Review Article

Adverse Drug Reactions in Allopathic versus Ayurvedic Therapy for Arthritis: A Comparative Review

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ABSTRACT

Arthritis is one of the most prevalent musculoskeletal disorders globally, affecting over 350 million individuals and posing a significant burden on healthcare systems. The management of arthritis encompassing osteoarthritis (OA), rheumatoid arthritis (RA), and related conditions involves both allopathic and Ayurvedic therapeutic approaches, each associated with distinct profiles of adverse drug reactions (ADRs). Allopathic agents including non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), corticosteroids, and biological agents demonstrate clinical efficacy but are frequently implicated in gastrointestinal toxicity, hepatotoxicity, nephrotoxicity, cardiovascular events, and immunosuppression. Conversely, Ayurvedic formulations such as Shallaki (*Boswellia serrata*), Guggul (*Commiphora mukul*), Ashwagandha (*Withania somnifera*), and Turmeric (*Curcuma longa*) are generally considered safer, although heavy metal toxicity from Rasa Shastra preparations, herb-drug interactions, and inadequate standardization remain significant concerns. This comparative review systematically analyzes pharmacovigilance data, clinical trial outcomes, and case reports related to ADR profiles in both therapeutic systems. The review critically evaluates the mechanisms underlying observed toxicities, organ-specific adverse effects, contraindications, and patient safety considerations. Findings suggest that integrated pharmacovigilance frameworks are essential for comprehensive ADR monitoring across both systems. A nuanced, evidence-based integration of allopathic and Ayurvedic therapies may offer optimal safety and efficacy in arthritis management.

Keywords: dverse Drug Reactions; Arthritis; Allopathic therapy; Ayurvedic therapy; NSAIDs; DMARDs; Shallaki; Pharmacovigilance; Herb-drug interactions; Osteoarthritis; Rheumatoid arthritis.

INTRODUCTION

Arthritis comprises a diverse group of musculoskeletal disorders characterized by joint inflammation, pain, stiffness, and progressive functional limitation. It represents a major global health concern, affecting approximately 350 million individuals worldwide, with prevalence increasing significantly with advancing age[1,2]. The condition imposes a substantial burden on healthcare systems, particularly in low and middle income countries, and is recognized by the World Health Organization as a leading contributor to disability adjusted life years (DALYs)[3].

Among the various forms of arthritis, osteoarthritis (OA) and rheumatoid arthritis (RA) are the most common and clinically significant. These two conditions differ considerably in their underlying mechanisms, progression, and therapeutic requirements. OA is primarily a degenerative joint disorder involving cartilage breakdown and structural alterations in subchondral bone, whereas RA is a chronic autoimmune disease characterized by persistent synovial inflammation and progressive joint destruction[4,5]. Both conditions typically require long-term pharmacological intervention, which increases the risk of cumulative adverse drug reactions (ADRs)[6].

Conventional (allopathic) management of arthritis relies on a range of pharmacological agents, including non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), corticosteroids, cyclooxygenase-2 (COX-2) inhibitors, and biological therapies. These medications are effective in alleviating symptoms and modifying disease progression; however, their use is frequently associated with clinically significant adverse effects[7,8]. For instance, NSAID-related gastrointestinal complications remain a major concern and contribute to a considerable number of hospitalizations annually in the United States[9].

In contrast, Ayurvedic medicine an ancient system of healthcare originating in India offers an alternative and holistic approach to arthritis management[10]. This system emphasizes individualized treatment strategies, herbal formulations, and lifestyle modifications. Within Ayurveda, arthritis is broadly classified under conditions such as Amavata (comparable to rheumatoid arthritis) and Sandhivata (analogous to osteoarthritis)[11,12]. Various plant-based and mineral based preparations are employed in treatment; however, despite the widespread perception of safety, these therapies are not entirely free from adverse effects. Issues such as heavy metal contamination, inconsistent standardization, and potential herb-drug interactions remain important safety concerns[13].

Furthermore, pharmacovigilance systems for Ayurvedic medicines are relatively underdeveloped compared to those for conventional pharmaceuticals, resulting in significant underreporting and limited characterization of adverse events[14]. With the growing global interest in integrative medicine and increased use of traditional therapies alongside modern drugs, there is a pressing need for systematic evaluation of safety profiles across both systems[15].

Therefore, this review aims to comprehensively examine and compare the adverse drug reaction profiles associated with major allopathic and Ayurvedic therapies used in arthritis management. Specifically, it seeks to (a) analyze ADRs linked to commonly prescribed allopathic drug classes, (b) document adverse effects associated with key Ayurvedic formulations, (c) compare organ specific toxicities across both systems, and (d) highlight implications for pharmacovigilance and integrative treatment strategies.

PATHOPHYSIOLOGY OF ARTHRITIS: ALLOPATHIC AND AYURVEDIC PERSPECTIVES

Allopathic Perspective

From the standpoint of modern medicine, osteoarthritis (OA) is characterized by progressive degeneration of articular cartilage accompanied by structural changes in the subchondral bone and mild synovial inflammation. This process is largely mediated by enzymatic degradation involving matrix metalloproteinases (MMPs) and aggrecanases, which break down cartilage component[16].

In rheumatoid arthritis (RA), the underlying mechanism is autoimmune in nature, involving chronic inflammation of the synovial membrane. Pro-inflammatory cytokines such as interleukin-1β (IL-1β), tumor necrosis factor-alpha (TNF-α), and interleukin-6 (IL-6) play central roles in driving disease progression[17]. These mediators activate intracellular signaling pathways, particularly the nuclear factor-kappa B (NF-κB) pathway, which further amplifies inflammatory responses and promotes synovial hyperplasia and pannus formation[18].

Additionally, increased expression of cyclooxygenase-2 (COX-2) leads to elevated production of prostaglandin E2 (PGE2), contributing to pain, inflammation, and edema in affected joints[19]. The pharmacological targets of commonly used allopathic drugs including COX enzymes (for NSAIDs), TNF-α (for agents like adalimumab), interleukin-6 receptors (for tocilizumab), and Janus kinases (for tofacitinib) are closely aligned with these underlying molecular mechanisms[20]. While targeting these pathways provides therapeutic benefits, it also explains the mechanism based adverse drug reactions associated with these medications.

Ayurvedic Perspective

In Ayurveda, arthritis is broadly categorized into Amavata and Sandhivata, each reflecting distinct pathological concepts. Amavata, which closely resembles rheumatoid arthritis, is believed to result from the accumulation of Ama (metabolic toxins) due to impaired digestive function. This toxic material circulates through the body and deposits in the joints, leading to inflammation and pain through aggravation of Vata dosha[21].

Sandhivata, considered analogous to osteoarthritis, is primarily attributed to the imbalance of Vata dosha, resulting in degeneration of joint structures and depletion of lubricating elements such as Shleshaka Kapha[22].

Contemporary scientific studies have provided partial validation for several Ayurvedic concepts by identifying bioactive compounds with anti-inflammatory properties. For example, Boswellia serrata inhibits the 5-lipoxygenase (5-LOX) pathway, thereby reducing leukotriene synthesis. Curcumin, derived from turmeric, suppresses inflammatory mediators by inhibiting NF-κB activation and COX-2 expression. Similarly, *Withania somnifera* (Ashwagandha) exhibits immunomodulatory and anti-inflammatory effects through regulation of stress hormones and immune responses[23,24].

Despite these mechanistic similarities with allopathic pathways, the safety profiles and patterns of adverse drug reactions differ considerably between the two systems, reflecting variations in pharmacological targets, formulation complexity, and regulatory oversight[25].

ADVERSE DRUG REACTIONS IN ALLOPATHIC THERAPY FOR ARTHRITIS

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

NSAIDs constitute the cornerstone of arthritis symptom management, acting primarily through inhibition of cyclooxygenase (COX-1 and COX-2) enzymes[26.] However, their widespread and long-term use is associated with a well-characterized spectrum of ADRs. Gastrointestinal adverse events, including peptic ulcers, erosive gastropathy, and life-threatening hemorrhage, occur in 10-30% of chronic NSAID users[27.] The mechanism involves COX-1 inhibition, which reduces prostaglandin-mediated mucosal protection in the gastric lining[28.]

Renal adverse effects of NSAIDs include acute kidney injury (AKI), interstitial nephritis, and electrolyte imbalances, particularly in patients with pre-existing renal compromise, cardiac failure, or concurrent diuretic therapy[29]. Cardiovascular risks, including myocardial infarction and stroke, have been documented for both non-selective NSAIDs (particularly diclofenac) and COX-2 selective agents[30]. A landmark meta-analysis by Bhala et al. demonstrated a 3-fold increase in cardiovascular events with high-dose diclofenac[31].

Hepatotoxicity, though less common, has been reported with diclofenac and sulindac. Cutaneous reactions, including photosensitivity and Stevens-Johnson syndrome, and hematologic adverse effects such as platelet dysfunction further characterize the NSAID ADR profile[32].

Disease-Modifying Antirheumatic Drugs (DMARDs)

Conventional DMARDs, particularly methotrexate (MTX), remain the first-line therapy for RA[33]. MTX's principal ADRs include hepatotoxicity (hepatic fibrosis in 5-10% with long-term use), myelosuppression (pancytopenia), pulmonary toxicity (MTX pneumonitis), mucositis, and teratogenicity[34]. Folic acid supplementation attenuates many MTX-related ADRs but does not eliminate hepatotoxic risk[35].

Sulfasalazine is associated with GI disturbances, hypersensitivity reactions, oligospermia, and rare

hepatotoxicity. Hydroxychloroquine, while generally well-tolerated, carries a risk of cumulative retinal toxicity requiring regular ophthalmologic monitoring[36]. Leflunomide may induce hypertension, hepatotoxicity, and peripheral neuropathy, mandating liver function monitoring[37] .

Corticosteroids

Systemic corticosteroids (prednisolone, dexamethasone, methylprednisolone) are highly effective in reducing arthritic inflammation but carry significant risks with chronic use.[38] ADRs include osteoporosis (10-20% of chronic users develop fractures), adrenal suppression, hyperglycemia, hypertension, cataracts, increased infection susceptibility, and Cushingoid features[39]. The dose dependent and cumulative nature of corticosteroid toxicity necessitates use of the lowest effective dose and regular bone density monitoring[40].

Biological Agents and Targeted Synthetic DMARDs

Biologics targeting TNF-α (adalimumab, etanercept, infliximab), IL-6 (tocilizumab), and CD20 (rituximab) represent a significant therapeutic advance in RA management.[41] However, their immunosuppressive mechanism predisposes patients to serious infections, including tuberculosis reactivation, opportunistic infections, and sepsis[42]. Long-term registry data indicate an increased risk of certain malignancies, particularly lymphoma, with TNF-α inhibitors[43].

JAK inhibitors (tofacitinib, baricitinib) carry risks of herpes zoster reactivation, deep vein thrombosis, pulmonary embolism, and cardiovascular events[44]. These risks have prompted regulatory agencies including the FDA and EMA to issue black box warnings for this drug class[45].

Table 1: Comparison of Drug Classes and Their ADR Profiles in Arthritis Management

Drug Class	Allopathic Agents	Ayurvedic Equivalent	Primary ADRs
NSAIDs	Ibuprofen, Naproxen, Diclofenac	Shallaki (B. serrata), Nirgundi	GI bleeding, renal toxicity
DMARDs	Methotrexate, Sulfasalazine	Guduchi, Ashwagandha	Hepatotoxicity, myelosuppression
COX-2 Inhibitors	Celecoxib, Etoricoxib	Turmeric (Curcumin)	Cardiovascular risk
Corticosteroids	Prednisolone, Dexamethasone	Rasayana formulations	Osteoporosis, hyperglycemia
Biologics	Adalimumab, Etanercept	No direct equivalent	Infection risk, malignancy
Analgesics	Tramadol, Codeine	Mahayogaraj Guggul	Dependence, sedation

ADVERSE DRUG REACTIONS IN AYURVEDIC THERAPY FOR ARTHRITIS

Plant-Based Formulations

Shallaki (*Boswellia serrata*) is among the most clinically studied Ayurvedic anti-arthritic agents. Randomized controlled trials demonstrate significant reduction in OA pain and improvement in physical function[46]. Reported ADRs include mild gastrointestinal disturbances (nausea, diarrhea, abdominal pain) in 5-10% of users, generally mild and self-limiting[47]. Rare hypersensitivity reactions have been documented. Overall, Shallaki demonstrates a substantially more favorable GI safety profile compared to NSAIDs[48].

Guggul (*Commiphora mukul*), used as Yogaraj Guggul and Mahayogaraj Guggul in arthritis, can cause GI upset, skin rashes, and thyroid dysfunction with prolonged use[49]. Interactions with thyroid medications and anticoagulants have been reported[50] . Turmeric (curcumin) is generally well-tolerated; high doses may cause GI disturbance and theoretical interference with antiplatelet therapy[1] .

Ashwagandha (*Withania somnifera*) has documented adaptogenic and anti-inflammatory properties relevant to arthritic conditions. ADRs include thyroid stimulation (contraindicated in hyperthyroidism), sedation, and rare hepatotoxicity[2]. Nirgundi (*Vitex negundo*) applied externally or internally may cause contact dermatitis in sensitive individuals[3].

Rasa Shastra (Heavy Metal-based Formulations)

Rasa Shastra preparations, including Swarna Bhasma (gold ash), Abhraka Bhasma (mica ash), Tamra Bhasma (copper ash), and Vanga Bhasma (tin ash), represent a unique and controversial domain of Ayurvedic pharmacology[4]. These metallic preparations undergo extensive purification (Shodhana) and incineration (Marana) processes claimed to render metals biocompatible and therapeutically active[5].

Despite classical Ayurvedic quality assurances, modern analytical studies have detected significant concentrations of lead, mercury, and arsenic in some commercially available Rasa Shastra preparations[6]. Cases of heavy metal poisoning including lead encephalopathy, mercury nephrotoxicity, and arsenic polyneuropathy—following Ayurvedic medication use have been reported in India and internationally[7,8]. A cross-sectional study found detectable blood lead levels in 38% of Ayurvedic medicine users consuming Rasa Shastra preparations[9] .

Regulatory authorities including the WHO and national pharmacovigilance programs have flagged these risks, necessitating stricter quality control, standardization, and pharmacovigilance for metallic Ayurvedic preparations[10].

Herb-Drug Interactions

The concurrent use of Ayurvedic herbs with allopathic medications presents a significant but underappreciated risk of pharmacokinetic and pharmacodynamic interactions[11]. Curcumin inhibits CYP3A4 and P-glycoprotein, potentially altering the metabolism of co-administered drugs including warfarin, cyclosporine, and HIV antiretrovirals[12].

Ashwagandha may potentiate the effects of sedatives, thyroid medications, and immunosuppressants[13]. Guggul has documented interactions with warfarin (reduced anticoagulant effect) and propranolol (reduced bioavailability)[14]. Ginger (*Zingiber officinale*), frequently included in arthritis formulations, may enhance antiplatelet effects and increase bleeding risk in patients on NSAIDs or anticoagulants[15].

PHARMACOVIGILANCE IN ARTHRITIS: ALLOPATHIC VS. AYURVEDIC SYSTEMS

Allopathic Pharmacovigilance Framework

Pharmacovigilance for conventional pharmaceuticals is governed by comprehensive national and international regulatory frameworks[16]. In India, the Pharmacovigilance Programme of India (PvPI) coordinates ADR monitoring through a network of adverse event reporting centers, providing systematic data on drug safety signals[17]. Internationally, the WHO's VigiBase database aggregates Individual Case Safety Reports (ICSRs) from over 130 countries, representing the most comprehensive global pharmacovigilance resource[18] .

For arthritis drugs specifically, post-marketing surveillance has been instrumental in identifying safety signals not detected in pre-approval clinical trials[19]. The identification of cardiovascular risks with rofecoxib (Vioxx), leading to market withdrawal in 2004, exemplifies the critical role of post-marketing pharmacovigilance in protecting public health[20].

Ayurvedic Pharmacovigilance: Challenges and Gaps

Pharmacovigilance for Ayurvedic medicines is comparatively underdeveloped, with the National Pharmacovigilance Programme for ASU (Ayurveda, Siddha, Unani) & Homeopathy established in India only in 2013[21]. Major challenges include: underreporting of adverse events due to cultural perceptions of Ayurvedic medicines as inherently safe, absence of standardized reporting frameworks, lack of trained personnel in ADR reporting in Ayurvedic practice settings, and significant heterogeneity in product composition and quality[22,23].

Studies have demonstrated that only 0.5-1% of Ayurvedic ADRs are formally reported, representing a gross underestimation of the true incidence of adverse effects[24]. The WHO Traditional Medicine Strategy 2019-2024 explicitly calls for strengthened pharmacovigilance systems for traditional medicines, recognizing this critical gap[25].

ORGAN-SPECIFIC TOXICITY COMPARISON

Gastrointestinal Toxicity

NSAID-induced gastropathy represents the most prevalent and clinically significant ADR in allopathic arthritis management[26]. The incidence of symptomatic peptic ulcer disease in NSAID users is 3-4 times higher than in non-users, and the risk of GI hemorrhage is 6-fold elevated[27]. Proton pump inhibitor (PPI) co-prescription mitigates but does not eliminate this risk[28].

In contrast, Ayurvedic anti-arthritic agents generally demonstrate a favorable GI safety profile. Clinical trials of Shallaki report GI adverse events in only 5% of participants versus 15-20% with ibuprofen comparators[29]. However, certain Ayurvedic preparations including Guggul may cause GI upset, and heavy metal contamination may induce GI toxicity including nausea, vomiting, and abdominal cramping[30].

Hepatotoxicity

Drug-induced liver injury (DILI) is a major concern in allopathic arthritis therapy, particularly with MTX, leflunomide, and diclofenac[31]. MTX causes hepatic fibrosis in a cumulative dose dependent manner, with risk factors including alcohol consumption, obesity, diabetes, and pre-existing liver disease[32]. Regular liver biopsy or surrogate fibrosis markers are recommended for long-term MTX users[33].

Herbal hepatotoxicity (herb-induced liver injury, HILI) is an emerging concern in Ayurvedic medicine[34]. Cases of hepatotoxicity attributed to Ayurvedic preparations including those containing Ashwagandha and certain Rasa Shastra formulations have been published[35]. The LiverTox database identifies several Ayurvedic botanical ingredients as potential hepatotoxins, requiring heightened awareness[36].

Nephrotoxicity

NSAID-induced nephrotoxicity is a significant concern, particularly in elderly patients, those with pre-existing chronic kidney disease (CKD), and patients receiving renin-angiotensin system inhibitors[37]. Mechanisms include reduction of renal prostaglandin synthesis, causing vasoconstriction and reduced glomerular filtration rate (GFR)[38]. Chronic NSAID use can lead to analgesic nephropathy, characterized by papillary necrosis and chronic interstitial nephritis[39].

Nephrotoxicity in Ayurvedic medicine is primarily associated with heavy metal contamination. Lead nephrotoxicity presents as proximal tubular dysfunction (Fanconi syndrome), while mercury exposure causes glomerulonephritis and tubular damage[40]. Plant-based Ayurvedic agents for arthritis have not been associated with clinically significant nephrotoxicity when used at recommended doses and preparations[41].

Cardiovascular Adverse Effects

Cardiovascular toxicity represents a critical and evolving concern in allopathic arthritis pharmacotherapy[42]. Both non-selective NSAIDs and COX-2 inhibitors increase cardiovascular risk through alteration of prostacyclin-thromboxane balance, promoting a prothrombotic state[43]. The PRECISION trial demonstrated non-inferiority of celecoxib versus naproxen and ibuprofen in cardiovascular safety, but absolute risk remains elevated compared to placebo[44].

Ayurvedic medicines used in arthritis are generally not associated with direct cardiovascular toxicity. Guggul (*Commiphora mukul*) has been studied for lipid-lowering effects, potentially beneficial in cardiovascular risk management[45]. However, herb-drug interactions between Ayurvedic agents and antihypertensive or anticoagulant medications may indirectly affect cardiovascular outcomes[46].

COMPARATIVE ANALYSIS AND DISCUSSION

The comparative analysis of ADR profiles in allopathic and Ayurvedic arthritis therapies reveals fundamental differences in the nature, frequency, mechanism, and severity of adverse effects across both systems[47]. Allopathic agents demonstrate higher overall ADR frequencies, with mechanism-based toxicities that are well-characterized, predictable, and systematically monitored. The absolute ADR burden particularly GI toxicity from NSAIDs translates to substantial morbidity and healthcare costs[48].

Ayurvedic medicines present a qualitatively different risk profile: lower frequency of conventional pharmacological ADRs, but unique risks from heavy metal contamination, inadequate standardization, herb-drug interactions, and quality heterogeneity[49]. The challenge of Ayurvedic pharmacovigilance lies not in the inherent dangerousness of the therapeutic system, but in the absence of robust monitoring frameworks to detect and characterize ADRs systematically[50].

Several randomized controlled trials support the non-inferiority of specific Ayurvedic interventions compared to NSAIDs for mild-to-moderate arthritis, with superior safety profiles for GI outcomes[1]. A network meta-analysis by Christensen et al. demonstrated that Shallaki extract produced equivalent pain reduction to celecoxib in knee OA with significantly fewer GI adverse events[2].

For moderate-to-severe RA with erosive joint disease, biological DMARDs and conventional DMARDs remain irreplaceable given their capacity to inhibit structural joint damage an outcome not yet demonstrated for Ayurvedic therapies in rigorous clinical trials[3]. An integrative approach, wherein Ayurvedic adjuncts reduce allopathic drug dosage requirements and attendant ADRs while providing additional symptomatic relief, represents a promising therapeutic model[4,5].

ADR CONSIDERATIONS IN SPECIAL POPULATIONS

Elderly patients with arthritis face compounded ADR risks due to age-related pharmacokinetic changes (reduced renal clearance, altered hepatic metabolism), polypharmacy, and increased comorbidity burden[6]. NSAIDs are classified as potentially inappropriate medications in elderly patients by the Beers Criteria, given elevated risks of GI hemorrhage, renal impairment, and fluid retention[7]. Ayurvedic formulations may offer advantage in this population, though systematic safety data in elderly patients are lacking[8].

In pregnancy, most DMARDs and NSAIDs (particularly in the third trimester) are contraindicated due to fetal risks[9] . Ayurvedic medicines have not been adequately studied in pregnancy; several herbs including Guggul and Ashwagandha are traditionally contraindicated during pregnancy[10]. Pediatric arthritis management presents similar challenges, with limited safety data for both systems in children[11].

REGULATORY AND QUALITY CONSIDERATIONS

In India, allopathic pharmaceuticals are regulated under the Drugs and Cosmetics Act, 1940, with rigorous requirements for efficacy, safety, and quality demonstration prior to market authorization[12]. Post-marketing surveillance is mandated for approved drugs, with structured ADR reporting to the Central Drugs Standard Control Organisation (CDSCO)[13].

Ayurvedic medicines are regulated under Schedule E1 and the Drugs and Cosmetics (Amendment) Rules, 2018[14]. The Ministry of AYUSH oversees quality standards through pharmacopoeial monographs in the Ayurvedic Pharmacopoeia of India (API)[15]. However, enforcement gaps, extensive cottage industry manufacturing, and the availability of Ayurvedic products as dietary supplements (exempt from drug regulation in some jurisdictions) significantly compromise quality assurance[16].

The CCRAS (Central Council for Research in Ayurvedic Sciences) has developed guidelines for safety assessment of Ayurvedic medicines, including mandatory pre-clinical and clinical toxicity studies for novel formulations[17]. However, thousands of traditional preparations marketed on the basis of classical texts remain largely exempt from modern toxicological evaluation, creating a significant regulatory gap[18].

CONCLUSION

This comparative review demonstrates that both allopathic and Ayurvedic therapeutic systems for arthritis are associated with clinically significant adverse drug reactions, albeit with distinct profiles, frequencies, and mechanisms[24]. Allopathic agents offer superior evidence of efficacy for moderate-to-severe disease but carry substantial ADR burdens, particularly GI toxicity from NSAIDs, hepatotoxicity from DMARDs, and immunosuppression from biological agents[25].

Ayurvedic formulations demonstrate generally favorable ADR profiles for conventional pharmacological toxicities but present unique challenges including heavy metal contamination in Rasa Shastra preparations, herb-drug interactions, and quality inconsistency[26]. The inadequate pharmacovigilance framework for Ayurvedic medicines represents a significant public health gap requiring urgent attention[27].

An integrative approach, combining the disease-modifying efficacy of conventional DMARDs with the symptomatic benefits and favorable safety profile of select Ayurvedic agents, may represent the optimal strategy for many arthritis patients[28]. Advancement of this integrative model requires strengthened pharmacovigilance, rigorous clinical research, and harmonized regulatory frameworks that ensure patient safety across both therapeutic systems[29,30].

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