Review of Artificial Intelligence Tools in the Clinical Treatment of Rheumatoid Arthritis

Joanna Maj*

[1]*Harvard University, Division of Continuing Education, Cambridge, MA*

Corresponding Author*

Joanna Maj
Harvard University, Division of Continuing Education,
Cambridge
MA
E-mail: joannamaj@uchicago.edu

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Abstract

Background: Nearly 1.6 million Americans are diagnosed with Rheumatoid Arthritis (RA). 90% of patients with a diagnosis of RA have been prescribed a Tumor Necrosis Factor- Inhibitor (TNFi) or Targeted Synthetic Disease-Modifying Antirheumatic Drug (b/tsDMARD) as their first biologic, despite up to 70% ineffectiveness. Artificial intelligence tools can be used in the field of Rheumatology to predict inadequate response to TNFi therapies.

Methods: This literature review analyzed the usefulness of Artificial Intelligence (AI) tools for patients with an RA diagnosis to determine if patients can benefit from an AI predictive tool to predict non-response to RA therapies. A total of 21 articles were thoroughly examined and included in this review.

Results: AI tools can confirm which patients are non-responders to certain treatments. Results from this literature review support targeted therapy treatment selection in treat-to-target management strategies.

Conclusion: An AI tool can correctly predict which RA patients would likely fail to achieve a response to TNFi therapies and other therapies for RA post-treatment initiation. An AI tool halts the progression of RA in patients and helps inform doctors of the best treatment routes.

Keywords: Clinical utility • Artificial intelligence • TNFi therapy • Decision impact • Molecular signature • Precision medicine • Real-world evidence • Response prediction • Rheumatoid arthritis

Introduction

Rheumatoid Arthritis (RA) is a chronic inflammatory disorder affecting the joints [1,2]. Joint inflammation in RA can lead to bone erosion and joint deformity over time [1]. In newly diagnosed RA patients, nearly 90% are prescribed a Tumor Necrosis Factor-Alpha Inhibitor (TNFi) as their first biologic or Targeted Synthetic Disease-Modifying Antirheumatic Drug (b/tsDMARD) [3]. However, TNFi therapy fails in approximately 70% of patients with RA [3]. Most patients do not respond to csDMARDs plus methotrexate, which is the first line of therapy. The American College of Rheumatology (ACR) has a 50% response rate for methotrexate. A second-line therapy, such as TNFi, is often needed for patients on methotrexate [3-8]. This shows how rheumatologists face difficulties in determining the best treatment for each patient, based on their unique biology and predicting non-responders to therapies. Thus, precision tools are needed to identify non-responders to RA therapies and inform physician decision-making.

An artificial intelligence tool has been shown to accurately predict non-response to TNFi therapies in RA patients and is intended for use before starting, while switching, or before changing the dose of a patient's TNFi treatment [1-10]. Artificial Intelligence (AI) tools integrate gene expression and clinical features to predict the likelihood that a patient with RA will show non-response to TNFi therapy [10]. Integrating AI tools into clinical workflows improved patient outcomes, reduced patient burden, and showed a decline in disease progression [11-17]. Identifying likely inadequate responders to TNFi therapies has the potential to reduce time spent on trial-and-error approaches for treatment selection. In a treat-to-target management approach, early assessment is critical for success; thus, AI validation outcomes at time points before 6 months are needed.

Minimal response to treatment at 3 months is indicative of poor treatment response targets at later time points [6, 7]. Evaluation at the 3-month time point allows patients to change targeted therapy sooner if needed. This study evaluated the efficacy of AI tools to identify non-responders to TNFi therapy at 3 months to better inform physicians of treatment direction in clinical practice. Treatment can be re-directed sooner, and new targeted treatment can be started if a patient is an identified non-responder to TNFi therapy at 3 months. In a treat-to-target strategy, assessment at 3 months after treatment initiation is recommended to evaluate treatment response and adjust as needed; therefore, validation of AI tools at 3 months is warranted. This review shows the efficacy of early time points in data selection and how this can influence patient prognosis. AI tools have the potential to be the new standard of care in rheumatology for the treatment of patients with RA.

Methods

A total of 40 articles were analysed and 21 articles were chosen to consider in this review paper. 19 articles were excluded from this review because of repetition. The importance of analysing literature with a wide range of demographics was upheld in this review.

Results

This review found that AI tools have the potential to be the new standard of care in rheumatology for the treatment of patients with RA. AI tools can confirm which patients are non-responders to certain treatments. Results support targeted therapy treatment selection in treat-to-target management strategies.

Discussion

This review showed that AI tools can successfully predict non-response to TNFi therapy based on the literature analyzed. Results could assist rheumatologists in selecting personalized treatment plans for RA patients [10]. AI tools can investigate gene expression data alongside clinical features to precisely identify biologic-naive and TNFi-exposed patients who are likely to be non-responders to TNFi therapy [10]. AI can be used to inform physicians of treatment selection before initial therapy begins as well as 3 months and 6 months after TNFi therapy has begun [3]. Early identification of non-responders at 3 months could inform physicians' consideration of a second-line therapy or medication dose adjustment.

At least 50% of patients do not respond to TNFi therapies. An AI tool could determine the best-individualized therapies for patients which could increase remission rates or help achieve treat-to-target goals of low disease activity. Results received before treatment initiation could support the appropriate medication selection in treat-to-target management strategies. Current clinical guidelines for the treatment of RA lack direction towards specific biological or targeted medication classes and suggest a need for predictive tests such as AI tests. Response rates for individual therapies are low, and thus there is no recommendation for one treatment over another [1-10]. Since RA is a progressive disease that needs early,

Figure 1. Ideal study design plan recommendation for AI products in Rheumatology.

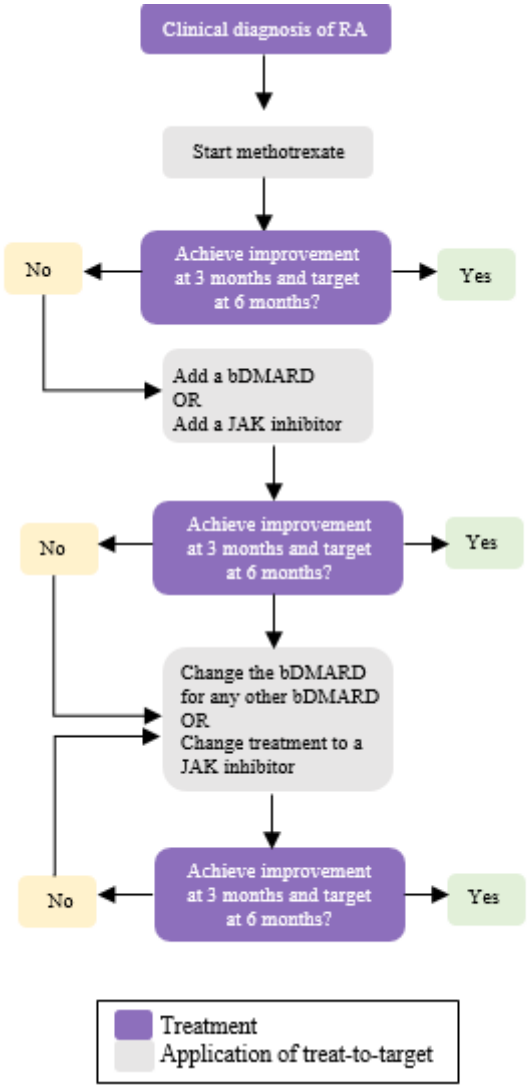

Figure 2. The principle of the treat-to-target concept. A routine treatment plan after a patient is newly diagnosed with RA involves several steps, including identification of the target, initiation of therapeutic steps to achieve the target, assessment of whether the target has been achieved after a suitable interval, and, if not, adjustment of the treatment.

effective intervention to prevent irreversible joint damage, there is a need to find the most effective treatment as soon as possible. AI test results can help rheumatologists and their patients make the best treatment decisions earlier and more confidently. Data from this study were consistent with results found in patients who were b/tsDMARD naïve at the time of patient testing with AI. AI results received before treatment can support targeted therapy treatment selection in treat-to-target management strategies. Decisive individualized treatment plans increase rates of remission and help patients reach treat-to-target goals of low disease activity or remission earlier [11, 12].

AI integration into clinical workflows has been shown to improve patient outcomes, reduce patient burden, and show strong potential for a decline in disease progression at 6 months. This study provides further validation of the performance of AI tools among a new cohort of targeted therapy-naïve RA patients. Now, the diagnostic test can be used at an earlier time point in a patient's treatment journey and help them reach their goals even sooner. This study concludes, based on the literature evaluated, that AI tools can correctly predict the patients with RA that will fail to achieve response to TNFi therapies at 3 months post-treatment initiation, indicating non-response to targeted therapies [5, 6, 8]. AI results can support targeted therapy treatment selection in treat-to-target management approaches 3 months into therapy initiation. It is important to consider all demographics in AI-targeted therapy treatment. Manufacturers of AI instruments should conduct clinical trials in hospitals with a range of subjects from diverse backgrounds. This will ensure high clinical utility and validity across all races, genders, and ethnicities. This review specifically considered research of high regard to a wide range of demographics and encourages sites to pay close attention to demographics in underlying rheumatology research shown in (Figures 1 and 2).

AI tools have the potential to be the new standard of care in rheumatology for the treatment of patients with RA.

Disclosure Statement

The author declares that she has no relevant or material financial interests that relate to the research described in this paper.

Conclusion

An AI tool can correctly predict which RA patients would likely fail to achieve a response to TNFi therapies and other therapies for RA post-

treatment initiation. An AI tool halts the progression of RA in patients and helps inform doctors of the best treatment routes.

References

1. Ball, Robert, et al. "The FDA's sentinel initiative—a comprehensive approach to medical product surveillance." *Clin. Pharm. Therap.* 99.3 (2016): 265-268.
2. Daien, Claire I., and Jacques Morel. "Predictive factors of response to biological disease-modifying antirheumatic drugs: towards personalized medicine." *Mediators Inflamm* (2014).
3. Van Nies, J. A. B., et al. "What is the evidence for the presence of a therapeutic window of opportunity in rheumatoid arthritis? A systematic literature review." *Ann. Rheum. Dis.* 73.5 (2014): 861-870.
4. Schipper, Lydia G., et al. "Time to achieve remission determines time to be in remission." *Arthritis Res Ther* 12.3 (2010): 1-11.
5. Aletaha, Daniel, Farideh Alasti, and Josef S. Smolen. "Optimisation of a treat-to-target approach in rheumatoid arthritis: strategies for the 3-month time point." *Ann. Rheum. Dis.* 75.8 (2016): 1479-1485.
6. Pappas, Dimitrios A., et al. "Design characteristics of the CORRONA CERTAIN study: a comparative effectiveness study of biologic agents for rheumatoid arthritis patients." *BMC Musculoskelet. Disord* 15.1 (2014): 1-10.
7. Norvang, Vibeke, et al. "Predicting achievement of the treatment targets at 6 months from 3-month response levels in rheumatoid arthritis: data from real-life follow-up in the NOR-DMARD study." *RMD open* 4.2 (2018): e000773.
8. Crimmins, Eileen M. "Lifespan and healthspan: past, present, and promise." *The Gerontologist* 55.6 (2015): 901-911.
9. Curtis, Jeffrey R., et al. "Use of oral and subcutaneous methotrexate in rheumatoid arthritis patients in the United States." *Arthritis Care Res* 66.11 (2014): 1604-1611.
10. Smith, Samantha Louise, et al. "The potential use of expression profiling: implications for predicting treatment response in rheumatoid arthritis." *Ann. Rheum. Dis.* 72.7 (2013): 1118-1124
11. Smolen, Josef S., et al. "EULAR recommendations for the management of rheumatoid arthritis with synthetic and biological disease-modifying antirheumatic drugs: 2019 update." *Ann. Rheum. Dis* 79.6 (2020): 685-699.
12. Bluett, James, and Anne Barton. "Precision medicine in rheumatoid arthritis." *Rheum Dis Clin* 43.3 (2017): 377-387.
13. Singh, Jasvinder A., et al. "2015 American College of Rheumatology guideline for the treatment of rheumatoid arthritis." *Arthritis Rheumatol* 68.1 (2016): 1-26.
14. Patino, Cecilia Maria, and Juliana Carvalho Ferreira. "Internal and external validity: can you apply research study results to your patients?." *J Bras Pneumol.* 44 (2018): 183.
15. Man-Son-Hing, Malcolm, et al. "Determination of the clinical importance of study results." *J Gen Intern Med* 17.6 (2002): 469-476.
16. Wouterse, Bram, et al. "The effect of trends in health and longevity on health services use by older adults." *BMC Health Serv. Res* 15.1 (2015): 1-14.
17. Strait, Adrienne, et al. "Demographic characteristics of participants in rheumatoid arthritis randomized clinical trials: a systematic review." *JAMA Netw. Open* 2.11 (2019): e1914745-e1914745.

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