Original Investigation

Extent and Consequences of Antibody Formation Against Adalimumab in Patients With Psoriasis
One-Year Follow-up

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IMPORTANCE In a previously reported cohort of 29 patients with plaque-type psoriasis followed up for 24 weeks, clinically relevant antidrug antibody (ADA) to adalimumab was frequently found. Long-term data were lacking. We now present the extension of this study: 80 patients followed up for 1 year.

OBJECTIVES To assess the extent of ADA and its clinical consequences after 24 weeks of adalimumab treatment for psoriasis in a cohort of 80 patients.

DESIGN, SETTING, AND PARTICIPANTS A multicenter cohort study, performed in the outpatient dermatology clinic of 2 academic hospitals, included 80 sequential patients receiving adalimumab therapy for plaque-type psoriasis and had a follow-up of 1 year. Outcome assessors were not aware of the presence of antibodies to adalimumab or the adalimumab serum concentration when assessing patients' Psoriasis Area and Severity Index (PASI), and personnel analyzing serum samples were blinded to patients' PASI.

INTERVENTIONS For 80 patients treated with adalimumab for psoriasis, disease severity (PASI) was assessed, blood samples were collected, and adalimumab and ADA concentrations was determined at baseline and at weeks 12, 24, and 52.

MAIN OUTCOMES AND MEASURES Patient PASI and adalimumab and ADA concentrations.

RESULTS Antidrug antibody formed in 49% of patients, before week 24 in 90% of them. Adalimumab and ADA concentrations, clinical response and ADA concentration, and adalimumab concentration and clinical response had correlations of −0.872, −0.606, and 0.519, respectively. The adalimumab dose interval was shortened because of lack of efficacy in 15 patients, 7 with and 8 without ADA; improvement in responder status occurred in 1 of 7 and 4 of 8, respectively.

CONCLUSIONS AND RELEVANCE Patients with no ADA formation in the first 24 weeks of treatment have little chance of it in the following 24 weeks. The presence of ADA is strongly correlated with adalimumab concentration and greatly influences clinical response. If ADA is present, dose interval shortening is less useful.

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Adalimumab is a human monoclonal immunoglobulin G1 antibody and tumor necrosis factor antagonist that is a valuable treatment option for patients with moderate to severe psoriasis seen in clinical practice. As has been shown for patients with Crohn disease and rheumatologic conditions, antibodies against adalimumab are associated with nonresponse and loss of initial response to adalimumab in a substantial proportion of patients.[1-8] This effect has also been shown for patients with psoriasis. In a cohort study of 29 patients evaluated for up to 24 weeks of treatment, antidrug antibody (ADA) to adalimumab formed in 45%.[9] This cohort has been extended to 80 patients (including the original 29), and here we present 1-year follow-up data. The purpose of this study is to assess whether ADAs develop, persist, or reduce after 24 weeks of adalimumab treatment and to determine the clinical consequences.

Methods

Detailed methods and study design have been reported elsewhere[9] and have not changed. Briefly, approached for this prospective observational cohort study were all consecutive patients with psoriasis who were naive to adalimumab and starting treatment with adalimumab for psoriasis at the Academic Medical Center, Amsterdam, and the Radboud University Nijmegen Medical Centre, Nijmegen (both in the Netherlands), between September 1, 2008, and July 12, 2012. The study was approved by the ethical committee of the participating hospitals and conducted according to Declaration of Helsinki principles. Patients gave written informed consent before initiation.

Certain baseline characteristics were collected. At the time of evaluation for this report, 80 patients were enrolled. Patients were treated with adalimumab according to the manurcturer's recommendations, with an initial dose of 80 mg subcutaneously followed by 40 mg subcutaneously every other week, starting 1 week after the initial dose. Patients could be treated concomitantly with methotrexate from the start of the study. In patients with inadequate response to adalimumab, concomitant methotrexate could be started or the dose interval for adalimumab could be reduced to every 7 or 10 days (referred to hereafter as *dose interval shortening*). Treatment could be terminated because of nonresponse or adverse events. The reason for termination of treatment was registered. Decisions were made by the treating dermatologist and did not deviate from daily practice. The treating dermatologist was masked to the antibody status of the patient.

Disease severity was assessed by the treating physician at baseline and at weeks 12, 24, and 52 using the Psoriasis Area and Severity Index (PASI). Improvement was measured as the percentage of improvement compared with baseline PASI. Nonresponders were defined as patients achieving less than 50% improvement compared with baseline PASI, moderate responders as those achieving 50% to less than 75% improvement, and good responders as those achieving at least 75% improvement.[10] In case patients switched to adalimumab therapy from a previous biologic therapy without a washout period, the PASI before this biologic therapy was used as the baseline PASI. This was done because otherwise these patients would seem to be nonresponders despite a good response to adalimumab therapy.

Blood samples were obtained before initiation of adalimumab treatment and at adalimumab serum trough levels at baseline and at weeks 12, 24, and 52 (just before administration of adalimumab, patients received a letter notifying them of trough level sampling so this could be timed in relation to adalimumab administration). The adalimumab levels were measured by means of enzyme-linked immunosorbent assay, and the ADAs were detected with a radioimmunoassay[2] (both performed at the Laboratory for Monoclonal Therapeutics, Sanquin Diagnostic Services). The radioimmunoassay does not detect ADA bound to adalimumab and might therefore underestimate ADA formation.[11,12]

The antibody test results were considered positive when the antibody concentration exceeded 12 AU/mL. Concentrations between 12 and 100 AU/mL were considered low ADA titers and those above 100 AU/mL were considered high ADA titers. If no detectable ADAs were present (<12 AU/mL) this result was categorized as "no ADA."

The methods of statistical analysis are explained in the earlier report.[9] In addition, we used the Spearman rank test to calculate the correlation coefficients between the clinical response (expressed as ΔPASI), the level of antibodies against adalimumab, and the adalimumab trough level. To replace missing baseline PASI values, imputation of the mean was used. For missing visits, missing adalimumab levels, and missing antibody titers, the last observation carried forward method was used.

Results

Patient Characteristics

This cohort included 80 patients, 52 male and 28 female, with a mean age of 46 years (range, 24-73 years). The mean disease duration of psoriasis was 23 years (range, 7-51 years), and the mean PASI at baseline was 12 (range, 1.5-27). Three patients had low baseline PASI (1.5, 1.7, and 3.8) because they had to switch directly from efalizumab to adalimumab when efalizumab was withdrawn from the market. One patient had a baseline PASI of only 3 because she had switched from etanercept, to which her psoriasis responded but her arthritis did not. For these 4 patients, the baseline PASI from prior biologic therapy (9.6, 8.6, 18.8, and 11.7) was used as the baseline PASI for this study, as described in the Methods section.

Sixty-five percent of patients had a PASI of at least 10.0 (excluding the 4 patients just mentioned with replaced PASI values). Sixty-nine percent had used at least 4 previous systemic treatments for psoriasis; the most frequently used previous treatments were methotrexate and UV-B (in 95% and 94% of patients, respectively). The mean body mass index (calculated as weight in kilograms divided by height in meters squared) was 29.4, and 25% of patients had a diagnosis of psoriatic arthritis. See the **Table** for patient characteristics.

Table. Patient Characteristics

Characteristic	Total (N = 80)	Patients With ADA (n = 39)	Patients Without ADA (n = 41)
Age, mean (SD), y	46 (13)	46 (12)	46 (13)
Male, sex, No. (%)	52 (65)	26 (67)	26 (63)
Disease duration, mean (SD), y	23 (11)	22 (11)	25 (12)
PASI baseline, mean (SD)	13 (5)	13 (6)	12 (5)
BMI, mean (SD)	29 (6)	30 (5)	29 (7)
PsA, No. (%)	20 (25)	10 (26)	10 (24)
Concomitant methotrexate from week 0, No. (%)	8 (10)	3 (8)	5 (12)
Previous systemic treatment, No. (%)			
Methotrexate	76 (95)	37 (95)	39 (95)
Cyclosporine	55 (69)	29 (74)	26 (63)
Fumaric acid esters	23 (29)	13 (33)	10 (24)
UV-B	75 (94)	36 (92)	39 (95)
Psoralen–UV-A	45 (56)	23 (59)	22 (54)
Etanercept	54 (68)	29 (74)	25 (61)
Infliximab	3 (4)	1 (3)	2 (5)
Efalizumab	16 (20)	11 (28)	5 (12)
Adalimumab	0	0	0
Ustekinumab	0	0	0
No. of previous treatments, mean (SD)	4 (1)	5 (1)	4 (1)

Abbreviations: ADA, antidrug antibody; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); PASI, the Psoriasis Area and Severity Index; PsA, psoriatic arthritis.

Figure 1. Adalimumab Trough Level at Study Termination Categorized by Responder Status
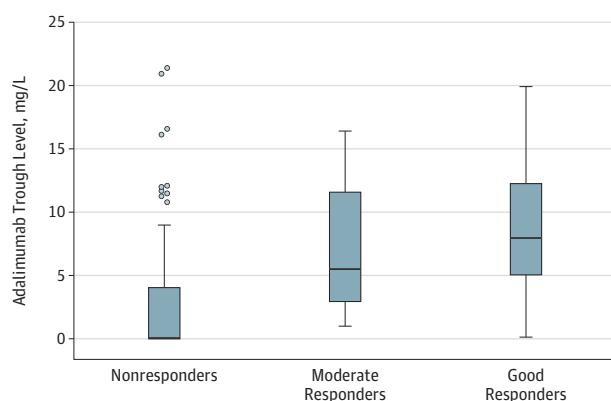
Adalimumab trough levels are shown by responder status at study termination (week 52 or early termination visit). Responses were assessed according to the Psoriasis Area and Severity Index (PASI). Nonresponders were defined as patients achieving less than 50% improvement compared with baseline, moderate responders as those achieving 50% to less than 75% improvement, and good responders as those achieving at least 75% improvement. Outliers were included in the analyses. Nonresponders attained significantly lower adalimumab trough levels than good responders.

Clinical Response

All patients reached the week 12 visit, at which point 38 patients (48%) were nonresponders, 16 (20%) were moderate responders, and 26 (32%) were good responders. Of 71 patients who reached the week 24 visit, 24 (30%) were nonresponders, 22 (28%) were moderate responders, and 25 (31%) were good responders. Of the 9 patients who stopped treatment between the week 12 and 24 visits, 5 discontinued treatment early because of nonresponse and 3 because of an adverse event (herpes zoster, pneumonia, and abscess formation in the adalimumab injection site). One patient stopped treatment because of nonresponse together with an adverse event (psoriasis palmoplantaris). Fifty-nine patients (74%) reached the week 52 visit. Fifteen (19%) were nonresponders, 12 (15%) were moderate responders, and 32 were good responders (40%). Between the week 24 and 52 visits, 12 patients (15%) discontinued treatment; 3 were lost to follow-up, 8 stopped treatment with adalimumab because of nonresponse, and 1 stopped treatment because of nonresponse together with an adverse event. Termination of treatment for nonresponse occurred after a mean duration of 7.8 months. In total, 21 patients (26%) did not complete 1 year of treatment with adalimumab.

Of the 38 patients who were nonresponders at the week 12 visit, 18 and 9, respectively, remained nonresponders at weeks 24 and 52. Treatment was terminated early because of nonresponse in 6 nonresponders between weeks 12 and 24 and in 11 between weeks 24 and 52. Of the 26 patients who were good responders at the week 12 visit, 18 and 19, respectively, remained so at weeks 24 and 52. Treatment was terminated early (before week 52) in 6 good responders: in 1 because of an adverse event, in 3 because of loss of effectiveness over time, and in 2 because of loss to follow-up.

Clinical Response and Adalimumab Trough Levels

At the study termination (at week 52 or the early termination [ET] visit), the adalimumab level varied significantly between nonresponders and moderate responders and between nonresponders and good responders ($P < .05$). There was no significant difference between moderate responders and good responders.
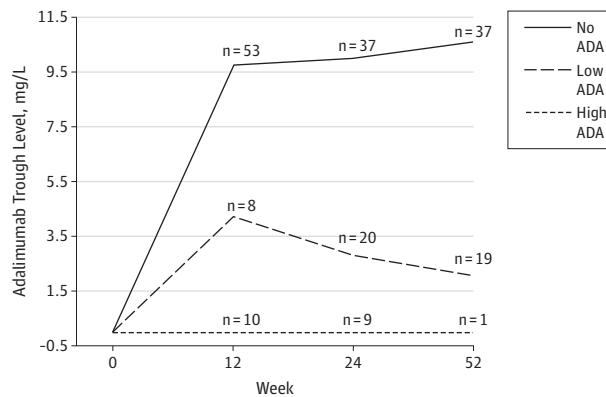
The 3 lines represent adalimumab trough levels by ADA group at weeks 12, 24, and 52. Antidrug antibody titers less than 12 AU/mL are considered no ADA; titers between 12 and 100 AU/mL, low ADA; and titers above 100 AU/mL, high ADA. Patients with low ADA titers or no ADA attained detectable adalimumab trough levels, but patients with high ADA titers did not.

Adalimumab trough levels ranged from 0.0 to 20.9 mg/L for nonresponders, 1.1 to 16.5 mg/L for moderate responders, and 0.1 to 29.2 mg/L for good responders (**Figure 1**). The Spearman rank correlation coefficient was calculated and showed a moderately strong correlation coefficient of 0.519.

Concentrations of Antibodies to Adalimumab

During 52 weeks of follow-up, ADAs were detected in 39 of 80 patients (49%). Antidrug antibody formation occurred for the first time before week 12 in 18 patients, between weeks 12 and 24 in 17, and between weeks 24 and 52 in 4. At the week 12 visit, 8 patients had a low ADA titer (13-34 AU/mL), 10 had a high ADA titer (195-7300 AU/mL), 53 had no ADA, and 9 had a missing value. In 16 of the 18 patients with ADA, the ADA titer at week 24 or ET had risen. At the week 24 visit, 20 patients had a low ADA titer (13-96 AU/mL), 9 had a high titer (1220-55700 AU/mL), 37 had no ADA, and 5 had a missing value. In 5 patients with ADA at week 24 (range, 14-35 AU/mL), ADA had disappeared at week 52 (no explanation found). In the remaining patients with ADA at week 24, ADA had increased or remained the same or patients had undergone ET. At the week 52 visit, 19 had a low ADA titer (13-96 AU/mL), 1 had a high ADA titer (68 333 AU/mL), 37 had no ADA, and 2 had a missing value (**Figure 2**).

All 18 patients with ADA at week 12 had ADA at week 24 or underwent ET before week 24. All patients with low ADA titers continued to have low or high ADA titers at week 24. Of the 31 patients with ADA at the week 24 visit, 4 showed no ADA at week 52 (all had low ADA titers at week 24; range, 14-35 AU/mL). The remaining 27 patients still showed ADA at week 52 or underwent ET.

Adalimumab Trough Level and Antibodies to Adalimumab

Adalimumab trough level ranged from undetectable to 31 mg/L. At week 12, the median adalimumab level in patients receiv-
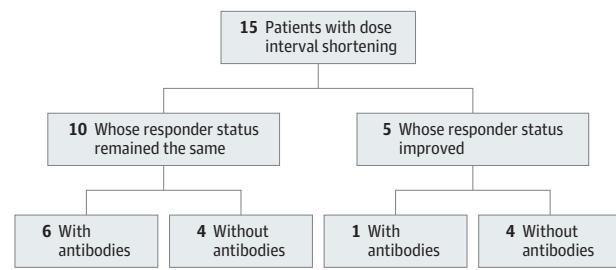
This flowchart shows patients in whom the adalimumab dose interval was shortened and the effect on clinical response. The antidrug antibody status seems to influence the effect of dose interval shortening; in other words, dose interval shortening seems less useful if antidrug antibodies to adalimumab are present.

ing 40 mg of adalimumab every other week was 8 mg/L (range, 0-20). At weeks 24 and 52, the median (range) levels were 5 (0-31) and 7 (0-19) mg/L, respectively. Figure 2 shows different median adalimumab trough levels by ADA status and week. For weeks 12, 24, and 52, respectively, 9, 5, and 2 patients had no serum samples obtained. At week 52, in 5 patients it was not certain that serum samples were obtained at a trough level; these 5 measurements were excluded from analysis.

At termination of the study (week 52 or the ET visit), the adalimumab level did vary significantly among patients with no, low, and high ADA, with a median (range) of 10.5 (2.0-29.2), 2.0 (0.1-6.5), and 0.0 (0.0-0.1) mg/L, respectively (Figure 2). The Spearman rank correlation coefficient was calculated and showed a very strong negative correlation coefficient of −0.872 between adalimumab level and ADA concentration.

Adalimumab Dose Interval Shortening

Two patients had the dosing interval shortened at week 12, both because of nonresponse. One patient had no ADA and changed into a good responder. One patient was receiving oral prednisone for asthma together with a shortened dose interval. This patient had high ADA (474 AU/mL) at week 12 and changed into a moderate responder, with low ADA (25 AU/mL) at week 52. Seven patients had the dosing interval shortened between weeks 12 and 24, because of nonresponse in 5 and moderate response in 2. Three of the nonresponders had high ADA titers before dose interval shortening and remained nonresponders. Two patients without ADA before dose interval shortening improved in responder status, and 2 without ADA remained at the same level of responder status. Six patients had the dosing interval shortened between weeks 24 and 52, because of nonresponse and moderate response in 3 each. Three of the patients had ADA before dose interval shortening and did not improve responder status. Three of the patients had no ADA; responder status did not improve in 2 and did improve in 1 (**Figure 3**). There was no significant difference in adalimumab trough level between patients who underwent dose interval shortening and those who did not.
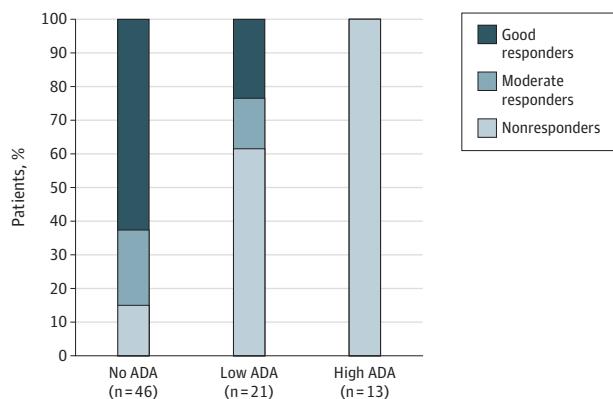
Antidrug antibody titers less than 12 AU/mL are considered no ADA; titers
between 12 and 100 AU/mL, low ADA; and titers above 100 AU/mL, high ADA.
Responder status was based on improvement in the Psoriasis Area and Severity
Index, relative to baseline (see Methods). This figure shows that patients with
high ADA titers are always nonresponders. (Study termination was at week 52
or the early termination visit.)

Concomitant Use of Methotrexate

Eight patients received concomitant methotrexate therapy
from week 0. Among these 8 patients, (low) ADA developed
in 3 (at weeks 12, 24, and 52). No methotrexate-treated pa-
tients had high ADA titers, and 5 had no ADA formation. Metho-
trexate dosage ranged from 2.5 to 20 mg/wk. Methotrexate
therapy was initiated in 1 patient at week 12. Responder sta-
tus improved in this patient who did not have ADA forma-
tion. At week 24, methotrexate therapy was initiated in 3 pa-
tients. Responder status improved in 2. In 1 of 2 patients who
had ADA before concomitant methotrexate therapy, ADA ti-
ters went from high to low.

In 2 patients, the dose interval was shortened during the
same time interval methotrexate was added. One patient re-
mained a moderate responder, but ADA titers went from 2950
to 87 AU/mL; the other patient had no ADA and went from being
a nonresponder to a good responder. There was no signifi-
cant difference in adalimumab trough level between patients
who were concomitantly treated with methotrexate and who
were not.

Clinical Response and Concentrations
of Antibodies to Adalimumab

Among the 32 good responders at the week 52 visit, 27 had no
ADA, 5 had low ADA (range, 16-73 AU/mL), and none had high
ADA. Among the 13 moderate responders, 7 had no ADA, 6 had
low ADA (range, 13-96 AU/mL), and none had high ADA. Among
the 14 nonresponders, 4 had no ADA, 9 had low ADA titers
(range, 13-62 AU/mL), and 1 had a high ADA titer (68 333 AU/
mL). In total, 14 patients underwent ET because of nonre-
sponse, 5 between week 12 and 24 and 9 between week 24 and
52. Two of them had no ADA, 3 had low ADA, and 9 had high
ADA. **Figure 4** shows the responder status by ADA titer at the
termination of the study (week 52 or ET visit, whichever came
first). All patients with high ADA at week 12, 24, or 52 or ET were

nonresponders at that time. Not all nonresponders had high
ADA. At the termination of the study (at week 52 or ET visit,
whichever came first), the ADA concentration varied signifi-
cantly between nonresponders and moderate responders and
between nonresponders and good responders ($P < .05$). There
was no significant difference between moderate responders
and good responders. The median (range) in AU/mL was 0 (0-
73), 0 (0-31), and 39 (0-68333) for good, moderate, and nonre-
sponders, respectively. The Spearman rank correlation coef-
ficient was calculated and showed a moderately strong negative
correlation coefficient of −0.606.

Discussion

The purpose of our study was to assess whether the extent of
antibody formation against adalimumab in the treatment of
psoriasis vulgaris increases, persists, or decreases after 24
weeks of adalimumab treatment and to determine the clini-
cal consequences of such changes. In conclusion, our find-
ings show that the biggest chance of first-time ADA develop-
ment is in the first 24 weeks of treatment (35 vs 4 patients) and
further support the notion that the presence of ADA is strongly
correlated with adalimumab level (correlation coefficient,
−0.872) and greatly influences clinical response (correlation co-
efficient, −0.606), also after 24 weeks of treatment. Dose in-
terval shortening might be useful if no ADAs are present, but
it seems less useful if they are present.

In the previous study, 13 of 29 patients (45%) had ADA
formation,[9] compared with 39 of 80 (49%) in the current study.
In studies performed in patients with rheumatoid arthritis
treated with adalimumab, these percentages are lower. Bar-
telds et al[13] showed in a 3-year follow-up study that 28% of pa-
tients had ADA formation. Many patients (74%) in that study
used concomitant methotrexate, but patients with ADA forma-
tion less often had concomitant MTX. Moreover, in other stud-
ies, the concomitant use of immunosuppressants reduces the
frequency of antibody formation in response to biologic
therapy,[14,15] and a favorable effect of concomitant methotrex-
ate on reducing antibody formation has been postulated. In a
letter by Krieckaert et al,[16] it was reported that methotrexate
seems to reduce ADA formation efficiently and in a dose-
dependent manner.

Methotrexate treatment did not reduce ADA formation in
our study; 3 of 8 patients (38%) who received methotrexate had
(low) ADA. This might be due to the low dose of methotrexate
used by these 3 patients (2.5, 10, and 10 mg/wk). The number
of patients using concomitant methotrexate in our study was
limited, so these data should be interpreted with caution. Of
the patients in our cohort not receiving concomitant metho-
trexate, 50% (36 of 72 patients) had ADA formation. Bartelds
et al[13] found the same, with ADA formation in 50% of patients
(35 of 70) not receiving concomitant methotrexate. Of their pa-
tients receiving concomitant methotrexate, only 20% (41 of 202)
had ADA formation, which further supports the role of metho-
trexate in reducing immunogenicity, instead of, for example,
disease (psoriasis)-related factors. The treatment dose of ada-
limumab is similar for psoriasis and rheumatoid arthritis. A

study by Karmiris et al[17] included patients treated with adalimumab for Crohn disease; only 9.2% had ADA formation. This finding may be explained by disease-related factors or the fact that most of these patients (75% of 168) were treated with an initial dose of 160 mg for the first week and 80 mg for the next, instead of 80 mg as an initial dose and 40 mg for the next week, which is common practice in psoriasis treatment.

Obtaining a sufficient adalimumab trough level does not imply good clinical improvement. In our cohort, some patients obtained a good adalimumab trough level but no sufficient clinical improvement. Is it is not clear what factors other than antibody formation may impair treatment. A hypothesis could be that tumor necrosis factor may not be the leading inflammatory agent in these patients.

Adalimumab was administered every other week, and dose interval shortening to every 7 or 10 days could be applied in case of nonefficacy. As shown by our results, dose interval shortening might be useful if no ADAs are present. This might be explained by the fact that ADAs result in functional neutralization of adalimumab.[12] However, given the limited size of this specific population within this study, these data should be interpreted with caution. Leonardi et al[18] observed that patients weighing 102 kg or less or with a disease duration of less than 8.3 years were most likely to benefit from dose escalation. In the 15 patients with dose escalation presented here, we did not observe this.

In the group of patients with ADA, 90% had ADA formation for the first time before week 24. This is in line with the findings by Bartelds et al,[13] in which 67% of patients had ADA formation during the first 28 weeks. This implies that most patients who have ADA formation will do so during the first 24 weeks of treatment.

As reported in the previous study, the response rate in the current study is surprisingly lower than those reported in 3 phase 3 trials,[19-21] with PASI improvement of at least 75% at week 12 or 16 in 53%, 71%, and 80% of patients. In our current study, 33% of patients showed at least 75% improvement relative to baseline, in accordance with a study by van Lümig et al,[22] in which 34% of patients showed at least 75% improvement at week 12; both of these studies present "real-world data," which might explain the difference in response rates compared with the phase 3 trials.

Nine patients continued adalimumab treatment until at least week 52 despite remaining nonresponders. Six of them had PASI improvement of 32% to 43% at week 52 and were content with this result. Eight of 9 patients had been previously treated with etanercept. In these cases, treatment with adalimumab may also be continued because of lack of other treatment options. Infliximab would have to be administered intravenously in a daycare setting, and experience with ustekinumab was still small.

In this study, we have also further endorsed the strong negative correlation between ADA formation and adalimumab serum trough levels, with a correlation coefficient of −0.872. The higher the ADA titer, the lower the adalimumab trough level. In a different study,[12] it was shown that virtually all ADAs are neutralizing and that the ADAs are highly specific for adalimumab, forming small immune complexes, in this way neutralizing the drug. It has been suggested that ADA may lead to thromboembolic events[23] or a type III hypersensitivity reaction,[12] which has not been observed in this cohort.

This study has some limitations. Because of the limited number of patients experiencing dose interval shortening and the limited number using concomitant methotrexate, the influence of these interventions on antibody formation and effectiveness should be further investigated in a larger cohort.

The last observation carried forward method was used to replace missing values for adalimumab levels and antibody titers. This may have led to underestimation of ADA formation and overestimation of drug levels.

The antibody assay used in this study (a radioimmunoassay) is the same used in the studies by Bartelds et al[1,2,13] and Krieckaert et al[16] but different from the bridging enzyme-linked immunosorbent assay used by Vermeire et al[15] and Karmiris et al.[17] The latter is more sensitive to drug interference and does not detect immunoglobulin G4 ADA,[11] making comparison between these studies less reliable. The influence of methotrexate on ADA formation needs further research, as well as the influence of dose interval shortening in ADA-positive and ADA-negative patients.

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Invited Commentary

PRACTICE GAPS

Preventing and Detecting Antibodies to Anti–Tumor Necrosis Factor Agents
Gaps in Practice or in Evidence?

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Although anti-tumor necrosis factor (TNF) agents are considered highly effective therapies for psoriasis, treatment failure is common. As highlighted in the study by Menting et al,[1] primary failure is more frequent in the "real-world"

setting compared with randomized clinical trials with adalimumab and is associated with formation of antidrug antibodies (ADAs) and low serum drug levels. This article further highlights the high frequency of ADA forma-

tion (50%) in patients not receiving concomitant methotrexate. These issues raise 2 questions: (1) should adalimumab be prescribed with methotrexate at the outset and (2) should ADA and trough drug levels be drawn when patients fail to respond to adalimumab to aid in the decision to escalate dose or switch therapy?

There are no consensus guidelines that recommend methotrexate be routinely prescribed with adalimumab to prevent ADA formation and therefore prevent treatment failure. There have just not been enough data to support this when treat-