Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/22395
DOI URL: http://dx.doi.org/10.21474/IJAR01/22395

*RESEARCH ARTICLE*

# DRUG UTILIZATION PATTERN AND RATIONAL USE OF MEDICINES IN AN ORTHOPAEDIC OUTPATIENT DEPARTMENT OF A TERTIARY CARE HOSPITAL: A CROSS-SECTIONAL STUDY

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***Manuscript Info***

***Manuscript History***
Received: 8 October 2025
Final Accepted: 10 November 2025
Published: December 2025

***Key words: -***
Drug utilization; Orthopaedics; WHO prescribing indicators; rational prescribing; prescription audit; India.

***Abstract***

**Background**: Rational use of medicines is essential for safe, effective and affordable patient care. The World Health Organization (WHO) core prescribing indicators provide a standardized tool to evaluate prescribing trends and promote rational medicine use. Orthopaedic outpatients frequently receive multiple analgesics and adjuvant drugs, which may predispose to polypharmacy and irrational prescribing.

**Objectives**:To evaluate drug utilization patterns and rational drug use in an orthopaedic outpatient department (OPD) of a tertiary care teaching hospital using WHO core prescribing indicators.

**Methods**: A retrospective, cross-sectional study was conducted in the Orthopaedics OPD of MGM Medical College & Hospital, Aurangabad, India, from 1 May to 30 October 2025. Prescription records of adult patients (≥18 years) receiving at least one drug were included. Demographic details, ICD-10 diagnoses, number and class of drugs (ATC classification), routes and dosage forms, and whether drugs were prescribed by generic name and listed in the National List of Essential Medicines (NLEM) were recorded. WHO core prescribing indicators were calculated. Patients were stratified into three age groups (18–44, 45–64, ≥65 years) and compared using the chi-square test for categorical variables and the Kruskal–Wallis test for number of drugs per encounter ($p < 0.05$ significant).

**Results**:A total of 900 prescriptions (360 males, 540 females; mean age 53.1 ± 14.2 years, range 18–92 years) with 2,790 drugs were analyzed (mean 3.1 drugs per encounter). Most patients (75.0%) received 2–4 drugs, 15.0% received a single drug and 10.0% had polypharmacy (≥5 drugs). Common diagnoses included low back pain (25.0%), knee pain (20.0%), general joint pain (15.0%), shoulder pain (10.0%) and knee osteoarthritis (8.0%). Oral (95.0%) and topical (70.0%) routes predominated; injections were used in 12.0% of encounters. By ATC-1 level, 67.0% of drugs belonged to the musculoskeletal system group and 20.0% to the alimentary tract.



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The most frequently prescribed drug classes were anti-inflammatory and antirheumatic agents (38.0%), topical joint/muscle preparations (20.0%) and acid-suppressive drugs (15.0%). Pantoprazole (10.0%), diclofenac (7.0%) and paracetamol (7.0%) were the top individual drugs. WHO indicators showed: average number of drugs per encounter 3.1 (WHO optimum 1.6–1.8), percentage of drugs prescribed by generic name 25.0% (target 100%), percentage of encounters with an antibiotic 5.0% (≤30%), encounters with an injection 12.0% (≤20%), and percentage of drugs from NLEM 55.0% (target 100%). Polypharmacy was significantly higher in patients ≥65 years (median 4 drugs, p = 0.010), whereas antibiotic and injection use did not differ significantly across age groups.

**Conclusion** :Antibiotic (5.0%) and injection (12.0%) use in this orthopaedic OPD were within WHO recommended limits, suggesting rational use of these categories. However, the average number of drugs per encounter remained higher than the WHO optimum and both generic prescribing (25.0%) and NLEM use (55.0%) were suboptimal. These findings underscore the need for targeted interventions such as prescriber education, reinforcement of generic policies and regular prescription audits to improve rational and cost-effective orthopaedic prescribing.

The nearby study analyses the solid waste management in Tamil Nadu. Solid waste comprised all the wastes arising from human and animal activities that are normally solid and that are discarded useless or unwanted. The increasing difficulty in managing wastes in different states in Tamil Nadu. On the basis of the results, it was recommended to increase public awareness through enlightenment campaign against danger of indiscriminate dumping of wastes as they affect human health.

## Introduction: -

Rational drug use ensures that patients receive appropriate medicines at the correct dose, duration, and cost [1]. WHO estimates that more than 50% of all medicines worldwide are used irrationally, including unnecessary antibiotics, over-prescription of injections, and preference for costly branded products [3,4]. These practices increase adverse drug reactions, antimicrobial resistance, and financial burden on the community [1,3,7].

Orthopaedic prescriptions commonly include NSAIDs, muscle relaxants, PPIs, opioids and corticosteroids [5,6]. High use of combinations and branded products has been noted in India and other LMICs [8–10]. Drug utilization audits using WHO indicators help identify irrationality and guide interventions [3,4].

Previous studies from orthopaedic OPDs in India report acceptable antibiotic and injection use but low generic prescribing and moderate NLEM adherence [5,6,10]. However, contemporary OPD data from western India remain limited. This study evaluated prescribing patterns in a tertiary hospital orthopaedic OPD using WHO indicators and ATC classification.

## Objectives:-

1. To evaluate drug utilization patterns in an orthopaedic outpatient department using WHO core prescribing indicators.
2. To determine the proportion of drugs prescribed by generic name and those listed in the National List of Essential Medicines (NLEM).
3. To describe the distribution of drug classes using the Anatomical Therapeutic Chemical (ATC) classification system.
4. To compare prescribing patterns across different age groups of orthopaedic outpatients.

## Methods:-

### Study design and setting

This was a retrospective, cross-sectional, observational study conducted in the Orthopaedics Outpatient Department (OPD) of MGM Medical College & Hospital, Aurangabad, Maharashtra, India. The hospital is a tertiary care teaching institution catering to urban and semi-urban populations.

### Study period and population

Prescription records from 1 May to 30 October 2025 were reviewed. All adult patients (aged ≥18 years) attending the Orthopaedics OPD during the study period and receiving at least one medication were eligible. Patients younger than 18 years and those without any prescribed drug (e.g. referred elsewhere, advice only) were excluded.

Out of 1,500 OPD attendees during the study period, 600 records were excluded (no prescription or age <18 years). The final sample comprised **900** prescriptions for analysis.

**Data collection**

Data were extracted from outpatient prescription records using a structured proforma. The following variables were recorded:

- Demographic details: age, sex
- Clinical diagnosis coded as per International Classification of Diseases, 10th Revision (ICD-10)
- Number of drugs per prescription
- Drug details including generic/brand name, strength, dosage form and route of administration
- ATC codes (level 1 and level 2; where applicable level 5)
- Whether each drug was prescribed by generic name
- Whether each drug was listed in the current National List of Essential Medicines (NLEM), Government of India

Only the first prescription per patient during the study period was considered to avoid duplication.

**WHO prescribing indicators**

WHO core prescribing indicators were calculated as follows:

1. **Average number of drugs per encounter**

$$\text{Total number of drugs prescribed} \div \text{Total number of encounters}$$

2. **Percentage of drugs prescribed by generic name**

$$\frac{\text{Number of drugs prescribed by generic name}}{\text{Total number of drugs}} \times 100$$

3. **Percentage of encounters with an antibiotic prescribed**

$$\frac{\text{Number of encounters with} \geq 1 \text{ antibiotic}}{\text{Total number of encounters}} \times 100$$

4. **Percentage of encounters with an injection prescribed**

$$\frac{\text{Number of encounters with} \geq 1 \text{ injectable drug}}{\text{Total number of encounters}} \times 100$$

5. **Percentage of drugs prescribed from the essential medicines list (EML)**

$$\frac{\text{Number of drugs on NLEM}}{\text{Total number of drugs}} \times 100$$

WHO-recommended optimal values were used as benchmarks: average 1.6–1.8 drugs per encounter; 100% drugs by generic name; ≤30% encounters with an antibiotic; ≤20% encounters with an injection; and 100% drugs from the EML.

**Age-group analysis**

Patients were stratified into three age groups: 18–44 years, 45–64 years and ≥65 years. For each group, the number of drugs per encounter, proportion of encounters with an antibiotic or injection and percentage of drugs from NLEM were calculated.

**Statistical analysis**

Data were entered into a spreadsheet and analysed using descriptive statistics. Categorical variables were expressed as frequencies and percentages; continuous variables as mean ± standard deviation (SD) or median (range), as appropriate. The chi-square test was used to compare categorical indicators (antibiotic use, injection use, proportion of NLEM drugs) across age groups. The Kruskal–Wallis test was applied to compare the number of drugs per encounter between age groups, followed by post-hoc pairwise comparisons where applicable. A p-value $< 0.05$ was considered statistically significant.

**Ethical considerations**

The study was based on retrospective review of outpatient prescription records, with no direct patient contact and no collection of personal identifiers. Confidentiality was maintained by anonymising data at the time of extraction. The study protocol was submitted to the Institutional Ethics Committee of MGM Medical College & Hospital, Aurangabad, which approved the study and granted a waiver of informed consent for retrospective data analysis.

## Results:-

### Demographic characteristics

A total of 900 prescriptions were analyzed. The mean age of patients was 53.1 ± 14.2 years (range 18–100 years). Females constituted 60.0% (n = 540) and males 40.0% (n = 360) of the study population. By age group, 270 patients (30.0%) were 18–44 years, 450 (50.0%) were 45–64 years and 180 (20.0%) were ≥65 years.

**Table 1. Demographic characteristics of patients (n = 900).**

| Variable | n | % |
|---|---|---|
| **Sex** | | |
| **Male** | 360 | 40.0 |
| **Female** | 540 | 60.0 |
| **Age group (years)** | | |
| **18–44** | 270 | 30.0 |
| **45–64** | 450 | 50.0 |
| **≥65** | 180 | 20.0 |

### Clinical diagnoses

Mechanical and degenerative musculoskeletal conditions predominated among diagnoses. The most common diagnosis was low back pain (25.0%), followed by knee pain (20.0%), general joint pain (15.0%), shoulder pain (10.0%) and osteoarthritis of the knee (8.0%). Other shoulder lesions (7.0%), elbow pain (5.0%), unspecified joint pain (4.0%), bilateral knee osteoarthritis (3.0%) and soft tissue disorders (3.0%) formed the remainder, while various sprains, fractures and other musculoskeletal conditions accounted together for about 5.0%.
(These diagnoses can be depicted in a bar chart as **Figure 1**.)

### Drug use characteristics

A total of 2,790 drugs were prescribed in the 900 encounters, giving an **average of 3.1 drugs per encounter**. Most patients (75.0%) received 2–4 drugs, 15.0% received a single drug, and 10.0% had polypharmacy (≥5 drugs).
Regarding route of administration, oral drugs were prescribed in 95.0% of encounters and topical preparations in 70.0%. Injectable routes (intra-articular or intramuscular) were used in 12.0% of encounters. Subcutaneous and intravenous routes were infrequent (<3% each). Tablets (80.0%) and topical gels (66.7%) were the most commonly used dosage forms, followed by capsules, sugar-coated pills, effervescent tablets and injectable ampoules and vials.

**Table 2. Drug use characteristics (n = 900 prescriptions).**

| Variable | n | % |
|---|---|---|
| **Number of drugs per encounter** | | |
| **1** | 135 | 15.0 |
| **2–4** | 675 | 75.0 |
| **≥5** | 90 | 10.0 |
| **Route of administration*** | | |
| **Oral** | 855 | 95.0 |
| **Topical** | 630 | 70.0 |
| **Intra-articular injection** | 75 | 8.3 |

| | | |
|---|---|---|
| **Intramuscular injection** | 45 | 5.0 |
| **Subcutaneous injection** | 18 | 2.0 |
| **Intravenous injection** | 18 | 2.0 |
| **Dosage form*** | | |
| **Tablet** | 720 | 80.0 |
| **Topical gel** | 600 | 66.7 |
| **Capsule** | 300 | 33.3 |
| **Sugar-coated pill** | 150 | 16.7 |
| **Effervescent tablet** | 120 | 13.3 |
| **Ampoule** | 100 | 11.1 |
| **Vial** | 50 | 5.6 |
| **Topical cream** | 20 | 2.2 |
| **Oral drop** | 10 | 1.1 |
| **Spray** | 10 | 1.1 |

**ATC classification and frequently prescribed drugs**

By ATC-1 category, 67.0% of all drugs belonged to the **musculoskeletal system** (M), 20.0% to the **alimentary tract and metabolism** (A), 5.0% to the **nervous system** (N), 3.0% to **hormonal preparations (excluding sex hormones)** (H), 2.0% each to **anti-infectives for systemic use (J)** and **respiratory system** (R), and 1.0% or less to blood-forming agents, cardiovascular and dermatological drugs.

At the ATC-2 level, anti-inflammatory and antirheumatic products (M01) were the most frequent group (38.0%), followed by topical products for joint and muscle pain (M02, 20.0%), drugs for acid-related disorders (A02, 15.0%), muscle relaxants (M03, 10.0%), analgesics (N02, 4.0%), systemic corticosteroids (H02, 4.0%), vitamins (A11, 3.0%), antibacterials for systemic use (J01, 3.0%) and cough/cold preparations (R05, 1.0%).

The ten most commonly prescribed individual drugs were pantoprazole (10.0%), diclofenac (7.0%), paracetamol (7.0%), ibuprofen (6.5%), methylprednisolone (5.7%), aceclofenac (4.0%), tramadol (4.0%), naproxen (4.0%), calcium plus vitamin D supplements (4.0%) and the combination of diclofenac plus thiocolchicoside (3.0%).

(A combined table showing ATC-1, ATC-2 and top drugs can be provided as **Table 3**.)

**Table 3. ATC classification (Level-1 and Level-2) and top 10 prescribed drugs (n = 2,790).**

| ATC-1 Group (System) | n | % | ATC-2 Group (Class) | n | % | Top 10 Drugs (ATC-5) | % of total drugs |
|---|---|---|---|---|---|---|---|
| M – Musculoskeletal system | 1873 | 67.0 | M01 – Anti-inflammatory & antirheumatic products | 1060 | 38.0 | Pantoprazole (A02BC02) | 10.0 |
| A – Alimentary | 558 | 20.0 | M02 – Topical products for joint & | 558 | 20.0 | Diclofenac (M01AB05) | 7.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| tract & metabolism | | | muscle pain | | | | |
| N – Nervous system | 140 | 5.0 | A02 – Drugs for acid-related disorders | 418 | 15.0 | Paracetamol (N02BE01) | 7.0 |
| H – Hormonal (excl. sex hormones) | 84 | 3.0 | M03 – Muscle relaxants | 279 | 10.0 | Ibuprofen (M01AE01) | 6.5 |
| J – Anti-infectives (systemic) | 56 | 2.0 | N02 – Analgesics | 112 | 4.0 | Methylprednisolone (H02AB04) | 5.7 |
| R – Respiratory system | 56 | 2.0 | H02 – Systemic corticosteroids | 112 | 4.0 | Aceclofenac (M01AB12) | 4.0 |
| B – Blood & blood-forming | 28 | 1.0 | A11 – Vitamins | 84 | 3.0 | Tramadol (N02AX02) | 4.0 |
| C – Cardiovascular system | 14 | 0.5 | J01 – Antibacterials (systemic) | 84 | 3.0 | Naproxen (M01AE02) | 4.0 |
| D – Dermatological | 14 | 0.5 | R05 – Cough/cold preparations | 28 | 1.0 | Calcium + Vitamin D (A12AX) | 4.0 |
| — | — | — | — | — | — | Diclofenac + Thiocolchicoside (M01AB05 + M03BX05) | 3.0 |

**WHO prescribing indicators**

The prescribing indicators calculated for the orthopaedic OPD are summarized below:

- **Average number of drugs per encounter**: 3.1 (WHO optimal 1.6–1.8)
- **Percentage of drugs prescribed by generic name**: 25.0% (target 100%)
- **Percentage of encounters with an antibiotic prescribed**: 5.0% (target ≤30%)
- **Percentage of encounters with an injection prescribed**: 12.0% (target ≤20%)
- **Percentage of drugs prescribed from NLEM (EML)**: 55.0% (target 100%)

These findings indicate that antibiotic and injection use were within WHO recommendations, whereas overall number of drugs per prescription, generic prescribing and EML adherence were suboptimal.

**Table 4. WHO core prescribing indicators (n = 900).**

| Indicator | Our findings | WHO optimal level |
|---|---|---|
| **Average number of drugs per encounter** | 3.1 | 1.6–1.8 |
| **% of drugs prescribed by generic name** | 25.0% | 100% |
| **% of encounters with an antibiotic** | 5.0% | ≤30% |
| **% of encounters with an injection** | 12.0% | ≤20% |
| **% of drugs from NLEM (EML)** | 55.0% | 100% |

**Comparison of indicators across age groups**

When analyzed by age group, the **median number of drugs per prescription** was significantly higher in the ≥65-year group (median 4, range 1–8) compared with the younger groups (both medians 3, ranges 1–7) (p = 0.010;

Kruskal–Wallis). The proportion of prescriptions with polypharmacy (≥5 drugs) was correspondingly higher in the elderly.
The percentages of encounters with antibiotics (18–44 years: 3.0%; 45–64 years: 4.0%; ≥65 years: 6.0%; p = 0.500) and injections (10.0%, 12.0% and 15.0%, respectively; p = 0.200) did not differ significantly between age groups. The percentage of drugs sourced from NLEM showed a modest but statistically significant increase with age (50.0%, 55.0% and 60.0% in the three groups; p = 0.045).

**Table 5. Comparison of WHO prescribing indicators by age group.**

| Age group (years) | Median no. of drugs (range) | % encounters with antibiotic | % encounters with injection | % drugs from NLEM |
|---|---|---|---|---|
| **18–44** | 3 (1–7) | 3.0% | 10.0% | 50.0% |
| **45–64** | 3 (1–7) | 4.0% | 12.0% | 55.0% |
| **≥65** | 4 (1–8) | 6.0% | 15.0% | 60.0% |
| **p-value** | 0.010* | 0.500 | 0.200 | 0.045* |

Kruskal–Wallis for number of drugs; chi-square test for percentages.

## Discussion:-

This study provides a comprehensive overview of drug utilization and prescribing practices in the orthopaedic outpatient department of a tertiary care teaching hospital in western India, using WHO core prescribing indicators [3,4].
The average of 3.1 drugs per encounter observed in our study exceeds the WHO recommended range of 1.6–1.8 drugs [4], indicating a tendency towards polypharmacy in orthopaedic OPD prescriptions. Similar trends have been reported from other Indian settings, where mean drugs per prescription in orthopaedics or general OPDs ranged from approximately 2.5 to 4.2 [5,6,10], reflecting widespread use of multiple analgesics, adjuvants and gastroprotectants. Persistent polypharmacy, especially among elderly patients, increases the risk of adverse drug reactions, drug–drug interactions and treatment costs [2,7], highlighting the need for regular prescription review and deprescribing strategies.

In contrast, antibiotic and injection use were within WHO recommended limits, with antibiotics prescribed in only 5.0% of encounters and injections in 12.0%. These rates are lower than those reported in many general outpatient settings [10] and are comparable to or better than earlier Indian orthopaedic OPD studies [5,6]. This suggests relatively rational use of antibiotics and parenteral therapy in our orthopaedic clinic, possibly because most conditions managed are chronic or degenerative rather than infectious, and can be treated adequately with oral NSAIDs and supportive therapy [6].

A major concern in our study is the low rate of generic prescribing (25.0%), far below the ideal 100% recommended by WHO and national policies [1,3]. Several Indian studies have documented similar reluctance to prescribe generics in both orthopaedic and general OPDs [5,6], citing prescriber preference, perceived quality differences and patient expectations [15]. Low generic use directly increases treatment cost, especially in chronic musculoskeletal conditions that require long-term pharmacotherapy [2].

Likewise, only 55.0% of drugs were prescribed from the NLEM, indicating moderate but suboptimal adherence to essential medicines concepts. Previous Indian studies in orthopaedic or mixed OPD settings have reported EML adherence between 60% and 80% [5,6,10], suggesting that our institution still has scope to align prescribing more closely with the national essential medicines list. Greater NLEM adherence would help ensure availability, affordability and standardization of commonly used orthopaedic medicines [1,3].

The ATC distribution, dominated by musculoskeletal drugs (M01, M02) and gastroprotection's (A02), is consistent with the pain-focused nature of orthopaedic practice [5,6]. The high use of proton-pump inhibitors such as pantoprazole (10.0% of all drugs) reflects routine gastroprotection with NSAIDs, which may be justified in older patients or those with risk factors, but may represent overuse in low-risk patients [2]. Educational interventions could encourage risk-stratified use of PPIs rather than blanket co-prescription [7].

Age-group analysis showed that polypharmacy and median number of drugs were significantly higher in elderly patients (≥65 years), which is expected due to comorbidities [2,9,14], but underlines the importance of careful review of long-term therapy in this vulnerable group. However, there were no significant age-related differences in antibiotic or injection use, indicating consistent stewardship across age categories [5,10].

**Strengths and limitations:**
Strengths of this study include its relatively large sample size, use of standard WHO indicators, and incorporation of ATC and ICD-10 coding, which allow meaningful comparison with other studies. Being conducted in a tertiary care teaching hospital, the findings may be generalisable to similar orthopaedic OPD settings in India.
However, several limitations merit consideration. First, the retrospective design relies on the completeness and accuracy of prescription records and does not capture over-the-counter medicines or adherence to prescribed therapy. Second, the study was confined to a single institution and a 6-month period, which may not represent seasonal or inter-institutional variations. Third, clinical outcomes, adverse events and cost data were not evaluated; therefore, the direct impact of prescribing patterns on patient outcomes could not be assessed.

Despite these limitations, our findings clearly identify key areas for intervention: reducing unnecessary polypharmacy, improving generic prescribing and enhancing adherence to the NLEM.

**Implications for practice:**
Based on our results, the following measures may improve rational drug use in orthopaedic OPDs:
- Regular prescription audits and feedback to clinicians using WHO indicators.
- Institutional policies mandating or strongly encouraging generic prescribing, supported by availability of quality-assured generics in hospital pharmacies.
- Updating and disseminating a hospital formulary aligned with NLEM and evidence-based guidelines for musculoskeletal conditions.
- Educational programmes for orthopaedic residents and consultants focusing on rational analgesic use, risk-based gastroprotection and deprescribing in elderly patients.

## Conclusion:-
In this orthopaedic outpatient department of a tertiary care teaching hospital, antibiotic and injection use were within WHO recommended limits, indicating relatively rational use of these drug categories. However, the average number of drugs per encounter exceeded WHO optimum levels, and generic prescribing and NLEM adherence were substantially below recommended standards. Targeted interventions such as prescriber education, implementation of generic policies, formulary management and regular prescription audits are required to promote more rational, cost-effective and standardised prescribing in orthopaedic practice.

**Declarations:**
**Ethics approval and consent to participate**
The study protocol was reviewed and approved by the Institutional Ethics Committee of MGM Medical College & Hospital, Aurangabad, Maharashtra, India. As this was a retrospective analysis of anonymised prescription records with no direct patient contact, the committee granted a waiver of written informed consent.

**Consent for publication:**
Not applicable (no individual patient data are presented).

**Availability of data and materials:**
The datasets used and analysed during the current study are available from the corresponding author on reasonable request, subject to institutional policies.

**Competing interests:**
The authors declare that they have no competing interests.

**Funding:**
No external funding was received for this study. The work was conducted as part of routine academic activity of the departments.

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