Cross-Sectional Study of Outpatient Drug Indicators, Prescribing Trends and Economic Data of Chinese Jingzhou Area With WHO/INRUD Methodology

Jun Zou (zoujun1369@sina.com)
Hainan Women and Children's Medical Center

Jingsong Mei
Jingzhou Central Hospital

Yuanrong Yang
Jingzhou Central Hospital

Guohua Jia
Hainan Women and Children's Medical Center

Research Article

Keywords: cross-sectional study, pharmacoepidemiology, rational use of drugs, drug indicator, prescribing indicator, antibiotic percent, injection percent, economic data

Posted Date: December 7th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-114710/v1

Abstract

Background: In order to get the baseline data of Chinese hospital overall medical reformation and investigate the drug indicators, prescribing trends and economic data, we investigated the data before administrative interventions with the historical control method.

Method: According to the WHO/INRUD criteria and cross-sectional studies, the retrospective method and equal sample interval of systematic sampling were used. We sampled from daily ordinary prescriptions, computed the drug indicators, prescribing trends and economic data and compared the mean of twelve days.

Result: We sampled 1171 from 38246 adult ordinary prescriptions, the sampling percent was 3.06%, percentage of drugs prescribed by generic name 100.00%, In 2012-2014, the percentage of antibiotic cost in the daily drug cost decreased from17.44% to 8.01%, percentage of prescriptions with an antibiotic prescribed decreased from 12.64% to 9.64%, percentage of encounters with an injection prescribed decreased from 15.21% to 12.77%, the percentage of antibiotic cost in the daily drug cost decreased from 17.44% to 8.01%.

Conclusion: By comparing the related data, most indicators were in decreasing trend and becoming more rational, administrative interventions had greatly most prescribing indicators, our hospital overall medical reformation was steadily advanced.

Background

In 2016 the Chinese public hospitals of 200 pilot cities abolished 15% markups on pharmaceuticals. Report on the Work of the Government (2017)[1] introduced overall reform in all public hospitals in China, abolished all markups on pharmaceuticals, and made coordinated progress in reforming health care pricing, staffing and remuneration, medicine distribution and models of health insurance payment. After the reformation, drug markups were cancelled and public hospitals had two channels of service charge and government subsidy.

The National Health Commission of the People's Republic of China (NHCPRC) [2] promulgated 'Prescription Management Regulation' in 2007, 'Management Practices of Hospital Prescription Comment (trial)' in 2010, 'National Antibiotic Special Rectification Activities' in 2011, 'The Guidelines for Clinical Application of Antibacterial Drugs' in 2015 and 'National Action Plan to Contain Antimicrobial Resistance (2016–2020)' in 2016. In order to get the baseline data of overall reformation and investigate the drug indicators and prescribing trends impacted by the related regulations, we sampled prescriptions in the second quarter of 2012–2014 to compare with our previous research of 2006–2009[3]. According to the World Health Organization (WHO)/ International Network for Rational Use of Drugs (INRUD) criteria and cross-sectional studies, the effect of 15% markups on pharmaceuticals was investigated at the outpatient of tertiary teaching hospital in Jingzhou, Hubei province, China.

WHO published 'How to Investigate Drug Use in Health Facilities[4]' in 1993, 'WHO handbook for guideline development' [5] in 2014 and 'Monitoring and evaluation of the global action plan on antimicrobial resistance: framework and recommended indicators'[6] in 2019, the indicators could be used to make comparisons between different areas and in different time. The European Surveillance of Antimicrobial Consumption (ESAC; http://www.esac.ua.ac.be) project [7] proposed a set of 21 disease-specific antibiotic prescribing quality indicators to assess the quality of antibiotic prescribing in primary care. How to Investigate Antimicrobial Use in Hospitals[8] was published by the U.S. Agency for International Development, 16 indicators were related to inpatient antimicrobial use in hospitals were described: 5 were hospital related, 9 were prescribing indicators, 2 were related to patient care and the 17th supplemental indicator was related to drug sensitivity tests. Compared with WHO indicators, American and European indicators were more complex and consumed more effort.

In 2020 China was classified as upper-middle-income economies following the World Bank categorization based on gross national income per capita (GNI)[9, 10]. According to the statistical bulletin of national economic and social development of Jingzhou[11, 12] in 2019, there are about 6,412,800 registered residents, 1,113,600 urban residents. There are about 3,204 medical institutions, 31,342 beds and 42,145 medical professionals. The Jingzhou hospital affiliated to Tongji Medical College was the biggest general tertiary teaching hospital in Jiangzhou; which has 2,200 registered beds, 2,000 employees, the annual 1,300,000 outpatient clients and 70,000 inpatient clients.

Methods And Materials

We selected the First Monday of second quarter (April, May and June) in 2012, Tuesday of next week, Wednesday of the week after next week, four days in every month…until twelve days of second quarter in 2012; then the next year, until 2014. These twelve days included ten working days from Monday to Friday, two holidays of Saturday and Sunday. The daily prescriptions were summed to N, SQRT (N) [3] which was used as daily prescription number and equal sample interval. We totally sampled 1171 from 38246 prescriptions; the total sampling percent was 3.06%.

Inclusion and Exclusion Criteria

We sampled from daily prescriptions, computed the daily drug indicators, prescribing trends and economic data an[10]d compared the means of twelve days. The departments of pediatrics, emergency department, and traditional Chinese Medicine (TCM) were excluded. The narcotic, poisonous substance and radiopharmaceuticals prescriptions were excluded as well.

Antibiotics were defined as any agents included in the J01 group of the Anatomical Therapeutic Chemical (ATC) classification system[13]. Except that the antidiarrhoeal drugs such as gentamycin, quinolones, nifuroxazide or their combinations were regarded as antibiotics[14]. Antituberculosis drugs, Antifungal drugs, antivirus drugs, antiparasite drugs, antitumoral antibiotics and botanical antimicrobials were not

regarded as antibiotics. Vaccines, menstruum, local anesthetic, local sealant, conjunctival and retrobulbar injection were not regarded as injection.

Statistical Method

SPSS17.0 for windows was used to make statistical analysis. The results were expressed as Mean ± Standard Deviation (M±SD). Levene test was used to test homoscedasticity of measurement data. Analysis of variance (ANOVA) was used to compare mean of measurement data, Kruskal-Wallis H was used to compare mean of numeration data. Post Hoc Test was used for Multiple Comparisons. The P-value <0.05 was statistically significant.

Results

1171 prescriptions were sampled from 38246 cases. The descriptive results were shown in Table 1. Because the hospital took new hospital information system (HIS) of Meigujia Network Science Technologies Co, .LTD (http://www.wosun.com.cn/) in 2009, the prescriptions were prescribed by computer, so the percentage of drugs prescribed by generic name was 100.00%. Percentage of injection prescriptions in the sampled prescription was 14.43%, Percentage of antibiotic prescriptions in the sampled prescription was 25.36%.

Table 1: Total Prescribing Indicators of 1171 Prescriptions

Indicators	2012-2014	WHO Optimal Value[15, 16]	Africa Standard[17, 18]
Total sampling percent=sampled prescription/Total ordinary prescription	3.06%	-	-
Percentage of drugs prescribed by generic name	100.00%	100	65.1
Average number of drugs per prescription	2.29	1.6-1.8	< 2
Average number of antibiotics per prescription	0.31	-	
Percentage of injection prescriptions in the sampled prescription	14.43%	13.4–24.1	45.9
Percentage of antibiotic prescriptions in the sampled prescription	25.36%	20.0–26.8	28.4
Percentage of antibiotic numbers in the drug number	13.62%	-	-
Average drug cost per prescription(RMB)	244	-	-
Average drug cost per antibiotic prescription(RMB)	175.71	-	-
The percentage of antibiotic cost in the total drug cost	12.53%	-	-
The percentage of antibiotic prescription cost in the total prescription cost	18.26%	-	-
Percentage of prescriptions with an antifungal prescribed	2.90%	-	-
Chinese yuan, RMB: Renminbi, - uninvestigated			

The average number of drugs per prescription in Table 2 ranged from 1.87 to 3.4, which was similar to other countries. The 5099 prescriptions from May 2011 to April 2012 in Anhui province were analyzed[19], the average number of drugs prescribed was 3.52, which was higher than the relevant domestic research findings of Inner Mongolia (2.7), Guangdong (2.36), Guangxi (1.95) and Beijing (2.0)[20].

Table 2: Outpatient Drug indicators and prescribing trends of 2012-2014

Indicator s(N=12)	2012	2013	2014
Daily ordinary prescriptions	1014.42±303.32	1119.42±333.07	1053.33±274.48
Sampled ordinary prescriptions	31.67±4.85	33.58±5.37	32.33±4.46
Percentage of ordinary prescriptions in daily prescriptions (%)	3.32±0.75	3.18±0.73	3.19±0.53
Daily antibiotic prescriptions	9.25±2.77	7.33±1.78	8.17±2.25
Daily injection prescriptions	4.92±2.71	5.00±1.81	4.17±2.12
Number of antifungal prescriptions	0.92±0.90	1.25±1.36	0.67±0.65
Daily drug number**	63.92±11.67	62.92±10.77	97.00±10.22**
Daily antibiotic number**	12.17±3.81	9.00±2.32	9.33±2.93
Average number of drugs per prescription**	2.04±0.34	1.91±0.38	3.03±0.37**

* P<0.05, **P<0.01

The WHO used 0/1 (no or yes) in the survey of antibiotics and injections. The number of the prescriptions with two or more antibiotics was 1(yes), which might result in loss of information. So we used actual number instead of 0/1 (no or yes). The WHO recommended that the average number of medications per encounter for outpatients should be 1.6 to 2.8 in developing countries [15, 16].

Table 3: Prescribing Core Drug Indicators of 2012-2014

Indicators (N=12)	2012 (%)	2013 (%)	2014 (%)
Percentage of prescriptions with an antibiotic prescribed	12.64±3.65	10.30±3.79	9.64±2.83
Percentage of antibiotic prescriptions in the daily prescription	29.54±8.59	22.63±8.24	25.59±7.39
Percentage of encounters with an injection prescribed	15.21±6.89	14.68±4.36	12.77±6.22
Percentage of prescriptions with an antifungal prescribed	2.91±2.76	3.73±3.76	2.23±2.54
Percentage of drugs prescribed by generic name	100	100	100

* P<0.05, **P<0.01

Prescribing core drug indicators of 2012-2014was shown in table3, according to the WHO recommendation for the rational use of medications, the optimal proportion of injections should be 13.4%-24.1% of total prescriptions, in Beijing the percentages of encounters with antibiotics or injections prescribed were 15.1 and 3.7% [20].

Table 4: Outpatient Economic Indicators of 2012-2014

Indicators (N=12)	2012	2013	2014
Daily prescription cost(RMB)**	6054.50±1623.92	6059.17±1451.62	11696.48±2771.64**
Cost of antibiotic prescriptions(RMB)	1610.71±624.76	1222.26±540.92	1515.83±567.13
Daily antibiotic cost(RMB)	1079.10±497.97	945.54±356.18	959.05±498.21
Average drug cost per prescription(RMB)	191.32±41.89	179.37±26.70	363.22±76.54**
Average drug cost per antibiotic prescription(RMB)	178.07±65.36	169.33±49.38	186.66±65.65
The percentage of antibiotic cost in the daily drug cost (%) **	17.44±6.83	16.46±7.99	8.01±3.65**

* P<0.05, **P<0.01

The economic data was shown in Table 4. The average drug cost per prescription in 2014 greatly increased, because of the increase of the inpatient expense reimbursement and the outpatient expense. Some valuable and expensive drugs which were not reimbursed by the social medical insurance were bought in the dispensary for inpatients. Though average drug cost per prescription increased, the percentage of antibiotic cost in the daily drug cost remarkably decreased from 17.44% to 8.01%. The improvement must have direct relation with the administrative interventions.

Table 5: Results of WHO/INRUD Indicator Studies in Different Countries [15, 16]

Performance Indicators	Study Reference[15, 16]										Mean
	[A]	[B, C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	
Average number of medicines prescribed per patient encounter	2.2	2.4	2.3	2.5	2.3	3	2.2	2.2	2.4	3.1	2.5
Percent medicines prescribed by generic name	74	61.2	5.1	95.4	75.5	63.1	99	79.4	99.8	10.1	66.3
Percent encounters with an antibiotic prescribed	37	32.2	60.9	39.2	35.4	54.2	43	24.9	66	33	42.6
Percent encounters with an injection prescribed	11	2	1.2	9.9	19	38	18	10.6	2.4	2.4	11.4
Percent medicines prescribed from EML	78	99.2	93	95.4	87.1	75.6	98.8	90.3	99.7	65.2	88.2
Average consultation time (minutes)	5.8	7.3	3.9	7.1	3.6	6.1	3.7	6.2	4.4	2.3	5
Average dispensing time (seconds)	17	100	28.8	47.4	39.9	18.1	37	78	234	258	85.8
Percent medicines actually dispensed	66	99.6	81.8	95.9	91.6	99.1	84.5	83.4	100	81	88.3
Percent medicines adequately labeled	63	10	91.4	0	87.6	55.9	86.2	70.1	0	99.4	56.4
Percent patients with knowledge of correct doses	54	79.3	77.7	94	96.1	86.5	81.7	72.1	55	74.3	77.1
Availability of EML to	50	90	100	80	100	100	100	50	100	100	87

practitioners											
Percent key medicines available	55	59.2	80	78.3	100	91.7	86.5	65	86.6	84	78.6

EML Essential Medicines List; [A] Fortaleza of Brazil; [B, C] Saudi Arabia; [D] Jordan, [E] Alexandria of Egypt; [F] Dar Es Salaam of Tanzanian; [G] Africa; [H] Mozambique, [I] Ethiopia; [J] Kampong Thom of Cambodia; [K] Kolkata of India.

Discussion

Discussion of Methodology

The majority of analytical observational[21] studies assessing the association between an exposure and an outcome were cross-sectional studies, cohort or case-control studies. The advantages of cross-sectional studies [22] were easy and quick to conduct and less expensive compared with cohort or case-control studies. The information on attitudes, knowledge and regulation practice, which was available only from cross-sectional studies, was useful for planning health interventions. Point-prevalence surveys [23] were useful when time and resources didn't allow for continuous surveillance. Repeated point-prevalence surveys within the same institution could be used to monitor trends and effectiveness.

Sampling method was very important for the comparability of date. The sample size was the compromise between statistically goals and feasible ways. WHO/INRUD suggested that one year or longer and large cases were demanded to minimize bias due to seasonal variations or interruptions in the drug supply cycle[24]. In 2006 we sampled prescriptions of September 1, then September 2… until September 10, then the next year, until 2009. In 2006 we totally sampled 1180 from 36581 prescriptions; the sampling percent was 3.23%. In 2012 we sampled 1171 from 38246 adult ordinary prescriptions; the sampling percent was 3.06%.

According to the related regulations, every prescription was assumed to be from one encounter. Compared the WHO and Chinese indicators of Prescription Management Regulation, the difference was that "every encounter" was emphasized in WHO indicators, while "every prescription" was emphasized in Chinese regulations.

The 'Guidelines for Clinical Application of Antibacterial Drugs' in 2015 required that percentage of inpatient prescriptions with an antibiotic prescribed should be less than 20%, percentage of emergency prescriptions with an antibiotic prescribed should be less than 40%, the defined daily dose(DDD) should be less than 40. The pediatric patients thought that injections were more convenient, effective, poorer compliant than oral drugs. They required clinicians to use injection and antibiotics. Because of serious diseases and anxious conditions of emergence patients, more injection and antibiotics could be used by

the emergency and pediatric physicians. In order to minimize bias, only the adult ordinary prescriptions were included in our calculation. The departments of pediatrics, emergency and TCM were excluded.

Discussion of Rational Drug Use

A questionnaire was designed to evaluate the knowledge levels of physicians[25], total of 334 physicians in 60 county hospitals filled out the questionnaires and 385,529 prescriptions were collected. But there was still a popular belief in China that injections and antibiotics were more convenient and effective[26], which was very common that patients demanded injections and antibiotics for quick recovery from sickness. The knowledge gap of Chinese physicians was evident and those with a higher degree of knowledge always prescribe fewer antibiotics. The National Health Commission of the People's Republic of China[27] had made more special efforts to enhance health education on the rational drug use and antimicrobial resistance[28], develop more targeted policies[29] and programs for prescription practice at medical facilities.

The results of WHO/INRUD Indicator Studies in developed and developing countries[30] had showed in table 5, our results of table 2, table 3 and table 4 were different from the table 5, any indicator were out of range of WHO optimal value and Africa standard in table 1. Targeted training and courses to educate physicians about the risks of over-prescription should be conducted to improve the practice of antibiotic prescriptions. The governments should also take action to control antimicrobial resistance[6, 31] according to WHO 'Global action plan on antimicrobial resistance' [28].

Discussion of Economic view

'Health in the 2030 Agenda for Sustainable Development' [32] pointed out that Sustainable Development Goals included much broader range of environmental, economic and social issues. WHO reported supporting a total of 241 South–South and/or triangular cooperation initiatives[32], 47% covered health systems and universal health care, 30% covered promoting health through the life-course and 16% covered other issues. In addition, 74% included training and capacity-building, 76% of initiatives included technical support, 32% provided financial[33] and equipment support and 18% providde other services. Essential medicines [34, 35]covered a wide range of diseases which could decrease medical expenditure, including pain management and palliative care. Data from health facility surveys conducted nationally in 29 countries during the period 2007–2017[32, 33] indicate that 58% of public-sector facilities surveyed in lower-middle income countries stocked medicines for pain management and palliative care.

Chinese medical insurance was consisted of commercial health insurance and social medical insurance[36]. The latter was consisted of basic medical insurance system for urban and township employees and new rural cooperative medical system. Our outpatient Economic Indicators of 2012-2014 was shown in Table 4. According to the statistical bulletin of national economic and social development

of Jingzhou[11, 12] in 2019, there are about 6,412,800 registered residents, 1,113,600 urban residents. There are about 3,204 medical institutions, 31,342 beds and 42,145 medical professionals. Though average drug cost per prescription increased from 191.31 to 363.22 RMB, the percentage of antibiotic cost in the daily drug cost remarkably decreased from 17.44% to 8.01%.

Chinese Zhuhai's [36]new expenditure per common disease outpatient and prescribing indicators were benefited from medical insurance and expanded access to primary care, but it could led to reduction in expensive specialist inpatient services. More explicit incentives and specific quality of medication prescribing targets need to be incorporated into the insurance system.

Conclusion

The baseline data of the drug indicators, prescribing trends and economic data were investigated, most indicators were in decreasing trend and becoming more rational, administrative interventions had greatly affected some prescribing indicators, our hospital overall medical reformation were steadily advanced.

Abbreviations

NHCPRC: National Health Commission of the People’s Republic of China

INRUD: International Network for Rational Use of Drugs

WHO: World Health Organization

GNI: gross national income per capita

TCM: traditional Chinese Medicine

ATC: Anatomical Therapeutic Chemical

SD: Standard Deviation

ANOVA: Analysis of variance

HIS: hospital information system

DDD: defined daily dose

Declarations

Ethics approval and consent to participate

We just collect the prescription content and compute the indicators, we don’t collect patient information (image, face, name etc.); we declare that all protocols are carried out in accordance with relevant

guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

Data and materials are available on the publication.

Competing interests

We have no competing interests (financial and non-financial) or other interests that might be perceived to influence the results and/or discussion reported in this paper.

Funding

Funded by 2020 Health Research Project of Hainan Province, Project number was 182.

Authors' contributions

Yang YY collected and analyzed the data. Mei JS prepared table 1-4. Zou J wrote the main manuscript. Jia GH conceived and designed the study, drafted critical revision of the manuscript. All authors reviewed and approved the manuscript.

Acknowledgements

Thank Ms. Li Linyun for her modification of the grammar and expression.

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