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ANTIEPILEPTIC DRUG PRESCRIBING PATTERNS AND CLINICAL OUTCOMES IN PEDIATRIC SEIZURE DISORDERS: A CROSS-SECTIONAL STUDY FROM A TERTIARY CARE HOSPITAL IN KASHMIR

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ABSTRACT

Background: Anticonvulsant prescribing in children must balance seizure control against the vulnerabilities of a developing brain, yet drug utilization data from paediatric epilepsy populations in the Kashmir valley remain scarce.

Objectives: To describe the demographic, clinical, and etiological profile of children admitted with seizure disorders; to characterize antiepileptic drug (AED) prescribing patterns; and to determine short-term clinical outcomes at discharge and their association with therapy pattern and seizure category.

Methods: This cross-sectional, observational study enrolled 200 children (<18 years) admitted with seizure disorders to a tertiary paediatric referral centre in Srinagar, following Institutional Ethics Committee approval (Ref. IRBGMC-SGR/Pharma/533). Structured, pretested proformas captured demographic, clinical, aetiological, investigational, and prescribing variables. Data were analysed in SPSS v26.0; categorical comparisons used the chi-square test, with $p<0.05$ considered significant.

Results: Infants (≤1 year) formed the largest age group (36.0%), with a male predominance (59.0%, M:F 1.44:1) and a majority from lower-middle socioeconomic strata (70.0%). Epilepsy with acute symptomatic seizures accounted for 69.0% of admissions; structural brain abnormalities (31.5%) and idiopathic causes (31.0%) were the leading aetiologies. Levetiracetam was the most frequently prescribed AED (62.0%), followed by sodium valproate (49.0%); monotherapy was used in 56.0% of patients. A favourable outcome at discharge (seizure controlled or improved) was achieved in 89.0% of patients, and was more frequent with monotherapy than polytherapy (92.9% vs 84.1%) and in acute symptomatic seizures than epileptic encephalopathy (91.3% vs 80.0%).

Conclusion: Levetiracetam-predominant, largely monotherapy-based prescribing in this Kashmiri

paediatric cohort was associated with favourable short-term seizure outcomes, while epileptic encephalopathy and polytherapy subgroups showed higher rates of partial or poor discharge outcomes reflecting greater underlying disease severity. Underutilisation of EEG (54.0%) and neuroimaging (53.0%) represents an actionable diagnostic gap.
Key words: antiepileptic drugs; drug utilization study; pediatric epilepsy; levetiracetam; Kashmir**;** prescribing pattern

Introduction

Epilepsy is among the commonest chronic neurological disorders of childhood, with the steepest rise in cumulative incidence occurring in the first year of life.[15] The immature brain is disproportionately susceptible to seizures because of incomplete myelination, delayed maturation of GABAergic inhibitory circuits, and a relative predominance of excitatory NMDA-receptor signalling during early development. Rational antiepileptic drug (AED) prescribing in children is complicated by age-dependent pharmacokinetics, a narrower margin for weight-based dosing error, and drug-specific safety concerns valproate hepatotoxicity in infancy, phenobarbitone-related neurocognitive effects, and the idiosyncratic cutaneous reactions associated with aromatic AEDs in South Asian populations.[43] Drug utilization studies (DUS), grounded in the World Health Organization's framework for the marketing, distribution, prescription, and use of medicines, provide the descriptive foundation needed before prescribing rationality can be improved.[1] The Kashmir valley presents a distinct epidemiological context: a documented burden of vitamin D deficiency-related hypocalcaemic seizures in infants,[64] a predominantly public-sector tertiary care system serving a population with a substantial lower-and lower-middle socioeconomic strata,[62],[63] and to our knowledge no published paediatric AED drug utilization data. Regional prescribing patterns, aetiological spectra, and short-term outcomes in this setting have therefore not been systematically characterised.

This study describes the demographic and clinical profile, aetiological spectrum, antiepileptic drug prescribing pattern, and short-term discharge outcomes of children admitted with seizure disorders to a tertiary care paediatric hospital in Srinagar, and examines the association between therapy pattern, seizure category, and clinical outcome.

2. Materials and Methods

2.1 Study design and setting

This was an observational, cross-sectional drug utilization study conducted by the Postgraduate Department of Pharmacology, Government Medical College, Srinagar, in collaboration with the Department of Pediatrics, Government Medical College and Associated Hospitals (Children's Hospital), Bemina, Srinagar. The observational design was chosen to characterise real-world prescribing without altering clinician decision-making, in accordance with WHO guidance on drug utilization research and the INRUD prescribing-indicator framework.[1]

2.2 Study duration and ethical approval

The study was conducted over a 24-month period (January 2024–December 2025), comprising protocol development and ethics approval, a 12-month patient recruitment and data-collection phase, and a data analysis and manuscript preparation phase. Institutional Ethics Committee approval was obtained (Ref. No. IRBGMC-SGR/Pharma/533), and written informed consent was taken from parents/legal guardians, with assent from children above 7 years where appropriate. No therapeutic intervention or alteration of standard care was involved.

2.3 Participants

Consecutive pediatric patients (<18 years) admitted with a diagnosis of epilepsy or acute seizure and receiving anticonvulsant therapy were enrolled after informed consent. Children whose

parents/guardians declined consent were excluded. Based on an anticipated AED-prescription prevalence of 15–20% among pediatric admissions (Z=1.96, d=0.05), a minimum sample of 190 was calculated and rounded to 200 to allow for incomplete records.

2.4 Data collection and variables

Data were recorded on a structured, pretested proforma covering demographic variables (age, sex, weight, socioeconomic status by the Modified Kuppuswamy Scale), clinical variables (seizure category and semiology per ILAE 2017 criteria, past seizure history, developmental status), investigational findings (EEG, neuroimaging), and drug-related variables (individual AED, therapy type, route and duration of administration).

2.5 Statistical analysis

Data were entered in Microsoft Excel and analysed using IBM SPSS Statistics v26.0. Continuous variables are expressed as mean ± standard deviation; categorical variables as frequency and percentage. The chi-square test was used for categorical comparisons (e.g., outcome by therapy pattern, outcome by seizure category); $p<0.05$ was considered statistically significant.

2.6 Note on prescribing-indicator scope

Formal WHO/INRUD prescribing-indicator quantification (percentage of drugs prescribed by generic name, percentage from the National List of Essential Medicines, injection-use rate) and DU90% segment analysis were not performed in the present dataset and are therefore not reported here; this is stated explicitly as a scope limitation (Section 4.6) rather than inferred from the descriptive findings, and is recommended as the focus of a dedicated follow-up indicator-based analysis.

3. Results

Two hundred children met inclusion criteria. Findings are presented by demographic profile, clinical and etiological characteristics, AED utilization pattern, and short-term outcome.

3.1 Demographic and socioeconomic profile

Infants (≤1 year) constituted the largest age subgroup (36.0%), followed by toddlers (25.5%); the mean body weight of the cohort was 13.57 ± 8.54 kg (Table 1, Figure 1). A male predominance was observed (59.0%; M:F ratio 1.44:1), consistent across all age bands. Seventy percent of the cohort belonged to the lower-middle socioeconomic class.

Table 1. Demographic and socioeconomic characteristics of the study population (N = 200)

Characteristic	n	%
Age group Infants (≤1 yr)	72	36.0
Age group Toddlers (>1–3 yr)	51	25.5
Age group Preschool (>3–5 yr)	29	14.5
Age group School-age (>5–10 yr)	35	17.5
Age group Adolescents (>10–18 yr)	13	6.5
Sex Male	118	59.0
Sex Female	82	41.0
Socioeconomic class Lower	20	10.0
Socioeconomic class Lower middle	140	70.0
Socioeconomic class Middle	34	17.0
Socioeconomic class Upper middle	6	3.0

Mean body weight of the cohort: 13.57 ± 8.54 kg. Socioeconomic class assigned using the Modified Kuppuswamy Scale.

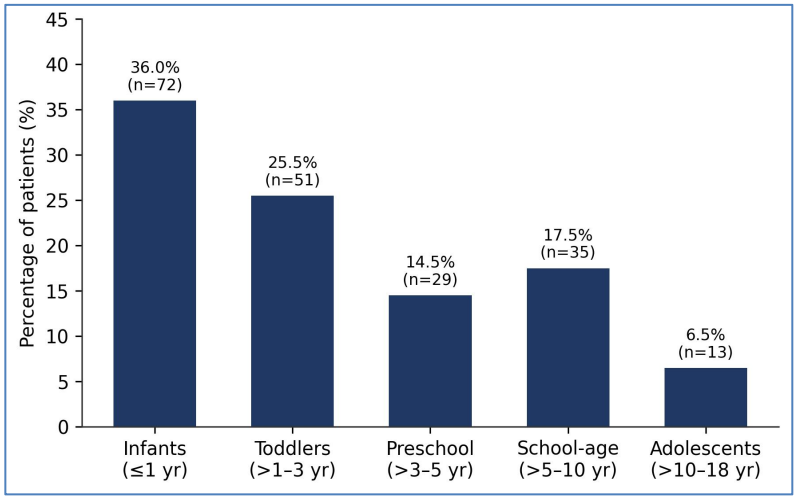

Figure 1. Age distribution of the study population (N = 200).

3.2 Clinical and seizure characteristics

Epilepsy with acute symptomatic seizures was the predominant category (69.0%), followed by chronic epilepsy (21.0%) and epileptic encephalopathy with repetitive/continuous seizures (10.0%) (Table 2, Figure 2A). Generalized tonic–clonic seizures were the commonest semiology (48.0%). A first seizure episode was the presentation in 57.0% of children, and developmental delay was documented in 31.0%, predominantly among those with epileptic encephalopathy and structural aetiologies.

Table 2. Clinical and seizure characteristics of the study population (N = 200)

Characteristic	n	%
Epilepsy with acute symptoms	138	69.0
Chronic epilepsy	42	21.0
Epileptic encephalopathy	20	10.0
GTCS	96	48.0
Focal seizures	38	19.0
Focal with secondary generalization	30	15.0
Myoclonic seizures / epileptic spasms	20	10.0
Semiology not specified	16	8.0
Past history of seizures present	86	43.0
First seizure episode	114	57.0
Developmental delay	62	31.0
Normal development	138	69.0

GTCS: generalized tonic–clonic seizures. Seizure category and semiology classified per ILAE (2017) criteria.

3.3 Etiological and investigational profile

Structural brain abnormalities (31.5%) and idiopathic/unknown causes (31.0%) were the leading aetiologies, followed by metabolic causes (19.5%) and genetic/epileptic syndromes (18.0%) (Table 3, Figure 2B). EEG and neuroimaging were performed in 54.0% and 53.0% of children respectively; among those investigated, abnormal findings were seen in 30.0% (EEG) and 26.0% (neuroimaging). Intensive care (ICU/PICU) admission was required in 28.0% of the cohort overall, and was most frequent among children with epileptic encephalopathy (50.0% of that subgroup) compared with chronic epilepsy (33.3%) and acute symptomatic seizures (23.2%).

Table 3. Etiological spectrum, investigational profile, and ICU utilization (N = 200)

Variable	n	%
Structural brain abnormality	63	31.5
Idiopathic / unknown	62	31.0
Metabolic cause	39	19.5
Genetic / epileptic syndrome	36	18.0
EEG performed	108	54.0
EEG abnormal (of total N)	60	30.0
Neuroimaging performed	106	53.0
Neuroimaging abnormal (of total N)	52	26.0
ICU / PICU admission required	56	28.0

ICU admission rate by seizure category: epileptic encephalopathy 50.0% (10/20), chronic epilepsy 33.3% (14/42), acute symptomatic seizures 23.2% (32/138).

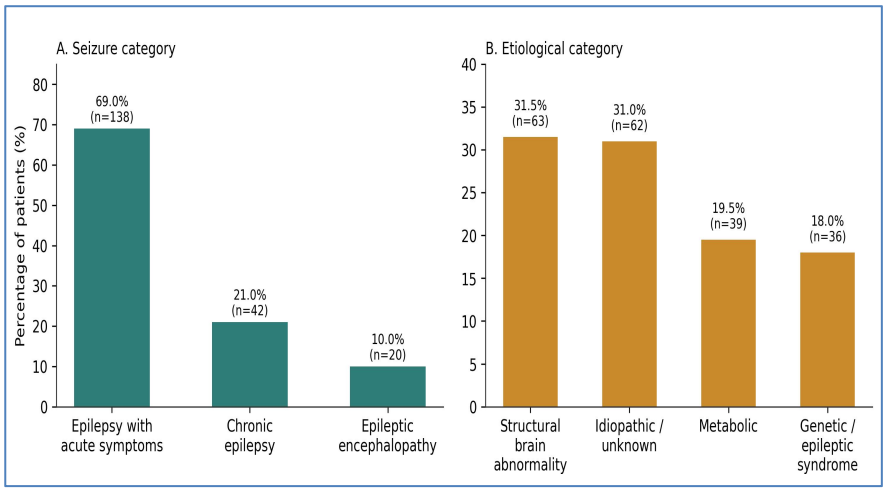

Figure 2. Seizure category (A) and etiological spectrum (B) of the study population (N = 200).

3.4 Antiepileptic drug utilization pattern

Levetiracetam was the most frequently prescribed AED (62.0%), followed by sodium valproate (49.0%), benzodiazepines (34.0%), phenytoin (28.0%), phenobarbitone (26.0%), and newer agents lacosamide, topiramate, clobazam in 18.0% (percentages exceed 100% as patients could receive >1 AED) (Table 4, Figure 3). Monotherapy was used in 56.0% of patients and polytherapy in 44.0% (two AEDs 23.0%; ≥3 AEDs 12.0%); 9.0% required no AED. Oral administration was the commonest route overall (44.0%), with 31.0% receiving intravenous therapy only and 25.0% transitioning from IV to oral.

Table 4. Antiepileptic drug utilization pattern (N = 200)

Variable	n	%
Levetiracetam	124	62.0
Sodium valproate	98	49.0
Benzodiazepines	68	34.0

Phenytoin	56	28.0
Phenobarbitone	52	26.0
Newer AEDs (lacosamide/topiramate/clobazam)	36	18.0
Monotherapy	112	56.0
Dual therapy (2 AEDs)	46	23.0
Triple or more AEDs	24	12.0
No AED required	18	9.0
Oral route only	88	44.0
Intravenous route only	62	31.0
IV → oral (step-down)	50	25.0

AED: antiepileptic drug. Individual-drug percentages are not mutually exclusive.

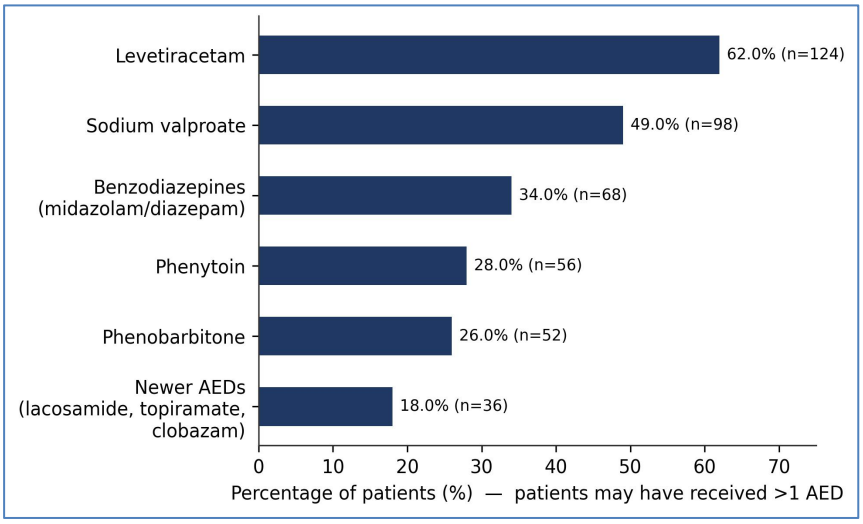

Figure 3. Frequency of individual antiepileptic drugs prescribed (N = 200).

3.5 Clinical outcome at discharge and associations

A favourable outcome (seizure controlled or clinically improved) was achieved in 89.0% of the cohort; 66.0% were seizure-free and 23.0% improved, while 7.0% showed partial control and 4.0% were referred or left against medical advice (Table 5). Favourable outcome was more common with monotherapy than polytherapy (92.9% vs 84.1%) and in acute symptomatic seizures than in chronic epilepsy or epileptic encephalopathy (91.3%, 85.7%, and 80.0% respectively) (Figure 4). Both associations are consistent with confounding by underlying disease severity rather than a direct causal effect of therapy choice or seizure category.

Table 5. Outcome at discharge and its association with therapy pattern and seizure category (N = 200)

Variable	Controlled/ improved n (%)	Partial/ poor n (%)	Total
Overall outcome	178 (89.0)	22 (11.0)	200
Monotherapy (n=112)	104 (92.9)	8 (7.1)	112
Polytherapy (n=88)	74 (84.1)	14 (15.9)	88
Acute symptomatic seizures (n=138)	126 (91.3)	12 (8.7)	138

Variable	Controlled/ improved n (%)	Partial/ poor n (%)	Total
Chronic epilepsy (n=42)	36 (85.7)	6 (14.3)	42
Epileptic encephalopathy (n=20)	16 (80.0)	4 (20.0)	20

"Controlled/improved" combines seizure-free and clinically improved categories; "partial/poor" combines partial control, referral, and leaving against medical advice (LAMA).

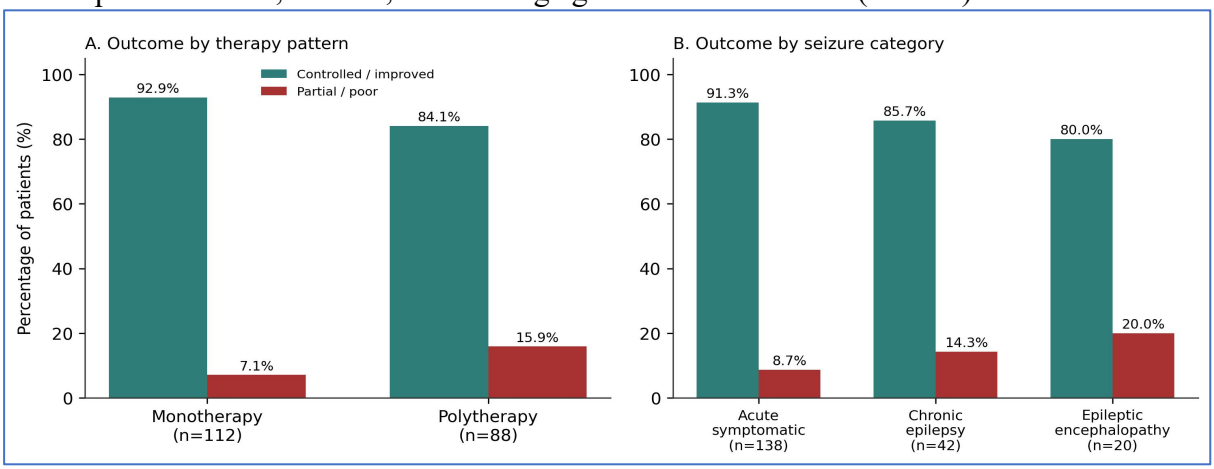

Figure 4. Outcome at discharge stratified by therapy pattern (A) and seizure category (B) (N = 200).

4. Discussion

4.1 Demographic and socioeconomic profile

The predominance of infants and toddlers (61.5% combined) in the present cohort is consistent with the well-documented peak susceptibility of the immature brain to seizure activity,[15] and mirrors findings from Bangalore[77] and other Indian tertiary paediatric neurology settings.[73] The male predominance (59.0%, M:F 1.44:1) is likewise consistent with regional[77] and international cohorts,[88] and with the broader epidemiological literature suggesting a modestly higher incidence of epilepsy in males.[13] The concentration of patients in lower and lower-middle socioeconomic strata (80.0% combined) reflects the demography of tertiary public-sector paediatric care in this setting and carries direct implications for AED affordability, adherence, and follow-up.

4.2 Seizure category and etiological spectrum

Epilepsy with acute symptoms accounted for the majority of admissions (69.0%), a pattern that reflects the case-mix of an acute inpatient referral service rather than an outpatient epilepsy clinic; multicentre Indian outpatient series report a substantially higher proportion of chronic epilepsy.[82] Structural and idiopathic causes together accounted for 62.5% of aetiologies, with metabolic causes including hypocalcaemia associated with vitamin D deficiency, a locally documented problem in Kashmiri children[64] contributing 19.5%. This aetiological distribution reinforces the importance of a systematic metabolic and structural work-up before committing a child to long-term AED therapy, since correction of a reversible biochemical cause may obviate the need for chronic pharmacotherapy.

EEG and neuroimaging were performed in only 54.0% and 53.0% of children respectively. Given that EEG is central to ILAE-based epilepsy syndrome classification and therefore to rational AED selection,[53] this represents a diagnostic gap; comparable under-utilisation of EEG has been linked to inappropriate broad-spectrum prescribing in focal epilepsy in other cohorts.[88]

4.3 Antiepileptic drug prescribing pattern

Levetiracetam's emergence as the leading AED (62.0%), ahead of sodium valproate (49.0%), represents a marked departure from the historical Indian pattern of valproate/carbamazepine dominance[26] and exceeds the levetiracetam-prescribing proportions reported from other Indian tertiary centres.[71],[82] This is pharmacologically plausible: levetiracetam's SV2A-mediated mechanism, linear pharmacokinetics, minimal hepatic metabolism, and availability in both oral and intravenous formulations make it well suited to a cohort dominated by infants and acute presentations, and it has demonstrated efficacy in paediatric convulsive status epilepticus with a favourable respiratory-depression profile relative to phenytoin.[67] The continued use of phenytoin (28.0%) and phenobarbitone (26.0%) for acute and neonatal indications respectively reflects their low cost and rapid availability in a resource-constrained public health setting, notwithstanding their less favourable neurocognitive and pharmacokinetic profiles.[71]

Monotherapy was achieved in 56.0% of patients lower than the 58–94% typically reported from outpatient chronic-epilepsy cohorts[87] but consistent with a more acute, inpatient case-mix that includes epileptic encephalopathies and status epilepticus requiring sequential drug escalation. The step-down pattern of administration (31.0% IV-only, 25.0% IV-to-oral) mirrors recommended emergency neurology protocols for transitioning from acute parenteral control to oral maintenance therapy.

4.4 Clinical outcome

A favourable short-term outcome in 89.0% of the cohort compares favourably with published series reporting 71–75% seizure freedom or improvement at comparable time-points.[95],[82] This is most plausibly explained by the large proportion of acute symptomatic seizures in the present cohort, which generally respond well once the precipitant is treated, rather than by any specific pharmacological superiority. The lower favourable-outcome rate in polytherapy (84.1% vs 92.9% for monotherapy) and in epileptic encephalopathy (80.0% vs 91.3% for acute symptomatic seizures) should be interpreted as confounding by indication: children requiring polytherapy or carrying an encephalopathy diagnosis have intrinsically more severe and refractory disease, and the observed outcome gap reflects that severity rather than any inadequacy of the therapy itself.

4.5 Strengths

This is, to our knowledge, the first systematic drug utilization study of paediatric anticonvulsant prescribing from the Kashmir valley. The cohort spans the full clinical spectrum of paediatric seizure disorders acute symptomatic seizures, chronic epilepsy, and epileptic encephalopathy encountered at a tertiary referral centre, and provides a baseline against which future prescribing-pattern changes can be benchmarked.

4.6 Limitations

- Cross-sectional, single-centre design precludes causal inference and limits generalisability to primary/secondary care settings.
- Outcome was assessed only at discharge; longer-term seizure control, adherence, and neurodevelopmental outcome were not captured.
- Formal WHO/INRUD prescribing-indicator quantification (percentage generic prescribing, percentage from the National List of Essential Medicines, injection-use rate) and DU90% segment analysis were not performed on this dataset; prescribing rationality is therefore discussed qualitatively rather than quantified against these indicators, and this is identified as a priority for a dedicated follow-up analysis using the underlying prescription-level data.
- Adverse drug reaction outcomes associated with these AED regimens are reported separately (companion pharmacovigilance analysis) and are not included in the present outcome measures.

5. Conclusion

In this first paediatric anticonvulsant drug utilization study from the Kashmir valley, prescribing was predominantly levetiracetam-based and monotherapy-oriented, and was associated with a favourable short-term outcome in the large majority of children. Epileptic encephalopathy and polytherapy subgroups carried a disproportionate share of partial or poor outcomes, consistent with greater underlying disease severity rather than treatment inadequacy. Under-utilisation of EEG and neuroimaging represents an actionable target for diagnostic quality improvement, and a dedicated indicator-based (WHO/INRUD, DU90%) analysis of the same prescription dataset is recommended as the next step toward a complete rationality assessment.

Ethical Approval

Institutional Ethics Committee, Government Medical College, Srinagar (Ref. No. IRBGMC-SGR/Pharma/533).

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