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Original Article

To Analyze the Prescription Pattern and Evaluate the Safety of Drugs Prescribed Among Stroke Patients Admitted to the Neuro Medicine Department of A Tertiary Care Teaching Hospital

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ABSTRACT

Background: Stroke is a leading cause of mortality and long-term disability worldwide. Patients with stroke often require multiple medications for the management of the primary condition and associated comorbidities, increasing the risk of polypharmacy and adverse drug reactions (ADRs). Evaluation of prescribing practices is essential to promote rational drug use and improve patient safety.

Objectives: To analyze the prescription pattern and evaluate the safety of drugs prescribed among stroke patients admitted to the Neuro-Medicine Department of a tertiary care teaching hospital.

Materials and Methods: A prospective, observational hospital-based study was conducted over 18 months among 141 radiologically confirmed stroke patients. Data regarding demographics, clinical characteristics, prescribed medications, and ADRs were collected using a structured proforma. Prescription patterns were assessed using World Health Organization (WHO) prescribing indicators. ADR causality and severity were evaluated using the Naranjo Scale and Modified Hartwig and Siegel Severity Classification, respectively. Statistical analysis was performed using SPSS version 23.0.

Results: Among 141 patients, 61.0% were males and 45.4% belonged to the 61–75 years age group. Acute ischemic stroke accounted for 70.2% of cases. A total of 851 drugs were prescribed, with an average of 6.04 drugs per encounter. Generic prescribing constituted 63.46% of prescriptions, while 96.24% of drugs were from the Essential Drug List. Antibiotics were prescribed in 43.97% of encounters and injections in 51.94%. Proton pump inhibitors (16.45%), antiplatelet agents (14.22%), and antiemetics (13.75%) were the most frequently prescribed drug classes. Fifteen ADRs were identified, predominantly involving gastrointestinal, neurological, and metabolic systems. According to the Naranjo Scale, 53.33% of ADRs were classified as possible and 46.67% as probable. Severity assessment revealed that 46.67% of ADRs were severe, 33.33% moderate, and 20.0% mild.

Conclusion: Acute ischemic stroke was the predominant diagnosis among hospitalized stroke patients. Although most drugs were prescribed from the Essential Drug List, polypharmacy, antibiotic use, and injection prescribing exceeded WHO recommendations. Continuous prescription monitoring and pharmacovigilance are necessary to promote rational drug use and enhance patient safety in stroke management.

Keywords*: Stroke, Prescription Pattern, Drug prescription, WHO Prescribing Indicators, Adverse Drug Reactions, Polypharmacy, Pharmacovigilance.*

INTRODUCTION

Stroke is a major global public health problem and remains one of the leading causes of mortality and long-term disability worldwide. It is characterized by the sudden onset of neurological deficits resulting from disturbances in cerebral blood circulation. Based on its pathophysiology, stroke is broadly classified into ischemic stroke, caused by interruption of blood flow to the brain, and haemorrhagic stroke, resulting from rupture of cerebral blood vessels. Ischemic stroke accounts for approximately 70–85% of all stroke cases, whereas haemorrhagic stroke contributes to the remaining cases but is associated with higher mortality and morbidity rates [1,2].

According to the World Health Organization (WHO), stroke is the second leading cause of death globally and a major contributor to disability-adjusted life years (DALYs) lost. The burden of stroke is particularly increasing in low- and middle-income countries, including India, due to demographic transitions, population aging, urbanization, and increasing prevalence of cardiovascular risk factors such as hypertension, diabetes mellitus, dyslipidaemia, smoking, obesity, and sedentary lifestyles [3,4].

The management of stroke requires a multidisciplinary approach involving acute stabilization, prevention of complications, secondary prevention, and rehabilitation. Pharmacotherapy forms the cornerstone of stroke management and commonly includes antiplatelet agents, anticoagulants, antihypertensive drugs, statins, osmotic diuretics, neuroprotective agents, proton pump inhibitors, and supportive medications. However, stroke patients often receive multiple medications simultaneously because of associated comorbidities and the complexity of treatment protocols, leading to polypharmacy [5].

Polypharmacy in stroke patients may increase the risk of adverse drug reactions (ADRs), drug-drug interactions, medication errors, reduced treatment adherence, prolonged hospitalization, and increased healthcare expenditure. Therefore, periodic evaluation of prescribing practices is essential to ensure rational drug use and optimize therapeutic outcomes [6]. Drug prescription studies provide valuable insights into prescribing trends and help identify areas where prescribing practices may deviate from established treatment guidelines. Such studies are important tools for promoting rational prescribing and improving patient safety [7].

The World Health Organization has developed standardized prescribing indicators that serve as objective measures for assessing the quality of prescription practices. These indicators include the average number of drugs per encounter, percentage of drugs prescribed by generic name, percentage of encounters with antibiotics prescribed, percentage of encounters with injections prescribed, and percentage of drugs prescribed from the Essential Drug List (EDL) [8]. Evaluation of these indicators helps in identifying irrational prescribing patterns and provides evidence for interventions aimed at improving prescribing behavior.

Monitoring ADRs is another critical component of pharmacovigilance in stroke patients. Early identification and assessment of ADRs can reduce patient morbidity, improve medication adherence, and prevent serious complications. Standardized tools such as the Naranjo Causality Assessment Scale and the Modified Hartwig and Siegel Severity Assessment Scale are commonly used to evaluate the causality and severity of ADRs [9,10].

Although several studies have investigated drug prescription patterns in different clinical settings, limited data are available regarding prescription patterns and ADR profiles among stroke patients in tertiary care teaching hospitals in northern India. Therefore, the present study was undertaken to analyze the prescription pattern and evaluate the safety of drugs prescribed among stroke patients admitted to the Neuro-Medicine Department of a tertiary care teaching hospital.

MATERIALS AND METHODS

Study Design and Duration

This prospective, observational, hospital-based study was conducted to evaluate the prescription pattern and safety of drugs prescribed among patients with stroke. The study was carried out over a period of 18 months in the Department of Pharmacology in collaboration with the Department of Neuro-Medicine, G.S.V.M. Medical College, Kanpur, and its associated hospitals.

Study Population

The study population comprised patients admitted with a diagnosis of stroke who fulfilled the eligibility criteria.

Inclusion Criteria

Patients were included if they:

- Were aged more than 18 years.
- Had a diagnosis of stroke confirmed by computed tomography (CT) or magnetic resonance imaging (MRI).
- Were receiving one or more prescription medications.

- Provided written informed consent to participate in the study.

Exclusion Criteria
Patients were excluded if they:
- Had intracranial abnormalities such as subdural hematoma, brain tumor, or dementia.
- Could not undergo CT or MRI confirmation.
- Declined to provide informed consent.
- Were immunocompromised.
- Were pregnant or lactating women.

Sampling Including Sample Size Calculation
The sample size was calculated using Yamane's formula:

$$n=\frac{N}{1+N(e)^2}$$

Where:
- n = Sample size
- N = Population size
- e = Margin of error (0.05)

Substitution:
- N = 218
- e = 0.05

$$n=\frac{218}{1+218(0.05)^2}$$

$$n=\frac{218}{1+218(0.0025)}$$

$$n=\frac{218}{1+0.545}$$

$$n=\frac{218}{1.545}$$

$$\boldsymbol{n=141.1\approx 141}$$

Final Sample Size
The calculated sample size was 141 patients**.**

Data Collection
Eligible patients were identified according to the predefined inclusion and exclusion criteria. After obtaining written informed consent, relevant information was collected using a structured data collection proforma.

Data were obtained from:
- Bed Head Tickets (BHTs)
- Patient prescriptions
- Clinical records

The following variables were recorded:
- Demographic characteristics (age and gender)
- Educational status
- Occupation
- Socioeconomic status
- Type of stroke
- Prescribed medications
- Route of drug administration
- Adverse drug reactions (ADRs)

Assessment of Prescription Pattern
Prescription analysis was performed using the World Health Organization (WHO) prescribing indicators. The following indicators were evaluated:

1. Average number of drugs per encounter.
2. Percentage of drugs prescribed by generic name.
3. Percentage of encounters with an antibiotic prescribed.
4. Percentage of encounters with an injection prescribed.
5. Percentage of drugs prescribed from the Essential Drug List (EDL).

The completeness of prescription writing was assessed based on the documentation of:

- Drug name (generic or brand)
- Dose
- Frequency of administration
- Route of administration
- Date of prescription
- Signature of the prescriber

Drug prescription patterns were further analyzed according to therapeutic drug classes and the number of drugs prescribed per encounter.

Stroke Severity Assessment
Clinical assessment of stroke severity was performed using the National Institutes of Health Stroke Scale (NIHSS) wherever applicable. The scale was utilized to provide a standardized evaluation of neurological deficits among stroke patients.

Socioeconomic Assessment
Socioeconomic status of the participants was assessed using the Modified Kuppuswamy Socioeconomic Scale (2023 update).

Adverse Drug Reaction Monitoring
Patients were monitored throughout their hospital stay for the occurrence of adverse drug reactions. All suspected ADRs were documented and classified according to the affected organ system and clinical presentation.

Causality Assessment
The causality relationship between the suspected drug and the reported adverse event was assessed using the Naranjo Adverse Drug Reaction Probability Scale. ADRs were categorized as definite, probable, possible, or doubtful according to the obtained score.

Severity Assessment
The severity of ADRs was evaluated using the Modified Hartwig and Siegel Severity Assessment Scale and categorized as mild, moderate, or severe.

Pilot Study
A pilot study was conducted on a small subset of patients before initiation of the final study. The pilot phase was undertaken to evaluate the feasibility of the study design, validate the data collection instrument, and identify potential operational difficulties. Necessary modifications were incorporated before commencement of the main study.

Validity and Reliability
The structured data collection proforma was validated by experts from the Departments of Pharmacology and Medicine. Standard WHO prescribing indicators and validated ADR assessment scales were employed to ensure content validity. Data accuracy and reliability were maintained through regular cross-checking and verification of collected information.

Ethical Considerations
The study protocol was approved by the Institutional Ethics Committee of G.S.V.M. Medical College, Kanpur, before the initiation of the study. Written informed consent was obtained from all participants. Confidentiality and anonymity of patient information were maintained throughout the study. Participation was voluntary, and patients were free to withdraw from the study at any stage without affecting their treatment.

Statistical Analysis
Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 23.0. Categorical variables were expressed as frequencies and percentages, whereas continuous variables were expressed

as mean ± standard deviation (SD) and median values where appropriate. Associations between categorical variables were assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

A total of 141 stroke patients were included in the study. Demographic characteristics, socioeconomic status, stroke type, prescribing patterns, WHO prescribing indicators, drug prescription patterns, and adverse drug reactions were analyzed.

Table 1. Demographic Characteristics of Study Participants (n = 141)

Variable	Frequency	Percentage (%)
Age (years)		
18–30	**4**	**2.8**
31–45	**15**	**10.6**
46–60	**41**	**29.1**
61–75	**64**	**45.4**
>75	**17**	**12.1**
Gender		
Male	**86**	**61.0**
Female	**55**	**39.0**

The majority of patients belonged to the 61–75 years age group (45.4%). Males constituted 61.0% of the study population.

Table 2. Educational and Occupational Status of Study Participants (n = 141)

Variable	Frequency	Percentage (%)
Educational Status		
Illiterate	**38**	**27.0**
Primary School	**27**	**19.1**
High School	**27**	**19.1**
Intermediate	**22**	**15.6**
Graduate	**27**	**19.1**
Occupation		
Service Class	**21**	**14.9**
Skilled Workers	**11**	**7.8**
Business/Self-employed	**15**	**10.6**
Agricultural Workers	**9**	**6.4**
Manual Labour	**9**	**6.4**
Non-working/Dependent	**76**	**53.9**

Most participants were non-working/dependent (53.9%), while 27.0% were illiterate.

Table 3. Socioeconomic Status and Stroke Type Distribution (n = 141)

Variable	Frequency	Percentage (%)
Socioeconomic Class		
Upper (I)	**6**	**4.5**
Upper Middle (II)	**4**	**3.0**
Lower Middle (III)	**39**	**27.7**
Upper Lower (IV)	**85**	**60.3**
Lower (V)	**7**	**5.0**
Type of Stroke		
Acute Ischemic Stroke	**99**	**70.2**
Acute Hemorrhagic Stroke	**42**	**29.8**

Most patients belonged to the Upper Lower socioeconomic class (60.3%). Acute ischemic stroke was the predominant diagnosis (70.2%).

Table 4. Prescription Profile of Study Population

Parameter	Value
Total number of patients	**141**
Total number of drugs prescribed	**851**
Average drugs per encounter	**6.04**

A total of 851 medications were prescribed, with an average of 6.04 drugs per encounter.

Table 5. Generic Prescribing and Essential Drug List

Parameter	Value	Percentage (%)
Drugs prescribed by generic name	540	63.46
Drugs prescribed by brand name	311	36.54
Drugs from EDL	819	96.24
Drugs not from EDL	32	3.76

Most drugs were prescribed by generic name, and 96.24% of medications belonged to the Essential Drug List.

Table 6. Antibiotic and Route of Administration Pattern

Parameter	Value	Percentage (%)
Encounters with antibiotics prescribed	62	43.97
Intravenous drugs	442	51.94
Oral drugs	409	48.06

Antibiotics were prescribed in 43.97% of encounters. Intravenous administration was slightly more common than oral administration.

Table 7. Distribution of Number of Drugs per Encounter

Number of Drugs	Frequency	Percentage (%)
<5 drugs	18	12.76
5–8 drugs	117	82.98
≥9 drugs	6	4.25

Most patients (82.98%) received 5–8 medications per encounter, indicating moderate polypharmacy.

Table 8. WHO Prescribing Indicators

Indicator	Value
Average number of drugs per encounter	6.04
Drugs prescribed by generic name (%)	63.46
Encounters with antibiotics prescribed (%)	43.97
Encounters with injections prescribed (%)	51.94
Drugs prescribed from EDL (%)	96.24

The average number of drugs per encounter, antibiotic use, and injection use were higher than WHO recommended values, whereas EDL was high.

Table 9. Distribution of Drug Classes Prescribed (n = 851)

Drug Class	Frequency	Percentage (%)
Proton Pump Inhibitors	140	16.45
Antiplatelet Drugs	121	14.22
Antiemetics	117	13.75
Osmotic Diuretics	110	12.93
Laxatives	93	10.93
Antihypertensives	93	10.93
Statins	66	7.76
Antibiotics	62	7.29
CNS Drugs	27	3.17
Antidiabetics	8	0.94
Others	14	1.63

Proton pump inhibitors were the most commonly prescribed drug class, followed by antiplatelet agents and antiemetics.

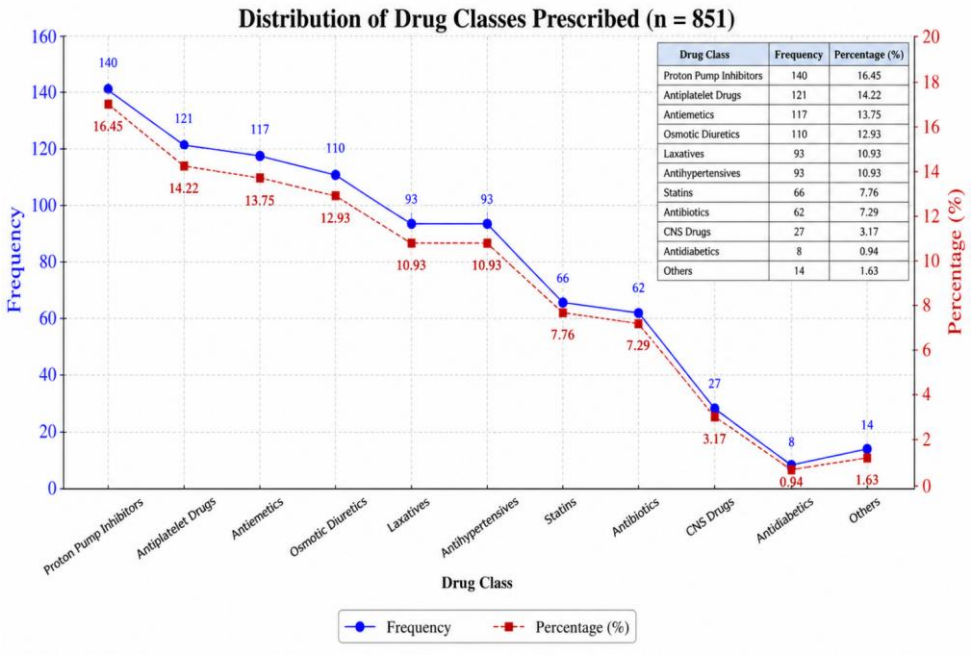

Table 10. Adverse Drug Reactions, Naranjo Causality Assessment and MHSC Severity Classification

Parameter	Frequency	Percentage (%)
Adverse Drug Reactions		
Gastritis	**3**	**20.00**
Dizziness/Headache	**3**	**20.00**
Myalgia	**2**	**13.33**
Nausea/Vomiting	**2**	**13.33**
Abdominal cramps/Weakness	**3**	**20.00**
Rash	**1**	**6.67**
Pedal edema	**1**	**6.67**
Electrolyte imbalance	**3**	**20.00**
Naranjo Scale		
Possible	**8**	**53.33**
Probable	**7**	**46.67**
MHSC Severity		
Mild	**3**	**20.00**
Moderate	**5**	**33.33**
Severe	**7**	**46.67**

DISCUSSION

The present prospective observational study was conducted among 141 stroke patients admitted to a tertiary care teaching hospital to evaluate prescribing patterns and assess the safety of prescribed medications. The findings provide valuable information regarding demographic characteristics, prescribing behaviour, WHO prescribing indicators, drug prescription trends, and adverse drug reactions among stroke patients.

The majority of patients belonged to the 61–75 years age group (45.4%), indicating that stroke predominantly affects the elderly population. Similar findings have been reported by previous studies, which demonstrated that increasing age is a major risk factor for stroke due to progressive vascular changes, atherosclerosis, and accumulation of cardiovascular risk factors [11,12]. Male patients constituted 61.0% of the study population, which is consistent with earlier reports showing a higher incidence of stroke among males compared to females, possibly because of greater exposure to behavioural and cardiovascular risk factors [13].

The socioeconomic analysis revealed that most patients belonged to the upper-lower socioeconomic class (60.3%). This finding may reflect the increased burden of stroke among economically disadvantaged populations who often have limited access to preventive healthcare services and poor control of modifiable risk factors [14]. Furthermore, a substantial proportion of participants were non-working or dependent, which may be attributable to advanced age and disability associated with stroke.

In the present study, ischemic stroke accounted for 70.2% of cases, whereas hemorrhagic stroke constituted 29.8%. This distribution is comparable with global epidemiological data indicating that ischemic stroke is the predominant subtype worldwide [15]. The higher frequency of ischemic stroke may be related to the widespread prevalence of hypertension, diabetes mellitus, dyslipidemia, and atherosclerotic vascular disease.

A total of 851 drugs were prescribed to 141 patients, resulting in an average of 6.04 drugs per encounter. This value is considerably higher than the WHO recommended range of 1.6–1.8 drugs per encounter [8]. Similar observations have been reported in other stroke drug prescription studies where multiple medications were required for management of the primary neurological condition and associated comorbidities [16]. Although polypharmacy is often clinically justified in stroke patients, excessive medication use may increase the risk of adverse drug reactions and drug interactions.

The percentage of drugs prescribed by generic name was 63.46%, which is lower than the WHO ideal value of 100%. Generic prescribing is encouraged because it reduces treatment costs and improves accessibility of medicines [8]. The observed rate suggests a need for further interventions to promote generic prescribing practices among healthcare professionals.

Antibiotics were prescribed in 43.97% of encounters, exceeding the WHO reference range of 20–26.8%. Increased antibiotic use may be explained by the presence of aspiration pneumonia, respiratory infections, urinary tract infections, and other complications commonly observed among hospitalized stroke patients [17]. Nevertheless, rational antibiotic stewardship remains essential to minimize antimicrobial resistance.

Injection use was observed in 51.94% of encounters, which is considerably higher than WHO recommendations. The predominance of injectable medications may reflect the acute nature of stroke management, the need for rapid therapeutic effects, and the frequent inability of patients to swallow oral medications during the acute phase of illness [18].

A notable finding of the study was the high Essential Drug List medications (96.24%). This observation reflects good adherence to institutional and national prescribing guidelines and indicates rational medicine selection practices.

Analysis of drug prescription patterns revealed that proton pump inhibitors were the most frequently prescribed medications (16.45%), followed by antiplatelet drugs (14.22%), antiemetics (13.75%), and osmotic diuretics (12.93%). Proton pump inhibitors were commonly prescribed for gastroprotection, especially in patients receiving antiplatelet therapy and multiple medications. Antiplatelet agents constituted a major component of therapy because of their established role in secondary prevention of ischemic stroke [19]. The frequent use of osmotic diuretics can be attributed to their effectiveness in reducing raised intracranial pressure in acute neurological conditions.

A total of 15 adverse drug reactions were documented during the study period. Gastrointestinal manifestations, including gastritis and nausea/vomiting, were among the most common ADRs observed. Neurological symptoms such as dizziness and headache were also frequently reported. Similar ADR patterns have been documented in previous pharmacovigilance studies involving stroke patients [20].

Causality assessment using the Naranjo Scale showed that 53.33% of ADRs were classified as possible and 46.67% as probable. None of the reactions were categorized as definite. These findings are consistent with earlier studies where most ADRs fell into the possible or probable categories because of the complexity of clinical conditions and concomitant medication use [21].

Severity assessment according to the Modified Hartwig and Siegel Scale revealed that severe ADRs accounted for 46.67% of cases, followed by moderate ADRs (33.33%). The occurrence of severe ADRs highlights the importance of continuous monitoring and pharmacovigilance in hospitalized stroke patients, particularly those receiving multiple medications.

Overall, the findings of the present study demonstrate a predominance of ischemic stroke, considerable polypharmacy, high Essential Drug List medicines, and the occurrence of clinically significant adverse drug reactions. It helps adherence to evidence-based guidelines, promotion of generic prescribing, and active pharmacovigilance programs may further improve the quality and safety of stroke management in tertiary care settings.

CONCLUSION

This study demonstrated that acute ischemic stroke was the predominant type of stroke and was more common among elderly male patients. Prescription analysis revealed moderate polypharmacy, with an average of 6.04 drugs per encounter. Most drugs were prescribed from the Essential Drug List, although the use of antibiotics and injections

exceeded WHO-recommended values. Proton pump inhibitors, antiplatelet agents, and antiemetics were the most frequently prescribed medications. Adverse drug reactions were relatively infrequent, with most classified as possible or probable and varying from mild to severe in intensity. The findings emphasize the need for rational prescribing, regular prescription monitoring, and effective pharmacovigilance to improve patient safety and therapeutic outcomes in stroke management.

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