

Improvement in Disease Activity Assessment Frequency in Patients with Rheumatoid Arthritis Through the Introduction of the “MiRAi” System: An Observational Study Regarding Enhancing Quality in Routine Clinical Practice

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Abstract

Background: Rheumatoid arthritis (RA) is a global health concern with increasing prevalence. Despite recommendations for regular disease activity assessments, their implementation in routine clinical practice remains challenging.

Objective: This study evaluated the association between the implementation of a Medical Support System for Rheumatoid Arthritis (MiRAi), an automated tool integrated with electronic health records that calculates the Disease Activity Rating Index for RA, and the frequency of disease activity assessments in patients with RA.

Methods: This retrospective cohort study included patients with RA treated at a tertiary hospital in Japan between April 2022 and March 2023. The primary outcomes were the Clinical Disease Activity Index (CDAI) and modified Health Assessment Questionnaire (mHAQ) evaluations. A post-implementation survey was conducted among rheumatologists to assess their perceptions of MiRAi.

Results: MiRAi was utilized in 236 of 884 (26.7%) patients with RA. CDAI and mHAQ scores increased from 5.9% in June 2022 to 19% in November 2022. The post-implementation survey revealed mixed perceptions among rheumatologists; 50% of respondents reported regular use of MiRAi.

Conclusions: MiRAi may increase assessment frequency; however, increasing the adoption rate of MiRAi in daily clinical practice among physicians remains a significant challenge. Further research is warranted to evaluate the impact of MiRAi implementation on treatment choices and patient outcomes.

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Original Manuscript

Original Paper

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Conclusions: MiRAi may increase assessment frequency; however, increasing the adoption rate of MiRAi in daily clinical practice among physicians remains a significant challenge. Further research is warranted to evaluate the impact of MiRAi implementation on treatment choices and patient outcomes.

Keywords: disease management; electronic health records; quality improvement; rheumatoid arthritis

Introduction

Rheumatoid arthritis (RA) is a major global health concern. A 2021 meta-analysis, which included data from 67 facilities across 41 countries, reported a pooled RA prevalence of 0.46% (95% confidence interval, 0.37–0.57%) based on studies conducted between 1986 and 2014 [1]. A 2020 national survey in Japan estimated the prevalence of RA to be 0.75% [2]. The prevalence of RA varies by country and is influenced by socioeconomic factors, environmental risk factors, and the availability of rheumatologists. Despite regional differences, the global prevalence of RA continues to increase annually [3]. The assessment of RA activity requires both clinical and biological evaluations. Standard assessment tools for RA, such as the Clinical Disease Activity Index (CDAI) and Disease Activity Score in 28 Joints (DAS28), include subjective assessments [4]. Treatment adjustments based on disease activity are widely recommended [5].

The CDAI and DAS28 rely on complex formulas, limiting their practicality in routine clinical settings. A 2015 survey revealed that 59% of Japanese rheumatologists aimed to achieve clinical remission; however, only 45% used a composite measure of disease activity [6]. An online assessment tool has been developed for RA; however, it cannot be used if electronic health records (EHRs) are not connected to the Internet because of security concerns [7].

The Medical Support System for Rheumatoid Arthritis (MiRAi) is an automated offline tool that integrates data from electronic health records to calculate objective assessment scores for collagen diseases. Since its development in 2009, the MiRAi has been implemented in 16 facilities across Japan. The use of MiRAi for RA disease activity assessment has been shown to improve patient satisfaction [8]; however, its impact on the frequency of assessment remains unclear.

We aimed to evaluate whether the implementation of MiRAi increased the frequency of assessment of disease activity in patients with RA.

Methods

Study Design and Participants

This retrospective cohort study was conducted at the Chubu Rosai Hospital, a tertiary-care facility in Japan, and included patients with RA who visited the Rheumatology Department between April 2022 and March 2023. In this institute, the operational use of MiRAi began in June 2022. After integrating MiRAi into the EHR system, we began using it in an outpatient setting. Initially, a few physicians used the MiRAi on a trial basis. In October 2022, all 10 staff members were informed about the system, and MiRAi was fully implemented.

The MiRAi System

MiRAi, developed by a Japanese medical institution in 2009, is an electronic system that automatically provides RA activity indicators after patient and physician assessments are entered into an attached tablet and EHR. The MiRAi system operates as follows. First, the patient enters the patient Visual Analog Scale (VAS) and modified Health Assessment Questionnaire (mHAQ) on a tablet in an outpatient setting. Next, during the consultation, the physician clicks on the MiRAi tab, and the values entered by the patient are reflected in the EHR. The physician then enters the doctor VAS, C-reactive protein level, erythrocyte sedimentation rate, following which the DAS28 and CDAI are automatically calculated. The locations of the swollen and tender joints are entered by clicking on the diagram, and the previously recorded data can also be reviewed.

Outcomes

To verify the changes in disease activity frequency following the introduction of MiRAi, we assessed the following factors: the proportion of CDAI and mHAQ evaluations among unique patients with RA per month; for patients with active RA (CDAI > 22), the percentage of patients who changed or added targeted synthetic disease-modifying antirheumatic drugs (tsDMARDs), biological DMARDs (bDMARDs), or conventional synthetic DMARDs (csDMARDs); and the proportion of patients who received steroid joint injections during the follow-up period.

Questionnaire Survey and Data Analysis

In April 2024, we conducted a questionnaire survey based on the behavior change stage model [9]. The survey was administered to physicians who provided care at the outpatient clinic of the Rheumatology Department. The survey included multiple-choice questions regarding the disease activity indicators used for RA and the use of MiRAi. Information regarding advantages and disadvantages of MiRAi was collected from physicians who reported using it, while non-users were requested to state their reasons for not adopting MiRAi. We performed descriptive statistics to analyze the data using R Studio (Posit PBC, Boston, MA, USA) [10].

Ethical Considerations

This study complied with the Ethical Guidelines of the World Medical Association Declaration of Helsinki [11] and was approved by the Ethics Committee of Chubu Rosai Hospital (202102-06). Informed consent was obtained from all study participants before study initiation.

Results

During the study period, 884 patients with RA visited our outpatient clinic, with an average of approximately 480 visits per month. MiRAi was used in 236 patients, accounting for 26.7% of all patients with RA.

Evaluation of Disease Activity and Therapeutic Interventions for Patients

Before the introduction of MiRAi, no quantitative evaluations of disease activity were performed at

our facility. The number of CDAI and mHAQ evaluations increased from 29 (5.9%) in June 2022 during the trial period to 81 (19%) in November 2022 after the full implementation of MiRAi (Figure 1). Additionally, the percentage distribution of MiRAi ratings assigned to each physician was analyzed (Figure 2). We performed treatment evaluations in patients with high RA activity and those with RA remission. The number of events did not exceed five (Figure 3).

Questionnaire Survey

We mailed the survey to 10 rheumatologists affiliated with the Collagen Disease Department at Chubu Rosai Hospital, and all 10 responded. Among them, 70% had over 4 years of experience in treating collagen diseases, while 30% had less than 3 years of experience. Half of the rheumatologists believed that their disease activity assessments were appropriate, 40% were not confident, and 10% were unsure. Additionally, 50% of the physicians reported regular use of MiRAi. The results of the content analysis are presented in Table 1.

Table 1. Post-implementation survey results.

Category	Negative comments	Positive comments
System	I do not understand how to use the system.	It was convenient after using it.
	Using MiRAi takes time.	
	I want to be able to easily attach joint diagrams to medical records.	
	I want to be able to easily make reservations for equipment.	
	I want detailed explanations on how to use it.	
Evaluation Method	I think other evaluation methods are sufficient.	I thought about improving the RA evaluation method.
	There is a discrepancy between MiRAi's evaluation and my own activity assessment.	It allows for more accurate assessments of disease activity.
	It is hard to grasp the degree of joint swelling.	Deciding on treatment plans became easier.
		Communication with patients became smoother.
Information Sharing	I want a mechanism to explain, distribute, and introduce MiRAi for all RA patients.	It became easier to share information with other medical staff.
	I do not have time to explain the introduction of MiRAi to patients.	

RA, rheumatoid arthritis; MiRAi, Medical Support System for Rheumatoid Arthritis.

Discussion

Principal Results

To our knowledge, this study is the first to examine whether the introduction of MiRAi, a semi-automated system, into routine clinical practice increases the rate of RA activity assessment. Prior to the implementation of MiRAi, quantitative disease activity assessments were not routinely performed. However, 1 year after MiRAi integration, approximately 20% of the patients underwent quantitative assessments. However, evaluating treatment outcomes in patients with high disease activity and those in remission was challenging because of the limited number of events.

In the setting of outpatient visits occurring every 1–3 months, the implementation of MiRAi increased the frequency of quantitative disease activity assessments in patients with RA. This finding contrasts with those of previous studies that reported less frequent assessments. On analyzing the METEOR database, Navarro-Compán et al. observed that 85.9% of patients with RA were assessed for disease activity at least once during 4 years [7]. In our study, approximately 20% of patients with RA underwent quantitative evaluation within 1 year of MiRAi implementation, which resulted in a higher frequency of assessment than the outcomes reported in the referenced database. Additionally, Seyferth et al. reported that in the USA, only 44.1% of patients with RA were referred to a rheumatologist within 1 year of diagnosis, and 31.3% did not meet any of the evaluated care quality indicators, including annual clinical examinations [12]. The semi-automated nature of MiRAi might improve the frequency of disease activity assessments compared with previous findings.

Our study highlights the need for further research to determine whether the increased frequency of disease activity assessments enabled by MiRAi can meaningfully impact the clinical outcomes of patients with RA. Although MiRAi has been associated with a higher rate of quantitative assessment, its long-term effectiveness on patient outcomes remains unclear. This study is limited by the small number of patients included during the observation period. Of the patients with RA attending our clinic, MiRAi was used for only 81 (19%). Therefore, our study did not have sufficient power to detect changes in treatment interventions. Future studies should include larger sample sizes and longer observation periods to evaluate the potential benefits of increased assessment frequency on treatment decisions and patient outcomes more accurately.

Limitations

Our study had some limitations. After the introduction of the system, only half of the physicians conducting outpatient consultations adopted MiRAi. Furthermore, the extent of improvement in disease assessment frequency among physicians using the system varied significantly. To investigate the reasons for this limited adoption, we conducted a post-observation survey of physicians and performed content analysis, which revealed several key findings. First, some physicians initially did not know how to use MiRAi. This indicates that the explanation provided during the introduction of the system was insufficient, underscoring the need for accessible user manuals. Second, many physicians rely on swollen joint counts, tender joint counts, and C-reactive protein levels for evaluation [13]. In contrast, half the physicians admitted that they lacked confidence in their disease activity assessments during consultations. This may be due to the absence of clear indicators of disease activity in routine clinical practice. Some physicians noted the benefits of MiRAi, including more accurate disease activity assessments and improved decision-making regarding treatments. These findings suggest that MiRAi can serve as a valuable tool for conducting appropriate disease activity evaluations. Many physicians who did not regularly use MiRAi cited time constraints,

indicating that integrating the new system within a limited consultation time may have been burdensome for outpatient doctors. Therefore, it is necessary to automate the system to seamlessly incorporate objective evaluations into daily clinical practice. Additionally, tablet-based input by all patients with RA, without requiring explanations from attending physicians, could help reduce the clinicians' workload.

Conclusions

The implementation of MiRAi may increase the frequency of RA disease activity assessment. Future multicenter studies with sufficient sample sizes using MiRAi are warranted to verify whether the continued quantitative assessment of patients with RA leads to appropriate treatment changes.

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Author Contributions

All authors contributed to the study's conception and design. Mari Yamamoto, Fumika Nagase, Keita Iwasaki, Yuuki Ito, Hiroki Ikai, Tsuyoshi Watanabe, Waka Yokoyama-Kokuryo, Naoho Takizawa, and Yoshiro Fujita participated in the research process. Mari Yamamoto, Yuki Kataoka, and Yasushi Tsujimoto conducted documentation, data collection, and analysis. Mari Yamamoto drafted the initial manuscript, and all authors provided critical revisions. All authors reviewed and approved the final manuscript.

Conflicts of Interest

None declared.

Abbreviations

bDMARDs: biological disease-modifying antirheumatic drugs

CDAI: Clinical Disease Activity Index

csDMARDs: conventional synthetic disease-modifying antirheumatic drugs

DAS28: Disease Activity Score in 28 Joints

EHR: electronic health record

mHAQ: modified Health Assessment Questionnaire

MiRAi: Medical Support System for Rheumatoid Arthritis

RA: rheumatoid arthritis

tsDMARDs: targeted synthetic disease-modifying antirheumatic drugs

VAS: visual analog scale

Data Availability

The data supporting this study's findings are available from the corresponding author, Mari Yamamoto, upon reasonable request.

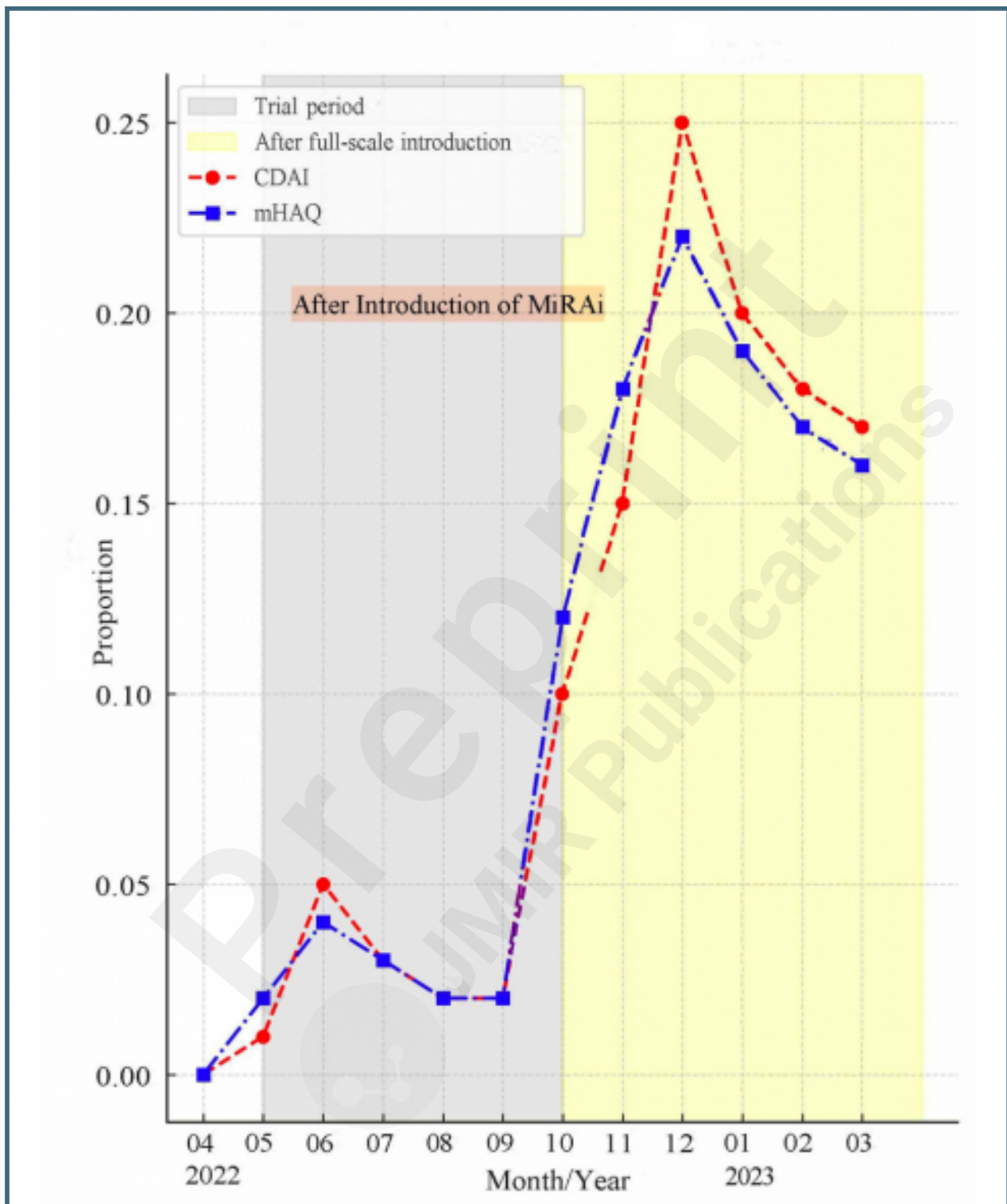
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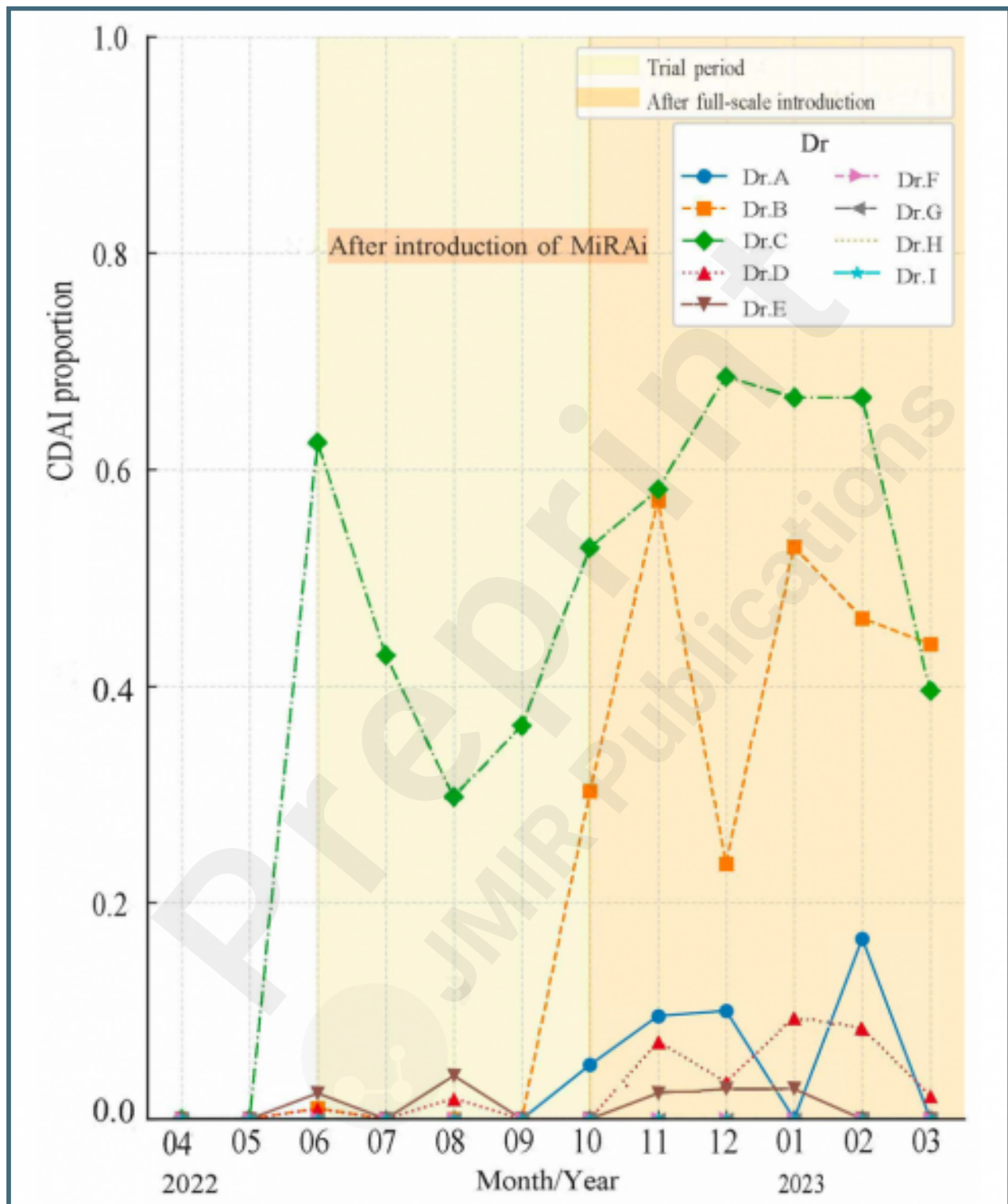
Supplementary Files

Figures

CDAI and mHAQ evaluation.



CDAI proportion for each Dr.



Proportion of patients with active RA (CDAI > 22) who changed or added tsDMARDs, bDMARDs, or csDMARDs, and those who received steroid joint injections during the follow-up period.

