

Journal of Dermatology and Cosmetic Surgery

Review Article

Comparative Analysis of biologic therapy for psoriasis versus Standard Care in plaque psoriasis

Yang J^{1*}, Yang B² and Huang F³

¹Department of Clinical Dermatology, Tajo Academy of Dermatology, China

²Division of Dermatology, Nille Center for Cosmetic and Aesthetic Surgery, Philippines

³Department of Dermatology, Murray Institute for Advanced Cosmetic and Aesthetic Surgery, Indonesia

*Address for Correspondence: Jun Yang, Department of Clinical Dermatology, Tajo Academy of Dermatology, China; E-mail: jun.yang@tajo.edu

Received: 23 July 2019; Accepted: 26 October 2019; Published: 20 January 2020.

Citation of this article: Yang J, Yang B, Huang F (2020) Comparative Analysis of biologic therapy for psoriasis versus Standard Care in plaque psoriasis. J Dermatol Cosmet Surg, 1(1): 01-06. DOI: [10.5281/zenodo.22814266](https://doi.org/10.5281/zenodo.22814266)

Copyright: © 2020 Jun Yang, et al. This is an open access article distributed under the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

Background: Plaque psoriasis is a chronic immune-mediated skin disease for which biologic agents targeting tumor necrosis factor-alpha, interleukin-12/23, interleukin-17, and interleukin-23 have progressively supplemented conventional systemic care.

Objective: This review compares the efficacy, safety, and practical positioning of biologic therapy against standard care, including phototherapy, methotrexate, and cyclosporine, in adults with moderate-to-severe plaque psoriasis.

Methods: We synthesized pivotal randomized controlled trials, head-to-head biologic comparisons, network meta-analyses, and long-term registry studies reporting Psoriasis Area and Severity Index response, drug survival, safety outcomes, and cost-effectiveness.

Findings: Biologic agents consistently achieved higher rates of skin clearance than conventional systemic therapy, with response rates rising across successive drug classes from tumor necrosis factor-alpha inhibitors through interleukin-17 and interleukin-23 inhibitors; long-term registry data showed comparable or better tolerability and longer treatment persistence for biologic agents relative to conventional therapy, while acquisition cost remained the principal factor favoring standard care.

Conclusions: Biologic therapy offers superior and more durable disease control than standard care in moderate-to-severe plaque psoriasis, and its comparative advantage over conventional systemic agents is now supported by a broad and consistent evidence base, though cost and access continue to shape real-world treatment sequencing.

Keywords: plaque psoriasis; biologic therapy; TNF-alpha inhibitors; IL-17/IL-23 inhibitors; PASI response

1. Introduction

Plaque psoriasis is a chronic, immune-mediated inflammatory skin disease affecting an estimated 2-3% of the global population, with prevalence varying substantially by geography and ancestry [1]. Population-based surveys in the United Kingdom and comparable Western cohorts have repeatedly shown that a large minority of affected patients carry moderate-to-severe disease, defined variably by body surface area, Psoriasis Area and Severity Index (PASI) score, or the degree of functional and psychosocial impairment the disease imposes [2]. The disease's clinical burden extends well beyond the skin: patients with extensive plaque disease report quality-of-life decrements comparable to those seen in other major chronic illnesses, and the Dermatology Life Quality Index has become the standard instrument for capturing that burden in both trials and everyday clinical decision-making [3]. A European consensus effort formalized what "adequate" treatment response should mean in this context, proposing PASI 75 as a minimum acceptable outcome and PASI 90 as the preferred target for patients on sustained systemic therapy [4].

For three decades, standard systemic care for moderate-to-severe plaque psoriasis rested on a narrow set of conventional agents, methotrexate, cyclosporine, acitretin, and narrowband ultraviolet B phototherapy, each effective for a meaningful fraction of patients but each constrained by cumulative toxicity, incomplete responses, or the practical burden of repeated clinic visits [5]. The clinical picture changed with the therapeutic exploitation of the disease's underlying immunology: as the central role of tumor necrosis factor- α , and later the interleukin-23/T-helper-17 axis, became clear, a succession of biologic agents entered practice that offered levels of skin clearance conventional therapy rarely achieved. This review compares the efficacy, safety, and practical positioning of biologic therapy against standard care in plaque psoriasis, synthesizing pivotal randomized

trials, head-to-head comparisons, long-term registry data, and cost-effectiveness analyses to clarify where each approach now fits in contemporary management.

2. Pathogenesis and Rationale for Targeted Biologic Therapy

Plaque psoriasis arises from a self-amplifying interaction between innate and adaptive immunity in genetically susceptible skin. Dendritic cells activated by an initiating stimulus produce interleukin-12 and interleukin-23, which respectively drive T-helper-1 and T-helper-17 differentiation; the resulting interleukin-17 and interleukin-22 output from T-helper-17 cells, together with tumor necrosis factor- α from multiple cellular sources, drives keratinocyte hyperproliferation, abnormal differentiation, and the recruitment of further inflammatory infiltrate that sustains the plaque [6]. Di Cesare and colleagues detailed how the interleukin-23/T-helper-17 axis in particular functions as the dominant effector pathway in established plaque disease, providing the mechanistic rationale for therapies that block interleukin-23 or interleukin-17 signaling further downstream than the older tumor necrosis factor- α inhibitors [7]. This mechanistic clarity, largely absent when methotrexate and cyclosporine were first adopted empirically, is what allowed biologic development to proceed rationally from target identification to clinical trial with a specificity conventional immunosuppressants never offered [5].

3. Standard Care in Plaque Psoriasis

Conventional systemic therapy remains the recommended first step for many patients with moderate disease under most contemporary guidelines, reflecting decades of accumulated experience, low acquisition cost, and oral or outpatient administration [8]. Narrowband ultraviolet B phototherapy achieves PASI 75 in a substantial proportion of adherent patients and remains attractive where biologic access is limited, though sustained clearance requires two to three clinic-based

sessions weekly and relapse is common once treatment stops [9]. Methotrexate, typically titrated to 15-25 mg weekly, produces meaningful but generally modest average PASI improvement relative to biologic agents, and its use is constrained by hepatotoxicity, cytopenia, and the need for regular laboratory monitoring over years of continuous therapy [10]. A comprehensive meta-analysis of randomized trials confirmed that conventional systemic agents as a class achieve substantially lower PASI 75 response rates than biologic therapy, with cyclosporine performing best among conventional options but limited to short courses because of nephrotoxicity and hypertension risk [11]. These constraints, rather than any single dramatic failure, are what created the clinical space biologic therapy subsequently filled.

4. TNF-alpha Inhibitors versus Standard Care

Tumor necrosis factor-alpha inhibitors were the first biologic class to demonstrate that near-complete skin clearance was achievable at scale. Etanercept monotherapy produced PASI 75 responses clearly exceeding placebo in the pivotal trial by Leonardi and colleagues, establishing proof of concept for cytokine-targeted therapy in psoriasis [12]. Adalimumab, evaluated in the CHAMPION trial, achieved PASI 75 in the majority of treated patients at 16 weeks and was directly compared against methotrexate within the same study, with adalimumab significantly outperforming methotrexate on every efficacy endpoint measured [13]. Infliximab produced the fastest and most complete responses among the early tumor necrosis factor-alpha inhibitors in the EXPRESS trial, with most patients achieving PASI 75 by week 10, though maintenance dosing and infusion-related considerations shaped its later positioning relative to subcutaneous alternatives [14]. Taken together, these trials established that tumor necrosis factor-alpha blockade could roughly double or triple the PASI 75 response rate achieved with methotrexate, a gap subsequent meta-analyses confirmed was neither a statistical artifact nor specific to any single

trial population [11].

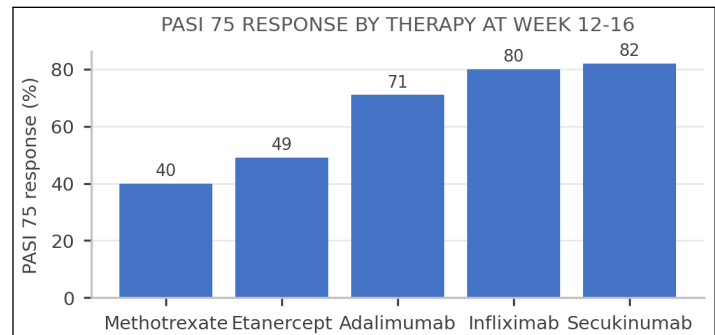


Figure 1: PASI 75 response rates at week 12-16 across methotrexate, the tumor necrosis factor-alpha inhibitors etanercept, adalimumab, and infliximab, and the interleukin-17 inhibitor secukinumab, drawn from pivotal randomized trials and a class-level meta-analysis [11,13,14,18].

5. IL-12/23 and IL-17 Inhibitors

Ustekinumab, targeting the shared p40 subunit of interleukin-12 and interleukin-23, extended the efficacy gain further while reducing dosing frequency to once every 12 weeks after induction. The PHOENIX 1 and PHOENIX 2 trials both showed PASI 75 responses well above placebo and numerically above the first-generation tumor necrosis factor-alpha inhibitors, an advantage sustained through extended follow-up [15,16]. Long-term extension data through three years confirmed that efficacy was durable rather than an early-trial artifact, with response rates maintained in patients who continued therapy without interruption [17]. The subsequent generation of interleukin-17A inhibitors pushed clearance rates higher still: secukinumab achieved PASI 90 in roughly half of treated patients in the ERASURE and FIXTURE trials, a magnitude of response conventional care essentially never produced [18], and head-to-head comparison in the CLEAR trial showed secukinumab achieving statistically superior clearance to ustekinumab at 52 weeks [19]. Ixekizumab, evaluated across the UNCOVER program, achieved even higher PASI 90 and PASI 100 rates than earlier interleukin-17 pathway agents, with most treated patients reaching PASI 90 by week 12 [20]. Brodalumab, blocking the interleukin-17 receptor rather than the ligand itself, outperformed ustekinumab

directly on PASI 100 in the AMAGINE program, illustrating that receptor blockade could extend clearance further even within an already highly effective drug class [21].

6. IL-23 Inhibitors and Head-to-Head Comparisons

The most selective agents, blocking interleukin-23 at its p19 subunit while sparing interleukin-12 signaling, have set the current benchmark for sustained clearance. Guselkumab outperformed adalimumab on both PASI 90 and Investigator's Global Assessment endpoints in the VOYAGE 1 and VOYAGE 2 trials, with the advantage widening through week 48 as adalimumab responses attenuated while guselkumab responses were sustained or improved [22,23]. Risankizumab produced an even larger separation from adalimumab in the IMMvent trial, and the UltIMMa program confirmed PASI 90 rates well above 70% at week 16 against both placebo and ustekinumab comparator arms [24,25]. Tildrakizumab, evaluated in the reSURFACE program, likewise demonstrated superiority over both placebo and etanercept, reinforcing that selective interleukin-23 blockade outperforms first-generation tumor necrosis factor-alpha inhibition directly rather than only against placebo [26]. Network meta-analyses synthesizing this now-extensive head-to-head evidence base consistently rank interleukin-17 and interleukin-23 inhibitors above tumor necrosis factor-alpha inhibitors, which in turn rank well above conventional systemic agents, on both PASI 90 and PASI 100 response [27,28]. No conventional agent evaluated in these analyses approached the response rates of any modern biologic class, a finding that has been remarkably consistent across independent statistical methodologies and patient populations.

Class	Representative agent	Target	Approx. PASI 90
IL-17A inhibitor	Secukinumab / Ixekizumab	IL-17A / receptor	~65-80%
IL-23p19 inhibitor	Risankizumab / Guselkumab	IL-23 p19	~75-90%

7. Safety, Tolerability, and Long-Term Drug Survival

Efficacy alone does not determine a therapy's long-term clinical value, and registry-derived drug survival, the proportion of patients remaining on a given agent over time, has become a key comparative metric because it captures effectiveness, tolerability, and patient satisfaction together. Long-term ustekinumab safety data through five years of follow-up showed no unexpected signal beyond the known infection and malignancy risks associated with biologic immunosuppression as a class, with serious adverse event rates remaining stable across successive years of exposure [29]. Comparative registry analyses have found that biologic agents as a class demonstrate meaningfully longer drug survival than conventional systemic therapy, reflecting both better sustained efficacy and lower discontinuation for toxicity [30]. Within the biologic class itself, drug survival differs by mechanism: the BADBIR cohort study found that ustekinumab and secukinumab both outperformed adalimumab on multi-year drug survival, driven predominantly by lower rates of secondary loss of efficacy rather than by differences in acute toxicity [31]. Patient-reported satisfaction with biologic therapy is correspondingly high in prospective registry cohorts, with most patients continuing therapy specifically because of perceived efficacy rather than tolerating it despite reservations [32]. Standard care is not without its own toxicity burden over comparable follow-up: methotrexate's hepatic and hematologic monitoring requirements and cyclosporine's renal and cardiovascular effects impose a different, but not necessarily smaller, cumulative risk profile than biologic therapy carries, a distinction guideline bodies now weigh explicitly when

Table 1: Representative biologic classes for plaque psoriasis, mechanism of action, and approximate week 12-16 PASI 90 response from pivotal and head-to-head trials [24,25,26,22].			
Class	Representative agent	Target	Approx. PASI 90
TNF-alpha inhibitor	Adalimumab	TNF-alpha	~45%
IL-12/23 inhibitor	Ustekinumab	IL-12/23 p40	~55-65%

framing treatment sequencing [8].

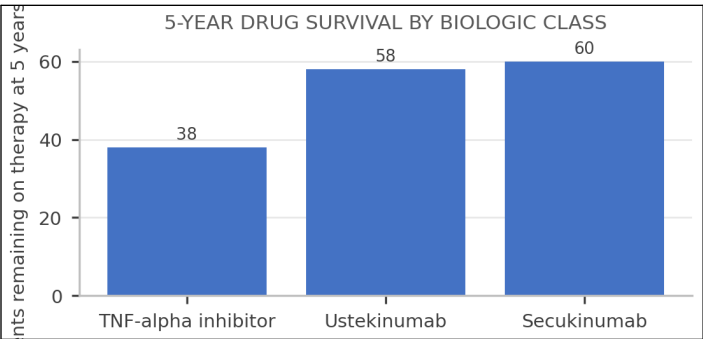


Figure 2: Five-year drug survival among patients started on a tumor necrosis factor-alpha inhibitor, ustekinumab, or secukinumab in prospective biologics registries, reflecting combined discontinuation for loss of efficacy and for adverse events [30,31].

8. Cost-effectiveness, Access, and Quality of Life

Biologic therapy's acquisition cost remains the principal argument in favor of retaining standard care as a first option for eligible patients, and cost-effectiveness analyses have generally found that biologics, despite superior clinical response, do not achieve cost parity with conventional agents on a straightforward cost-per-responder basis at list pricing [33]. That calculus shifts once quality-adjusted outcomes and indirect costs, lost productivity, comorbidity management, and the psychosocial burden of undertreated disease, are incorporated, since the disability associated with extensive, poorly controlled plaque psoriasis carries substantial indirect economic cost of its own [34]. Large prospective registries characterizing the real-world population that ultimately receives biologic therapy show these are disproportionately patients with more extensive disease, higher baseline Dermatology Life Quality Index impairment, and more treatment failures behind them, precisely the population in whom the marginal clinical benefit of biologic therapy over standard care is largest [35]. Recognizing that PASI thresholds alone do not capture this full picture, the International Psoriasis Council's Delphi consensus recommended recategorizing moderate disease using quality-of-life and treatment-history criteria alongside body surface area, a

shift that in practice broadens eligibility for biologic therapy beyond body-surface-area criteria alone [36].

Table 2: Standard care versus biologic therapy across key decision-relevant domains in moderate-to-severe plaque psoriasis [8,33,27,36].		
Domain	Standard care	Biologic therapy
PASI 75 response	Lower, variable by agent	Consistently high across classes
Monitoring burden	Regular labs (MTX, CsA) or clinic visits (phototherapy)	Periodic infection/TB screening; less lab monitoring
Acquisition cost	Low	High at list price
Cost-per-responder	Favorable at list pricing	Improves once QoL/indirect costs included
Typical positioning	Milder or contraindicated-biologic disease	Moderate-to-severe or QoL-limiting disease

9. Conclusion

Across pivotal randomized trials, head-to-head comparisons, network meta-analyses, and long-term registry follow-up, biologic therapy consistently and substantially outperforms standard care in plaque psoriasis on every major efficacy endpoint, from PASI 75 through PASI 100, and this advantage has widened with each successive drug class from tumor necrosis factor-alpha inhibitors through interleukin-17 and interleukin-23 inhibitors [27,28]. Long-term safety and drug survival data have not identified a durability or tolerability penalty that offsets this efficacy gain; if anything, better sustained response translates into longer treatment persistence than conventional agents typically achieve [30,31]. The remaining barrier is economic rather than clinical: acquisition cost and access constraints, not comparative effectiveness, are what continue to justify standard care as an appropriate first-line option for patients with more limited disease, while biologic therapy is increasingly positioned as the standard of care for patients whose disease burden, whether measured by body surface area or by quality-of-life impact, exceeds what conventional agents can adequately control [8,36].

As interleukin-23-directed agents continue to demonstrate the deepest and most durable responses reported to date, the comparative case for biologic therapy over standard care in moderate-to-severe plaque psoriasis is now supported by a breadth of evidence that conventional systemic agents, whatever their continuing role in milder disease, are unlikely to match.

10. References

1. Parisi, R., Symmons, D.P., Griffiths, C.E., Ashcroft, D.M. (2013) Global epidemiology of psoriasis: a systematic review of incidence and prevalence. *Journal of Investigative Dermatology*, 133(2): 377-385.
2. Gelfand, J.M., Weinstein, R., Porter, S.B., Neimann, A.L., Berlin, J.A., Margolis, D.J. (2005) Prevalence and treatment of psoriasis in the United Kingdom: a population-based study. *Archives of Dermatology*, 141(12): 1537-1541.
3. Finlay, A.Y., Khan, G.K. (1994) Dermatology Life Quality Index (DLQI): a simple practical measure for routine clinical use. *Clinical and Experimental Dermatology*, 19(3): 210-216.
4. Mrowietz, U., Kragballe, K., Reich, K., Spuls, P., Griffiths, C.E., Nast, A., et al. (2011) Definition of treatment goals for moderate to severe psoriasis: a European consensus. *Archives of Dermatological Research*, 303(1): 1-10.
5. Griffiths, C.E., Barker, J.N. (2007) Pathogenesis and clinical features of psoriasis. *Lancet*, 370(9583): 263-271.
6. Lowes, M.A., Suarez-Farinas, M., Krueger, J.G. (2014) Immunology of psoriasis. *Annual Review of Immunology*, 32: 227-255.
7. Di Cesare, A., Di Meglio, P., Nestle, F.O. (2009) The IL-23/Th17 axis in the immunopathogenesis of psoriasis. *Journal of Investigative Dermatology*, 129(6): 1339-1350.
8. Nast, A., Smith, C., Spuls, P.I., Avila Valle, G., Bata-Csorgo, Z., Boonen, H., et al. (2020) EuroGuiDerm guideline on the systemic treatment of psoriasis vulgaris. *Journal of the European Academy of Dermatology and Venereology*, 34(11): 2461-2498.
9. Menter, A., Korman, N.J., Elmetts, C.A., Feldman, S.R., Gelfand, J.M., Gordon, K.B., et al. (2010) Guidelines of care for the management of psoriasis and psoriatic arthritis: section 5, guidelines of care for the treatment of psoriasis with phototherapy and photochemotherapy. *Journal of the American Academy of Dermatology*, 62(1): 114-135.
10. Nast, A., Jacobs, A., Rosumeck, S., Werner, R.N. (2015) Efficacy and safety of systemic long-term treatments for moderate-to-severe psoriasis: a systematic review and meta-analysis. *Journal of Investigative Dermatology*, 135(11): 2641-2648.
11. Schmitt, J., Rosumeck, S., Thomaschewski, G., Sporbeck, B., Haufe, E., Nast, A. (2014) Efficacy and safety of systemic treatments for moderate-to-severe psoriasis: meta-analysis of randomized controlled trials. *British Journal of Dermatology*, 170(2): 274-303.
12. Leonardi, C.L., Powers, J.L., Matheson, R.T., Goffe, B.S., Zitnik, R., Wang, A., et al. (2003) Etanercept as monotherapy in patients with psoriasis. *New England Journal of Medicine*, 349(21): 2014-2022.
13. Menter, A., Tying, S.K., Gordon, K., Kimball, A.B., Leonardi, C.L., Langley, R.G., et al. (2008) Adalimumab therapy for moderate to severe psoriasis: a randomized, controlled phase III trial. *Journal of the American Academy of Dermatology*, 58(1): 106-115.
14. Reich, K., Nestle, F.O., Papp, K., Ortonne, J.P., Evans, R., Guzzo, C., et al. (2005) Infliximab induction and maintenance therapy for moderate-to-severe psoriasis: a phase III, multicentre, double-blind trial. *Lancet*, 366(9494): 1367-1374.
15. Leonardi, C.L., Kimball, A.B., Papp, K.A., Yeilding, N., Guzzo, C., Wang, Y., et al. (2008) Efficacy and safety of ustekinumab, a human interleukin-12/23 monoclonal antibody, in patients with psoriasis: 76-week results from a randomised, double-blind, placebo-controlled trial (PHOENIX 1). *Lancet*,

- 371(9625): 1665-1674.
16. Papp, K.A., Langley, R.G., Lebwohl, M., Krueger, G.G., Szapary, P., Yeilding, N., et al. (2008) Efficacy and safety of ustekinumab, a human interleukin-12/23 monoclonal antibody, in patients with psoriasis: 52-week results from a randomised, double-blind, placebo-controlled trial (PHOENIX 2). *Lancet*, 371(9625): 1675-1684.
 17. Kimball, A.B., Gordon, K.B., Fakhrazadeh, S., Yeilding, N., Szapary, P.O., Schenkel, B., et al. (2012) Long-term efficacy of ustekinumab in patients with moderate-to-severe psoriasis: results from the PHOENIX 1 trial through up to 3 years. *British Journal of Dermatology*, 166(4): 861-872.
 18. Langley, R.G., Elewski, B.E., Lebwohl, M., Reich, K., Griffiths, C.E., Papp, K., et al. (2014) Secukinumab in plaque psoriasis: results of two phase 3 trials. *New England Journal of Medicine*, 371(4): 326-338.
 19. Blauvelt, A., Reich, K., Tsai, T.F., Tying, S., Vanaclocha, F., Kingo, K., et al. (2017) Secukinumab is superior to ustekinumab in clearing skin of subjects with moderate-to-severe plaque psoriasis: 52-week results from CLEAR, a randomized controlled trial. *Journal of the American Academy of Dermatology*, 76(1): 60-69.
 20. Gordon, K.B., Blauvelt, A., Papp, K.A., Langley, R.G., Luger, T., Ohtsuki, M., et al. (2016) Phase 3 trials of ixekizumab in moderate-to-severe plaque psoriasis. *New England Journal of Medicine*, 375(4): 345-356.
 21. Lebwohl, M., Strober, B., Menter, A., Gordon, K., Weglowska, J., Puig, L., et al. (2015) Phase 3 studies comparing brodalumab with ustekinumab in psoriasis. *New England Journal of Medicine*, 373(14): 1318-1328.
 22. Blauvelt, A., Papp, K.A., Griffiths, C.E., Randazzo, B., Wasfi, Y., Shen, Y.K., et al. (2017) Efficacy and safety of guselkumab, an anti-interleukin-23 monoclonal antibody, compared with adalimumab for the continuous treatment of patients with moderate to severe psoriasis: results from the phase III, double-blinded, placebo- and active comparator-controlled VOYAGE 1 trial. *Journal of the American Academy of Dermatology*, 76(3): 405-417.
 23. Reich, K., Armstrong, A.W., Foley, P., Song, M., Wasfi, Y., Randazzo, B., et al. (2017) Efficacy and safety of guselkumab compared with adalimumab for the treatment of patients with moderate to severe psoriasis with randomized withdrawal and retreatment: results from the phase III, double-blind, placebo- and active comparator-controlled VOYAGE 2 trial. *Journal of the American Academy of Dermatology*, 76(3): 418-431.
 24. Reich, K., Gooderham, M., Thaci, D., Crowley, J.J., Ryan, C., Krueger, J.G., et al. (2019) Risankizumab compared with adalimumab in patients with moderate-to-severe plaque psoriasis (IMMvent): a randomised, double-blind, active-comparator-controlled phase 3 trial. *Lancet*, 394(10198): 576-586.
 25. Gordon, K.B., Strober, B., Lebwohl, M., Augustin, M., Blauvelt, A., Poulin, Y., et al. (2018) Efficacy and safety of risankizumab in moderate-to-severe plaque psoriasis (UltIMMa-1 and UltIMMa-2): results from two double-blind, randomised, placebo-controlled and ustekinumab-controlled phase 3 trials. *Lancet*, 392(10148): 650-661.
 26. Papp, K., Reich, K., Leonardi, C.L., Kircik, L., Chimenti, S., Langley, R.G., et al. (2017) Tildrakizumab (MK-3222), an anti-interleukin-23p19 monoclonal antibody, in patients with moderate to severe psoriasis: results from two randomised controlled, phase 3 trials (reSURFACE 1 and reSURFACE 2). *Lancet*, 390(10091): 276-288.
 27. Sbidian, E., Chaimani, A., Garcia-Doval, I., Do, G., Hua, C., Mazaud, C., et al. (2020) Systemic pharmacological treatments for chronic plaque psoriasis: a network meta-analysis. *Cochrane Database of Systematic Reviews*, 1: CD011535.
 28. Armstrong, A.W., Puig, L., Joshi, A., Skup, M., Williams, D., Li, J., et al. (2020) Comparison of biologics and oral treatments

- for plaque psoriasis: a meta-analysis. *JAMA Dermatology*, 156(3): 258-269.
29. Papp, K.A., Griffiths, C.E., Gordon, K., Lebwohl, M., Szapary, P.O., Wasfi, Y., et al. (2013) Long-term safety of ustekinumab in patients with moderate-to-severe psoriasis: final results from 5 years of follow-up. *British Journal of Dermatology*, 168(4): 844-854.
30. Gniadecki, R., Bang, B., Bryld, L.E., Iversen, L., Lasthein, S., Skov, L. (2015) Comparison of long-term drug survival and safety of biologic agents in patients with psoriasis vulgaris. *British Journal of Dermatology*, 172(1): 244-252.
31. Yiu, Z.Z., Mason, K.J., Hampton, P.J., Reynolds, N.J., Smith, C.H., Owen, C.M., et al. (2020) Drug survival of adalimumab, ustekinumab and secukinumab in patients with psoriasis: a prospective cohort study from the British Association of Dermatologists Biologics and Immunomodulators Register (BADBIR). *British Journal of Dermatology*, 183(2): 294-302.
32. van den Reek, J.M., van Lumig, P.P., Otero, M.E., Zweegers, J., Driessen, R.J., Njoo, M.D., et al. (2014) Satisfaction of treatment with biologics is high in patients with psoriasis: results from the BioCAPTURE registry. *British Journal of Dermatology*, 170(5): 1091-1099.
33. D'Souza, L.S., Payette, M.J. (2017) Estimated cost efficacy of systemic treatments that are approved by the US Food and Drug Administration for the treatment of moderate to severe psoriasis. *Journal of the American Academy of Dermatology*, 77(6): 1111-1117.
34. Feldman, S.R., Malakouti, M., Koo, J.Y. (2014) Social impact of the burden of psoriasis: effects on patients and practice. *Dermatology Online Journal*, 20(8): 13030.
35. Kimball, A.B., Leonardi, C., Stahle, M., Gulliver, W., Chevrier, M., Fakharzadeh, S., et al. (2010) Demography, baseline disease characteristics and treatment history of patients with psoriasis enrolled in a multicentre, prospective, disease-based registry (PSOLAR). *British Journal of Dermatology*, 172(6): 1701-1710.
36. Strober, B., Ryan, C., van de Kerkhof, P., van der Walt, J., Kimball, A.B., Barker, J., et al. (2020) Recategorization of psoriasis severity: delphi consensus from the International Psoriasis Council. *Journal of the American Academy of Dermatology*, 82(1): 117-122.