

Drug prescribing indicators in village health clinics across 10 provinces of Western China

Lifang Dong^{a,b}, Hong Yan^{b,*} and Duolao Wang^c

^aDepartment of AIDS Control and Prevention, Shaanxi Centre for Disease Control and Prevention, Xi'an, Shaanxi 710054, People's Republic of China, ^bDepartment of Epidemiology and Health Statistics, School of Public Health, Xi'an Jiaotong University College of Medicine, Xi'an, Shaanxi 710061, People's Republic of China and ^cDepartment of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London WC1E 7HT, UK.

*Correspondence to Hong Yan, PO Box 46, Department of Epidemiology and Health Statistics, School of Public Health, Xi'an Jiaotong University College of Medicine, Xi'an, Shaanxi 710061, People's Republic of China; E-mail: xjtu_yh.paper@yahoo.com.cn

Received 16 June 2010; Revised 7 August 2010; Accepted 20 August 2010.

Background. The irrational use of drugs was a global problem, especially in developing countries. However, there are no studies available on irrational use of drugs in rural Western China.

Objective. To assess the drug prescribing patterns using World Health Organization Drug Use Indicators at village health clinics in rural areas of Western China.

Methods. A total of 20 125 prescriptions were collected from 680 primary health clinics in villages from 40 counties in 10 provinces of Western China. Five measurements were used to assess the irrational drug use: percentage of encounters with an antibiotic prescribed, average number of drugs per encounter, percentage of encounters with an injection prescribed, percentage of drugs prescribed by generic name and percentage of drugs prescribed from National Essential Medicines List or Formulary. Index of Rational Drug Prescribing (IRDP) was used as an indicator of rational drug use.

Results. The percentage of prescriptions containing antibiotics was 48.43%, while the average number of drugs per prescription was 2.36, and the percentage of injection prescriptions was 22.93%. The percentage of drugs prescribed by generic name was 64.12%, and the percentage of drugs prescribed from the National Essential Drug List was 67.70%. The IRDP of the present study was 3.32 with the optimal level of 5. There are also some regional variations in these measurements.

Conclusions. The study provides some evidence of irrational use of drugs to a great extent in rural areas of Western China. Overuse of injection and overuse of antibiotics were the most prominent manifestations of such irrational drug prescribing.

Keywords. Drug prescribing, pharmacoepidemiology, rural China, rural population.

Introduction

Medically inappropriate, ineffective and economically inefficient use of medicinal drugs occurs commonly in health care facilities worldwide. The costs of such irrational drug use are enormous in terms of both the scarce medical care resources and the adverse clinical consequences of irrational drug use. The World Health Organization (WHO) estimated that half of all drugs in the world are used irrationally. Severe consequences incurred by irrational use of drugs include adverse drug reactions, drug resistance, protracted illness and even death.¹ The financial cost due to irrational use of drugs is extremely unnecessary and often unexpectedly high, particularly in developing countries.^{2,3} In China, ~2 500 000 inpatients/year are closely related to adverse drug reactions and ~60% deaf and dumb children have resulted from irrational use of drugs.⁴ In addition,

misuse of antibiotics, overuse of injections, inadequate treatment of a serious illness, self-medication of prescription drugs, etc. are also common practices in China.⁵ It is important to assess the occurrence of irrational drug utilization in China, specially underdeveloped rural areas of China. A village clinic usually has one or two doctors. The village doctors receive and treat patients, prescribe medicines and refer patients to a township health centre or county hospital. The aim of this study was to explore the drug prescribing patterns using World Health Organization Drug Use Indicators in rural areas of Western China.⁶

Materials and methods

Study population and design

The study was conducted at primary health clinics in villages of rural Western China. Data collection sites

were selected from 40 counties in 10 provinces of Western China using a three-stage probability proportion to size sampling method. We selected five townships in each county and then we selected four villages from each township.

The last 30 paper prescriptions up to 31 May 2005 were collected at each selected village health clinic from June 2005 to August 2005 by investigators from Xi'an Jiaotong University College of Medicine. The prescriptions collected in this survey were independent and discrete. Signed informed consent was obtained from the village doctors after this study was fully explained to them.

Outcomes and analysis

We used five measurements to describe the irrational drug prescribing: percentage of encounters with an antibiotic prescribed, average number of drugs per encounter, percentage of encounters with an injection prescribed, percentage of drugs prescribed by generic name and percentage of drugs prescribed from National Essential Medicines List or Formulary.

To assess the rational drug use comprehensively, we developed a new index called Index of Rational Drug Prescribing (IRDP) by applying a mathematical model developed by Zhang and Zhi⁷ for comprehensive appraisal of medical care. The method has been validated and used in medical and health research.⁷ We then derived five indicators of rational drug prescribing from the above five measures according to the optimal levels of prescribing indicators defined in Table 1.^{8,9} All the five prescribing indicators had the same optimal index of 1: the closer to 1, the more rational a drug prescribing. The index of rational antibiotic prescribing was defined as dividing the optimal level (30%) by the percentage of prescriptions including antibiotic. The index of safety injection was calculated by dividing the optimal level (10%) by the percentage of prescriptions including injection. Generic name index was measured by the percentage of drugs prescribed by generic name and so did in essential medicine index. In this study, prescriptions with five or more drugs were defined as polypharmacy. And the index of polypharmacy was measured by the percentage of non-polypharmacy prescriptions. A synthetic index,

namely IRDP, is calculated by adding up all the five indices above. The Cronbach's alpha was used to evaluate the internal validity of the IRDP.

Results

Data collection

We finally obtained 20 125 prescriptions from 680 village health clinics, which are used for the data analysis in this study. One hundred and twenty villages were excluded for the following reasons: 38 villages without village clinics, 55 villages without doctors, 11 villages without prescriptions, 15 villages where village doctors were not found and a township that had only three villages. The response rate at the village level was 85%. We calculated the values for indicators of irrational and rational use for each province as well as for pooled sample of Western China.

Drug prescribing indicators

The results on irrational drug prescribing were showed in Table 2. The percentage of prescriptions containing antibiotics was 48.43%, while the average number of drugs per prescription was 2.36, and the percentage of injection prescriptions was 22.93%. The percentage of drugs prescribed by generic name was 64.12%, and the percentage from the National Essential Drug List was 67.70%. These five irrational drug prescribing indicators varied across the 10 provinces.

Index of rational drug prescribing

As shown in Table 3, the 10 provinces were ranked according to their IRDP. There are some regional differences in the IRDP, with Gansu and Inner Mongolia having better rational prescribing than other provinces. The overall IRDP of the present study was 3.32 with the optimal level of 5. The overall IRDP 3.32 was made up of the index of antibiotic 0.62, the index of polypharmacy 0.94, the index of injection 0.44, the index of generic name 0.64 and that of essential medicine 0.68. The estimated Cronbach's alpha was 0.315 and is statistically significantly different from zero ($P < 0.001$).

Discussion

The drug use indicators used in the study were originally designed for inpatients.¹⁰ These indicators were also used in measuring the validity of primary health care. The rural three-quarters of the Chinese population is served by a three-tier system of health services and referral with village clinics and village doctors as the first tier, township health centres as the second tier and county-level hospitals as the third tier.¹⁰ Village clinics act as primary health care in rural areas of

TABLE 1 Optimal levels of drug prescribing indicators^{8,9}

Prescribing indicators	Optimal level (%)	Optimal index
% Prescriptions including antibiotic	<30	1
% Polypharmacy prescription	0	1
% Prescriptions including injection	<10	1
% Drugs prescribed by generic name	100	1
% Drugs prescribed from essential medicines list or formulary	100	1

TABLE 2 Indicators of irrational drug prescribing in village clinics across 10 provinces of rural Western China

Province	% Prescriptions including antibiotic (95% CI)	Mean number of drugs per prescription (95% CI)	% Prescriptions including injection (95% CI)	% Drugs prescribed by generic name (95% CI)	% Drugs prescribed from essential medicines list or formulary (95% CI)
Chongqing	50.7 (50.5–50.9)	3.0 (2.9–3.1)	22.7 (22.5–22.9)	66.2 (66.0–66.4)	63.5 (63.3–63.7)
Sichuan	57.5 (57.3–57.7)	3.1 (3.0–3.2)	19.0 (18.9–19.1)	65.5 (65.3–65.7)	68.1 (67.9–68.3)
Xinjiang	56.3 (56.0–56.6)	2.2 (2.1–2.3)	32.7 (32.4–32.0)	63.4 (63.1–63.7)	72.2 (71.9–72.5)
Guangxi	54.6 (54.4–54.8)	2.6 (2.5–2.7)	32.5 (32.3–32.7)	64.1 (63.9–64.3)	68.9 (68.7–69.1)
Gansu	49.8 (49.5–50.1)	2.5 (2.4–2.6)	8.0 (7.9–8.1)	62.3 (62.0–62.6)	64.8 (64.5–65.1)
Guizhou	45.9 (45.7–46.1)	2.1 (2.0–2.2)	32.0 (31.8–32.2)	59.7 (59.4–59.9)	66.5 (66.3–66.7)
Jiangxi	41.7 (41.5–41.9)	2.1 (2.0–2.2)	16.8 (16.7–17.0)	62.8 (62.6–63.0)	70.7 (70.5–70.9)
Inner Mongolia	46.7 (46.5–46.9)	1.7 (1.6–1.8)	12.0 (11.9–12.1)	75.9 (75.7–76.1)	75.7 (75.5–75.9)
Qinghai	41.1 (40.9–41.3)	2.3 (2.2–2.3)	35.5 (35.3–35.7)	61.1 (60.9–61.3)	65.2 (65.0–65.4)
Ningxia	44.9 (44.7–45.1)	1.9 (1.8–2.0)	15.2 (15.0–15.4)	57.2 (57.0–57.4)	65.6 (65.3–65.8)
Total	48.4 (48.3–48.5)	2.4 (2.3–2.5)	22.9 (22.8–23.0)	64.1 (64.0–64.2)	67.7 (67.6–67.8)

CI, confidence interval.

TABLE 3 IRDP in village clinics across 10 provinces of rural Western China

Province	Index of rational antibiotic prescribing	Index of polypharmacy	Index of safety injection	Generic name index	Essential medicine index	IRDP	Rank
Chongqing	0.59	0.87	0.44	0.66	0.64	3.20	7
Sichuan	0.52	0.89	0.53	0.66	0.68	3.27	5
Xinjiang	0.53	0.96	0.31	0.63	0.72	3.15	9
Guangxi	0.55	0.94	0.31	0.64	0.69	3.12	10
Gansu	0.60	0.95	1.00	0.62	0.65	3.82	2
Guizhou	0.65	0.95	0.31	0.60	0.66	3.18	8
Jiangxi	0.72	0.99	0.59	0.63	0.71	3.64	3
Inner Mongolia	0.64	0.99	0.83	0.76	0.76	3.98	1
Qinghai	0.73	0.94	0.28	0.61	0.65	3.21	6
Ningxia	0.67	0.97	0.66	0.57	0.66	3.52	4
Total	0.62	0.94	0.44	0.64	0.68	3.32	—

China. Indicators used in primary health care were valid in Chinese rural primary health care: village clinics. Measurements for rational drug prescribing suggested by WHO include five dimensions of antibiotic, polypharmacy, injection, generic name and essential medicine.¹¹ IRDP was synthesized by these five dimensions. IRDP revealed that to what extent prescriptions met the optimal level of rational drug prescribing. In this study, we found that IRDP was 3.32 with the optimal level of 5, suggesting that drug prescribing was far from rational in rural areas of Western China.

The percentage of prescriptions containing antibiotics was 48.43% exceeding the optimal level of 30%. The value of 0.62 for index of rational antibiotic prescribing indicated that the rational degree of antibiotic prescribing was 62%, far below the optimal level. The polypharmacy index was 0.94, very close to the optimal level of 1, indicating that the occurrence of polypharmacy was not bad. But overuse of injection was very popular in rural Western China with the index of

safety injection 0.44. The generic name index 0.64 and the essential medicine index 0.68 implied that generic name and essential medicine were not widely used in village clinics of rural Western China.

As shown in Table 3, injection had the lowest index of rational prescribing, meaning that overuse of injection has the most prominent manifestation of irrational prescribing in the studied areas. Overuse of injection played a very important role in transmission of blood-borne infections, such as hepatitis B virus, hepatitis C virus and human immunodeficiency virus, which always led to heavy burden of diseases. In rural areas of Western China where the economy is underdeveloped and the health care services are poor, diseases and burden of diseases can make the situation even worse. It is therefore imperative that interventional measures must be taken to reduce overuse of injection. Study showed that after an intervention on safety injection, the proportion of outpatients receiving an injection dropped dramatically.¹² Education of safety injection on village doctors may help reduce injection prescribing.¹³

The use of antibiotics had the second lowest index of rational prescribing. It has been well established that overuse of antibiotics can lead to bacterial resistance, which is a very intractable and difficult problem to deal with.¹⁴ Overuse and misuse of antibiotics have also given rise to increased risks of side effects and high costs. Interventions to improve antibiotic prescribing practices among village doctors are needed in the studied areas.¹⁵

Essential medicine list was commonly used in drug utilization intervention all over the world.¹⁶ The low percentage (64.12%) of essential medicine prescribed found in this study suggests that there is a lot for village doctors to do to improve the rational drug prescribing in rural Western China. For example, medical education curriculum should be modified to suit the medical and health conditions in rural areas to improve rational drug use.

Rural Western China is the most underdeveloped area in China. Most village doctors are half-peasant and half-doctor because they cannot fully depend on incomes from medical practices alone. Generally, their incomes are made up of medical practices, agriculture production, stock raising and others. Most of village doctors here did not get systematic medical education. Village doctors play key roles in drug prescribing in rural Western China. Formal medical training, especially rational drug prescribing education, is needed for village doctors.

The strength of this study is that it is by far the largest study of drug prescribing indicators in Chinese rural areas, filling a gap on drug prescribing indicators in this geographical part of China. The IRDP used in this study revealed the extent of irrational drug prescribing. Data were collected across 151 548 km² in Western China. The authenticity of the findings was warranted by original paper prescriptions collected from village clinics. The study also has a number of limitations. Firstly, it is a clinic-based study, which did not include prescribing indicators among inpatients in hospitals. The cited studies in our reference are in a different health system with different cultural values. Reasons for irrational drug prescribing could not be analysed in the present study. Secondly, as the prevalence rates of infectious diseases differ among countries, antibiotic prescribing and utilization may also vary accordingly. Therefore, the conclusions from this study may not be generalizable to other countries or areas. Thirdly, the findings from this study may be subject to confounding factors, such as age composition of the study population, availability and accessibility of drugs in the study area.

In conclusion, this study described the current status of drug prescribing in village health clinics across 10 provinces of Western China. The results demonstrate that in rural Western China, drug prescribing was far from optimal level of rational use, especially in terms

of prescribing injection and antibiotics. Further intervention studies should be conducted to assess how to promote rational drug prescribing. For example, an education training programme could be conducted and assessed among the village doctors to reduce the irrational use of drugs, in particular, antibiotics and injection.

Acknowledgements

We would like to thank all GPs who participated in this study and all investigators for data collection. We are also grateful to Paul Milligan for his comments on the earlier draft of this manuscript. LD designed the prescription study, collected the data, conducted the data analysis and prepared the manuscript. HY contributed to the design and analysis of the study and the preparation of the manuscript. DW contributed to the data analysis and writing of the manuscript.

Declaration

Funding: Chinese Ministry of Health; United Nations Children's Fund (Yan001).

Ethical approval: Human Research Ethics Committee of the Xi'an Jiaotong University College of Medicine.

Conflict of interest: none.

References

- Edwards IR, Aronson JK. Adverse drug reactions: definitions, diagnosis, and management. *Lancet* 2000; **356**: 1255–9.
- Ess SM, Schneeweiss S, Szucs TD. European healthcare policies for controlling drug expenditure. *Pharmacoeconomics* 2003; **21**: 89–103.
- Hu S, Chen W, Cheng X *et al*. Pharmaceutical cost-containment policy: experiences in Shanghai, China. *Health Policy Plan* 2001; **16** (suppl 2): 4–9.
- Ye K, Wu Y. Rational drug utilization for commonly clinical cases. *China Food Drug Admin* 2007; **2**: 53–5.
- Dong L, Yan H, Wang D. Antibiotic prescribing patterns in village health clinics across 10 provinces of Western China. *J Antimicrob Chemother* 2008; **62**: 410–5.
- Batty GM, Grant RL, Aggarwal R *et al*. Using prescribing indicators to measure the quality of prescribing to elderly medical inpatients. *Age Ageing* 2003; **32**: 292–8.
- Zhang Y, Zhi M. Index system, appraising method for comprehensive appraisal. *J North Jiaotong Univ* 1995; **19**: 393–400.
- Joncheere KD. Implementation of rational pharmacotherapy. In: *Perspectives and Achievements with Rational Pharmacotherapy, 2002*. Copenhagen, Denmark: WHO/EURO.
- Melander A. Variation in drug utilisation in the EU: causes and consequences as illustrated by antibiotics. In: *Perspectives and Achievements with Rational Pharmacotherapy, 2002*. Copenhagen, Denmark: WHO/EURO.
- Karen E, Li L, Meng Q, Magnus L, Adam W. Health service delivery in China: a literature review. *Health Econ* 2008; **17**: 149–65.
- Santos V, Nitrini SM. Prescription and patient-care indicators in healthcare services. *Rev Saude Publica* 2004; **38**: 819–26.

- ¹² Vos J, Gumodoka B, van Asten HA *et al*. Improved injection practices after the introduction of treatment and sterility guidelines in Tanzania. *Trop Med Int Health* 1998; **3**: 291–6.
- ¹³ Ernest SK. Injection safety: knowledge and practice among health workers. *West Afr J Med* 2002; **21**: 70–3.
- ¹⁴ Magee JT, Pritchard EL, Fitzgerald KA, Dunstan FD, Howard AJ. Antibiotic prescribing and antibiotic resistance in community practice: retrospective study, 1996–8. *BMJ* 1999; **319**: 1239–40.
- ¹⁵ Bjerrum L, Cots JM, Llor C, Molist N, Munck A. Effect of intervention promoting a reduction in antibiotic prescribing by improvement of diagnostic procedures: a prospective, before and after study in general practice. *Eur J Clin Pharmacol* 2006; **62**: 913–8.
- ¹⁶ le Grand A, Hogerzeil HV, Haaijer-Ruskamp FM. Intervention research in rational use of drugs: a review. *Health Policy Plan* 1999; **14**: 89–102.