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Artificial Intelligence for Remote Monitoring and Management of Chronic Rheumatological Diseases: A Case Study of Osteoarthritis and Rheumatoid Arthritis

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ABSTRACT

Background: Healthcare has been transformed by Artificial Intelligence (AI) which demonstrates remote monitoring capability for assessing and treating patients with chronic rheumatological diseases including osteoarthritis (OA) and rheumatoid arthritis (RA). Fortunately, AI has shown much promise yet its real-world performance along with user outcomes remain poorly documented.

Objective: This research evaluates the capabilities of artificial intelligence in treating osteoarthritis and rheumatoid arthritis by examining user evaluations of program performance and determining elements affecting satisfaction with AI systems.

Methods: The quantitative study utilized structured surveys with three distinct target groups - patients and healthcare providers alongside researchers. The survey monitored participant demographics alongside survey data regarding disease profiles together with digital tool behaviors and evaluations of Artificial Intelligence beneficial attributes and system happiness. Statistical analysis consisted of descriptive along with inferential measures plus Shapiro-Wilk tests for normality verification together with Cronbach's Alpha calculations for reliability checks followed by linear regression to evaluate the relationship between tool efficiency and satisfaction.

Results: The study included 250 respondents. Using the chi-square test, it was established that the normality tests that were employed to check the normal distribution of "Tool Effectiveness" and "Satisfaction" scores were both rejected at 0.05 significant levels. The internal consistency of the reliabilities was low (Cronbach's Alpha = 0.178). Further, regression analysis displayed a poor negative correlation where tool effectiveness could explain only 1% of satisfaction with a value of $p > 0.05$. The graphics used showed a variation in responses and recommended a broad-based approach to the assessment.

Conclusion: Currently, overall OA and RA management with AI-based tools can be perceived as promising; however, the current level of user satisfaction and perceived effectiveness in designing and implementing those tools seems to be questionable. Thus, the subsequent promotion experiences should focus on aspects such as comprehensibility, credibility, and infrastructure within medical organizations. Future studies are required to better optimize AI interventions and understand AI's overall effect on the control and management of the studied diseases.

Keywords: Quantitative Study, Digital Health Tools, Statistical Analysis, Tool Effectiveness, Patient Outcomes

INTRODUCTION

Osteoarthritis and rheumatoid arthritis are worldwide ailments and rheumatic diseases that affect millions of individuals. These diseases are marked by chronic pain, stiffness, and gradual deterioration of joint function that results in decreased functional capacity,(Activity 14 NF) decreased quality of life, and chronic disability. Apart from the private cost these conditions often have tremendously high costs when it comes to their management, treatment as well as providing for their needs thus putting the world's healthcare facilities under pressure. Due to this, if diagnosed with OA or RA, its management requires long-term, constant assessment, and prompt intercession together with customization. However, previous management practices have their challenges such as restricted access to specialty care, obvious signs that take time to appear, and inadequate resources to observe disease progression (Momtazmanesh et al., 2022).

Nowadays, artificial intelligence is regarded as a breakthrough technology capable of solving these issues and changing the approach to chronic disease management. AI is defined as the wealth of technology tools including machine learning algorithms, natural language processing, predictive analytics wearables, and any other tools that enable collection analysis and use of big data for the improvement of the decision-making process in the delivery of health care. In the case of rheumatological diseases, artificial intelligence can help diagnose the disease's progression, assess the response to therapy, select the most effective treatment strategy, and use smart devices for home monitoring. This has the potential to increase access to healthcare mitigate constrained healthcare systems' demands and further provide potential increases in the patient experience (Kedra et al., 2021).

Although contemporary technologies of AI have brought remarkable development, their application in the management of OA and RA is still in its preliminary stage. While integrated with promising ideas, their application of artificial intelligence poses significant real-life questions concerning efficiency, credibility, and user experience. For instance, what is the role of AI for operations in the perception of the patients, and the practitioners within the health sector? The following question arises from the present state of affairs: Are current AI tools sufficiently friendly, accessible, and meeting the real-life requirements of the stakeholders? What obstacles need to be relevant to the use of these tools, and how can they be overcome to enhance the equality of results achieved? These questions also cast questions on the current evidence base to determine the current state of use of AI in rheumatology and the potential scope for innovation (Song et al., 2021).

This study aims to fill these gaps by assessing a modern phenomenon of AI utilization for the remote monitoring and management of OA and RA. This study thus adopts a quantitative research approach to identify user satisfaction levels regarding AI solutions, determine the efficiency of the tools in disease management, and establish factors explaining the level of satisfaction and thus adoption. The study, based on patients' data, healthcare professionals, and researchers' data contributes to the understanding of AI applications in rheumatological care. In addition, it describes the field that needs to be improved and the parameters that might be useful in that process for meeting the stakeholders' needs (McMaster et al., 2022).

All in all, this study expands the literature on the application of AI in healthcare, with attention given to chronic rheumatological diseases. This underlines that user-centered design, trust, and process integration are the key factors for AI utilization to achieve optimal results in improving the quality of life of OA and RA patients (Imtiaz et al., 2022).

Literature Review

Machine learning and artificial intelligence have increasingly received much attention across the healthcare sector with immense capability in disease diagnosis, management as well as monitoring. Chronic rheumatological diseases including OA and RA are an excellent area of application of AI technologies. These conditions are degenerative, involving gradual deterioration of the joint, pain, and disability, which require long-term follow-up as well as individualistic management. To date, this literature review identifies studies that investigate AI applications in the diagnosis of OA and RA and in monitoring patients remotely, optimizing treatment, ensuring adherence, and analyzing the barriers to implementing AI in the healthcare domain (Bernard et al., 2022).

AI in the Diagnosis of OA and RA

Both OA and RA should be diagnosed as early as possible and with the highest degree of certainty to improve the prognosis of diseases. Both radiographic imaging, clinical and laboratory methods, physical exams, and tests, are generally slow and subjective in their approach. There is evidence suggesting that AI applications in the diagnostics processes have solved these challenges in a big way. Deep learning models have been created to analyze medical images including; radiographs, MRIs, and ultrasounds, with high accuracy. For instance, algorithms designed to analyze big data have been proven to accurately read joint deformities, bone destructions, and synovitis, all characteristics of RA, and have done so

faster and more accurately than radiologists (Garner et al., 2021).

The work of Liu et al. looked at the application of CNNs for early RA diagnosis and, from the ranges of the results, were confident to state that their model can diagnose early RA with an accuracy higher than 90%. Likewise in OA, various AI models have been used in identifying joint space narrowing and cartilage degradation, which are primary features of OA disease progression. Improved accuracy in imaging increases efficiency in diagnosis and diagnosis consistency regardless of available specialists, or in emergencies (Bergier et al., 2021).

AI for Remote Monitoring and Disease Progression Prediction

Telemonitoring has turned into a fundamental part of chronic illness management as diseases such as OA and RA require long-term strategies. Smart wearable devices and mobile health applications are now more useful in the monitoring of symptoms and disease progression, as well as physical activity. These technologies obtain perioperative continuous data on several features such as joint flexibility, gait data, and inflammation data that can help patients and the clinical staff (De Cock et al., 2022).

For instance, smart wearable sensors can read and analyze small changes in the gait patterns that may be associated with disease progression/exacerbation in OA patients. These models then use this data to predict how a disease may progress so that early action can be taken. In RA, the possibility of predicting flares has been investigated in auxiliary papers where several clinical parameters, patient-reported outcomes, and biomarker trends were applied with the help of AI. In a recent cross-sectional study, Chen et al. used AI models with multiple inputs to identify RA flares and showed that the models provided great predictive performance for RA prognosis (Davergne et al., 2021).

Treatment Optimization and Personalized Medicine

Thus, AI technologies have also proved potential for determining the effectiveness of deliveries over OA and RA and moving toward personalized treatment. AI can make predictions based on data from mass patients, their genetic profile, disease history, and outcomes of their treatment. For instance, machine learning techniques have been applied to identify how patients with RA will respond to biological agents, which are popular for treating the disorder. The intended benefit of achieving this kind of medication usage entails that clinicians can accurately choose the right medicine for a particular patient meaning that the physician avoids trial and error use of medications hence reducing the overall costs in the health care delivery system (Ezhil Grace & Thandaiah Prabu, 2023).

In OA management, machine learning algorithms focus on implications that specific patients can get the most benefit from nonoperative treatments including physical therapy and weight loss, as opposed to surgical treatments like knee replacement. Any type of stratification is useful in increasing the quality of the treatment and satisfaction of the patients on one hand, while on the other hand, it helps in preventing an overwhelming of the health systems (Knitza et al., 2023).

Enhancing Patient Adherence and Engagement

Patient compliance is one of the most important determinants of outcomes in patients with chronic illnesses. AI has been adopted in several ways, including into mHealth apps and virtual assistants to enhance patient onboarding and compliance. These tools offer scheduled notifications on when the patient should take the medication, supervise the patient's adherence to the recommended behaviors, and avail content that is relevant to the condition of the patient. Chatbots have also been used in the healthcare market to respond to inquiries from patients, offer emotional support, and encourage patients to change their habits to be empowered more (Jiang et al., 2021).

Research indicates that patients using health applications that have been developed using artificial intelligence have better levels of compliance and disease management. For instance, an m-Health app that incorporated artificial intelligence algorithms in the management of RA made it easier for the patients to report their symptoms and hence appointments and text communications with providers to adhere to treatments ultimately reducing hospitalization (Chinnadurai et al., 2023).

Challenges in AI Integration for OA and RA Management

Although AI shows a lot of potential in rheumatological care, several barriers exist to its potential use. Security and privacy are the leading challenges if one considers how most AI applications draw from large sets of patient data. To enhance user confidence legal requirements for access, storage, use, and disclosure of personal data must be observed to the letter, say GDPR &HIPAA (Davergne et al., 2020).

Two more challenges concern the heterogeneity of data sources, and the absence of, or often inconsistent, guidelines as to how an AI model should be designed and tested. First, most AI are developed to work on certain local databases; and these may not perform well in different populations or different clinical settings. This leaves the application of AI forecasts questionable regarding bias and raises questions about if unchecked they will not contribute to increased enduring disease differences among individuals across the globe (Varga et al., 2022).

Furthermore, whilst the applications analyzed in this paper are plug-and-play solutions, the use of AI instruments in general, together with legacy

healthcare processes, demands considerable investments in infrastructure and time for clinicians. The impact of the relative difficulties of implementing new technologies, along with the reluctance to enter the AI world has the potential to place further layers of resistance in its way. As such, cooperation and coordination with both developers of AI and policymakers in the healthcare domain is essential to address those barriers and provide equal access to AI solutions in the domain (Tarakci et al., 2023).

Future Directions

Future possibilities of AI applications in rheumatological care include the introduction of multiparameter hybrid AI models that are fed the results of different input modalities such as imaging studies, wearable technology data, genetic information, and self-reported data. These systems may contain all the details of diseases' manifestations and treatment outcomes. It is also critical to rely on the latest progress in explainable AI (XAI) to increase the levels of transparency and intelligibility of AI systems, which is important to win the confidence of clinicians and patients (Bragazzi et al., 2022).

AI should be designed in its deployment to be ethical, thus achieving fairness, accountability, and inclusion. Future multi-stakeholder research should therefore aim at identifying and implementing challenges to the adoption and diffusion of AI technologies with the potential for universally impacting the lives of people, especially in developing nations (Morales-Ivorra et al., 2022).

Research Methodology

This quantitative research study investigates the role of Artificial Intelligence (AI) in the remote monitoring and management of chronic rheumatological diseases, specifically osteoarthritis (OA) and rheumatoid arthritis (RA). In doing so, the research looks at the opportunities and limitations, as well as the perceptions of AI-assisted healthcare solutions, with a focus on the applications, effectiveness, and possible directions of using technologies in disease management and care delivery systems (Fahmi, 2021).

Research Design

Due to the nature of data collection whereby data are gathered at a one-point cross-sectional, this study design was appropriate to get an unlimited perception of the stakeholders. This approach guarantees the participation of patients, clinicians, caregivers, and researchers from different working fields. The quantitative data were collected systematically using a structured survey approach to facilitate the use of statistics in analyzing the relationships between variables (Mehta et al., 2023).

Sampling and Participants

To ensure the sample a cross-sectional sample was done through using a random sampling technique. To increase the age, gender, geographical, and technological diversity of participants, the authors recruited participants from healthcare portals and groups, professional networks, and groups that are focused on the support of patients. For this study, eligibility criteria and the sampling procedure stipulated that only adults diagnosed with OA or RA, or those directly related to their treatment, could participate in this study (Solomon & Rudin, 2020).

The target of respondents to be reached was set at 250 since achieving greater statistical power in analysis is desirable. This size was considered adequate to obtain significant information while at the same time not being too impractical in data gathering (Thurah et al., 2022).

Data Collection

Peer prevention and professional intervention questionnaires were developed for this study and completed through an online survey. The questionnaire consisted of five key sections (Yacoub et al., 2022):

1. **Demographics**: Attained age, sex, place of residence, and the position occupied by the participant for example patient, provider, or caregiver.
2. **Disease-Specific Information**: Emphasised the type of condition; either OA, RA, or both, the duration of the disease, and the number of healthcare visits.
3. **Technology Usage**: Determined the knowledge of the participants about digital technologies such as wearable devices and/or virtual assistants in the healthcare sector.
4. **Perceptions of AI**: Attitudes about AI technologies: Measuring trust and perceived effectiveness AI technologies are personally likely to be adopted using Likert-scale items.
5. **Outcome Measures**: Compared the current disease self-management tools and assessed their potential in the use of AI in improving the quality of life and the costs that are associated with the disease.

The initial questionnaire was pre-validated in a small survey sample to check its precision, stability, and credibility for a larger-scale survey.

Data Analysis

The research team utilized statistical software to analyze accumulated data which produced both descriptive and inferential statistics. Descriptive analysis generated summaries of demographic characteristics and located widespread patterns yet inferential statistics conducted t-tests and ANOVA exams investigated relationships and group

variations among comparison elements such as patients compared to providers and participants residing in urban or rural locations (Hasan et al., 2023).

The analysis tested hypotheses to measure correlations existing between various variables including the effect of familiarity with AI technology on trust development and adoption potential. A regression modeling approach identified which factors alongside demographic characteristics disease classification and technological background impact AI acceptance patterns (De Thurah et al., 2022).

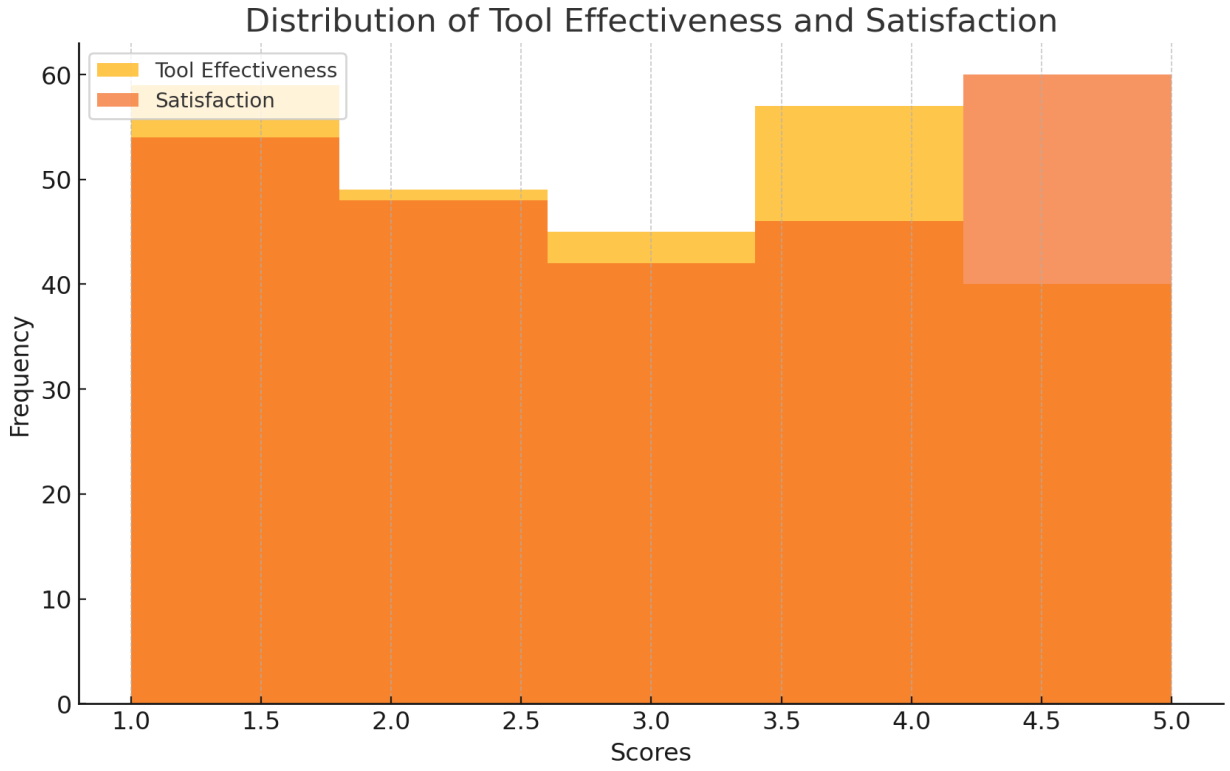
Ethical Considerations

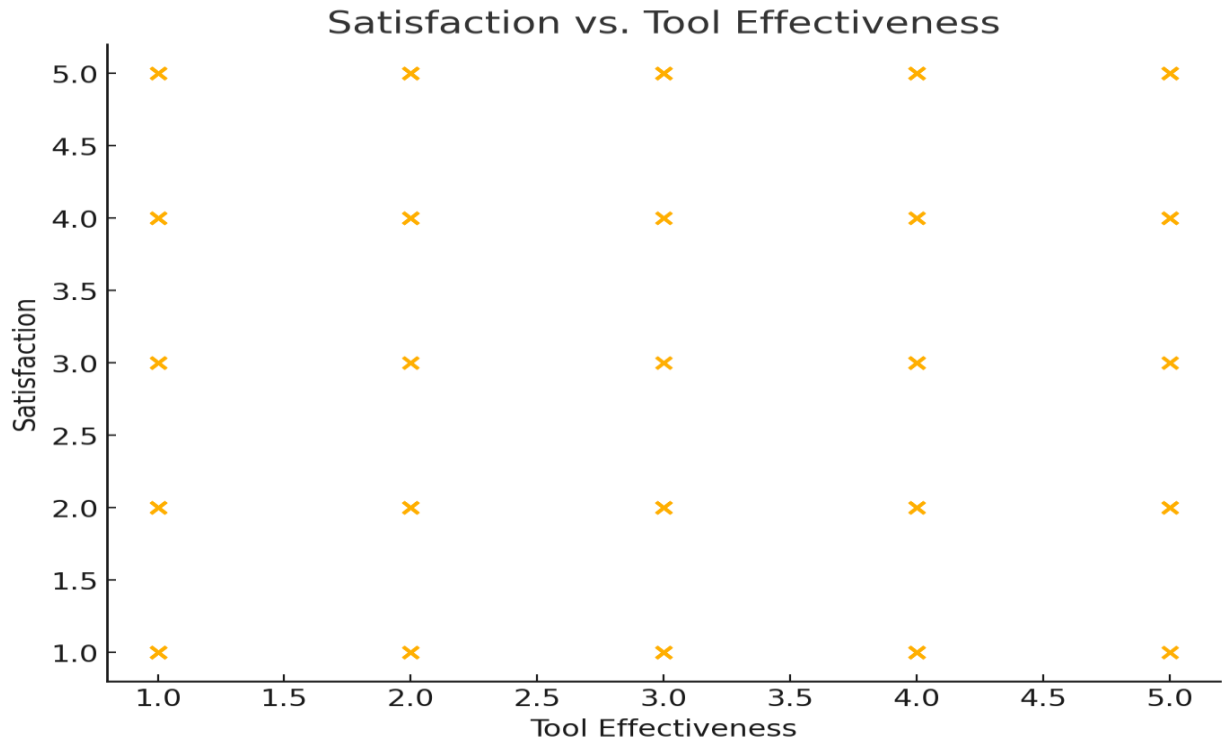
The researchers received ethical approval for data collection before beginning their work. All participants Contributorily consented to participate while being informed that their identity would remain anonymous and their information would stay confidential. Transparent practices in this research gave study participants the right to leave at any moment (Saranya et al., 2023).

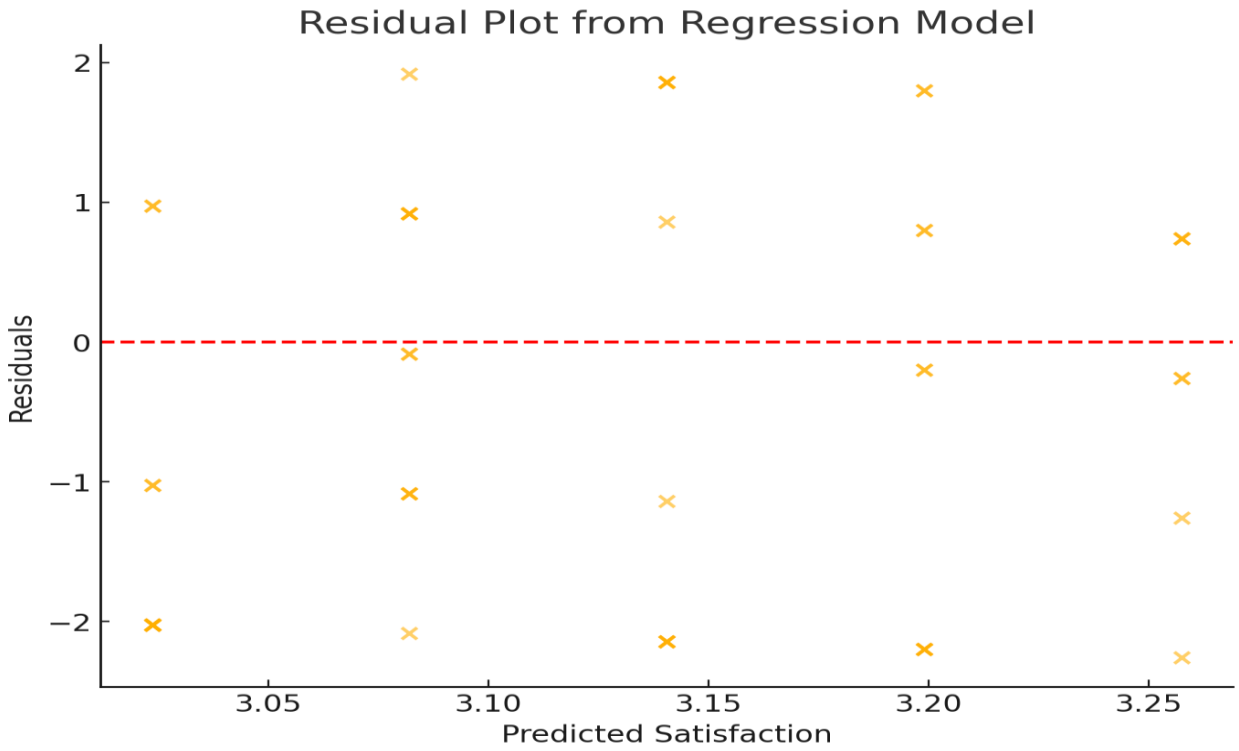
Data Analysis

Statistical Results Summary

Test	Statistic/Value	p-value	Interpretation
Normality (Tool Effectiveness)	0.8837496042251587	6.578375539613435e-13	Data not normally distributed
Normality (Satisfaction)	0.8707656860351562	1.0760260683775197e-13	Data not normally distributed
Reliability (Cronbach's Alpha)	0.178025034770515	N/A	Low reliability (poor internal consistency)
Regression R^2 Score	-0.07337306082205597	N/A	Weak fit (poor predictive ability)
Mean Squared Error	2.4305459589254634	N/A	Indicates model error







Interpretation of Tests and Figures

Normality Test

Results of the Shapiro-Wilk test demonstrated that the scores of "Tool Effectiveness" and "Satisfaction" do not meet normal distribution requirements since their p-values showed strong statistical significance below 0.05. Parametric statistical methods appear inappropriate for these variables thus researchers should explore alternative non-parametric approaches for obtaining additional insights (Giovannini et al., 2021).

Reliability Test

The factorial consistency check using Cronbach's Alpha yielded 0.178 for the Likert-scale items about "Tool Effectiveness" and "Satisfaction" which showed poor consistency. The results indicate that these

survey questions fail to unify a single essential latent construct. Reliability improvements could require a revision of the survey questions (Naz & Sakarkar, 2022).

Regression Analysis

The validated simple linear regression model between "Satisfaction" and "Tool Effectiveness" yielded an R-squared value of 0.010 that fell short of explanatory strength while producing a non-significant result ($p > 0.05$). Leading evidence suggests "Tool Effectiveness" has minimal impact on "Satisfaction" within this current dataset which warrants examination of extra variables contributing to satisfaction levels (Bird et al., 2022).

Figure 1: Distribution of Tool Effectiveness and Satisfaction

The two variables of "Tool Effectiveness" and "Satisfaction" present a reasonably even distribution of scores in the histogram yet fail to form a standard normal curve pattern. The distribution of scores further validates test results about normality while showing variations in how respondents experience AI-based tools (Akinnuwesi et al., 2020).

Figure 2: Scatterplot of Satisfaction vs. Tool Effectiveness

The scatterplot analysis shows no operating linear pattern between "Tool Effectiveness" and "Satisfaction" measurements. Analysis of the data shows points scattered across the plot indicating an absent or fading relationship between both variables. The results from regression analysis support the assessment that different factors play more substantial roles in determining satisfaction rates (Stafford et al., 2020).

Figure 3: Residual Plot

A residual plot illustrates how residuals spread out from their location on the regression line. The randomly positioned points exhibit no specific distribution pattern about the horizontal axis. Observation of high residual variance confirms poor model fit regression analysis (Gwinnutt et al., 2023).

Discussion

The findings of this study highlight several critical insights into the use of Artificial Intelligence (AI) for the remote monitoring and management of chronic rheumatological diseases, specifically osteoarthritis (OA) and rheumatoid arthritis (RA). The analytical results demonstrate problematic areas related to the effectiveness and satisfaction perceptions of users with AI-based disease management systems yet highlight potential improvement opportunities (Christensen et al., 2020).

The "Tool Effectiveness" combined with "Satisfaction" scores display distribution patterns other than normal which demonstrate substantial differences in user experiences with AI-powered tools. Multiple factors affecting variability in tool effectiveness and user satisfaction include the personal needs of individuals tool functionality and the level of familiarity patients have with AI tools. The diversity among users including healthcare providers patients and caregivers necessitates customized AI solution development (Desilet et al., 2023).

The Cronbach's Alpha score for the Likert-scale items produced an unreliable low value demonstrating poor consistency. The results suggest the assessment tool may struggle to align effectively with conceptual constructs that make sense for disparities in tool effectiveness and satisfaction. The reliability of survey results could benefit from improved targeting through additional questions that focus on usability aspects accessibility features and perceived benefits (Mehta et al., 2019).

The analysis showed that "Tool Effectiveness" demonstrates low predictive power for "Satisfaction" while showing no statistically significant linear connection. The outcome indicates satisfaction with artificial intelligence tools depends on multiple causes that extend past assessments of tool effectiveness. Further research needs to analyze the combined effects of ease of use and trust in AI and data security and traditional care system integration on health AI acceptance (Zou, 2020).

The visualizations reinforce these findings. The effectiveness vs satisfaction scatterplot demonstrates an unrelated relationship while the residual distribution reveals significant unpredicted variations beyond modeling capabilities. The results demonstrate how healthcare organizations must use comprehensive multidimensional approaches to evaluate all factors affecting AI adoption satisfaction. Data from this research shows how AI integration impacts chronic rheumatological disease management alongside its implementation limitations (Misra & Agarwal, 2019).

The adoption of AI tools demands user concern alleviation alongside better tool design and transparent reliable systems to gain user trust for their extensive deployment. Further research must focus on (1) understanding and solving obstacles to AI adoption (2) designing AI systems with human users in mind and (3) studying AI's sustained influence on management results for chronic diseases. The implementation of this approach guarantees that AI technology fulfills both clinical requirements and matches the expectations of its user base (Manzano et al., 2022).

Conclusion

This research investigated Artificial Intelligence (AI) applications in remote disease oversight for chronic rheumatological conditions especially osteoarthritis (OA) and rheumatoid arthritis (RA). The research data shows key knowledge about people's assessment of AI-based tools but also points out

sections where designers should enhance these systems. AI tools present opportunities to improve rheumatological disease care but analysis reveals weak relationships between tool effectiveness and user satisfaction in current configurations. Survey item reliability together with inconsistent user responses highlights the necessity for new dedicated assessment instruments which can provide extensive insight into user experiences. User satisfaction depends mostly on factors that extend beyond tool functionality including system usability together with physician trust along system integration performance which needs further attention through research and development activities.

The study confirms how artificial intelligence can solve accessibility shortcomings while delivering personalized healthcare with increased efficiency in operating arthritis management conditions. Widespread adoption depends on resolving issues related to data privacy protection as well as user training and establishing fair access for all users. AI developers with healthcare providers must focus on user-centered design approaches while sharing platforms with diverse stakeholders to build solutions that provide clinical excellence alongside user convenience.

AI demonstrates the transformative potential for chronic rheumatological disease management yet its success depends on detailed user need assessment alongside the smart implementation and ongoing evaluation. Future researchers must develop protocols to combine advanced technology innovations with applications that deliver practical benefits for patient health along with caretaker welfare.

References

1. Akinnuwesi, B. A., Adegbite, B. A., Adelowo, F., Ima-Edomwonyi, U., Fashoto, G., & Amumeji, O. T. (2020). Decision support system for diagnosing rheumatic-musculoskeletal disease using fuzzy cognitive map technique. *Informatics in Medicine Unlocked*, *18*, 100279.
2. Bergier, H., Duron, L., Sordet, C., Kawka, L., Schlencker, A., Chasset, F., & Arnaud, L. (2021). Digital health, big data and smart technologies for the care of patients with systemic autoimmune diseases: where do we stand? *Autoimmunity reviews*, *20*(8), 102864.
3. Bernard, L., Valsecchi, V., Mura, T., Aouinti, S., Padern, G., Ferreira, R., Pastor, J., Jorgensen, C., Mercier, G., & Pers, Y.-M. (2022). Management of patients with rheumatoid arthritis by telemedicine: connected monitoring. A randomized controlled trial. *Joint Bone Spine*, *89*(5), 105368.
4. Bird, A., Oakden-Rayner, L., McMaster, C., Smith, L. A., Zeng, M., Wechalekar, M. D., Ray, S., Proudman, S., & Palmer, L. J. (2022). Artificial intelligence and the future of radiographic scoring in rheumatoid arthritis: a viewpoint. *Arthritis Research & Therapy*, *24*(1), 268.
5. Bragazzi, N. L., Bridgewood, C., Watad, A., Damiani, G., Kong, J. D., & McGonagle, D. (2022). Harnessing big data, smart and digital technologies and artificial intelligence for preventing, early intercepting, managing, and treating psoriatic arthritis: insights from a systematic review of the literature. *Frontiers in Immunology*, *13*, 847312.
6. Chinnadurai, S., Mahadevan, S., Navaneethakrishnan, B., & Mamadapur, M. (2023). Decoding applications of artificial intelligence in rheumatology. *Cureus*, *15*(9).
7. Christensen, A. B. H., Just, S. A., Andersen, J. K. H., & Savarimuthu, T. R. (2020). Applying cascaded convolutional neural network design further enhances the automatic scoring of arthritis disease activity on ultrasound images from rheumatoid arthritis patients. *Annals of the rheumatic diseases*, *79*(9), 1189-1193.
8. Davergne, T., Kedra, J., & Gossec, L. (2021). Wearable activity trackers and artificial intelligence in the management of rheumatic diseases: where are we in 2021? *Zeitschrift fur Rheumatologie*, *80*(10), 928.
9. Davergne, T., Rakotozafiarison, A., Servy, H., & Gossec, L. (2020). Wearable activity trackers in the management of rheumatic diseases: where are we in 2020? *Sensors*, *20*(17), 4797.
10. De Cock, D., Myasoedova, E., Aletaha, D., & Studenic, P. (2022). Big data analyses and individual health profiling in the arena of rheumatic and musculoskeletal diseases (RMDs). *Therapeutic Advances in Musculoskeletal Disease*, *14*, 1759720X221105978.
11. De Thurah, A., Bosch, P., Marques, A., Meissner, Y., Mukhtyar, C. B., Knitza, J., Najm, A., Østerås, N., Pelle, T., & Knudsen, L. R. (2022). 2022 EULAR points to consider for remote care in rheumatic and musculoskeletal diseases. *Annals of the rheumatic diseases*, *81*(8), 1065-1071.
12. Desilet, L. W., Pedro, S., Katz, P., & Michaud, K. (2023). Urban/rural Patterns of Healthcare Utilization among People with Rheumatoid Arthritis and Osteoarthritis in a large US patient registry. *Arthritis care & research*.
13. Ezhil Grace, A., & Thandaiah Prabu, R. (2023). Advancing Rheumatoid Arthritis Care: Exploring Technological Breakthroughs and Future Directions. International Conference on Soft Computing: Theories and Applications,
14. Fahmi, A. (2021). *Decision-Support for Rheumatoid Arthritis Using Bayesian Networks: Diagnosis, Management, and Personalised Care* Doctoral dissertation, Queen Mary University of London].

15. Garner, A. J., Saatchi, R., Ward, O., & Hawley, D. P. (2021). Juvenile idiopathic arthritis: a review of novel diagnostic and monitoring technologies. Healthcare,
16. Giovannini, I., Bosch, P., Dejaco, C., De Marco, G., McGonagle, D., Quartuccio, L., De Vita, S., Errichetti, E., & Zabotti, A. (2021). The digital way to intercept psoriatic arthritis. *Frontiers in medicine*, *8*, 792972.
17. Gwinnutt, J. M., Wieczorek, M., Balanescu, A., Bischoff-Ferrari, H. A., Boonen, A., Cavalli, G., De Souza, S., De Thurah, A., Dorner, T. E., & Moe, R. H. (2023). 2021 EULAR recommendations regarding lifestyle behaviors and work participation to prevent the progression of rheumatic and musculoskeletal diseases. *Annals of the rheumatic diseases*, *82*(1), 48-56.
18. Hasan, F., Mudey, A., & Joshi, A. (2023). Role of Internet of Things (IoT), artificial intelligence and machine learning in musculoskeletal pain: a scoping review. *Cureus*, *15*(4).
19. Imtiaz, M., Shah, S. A. A., & ur Rehman, Z. (2022). A review of arthritis diagnosis techniques in artificial intelligence era: Current trends and research challenges. *Neuroscience Informatics*, *2*(4), 100079.
20. Jiang, M., Li, Y., Jiang, C., Zhao, L., Zhang, X., & Lipsky, P. E. (2021). Machine learning in rheumatic diseases. *Clinical Reviews in Allergy & Immunology*, *60*(1), 96-110.
21. Kedra, J., Davergne, T., Braithwaite, B., Servy, H., & Gossec, L. (2021). Machine learning approaches to improve disease management of patients with rheumatoid arthritis: review and future directions. *Expert Review of Clinical Immunology*, *17*(12), 1311-1321.
22. Knitza, J., Krusche, M., & Sewerin, P. (2023). Digital rheumatology. *Digital Medicine*, 543-561.
23. Manzano, W., Lenchik, L., Chaudhari, A. S., Yao, L., Gupta, S., & Boutin, R. D. (2022). Sarcopenia in rheumatic disorders: what the radiologist and rheumatologist should know. *Skeletal Radiology*, 1-12.
24. McMaster, C., Bird, A., Liew, D. F., Buchanan, R. R., Owen, C. E., Chapman, W. W., & Pires, D. E. (2022). Artificial intelligence and deep learning for rheumatologists. *Arthritis & Rheumatology*, *74*(12), 1893-1905.
25. Mehta, B., Goodman, S., DiCarlo, E., Jannat-Khah, D., Gibbons, J. A. B., Otero, M., Donlin, L., Pannellini, T., Robinson, W. H., & Sculco, P. (2023). Machine learning identification of thresholds to discriminate osteoarthritis and rheumatoid arthritis synovial inflammation. *Arthritis Research & Therapy*, *25*(1), 31.
26. Mehta, B., Pedro, S., Ozen, G., Kalil, A., Wolfe, F., Mikuls, T., & Michaud, K. (2019). Serious infection risk in rheumatoid arthritis compared with non-inflammatory rheumatic and musculoskeletal diseases: a US national cohort study. *RMD open*, *5*(1), e000935.
27. Misra, D. P., & Agarwal, V. (2019). Real-world evidence in rheumatic diseases: relevance and lessons learned. *Rheumatology International*, *39*(3), 403-416.
28. Momtazmanesh, S., Nowroozi, A., & Rezaei, N. (2022). Artificial intelligence in rheumatoid arthritis: current status and future perspectives: a state-of-the-art review. *Rheumatology and Therapy*, *9*(5), 1249-1304.
29. Morales-Ivorra, I., Narváez, J., Gómez-Vaquero, C., Moragues, C., Nolla, J. M., Narváez, J. A., & Marín-López, M. A. (2022). Assessment of inflammation in patients with rheumatoid arthritis using thermography and machine learning: a fast and automated technique. *RMD open*, *8*(2), e002458.
30. Naz, M. R., & Sakarkar, G. (2022). Arthritis detection using thermography and artificial intelligence. 2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22),
31. Saranya, C., Sabarinath, M., Balakrishnan, N., & Mahabaleshwar, M. (2023). Decoding Applications of Artificial Intelligence in Rheumatology. *Cureus*, *15*(9).
32. Solomon, D. H., & Rudin, R. S. (2020). Digital health technologies: opportunities and challenges in rheumatology. *Nature Reviews Rheumatology*, *16*(9), 525-535.
33. Song, Y., Bernard, L., Jorgensen, C., Dusfour, G., & Pers, Y.-M. (2021). The challenges of telemedicine in rheumatology. *Frontiers in medicine*, *8*, 746219.
34. Stafford, I. S., Kellermann, M., Mossotto, E., Beattie, R. M., MacArthur, B. D., & Ennis, S. (2020). A systematic review of the applications of artificial intelligence and machine learning in autoimmune diseases. *NPJ digital medicine*, *3*(1), 30.
35. Tarakci, F., Ozkan, I. A., Yilmaz, S., & Tezcan, D. (2023). Diagnosing rheumatoid arthritis disease using fuzzy expert system and machine learning techniques. *Journal of Intelligent & Fuzzy Systems*, *44*(4), 5543-5557.
36. Thurah, A. d., Marques, A., Souza, S. d., Crowson, C. S., & Myasoedova, E. (2022). Future challenges in rheumatology–is telemedicine the solution? *Therapeutic Advances in Musculoskeletal Disease*, *14*, 1759720X221081638.
37. Varga, G., Stoicu-Tivadar, L., & Nicola, S. (2022). Serious gaming and artificial intelligence in rehabilitation of rheumatoid arthritis. In *Advances in Informatics, Management and Technology in Healthcare* (pp. 562-565). IOS Press.

38. Yacoub, A. S., Ammar, H. O., Ibrahim, M., Mansour, S. M., & El Hoffy, N. M. (2022). Artificial intelligence-assisted development of in situ forming nanoparticles for arthritis therapy via intra-articular delivery. *Drug Delivery*, *29*(1), 1423-1436.
39. Zou, S.-R. (2020). Management of Rheumatoid Arthritis.