Proceedings of the 4th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/49/20241296

Comments on prescriptions of big data from outpatient and emergency services using R

Xinyi Zhu

Department of Statistics and Data Science, School of Science, Southern University of Science and Technology, Shenzhen, Guangdong, 518055, China

12112944@mail.sustech.edu.cn

Abstract. To explore the high-frequency influencing factors of unqualified prescriptions, and promote rational drug use, the author evaluated on prescriptions of 245,352 from outpatient and emergency services using R in a large 3A hospital in 2023. Among the 245,352 prescriptions, 1,327 were evaluated as unreasonable, with a percentage of 0.54%. There were 1,368 issues related to irrational drug usage. Among the irrational prescriptions identified, the most prominent issues were inappropriate indications (59.16%) and incomplete writing in clinical diagnosis (17.78%). The departments with relatively high rates included head and neck surgery (5.94%), general medicine (3.33%), and convenient outpatient service (2.02%). The top five drugs in irrational prescriptions were Atorvastatin calcium tablets, Aspirin enteric-coated tablets, Calcium carbonate D3 tablets, Rabeprazole sodium enteric-coated tablets, and Metformin tablets, which were commonly used in chronic diseases. There was no significant correlation between the irrational rate and the professional title of the prescribing doctor. Overall, the quality of prescriptions in the hospital was satisfied, but there were still cases of irrational drug use. Hospitals should strengthen prescription review and rational drug use management to ensure the safety and effectiveness of patient medication.

Keywords: R language, outpatient, emergency, prescription comment, R packages

1. Introduction

Irrational usage of drugs has become a significant medical issue worldwide according to the World Health Organization (WHO), with over half of medications prescribed, dispensed, and used inappropriately [1]. In fact, irrational drug usage has been ranked as one of the top ten causes of death in USA [2]. Specifically, the utilization of antibiotics and injection drugs in China are significantly higher than the recommended range of the WHO, representing severe issues of irrational drug usage [3]. As we known, rational drug usage is not only the basis for ensuring the safety, economy, effectiveness of medication for patients, but also a prerequisite for the sustainable use of medical insurance funds, and a necessary requirement for the reform of hospital management [4]. Here in, prescription comment as an effective management tool is able to promote rational usage in clinic drugs. However, prescription comment belongs to post-intervention, which is not possible to correct irrational prescriptions. Additionally, it is limited by differences in sampling methods among various medical institutions, as well as the perspectives between doctors and pharmacists regarding medication issues, thus leading to a lack of comprehensive and objective evaluation of prescription comment results.

DOI: 10.54254/2753-8818/49/20241296

Adequate tools are needed for big data processing, and currently, the Excel is the most widely used office software for data processing. It is worth noting there are bottlenecks for big data processing, such as the limited amount of data, a single processing method, low efficiency, and high technical requirements for complex operations [5]. R language is a practical and open-source programming language primarily used for statistical analysis, plotting, and data mining, which can convert boring and simple numbers into graphical representations [6,7]. In this study, the author evaluated on prescriptions of 245,352 from outpatient and emergency services using R in a large 3A hospital in 2023, subsequently analyzed the influencing factors of unqualified prescriptions and displayed high-frequency factors visually. Collectively, this study provided a scientific basis for formulating relevant policies and improved rational drug use continuously.

2. Materials and Methods

2.1. Data Sources

A retrospective analysis was conducted on the evaluation results of irrational prescriptions at outpatient and emergency services in a 3A hospital from January to December 2023. A total of 245,352 prescriptions were evaluated, including 1,327 irrational prescriptions with 1,368 issues related to irrational drug usage. The information of prescriptions consisted of date, doctor's name, department, patient information (name, gender, age), diagnosis, medications (name, antibiotics, medical insurance status, essential drugs, cost, etc.), and existing problems in current and corresponding recommendations.

2.2. Methods

The pharmacists evaluated prescriptions based on the National Basic Drug List (2012 edition), Clinical Drug Use Guidelines from Pharmacopoeia of the People's Republic of China (2020 edition), Prescription Management Measures, Guiding Principles for Clinical Application of Antimicrobial Agents (2015 edition), Hospital Prescription Evaluation Management Regulations (Trial), drug instructions, and relevant references. The evaluation was conducted using both Meikang Pharmaceutical Software and manual methods. Approximately 20,000 prescriptions were evaluated monthly, with an annual sampling rate of 17.56%. According to the Guideline for the evaluation of prescription appropriateness, the prescriptions were evaluated and analyzed based on 3 main categories including non-standard prescriptions, inappropriate prescriptions, and excessive prescriptions, and and 24 sub-categories. Additionally, the other information was recorded including patient's information, the types, problem codes, the prescribed drugs, the reasons for irrational drug use, and handling recommendations of prescription.

2.3. Statistical Analysis

Excel 2010 was used for data registration and organization, and RStudio was employed for statistical analysis. The creation of Pareto charts for types of irrational drug used for factor analysis.

3. Results

3.1. Overview of irrational prescriptions

A total of 245,352 prescriptions were evaluated throughout 2023, among which 1,327 were registered as unreasonable, resulting in an irrational rate of 0.54%. Among these, the average drug types were 2.76 ± 1.41 per unreasonable prescription. The unreasonable use of antimicrobial drug was 13.04%, which met the national standard below 20%. The percentage of injection use was 0.78%. The proportion of national essential drugs accounted for 56.83%, exceeding the standard of $\geqslant$30%. The average prescription amount was 230.92 RMB, with the essential drugs accounting for 37.92% (Table 1).

DOI: 10.54254/2753-8818/49/20241296

3.2. Analysis of types for irrational prescriptions

There were 1,368 irrational items among the 1,327 unreasonable prescriptions. These included 468 cases of irregular prescriptions (34.21%), 899 cases of inappropriate prescriptions for drug use (65.72%), and 1 case of excessive prescriptions (0.08%). The top five issues in terms of frequency were inappropriate indications (2-1) (59.16%), incomplete in clinical diagnosis (1-10) (17.78%), unjustified overdosing (1-12) (16.96%), repeated dosing (2-7) (3.39%), and inappropriate dosage and usage (2-5) (2.86%), as displayed in Table 1.

Table 1. The codes and proportions of unreasonable prescriptions.(n=1327)

Types	Item names	Codes	Counts	Proportion(%)
Irregular prescriptions	Ambiguous words in usage and dosage	1-8	3	0.23
	Incomplete in clinical diagnosis	1-10	236	17.78
	Overdosing	1-12	225	16.96
	Unreasonable prescriptions in specially managed drugs	1-13	4	0.30
Inappropriate prescriptions	Inappropriate indications	2-1	785	59.16
	Inappropriate selections	2-2	15	1.13
	Inappropriate dosages and routes	2-3	1	0.08
	Inappropriate dosages and usages	2-5	38	2.86
	Inappropriate combined medications	2-6	12	0.90
	Repeated dosing	2-7	45	3.39
	Incompatibilities or side effects	2-8	2	0.15
	Other inappropriate situations	2-9	1	0.08
Excessive prescriptions	Medication without indication	3-1	1	0.08

Moreover, a Pareto chart was used to visualize these results. As displayed in Figure 1, the x-axis represented the various issues for irrational prescriptions, the left y-axis represented the number of that, displayed as bar charts, while the right y-axis represented the cumulative proportion of that, displayed as a line chart. The results of the bar chart and line slope indicated that inappropriate indications, incomplete in clinical diagnosis, and unjustified overdosing were the three most common factors for irrational prescriptions, with a proportion of 93.9%. Among them, inappropriate indications occurred most frequently (Figure 1).

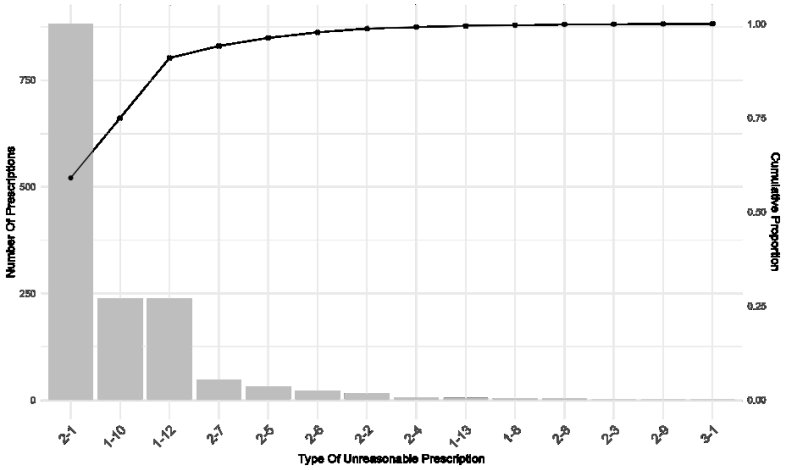

Figure 1. Pareto chart of unreasonable prescription types.

DOI: 10.54254/2753-8818/49/20241296

3.3. Distribution of irrational prescriptions among clinical departments

Among these irrational prescriptions, the top 10 departments were convenient outpatient service (252, 18.99%), general medicine (142, 10.70%), cardiology (110, 8.29%), infectious diseases (107, 8.06%), endocrinology (91, 6.86%), respiratory medicine (84, 6.33%), emergency (67, 5.05%), pediatrics (62, 4.67%), urology (56, 4.22%), and neurology (54, 4.07%) (Figure 2).

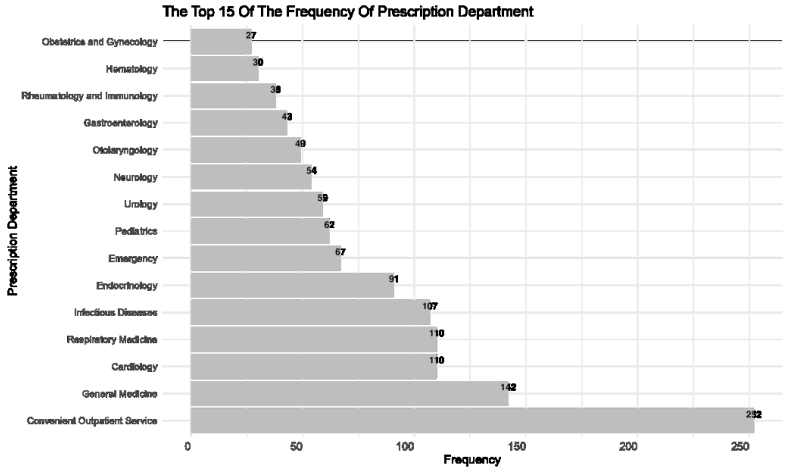

Figure 2. Distribution of unreasonable prescriptions in different departments.

3.4. Proportion of irrational prescriptions among different departments

The percentage of irrational prescriptions issued by each department was calculated, as displayed in Figure 3. The top 10 departments were head and neck surgery (5.94%), general medicine (3.33%), convenient outpatient service (2.02%), vascular surgery (1.71%), breast surgery (1.68%), cardiothoracic surgery (1.67%), neurosurgery (1.66%), hematology (1.54%), endocrinology (1.09%), and oncology (0.99%).

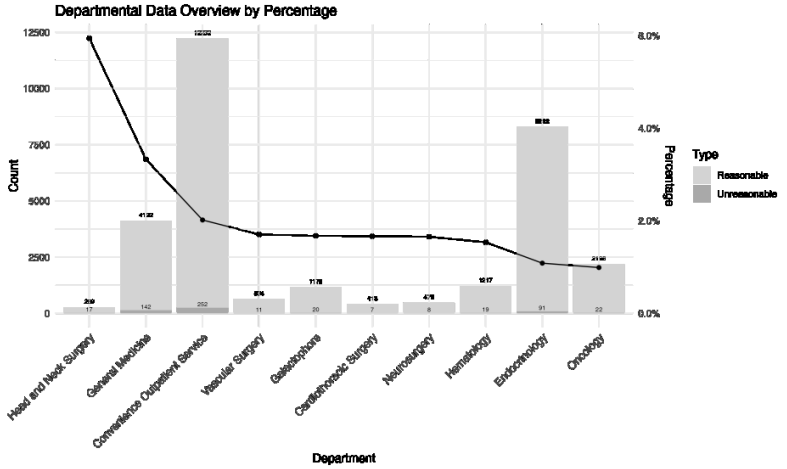

Figure 3. Proportion of unreasonable prescriptions in different departments.

3.5. Drugs with high frequency of irrational prescriptions

A total of 3,492 drugs were involved in the irrational prescriptions. The top 10 drugs in terms of frequency were Atorvastatin calcium tablets, Aspirin enteric-coated tablets, Calcium carbonate D3 tablets, Rabeprazole sodium enteric-coated tablets, Metformin tablets, Omeprazole enteric-coated capsules, Tylenol cold tablets, Clopidogrel hydrogen sulfate tablets, Cefuroxime axetil tablets, and Levofloxacin tablets. These drugs appeared a total of 566 times, accounting for 16.21% of the irrational prescriptions (Figure 4).

DOI: 10.54254/2753-8818/49/20241296

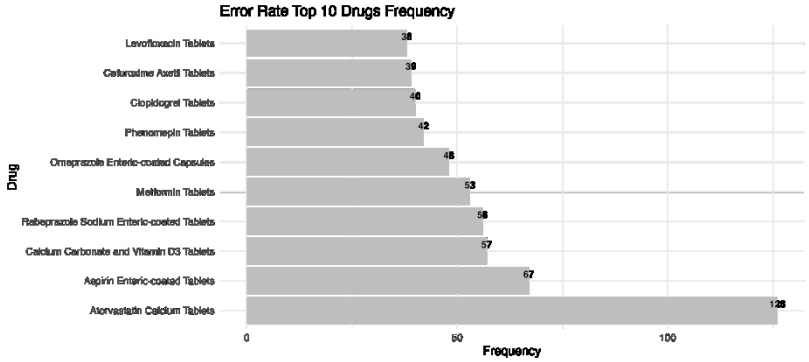

Figure 4. Distribution of the top 10 most frequently prescribed drugs.

3.6. Distribution of irrational prescriptions by professional titles

Among these irrational prescriptions, 518 (39.04%) were issued by attending physicians, 441 (33.23%) by associate chief physicians, 363 (27.35%) by chief physicians, and 128 (9.65%) by physicians. The percentage of irrational prescriptions issued by different titles was calculated: physicians (0.38%), attending physicians (0.60%), associate chief physicians (0.60%), and chief physicians (0.70%). The statistical analysis showed no significant difference (Figure 5).

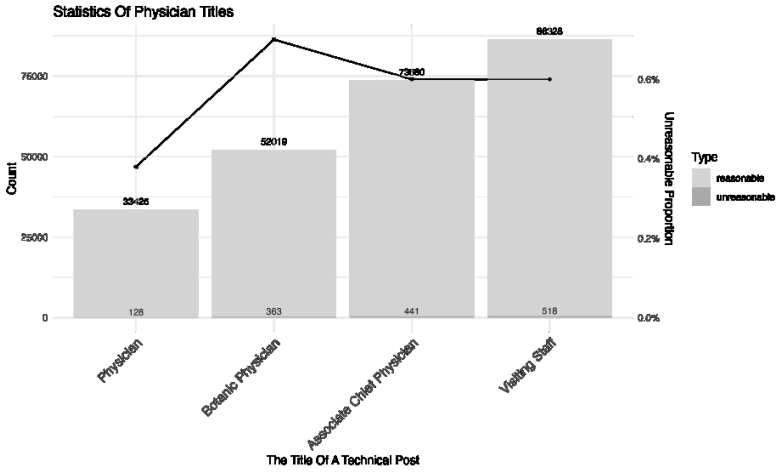

Figure 5. Number of prescriptions issued by doctors with different professional titles and their proportion of unreasonable prescriptions.

4. Discussion

This study retrospectively analyzed the results of prescription comments at outpatient and emergency service in a 3A hospital during 2023. Using R software for big data analysis, the author delved into the irrational prescribing situations and their influencing factors. The results revealed that out of the 245,352 prescriptions reviewed in 2023, 0.54% were classified as unreasonable. It was lower than that of other hospitals in China [8-10], which represented the overall high quality of prescriptions in this selected hospital. Nonetheless, even with a lower proportion, the actual number of irrational prescriptions still amounts to thousands, highlighting the critical need for continuous attention on rational drug use. The average number of drugs per prescription was 2.76 ± 1.41, which aligned with "Prescription Management Measures" stipulating that the drug varieties should not exceed 5 per prescription. It also associated with the recommended by WHO for developing countries, which was 1.6 - 2.8 varieties per prescription [11].

The irrational prescriptions identified in this review were primarily categorized as unstandard prescriptions, inappropriate prescriptions, and excessive prescriptions. Among these, inappropriate

DOI: 10.54254/2753-8818/49/20241296

indications (59.16%) and incomplete in clinical diagnosis (17.78%) were the most prominent issues. The possible factors of these issues could be related to the clinical experience, prescribing habits, and patient characteristics.

Further analysis revealed the distribution of irrational prescriptions in clinical departments. The irrational ratio is relatively high in departments of head and neck surgery (5.94%), general medicine (3.33%), and convenient clinic (2.02%), separately. The higher rate in head and neck surgery department suggested the unsatisfied prescribing habits among its clinicians. The irrational prescriptions in the general medicine department and convenient clinic may be attributed to the broad range of illnesses they covered, which often prescribed multiple medications within a single script. While the convenient clinic aims to serve chronic disease patients, it leads to an increase in the ratio of irrational prescriptions, posing higher demands on the clinicians' experience and professional standards.

The medications for chronic diseases such as Atorvastatin calcium tablets, Aspirin enteric-coated tablets ranked high in irrational prescriptions. The possible explanation is that these drugs are misused due to the lack of corresponding diagnosis and the most widely used in clinic, associating with previous reports from other comprehensive hospitals [4].

Physicians' personal attributes, including professional titles, clinical experience, professional backgrounds, and continuing education, were often cited as factors related to prescribing practices. Among these, professional titles or clinical experience were often listed as factors influencing prescription decisions in most research articles [12,13]. Some suggested that irrational prescribing gradually decreased with increasing clinical experience, while other studies claimed that medical quality might decline as clinical experience accumulated [14]. The personalized treatment increased with accumulation in clinic experience that might conflict with drug instructions or guidelines, resulting in irrational prescribing [15]. Contrary to these reports, the author's analysis revealed no significant correlation between the irrational prescribing rate and the professional titles in this hospital, which might be attributed to the hospital's management policies.

5. Conclusion

In summary, prescription comment is crucial for the management of clinical drug application in hospitals, thus benefit for continuously improvement in medical quality. In this study, the overall prescribing practices were reasonable in this hospital in 2023, while there were still instances of unstandard prescriptions, necessitating further strengthen prescription comment. Additionally, targeted improvement measures should be implemented to address the influencing factors identified in this analysis. Given the high rates in the head and neck surgery department, general medicine department, and convenient clinic, it is imperative to enhance prescription management and guidance at the hospital level through analyzing and disseminating information regarding problematic prescriptions in these departments. Practical experience has demonstrated that integrating prescription comment with feedback and intervention can effectively improve physicians' prescription behavior and enhance rational drug use. For frequently encountered drugs in irrational prescriptions, training and guidance on their appropriate use are equally necessary. In addition to conventional methods, information technology such as the combination of electronic prescription systems with rational drug use systems to form alert systems have been proven to be effective in reducing irrational prescriptions. By implementing strict rules within the rational drug use system, reminders and interceptions can be employed to minimize the occurrence of irrational prescriptions. Following the implementation of the aforementioned measures, it is essential to conduct regular specialized reviews to assess the effectiveness of intervention, thereby achieving continuous improvement in rational drug use and ensuring patient medication safety.

Acknowledgments

Pharmacist Lingzhi Wu from the Department of Pharmacy of the First Hospital of Jiaxing City, Zhejiang Province provided support in providing data materials, analysis and discussion for this article.

References

[1] Bogert, C. A. V. D. , Mestrinaro, M. , & Weerasuriya, K. . (2012). The pursuit of responsible use of medicines: sharing and learning from country experiences. world health organization. http://www.who.int/medicines/areas/rational_use/en.

[2] Mao, W., Vu, H., Xie, Z., Chen, W., & Tang, S. (2015). Systematic review on irrational use of medicines in China and Vietnam. PloS one, 10(3), e0117710. https://doi.org/10.1371/journal.pone.0117710

[3] Gong, Y., Yang, C., Yin, X., Zhu, M., Yang, H., Wang, Y., Li, Y., Liu, L., Dong, X., Cao, S., & Lu, Z. (2016). The effect of essential medicines programme on rational use of medicines in China. Health policy and planning, 31(1), 21–27. https://doi.org/10.1093/heapol/czv008

[4] Song, Z., Liu, Y, & Zhou, Y.. (2022). Analysis of prescription review big data of a hospital based on R language. China Pharmaceutical Industry,31(23): 20-23.

[5] Tang, W., Li, X., &Wang, Y.. (2024). Application of R language in environmental epidemiology processing——taking research on the health effects of air pollution as an example[J]. Journal of Environmental Health, 14(1): 19-27. DOI:10.13421/j.cnki.hjwsxzz.2024.01.004

[6] Zhenjiang, T. , Bing, Z. , College, C. , & University, J. N. . (2017). Analysis of students' performances based on r language. Intelligent Computer and Applications. DOI:10.15887/j.cnki.13-1389/r.2024.07.007

[7] KABACOFF R. (2015). R in Action. 2nd ed. New York: Manning Publications Co., 435-462.

[8] Zhao, D., Zheng, L., Han, R.. (2024). Analysis of unreasonable prescriptions in outpatient and emergency departments of a tertiary dental hospital in Beijing. Clinical Rational Drug Use, 17(07): 26-28+32.DOI :10.15887/j.cnki.13-1389/r.2024.07.007.

[9] Liang, C.. (2023). Comments on outpatient and emergency prescriptions and Plato analysis of irrational drug prescriptions in a hospital from 2021 to 2022. China Rural Medicine, 30(23): 45-47.DOI: 10.19542/j.cnki.1006 -5180.2212-264.

[10] Li, Y., Lu, Y., & Li, Y.. (2024). Pareto chart analysis of unreasonable prescriptions in hospital outpatient and emergency departments. Clinical Rational Drug Use, 17(01): 35-38+42. DOI: 10.15887/j. cnki.13-1389/r.2024.01.008.

[11] Shankar P R .. (2009). Medicines use in primary care in developing and transitional countries: fact book summarizing results from studies reported between 1990 and 2006. Bulletin of the World Health Organisation, 87(10):804-804.DOI:10.1590/S0042-96862009001000019.

[12] Al-Areefi, M. A., Hassali, M. A., & Mohamed Ibrahim, M. I. (2013). The role of phar maceutical marketing and other factors in prescribing decisions: the Yemeni experienc e. Research in social & administrative pharmacy : RSAP, 9(6), 981–988. https://doi.or g/10.1016/j.sapharm.2012.10.006

[13] Marić, N. P., Stojiljković, D. J., Pavlović, Z., & Jasović-Gamsić, M. (2012). Factors influencing the choice of antidepressants: a study of antidepressant prescribing practice at University Psychiatric Clinic in Belgrade. Vojnosanitetski pregled, 69(4), 308–313.

[14] Choudhry, N. K., Fletcher, R. H., & Soumerai, S. B. (2005). Systematic review: the relationship between clinical experience and quality of health care. Annals of internal medicine, 142(4), 260–273. https://doi.org/10.7326/0003-4819-142-4-200502150-00008

[15] Carthy, P., Harvey, I., Brawn, R., & Watkins, C. (2000). A study of factors associated with cost and variation in prescribing among GPs. Family practice, 17(1), 36–41. https://doi.org/10.1093/fampra/17.1.36