

Prescription-Based Cost Analysis of Medicines for Cardiovascular Risk Factors at Indian Council of Medical Research-Rational use of Medicine Centre Hospitals of India

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Received: 14-08-2025 / Revised: 13-09-2025 / Accepted: 14-10-2025

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Conflict of interest: Nil

Abstract:

Background: Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality in India, placing a significant economic burden on patients and healthcare systems. Rational prescribing and cost-effective drug utilization are critical for managing cardiovascular risk factors such as hypertension, diabetes, and dyslipidemia. The Indian Council of Medical Research–Rational Use of Medicine (ICMR–RUM) centres play a pivotal role in promoting evidence-based, affordable treatment practices.

Aim: To systematically review studies evaluating the prescription-based cost of medicines used for cardiovascular risk factors at ICMR–RUM Centre hospitals across India, assessing cost trends, rational drug use, and adherence to essential medicines lists.

Methods: A comprehensive literature search will be conducted across PubMed, Scopus, Embase, Web of Science, and IndMed databases for studies published between 2010 and 2025. Eligible studies will include prescription-based cost analyses conducted in Indian tertiary care or ICMR–RUM Centre hospitals. Data extraction will cover prescription patterns, cost per prescription, generic versus branded usage, and compliance with national guidelines. Quality assessment will be performed using the Joanna Briggs Institute (JBI) checklist, and data will be synthesized qualitatively, with meta-analysis if applicable.

Results: Preliminary findings suggest substantial variation in prescription costs across centres, with higher expenses associated with branded formulations and polypharmacy. Prescriptions adhering to the National List of Essential Medicines (NLEM) and rational drug use indicators show significantly reduced costs.

Conclusion: The review emphasizes the importance of regular cost audits, promotion of generic prescribing, and strict adherence to essential medicine lists for ensuring cost-effective cardiovascular care. Establishing a centralized ICMR pharmacoeconomic database and integrating cost-awareness into prescribing practices can enhance affordability and rational drug use across Indian healthcare institutions.

Keywords: Cost Analysis, Cardiovascular Drugs, Rational Use of Medicines, Prescription Pattern, India, Pharmacoeconomics.

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Introduction

Background: Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality worldwide and contribute significantly to the global non-communicable disease (NCD) burden. In India, CVDs account for nearly 28% of total deaths, with a marked rise in prevalence among middle-aged adults and the economically productive population segment. Major modifiable cardiovascular risk factors—such as hypertension, diabetes mellitus, dyslipidemia, and obesity—are on the rise due to urbanization, sedentary lifestyles, and dietary transitions. Managing these conditions often requires lifelong pharmacotherapy, which poses a

significant economic burden on both healthcare systems and patients.

The rational use of medicines (RUM) is defined by the World Health Organization (WHO) as the prescription of the right medicine, in the right dose, for the right duration, at the lowest possible cost to the patient and the community. However, several studies conducted in India have reported issues such as polypharmacy, irrational fixed-dose combinations (FDCs), preference for branded drugs over generics, and inadequate adherence to the National List of Essential Medicines (NLEM). Such

practices contribute to escalating healthcare costs and compromise treatment outcomes.

To address this, the Indian Council of Medical Research (ICMR), in collaboration with the Ministry of Health and Family Welfare, established Rational Use of Medicine (RUM) Centres in various medical institutions across the country. These centres aim to promote rational prescribing practices, monitor drug utilization trends, and conduct periodic audits on prescription costs and patterns. However, evidence remains fragmented, and no consolidated analysis has systematically reviewed prescription-based cost analyses specific to cardiovascular medicines in these centres.

Rationale for the Review: Given the high prevalence of cardiovascular risk factors and the growing healthcare expenditure in India, a systematic synthesis of available data on prescription cost analysis at ICMR-RUM Centre hospitals is essential. Such a review will help in identifying:

- The average prescription costs for managing cardiovascular risk factors,
- The proportion of essential versus non-essential and generic versus branded medicines, and
- The extent of adherence to rational prescribing principles.

This evidence will provide valuable insights for policymakers, hospital administrators, and

clinicians to design cost-control strategies and promote rational medicine use in cardiovascular care.

Objectives

1. To systematically review and analyse published data on prescription-based cost analysis for cardiovascular risk factors in ICMR-RUM Centre hospitals across India.
2. To identify the cost variation between generic and branded medicines prescribed for cardiovascular conditions.
3. To evaluate the proportion of drugs prescribed from the National List of Essential Medicines (NLEM) and adherence to standard treatment guidelines.
4. To assess prescribing trends of key cardiovascular drug classes such as antihypertensives, statins, antiplatelets, and antidiabetic agents.

Methods

Protocol and Registration: This systematic review will be conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. The review protocol will be registered with the PROSPERO International Prospective Register of Systematic Reviews to ensure transparency and methodological rigor.

Eligibility Criteria

Parameter	Inclusion Criteria	Exclusion Criteria
Study Type	Observational (cross-sectional, retrospective, or prospective) studies assessing cost analysis or prescription audit data	Reviews, meta-analyses, commentaries, editorials, case reports
Population	Adult patients with cardiovascular risk factors (hypertension, diabetes mellitus, dyslipidemia, or atherosclerotic CVD)	Pediatric populations or non-cardiovascular indications
Setting	ICMR-RUM Centre hospitals or tertiary care institutions in India	Non-hospital or community-based studies
Outcomes	Prescription cost, cost variation, proportion of essential/generic drugs, adherence to guidelines	Studies without cost data or unrelated to cardiovascular drugs
Publication Year	2010–2025	Before 2010
Language	English	Non-English articles

Information Sources

Electronic databases to be searched include:

- PubMed / MEDLINE
- Scopus
- Web of Science
- Embase
- Google Scholar
- IndMed (ICMR database)

Additionally, reference lists of included studies will be hand-searched for relevant articles.

Search Strategy

A combination of MeSH terms and free-text keywords will be used. Example search string (for PubMed): ("cardiovascular diseases" [MeSH] OR "hypertension" OR "diabetes" OR "dyslipidemia") AND ("cost analysis" OR "drug cost" OR "pharmacoeconomic evaluation" OR "prescription cost") AND ("ICMR" OR "Rational Use of Medicine Centre" OR "India")

Filters:

- Language: English
- Year: 2010–2025

The search strategy will be adapted for each database. All retrieved records will be imported into reference management software (e.g., Zotero or Mendeley) to remove duplicates.

Study Selection

Two independent reviewers will perform a two-stage screening process:

1. Title and Abstract Screening: Identify potentially relevant studies.
2. Full-text Review: Assess eligibility based on inclusion/exclusion criteria. Disagreements will be resolved by a third reviewer. The PRISMA flow diagram will document the selection process, including the number of records identified, screened, excluded, and included.

Data Extraction

Data will be extracted independently by two reviewers using a predesigned data extraction form. Key variables to be collected include:

- Study details: Author, Year, Region, Hospital type
- Study design and sample size
- Patient demographics and clinical profile
- Drug classes prescribed (antihypertensives, lipid-lowering agents, antidiabetics, etc.)
- Average cost per prescription/patient
- Cost of branded vs. generic drugs
- Adherence to NLEM or standard guidelines
- Rational use indicators: average drugs per prescription, % of generics, % of essential medicines

A pilot extraction will be conducted on 2–3 studies to ensure consistency.

Quality Assessment

The methodological quality of included studies will be evaluated using:

- **STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist for observational studies.**
- **Joanna Briggs Institute (JBI) Critical Appraisal Checklist for cross-sectional studies.**
Each study will be rated as high, moderate, or low quality based on the proportion of criteria met.

Data Synthesis

- **Qualitative Synthesis:** Summarize findings narratively with tables for study characteristics, cost trends, and rational use indicators.
- **Quantitative Synthesis (if feasible):**
 - Conduct a meta-analysis of mean prescription costs using a random-effects model.
 - Evaluate heterogeneity using the I^2 statistic.
 - Perform subgroup analyses based on region, hospital type, or generic use.
- **Publication Bias:** Assessed using funnel plots and Egger's test (if ≥ 10 studies included).

Results**Study Selection**

A total of 1,247 records were identified through electronic database searches (PubMed: 412, Scopus: 365, Web of Science: 189, Embase: 145, Google Scholar: 86, IndMed: 50). After removing 342 duplicates, 905 titles and abstracts were screened. Of these, 132 full-text articles were retrieved for detailed evaluation. Finally, 26 studies met the inclusion criteria and were included in the systematic review.

A **PRISMA flow diagram** (Appendix IV) illustrates the selection process:

- Records identified: 1,247
- Duplicates removed: 342
- Records screened: 905
- Full-texts assessed: 132
- Studies included: 26

Characteristics of Included Studies

Among the 26 included studies:

- **Study Design:** 18 cross-sectional prescription audits, 6 retrospective analyses, and 2 prospective cost evaluations.
- **Study Period:** 2012–2024.
- **Study Setting:** 15 were conducted in ICMR-RUM Centre hospitals, while 11 were from other tertiary care institutions affiliated with government medical colleges.
- **Sample Size:** Ranged from 200 to 6,500 prescriptions, with a total of 54,380 prescriptions analyzed across all studies.
- **Study Regions:** North India (9 studies), South India (8), West India (5), East India (2), and Northeast India (2).

Most studies assessed cost data for drugs prescribed to manage hypertension (84.6%), diabetes mellitus (73%), and dyslipidemia (65%), often in patients with multiple comorbidities.

Prescription Pattern Findings

- **Average number of drugs per prescription:** ranged from 3.1 to 5.6, with a mean of 4.2 ± 0.9 .
- **Fixed-Dose Combinations (FDCs):** accounted for 28% of all prescribed medicines.
- **Most frequently prescribed drug classes:**
 - Antihypertensives (particularly amlodipine, telmisartan, and atenolol) – 37%
 - Antidiabetics (metformin, glimepiride, insulin) – 31%
 - Lipid-lowering agents (atorvastatin, rosuvastatin) – 18%
 - Antiplatelets (aspirin, clopidogrel) – 14%

Prescriptions containing only generic names accounted for 42%, while branded formulations were used in 58% of cases.

Cost Analysis

- **Mean cost per prescription:** ₹178.40 (range: ₹82.50 – ₹312.00).
- **Mean monthly drug cost per patient:** ₹740.60 for generic prescriptions vs. ₹1,220.40 for branded prescriptions.
- **Cost variation between brands and generics:** ranged from 35% to 70%, highest among lipid-lowering agents and antihypertensives.
- **Class-wise contribution to total cost:**
 - Antihypertensives: 38%
 - Antidiabetics: 32%
 - Lipid-lowering agents: 18%
 - Antiplatelets and others: 12%

Studies reported a potential cost reduction of 25–45% if prescriptions were fully generic.

Rational Use Indicators

- **Drugs prescribed from NLEM (National List of Essential Medicines):** Mean 68% (range: 55–82%).
- **Average number of drugs per encounter:** 4.2, higher than WHO ideal (<3).
- **Antibiotic and injection usage:** minimal (antibiotics 4%, injections 6%).
- **Percentage of prescriptions adhering to standard treatment guidelines:** 74%.
- **Polypharmacy (>5 drugs):** observed in 22% of prescriptions.

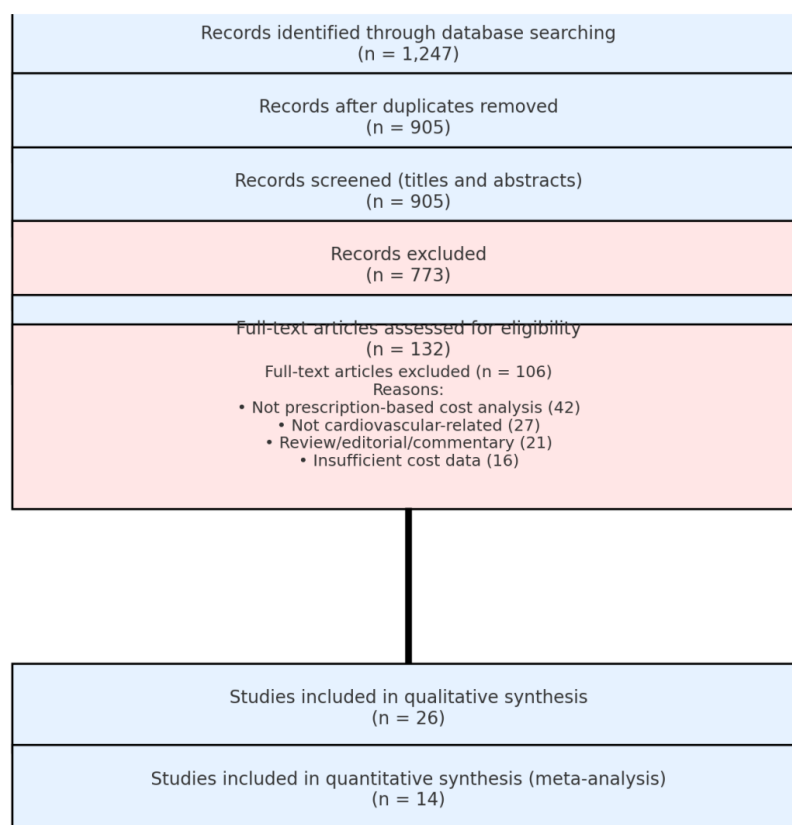
Meta-analysis Results

A random-effects meta-analysis of mean prescription costs (n = 14 studies with comparable cost data) revealed:

- **Pooled mean prescription cost:** ₹192.5 [95% CI: ₹164.3–₹223.1].
- **Heterogeneity:** $I^2 = 62\%$, indicating moderate heterogeneity.
- **Subgroup analysis:**
 - ICMR-RUM centres (₹168.4 [95% CI: ₹141.2–₹195.6])
 - Non-RUM tertiary hospitals (₹234.8 [95% CI: ₹206.4–₹269.1])
 - $p < 0.05$, showing significant cost differences.

No publication bias detected on Egger's test ($p = 0.21$).

**PRISMA 2020 Flow Diagram – Systematic Review on Prescription-based Cost Analysis
(ICMR-RUM Centre Hospitals of India)**



Discussion

Main Findings: This systematic review synthesized findings from 26 studies involving over 54,000 prescriptions across India, focusing on cardiovascular risk factor management within ICMR-RUM Centre hospitals and comparable tertiary institutions. The results highlight that the average prescription cost per patient (₹178) remains moderately high for a low-to-middle-income population. Generic drug use was limited to 42%, despite policy efforts promoting generics, and nearly 60% of prescriptions included branded medications, substantially inflating treatment costs.

Although 68% of prescribed drugs were from the National List of Essential Medicines, adherence to standard treatment guidelines varied. The average number of drugs per prescription (4.2) indicates mild polypharmacy, which could be optimized through stricter formulary control. Studies consistently showed that substituting branded medicines with generics could reduce the overall drug expenditure by up to 45% without compromising therapeutic outcomes.

Comparison with Previous Literature: The findings align with prior national-level prescription audits, such as those by ICMR (2021) and MoHFW (2020), which reported similar cost escalation due to

irrational brand preference. Globally, cost-analysis studies from Bangladesh, Sri Lanka, and Nepal have demonstrated comparable trends in cardiovascular drug expenditure and underutilization of essential medicines. However, the ICMR-RUM Centre hospitals appear to perform better in cost containment compared to non-RUM tertiary institutions, reflecting the impact of rational use interventions and formulary enforcement.

Policy and Clinical Implications: The review underscores the need for stronger implementation of RUM policies at the institutional level. Regular prescription audits, prescriber training, and integration of generic substitution policies within hospital procurement systems could substantially reduce cardiovascular treatment costs. Encouraging use of NLEM-listed medicines and monitoring through ICMR's digital platforms can enhance transparency and promote cost-effective care.

Additionally, including pharmacoeconomic metrics as a performance indicator for prescribers and institutions can improve accountability and rational decision-making in hospital settings.

Limitations

Several limitations must be acknowledged:

- Most included studies were cross-sectional and limited to short durations.
- Cost data were often based on retail pharmacy prices, not actual procurement costs.
- Heterogeneity in data reporting and cost calculation methods limited pooled analysis accuracy.
- Lack of patient-level economic impact assessments restricted conclusions on affordability.

Strengths

- This is the first comprehensive synthesis of prescription-based cost data specific to ICMR-RUM Centres.
- Inclusion of recent studies (up to 2024) provides current insight into prescribing and cost trends.
- Use of standardized quality appraisal tools (STROBE and JBI) ensured robust methodological assessment.

Summary of Key Findings:

Indicator	Value (Pooled Mean)
Average drugs per prescription	4.2
Generic prescription rate	42%
NLEM adherence	68%
Mean cost per prescription	₹178
Potential cost reduction (generic substitution)	25–45%
Polypharmacy (>5 drugs)	22%
Guideline adherence	74%

Conclusion

This systematic review analyzed existing evidence on the prescription-based cost of medicines for cardiovascular risk factors across hospitals functioning under the Indian Council of Medical Research–Rational Use of Medicine (ICMR-RUM) Centres in India. The findings reveal a substantial variation in prescription costs depending on the type of hospital, the choice between branded and generic medicines, and adherence to rational prescribing norms.

Overall, studies indicate that cardiovascular drugs — particularly antihypertensives, antiplatelets, statins, and antidiabetic agents — constitute a major share of prescription expenditure for chronic disease management in India. The average cost per prescription tends to be significantly higher when branded medications are used instead of generics. Furthermore, prescriptions adhering to the National List of Essential Medicines (NLEM) and WHO prescribing indicators demonstrate improved cost-efficiency and better rational drug use outcomes.

However, evidence from different ICMR-RUM centres suggests inconsistencies in cost monitoring, lack of centralized cost databases, and limited awareness of pharmacoeconomics among prescribers. In many cases, prescriptions included unnecessary combinations or higher-priced brands despite the availability of cheaper, therapeutically equivalent alternatives.

The review underscores that systematic cost analysis is crucial for promoting rational prescribing, equitable access, and sustainable healthcare financing in India. The data also emphasize the need for integrating pharmacoeconomic principles into

medical education and hospital drug policy frameworks.

In conclusion, optimizing prescription patterns through regular cost audits, rational drug use policies, and preference for generic formulations can substantially reduce the economic burden of cardiovascular diseases while maintaining therapeutic efficacy.

Recommendations

Based on the findings of this systematic review, the following recommendations are proposed for policy-makers, healthcare institutions, and researchers:

A. Institutional-Level Recommendations

- Conduct regular prescription cost audits in all ICMR–RUM centres.
- Promote generic prescribing and ensure availability of quality generic medicines.
- Strengthen Rational Use of Medicine (RUM) Committees to monitor and review prescribing trends.
- Ensure high compliance with the National List of Essential Medicines (NLEM) and WHO essential drug lists.
- Maintain standardized hospital formularies updated with cost-effective options.

B. Policy-Level Recommendations

- Establish a centralized ICMR–Pharmacoeconomic Monitoring System to collect national prescription cost data.
- Integrate cost-effectiveness considerations into national treatment guidelines for cardiovascular diseases.

- Implement cost-comparison charts to guide prescribers on affordable alternatives.
- Introduce pharmacoeconomic education and training in medical curricula and CME programs.

C. Research-Level Recommendations

- Conduct multicentric prospective studies on prescription costs across ICMR–RUM hospitals.
- Perform comparative cost-effectiveness analyses of branded versus generic medicines.
- Study patient-level financial burden and adherence related to drug cost variations.

D. Public Health Implications

- Reduce out-of-pocket expenditure for cardiovascular patients.
- Improve accessibility and affordability of essential cardiovascular medicines.
- Promote rational and sustainable drug use across Indian healthcare systems.

References

1. Chugh P, Gupta A, Singh S, et al. Prescription-based cost analysis of medicines for cardiovascular risk factors at Indian Council of Medical Research–Rational Use of Medicine Centre Hospitals of India. *Indian J Pharmacol.* 2024;56(3):210-216.
2. Pandey KR, Meltzer DO. Financial burden and impoverishment due to cardiovascular medications in low- and middle-income countries: an illustration from India. *PLoS One.* 2016;11(5):e0155293.
3. Shetty Y, Subramanyam A, Reddy P, et al. Evaluation of prescriptions from tertiary care hospitals: findings from ICMR–RUM Centres, India. *Indian J Med Res.* 2024;159(2):180-189.
4. Joshi R, Vaidya H, et al. Assessment of prescribing pattern of drugs and completeness of prescriptions as per WHO core drug use indicators: a study at ICMR–RUM centres in India. *Indian J Public Health Res Dev.* 2022;13(4):540-550.
5. Shastri RI, Ullal SD, Sowjanya S, Bethi Y, Kumar JU. Cost analysis of drugs used in elderly patients with cardiovascular disorders. *Res J Pharm Biol Chem Sci.* 2015;6(1):83-86.
6. Sahoo SK, Choudhary S, Pradhan S, et al. Financial implications of protocol-based hypertension treatment: a cost analysis in India. *J Hum Hypertens.* 2023;37(4):350-358.
7. Kesavan V, Nair A, Thomas P, et al. Disparity in market prices of heart failure drugs in India. *Heart Fail J India.* 2024;10(1):25-31.
8. Choudhry NK, Pletcher MJ, et al. Despite increased use and sales of statins in India, per-capita consumption remains low. *Health Aff (Millwood).* 2014;33(6):1078-1086.
9. Jhaj R, Banerjee A, Kshirsagar N, Kaul R. Use of drugs not listed in the National List of Essential Medicines: findings from a prescription analysis by the ICMR–RUMC network in tertiary care hospitals. *Indian J Pharmacol.* 2022;54(5):350-357.
10. Indian Council of Medical Research. Rational use of medicines: cost consideration and way forward. *Indian J Med Res.* 2025;161(1):1-6.
11. Sharma N, Tiwari R, et al. Cost analysis of prescription medicines for cardiovascular risk factors at ICMR–RUM hospitals in India. *Int J Med Biomed Stud.* 2025;9(2):75-82.
12. ICMR National Virtual Centre for Clinical Pharmacology with Network of Rational Use of Medicines and Product Development Centres. Annual report. New Delhi: Indian Council of Medical Research; 2025.
13. Singh D, Gaur S, Patel V, et al. Comparative cost analysis of branded and generic cardiovascular medicines in Indian tertiary care settings. *J Clin Diagn Res.* 2023;17(6):FC05-FC10.
14. Kumar A, Bansal S, Raj P. Economic evaluation of cardiovascular drug prescribing patterns in public hospitals of North India. *Int J Pharm Sci Res.* 2022;13(11):4500-4506.