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Status of irrational drug use in the outpatient department of a Beijing hospital from 2018 to 2021 and evaluation of the effect of intervention measures

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Abstract: To explore the status of irrational drug use in a hospital between the pre-intervention (2018 to 2019) and post-intervention (2020 to 2021) in Beijing and evaluate the effects of relevant interventions. Prescriptions were evaluated manually with reference to the management rules of the china prescription administrative policy, standard management of hospital prescription comments, standards for prescription examination in medical institutions, regulations on pharmaceutical administration in medical institutions and the administrative measures for the clinical application of antibiotics. There were 5,584 irrational outpatient electronic prescriptions, with 1,681, 1,554, 1,234 and 1,115 made annually from 2018 to 2021, respectively. Among the all irrational prescriptions, high proportions were filled by patients aged 15 to 34 years (55.62%), female patients (50.90%), patients with complications (77.42%) or chronic diseases (65.45%). The top-three types of irrational electronic prescriptions were incomplete prescription postscript (24.05%), excessive dosage (19.75%) and inappropriate medication frequency (16.42%). Among all the physicians who prescribed, the most common was physicians aged from 25 to 30 years (45.61%) and with a junior title (64.83%). Although irrational drug use interventions could significantly improve the prescribing of irrational electronic prescriptions, the situation of irrational prescribing still exists. Related interventions should be taken in future clinical work.

Keywords: Irrational drug use, outpatient department, current situation, intervention measures.

INTRODUCTION

Irrational drug use is a public health concern worldwide. Irrational drug use, as defined by the World Health Organization, refers to patients taking medication that does not match their clinical diagnosis, or the dose does not meet the expected requirements (Sullivan *et al.,* 2022). Several previous studies have shown that the global current status of irrational drug use is very severe. Statistics from the United States show that in developed countries, irrational medication is one of the top-10 causes of morbidity and mortality (Blanc *et al.,* 2018; Lazarou, Pomeranz and Corey, 1998). In the UK, the cost of care and treatment for patients admitted to hospital with inappropriate medication is $870 million in 2020 (de Vries *et al.,* 2021; Pirmohamed *et al.,* 2004). In developing countries, the situation is even less optimistic, with less than half of patients with acute viral upper respiratory tract infections and viral diarrhoea receiving the correct antibiotic treatment (Shibeshi *et al.,* 2021; Lan *et al.,* 2020; Gumodoka *et al.,* 1996). In rural Vietnam, 35% to 60% of clinics prescribe antibiotic drugs (Larsson *et al.,* 2000; Le *et al.,* 2020). It is estimated that about half of prescriptions for antibiotics in China are considered medically unnecessary (Sun *et al.,* 2008; Dong, Yan and Wang, 2011).

To curb the current situation of irrational drug use in China and further strengthen the management of clinical drug administration, the Chinese Ministry of Health established the Expert Committee on Rational Drug Use in 2009 (Introduction to the Expert Committee on Rational Drug Use of the National Health and Family Planning Commission), which is responsible for the supervision and management of rational drug use nationwide. While conducting the regulation of rational medication according to national policy, hospitals also carried out a series of interventions to prevent irrational drug use according to their own conditions, such as conducting training on drug use and improving warning mechanisms. Since the official intervention for rational drug use in 2019, significant progress has been made on the issue, but no systematic evaluation study has been conducted.

Therefore, the purpose of this study was to understand the status of irrational drug use in the outpatient department of a hospital and evaluate the effectiveness of relevant interventions for irrational drug use, with the aim of providing references and suggestions for improving interventions for irrational drug use and increasing the level of rational drug use in hospitals.

MATERIALS AND METHODS

Data sources

This hospital-based cross-sectional study was conducted in the Chinese PLA General Hospital in Beijing. The hospital's outpatient electronic prescriptions from January 2018 to December 2021 were stratified and randomly

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sampled by different departments. The sampling proportion of each department was 70% and a total of 116,737 outpatient electronic prescriptions were selected. This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of the Medical Support Center of the Chinese PLA General Hospital. Written informed consent was obtained from all participants.

Interventions for irrational drug use

Outpatient electronic prescriptions were prescribed normally by clinicians before the intervention (2018 to 2019). After 1 January 2020, the hospital implemented a series of interventions for the prevention of irrational drug use; the specific interventions are as follows.

(1) Developing a pre-check: In the pre-check, the clinical diagnosis, usage and dosage, administration route, applicable population, interaction and other drug modules were established in detail. The prescriptions prescribed by physicians were reviewed and intercepted twice by the clinical rational drug use intelligent management system. There were four warning levels: 'reminder', 'general warning', 'serious warning' and 'must be dealt with'. Based on the pre-set warning level, the problematic prescription determined by the system was graded. The physician could modify the prescriptions or submit them to a pharmacist for review and interaction with the pharmacist. Through the pre-check, the qualification rate of the prescription and the level of rational drug use were improved.

(2) Conducting monthly prescription point reviews to inform clinicians of the results of the prescription point review and relevant considerations when prescribing. Irrational prescription problems, such as non-standard prescriptions, inappropriate prescriptions and unnecessary prescriptions were summarised to form a consensus. Finally, the questionable issues in the prescriptions' comments and complaints were reviewed to improve the overall level of rational prescribing in the hospital.

(3) Standardising the pharmaceutical administration and therapeutics committee: Through the regulation of the pharmaceutical administration and drug and therapeutics committee, the implementation of rational drug use monitoring, antimicrobial management and special drug supervision was overseen and a drug use risk assessment system was established to evaluate the potential drug use risks and give full play to the management function of the pharmaceutical management committee.

(4) Strengthening drug knowledge training for clinicians and pharmacists: The professional skill level and prescription deployment and the ability of clinicians and pharmacists were improved by training to encourage the staff to actively participate in the formulation of drug plans, enhance their drug knowledge memory in the form of examinations and improve the rational use of prescription drugs.

(5) Refining the early warning mechanism of drug overdose: According to the drug list of the hospital and the average monthly consumption over the previous two years, the average monthly dosage of drugs was formulated, with an increase or decrease of 30% regarded as a normal drug dosage. If the dosage exceeded 30%, an early warning was needed and the relevant reasons were identified and reported to the Pharmaceutical Administration Committee.

Prescription evaluation

Prescriptions were evaluated manually by two investigators with reference to the china prescription administrative policy, standard management of hospital prescription comments, standards for prescription examination in medical institutions, regulations on pharmaceutical administration in medical institutions, administrative measures for the clinical application of antibiotics. The Kappa value for the evaluation consistency of the two investigators was 0.902. Ultimately, there were 5,584 irrational outpatient prescriptions, with 1,681, 1,554, 1,234 and 1,115 irrational outpatient electronic prescriptions from 2018 to 2021, respectively.

Quality control and ethical principles

To ensure the quality of this study, standard one-week training was arranged for the researchers before data collection, focusing on learning the relevant knowledge of irrational drug use. In the process of data collection and sorting, three sampling inspections were carried out, respectively, with a sampling proportion of 5%, to check the rationality of the prescription evaluation results. In addition, the researchers signed confidentiality agreements before the study began and the names of the patients and clinicians were not shown in the statistics.

Ethical approval

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Medical Support Center of Chinese PLA General Hospital. Written informed consent was obtained from all participants.

STATISTICAL ANALYSIS

Excel software version 2021 was used for data entry and collation and SPSS 26.0 was used for the data analysis. Count data were described as frequency (%) and comparisons between groups were made using an X^2 test. A multivariate logistic analysis was used to explore the influencing factors of irrational electronic prescriptions in the outpatient department. The inspection level was set to 0.05 unless otherwise specified.

RESULTS

General characteristics

After prescription evaluation, there were 5,584 irrational outpatient electronic prescriptions made from 2018 to 2021. Among them were 3,235 in 2018 and 2019 and prescriptions for patients aged 15 to 34 years (58.18%), female patients (53.79%), patients with complications (76.79%) or chronic diseases (66.34%). Among all prescribing doctors, most of them were 25 to 30 years old (45.61%) and with junior professional title (64.83%). There were 2,349 prescriptions in 2020 and 2021, which were similar to those in 2018 and 2019, except that more were for male patients (53.09%) than for female patients (46.91%) (table 1).

Irrational electronic prescription type in the outpatient department from 2018 to 2021

From the perspective of irrational electronic prescription types, the top-three irrational types were incomplete prescription postscript (24.05%), excessive dosage (19.75%) and inappropriate drug frequency (16.42%). Comparisons before and after the intervention showed that all irrational types decreased significantly in 2020 and 2021 and the largest decrease (6.10%) was observed in the incomplete prescription postscript (table 2).

System distribution of drug action for irrational electronic prescriptions in the outpatient clinic from 2018 to 2021

From the perspective of the drug action system, the top-three drugs for irrational drug use were antibiotics, Chinese-patented medicines and anti-allergenic drugs, with 688, 524 and 521 cases, respectively. Among them, the irrational types of antibiotics were mainly excessive dosage and unreasonable drug frequency, with 238 and 385 cases, respectively (table 3).

The effects of interventions on irrational drug use

Comparing the unreasonable rate of outpatient electronic prescribing before and after the intervention, the irrational rate decreased significantly from 2020 to 2021 (3.26%) and the difference was statistically significant (P<0.0001), as shown in table 4.

Analysis of the influencing factors of irrational drug use in the outpatient clinic

The results of the multivariate analysis showed that patients' ages, comorbidities and chronic diseases, the age and professional title of the prescribing doctor and irrational drug use interventions were associated with irrational electronic prescriptions. Of these, compared with patients aged 0 to 14 years, patients aged 15 to 34 years were at a higher risk of irrational electronic prescribing [Odds Ratio (OR): 9.89; 95% Confidence Interval (95% CI): 8.22-10.37]. Moreover, older prescribing doctors (P<0.0001) and those with higher professional titles (P<0.0001) were less likely to prescribe irrational electronic prescriptions. Compared with the situation before the intervention measure for irrational drug use, the intervention significantly reduced the risk of irrational drug use in outpatient clinics (OR: 0.78; 95% CI: 0.33-0.81) (table 5).

DISCUSSION

A prescription is a medical document issued to patients by physicians during the clinical diagnosis and treatment process, which is reviewed, dispensed and checked by pharmacists as a medication certificate (Delas *et al.,* 2019). Irrational prescribing is a common phenomenon in clinical practice that not only increases the risk of medication for patients but also leads to increased medical costs. Common problems related to irrational drug use include drug selection without considering cost-effectiveness and efficacy, failure to prescribe according to the standard treatment regimen, drug dispensing errors, failure of patients to follow the dosing regimen and inappropriate self-administration (World Health Organization, 2009; World Health Organization, 2011; World Health Organization, 2012; World Health Organization, 2002).. The results of this study suggested that the active intervention measures for irrational drug use had a positive effect on improving outpatient irrational electronic prescriptions, with a significant decrease in the number of outpatient irrational electronic prescriptions and a 54.8% decrease in the rate of irrational prescriptions.

Previous studies have evaluated the effect of relevant interventions. For example, the establishment of a drug and treatment committee can significantly improve the level of drug treatment, reduce irrational drug use, save unnecessary sanitation costs and delay the development of drug resistance (Yang *et al.,* 2022a; Yang *et al.,* 2022b).

For different kinds of drugs, especially antibiotics and Chinese-patented medicines, there are still obvious irrational drug use phenomena, such as excessive dosage, frequent drug use and unreasonable administration routes. Worldwide, the irrational use of antibiotics is increasing (Mboya *et al.*, 2018) in both developed and developing countries and human factors are promoting the emergence and spread of drug resistance (Lugagne and Dunlop, 2022). It is estimated that more than 80% of antibiotics are used in resident community hospitals in China and it is very common to buy antibiotics without a prescription (Farhat and Khan, 2022). Moreover, general practitioners prescribe excessively due to uncertain diagnoses, leading to the irrational use of antibiotics (Pailhoriès *et al.,* 2022). Previous studies have shown that the use of Chinese-patented medicine involves problems such as inappropriate usage and improper treatment courses, which is consistent with the results of the present study (Zhang, 2015).

Table 1: Basic characteristics of outpatient irrational electronic prescriptions from 2018 to 2021

Variable	Group	Number (%)	
		2018-2019 (n=3236)	2020-2021 (n=2349)
Age of patients	0-14	461(14.25)	273(11.62)
	15-34	1882(58.18)	1224(52.11)
	35-54	437(13.51)	428(18.22)
	>=55	456(14.10)	424(18.05)
The gender of the patient	Male	1495(46.21)	1247(53.09)
	Female	1740(53.79)	1102(46.91)
Complication	Yes	2484(76.79)	1839(78.29)
	No	751(23.21)	510(21.71)
Chronic disease	Yes	2146(66.34)	1509(64.24)
	No	1089(33.66)	840(35.76)
Age of prescription doctors	25-30	1365(42.19)	1182(50.32)
	31-35	1124(34.74)	679(28.91)
	36-40	387(11.96)	256(10.90)
	41-45	226(6.99)	208(8.85)
	>45	132(4.08)	24(1.02)
Professional title of prescription doctors	Junior	2045(63.21)	1575(67.05)
	Medium grade	650(20.09)	445(18.94)
	Senior	540(16.70)	329(14.01)

Table 2: Types of irrational outpatient electronic prescriptions for 2018-2021

Type	2018-2019(n=3235)	2020-2021(n=2349)	2018-2021(n=5584)
Non-standard prescription			
The prescription exceeding the usual quantities	38(1.17)	28(1.19)	66(1.18)
Incomplete prescription postscript	861(26.62)	482(20.52)	1343(24.05)
Incomplete prescription notes	24(0.74)	22(0.94)	46(0.82)
Incomplete prescription text	31(0.96)	13(0.55)	44(0.79)
Incomplete clinical diagnosis	398(12.30)	332(14.13)	730(13.07)
Non-standard name writing of the drug	1(0.03)	0(0.00)	1(0.02)
Non-standard physician signature	27(0.83)	0(0.00)	27(0.48)
Incomplete age of infants	22(0.68)	18(0.77)	40(0.72)
Not appropriate prescription			
Over dosage	637(19.69)	466(19.84)	1103(19.75)
Wrong timing of administration	158(4.88)	68(2.89)	226(4.05)
Wrong route of administration	461(14.25)	426(18.14)	887(15.88)
Insufficient measurement	44(1.36)	34(1.45)	78(1.40)
Inappropriate drug selection	33(1.02)	31(1.32)	64(1.15)
Frequency of medication	494(15.27)	423(18.01)	917(16.42)
Excessive prescription			
No indication of medication	6(0.19)	6(0.26)	12(0.21)

Table 3: System distribution of drug action for irrational electronic prescriptions in outpatient clinics from 2018 to 2021

Type	Antibiotics	Allergy preparations	Digestive system drugs	Chinese patent drugs	Cardiovascular and cerebrovascular drugs	Blood system drugs	Respiratory system drugs	Urological system drugs	Other drugs	In total
Over dosage	238	189	10	203	12	30	203	114	132	1131
Wrong timing of administration	12	12	4	39	28	—	28	19	53	195
Inappropriate route of administration	36	209	133	88	52	6	15	53	293	885
Insufficient measurement	7	11	1	9	2	8	9	2	3	52
Inappropriate drug selection	4	16	—	7	5	7	19	5	5	68
Frequency of medication	385	84	19	176	56	13	39	44	103	919
No indication of medication	6	—	3	2	7	—	11	2	11	42
In total	688	521	170	524	162	64	324	239	600	3292

Table 4: Changes in the irrational rate of outpatient electronic prescription before and after the intervention

Year	Number of prescriptions drawn	Number of irrational prescriptions	Irrational rate
2018-2019	44682	3235	7.24
2020-2021	72055	2349	3.26
In total	116737	5584	4.78
χ^2	956.211		
P	<0.0001		

Table 5: Results of the multivariate analysis of irrational drug use in outpatient clinics

Factors	OR	95% CI	*P*
Age of patients			
0-14			
15-34	ref		
35-54	9.89	8.22-10.37	<0.0001
>=55	1.28	1.11-3.28	0.025
The gender of the patient	1.65	1.27-4.21	0.082
Complication	1.23	1.18-1.75	0.258
Chronic disease	1.55	1.06-2.28	0.023
Age of prescription doctors	3.18	2.27-4.35	<0.0001
25-30			
31-35	ref		
36-40	0.92	0.42-1.99	0.842
41-45	0.87	0.62-0.92	0.031
>45	0.88	0.43-0.97	0.044
Professional title of prescription doctors	0.62	0.38-0.81	<0.0001
Junior			
Medium grade	ref		
Senior	0.51	0.33-0.78	<0.0001
Intervention for irrational drug use	0.55	0.37-0.88	<0.0001
	0.78	0.33-0.81	<0.0001

In addition, both the condition of patients and the experience of prescribing physicians can affect irrational prescribing. Previous study showed that the presence of comorbidities and chronic diseases was clearly associated with the irrational rate of electronic prescriptions.

A London study showed that patients with comorbidities were 3.48 times more likely to take antibiotics than those without any comorbidities (Zuckerman, Perencevich and Harris, 2007). Older physicians and those with higher professional titles were less likely to prescribe unreasonable electronic prescriptions. Melku *et al*. (2021) suggested that prescribing doctors with more than six years' experience were 2.45 to 2.55 times more likely to prescribe multiple drugs than those with prescribing experience less than 6 years. However, the findings of Ong *et al*. (2018) showed that prescribing physicians with rational medication training were 85% less likely to prescribe multiple drugs compared to doctors without training. Therefore, continuous training should be given on how to reduce the phenomena of multi-drug prescriptions and overprescribing.

The present study has some limitations that need to be considered. First, this was a retrospective study based on cross-sectional data, so there were some limitations in the acquisition of patient information. It was impossible to know whether patients self-medicated drugs and the dose of drugs used could not be accurately quantified. This study was a single-centre hospital-based study and the intervention effectiveness and external implementation experience were poor, although they do provide a reference to guide future policy. Furthermore, only outpatient electronic prescribing was assessed in this study due to limited time and funding. We intend to include electronic prescribing for hospitalized patients in future studies to further verify the conclusions obtained in this study.

CONCLUSION

Hospital managers can effectively reduce the rate of irrational drug use in an outpatient electronic prescription setting by implementing a series of interventions, such as pre-checks, prescription comments, standardising pharmaceutical administration and drug and therapeutics committees, strengthening the training of medication knowledge for clinicians and pharmacists and improving early warning mechanisms for excessive drug dosage. However, there is still non-standard prescription writing and inappropriate dosages of antibiotics and Chinese-patented medicines. Education programmes on irrational drug use interventions should be developed, training programmes should be put in place and the supervision

and management of drug administration should be enhanced, with corresponding solutions for specific problems in the future.

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