

Evidence for treating rheumatoid arthritis to target: results of a systematic literature search

Monika Schoels,¹ Rachel Knevel,² Daniel Aletaha,³ Johannes W J Bijlsma,⁴ Ferdinand C Breedveld,² Dimitrios T Boumpas,⁵ Gerd Burmester,⁶ Bernard Combe,⁷ Maurizio Cutolo,⁸ Maxime Dougados,⁹ Paul Emery,¹⁰ Desirée van der Heijde,² Tom W J Huizinga,² Joachim Kalden,¹¹ Edward C Keystone,¹² Tore K Kvien,¹³ Emilio Martin-Mola,¹⁴ Carlomaurizio Montecucco,¹⁵ Maarten de Wit,¹⁶ Josef S Smolen^{1,3}

► Additional data are published online only at <http://ard.bmj.com/content/vol69/issue4>

For numbered affiliations see end of the article

Correspondence to

Daniel Aletaha, Division of Rheumatology, Department of Medicine 3, Medical University of Vienna, Waehringer Guertel 18–20, A-1090 Vienna, Austria; daniel.aletaha@meduniwien.ac.at

Accepted 28 January 2010

ABSTRACT

Objectives To summarise existing evidence on a target oriented approach for rheumatoid arthritis (RA) treatment.

Methods We conducted a systematic literature search including all clinical trials testing clinical, functional, or structural values of a targeted treatment approach. Our search covered Medline, Embase and Cochrane databases until December 2008 and also conference abstracts (2007, 2008).

Results The primary search yielded 5881 citations; after the selection process, 76 papers underwent detailed review. Of these, only seven strategic clinical trials were extracted: four studies randomised patients to routine or targeted treatment, two compared two different randomised targets and one compared targeted treatment to a historical control group. Five trials dealt with early RA patients. All identified studies showed significantly better clinical outcomes of targeted approaches than routine approaches. Disability was reported in two studies with no difference between groups. Four studies compared radiographic outcomes, two showing significant benefit of the targeted approach.

Conclusion Only few studies employed randomised controlled settings to test the value of treatment to a specific target. However, they provided unanimous evidence for benefits of targeted approaches. Nevertheless, more data on radiographic and functional outcomes and on patients with established RA are needed.

INTRODUCTION

Many new treatment options make unprecedented outcomes achievable in rheumatoid arthritis (RA).^{1,2} In parallel, insights on the importance of early effective therapy^{3,4} and implications of disease activity on function^{5,6} and joint damage^{6–8} led to paradigmatic changes in therapeutic approaches, such as frequent evaluations of disease activity to allow for timely changes of therapies.^{9–13} Additionally, validated composite disease activity measures have made disease activity assessment easy.^{14,15} Nevertheless, heterogeneity of therapeutic aims and patient expectations¹⁶ characterise daily practice of RA treatment.¹⁷ All this suggests a need to provide rheumatologists and patients with pertinent information on therapeutic targets and means to achieve them.^{18,19}

Strict definitions of treatment targets intend to facilitate strategic acting in routine care and require physicians and patients to discuss and

adopt therapeutic changes within distinct time frames, ideally following therapeutic algorithms. This approach has been utilised in many diseases, like diabetes,^{20,21} hypertension^{22–24} or hyperlipidaemia.²⁵ However, this policy needs to be evidence based to the best possible extent.

Here we report on a systematic review of available evidence regarding the effects of treating RA strategically according to defined outcome targets.

METHODS

Shaping the systematic literature review

As a first step, the international steering committee of the Treat-To-Target (T2T) project, comprising a group of expert rheumatologists and a patient (MdW), designed a literature search that aimed at ‘treating to target’-strategy trials in RA. The search was then performed by a project fellow (MS), a control search by a second fellow (RK) and by two mentors (DA, DvdH).

The following definitions were made: (1) *strategy trial* – clinical trial of any RA drug treatment, in which a clear outcome target was the primary end point and therapeutic consequences of failing to reach the target were predefined; (2) *targets* – a target could be formulated by clinical, serological, patient-reported, functional, or radiographic variables; individual measures (eg, joint counts or acute phase reactants), composite scores (eg, disease activity score or simplified disease activity index), or response criteria (eg, those defined by the American College of Rheumatology (ACR) or the European League Against Rheumatism) were considered alike; (3) *outcomes* – Clinical, functional, serological and/or radiographic changes, as defined in the respective trials, were compared between treatment groups.

Implementation of the systematic literature review

We searched Medline, Embase and Cochrane databases from their inception until December 2008. Additionally, ACR and European League Against Rheumatism (EULAR) abstracts of 2007 and 2008 were screened. The search was limited to humans, adults and the English language. Detailed inclusion and exclusion criteria and the list of search strings are shown in supplementary tables (tables S1 and S2). We did not exclude studies based on quality.

From the identified strategy trials, data were extracted concerning definitions of targets and success rates of applied strategies.



This paper is freely available online under the BMJ Journals unlocked scheme, see <http://ard.bmj.com/info/unlocked.dtl>

RESULTS

We retrieved 5881 citations for further evaluation (figure 1). Title and abstract screening according to our selection criteria (supplementary table S1) left 76 papers for detailed review. Among those, 17 trials published in full and 2 abstracts addressed direct assessment of treating to target. By hand search of references, we identified three additional papers; further, one full paper and one abstract were included based on expert opinion. This gave a total of 24 publications for this review (figure 1), of which only 7 were strategic trials: 4 trials randomised patients to routine or targeted treatment,^{26–29} two compared different randomised targets^{30–31} and one compared targeted treatment to historical control.³²

Randomised strategic trials comparing targeted versus routine care

Only four trials had randomised patients to a targeted treatment algorithm versus routine care. In Tight Control of Rheumatoid Arthritis (TICORA),²⁶ treatment of early RA aimed at low disease activity (LDA) by Disease Activity Score (DAS), comparing DAS-driven treatment adaptations upon monthly assessments with 3-monthly routine care. Computer Assisted Management in Early Rheumatoid Arthritis (CAMERA)²⁷ aimed at remission of early RA, comparing monthly treatment adaptation by computerised decision if >20% (50%) reduction of several variables

was not attained with 3-monthly routine care. A cluster randomised trial by Fransen *et al*²⁸ compared the proportion of patients reaching LDA at the end of follow-up and the number of disease-modifying antirheumatic drug (DMARD) changes during 24 weeks (co-primary end points) in outpatient centres using systematic, DAS28-steered treatment protocols with centres providing routine care. The treatment decision in the DAS28-driven group depended on a threshold of 3.2, indicating LDA. Finally, Symmons *et al*²⁹ tested the effect of aggressive versus symptomatic therapy on physical outcome (*Health Assessment Questionnaire* (HAQ)) in established RA. Decisions for treatment adaption were driven by joint count- and C reactive protein (CRP) thresholds. Designs of these trials are depicted in figure 2; baseline characteristics are tabulated in supplementary table S3.

Characteristics of the core trials, including treatment targets and visit intervals, as well as clinical, functional and radiographic outcomes are summarised in table 1 and will be detailed below.

Significantly greater DAS reduction and higher likelihood to achieve remission following intensive disease management was evident in all four trials. In TICORA,²⁶ the primary end point, EULAR good response, as well as DAS remission were significantly more frequent upon intensive than routine care. CAMERA²⁷ showed significant benefits of targeted treatment regarding its primary end point, remission for 3 months.

Papers retrieved and selection process

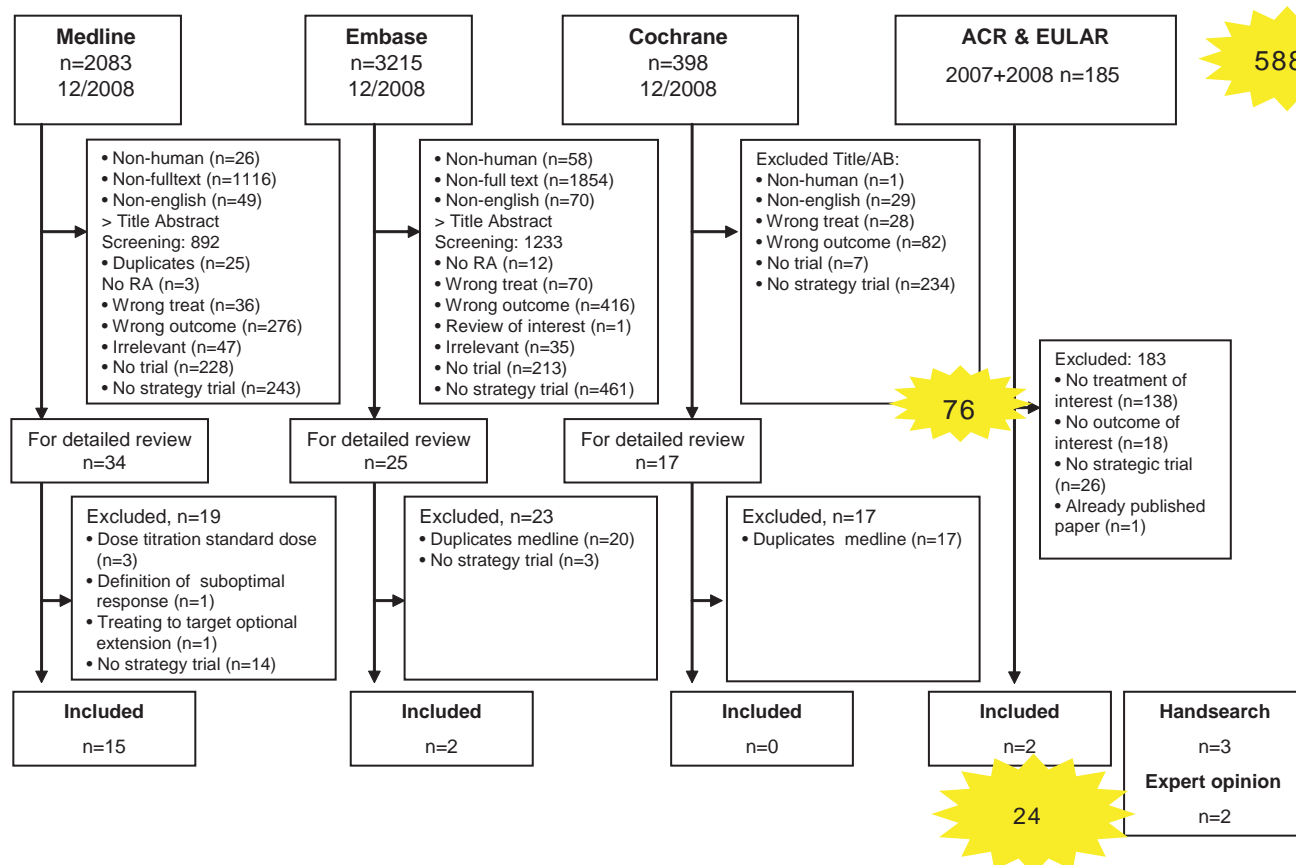


Figure 1 Flow chart of the systematic literature search. Illustrated are the results of the initial search and the selection process of abstract screening, full text review and hand search. AB, abstract; ACR, American College of Rheumatology; EULAR, European League Against Rheumatism; RA, rheumatoid arthritis.

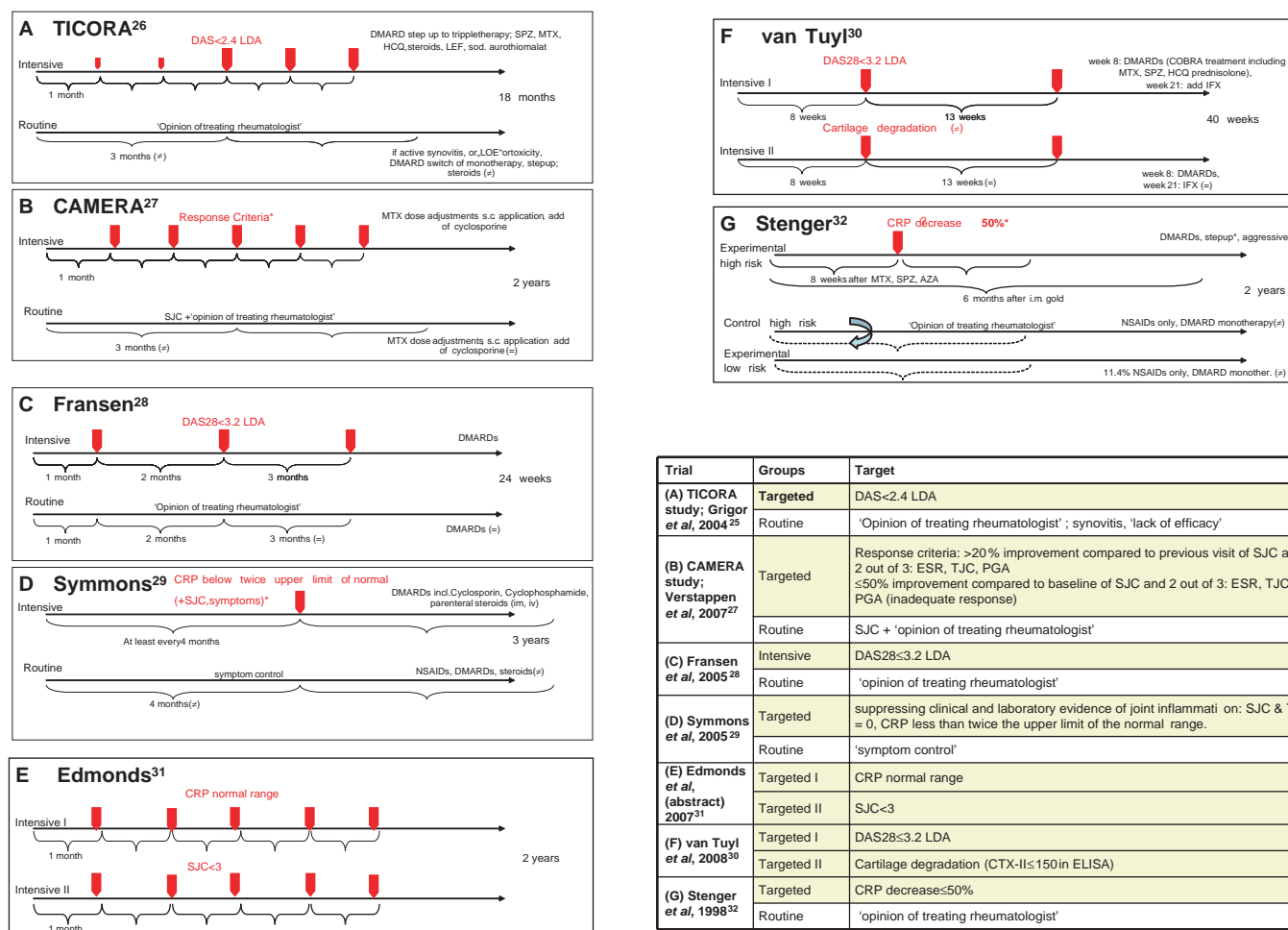


Figure 2 Design of the seven core clinical trials. (A) TICORA study (Grigor *et al* 2004)²⁶; (B) CAMERA study (Verstappen *et al* 2007)²⁷; (C) Fransen *et al* 2005²⁸; (D) Symmons *et al* 2005²⁹; (E) Edmonds *et al* 2007 (abstract)³¹; (F) van Tuyl *et al* 2008³⁰; and (G) Stenger *et al* 1998.³² Intensive and routine treatment arms are displayed, red arrows mark the scheduled intervals for target assessment. Table 1 specifies the targets of trials A–G. AZA, Azathioprine; CAMERA, Computer Assisted Management in Early Rheumatoid Arthritis; CRP, C reactive protein; DAS, Disease Activity Score; DMARD, disease-modifying antirheumatic drug; HCQ, hydroxychloroquine; IFX, infliximab; LDA, low disease activity; LEF, leflunomide; MTX, methotrexate; NSAID, non-steroidal anti-inflammatory drug; sc, subcutaneous; SJC, swollen joint count; sod., sodium; SPZ, sulfapyrazole; TICORA, tight control of rheumatoid arthritis.

Fransen *et al*²⁸ showed that both the proportion of patients reaching LDA and frequency of DMARD changes during follow-up favoured a DAS28-driven DMARD strategy. Symmons *et al*²⁹ found significant differences in clinical outcomes in the evaluator global assessment, while other measures, including joint counts, erythrocyte sedimentation rate and patient global visual analogue scale, were not significantly different.

Physical function was the primary outcome in the trial by Symmons *et al*²⁹; the intensive group failed to show significant differences compared to routine care regarding HAQ changes. Also CAMERA²⁷ did not show significant differences in functional outcomes.

Grigor *et al*²⁶ reported significantly less progression of radiographic changes²⁶ in the intensive treatment group. In contrast, no significant differences in annual radiographic progression were described in the CAMERA study.²⁷ Two of the studies did not report radiographic data^{28–29} (table 1, figure 2).

Randomised strategic trials comparing two targeted strategies

van Tuyl *et al*³⁰ presented a study protocol randomising early RA patients to different targeted and tight monitoring schedules: one

group aiming at DAS28 remission, the other at suppressing cartilage degradation as assessed by measuring urinary C-terminal cross-linking of type II collagen. Results did not differ significantly between the two groups with similar overall remission rates in both arms (figure 2, table 1). However, as the authors concede, this was a very small pilot study. Similarly, Edmonds *et al*³¹ reported in abstract form on steering at normal CRP levels versus a joint count targeted approach. Their results suggested that targeting CRP provides better interference with radiographic damage (table 1, figure 2).

Non-randomised cohort studies comparing two targeted strategies

Stenger *et al*³² compared an aggressive treatment protocol that stipulated change of DMARD therapy if after 8 weeks CRP decrease was less than 50% in patients with a high risk of developing aggressive disease; the comparator arm on regular therapy was a retrospectively assessed group of high risk patients. After 2 years, the area under the curve for CRP was significantly lower in the intensive treatment group than in the historic control. While no functional data were provided,

Table 1 Targets and visit intervals (left columns) and clinical, functional and structural outcomes (right columns) of core trials

Group	Treatment-decision driving target	Interval of controls	N	Outcomes/final treatment target p Values indicate differences of outcomes between the targeted (T) and the routine group (R)
(A) TICORA²⁶				
Targeted group (T)	DAS < 2.4 LDA	1 Month	55	Clinical outcome at 18 months
Routine control group (R)	Opinion of treating rheumatologist	1 Month	55	EULAR good response (primary outcome): OR* 5.8 (2.4 to 13.9); 82% targeted (T) versus 44% routine (R); p < 0.0001 EULAR remission: OR* 9.7 (3.9 to 23.9), 64% T versus 16% R; p < 0.0001 ACR70: OR* 11 (4.5 to 27), 71% T versus 18% R; p < 0.0001 Functional outcome at 18 months HAQ change: -0.97 ± 0.8 T versus -0.47 ± 0.9 R; p = 0.0025 Radiographic outcome at 18 months; median (IQR) Progression of erosion score: 0.5 (0–3.357) T versus 3 (0.5–8.5) R; p = 0.002 Change in TSS: 4.5 (1–9.875) T versus 8.5 (2.0–15.5) R; p = 0.02 Change in JSN: 3.25 (1.125–7.5) T versus 4.5 (1.5–9.0) R; p = 0.331
(B) CAMERA²⁷				
Targeted group (T)	Improvement of number of swollen joints: >20% compared to previous visit/50% compared to baseline Improvement in 2 out of 3 criteria: ESR, TJC, PGA >20% compared to previous visit	1 Month	151	Clinical outcome at 1 year† and at 2 years‡ Number of patients in remission for 3 months (primary outcome): 35% T versus 14% R; p < 0.001† 50% T versus 37% R; p < 0.029‡ Mean (95% CI) time until remission (months): 10.4 (9.1 to 11.7) T versus 14.3 (12.6 to 16.1) R; p < 0.001 Duration (months) of all periods of remission: 11.6 (10.1–13.1) T versus 9.1 (7.6–10.6) R; p = 0.025 ACR50: 58% T versus 43% R; p < 0.01† 46% T versus 45% R; p = NS‡ Functional outcome at 1 year† and at 2 years‡ HAQ mean ± SD change: -0.44 ± 0.59 T versus -0.39 ± 0.66 R; p = NS†; -0.41 ± 0.64 T versus -0.42 ± 0.76 R; p = NS‡ Radiographic outcome at 2 years Annual radiographic progression: median (IQR) change (units/year): 0 (0–2.0) T versus 0 (0–2.5) R; p = 0.9
Routine control group (R)	Decrease of SJC, if number of SJ unchanged, assessors' judgement, looking at TJC, ESR, PGA	3 Months	148	
(C) Fransen <i>et al</i>²⁸				
Targeted group (T)	DAS28 < 3.2 LDA	1 Month starting, then 2 months, then 3 months (both groups)	205	Clinical outcome at 24 weeks
Routine control group (R)	Opinion of treating rheumatologist		179	Patients in DAS28/LDA: 31% T versus 16% R; p = 0.028 Mean ± SD changes in DAS28: -0.4 ± 1.0 T versus -0.14 ± 1.2 R; p = 0.36 DMARD changes: 20% T versus 9% R; p = 0.013 Functional data: NR (NS) Radiographic: NR
(D) Symmons <i>et al</i>²⁹				
Targeted group (T)	CRP < twice the upper limit of normal range TJC = 0 and SJC = 0 Symptom control	At least every 4 months (both groups)	233	Clinical outcome at 3 years: (adjusted mean difference (95% CI)) EGA: 3.76 (0.03–7.52); p = 0.045 OSRA: 0.41 (0.01–0.71); p = 0.010 SJC, TJC, ESR and PGA: p = NS Functional outcome at 3 years: HAQ (primary outcome): sign deterioration in both arms; mean difference between T and R: p = 0.82 Radiographic outcome at 3 years: Total Larsen score: deterioration in both arms of (significant in routine group (p = 0.035) but not in the targeted group (p = 0.093); difference T versus R: p = NS Eroded joint count: increased slightly in both treatment arms, difference T versus R: p = NS
Routine control group (R)	Symptom control		233	
(E) Edmonds <i>et al</i>³¹ (abstract)				
Targeted group I	CRP normal range	1 Month	82	Clinical outcome at 2 years:
Targeted group II	SJC < 3	(both groups)	85	Target 'SJC < 3' was met in 29%, target 'normal CRP' in 41% of visits (p: NA) Functional outcomes: NR Radiographic outcomes at 2 years Radiographic progression scores NS between study arms but: erosion progression 0.2 ± 1.0 versus 1.0 ± 2.5 (p < 0.03), JSN 0.3 ± 1.3 versus 1.2 ± 2.6 (p < 0.03), total score 0.5 ± 1.6 versus 2.2 ± 4.2 (p < 0.005) if AUC-CRP target achieved, as compared to not achieved (not the case for SJC-target) (p NA).
Routine control group	—		82	
(F) van Tuyt <i>et al</i>³⁰				
Targeted group I	DAS28 < 3.2 LDA	8 Weeks, then 13 weeks (both groups)	11	Clinical outcomes at 40 weeks
Targeted group II	Cartilage degradation: CTX-II excretion ≤ 150 nmol/mmol creatinine		10	Remission rates: in both targeted arms: 90% (after 8 and 21 weeks: 57% and 76%) ACR20/50/70/90: 100%/95%/71%/43% Functional outcomes: NR Radiographic outcomes: NR
(G) Stenger <i>et al</i>³²				
Targeted group (T)	CRP decrease > 50%	8 Weeks (both groups)	139	Clinical outcomes at 1 year† and at 2 years‡ AUC-CRP (mg (week/L; median (range))): 1136 (144–3563) T versus 1836 (26–8051) R; p = 0.02†; 1963 (212–8515) T versus 3025 (46–15632) R; p = 0.002‡ Functional outcomes: NR Radiographic outcomes at 1 year† and at 2 years‡ Median (range) progression rate: 17.0 (0–74) T versus 17.5 (0–130) R; p = 0.22† 26.0 (0–100) T versus 35 (1–188) R; p = 0.03‡
Routine control group (R)	Opinion of treating rheumatologist		89	

*OR (95% CI); †outcome at 1 year; ‡outcome at 2 years.

AUC, area under the curve; ACR, American College of Rheumatology; CAMERA, Computer Assisted Management in Early Rheumatoid Arthritis; CRP, C reactive protein; CTX-II, C-terminal cross-linking of type II collagen; DAS, Disease Activity Score; DMARD, disease-modifying antirheumatic drugs; EGA, evaluator global assessment; ESR, erythrocyte sedimentation rate; EULAR, European League Against Rheumatism; HAQ, Health Assessment Questionnaire; JSN, joint space narrowing; LDA, low disease activity; NR, not reported; OSRA, overall status in rheumatoid arthritis; PGA, physician's global assessment; SJC, swollen joint count; TICORA, tight control of rheumatoid arthritis; TJC, total joint count; TSS, total Sharp score.

the reported radiographic progression favoured the intensive treatment (table 1).

Additional studies

A number of studies used the treat to target concept, but, in contrast to the mentioned papers, did not have a non-targeted control arm, since all arms pursued the same target with different treatment sequences (supplementary table S4). Likewise, several trials compared step-up with combination regimes, dose titration of agents or different therapies to reach a defined target without directly addressing the efficacy of treating to target. A description of these studies can be found in the supplementary material accompanying this manuscript.

DISCUSSION

Our review revealed that only few controlled studies investigated the value of strategic treatment schedules. Importantly, study designs and evaluated targets were very heterogeneous; for example, the Edmonds and van Tuyl studies are inherently different in design as compared to the others in that their approach compares two T2T approaches while the others compare a T2T approach with the routine approach. Nevertheless, all studies investigating early disease showed significantly better clinical outcomes of the targeted approach. Functional outcomes, reported in two trials, failed to show significant gains.^{27 29} Four studies compared radiographic outcomes,^{26 27 29 32} of which two showed a significant benefit of the targeted therapy.²⁶

Five^{26–28 30 32} studies investigated early disease (using different definitions of ‘early’ – see supplementary table S3). Only one trial²⁹ focused explicitly on late disease (duration: >5 years) and found no advantage of tight control on functional outcomes. Thus, patients with established RA seem to be underinvestigated regarding the value of treating to a target. Since longer disease duration impairs treatment outcomes,³³ extending results from early RA to the general patient population could be misleading. Furthermore, just focusing on HAQ might also be misleading, since with increasing disease duration responsiveness of physical function to therapeutic interventions decreases (even to placebo levels).³⁴

Utilised targets showed considerable heterogeneity (table 1, figure 2). Among the randomised trials comparing targeted versus routine approaches, three out of four employed state targets,^{26 28 29} an approach that has been favoured as being more appropriate than assessing changes from baseline.³⁵ Only in CAMERA,²⁷ the target was formulated as reaching defined improvement criteria. Also, visit intervals were noticeably heterogeneous: clinical assessments were performed from monthly^{26–28 31} to every 4^{29 36} months. Two trials randomised patients to different visit intervals.^{26 37} In both, patients assigned to intensive strategy were seen monthly, those in routine care every 3 months.

In conclusion, only few studies have used a randomised approach to test the value of treatment to a specific target. However, all of them provided compelling evidence of clinical benefits of such an approach. However, more data are needed concerning radiographic and functional outcomes and patients with longstanding RA have not been sufficiently investigated.

Author affiliations

¹2nd Department of Internal Medicine, Centre for Rheumatic Diseases, Hietzing Hospital, Vienna, Austria

²Department of Rheumatology, Leiden University Medical Center, Leiden, The Netherlands

³Department of Internal Medicine 3, Division of Rheumatology, Medical University of Vienna, Vienna, Austria

⁴Department of Rheumatology and Clinical Immunology, University Medical Center Utrecht, Utrecht, The Netherlands

⁵Department of Internal Medicine, University of Crete Medical School, Heraklion, Greece

⁶Department of Rheumatology and Clinical Immunology, Humboldt University, Charité Hospital, Berlin, Germany

⁷Service d'Immuno-Rhumatologie, Montpellier University, Lapeyronie Hospital, Montpellier, France

⁸Research Laboratory and Academic Clinical Unit of Rheumatology, Department of Internal Medicine, University of Genova, Genova, Italy

⁹Department of Rheumatology B, René Descartes University, Cochin Hospital, Paris, France

¹⁰Academic Unit of Musculoskeletal Disease, University of Leeds, Leeds, UK

¹¹Department of Internal Medicine III, Institute for Clinical Immunology at the Friedrich-Alexander University, Erlangen, Germany

¹²Rebecca MacDonald Centre for Arthritis and Autoimmune Disease, Mount Sinai Hospital, Toronto, Canada

¹³Department of Rheumatology, Diakonhjemmet Hospital, Oslo, Norway

¹⁴La Paz Hospital, Madrid, Spain

¹⁵Department of Rheumatology, University of Pavia, IRCCS Policlinico S. Matteo, Pavia, Italy

¹⁶EULAR Standing Committee of People with Arthritis/Rheumatism in Europe, Zurich, Switzerland

MS and RK Contributed equally to this study.

Competing interests This study was supported by an unrestricted educational grant from Abbott Immunology. Abbott had no influence on the selection of papers, extraction of data or writing of this manuscript. Francis Berenbaum was the Handling Editor.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- Smolen JS, Aletaha D, Koeller M, *et al*. New therapies for treatment of rheumatoid arthritis. *Lancet* 2007;**370**:1861–74.
- Emery P, Breedveld FC, Hall S, *et al*. Comparison of methotrexate monotherapy with a combination of methotrexate and etanercept in active, early, moderate to severe rheumatoid arthritis (COMET): a randomised, double-blind, parallel treatment trial. *Lancet* 2008;**372**:375–82.
- Combe B, Landewe R, Lukas C, *et al*. EULAR recommendations for the management of early arthritis: report of a task force of the European Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). *Ann Rheum Dis* 2007;**66**:34–45.
- van der Heide A, Remme CA, Hofman DM, *et al*. Prediction of progression of radiologic damage in newly diagnosed rheumatoid arthritis. *Arthritis Rheum* 1995;**38**:1466–74.
- Drossaers-Bakker KW, de Buck M, Van Zeben D, *et al*. Long term course and outcome of functional capacity in rheumatoid arthritis. The effect of disease activity and radiologic damage over time. *Arthritis Rheum* 1999;**42**:1854–60.
- Courvoisier N, Dougados M, Cantagrel A, *et al*. Prognostic factors of 10-year radiographic outcome in early rheumatoid arthritis: a prospective study. *Arthritis Res Ther* 2008;**10**:R106.
- Syversen SW, Gaarder PI, Goll GL, *et al*. High anti-cyclic citrullinated peptide levels and an algorithm of four variables predict radiographic progression in patients with rheumatoid arthritis: results from a 10-year longitudinal study. *Ann Rheum Dis* 2008;**67**:212–17.
- Plant MJ, Williams AL, O'Sullivan MM, *et al*. Relationship between time-integrated C-reactive protein levels and radiologic progression in patients with rheumatoid arthritis. *Arthritis Rheum* 2000;**43**:1473–7.
- Fiehn C, Jacki S, Heilig B, *et al*. Eight versus 16-week re-evaluation period in rheumatoid arthritis patients treated with leflunomide or methotrexate accompanied by moderate dose prednisone. *Rheumatol Int* 2007;**27**:975–9.
- Aletaha D, Funovits J, Keystone EC, *et al*. Disease activity early in the course of treatment predicts response to therapy after one year in rheumatoid arthritis patients. *Arthritis Rheum* 2007;**56**:3226–35.
- Breedveld FC, Kalden JR. Appropriate and effective management of rheumatoid arthritis. *Ann Rheum Dis* 2004;**63**:627–33.
- Smolen JS, Sokka T, Pincus T, *et al*. A proposed treatment algorithm for rheumatoid arthritis: aggressive therapy, methotrexate and quantitative measures. *Clin Exp Rheumatol* 2003;**21**(5 Suppl 31):S209–10.
- Combe B. Early rheumatoid arthritis: strategies for prevention and management. *Best Pract Res Clin Rheumatol* 2007;**21**:27–42.
- Aletaha D, Smolen JS. Remission of rheumatoid arthritis: should we care about definitions? *Clin Exp Rheumatol* 2006;**24** 6(Suppl 43):S–45–51.
- Aletaha D, Stamm T, Smolen J. Measuring disease activity for rheumatoid arthritis. *Z Rheumatol* 2006;**65**:93–6, 98–102.

16. **Heller JE**, Shadick NA. Outcomes in rheumatoid arthritis: incorporating the patient perspective. *Curr Opin Rheumatol* 2007;**19**:101–5.
17. **Schoels M**, Aletaha D, Smolen JS, *et al*. Follow-up standards and treatment targets in rheumatoid arthritis (RA): results of a questionnaire at the EULAR 2008. *Ann Rheum Dis* 2010;**69**:575–8.
18. **Aletaha D**, Nell VP, Stamm T, *et al*. Acute phase reactants add little to composite disease activity indices for rheumatoid arthritis: validation of a clinical activity score. *Arthritis Res Ther* 2005;**7**:R796–806.
19. **Smolen JS**, Breedveld FC, Schiff MH, *et al*. A simplified disease activity index for rheumatoid arthritis for use in clinical practice. *Rheumatology (Oxford)* 2003;**42**:244–57.
20. **Bray K**, Turpin RS, Jungkind K, *et al*. Defining success in diabetes disease management: digging deeper in the data. *Dis Manag* 2008;**11**:119–28.
21. **Moses RG**. Achieving glycosylated hemoglobin targets using the combination of repaglinide and metformin in type 2 diabetes: a reanalysis of earlier data in terms of current targets. *Clin Ther* 2008;**30**:552–4.
22. **Verdecchia P**, Staessen JA, Angeli F, *et al*. Usual versus tight control of systolic blood pressure in non-diabetic patients with hypertension (Cardio-Sis): an open-label randomised trial. *Lancet* 2009;**374**:525–33.
23. **Arguedas JA**, Perez MI, Wright JM. Treatment blood pressure targets for hypertension. *Cochrane Database Syst Rev* 2009;**3**:CD004349.
24. **Ogihara T**, Nakao K, Fukui T, *et al*. The optimal target blood pressure for antihypertensive treatment in Japanese elderly patients with high-risk hypertension: a subanalysis of the candesartan antihypertensive survival evaluation in Japan (CASE-J) trial. *Hypertens Res* 2008;**31**:1595–601.
25. **Milionis HJ**, Rizos E, Kostapanos M, *et al*. Treating to target patients with primary hyperlipidaemia: comparison of the effects of Atorvastatin and Rosuvastatin (the ATOROS study). *Curr Med Res Opin* 2006;**22**:1123–31.
26. **Grigor C**, Capell H, Stirling A, *et al*. Effect of a treatment strategy of tight control for rheumatoid arthritis (the TICORA study): a single-blind randomised controlled trial. *Lancet* 2004;**364**:263–9.
27. **Verstappen SM**, Jacobs JW, van der Veen MJ, *et al*. Intensive treatment with methotrexate in early rheumatoid arthritis: aiming for remission. Computer Assisted Management in Early Rheumatoid Arthritis (CAMERA, an open-label strategy trial). *Ann Rheum Dis* 2007;**66**:1443–9.
28. **Fransen J**, Bernelot Moens H, Speyer I, *et al*. Effectiveness of systematic monitoring of rheumatoid arthritis disease activity in daily practice: a multicentre, cluster randomised control trial. *Ann Rheum Dis* 2005;**64**:1294–8.
29. **Symmons D**, Tricker K, Roberts C, *et al*. The British Rheumatoid Outcome Study Group (BROSG) randomised controlled trial to compare the effectiveness and cost-effectiveness of aggressive versus symptomatic therapy in established rheumatoid arthritis. *Health Technol Assess* 2005;**9**:iii–iv, ix–x, 1–78.
30. **van Tuyl LH**, Lems WF, Voskuyl AE, *et al*. Tight control and intensified COBRA combination treatment in early rheumatoid arthritis: 90% remission in a pilot trial. *Ann Rheum Dis* 2008;**67**:1574–7.
31. **Edmonds J**, Lassere M, Sharp JT, *et al*. Objectives study in RA (OSRA): a RCT defining the best clinical target for disease activity control in RA. *Ann Rheum Dis* 2007;**66**(Suppl II):325.
32. **Stenger AA**, Van Leeuwen MA, Houtman PM, *et al*. Early effective suppression of inflammation in rheumatoid arthritis reduces radiographic progression. *Br J Rheumatol* 1998;**37**:1157–63.
33. **Anderson JJ**, Wells G, Verhoeven AC, *et al*. Factors predicting response to treatment in rheumatoid arthritis: the importance of disease duration. *Arthritis Rheum* 2000;**43**:22–9.
34. **Aletaha D**, Strand V, Smolen JS, *et al*. Treatment-related improvement in physical function varies with duration of rheumatoid arthritis: a pooled analysis of clinical trials. *Ann Rheum Dis* 2008;**67**:238–43.
35. **Aletaha D**, Funovits J, Smolen JS. The importance of reporting disease activity states in rheumatoid arthritis clinical trials. *Arthritis Rheum* 2008;**58**:2622–31.
36. **Verschueren P**, Esselens G, Westhovens R. Daily practice effectiveness of a step-down treatment in comparison with a tight step-up for early rheumatoid arthritis. *Rheumatology (Oxford)* 2008;**47**:59–64.
37. **Bakker MF**, Jacobs JW, Verstappen SM, *et al*. Tight control in the treatment of rheumatoid arthritis: efficacy and feasibility. *Ann Rheum Dis* 2007;**66**(Suppl 3):iii56–60.

Corrections

The department of one of the authors who co-authored all of the below papers has found that the affiliations were not correct. The correct affiliations for Professor P Emery, for all of the below articles, are: ¹Section of Musculoskeletal Disease, Leeds Institute of Molecular Medicine, University of Leeds; ²NIHR Leeds Musculoskeletal Biomedical Research Unit, Leeds Teaching Hospitals Trust, Leeds, UK.

1. **Keystone E**, Emery P, Peterfy CG, *et al*. Rituximab inhibits structural joint damage in patients with rheumatoid arthritis with an inadequate response to tumour necrosis factor inhibitor therapies. *Ann Rheum Dis* 2009;**68**:216–21.
2. **Doward LC**, McKenna SP, Whalley D, *et al*. The development of the L-QoL: a quality-of-life instrument specific to systemic lupus erythematosus. *Ann Rheum Dis* 2009;**68**:196–200.
3. **Potter C**, Hyrich KL, Tracey A, *et al*. Association of rheumatoid factor and anti-cyclic citrullinated peptide positivity, but not carriage of shared epitope or PTPN22 susceptibility variants, with anti-TNF response in RA. *Ann Rheum Dis* 2009;**68**:69–74.
4. **Smolen JS**, Han C, van der Heijde DM, *et al*. Active-Controlled Study of Patients Receiving Infliximab for the Treatment of Rheumatoid Arthritis of Early Onset (ASPIRE) Study Group. Radiographic changes in rheumatoid arthritis patients attaining different disease activity states with methotrexate monotherapy and infliximab plus methotrexate: the impacts of remission and tumour necrosis factor blockade. *Ann Rheum Dis* 2009;**68**:823–7.
5. **Buch MH**, Boyle DL, Rosengren S, *et al*. Mode of action of abatacept in rheumatoid arthritis patients having failed tumour necrosis factor blockade: a histological, gene expression and dynamic magnetic resonance imaging pilot study. *Ann Rheum Dis* 2009;**68**:1220–7.
6. **Emery P**, Van Vollenhoven R, Ostergaard M, *et al*. Guidelines for initiation of anti-tumour necrosis factor therapy in rheumatoid arthritis: similarities and differences across Europe. *Ann Rheum Dis* 2009;**68**:456–9.
7. **Bejarano V**, Conaghan PG, Proudman SM, *et al*. Long-term efficacy and toxicity of ciclosporin A in combination with methotrexate in poor prognosis rheumatoid arthritis. *Ann Rheum Dis* 2009;**68**:761–3.
8. **Rudwaleit M**, Landewé R, van der Heijde D, *et al*. The development of Assessment of SpondyloArthritis international Society classification criteria for axial spondyloarthritis (part I): classification of paper patients by expert opinion including uncertainty appraisal. *Ann Rheum Dis* 2009;**68**:770–6.
9. **Bennett AN**, Marzo-Ortega H, Emery P, *et al*. Leeds Spondyloarthritis Group. Diagnosing axial spondyloarthritis. The new Assessment in SpondyloArthritis international Society criteria: MRI entering centre stage. *Ann Rheum Dis* 2009;**68**:765–7.
10. **Marzo-Ortega H**, McGonagle D, O'Connor P, *et al*. Baseline and 1-year magnetic resonance imaging of the sacroiliac joint and lumbar spine in very early inflammatory back pain. Relationship between symptoms, HLA-B27 and disease extent and persistence. *Ann Rheum Dis* 2009;**68**:1721–7.
11. **Gilworth G**, Emery P, Gossec L, *et al*. Adaptation and cross-cultural validation of the rheumatoid arthritis work instability scale (RA-WIS). *Ann Rheum Dis* 2009;**68**:1686–90.
12. **Gilworth G**, Emery P, Gossec L, *et al*. Adaptation and cross-cultural validation of the RA-WIS (Work Instability Scale). *Ann Rheum Dis* 2009;**68**:1686–90.
13. **Jarrett SJ**, Sivera F, Cawthell LS, *et al*. MRI and clinical findings in patients with ankylosing spondylitis eligible for anti-tumour necrosis factor therapy after a short course of etoricoxib. *Ann Rheum Dis* 2009;**68**:1466–9.
14. **Haugeberg G**, Conaghan PG, Quinn M, *et al*. Bone loss in patients with active early rheumatoid arthritis: infliximab and methotrexate compared with methotrexate treatment alone. Explorative analysis from a 12-month randomised, double-blind, placebo-controlled study. *Ann Rheum Dis* 2009;**68**:1898–901.
15. **Genovese MC**, Breedveld FC, Emery P, *et al*. Safety of biological therapies following rituximab treatment in rheumatoid arthritis patients. *Ann Rheum Dis* 2009;**68**:1894–7.
16. **Kekow J**, Moots RJ, Emery P, *et al*. Patient-reported outcomes improve with etanercept plus methotrexate in active early rheumatoid arthritis and the improvement is strongly associated with remission: the COMET trial. *Ann Rheum Dis* 2010;**69**:222–5.
17. **Furst DE**, Keystone EC, Fleischmann R, *et al*. Updated consensus statement on biological agents for the treatment of rheumatic diseases, 2009. *Ann Rheum Dis* 2010;**69**(Suppl 1):i2–29.
18. **Freeston JE**, Wakefield RJ, Conaghan PG, *et al*. A diagnostic algorithm for persistence of very early inflammatory arthritis: the utility of power Doppler ultrasound when added to conventional assessment tools. *Ann Rheum Dis* 2010;**69**:417–9.
19. **Jones E**, Churchman SM, English A, *et al*. Mesenchymal stem cells in rheumatoid synovium: enumeration and functional assessment in relation to synovial inflammation level. *Ann Rheum Dis* 2010;**69**:450–7.
20. **Alten RE**, Zerbini C, Jeka S, *et al*. Efficacy and safety of pamapimod in patients with active rheumatoid arthritis receiving stable methotrexate therapy. *Ann Rheum Dis* 2010;**69**:364–7.
21. **Machold KP**, Landewé R, Smolen JS, *et al*. The Stop Arthritis Very Early (SAVE) trial, an international multicentre, randomised, double-blind, placebo-controlled trial on glucocorticoids in very early arthritis. *Ann Rheum Dis* 2010;**69**:495–502.
22. **Schoels M**, Knevel R, Aletaha D, *et al*. Evidence for treating rheumatoid arthritis to target: results of a systematic literature search. *Ann Rheum Dis* 2010;**69**:638–43.
23. **Smolen JS**, Aletaha D, Bijlsma JW, *et al*. T2T Expert Committee. Treating rheumatoid arthritis to target: recommendations of an international task force. *Ann Rheum Dis* 2010;**69**:631–7.
24. **Burr ML**, Naseem H, Hinks A, *et al*. BIRAC Consortium; YEAR Consortium. PADI4 genotype is not associated with rheumatoid arthritis in a large UK Caucasian population. *Ann Rheum Dis* 2010;**69**:666–70.
25. **Emery P**, Durez P, Dougados M, *et al*. Impact of T-cell costimulation modulation in patients with undifferentiated inflammatory arthritis or very early rheumatoid arthritis: a clinical and imaging study of abatacept (the ADJUST trial). *Ann Rheum Dis* 2010;**69**:510–16.
26. **Bennett AN**, Rehman A, Hensor EM, *et al*. The fatty Romanus lesion: a non-inflammatory spinal MRI lesion specific for axial spondyloarthritis. *Ann Rheum Dis* 2010;**69**:891–4.
27. **Nam JL**, Winthrop KL, van Vollenhoven RF, *et al*. Current evidence for the management of rheumatoid arthritis with biological disease-modifying antirheumatic drugs: a systematic literature review informing the EULAR recommendations for the management of RA. *Ann Rheum Dis* 2010;**69**:976–86.
28. **Smolen JS**, Landewé R, Breedveld FC, *et al*. EULAR recommendations for the management of rheumatoid arthritis with synthetic and biological disease-modifying antirheumatic drugs. *Ann Rheum Dis* 2010;**69**:964–75.
29. **Tan RJ**, Gibbons LJ, Potter C, *et al*. BRAGGSS. Investigation of rheumatoid arthritis susceptibility genes identifies association of AFF3 and CD226 variants with response to anti-tumour necrosis factor treatment. *Ann Rheum Dis* 2010;**69**:1029–35.
30. **Robinson JL**, Barrett JH, Taylor JC, *et al*. YEAR Consortium; BRAGGSS. Dissection of the FCGR3A association with RA: increased association in men and with autoantibody positive disease. *Ann Rheum Dis* 2010;**69**:1054–7.
31. **Cohen SB**, Keystone E, Genovese MC, *et al*. Continued inhibition of structural damage over 2 years in patients with rheumatoid arthritis treated with rituximab in combination with methotrexate. *Ann Rheum Dis* 2010;**69**:1158–61.
32. **Haugeberg G**, Bennett AN, McGonagle D, *et al*. Bone loss in very early inflammatory back pain in undifferentiated spondyloarthritis: a 1-year observational study. *Ann Rheum Dis* 2010;**69**:1364–6.
33. **Schoels M**, Aletaha D, Smolen JS, *et al*. Follow-up standards and treatment targets in rheumatoid arthritis: results of a questionnaire at the EULAR 2008. *Ann Rheum Dis* 2010;**69**:575–8.
34. **Eyre S**, Flynn E, Martin P, *et al*. No evidence for association of the KLF12 gene with rheumatoid arthritis in a large UK cohort. *Ann Rheum Dis* 2010;**69**:1407–8.
35. **Eyre S**, Hinks A, Flynn E, *et al*. Confirmation of association of the REL locus with rheumatoid arthritis susceptibility in the UK population. *Ann Rheum Dis* 2010;**69**:1572–3.
36. **Orozco G**, Eyre S, Hinks A, *et al*. Wellcome Trust Case Control consortium YEAR Consortium. Association of CD40 with rheumatoid arthritis confirmed in a large UK case-control study. *Ann Rheum Dis* 2010;**69**:813–16.
37. **Emery P**, Durez P, Dougados M, *et al*. Impact of T-cell costimulation modulation in patients with undifferentiated inflammatory arthritis or very early rheumatoid arthritis: a clinical and imaging study of abatacept (the ADJUST trial). *Ann Rheum Dis* 2010;**69**:510–16.
38. **Saleem B**, Keen H, Goeb V, *et al*. Patients with RA in remission on TNF blockers: when and in whom can TNF blocker therapy be stopped? *Ann Rheum Dis* 2010;**69**:1636–42.
39. **Barkham N**, Coates LC, Keen H, *et al*. Double-blind placebo-controlled trial of etanercept in the prevention of work disability in ankylosing spondylitis. *Ann Rheum Dis* 2010;**69**:1926–8.
40. **Emery P**, Deodhar A, Rigby WF, *et al*. Efficacy and safety of different doses and retreatment of rituximab: a randomised, placebo-controlled trial in patients who are biological naïve with active rheumatoid arthritis and an inadequate response to methotrexate (Study Evaluating Rituximab's Efficacy in MTX iNadequate rEsponders (SERENE)). *Ann Rheum Dis* 2010;**69**:1629–35.
41. **Dixon WG**, Hyrich KL, Watson KD, *et al*. BSRBR Control Centre Consortium; British Society for Rheumatology Biologics Register. Influence of anti-TNF therapy on mortality in patients with rheumatoid arthritis-associated interstitial lung disease: results from the British Society for Rheumatology Biologics Register. *Ann Rheum Dis* 2010;**69**:1086–91.

Ann Rheum Dis 2011;**70**:1519. doi:10.1136/annrheumdis-2011-70-08