. Armstrong, MD, MPH, Division of Dermatology, University of California, Los Angeles, 911 Broxton Ave, Suite 300, Los Angeles, CA 90024. E-mail: armstrongpublication@gmail.com.

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Methods: Using a modified Delphi process, 22 consensus statements were developed by the National Psoriasis Foundation Medical Board and COVID-19 Task Force, and infectious disease experts.
Results: Key recommendations include continuing most oral and biologic therapies without modification for patients receiving nonlive vaccines; consider interruption of methotrexate for nonlive vaccines. For patients receiving live vaccines, discontinue most oral and biologic medications before and after administration of live vaccine. Specific recommendations include discontinuing most biologic therapies, except for abatacept, for 2-3 half-lives before live vaccine administration and deferring next dose 2-4 weeks after live vaccination.

Limitations: Studies regarding infection rates after vaccination are lacking.

Conclusion: Interruption of antipsoriatic oral and biologic therapies is generally not necessary for patients receiving nonlive vaccines. Temporary interruption of oral and biologic therapies before and after administration of live vaccines is recommended in most cases. (J Am Acad Dermatol https://doi.org/10.1016/j.jaad.2023.12.070.)

Key words: abatacept; acitretin; adalimumab; apremilast; biologics; brodalumab; certolizumab; cyclosporine; deucravacitinib; etanercept; golimumab; guselkumab; infliximab; ixekizumab; methotrexate; psoriasis; psoriatic arthritis; recommendation; risankizumab; secukinumab; tildrakizumab; tofacitinib; ustekinumab; vaccination; vaccines.

INTRODUCTION

Vaccination is crucial in reducing morbidity and mortality from transmissible diseases. People with moderate-to-severe psoriasis and/or psoriatic arthritis (PsA) have a greater risk of severe infections.[1-3] Clinicians play an important role in counseling patients regarding vaccination while receiving antipsoriatic systemic therapy. Here we report an evidence-based synthesis of the literature, as well as evidence and consensus-based recommendations from the National Psoriasis Foundation (NPF) for adults treated with antipsoriatic systemic therapies receiving nonlive and live vaccines (Table I). This serves as an important update to recommendations published a decade ago.[4]

CAPSULE SUMMARY

- For patients receiving nonlive vaccines, continue oral and biologic therapies for the treatment of psoriasis and/or psoriatic arthritis without modification in most cases.
- For patients receiving live vaccines, temporarily discontinue most oral and biologic therapies for the treatment of psoriasis and/or psoriatic arthritis before and after vaccination.

METHODS

The consensus-building process consisted of a literature review and Delphi process. The literature review included PubMed articles from 1950-2022, combining MESH terms "vaccination" or "vaccines" with each systemic medication approved for psoriasis or PsA. Studies investigating vaccination in patients with inflammatory conditions other than psoriasis and PsA were reviewed. Of note, Mpox and COVID-19 were not included as living documents address recommendations for these vaccines.[12-15]

We performed a modified Delphi process to develop recommendations for adults treated with antipsoriatic systemic therapies receiving vaccines, based on the RAND appropriateness method.[16] Thirty members of the NPF Medical Board and COVID-19 Task Force, and infectious disease experts, participated in the Delphi voting. Voting members anonymously reported their level of agreement with each recommendation on a scale of 1 (complete disagreement) to 9 (complete agreement). Panel consensus was "low" when ≥25% of votes were in the 1-3 rating range with ≥25% of votes in the 7-9 rating range. Consensus was "high" if all 30 votes were within the 7-9 rating range. Other combinations of votes were considered "moderate." When evidence was insufficient, recommendations were achieved by expert opinion.

RESULTS

For each medication, a synthesis of available studies and abbreviated recommendations (degree of consensus) for patients receiving nonlive and live vaccines are presented below. The 22 complete consensus statements from the NPF providing guidance for adults treated with antipsoriatic systemic therapy receiving vaccines are listed in Tables II and III.

Abbreviations used:

HBV:	hepatitis B virus
IL:	interleukin
LZV:	live zoster vaccine
NPF:	National Psoriasis Foundation
PPSV23:	pneumococcal polysaccharide vaccine
PsA:	psoriatic arthritis
RA:	rheumatoid arthritis
RZV:	recombinant zoster vaccine
TNF:	tumor necrosis factor

Four recommendations achieved high consensus and 18 statements achieved moderate consensus. For reference, general vaccine recommendations for adults from the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices are summarized in Supplementary Table I, available via Mendeley at https://doi.org/10.17632/wzf2f59hbz.1.[17]

ORAL AGENTS

Deucravacitinib: Recommendations for adults treated with deucravacitinib receiving vaccines

Nonlive vaccines: continue deucravacitinib without interruption or dose modification (moderate)

Live vaccines: discontinue deucravacitinib for 2-3 half-lives prior to vaccination. Defer next deucravacitinib dose until 2-4 weeks after vaccination (moderate)

Deucravacitinib is an allosteric tyrosine kinase 2 inhibitor approved for psoriasis in 2022.[18] No vaccination studies have been published in patients receiving deucravacitinib. Until more data are available, recommendations for patients treated with deucravacitinib receiving vaccines are similar to those for patients treated with biologics.

Apremilast: Recommendations for adults treated with apremilast receiving vaccines

Nonlive and live vaccines: continue apremilast without interruption or dose modification (nonlive vaccine, high; live vaccine, moderate)

Apremilast is a phosphodiesterase-4 inhibitor used for psoriasis and PsA. No vaccination studies with patients receiving apremilast have been published. Adequate vaccine response is expected because apremilast does not affect production of immunoglobulins.[19]

Methotrexate: Recommendations for adults treated with methotrexate receiving vaccines

Nonlive vaccines: consider delaying methotrexate therapy for 2 weeks after vaccination (moderate)

Live vaccines: consider discontinuing methotrexate for 2-4 weeks prior to vaccination. Defer next methotrexate dose until 2-4 weeks after vaccination (moderate)

Methotrexate is a folate antimetabolite Food and Drug Administration-approved for psoriasis and PsA. Patients receiving methotrexate may have diminished immune response to nonlive vaccines, though much evidence comes from patients with inflammatory arthritides. For example, methotrexate-treated patients developed adequate immune responses to hepatitis B virus (HBV) vaccines and human papillomavirus vaccines.[20-22] However, patients receiving methotrexate had decreased serologic responses to influenza, pneumococcal polysaccharide vaccine (PPSV23), and pneumococcal conjugate vaccine 13.[23-27] A 2-week interruption of methotrexate after influenza vaccination resulted in higher seroprotection rates than continuous methotrexate treatment in rheumatoid arthritis (RA) patients.[28] Thus, interruption of methotrexate after nonlive vaccination may be beneficial.

Limited data are available with live vaccines. Immune responses to measles, mumps, and rubella vaccine were similar between patients with inflammatory arthritis receiving methotrexate alone and those receiving both methotrexate and etanercept.[29] No vaccine-related viral disease occurred after administration of measles, mumps, and rubella vaccine[29,30] or live zoster vaccine (LZV)[31] in patients receiving methotrexate. The primary live yellow fever vaccine produced adequate immune response in psoriatic patients receiving methotrexate.[32] Given the paucity of data, discontinuing methotrexate before and after live vaccination should be considered, similar to American College of Rheumatology guidelines.[33] The duration to pause methotrexate is based on its effect on lymphocyte numbers and function, which can last 8 days.[34]

Cyclosporine: Recommendations for adults treated with cyclosporine receiving vaccines

Nonlive vaccines: continue cyclosporine without interruption or dose modification (moderate)

Live vaccines: defer next cyclosporine dose until 2-4 weeks after vaccination (moderate)

Cyclosporine is a calcineurin inhibitor used for severe psoriasis. Most vaccination studies are in transplant patients receiving combination immunosuppression. Despite lower doses being used for psoriasis, transplant data provide insight into the impact of cyclosporine on immune response to vaccines; however, it is important to note that transplant patients may have other causes for decreased immunity.

Table I. Common nonlive and live vaccines

Nonlive vaccines	Live vaccines (duration of viral replication/viremia)
COVID-19	Bacille Calmette-Guérin (not well studied)
Haemophilus influenzae type b (Hib)	Intranasal influenza (not well studied)
Hepatitis B	Live zoster vaccine (Zostavax) (16% of patients had viral DNA in blood 2 wk postvaccination)[5]
Injectable influenza	Measles (no report of viremia in healthy humans[6]; 7-9 d postvaccination in monkeys)[7]
Pneumococcal (PCV13, PPSV23, PCV10, PCV15)	Mumps (not well studied)
Recombinant herpes zoster (Shingrix)	Rubella (viremia detected 7 to 21 d postvaccination)[8]
Tetanus toxoid (diphtheria-tetanus-pertussis, tetanus-diphtheria toxoid)	Yellow fever (viremia after primary immunization is cleared by 2 wk[9]; average viremia 3-5 d)[10]
	Smallpox* (no viremia detected)[11]
	Mpox* (not well studied)

PCV, Pneumococcal conjugate vaccine; *PPSV*, pneumococcal polysaccharide vaccine.
*The vaccina virus vaccine is used for the prevention of both Smallpox and Mpox. While the use of this vaccine for the prevention of Smallpox is no longer in practice, the use of this vaccine for prevention of Mpox is ongoing.

Cyclosporine-treated transplant patients had decreased antibody responses to seasonal and pandemic influenza vaccines.[35-38] Initial immune response to PPSV23, HBV, and tetanus toxoid vaccine was adequate, but antibodies declined rapidly.[36,39-42] These results suggest slightly diminished vaccine responses on cyclosporine, but modifying therapy for nonlive vaccination is not indicated. Vaccination is highly recommended to mitigate the risk of severe infection associated with cyclosporine use.[43]

No live vaccine data are available for cyclosporine. Cyclosporine should be paused after live vaccination due to its immunosuppressive effects (expert consensus).

Acitretin: Recommendations for adults treated with acitretin receiving vaccines

Nonlive and live vaccines: continue acitretin without interruption or dose modification (nonlive, moderate; live, moderate)

Acitretin is an oral retinoid approved for treatment of psoriasis. No vaccination studies have been published in patients receiving acitretin. Because acitretin is thought not to significantly suppress the immune system, adequate vaccination response is expected.

Tofacitinib: Recommendations for adults treated with tofacitinib receiving vaccines

Nonlive vaccines: continue tofacitinib without interruption or dose modification (moderate)

Live vaccines: discontinue tofacitinib for 1 week prior to vaccination. Defer next tofacitinib dose until 2-4 weeks after vaccination (moderate)

Tofacitinib is a Janus kinase inhibitor approved for PsA. Patients receiving tofacitinib may have slightly diminished vaccine responses, but the evidence is inconclusive. Antibody responses to influenza vaccine in patients with RA receiving tofacitinib were not different from those not receiving tofacitinib.[44] However, response to pneumococcal vaccine varied.[44,45] In tofacitinib-treated patients with RA, response to PPSV23 vaccine was impaired.[44] In tofacitinib-treated psoriasis patients, response to pneumococcal conjugate vaccine or tetanus toxoid vaccine was unaffected.[45] Furthermore, in RA patients, treatment interruption did not impact immune response to nonlive vaccine.[44]

Live vaccination during ongoing tofacitinib therapy has not been studied; however, studies have investigated live vaccination prior to tofacitinib initiation. In RA patients, LZV given 2-3 weeks before starting tofacitinib produced comparable vaccine response to those who did not receive tofacitinib.[46] However, LZV did not provide long-term protection in tofacitinib-treated RA patients; the earliest herpes zoster case occurred 218 days postvaccination.[47] LZV administration prior to starting tofacitinib was generally well-tolerated.[48] Due to the general lack of evidence, duration to pause tofacitinib before and after live vaccination was achieved through expert consensus.

BIOLOGICS

Tumor necrosis factor (TNF) inhibitors: Recommendations for adults treated with TNF inhibitors receiving vaccines

Nonlive vaccines: continue TNF inhibitors without interruption or dose modification (high)

Table II. Recommendations from the National Psoriasis Foundation for adults receiving oral systemic therapies for psoriasis and/or psoriatic arthritis receiving nonlive and live vaccines

Recommendation statement	Consensus level	Basis for consensus
Deucravacitinib and nonlive vaccine: In patients receiving deucravacitinib for psoriasis/PsA who require nonlive vaccines, deucravacitinib should be continued without interruption or dose modification.	Moderate	Expert consensus
Deucravacitinib and live vaccine*: Consider discontinuing deucravacitinib for 1 d (2-3 half-lives) prior to administering the live vaccine. Defer the next deucravacitinib dose until 2-4 wk after administration of the live vaccine.	Moderate	Expert consensus
Apremilast and nonlive vaccine: In patients receiving apremilast for psoriasis/PsA who require non-live vaccines, apremilast should be continued without interruption or dose modification.	High	Expert consensus
Apremilast and live vaccine: In patients receiving apremilast for psoriasis/PsA, there are no contraindications to receiving live vaccines; apremilast should be continued without interruption or dose modification.	Moderate	Expert consensus
Methotrexate and nonlive vaccine: In patients receiving methotrexate for psoriasis/PsA who require non-live vaccines, consider delaying methotrexate therapy for 2 wk after vaccination to increase the host immune response.	Moderate	Published, peer-reviewed literature
Methotrexate and live vaccine*: In patients receiving methotrexate for psoriasis/PsA, most live vaccines are not contraindicated if the dose does not exceed 0.4 mg/kg/wk (expert opinion). Consider discontinuing methotrexate for 2-4 wk prior to administering the live vaccine. Defer the next methotrexate dose until 2-4 wk after administration of the live vaccine. The decision to administer a live vaccine during methotrexate therapy requires careful case-by-case evaluation.	Moderate	Published, peer-reviewed literature
Cyclosporine and nonlive vaccine: In patients receiving cyclosporine for psoriasis/PsA who require nonlive vaccines, cyclosporine should be continued without interruption or dose modification.	Moderate	Published, peer-reviewed literature
Cyclosporine and live vaccine*: Live vaccine may be administered while receiving cyclosporine. Defer the next cyclosporine dose until 2-4 wk after the administration of the live vaccine.	Moderate	Expert consensus
Acitretin and nonlive vaccine: In patients receiving acitretin for psoriasis/PsA who require nonlive vaccines, acitretin should be continued without interruption or dose modification.	Moderate	Expert consensus
Acitretin and live vaccine: In patients receiving acitretin for psoriasis/PsA, there are no contraindications to receiving live vaccines; acitretin should be continued without interruption or dose modification.	Moderate	Exert consensus
Tofacitinib and nonlive vaccine: In patients receiving tofacitinib for psoriasis/PsA who require nonlive vaccines, tofacitinib should be continued without interruption or dose modification.	Moderate	Published, peer-reviewed literature
Tofacitinib and live vaccine*: Discontinue tofacitinib for 1 wk prior to administering the live vaccine. Defer the next tofacitinib dose until 2-4 wk after administration of the live vaccine.	Moderate	Expert consensus

PsA, Psoriatic arthritis.

*In general, live vaccines are to be avoided with the use of Janus kinase inhibitors, deucravacitinib, methotrexate, and cyclosporine. However, if the benefits of vaccination outweigh the risks, the above includes specific recommendations on how to administer these live vaccines in patients who are receiving oral systemic therapy.

Table III. Recommendations from the National Psoriasis Foundation for adults receiving biologic therapies for psoriasis and/or psoriatic arthritis receiving nonlive and live vaccines

Recommendation statement	Consensus level	Basis for consensus
TNF inhibitors and live vaccine[*†]**:** Consider discontinuing the TNF inhibitor for 2-3 half-lives prior to administering the live vaccine. Defer the next TNF inhibitor dose until 2-4 wk after the administration of the live vaccine.	Moderate	Published, peer-reviewed literature and expert consensus
IL-12/IL-23 inhibitor and nonlive vaccine[†]**:** In patients receiving IL-12/IL-23 inhibitor (ustekinumab) for psoriasis/PsA who require nonlive vaccines, IL-12/IL-23 inhibitor (ustekinumab) should be continued without interruption or dose modification.	Moderate	Published, peer-reviewed literature
IL-12/IL-23 inhibitor and live vaccine[*†]**:** Consider discontinuing the IL-12/IL-23 inhibitor (ustekinumab) for 2-3 half-lives prior to administering the live vaccine. Defer the next IL-12/IL-23 inhibitor (ustekinumab) dose until 2-4 wk after the administration of the live vaccine.	Moderate	Expert consensus
IL-17 inhibitors and nonlive vaccine[†]**:** In patients receiving IL-17 inhibitors for psoriasis/PsA who require nonlive vaccines, IL-17 inhibitors should be continued without interruption or dose modification.	High	Published, peer-reviewed literature
IL-17 inhibitors and live vaccine[*†]**:** Consider discontinuing the IL-17 inhibitor for 2-3 half-lives prior to administering the live vaccine. Defer the next IL-17 inhibitor dose until 2-4 wk after the administration of the live vaccine.	Moderate	Expert consensus
IL-23 inhibitors and nonlive vaccine[†]**:** In patients receiving IL-23 inhibitors for psoriasis/PsA who require nonlive vaccines, IL-23 inhibitors should be continued without interruption or dose modification.	High	Expert consensus
IL-23 inhibitors and live vaccine[*†]**:** Consider discontinuing the IL-23 inhibitor for 2-3 half-lives prior to administering the live vaccine. Defer the next IL-23 inhibitor dose until 2-4 wk after the administration of the live vaccine.	Moderate	Expert consensus
Abatacept and nonlive vaccine[†]**:** In patients receiving abatacept for psoriasis/PsA who require nonlive vaccines, abatacept should be continued without interruption or dose modification.	Moderate	Published, peer-reviewed literature
Abatacept and live vaccine[*†]**:** Discontinue abatacept for 1 wk (subcutaneous) or 4 wk (IV) prior to administering the live vaccine. Defer the next abatacept dose until 2-4 wk after the administration of the live vaccine.	Moderate	Expert consensus

IL, Interleukin; *PsA*, psoriatic arthritis; *TNF*, tumor necrosis factor.
*In general, live vaccines are to be avoided with the use of all biologics. However, if the benefits of vaccination outweigh the risks, the above includes specific recommendations on how to administer these live vaccines in patients who are receiving biologic therapy.
†The above recommendations for biologics apply to both the reference product (also known as the originator or innovator product) as well as the Food and Drug Administration-approved biosimilars.

Live vaccines: discontinue TNF inhibitor for 2-3 half-lives prior to vaccination. Defer next TNF inhibitor dose until 2-4 weeks after vaccination (moderate)

TNF inhibitor therapies for psoriatic disease include adalimumab, etanercept, certolizumab, infliximab, and golimumab. Influenza vaccination in patients receiving anti-TNFs appears to elicit adequate immune response. Specifically, psoriatic patients[49] and RA patients[50-56] treated with anti-TNFs did not have impaired immune response to influenza vaccine. However, pneumococcal vaccine data was mixed. Patients with RA[52,57,58] and PsA[59] demonstrated satisfactory responses to PPSV23 vaccine while patients with inflammatory bowel disease had impaired responses. Immune response to pneumococcal conjugate vaccine 13 was also impaired.[60,61] No safety signals were associated with pneumococcal vaccines in patients receiving anti-TNFs. Response rates to the HBV vaccine were significantly impaired in patients receiving anti-TNF therapy.[62]

Recent data imply that some live vaccines may be well-tolerated while receiving anti-TNF therapies, though evidence is limited. No cases of localized or disseminated zoster were observed after LZV in patients receiving anti-TNFs.[31] Similarly, patients treated with anti-TNFs had no increase in vaccine-related disease after LZV.[63,64] Ongoing studies are investigating the immunogenicity of varicella vaccine in patients receiving anti-TNFs.[64] Duration to pause anti-TNFs for patients receiving live vaccines was achieved by expert consensus.

Interleukin-12/Interleukin-23 inhibitor: Recommendations for adults treated with Interleukin-12/23 inhibitors receiving vaccines

Nonlive vaccines: continue interleukin (IL)-12/IL-23 inhibitor without interruption or dose modification (moderate)

Live vaccines: consider discontinuing IL-12/IL-23 inhibitor for 2-3 half-lives prior to vaccination. Defer next IL-12/IL-23 inhibitor dose until 2-4 weeks after vaccination (moderate)

Ustekinumab is an IL-12/IL-23 inhibitor approved for psoriasis and PsA. Nonlive vaccines are well-tolerated and immunogenic in patients receiving ustekinumab. Ustekinumab-treated patients with psoriasis developed adequate antibody responses to pneumococcal, tetanus toxoid, and HBV vaccines.[62,65,66] Responses to influenza vaccine in ustekinumab-treated patients with inflammatory bowel disease were comparable to adalimumab-treated patients and healthy controls.[67]

Live vaccine studies have not been performed in patients receiving ustekinumab. Recommendations were achieved by expert consensus.

IL-17 inhibitors: Recommendations for adults treated with IL-17 inhibitors receiving vaccines

Nonlive vaccines: continue IL-17 inhibitors without interruption or dose modification (high)

Live vaccines: discontinue IL-17 inhibitor for 2-3 half-lives prior to vaccination. Defer next IL-17 inhibitor dose until 2-4 weeks after vaccination (moderate)

IL-17 inhibitors for psoriatic disease include secukinumab, ixekizumab, and brodalumab. Available data suggest that IL-17 inhibitors may not impair vaccine response. Secukinumab-treated patients with PsA or ankylosing spondylitis achieved similar influenza seroprotection rates as healthy untreated controls.[68,69] No safety signals were associated with vaccination in secukinumab-treated patients.[68,70] Healthy patients treated with ixekizumab did not have impaired response to PPSV23 and tetanus toxoid vaccines.[71] Brodalumab has not been studied with vaccination.

Live vaccine studies have not been performed in patients receiving IL-17 inhibitors; recommendations were achieved by expert consensus.

IL-23 inhibitors: Recommendations for adults treated with IL-23 inhibitors receiving vaccines

Nonlive vaccines: continue IL-23 inhibitors without interruption or dose modification (high)

Live vaccines: discontinue IL-23 inhibitor for 2-3 half-lives prior to vaccination. Defer next IL-23 inhibitor dose until 2-4 weeks after vaccination (moderate)

IL-23 inhibitors for psoriatic disease include guselkumab, tildrakizumab, and risankizumab. No vaccination studies have been published with these medications; recommendations were achieved by expert consensus.

Live vaccine studies have not been performed in patients receiving IL-23 inhibitors; therefore, recommendations were achieved by expert consensus.

Abatacept: Recommendations for adults treated with abatacept receiving vaccines

Nonlive vaccination: continue abatacept without interruption or dose modification (moderate)

Live vaccination: discontinue abatacept for 1 week (subcutaneous) or 4 weeks (intravenous) prior to vaccination. Defer next abatacept dose until 2-4 weeks after vaccination (moderate)

Abatacept is a T-cell modulator FDA-approved for PsA. Studies suggest that patients treated with abatacept may have slightly diminished vaccine responses, but evidence is limited. Most patients receiving abatacept developed a satisfactory response to seasonal and pandemic influenza vaccines and tetanus vaccine.[50,72,73] However, immune response to PPSV23 was mixed.[72,74] No safety signals were associated with nonlive vaccination in patients receiving abatacept.[72,74,75]

Live vaccine studies have not been performed in patients receiving abatacept. Recommendations were achieved by expert consensus given the limited data.

DISCUSSION

Based on the available evidence, nonlive vaccines are generally well-tolerated in patients treated with antipsoriatic oral or biologic medications and may be given without interruption of therapy in most cases, apart from methotrexate (Tables II and III).

When possible, live vaccines should be administered before starting systemic therapy for psoriasis and/or PsA. While prescribing information for most

systemic medications states that live vaccines should be avoided altogether (Supplementary Table II, available via Mendeley at https://doi.org/10.17632/wzf2f59hbz.1), there are instances where patients already receiving oral or biologic therapies need live vaccines. In those instances, most therapies should be paused before and after live vaccine administration. Discontinuing a medication before live vaccination will minimize its effect on the body's immune response to the vaccine. The recommended duration to discontinue a medication before live vaccine administration is based on the medication's half-life (Supplementary Table III, available via Mendeley at https://doi.org/10.17632/wzf2f59hbz.1). Deferring the next dose of medication for 2-4 weeks after administration of live vaccine allows for live vaccine replication/viremia to cease before restarting therapy (Table I).

For patients receiving live vaccines, the NPF recommendations include discontinuing tofacitinib, methotrexate, and deucravacitinib before and after vaccination, discontinuing cyclosporine after vaccination and continuing apremilast and acitretin without modification (Table II). It is recommended that patients receiving anti-TNF, anti-IL-12/IL-23, anti-IL-23, and anti-IL-17 therapies, and abatacept, discontinue these medications before and after live vaccination (Table III).

Phototherapy involves the therapeutic use of ultraviolet radiation; narrow band UV-B is commonly used for the treatment of psoriasis. Some studies have shown that phototherapy has been linked to local and potentially systemic immunosuppression.[76] However, clinical studies investigating vaccination in patients receiving phototherapy are lacking; therefore, our group is not ready to make recommendations regarding phototherapy and vaccines.

These guidelines are meant to advise clinical practice but may not be appropriate for all patients. If the benefits of vaccination outweigh the risks, the NPF Medical Board offers specific recommendations on how to administer vaccines in patients who are receiving oral systemic or biologic therapy. The decision to implement these recommendations should be based on a risk-benefit evaluation for individual patients including comorbidities, risk factors, and psoriatic disease activity.

Limitations

Vaccination outcomes in psoriatic patients are understudied. Much evidence comes from inflammatory arthritis or inflammatory bowel disease patients receiving systemic therapies also approved for psoriasis or PsA (Supplementary Table IV, available via Mendeley at https://doi.org/10.17632/wzf2f59hbz.1). Thus, disease-specific differences in medication doses were considered when developing the recommendations. Most studies of live vaccines examined LZV, but current standard of care is the nonlive recombinant zoster vaccine. We included studies examining LZV as this data may be important to understanding the overall effects a medication may have on vaccine efficacy and safety; however, data from one live vaccine may not apply to another live vaccine. Several studies have investigated the immunogenicity of recombinant zoster vaccine in certain immunocompromised patient populations, including patients with HIV[77] and transplant patients,[78] though studies with psoriatic or rheumatologic patients are lacking. Psoriatic patients with high disease burden are at a mildly increased risk of herpes zoster infection[79]; therefore, it is important that psoriatic patients receive zoster vaccination. Previously published literature contains NPF recommendations for patients receiving antipsoriatic systemic therapy who need zoster vaccination.[79]

CONCLUSION

Vaccination is critical for reducing infection and is important for psoriatic patients receiving systemic therapy to prevent infectious diseases and mitigate the risk for severe complications. Clinicians should review vaccination status and recommendations prior to initiating systemic therapies for psoriatic disease. For patients already receiving systemic therapy for psoriasis and/or PsA, clinicians may apply these recommendations when determining whether to continue or discontinue systemic therapies for psoriasis and/or PsA while patients receive nonlive or live vaccines.

Conflicts of interest

Dr Chat, Dr Ellebrecht, Ms. Kingston, and Dr Cordoro have no conflicts of interest to declare. Dr Bell is an employee of the National Psoriasis Foundation. Author Gondo is an employee of the National Psoriasis Foundation. Dr Desai has served as a research investigator, consultant, speaker, and/or advisor for AbbVie, Galderma, Foundation for Research & Education of Dermatology, Almirall, Dermavant, Ferndale Laboratories, Inc, Incyte Corporation, Gore Range Capital, AOBiome, LLC, Bristol Myers Squibb, Verrica Pharmaceuticals, UCB, Ortho Dermatologics, Scientis, EPI Health, Avita, Pfizer, Lilly, LEO, Incyte Corporation, L'Oreal USA, Inc, Beiersdorf, Inc, and Johnson and Johnson; is a board member of the National Psoriasis Foundation and Women's Derm Society; and is a stockholder for Gore Range Capital. Dr Duffin has been a consultant, advisor, or served as an investigator for AbbVie, AnaptysBio, Amgen, Bristol-Myers Squib, Celgene, CorEvitas/Corrona,

Boehringer-Ingelheim, Janssen, Lilly, Novartis, Ortho Dermatologica, Pfizer, Regeneron, Sienna, Stiefel, and UCB. Dr Feldman has received research, speaking and/or consulting support from Eli Lilly and Company, GlaxoSmithKline/Stiefel, AbbVie, Janssen, Alovtech, vTv Therapeutics, Bristol-Myers Squibb, Samsung, Pfizer, Boehringer Ingelheim, Amgen Inc, Dermavant, Arcutis, Novartis, Novan, UCB, Helsinn, SunPharma, Almirall, Galderma, Leo Pharma, Mylan, Celgene, Valeant, Menlo, Merck & Co, Qurient Forte, Arena, Biocon, Accordant, Argenx, Sanofi, Regeneron, the National Biological Corporation, Caremark, Advance Medical, Suncare Research, Informa, UpToDate and the National Psoriasis Foundation; is the founder and majority owner of www.DrScore.com; is a founder and part owner of Causa Research; and has stock in Sensal Health. Dr Garg is an advisor for AbbVie, Aclaris Therapeutics, Anaptys Bio, Aristea Therapeutics, Boehringer Ingelheim, Bristol Myers Squibb, Incyte, InflaRx, Insmed, Janssen, Novartis, Pfizer, UCB, and Viela Biosciences; receives honoraria; and receives research grants from AbbVie, UCB and National Psoriasis Foundation. Dr Gelfand served as a consultant for Abbvie, BMS, Boehringer Ingelheim, Celldex (DSMB), FIDE (which is sponsored by multiple pharmaceutical companies) GSK, Happify, Lilly (DMC), Leo, Janssen Biologics, Neumentum, Novartis Corp, Pfizer, UCB (DSMB), Neuroderm (DSMB), Regeneron, Trevi, and Mindera Dx., receiving honoraria; receives research grants (to the Trustees of the University of Pennsylvania) from Boehringer Ingelheim, and Pfizer Inc; and received payment for continuing medical education work related to psoriasis that was supported indirectly pharmaceutical sponsors. Dr Gelfand is a co-patent holder of resiquimod for treatment of cutaneous T cell lymphoma. Dr Gelfand is a Deputy Editor for the Journal of Investigative Dermatology receiving honoraria from the Society for Investigative Dermatology, is Chief Medical Editor for Healio Psoriatic Disease (receiving honoraria) and is a member of the Board of Directors for the International Psoriasis Council, receiving no honoraria. Dr Gladman has served as a consultant for AbbVie, Amgen, BMS, Eli Lily, Galapagos, Gilead, Janssen, Novartis, Pfizer, and UCB; and has received grants from AbbVie, Amgen, Eli Lily, Janssen, Novartis, Pfizer, and UCB. Dr Green is a research investigator, speaker, and/or consultant for AbbVie, Amgen, Arcutis, BMS, Dermavant, Lilly, MC2, SunPharma, and UCB. Dr Gudjonsson has served as an advisor for Novartis, Janssen, Almirall, Eli Lilly, Sanofi, and Boehringer Ingelheim; and has received research support from Almirall, Eli Lilly, Prometheus, BMS, and Janssen. Dr Han has served as a research investigator, consultant, and/or speaker for AbbVie, Amgen, Boehringer Ingelheim, BMS, Dermavant, Janssen, Lilly, UCB, Novartis, Leo Pharma, Regeneron, Sanofi Genzyme, Ortho Dermatologics, Bond Avillion, Pellepharm, MC2, Athenex, Celgene, Sun Pharma, and Pfizer. Dr Hawkes is an advisor and/or consultant for AbbVie, Arcutis, Boehringer Ingelheim, Janssen, LearnSkin, LEO, Lilly, Novartis, Pfizer, Regeneron-Sanofi Genzyme, and UCB; is a board member of the National Psoriasis Foundation; and has stock ownership/equity of Regeneron Pharmaceuticals. Dr Kircik is a research investigator, speaker, advisor, and/or consultant for Abbott Laboratories, Allergan, Almirall, Amgen, Arcutis, Biogen-Idec, BMS, Boehringer-Ingleheim, Breckinridge Pharma, Celgene, Centocor, Inc, Cellceutix, Cipher, Combinatrix, Connetics Corporation, Coria, Dermavant, Dermira, Dow Pharmaceutical Sciences, Inc, Dr Reddy's Lab, Eli Lilly, Galderma, Genentech, Inc, GlaxoSmithKline, PLC, Idera, Leo, Maruho, Merck, Medicis Pharmaceutical Corp., Novartis AG, Promius, PharmaDerm, Pfizer, Serono, Stiefel Laboratories, Inc, Sun Pharma, Taro, UCB, Valeant Pharmaceuticals Intl, and XenoPort. Dr Koo is a speaker and/or advisor for AbbVie, Amgen, Lilly, UCB, Ortho Dermatologics, LEO, Sun Pharma, Janssen, and Epi Pharm. Dr Langley has been an investigator, served on the scientific advisory board, and/or has provided a lecture for AbbVie, Amgen, Boehringer Ingelheim, Celgene, Leo, Lilly, Merck, Novartis, Pfizer, and UCB. Dr Lebwohl is an employee of Mount Sinai; receives research funds from AbbVie, Amgen, Arcutis, Avotres, Boehringer Ingelheim, Cara Therapeutics, Dermavant Sciences, Eli Lilly, Incyte, Janssen Research & Development, LLC, Ortho Dermatologics, Regeneron, and UCB, Inc; and is a consultant for Aditum Bio, Almirall, AltruBio Inc, AnaptysBio, Arcutis, Inc, Arena Pharmaceuticals, Aristea Therapeutics, Arrive Technologies, Avotres Therapeutics, BiomX, Brickell Biotech, Boehringer-Ingelheim, Bristol Myers Squibb, Cara Therapeutics, Castle Biosciences, Corevitas, Dermavant Sciences, Dr Reddy's Laboratories, Evelo Biosciences, Evommune, Inc, Facilitatation of International Dermatology Education, Forte Biosciences, Foundation for Research and Education in Dermatology, Helsinn Therapeutics, Hexima Ltd., LEO Pharma, Meiji Seika Pharma, Mindera, Pfizer, Seanergy, and Verrica. Dr Lewitt has received speaking and/or consulting support from AbbVie, Lilly, Janssen, Ortho Dermatologics, UCB, Galderma, Pfizer; received honoraria; and served as an advisor for AbbVie, Janssen, and Dermavant. Dr Liao has received research/grant support from AbbVie, Amgen, Janssen, Leo, Novartis, Trex Bio, Pfizer, and Regeneron. Dr Martin has served as an advisor for Bristol Meyers Squibb, DUSA/SUN, AbbVie, Ortho/Bausch Health, Galderma, Pfizer, LEO, Janssen, Horizon, UCB, Trevi, Almirall, Dermavent, Incyte, and Lilly; has served as a consultant for Bristol Meyers Squibb, DUSA/SUN, AbbVie, Ortho/Bausch Health, Galderma, Pfizer, LEO, UCB, Trevi, Almirall, Lilly, Arcutis, and Dermavant; and has received speaking support from UCB, Almirall, LEO, Incyte, Dermavant, and Bristol Meyers Squibb. Dr Orbai is a consultant and/or advisor for Janssen, Novartis, and UCB; and receives research support from AbbVie, Amgen, and Celgene. Dr Reddy has served as a consultant for Novartis, AbbVie, Janssen, and UCB; and has received grant support from Pfizer. Ms Richardson has served as an advisor for and received honoraria from Boehringer Engelheim and Lilly. Dr Ritchlin is a consultant and/or speaker for Novartis, Lilly, AbbVie, Janssen, UCB, and Pfizer. Dr Schwartzman

has received speaking support from AbbVie, Janssen, Lilly, Pfizer, Novartis, and UCB; served as a consultant for Abbvie, Janssen, Lilly, Myriad, Novartis, Regeneron, Sanofi, UCB, Stelexis, Jubilant, and Teijin; is a board member of the National Psoriasis Foundation; and served as an advisor for Myriad. Dr Siegel has served as an advisor, speaker, and/or consultant for Abbvie, UCB, Lilly, Horizon, and BMS. Dr Van Voorhees has served as a research investigator and/or scientific advisor for Lilly, AbbVie, UCB, Bristol Meyers Squibb, Amgen, Boehringer Ingelheim, Novartis, and Merck. Dr Wallace serves as an investigator for Pfizer and Target RWE. Dr Weinberg is a research investigator, consultant, and/or speaker for Novartis, Lilly, Amgen, AbbVie, Sun, Janssen, and BMS. Dr Winthrop is a consultant for Pfizer, AbbVie, Union Chimique Belge (UCB), Eli Lilly & Company, Galapagos, GlaxoSmithKline (GSK), Roche, Gilead, Bristol Myers Squibb (BMS), Regeneron, Sanofi, AstraZeneca, and Novartis; and receives research funding from BMS and Pfizer. Dr Yamauchi serves as a research investigator, consultant, and speaker for Abbvie, Amgen, BMS, Janssen, Lilly, Novartis, Pfizer, Sun Pharma, UCB. Dr Armstrong has served as a research investigator, scientific advisor, and/or speaker to AbbVie, Almirall, Arcutis, ASLAN, Beiersdorf, BI, BMS, EPI, Incyte, Leo, UCB, Janssen, Lilly, Mindera, Nimbus, Novartis, Ortho Dermatologics, Sun, Dermavant, Dermira, Sanofi, Regeneron, and Pfizer.

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