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IMPROVING ADHERENCE TO THE WHO ANALGESIC LADDER: AUDIT AND SUBSEQUENT QUALITY IMPROVEMENT PROJECT IN A TERTIARY CARE HOSPITAL, PAKISTAN

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ABSTRACT

Background

Pain is one of the most common symptoms encountered in hospitalized patients, yet adherence to evidence-based pain management guidelines remains suboptimal, particularly in low- and middle-income countries. The World Health Organization (WHO) analgesic ladder provides a structured, stepwise approach to rational analgesic prescribing; however, inappropriate early opioid use and excessive reliance on injectable analgesics are frequently observed in routine clinical practice. Preliminary observations at a tertiary care teaching hospital in Pakistan suggested poor compliance with the WHO analgesic ladder, especially widespread first-line use of intravenous tramadol.

Objectives

This clinical audit and subsequent quality improvement (QI) project aimed to assess baseline adherence to the WHO analgesic ladder, identify patterns of inappropriate analgesic prescribing, and evaluate the impact of targeted interventions on improving guideline-compliant pain management.

Methods

A prospective clinical audit using a Plan–Do–Study–Act (PDSA) cycle was conducted in a medical unit of a tertiary care hospital. A total of 200 adult inpatients receiving analgesics were included, with 100 patients assessed pre-intervention and 100 post-intervention. Prescribing practices were evaluated against WHO analgesic ladder standards, including initial analgesic step, opioid and tramadol use, route of administration, appropriateness according to documented pain severity, and pain reassessment. Following baseline analysis, a multifaceted intervention comprising clinician education, visual reminders, and reinforcement during ward rounds was implemented, followed by a re-audit using identical methodology.

Results

At baseline, adherence to the WHO analgesic ladder was poor, with only 22% of patients initiated on Step 1 analgesia, while 61% were started on Step 2 and 17% on Step 3. Overall compliance with WHO standards was 26%. Intravenous tramadol was used as first-line therapy in 58% of patients, and 49% received tramadol without prior use of paracetamol or NSAIDs. Oral analgesics were prescribed in only 31% of cases, and pain reassessment within 6 hours was documented in 21%.

Following the intervention, initiation at Step 1 increased to 56%, while Step 2 and Step 3 initiation decreased to 34% and 10%, respectively. Overall compliance improved to 68%. Any tramadol use declined from 74% to 42%, and first-line intravenous tramadol use decreased from 58% to 21%. Oral route prescribing increased from 31% to 63%. Appropriateness of analgesic choice according

to pain severity improved from 29% to 67%, and documented pain reassessment within 6 hours increased from 21% to 61%.

Conclusion

this audit demonstrated significant baseline non-adherence to the WHO analgesic ladder, characterized by premature opioid use, excessive reliance on injectable tramadol, and inadequate pain reassessment. Implementation of a targeted, low-cost quality improvement intervention resulted in substantial improvements in stepwise analgesic prescribing, reduced inappropriate opioid and injectable use, and enhanced pain monitoring. Regular audit and ongoing clinician education are effective strategies for improving rational pain management in resource-limited tertiary care settings.

Keywords

WHO analgesic ladder; Pain management; Clinical audit; Quality improvement; Opioid prescribing; Tramadol use; Injectable analgesics; Tertiary care hospital; Pakistan

INTRODUCTION

Pain is one of the most common symptoms encountered in clinical practice and remains a major cause of patient distress, prolonged hospital stay, and reduced quality of life when inadequately managed. Effective pain control is therefore a fundamental component of patient-centred care and a key indicator of healthcare quality in both medical and surgical settings. Despite the availability of well-established, evidence-based guidelines, inappropriate analgesic prescribing continues to be reported worldwide, particularly in low- and middle-income countries[1,2].The World Health Organization (WHO) analgesic ladder, originally developed for cancer pain management and now widely applied to acute and chronic non-cancer pain, provides a simple, stepwise approach to rational analgesic use[3].Current WHO-endorsed and international guidelines recommend initiating pain management with non-opioid analgesics, such as paracetamol, with or without non-steroidal anti-inflammatory drugs (NSAIDs), for mild pain. For moderate pain, weak opioids (such as tramadol or codeine) may be added to non-opioid agents, while strong opioids are reserved for severe pain, always in combination with appropriate adjuvant therapies and regular pain reassessment[4,5].This structured approach aims to achieve effective analgesia while minimizing unnecessary opioid exposure and drug-related adverse effects. However, in routine clinical practice, adherence to the WHO analgesic ladder is often suboptimal. Studies from various healthcare settings have demonstrated frequent bypassing of initial ladder steps, excessive reliance on opioids, and inappropriate use of injectable analgesics without adequate trial of oral non-opioid options. Such practices increase the risk of adverse drug reactions, dependency, higher healthcare costs, and patient dissatisfaction[6,7].In Pakistan, pain management practices are influenced by high patient volumes, time constraints, limited institutional protocols, and prescribing habits that favour rapid symptom relief. In many tertiary care hospitals, including Ayub Teaching Hospital, Abbottabad, preliminary observations suggested very low compliance with the WHO analgesic ladder, with a predominant tendency to prescribe intravenous tramadol injections for a wide range of pain severities, often as first-line therapy. This practice frequently occurs without prior use of paracetamol, NSAIDs, or appropriate stepwise escalation, contrary to international recommendations. Such non-standardized analgesic prescribing highlights a critical gap between evidence-based guidelines and real-world clinical practice[2,8].Clinical audit and quality improvement (QI) projects offer a structured and effective method to identify deficiencies in care, implement targeted interventions, and measure subsequent improvement against predefined standards. By systematically assessing current prescribing patterns and aligning them with the WHO analgesic ladder, meaningful and sustainable improvements in pain management can be achieved[9].

This audit and subsequent quality improvement project was therefore conducted to assess baseline adherence to the WHO analgesic ladder at a tertiary care teaching hospital in Pakistan, identify patterns of inappropriate analgesic use—particularly the

overuse of intravenous tramadol—and to implement targeted interventions aimed at improving guideline-compliant, rational, and patient-centred pain management.

Aims and Objectives

Aim

The primary aim of this clinical audit and subsequent quality improvement project was to assess and improve adherence to the World Health Organization (WHO) analgesic ladder for pain management at a tertiary care teaching hospital in Pakistan, with a particular focus on reducing inappropriate first-line use of intravenous tramadol.

Objectives

Primary Objectives

To evaluate baseline compliance with the WHO analgesic ladder in the prescribing of analgesics for hospitalized patients.

To determine the frequency and patterns of analgesic use, with specific emphasis on the use of intravenous tramadol as first-line therapy across different pain severities.

To assess the extent to which non-opioid analgesics, including paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs), were utilized appropriately before escalation to opioid therapy.

Secondary Objectives

4. To identify common deviations from recommended stepwise pain management, including bypassing initial ladder steps and inappropriate route of administration.
5. To implement targeted quality improvement interventions aimed at promoting rational, stepwise analgesic prescribing in accordance with the WHO analgesic ladder.
6. To re-audit analgesic prescribing practices following the intervention in order to measure improvement in compliance with WHO guidelines.
7. To evaluate the impact of the quality improvement interventions on reducing unnecessary opioid exposure, particularly injectable tramadol use.

Materials & Methods

Study Design-

This study was conducted as a clinical audit followed by a quality improvement project, using a Plan–Do–Study–Act (PDSA) cycle methodology. The project consisted of an initial baseline audit to assess existing analgesic prescribing practices, followed by the implementation of targeted interventions and a subsequent re-audit to evaluate improvement in adherence to the World Health Organization (WHO) analgesic ladder.

Study Setting-

The audit was carried out at Medical Unit B, Ayub Teaching Hospital, Abbottabad, a large tertiary care teaching hospital in Pakistan that provides inpatient medical services to a high-volume and diverse patient population.

Audit Standards-

The audit standards were derived from the WHO analgesic ladder and contemporary international pain management guidelines. Prescribing practices were assessed against the following key principles:

Stepwise initiation of analgesia based on pain severity.

Use of non-opioid analgesics (paracetamol ± NSAIDs) as first-line therapy for mild pain.

Escalation to weak opioids (e.g., tramadol) only when pain control is inadequate with non-opioid agents.

Avoidance of unnecessary opioid use, particularly injectable opioids, without appropriate indication.

Preference for the oral route where clinically feasible.

Regular reassessment and appropriate escalation or de-escalation of analgesic therapy.

Study Population-

All adult patients admitted to Medical Unit B during the audit periods who received analgesic prescriptions for pain management were considered for inclusion.

Inclusion Criteria

Adult patients (≥18 years of age).

Patients admitted to Medical Unit B during the study period.

Patients prescribed one or more analgesic medications for acute or chronic pain during hospitalization.

Exclusion Criteria

Patients admitted to intensive care units.
Patients receiving palliative or end-of-life care.
Patients with documented contraindications to non-opioid analgesics.
Patients with incomplete or inaccessible medical records.

Data Collection-

Data were collected prospectively through systematic review of patient medical files and medication charts. Baseline data collection was conducted from 1st August 2025 till 20th September 2025.post intervention data was collected from 25th September 2025 till 25th 25th october 2026.

The following variables were recorded using a standardized data collection proforma:
Patient demographics (age and sex)
Primary indication for analgesia and documented pain severity
Relevant comorbidities (including diabetes mellitus, hypertension, chronic kidney disease, chronic liver disease, respiratory disease, and malignancy)
Type and dose of analgesic(s) prescribed
WHO analgesic ladder step at which treatment was initiated:
Step 1: Non-opioids (paracetamol ± NSAIDs)
Step 2: Weak opioids (e.g., tramadol, codeine)
Step 3: Strong opioids (e.g., morphine, fentanyl)
Use of adjuvant analgesics where applicable
Route of administration (oral, intravenous, intramuscular)
Appropriateness of the prescribed step in relation to documented pain severity
Presence of documented contraindications to the prescribed analgesic
Use of paracetamol and/or NSAIDs prior to opioid prescription
Use of intravenous tramadol as first-line therapy
Pattern of prescribing (scheduled vs PRN only) and prescription of breakthrough analgesia
Evidence of pain reassessment within 1–6 hours and documentation of analgesic-related side effects
Patient identifiers were not recorded to ensure confidentiality.

Baseline Audit (PDSA Cycle 1 – Plan and Do)

The baseline audit assessed existing analgesic prescribing practices against the predefined WHO analgesic ladder standards. This phase aimed to identify gaps in compliance, with particular attention to:
Inappropriate initiation of opioid therapy.
Excessive use of intravenous tramadol injections.
Bypassing of non-opioid analgesic steps.

Analysis and Feedback (PDSA Cycle 1 – Study)

Baseline findings were analyzed descriptively and presented to the medical team during departmental meetings. Key deficiencies and areas for improvement were highlighted, emphasizing patient safety, guideline adherence, and rational prescribing.

Intervention Strategy (PDSA Cycle 2 – Act)

Based on baseline audit findings, a targeted, multifaceted intervention was implemented, which included:
Educational sessions for junior and senior doctors on the WHO analgesic ladder and rational pain management.
Visual reminders and posters outlining the stepwise analgesic approach displayed in doctors' rooms and wards.
Informal reinforcement during ward rounds, encouraging initial use of paracetamol and NSAIDs where appropriate.
Emphasis on limiting the use of injectable tramadol to clearly indicated cases and promoting oral analgesics whenever feasible.

Post-Intervention Re-Audit (PDSA Cycle 2 – Do and Study)

Following implementation of the intervention, a re-audit was conducted using the same methodology, inclusion criteria, and data collection tools. Analgesic prescribing patterns were reassessed to determine changes in compliance with WHO analgesic ladder standards and reductions in inappropriate opioid and injectable analgesic use.

Ethical Considerations

Ethical approval for this study was obtained from institutional review board AMC (Approval Code/Ref. No.RC-EA-

2025/293.Confidentiality was strictly maintained throughout the study, and all data were anonymzed to ensure the privacy of participants,in accordance with the ethical standards of the institutional and national research committee and with the principles of the Declaration of Helsinki.

Results

Study Population

A total of 200 patients were included in the audit. Of these, 100 patients were assessed during the baseline (pre-intervention) audit and 100 patients during the post-intervention re-audit. All included patients met the predefined inclusion criteria. No patient identifiers were recorded.

Baseline Patient Characteristics

Baseline demographic and clinical characteristics were comparable between the pre- and post-intervention groups (Table 1).

Table 1: Demographic and Clinical Characteristics of Patients

Variable	Pre-intervention (n=100)	Post-intervention (n=100)
Mean age (years)	51.8 ± 16.4	50.9 ± 15.8
Male gender	58 (58%)	56 (56%)
Acute pain	62 (62%)	65 (65%)
Chronic non-cancer pain	26 (26%)	24 (24%)
Cancer-related pain	12 (12%)	11 (11%)
Diabetes mellitus	38 (38%)	36 (36%)
Hypertension	42 (42%)	40 (40%)
Chronic kidney disease	18 (18%)	17 (17%)
Chronic liver disease	9 (9%)	8 (8%)
Respiratory disease	11 (11%)	10 (10%)

Patient demographics, pain characteristics, and comorbidities were similar across both audit cycles, allowing meaningful comparison of prescribing practices before and after the intervention.

Baseline Compliance with WHO Analgesic Ladder

Baseline adherence to the WHO analgesic ladder was poor, with frequent bypassing of non-opioid steps and inappropriate early use of opioids (Table 2).

Table 2: Initial WHO Analgesic Ladder Step Prescribed

WHO Step	Pre-intervention	Post-intervention
Step 1 (Paracetamol ± NSAIDs)	22 (22%)	56 (56%)
Step 2 (Weak opioids)	61 (61%)	34 (34%)
Step 3 (Strong opioids)	17 (17%)	10 (10%)

Before intervention, most patients were started directly on Step 2 or Step 3 analgesics, contrary to WHO recommendations. After the intervention, initiation at Step 1 increased markedly, indicating improved guideline adherence.

Use of Intravenous Tramadol

The use of intravenous tramadol as first-line therapy was excessively high at baseline and decreased substantially following intervention (Table 3).

Table 3: Tramadol Prescribing Patterns

Variable	Pre-intervention	Post-intervention
Any tramadol use	74 (74%)	42 (42%)
IV tramadol as first-line	58 (58%)	21 (21%)
Tramadol prescribed without prior paracetamol/NSAIDs	49 (49%)	16 (16%)

Baseline data showed routine first-line IV tramadol use, often without trial of non-opioid analgesics. Post-intervention results demonstrate a significant reduction in inappropriate tramadol prescribing.

Route of Analgesic Administration

A strong preference for injectable analgesics was observed at baseline, with improvement after intervention (Table 4).

Table 4: Route of Analgesic Administration

Route	Pre-intervention	Post-intervention
Oral	31 (31%)	63 (63%)
Intravenous	59 (59%)	28 (28%)
Intramuscular	10 (10%)	9 (9%)

The intervention resulted in a shift towards oral analgesic use, aligning with WHO recommendations to avoid injectable routes when oral administration is feasible.

Appropriateness of Analgesic Choice

Appropriateness of the prescribed WHO step in relation to documented pain severity improved considerably (Table 5).

Table 5: Appropriateness of Analgesic Step

Assessment	Pre-intervention	Post-intervention
Appropriate for pain severity	29 (29%)	67 (67%)
Inappropriate	54 (54%)	21 (21%)
Insufficient documentation	17 (17%)	12 (12%)

More than half of baseline prescriptions were inappropriate for documented pain severity, whereas post-intervention data showed improved clinical decision-making and documentation.

Pain Reassessment and Safety Monitoring

Documentation of pain reassessment and monitoring for adverse effects was limited at baseline but improved after intervention (Table 6).

Table 6: Pain Reassessment and Safety Parameters

Parameter	Pre-intervention	Post-intervention
Pain reassessment within 1–6 hours	21 (21%)	61 (61%)
Documented side effects	14 (14%)	18 (18%)
Side effects appropriately managed	8 (8%)	15 (15%)
Breakthrough analgesia prescribed	19 (19%)	47 (47%)

Post-intervention findings indicate improved pain monitoring, breakthrough analgesia use, and safer prescribing practices. Percentages are calculated independently for each parameter; categories are not mutually exclusive.

Overall WHO Analgesic Ladder Compliance

Overall compliance with WHO analgesic ladder standards improved substantially following the quality improvement intervention (Figure/Table 7).

Table 7: Overall Compliance with WHO Analgesic Ladder

Compliance Status	Pre-intervention	Post-intervention
Compliant	26 (26%)	68 (68%)
Non-compliant	74 (74%)	32 (32%)

The intervention resulted in a more than two-fold increase in overall compliance, reflecting the effectiveness of targeted education and reinforcement strategies.

Table 8: Change in Key Prescribing Indicators (Pre vs Post)

Indicator	Pre-intervention (%)	Post-intervention (%)	Absolute Change (%)
Step-1 initiation	22	56	+34
Any opioid use	78	44	−34
IV tramadol as first-line	58	21	−37
Oral route preferred	31	63	+32
Appropriate WHO step	29	67	+38
Pain reassessed within 6 h	21	61	+40

Table 9: WHO Analgesic Step Prescribed According to Documented Pain Severity (Post-Intervention)

Pain Severity	Step 1 n (%)	Step 2 n (%)	Step 3 n (%)
Mild (n=65)	49 (75%)	14 (22%)	2 (3%)
Moderate (n=24)	7 (29%)	15 (63%)	2 (8%)
Severe (n=11)	0 (0%)	5 (45%)	6 (55%)

This table demonstrates improved alignment between pain severity and WHO step selection following intervention.

Table 10: Key Compliance Domains Summary (Derived from Tables 4–7)

Compliance Domain	Pre-intervention (%)	Post-intervention (%)
Stepwise prescribing followed	26	68
Oral route preferred	31	63
Opioid use justified by pain severity	29	67
Pain reassessed within 6 hours	21	61

Table 10 summarizes core compliance indicators already presented in preceding tables for ease of interpretation.

Pictorial presentations

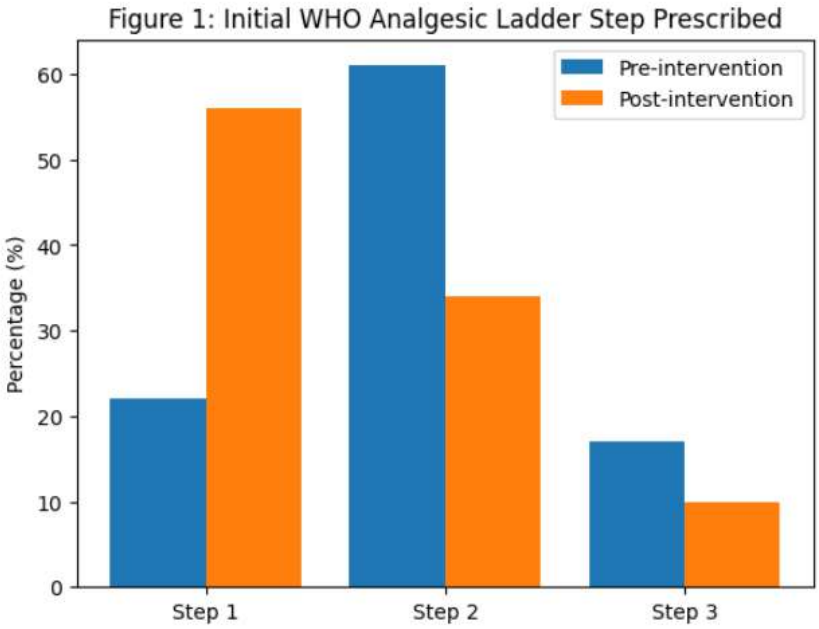


Figure 2: Tramadol Use (Pre-intervention)

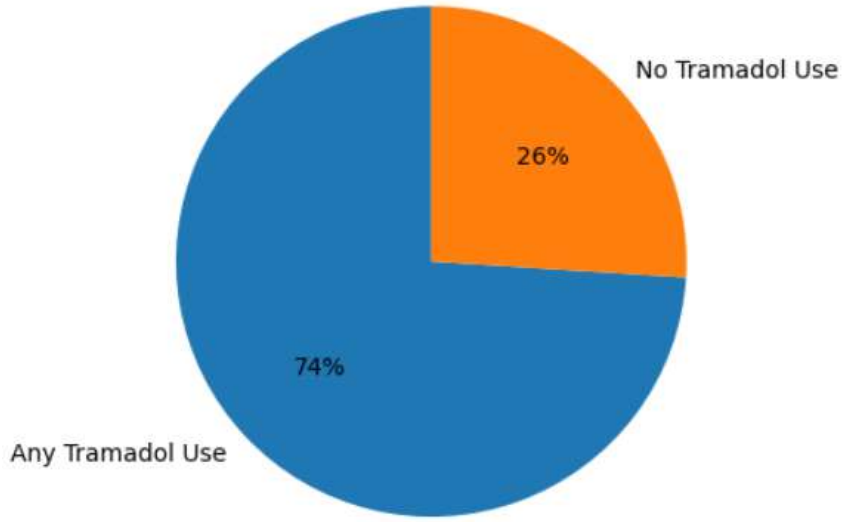


Figure 4: IV Tramadol as First-line Therapy

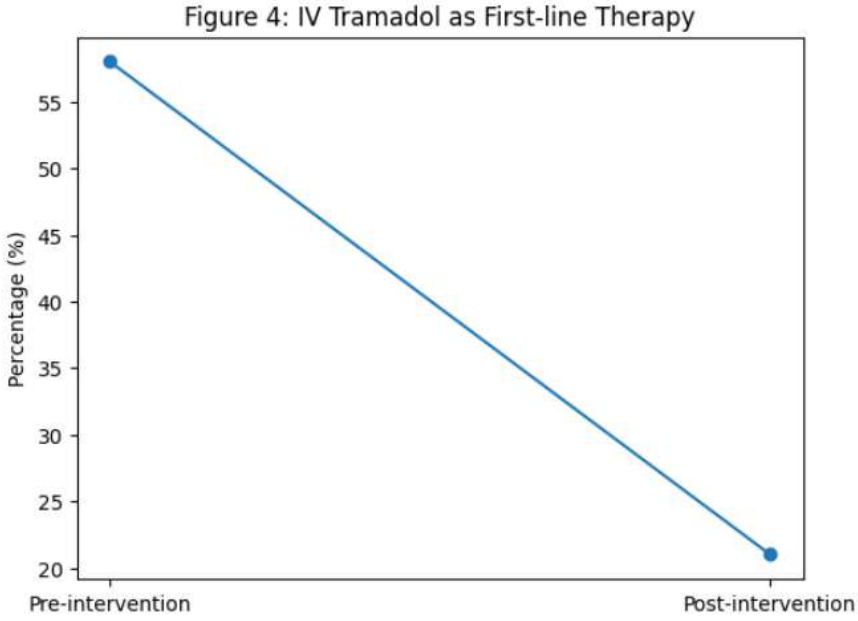


Figure 3: Tramadol Use (Post-intervention)

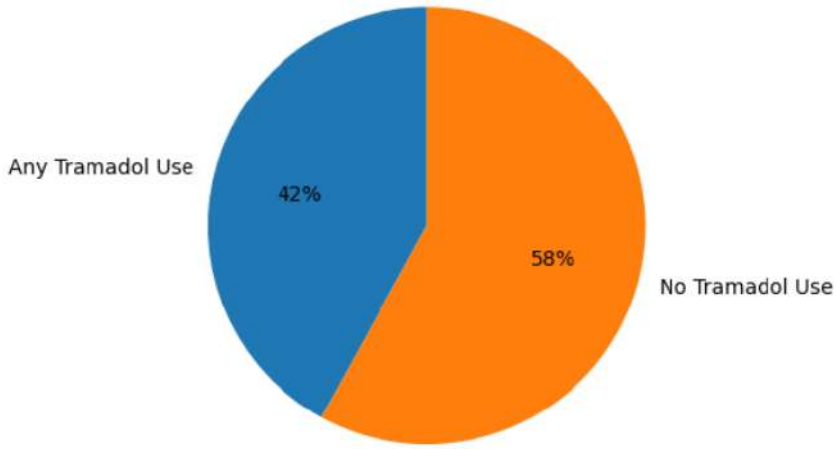
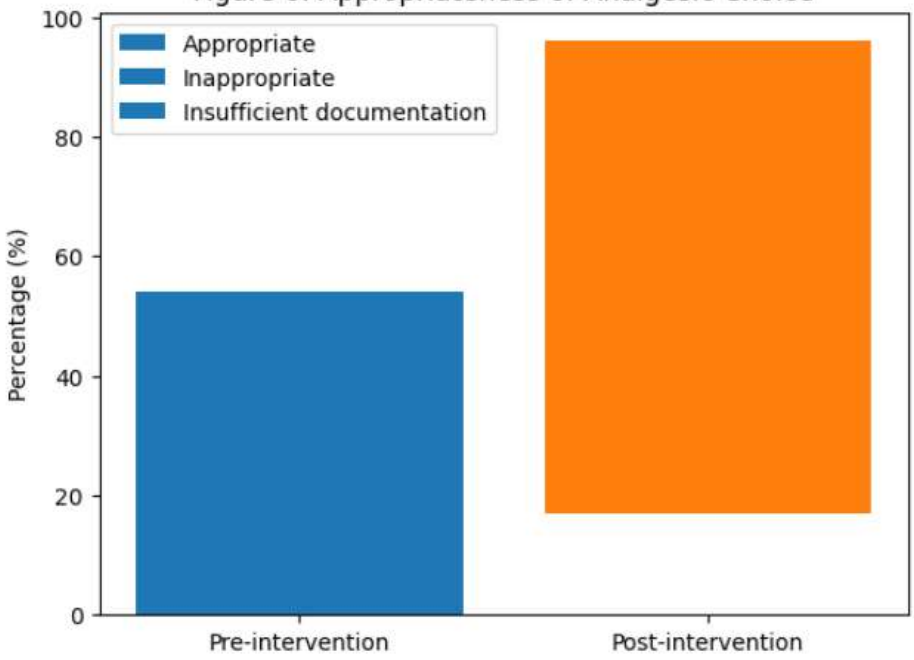
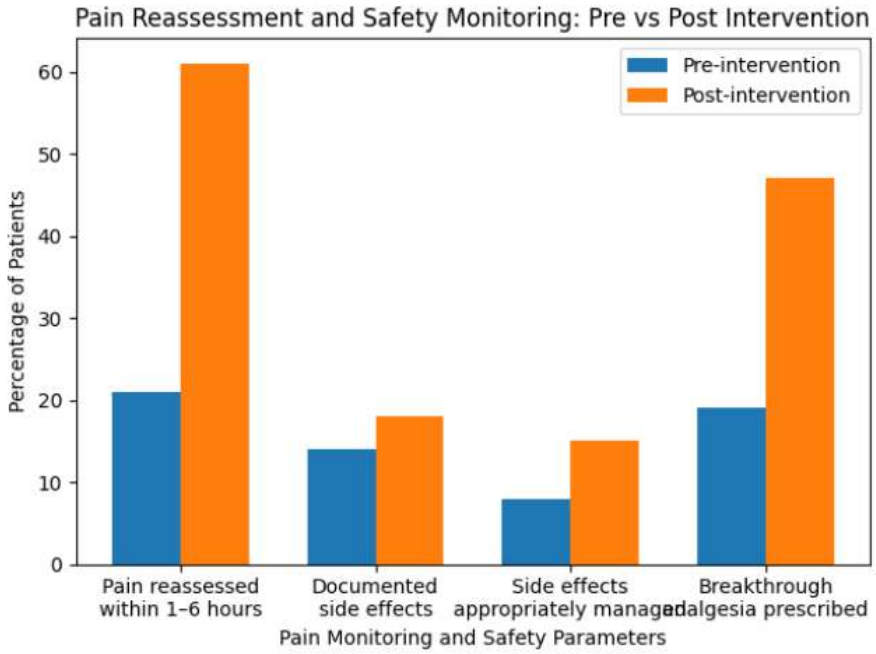


Figure 6: Appropriateness of Analgesic Choice




Pain Reassessment and Safety Monitoring: Pre vs Post Intervention
Pre-intervention
Post-intervention
Percentage of Patients
0
10
20
30
40
50
60
Pain reassessed within 1–6 hours
Documented side effects
Side effects appropriately managed
Breakthrough analgesia prescribed
Pain Monitoring and Safety Parameters

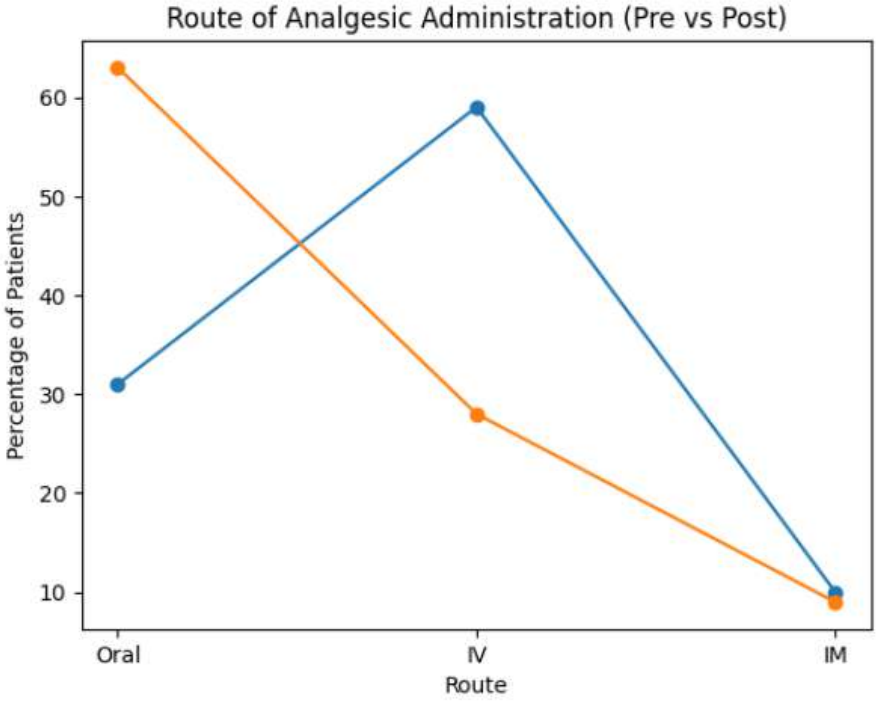
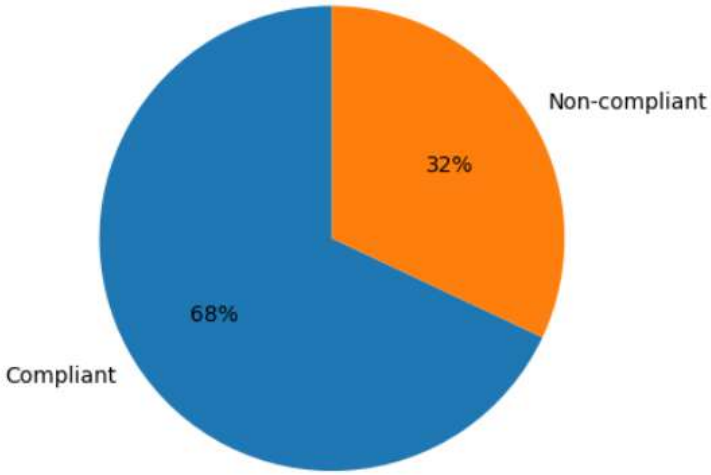

Route of Analgesic Administration (Pre vs Post)
Percentage of Patients
10
20
30
40
50
60
Oral
IV
IM
Route

Figure 7: Overall WHO Analgesic Ladder Compliance (Post-intervention)



Discussion

This clinical audit and subsequent quality improvement (QI) project identified significant baseline deficiencies in adherence to the WHO analgesic ladder and demonstrated that targeted, low-cost interventions can lead to marked and clinically meaningful improvements in analgesic prescribing practices. At baseline, analgesic use in this tertiary care medical unit was characterized by premature escalation to opioid therapy, excessive reliance on injectable tramadol, limited utilization of non-opioid analgesics, and poor documentation of pain reassessment. Following structured educational and behavioral interventions, substantial improvement was observed across all measured domains, including guideline adherence, route of administration, appropriateness of analgesic choice, and pain monitoring.

The poor baseline compliance observed in this study is consistent with a substantial body of regional and international literature. The WHO analgesic ladder, originally introduced in 1986 and subsequently reaffirmed in multiple guideline updates, emphasizes stepwise escalation, oral administration when feasible, and regular reassessment of pain10. Despite its simplicity and widespread endorsement, real-world adherence remains inconsistent. Studies from South Asia have repeatedly demonstrated a tendency to bypass Step 1 analgesics and initiate opioids early, particularly injectable tramadol. For instance, a prescribing audit by Khan et al. in a Pakistani tertiary hospital found that opioids were frequently prescribed without prior optimization of paracetamol or NSAIDs, even for mild to moderate pain12. Similar findings were reported by Aziz et al., who observed irrational analgesic prescribing patterns and overuse of injectable opioids in hospitalized patients across multiple departments13.

The excessive use of intravenous tramadol identified in the pre-intervention phase of this study reflects a broader prescribing culture prevalent in many LMIC healthcare systems. Tramadol is often perceived as a “safe” opioid with fewer regulatory constraints, leading to its widespread use despite well-documented risks, including nausea, seizures, serotonin syndrome, and dependence14. International data have raised concerns regarding inappropriate tramadol use, particularly in inpatient settings. A multicentre study by Thiels et al. demonstrated that tramadol exposure is associated with persistent opioid use following hospitalization, challenging the notion that it is a benign alternative to other opioids15. The high baseline rate of first-line intravenous tramadol use in the present study therefore represents not only guideline non-compliance but also a potential patient safety concern.

Following implementation of the QI intervention, initiation of analgesia at Step 1 of

the WHO ladder increased significantly, while inappropriate opioid use declined. This finding aligns with evidence from other audit-based interventions demonstrating that clinician education and real-time feedback are effective tools for modifying prescribing behavior. In a UK hospital-based audit, Curtis et al. reported sustained improvements in analgesic prescribing following targeted education on pain management guidelines16. Similarly, a study by Gordon et al. showed that embedding WHO analgesic principles into routine ward practice led to improved pain control and reduced opioid exposure without compromising patient comfort17. The present study adds to this evidence by demonstrating comparable benefits in a resource-limited, high-volume tertiary care setting.

A particularly important outcome of this project was the shift from injectable to oral analgesic routes. WHO and international pain societies consistently recommend oral administration as the preferred route due to its safety, cost-effectiveness, and patient acceptability18. Inappropriate use of injectable analgesics has been associated with increased risk of infections, medication errors, and healthcare costs. The marked increase in oral analgesic use observed post-intervention indicates improved alignment with global best practices and suggests increased clinician confidence in stepwise pain control rather than reliance on rapid parenteral relief.

Improvement in pain reassessment and documentation further strengthens the impact of this QI initiative. Pain is a dynamic symptom, and failure to reassess undermines both safety and effectiveness of treatment. International standards emphasize routine reassessment as a core component of pain management18. Although baseline documentation in this study was poor, post-intervention reassessment rates improved substantially, reflecting enhanced clinical vigilance. Similar improvements have been reported in studies where structured pain education was introduced, including work by Meissner et al., who demonstrated better pain outcomes and safer prescribing when reassessment was emphasized.

To sustain improvements, periodic re-audits and integration of WHO analgesic ladder principles into induction training are recommended.

Strengths and Limitations

Strengths

This study's main strength lies in its pragmatic, real-world design as a clinical audit with a structured quality improvement intervention using a PDSA cycle. Assessment against established WHO analgesic ladder standards ensured evaluation against robust, evidence-based criteria. Comparable pre- and post-intervention patient populations allowed meaningful attribution of observed improvements to the intervention. The multifaceted, low-cost intervention was feasible, reproducible, and particularly suited to resource-limited settings. Evaluation of multiple prescribing domains, including analgesic choice, route of administration, and pain reassessment, provided a comprehensive assessment of pain management quality.

Limitations

The clinical audit was conducted in a single medical unit, limiting generalizability. The sample size was modest and patient-reported outcomes such as pain scores and satisfaction were not assessed, restricting evaluation to process measures. Reliance on clinical documentation may have introduced information bias. Lack of long-term follow-up limit conclusions regarding causality and sustainability of improvements.

Conclusion

This clinical audit and subsequent quality improvement project demonstrated poor baseline adherence to the WHO analgesic ladder in a tertiary care medical unit, characterized by inappropriate early opioid use, excessive reliance on injectable tramadol, and inadequate pain reassessment. Implementation of a targeted, low-cost, educational intervention led to substantial improvement in guideline-compliant, stepwise analgesic prescribing, increased use of non-opioid and oral analgesics, and better documentation of pain monitoring. These findings highlight that simple, structured quality improvement measures can significantly enhance rational pain management practices even in high-volume, resource-limited settings.

Regular audit, ongoing clinician education, and institutional support are essential to sustain these improvements and ensure safe, patient-centred pain management.

Additional Information

Conflicts of Interest: None

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Critical Review &Final Approval; Ahmad Zeb1, Iram Akbar2

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