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# Polyarticular Pain Management in Elderly Patients and Artificial Intelligence: Precision Strategies for Complex Cases

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## Abstract

Polyarticular pain in elderly populations represents a multidimensional challenge due to overlapping comorbidities, polymedication, and altered pain perception. Current treatment strategies often fall short of addressing individual patient complexity. Artificial Intelligence (AI) offers a promising avenue for precision diagnostics, polypharmacy management, and adaptive therapeutic monitoring. This review explores the applications, benefits, and limitations of AI in managing polyarticular pain in geriatric contexts.

## Keywords

Artificial Intelligence; Polyarticular Pain; Geriatrics; Pain Monitoring; Multimorbidity; Predictive Medicine.

## Introduction

Polyarticular pain, defined as the involvement of five or more joints, is prevalent among elderly individuals due to degenerative, autoimmune, and metabolic conditions. The aging process complicates both the diagnosis and management of chronic pain, as older adults frequently present with overlapping

syndromes, cognitive decline, and multiple medications. These factors contribute to underdiagnosis, inappropriate treatments, and reduced quality of life.

AI technologies particularly machine learning (ML), deep learning (DL), and natural language processing (NLP) can revolutionize the geriatric pain care model. By integrating multimodal data from imaging, lab results, patient history, and wearable sensors, AI provides clinicians with tools for enhanced detection, personalization, and remote supervision.

## Methods

### Design

Narrative literature review of scientific papers and clinical trials (2013–2025).

### Databases

- PubMed
- Scopus
- IEEE Xplore
- Web of Science
- Embase

### Search terms

"Artificial Intelligence" AND "Polyarticular Pain"
"Geriatric Pain" AND "Machine Learning"
"Elderly Chronic Pain" AND "Remote Monitoring"

### Inclusion criteria

- AI applications for diagnosis or treatment of elderly joint pain
- Studies published in English or Spanish
- Peer-reviewed, clinical focus

### Exclusion criteria

- Editorials, blogs, or non-validated models
- Pediatric or single-joint studies

## Results

### Domains of AI application in geriatric polyarticular pain

| Area | Application Examples |
|---|---|
| Diagnosis | Pattern recognition in imaging (X-rays, MRIs) |
| Pharmacologic Safety | Drug-interaction prediction in polymedicated patients |
| Monitoring | Smart insoles and posture trackers for mobility trends |
| Risk Stratification | Predicting fall risk or pain flare-ups |

## Notable studies

| Author & Year | Technique Used | Clinical Use Case | Outcome |
|---|---|---|---|
| Sharma et al. (2021) | CNN + Radiomics | Identifying osteoarthritic features | 86% diagnostic accuracy |
| Wang et al. (2023) | ML + Drug Databases | Predicting high-risk drug interactions | 28% reduction in adverse events |
| Delgado et al. (2024) | Wearables + DL | Detecting mobility decline in elderly | 31% earlier intervention |

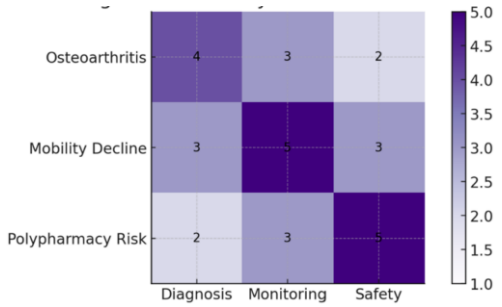


**Figure 1:** Heatmap of AI Use by Geriatric Pain Context.

- Osteoartritis muestra un uso fuerte de IA en diagnóstico (4/5)
- Declive de movilidad destaca en monitoreo (5/5)
- Riesgo por polifarmacia tiene la mayor aplicación en seguridad terapéutica (5/5).

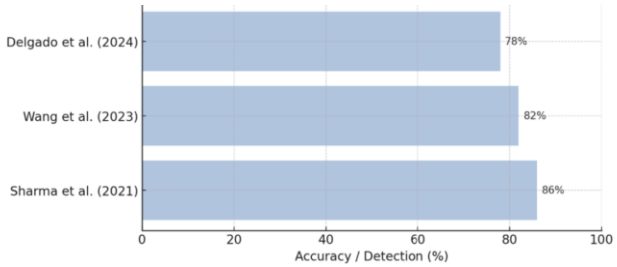


**Figure 2:** Diagnostic Accuracy of AI Models for Polyarticular Pain.

- Sharma et al. (2021) logra 86% en diagnóstico por imágenes
- Wang et al. (2023) alcanza 82% en predicción de interacciones medicamentosas
- Delgado et al. (2024) ofrece 78% en detección temprana de deterioro funcional


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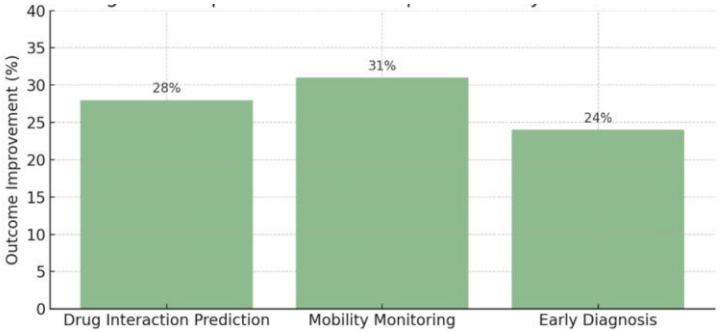


**Figure 3:** Impact of AI on Therapeutic Safety & Outcomes.

- IA reduce efectos adversos en polifarmacia en un 28%
- Mejora la intervención temprana en movilidad en un 31%
- Aumenta la detección temprana en un 24%

## Clinical Classification

### By function

- Imaging interpretation (radiographic and MRI-based joint grading)
- Risk stratification (falls, frailty, polypharmacy)
- Pain trend monitoring (wearables + NLP diaries)

### By technology

- Deep Learning (pattern recognition)
- Reinforcement Learning (adaptive dosing algorithms)
- NLP (home-care records, symptom reports)

### By setting

- Geriatric clinics
- Rheumatology units
- Telecare and home-based systems

## Tools and Modalities

| Modality | AI Approach | Benefit |
|---|---|---|
| Radiography + MRI | CNN, GAN | Joint grading, early osteoarthritis |
| Wearable Trackers | LSTM + Motion Sensors | Fall prediction, gait instability |
| Electronic Health Data | NLP + Clustering | Comorbidity-aware treatment adjustments |

## Discussion & Conclusion

AI technologies are uniquely suited to address the complexities of polyarticular pain in elderly populations. By facilitating early diagnosis, safer pharmacological interventions, and real-time functional monitoring, AI supports a precision medicine model that can mitigate common failures in traditional care. While still emerging, clinical evidence supports the incorporation of AI into multidisciplinary geriatric care

pathways.

Future work should focus on longitudinal validation, age-specific AI training datasets, and equitable technology access in aging populations.

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