Table 2. RCI treatment patterns, treatment duration and reasons for discontinuation in the 12 months post-RCI initiation.

RCI treatment patterns	n (%)
RCI starting dose	
80–120 unit/week (less than the recommended dose)	8 (12.7)
80 units twice/week (recommended dose per package insert)	47 (74.6)
240–400 unit/week (greater than the recommended dose)	8 (12.7)
Reasons for discontinuation (n=46)	
No longer required	22 (47.8)
Lack of efficacy	0 (0.0)
Side effects	2 (4.3)
Others[a]	9 (19.5)
Unknown	13 (28.4)
RCI treatment duration (n=63)	**Mean ± SD**
Cumulative duration of drug dispensed (months)[b]	14.0±12.9
Cumulative duration of prescription (months)[c] (n=63)	10.3±6.8

[a]Includes erroneous and payer mandate.
[b]Sum of all durations of exposure of each of the prescriptions, ignoring overlapping dates (this assumes that all refills provided to the patient were filled and taken).
[c]Last prescription's effective date minus first prescription's effective date plus duration of exposure from the last prescription, assuming that all refills provided to the patient were filled and taken.

RCI, repository corticotropin injection.

Table 3. Changes in disease activity assessments and PROs from 7 days before or after RCI initiation to 12 months post-RCI initiation.

Disease activity or PRO assessment	Observed values ±7 days from RCI initiation, mean ± SD (n)	Change from ±7 days from RCI initiation to 12 months post-RCI initiation,[a] mean ± SD (n)
CDAI[b]	23.5±10.0 (19)	−6.6±11.3 (17)
RAPID3[c]	17.6±6.0 (15)	−1.2±4.4 (14)
SJC	6.1±5.2 (19)	−1.3±5.5 (17)
TJC	13.3±6.4 (19)	−4.1±7.1 (17)
Pain VAS score[d]	7.0±2.9 (11)	−0.5±1.4 (11)
Physician global assessment	5.6±2.5 (8)	−0.7±1.8 (7)

[a]Only patients with assessment values documented within the 7 days before or after RCI initiation and 12 months post-RCI initiation were included in these descriptive paired measures statistics.
[b]CDAI minimum clinically important difference (MCID): 6.5-point decrease represents moderate improvement.[30]
[c]RAPID3 MCID: 3.8-point decrease represents moderate improvement.[36]
[d]Pain VAS score MCID: 0.5–1.1-point decrease represents moderate improvement.[29]
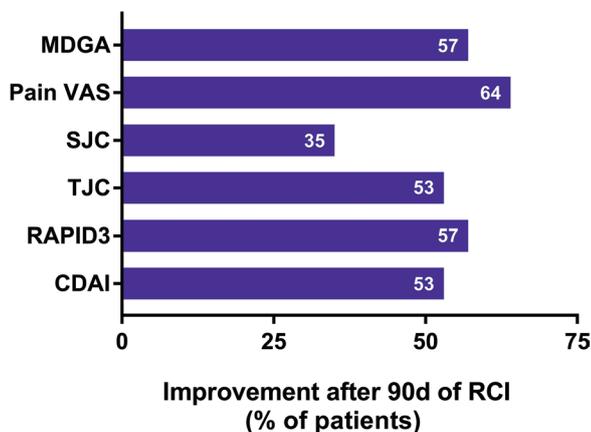
CDAI, Clinical Disease Activity Index; PRO, patient-reported outcome; RAPID3, Routine Assessment of Patient Index Data 3; RCI, repository corticotropin injection; SJC, swollen joint count; TJC, tender joint count; VAS, visual analogue scale.

At 12 months post-RCI initiation, a reduction in mean CDAI score (−6.6±11.3) was observed, which exceeded the threshold for a minimum clinically important difference (MCID) previously reported as a decrease of 6.5 (Table 3).[30] Less prominent decreases in mean RAPID3, pain VAS score and physician global assessment were also observed; however, the pain VAS score reduction also met the lower range of the MCID threshold of −0.5.[29] Both TJC and SJC decreased, with a greater magnitude of reduction for TJC than for SJC (Table 3). Of the patients with RA who had disease activity or PROs assessed at a 90-day follow-up visit, most saw improvements in clinical outcomes after 90 days of RCI treatment compared to values collected 7 days before or after RCI initiation (Figure 2). Clinical outcomes and PROs observed in ≤6 patients (i.e. patient global assessment, ESR, CRP, multibiomarker disease activity) were not reported.

Analysis of clinical quality measures showed that 25 (40%) patients had CDAI, TJC or SJC assessed; 49 (78%) patients had RAPID3 assessed; 45 (71%) had their pain VAS evaluated; and 11 (17%) received a physician global assessment within 12 months post-RCI initiation despite most of these patients reporting moderate to severe RA.

GC usage and dose
Relative to the 12 months pre-RCI initiation, the proportion of patients prescribed high-dose and moderate-dose GCs decreased from 14% to 2% and from 36% to 17%, respectively, in the 12 months post-RCI (Figure 3). Moreover, 71% of patients were prescribed low-dose GCs, whereas 10% of patients had no further GC prescriptions recorded within 12 months post-RCI initiation (Figure 3). The number of patients with a prescription of any dose of GCs decreased from 42 (67%) to 38 (60%) (Figure 4) with a mean prescribed GC dose of 8.3±5.3 mg/d. Of those patients prescribed GCs during the 12 months pre-RCI initiation (n=42), 40%

Figure 2. Proportion of patients showing any improvement in clinical assessments or patient-reported outcomes after 90 days of treatment with RCI compared to values observed within 7 days before or after RCI initiation.

Data from a subset of patients with RA for whom assessments were evaluated both within ±7 days of RCI initiation and at a 90-day post-RCI initiation follow-up visit. MDGA, n=7; pain VAS, n=11; SJC, n=17; TJC, n=17; RAPID3, n=14; CDAI, n=17.
CDAI, Clinical Disease Activity Index; MDGA, physician global assessment; RAPID3, Routine Assessment of Patient Index Data 3; RCI, repository corticotropin injection; SJC, swollen joint count; TJC, total joint count; VAS, visual analogue scale.

were prescribed lower dosing regimens of GCs 12 months post-RCI initiation.

DMARDs
DMARD prescriptions remained relatively stable throughout the study. A similar number of patients were prescribed DMARD treatment 12 months pre-RCI initiation (n=55, 87%) as during the 12 months post-RCI initiation (n=54, 86%). These patients' records indicated that they were prescribed approximately the same number of unique DMARDs during the 12 months pre-RCI initiation (1.8±1.2 DMARDs) and 12 months post-RCI (1.6±1.2 DMARDs). Five patients had stopped receiving prescriptions for csDMARDs, four patients began receiving prescriptions for bDMARDs or tsDMARDs, and one patient had no recorded DMARD prescriptions in the 12 months post-RCI initiation.

NSAID and opioid use
Medications regularly prescribed for the management of RA flare-associated pain include NSAIDs and opioids.[32,33] The proportion of patients prescribed opioids or NSAIDs was higher during the 12 months pre-RCI initiation (41% and 27%, respectively) than during the 12 months post-RCI initiation (29% and 19%, respectively; Figure 4).

BMI
The mean change in BMI at 12 months post-RCI initiation was 0.6±2.5 kg/m^2 (n=28). BMI was unchanged in 89.2% of patients from whom BMI data were gathered. Only 2 (7.1%) patients recorded increased BMI. Weight gain typically occurs following prolonged GC use; however, no significant weight gain was associated with RCI prescriptions in these patients.

Discussion

This study provides key information about treatment characteristics and clinical disease activity-related outcomes not reported in a previous chart review study, in which RCI was used in patients with RA with a high disease activity who had progressed to second-line or third-line therapies.[20] Our study included a population with refractory disease that is more difficult to treat, as demonstrated by high CDAI and RAPID3 scores, despite these patients being prescribed standard-of-care therapies. Patients also perceived their clinical status as being severe, which was consistent with high TJC and pain VAS scores (Table 3). Our findings are consistent with previous studies that demonstrated the effectiveness of RCI as an adjunctive therapy for short-term administration to manage RA flares because the category 'no longer required' was the main reason RCI was discontinued.[1,4,34] Only a small proportion (4.3%) of patients discontinued RCI due to side effects, but this may be because adverse events are not proactively collected in EMRs. Of note, a patient with a high RA disease activity may have several flares throughout the year, possibly warranting multiple intermittent courses of RCI therapy.

Our study also highlights the importance of recording follow-up disease activity assessments and PROs within the EMR database as outlined by ACR and CMS clinical quality measures guidelines.[35–38] These guidelines recommend at least annual assessments of functional status and clinical disease activity.[35–38] Though not all patients received both a clinical (e.g. CDAI) or functional (e.g. RAPID3) assessment in the 12 months following RCI initiation, most patients were administered one of the two assessments. RAPID3 is a quickly administered and scored assessment of RA disease activity that does not include clinical measures; however, it possibly overestimates disease severity compared to CDAI and Disease Activity Score with 28 joint count and ESR (DAS28-ESR).[39] Patients may be more empowered to manage their disease status and progression if they all received documented quality measures in the form of regular clinical assessments and physician feedback at follow-up visits.

Treatment patterns, medical history and GC dosing are important topics that should be continually discussed by practitioners with patients.[12,20,40,41] Recent ACR guidelines strongly discourage long-term GC use to maintain treatment targets in patients with RA. The European League Against Rheumatism (EULAR) advises GC tapering "as rapidly as clinically possible."[32] RCI treatment is associated with reduction

Figure 3. Proportion of patients prescribed GCs during the 12 months pre-RCI initiation (A) and 12 months post-RCI initiation (B).
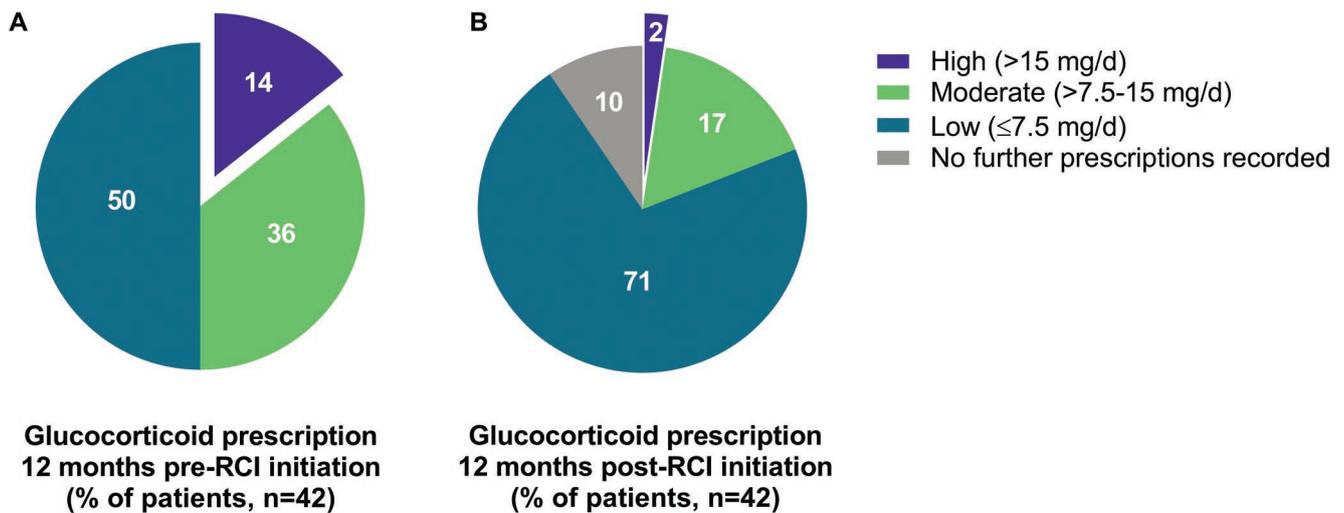
GCs, glucocorticoids; RCI, repository corticotropin injection.

Figure 4. Proportion of patients prescribed concomitant medications, including glucocorticoids, NSAIDs and opioids, during the 12 months pre-RCI and post-RCI initiation.
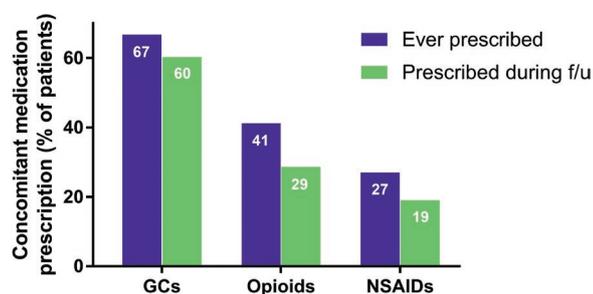
GCs, glucocorticoids; NSAIDs, nonsteroidal anti-inflammatory drugs; f/u, follow-up; RCI, repository corticotropin injection.

of the use of concomitant medications such as GCs and DMARDs.[12,14,18,21,38] In the current study, a larger proportion of patients receiving GCs were prescribed high doses (>15 mg/d) in the 12 months pre-RCI initiation (14%) *versus* at 12 months post-RCI (3%). The analyses performed in this real-world EMR study were unbiased as to dosing of any medications; however, these high GC doses are not recommended for the treatment of RA.[32,42–44] Our results did not show a similar reduction in DMARD prescriptions, possibly because having been recently prescribed DMARDs was necessary for inclusion and/or due to the small sample size. In the 12 months post-RCI initiation, five patients stopped receiving prescriptions for csDMARDs and

four patients began receiving prescriptions for tsDMARDs or bDMARDs. It is possible that these four patients with refractory RA did not achieve low disease activity within 12 months post-RCI initiation and thus were prescribed different DMARDs. Regardless, a similar proportion of patients were prescribed DMARDs in the 12 months pre-RCI and post-RCI initiation. Additionally, DMARDs are standard-of-care therapies through the maintenance phase of RA treatment, and we did not expect to see a change in dosing in this real-world study. Pain management with opioids is also a concern, as the prevalence of chronic opioid use amongst patients with RA doubled to 17% between 2002 and 2015.[32] Our study observed reductions in pain medications 12 months post-RCI initiation, which may be indicative of lessened RA flare severity. Patients are less likely to discontinue RCI therapy due to allergic reactions or infections and can tolerate RCI treatment longer when compared to biologics (e.g. infliximab).[16]

Data for RF and anti-CCP were often missing from the EMRs, likely because these procedures are regularly performed once at the time of diagnosis and the average time to diagnosis (6.0±2.8 years) was longer than the evaluation period of EMR data (1–4 years before the RCI initiation visit) for inclusion in the study. A recent study demonstrated that the M05* ICD-10 diagnosis code correlated with serum detection of anti-CCP or RF antibodies with approximately 85% accuracy; therefore, the M05* ICD-10 diagnosis code may be used as a proxy to impute RA seropositivity.[45]

The limitations of this study are mostly related to incomplete data in the EMRs. This retrospective and exploratory study comprised effectiveness assessments, which relied on comparison of outcomes between pre-RCI initiation and 12 months post-RCI initiation in a small subset of patients

with available EMR data. The availability of clinical disease activity measures was limited to CDAI because the EMRs did not contain routine assessments with the DAS28-ESR, which is currently the standard for evaluating RA disease activity. However, CDAI is easier to administer at any time and has been reported to be more effective at evaluating RA remission than DAS28.[30,46] The small subset sample size may not have allowed for detection of changes beyond an MCID threshold. Unlike medical-based and pharmacy-based claims database analyses, in which a continuous enrolment can be defined and treatment patterns can be tracked based on refill patterns, prescription patterns ascertained from EMR data are subject to greater uncertainty. Because linkage to pharmacy claims data was not available, the study assumed that patients filled their prescriptions over the period of observation unless physicians recorded a stop in treatment. Therefore, the categorization of medication use may be underestimated. Inferences based upon the findings described here may be limited to the included population (mostly middle-aged white women), which may constrain generalizations of these results to the larger population with refractory RA. However, this patient demographic is highly represented in both this study and the overall RA population. No comparator arm was included in this real-world study, but controlled comparator studies with other monotherapies are complicated by the fact that RCI is initiated in response to RA flares and high disease activity despite concomitant treatment with first-line therapies (GCs and/or DMARDs). Although this retrospective EMR study cannot directly conclude that RCI is effective in the treatment of refractory RA, as a recent placebo-controlled clinical trial has,[4] in real-world clinical practice we still observed that patients with refractory RA experienced clinical improvements 12 months after initiation with RCI. In future studies, systematic reporting of quality-of-care metrics (CDAI and patient functional assessments) and increased linkage of EMR data to prescription fill data would improve compliance monitoring and effectiveness assessments of RCI treatment.

Despite these limitations, data collected from the Columbus[TM] repository of EMRs obtained through BendCare, LLC, a large network of rheumatology practices, captured PROs and clinical disease activity assessments, which are data not frequently available in pharmacy or medical claims databases. The treatment patterns identified in our study may provide insights to improve patient care and help better understand practices for RCI use in RA. Similar real-world effectiveness studies have reported positive clinical outcomes after initiating RCI treatment in patients with refractory diseases, including multiple sclerosis,[40,47] sarcoidosis,[12] uveitis,[41] nephrotic syndrome,[48] systemic lupus erythematosus, and dermatomyositis or polymyositis.[20] Outcomes of these studies align with those presented here for RA. In the treatment of refractory sarcoidosis and moderate to severe uveitis, RCI reduced disease severity and concomitant medication use such as GCs.[12,41] Patients with nephrotic syndrome[48] or multiple sclerosis,[40,47] in whom prior immunosuppressive or cytotoxic treatments have failed, also showed reduced disease activity scores after initiation of RCI. These studies, combined with our data for RA, provide strong real-world evidence supporting the clinical effectiveness of RCI across a wide spectrum of inflammatory diseases.

Conclusions

This study suggests that patients with refractory, persistently active RA may benefit from RCI. Most patients in this study were white women older than 50 years, who were prescribed an RCI regimen of 80 units twice weekly for approximately 10 months. This treatment strategy was associated with a decreased number of prescriptions for concomitant medications, including GCs, NSAIDs and opioids, as well as improved disease activity (CDAI) and PROs. These real-world findings are consistent with other well-controlled clinical and observational studies that suggest RCI treatment is safe and effective for patients with refractory RA in routine clinical practice.

Compliance with ethics guidelines

The management of study data conformed to all applicable Health Insurance Portability and Accountability Act rules. All data were de-identified throughout the study to preserve patient anonymity and confidentiality. This observational study was conducted under the research exception provisions of the Privacy Rule, 45 CFR 164.514(e), and was exempt from Institutional Review Board informed consent requirements.

Data availability

The source data for this study are not available to be shared by the authors. The Columbus[TM] electronic medical system database is a proprietary analytic platform that can be accessed through contract with BendCare, LLC (contact at https://www.bendcare.com).

References

1. Hayes K, Panaccio MP, Goel N, Fahim M. Patient characteristics and indicators of treatment initiation with repository corticotropin injection in patients with rheumatoid arthritis: a claims database analysis. *Rheumatol Ther*. 2021;8(1):327–346. https://doi.org/10.1007/s40744-020-00272-x

2. Mallinckrodt ARD. Acthar Gel (Repository Corticotropin Injection). Bedminster, NJ: Mallinckrodt ARD LLC; 2021. https://www.acthar.com/Static/pdf/Acthar-PI.pdf. Accessed September 2, 2021.

3. Corrigan-Curay J, Sacks L, Woodcock J. Real-world evidence and real-world data for evaluating drug safety and effectiveness. *JAMA*. 2018;320(9):867–868. https://doi.org/10.1001/jama.2018.10136

4. Fleischmann R, Furst DE, Connolly-Strong E, Liu J, Zhu J, Brasington R. Repository corticotropin injection for active rheumatoid arthritis despite aggressive treatment: a randomized controlled withdrawal trial. *Rheumatol Ther*. 2020;7(2):327–344. https://doi.org/10.1007/s40744-020-00199-3

5. Ahmed TJ, Montero-Melendez T, Perretti M, Pitzalis C. Curbing inflammation through endogenous pathways: focus on melanocortin peptides. *Int J Inflam*. 2013;2013:985815. https://doi.org/10.1155/2013/985815

6. Catania A, Lonati C, Sordi A, Carlin A, Leonardi P, Gatti S. The melanocortin system in control of inflammation. *Sci World J*. 2010;10:1840–1853. https://doi.org/10.1100/tsw.2010.173

7. Cooray SN, Clark AJL. Melanocortin receptors and their accessory proteins. *Mol Cell Endocrinol*. 2011;331(2):215–221. https://doi.org/10.1016/j.mce.2010.07.015

8. Huang YJ GK, Zweifel B, Brooks LR, Wright AD. Distinct binding and signaling activity of Acthar Gel compared to other melanocortin receptor agonists. *J Recept Signal Transduct Res*. 2021;41(5):425–433. https://doi.org/10.1080/10799893.2020.1818094

9. Montero-Melendez T. ACTH: The forgotten therapy. *Semin Immunol*. 2015;27(3):216–226. https://doi.org/10.1016/j.smim.2015.02.003

10. Starowicz K, Przewłocka B. The role of melanocortins and their receptors in inflammatory processes, nerve regeneration and nociception. *Life Sci*. 2003;73(7):823–847. https://doi.org/10.1016/s0024-3205(03)00349-7

11. Fiechtner JM, Montroy T. Six months' treatment of moderately to severely active systemic lupus erythematosus with repository corticotropin injection: an extension of a single-site, open-label trial. *J Immunol Clin Res*. 2016;3(1):1025–1030.

12. Chopra I, Qin Y, Kranyak J, et al. Repository corticotropin injection in patients with advanced symptomatic sarcoidosis: retrospective analysis of medical records. *Ther Adv Respir Dis*. 2019;13:1753466619888127. https://doi.org/10.1177/1753466619888127

13. Fischer PA, Rapoport RJ. Repository corticotropin injection in patients with rheumatoid arthritis resistant to biologic therapies. *Open Access Rheumatol.* 2018;10:13–19. https://doi.org/10.2147/OARRR.S153307

14. Gaylis N, Needell S, Sagliani J. The effect of adrenocorticotropin gel (HP Acthar Gel) in combination with MTX in newly diagnosed RA patients from a clinical and structural perspective. *Ann Rheum Dis.* 2015;74(Suppl. 2):1066–1067. https://doi.org/10.1136/annrheumdis-2015-eular.2810

15. Gillis T, Crane M, Hinkle C, Wei N. Repository corticotropin injection as adjunctive therapy in patients with rheumatoid arthritis who have failed previous therapies with at least three different modes of action. *Open Access Rheumatol.* 2017;9:131–138. https://doi.org/10.2147/OARRR.S131046

16. Lower EE, Sturdivant M, Grate L, Baughman RP. Use of third-line therapies in advanced sarcoidosis. *Clin Exp Rheumatol.* 2020;38(5):834–840.

17. Nelson WW, Philbin MJ, Gallagher JR, Heap K, Carroll S, Wan GJ. A retrospective medical record review of utilization patterns and medical resource use associated with repository corticotropin injection among patients with rheumatologic diseases in the United States. *Rheumatol Ther.* 2017;4(2):465–474. https://doi.org/10.1007/s40744-017-0087-x

18. Philbin M, Niewoehner J, Wan GJ. Clinical and economic evaluation of repository corticotropin injection: a narrative literature review of treatment efficacy and healthcare resource utilization for seven key indications. *Adv Ther.* 2017;34(8):1775–1790. https://doi.org/10.1007/s12325-017-0569-9

19. Wu B, Deshpande G, Gu T, Popelar B, Philbin M, Wan GJ. Demographics, treatment patterns, and healthcare utilization and cost of repository corticotropin injection in patients with systemic lupus erythematosus or rheumatoid arthritis. *J Med Econ.* 2017;20(11):1170–1177. https://doi.org/10.1080/13696998.2017.1362411

20. Ho-Mahler N, Turner B, Eaddy M, Hanke ML, Nelson WW. Treatment with repository corticotropin injection in patients with rheumatoid arthritis, systemic lupus erythematosus, and dermatomyositis/polymyositis. *Open Access Rheumatol.* 2020;12:21–28. https://doi.org/10.2147/OARRR.S231667

21. Hayes K, Panaccio MP, Houston P, et al. Real-world treatment patterns and outcomes from an electronic medical records database for patients with rheumatoid arthritis treated with repository corticotropin injection. *Open Access Rheumatol.* 2021;13:315–323. https://doi.org/10.2147/OARRR.S329766

22. Dal-Ré R, Janiaud P, Ioannidis JPA. Real-world evidence: how pragmatic are randomized controlled trials labeled as pragmatic? *BMC Med.* 2018;16(1):49. https://doi.org/10.1186/s12916-018-1038-2

23. Sherman RE, Anderson SA, Dal Pan GJ, Gray GW, et al. Real-world evidence – what is it and what can it tell us? *N Engl J Med.* 2016;375(23):2293–2297. https://doi.org/10.1056/NEJMsb1609216

24. Boonstra AM, Schiphorst Preuper HR, Balk GA, Stewart RE. Cut-off points for mild, moderate, and severe pain on the visual analogue scale for pain in patients with chronic musculoskeletal pain. *Pain.* 2014;155(12):2545–2550. https://doi.org/10.1016/j.pain.2014.09.014

25. Pincus T, Furer V, Keystone E, Yazici Y, Bergman MJ, Luijtens K. RAPID3 (Routine Assessment of Patient Index Data 3) severity categories and response criteria: similar results to DAS28 (Disease Activity Score) and CDAI (Clinical Disease Activity Index) in the RAPID 1 (Rheumatoid Arthritis Prevention of Structural Damage) clinical trial of certolizumab pegol. *Arthritis Care Res.* 2011;63(8):1142–1149. https://doi.org/10.1002/acr.20481

26. Pincus T, Swearingen CJ, Bergman M, Yazici Y. RAPID3 (Routine Assessment of Patient Index Data 3), a rheumatoid arthritis index without formal joint counts for routine care: proposed severity categories compared to Disease Activity Score and Clinical Disease Activity Index categories. *J Rheumatol.* 2008;35(11):2136–2147. https://doi.org/10.3899/jrheum.080182

27. Pincus T, Yazici Y, Bergman MJ. RAPID3, an index to assess and monitor patients with rheumatoid arthritis, without formal joint counts: similar results to DAS28 and CDAI in clinical trials and clinical care. *Rheum Dis Clin North Am.* 2009;35(4):773–778, viii. https://doi.org/10.1016/j.rdc.2009.10.008

28. Ward MM, Castrejon I, Bergman MJ, Alba MI, Guthrie LC, Pincus T. Minimal clinically important improvement of Routine Assessment of Patient Index Data 3 in rheumatoid arthritis. *J Rheumatol.* 2019;46(1):27–30. https://doi.org/10.3899/jrheum.180153

29. Wolfe F, Michaud K. Assessment of pain in rheumatoid arthritis: minimal clinically significant difference, predictors, and the effect of anti-tumor necrosis factor therapy. *J Rheumatol.* 2007;34(8):1674–1683.

30. Aletaha D, Smolen J. The Simplified Disease Activity Index (SDAI) and the Clinical Disease Activity Index (CDAI): a review of their usefulness and validity in rheumatoid arthritis. *Clin Exp Rheumatol.* 2005;23(5 Suppl. 39):S100–108.

31. Curtis JR, Yang S, Chen L, et al. Determining the minimally important difference in the Clinical Disease Activity Index for improvement and worsening in early rheumatoid arthritis patients. *Arthritis Care Res.* 2015;67(10):1345–1353. https://doi.org/10.1002/acr.22606

32. Moore MN, Wallace BI. Glucocorticoid and opioid use in rheumatoid arthritis management. *Curr Opin Rheumatol.* 2021;33(3): 277–283. https://doi.org/10.1097/BOR.0000000000000788

33. Crofford LJ. Use of NSAIDs in treating patients with arthritis. *Arthritis Res Ther.* 2013;15(Suppl. 3):S2. https://doi.org/10.1186/ar4174

34. Furie R, Mitrane M, Zhao E, Das M, Li D, Becker PM. Efficacy and tolerability of repository corticotropin injection in patients with persistently active SLE: results of a phase 4, randomised, controlled pilot study. *Lupus Sci Med.* 2016;3(1):e000180. https://doi.org/10.1136/lupus-2016-000180

35. US Centers for Medicare and Medicaid Services. Quality metrics (CMS): Quality ID #178: Rheumatoid arthritis (RA): functional status assessment: MIPS Clinical Quality Measures (CQMS). https://qpp.cms.gov/docs/QPP_quality_measure_specifications/CQM-Measures/2020_Measure_178_MIPSCQM.pdf. Accessed September 2, 2021.

36. Barber CEH, Zell J, Yazdany J, et al. 2019 American College of Rheumatology recommended patient-reported functional status assessment measures in rheumatoid arthritis. *Arthritis Care Res.* 2019;71(12):1531–1539. https://doi.org/10.1002/acr.24040

37. England BR, Tiong BK, Bergman MJ, et al. 2019 Update of the American College of Rheumatology recommended rheumatoid arthritis disease activity measures. *Arthritis Care Res.* 2019;71(12):1540–1555. https://doi.org/10.1002/acr.24042

38. Suter LG, Barber CE, Herrin J, et al. American College of Rheumatology white paper on performance outcome measures in rheumatology. *Arthritis Care Res.* 2016;68(10):1390–1401. https://doi.org/10.1002/acr.22936

39. Kumar BS, Suneetha P, Mohan A, Kumar DP, Sarma KVS. Comparison of Disease Activity Score in 28 joints with ESR (DAS28), Clinical Disease Activity Index (CDAI), Health Assessment Questionnaire Disability Index (HAQ-DI) & Routine Assessment of Patient Index Data with 3 measures (RAPID3) for assessing disease activity in patients with rheumatoid arthritis at initial presentation. *Indian J Med Res.* 2017;146(Suppl.):S57–S62. https://doi.org/10.4103/ijmr.IJMR_701_15

40. Nazareth T, Datar M, Yu TC. Treatment effectiveness for resolution of multiple sclerosis relapse in a US health plan population. *Neurol Ther.* 2019;8(2):383–395. https://doi.org/10.1007/s40120-019-00156-5

41. Nelson WW, Lima AF, Kranyak J, et al. Retrospective medical record review to describe use of repository corticotropin injection among patients with uveitis in the United States. *J Ocul Pharmacol Ther.* 2019;35(3):182–188. https://doi.org/10.1089/jop.2018.0090

42. Rice JB, White AG, Scarpati LM, Wan G, Nelson WW. Long-term systemic corticosteroid exposure: a systematic literature review. *Clin Ther.* 2017;39(11):2216–2229. https://doi.org/10.1016/j.clinthera.2017.09.011

43. Rice JB, White AG, Johnson M, et al. Healthcare resource use and cost associated with varying dosages of extended corticosteroid exposure in a US population. *J Med Econ.* 2018;21(9):846–852. https://doi.org/10.1080/13696998.2018.1474750

44. Rice JB, White AG, Johnson M, et al. Quantitative characterization of the relationship between levels of extended corticosteroid use and related adverse events in a US population. *Curr Med Res Opin.* 2018;34(8):1519–1527. https://doi.org/10.1080/03007995.2018.1474090

45. Curtis JR, Xie F, Zhou H, Salchert D, Yun H. Use of ICD-10 diagnosis codes to identify seropositive and seronegative rheumatoid arthritis when lab results are not available. *Arthritis Res Ther.* 2020;22(1):242. https://doi.org/10.1186/s13075-020-02310-z

46. Dhaon P, Das SK, Srivastava R, Dhakad U. Performances of Clinical Disease Activity Index (CDAI) and Simplified Disease Activity Index (SDAI) appear to be better than the gold standard Disease Assessment Score (DAS-28-CRP) to assess rheumatoid arthritis patients. *Int J Rheum Dis.* 2018;21(11):1933–1939. https://doi.org/10.1111/1756-185X.13110

47. Kaplan J, Miller T, Baker M, Due B, Zhao E. A prospective observational registry of repository corticotropin injection (Acthar® Gel) for the treatment of multiple sclerosis relapse. *Front Neurol.* 2020;11:598496. https://doi.org/10.3389/fneur.2020.598496

48. Madan A, Mijovic-Das S, Stankovic A, Teehan G, Milward AS, Khastgir A. Acthar Gel in the treatment of nephrotic syndrome: a multicenter retrospective case series. *BMC Nephrol.* 2016;17:37. https://doi.org/10.1186/s12882-016-0241-7