The impact of the National Essential Medicines Policy on prescribing behaviours in primary care facilities in Hubei province of China

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Aim To assess the impact of the National Essential Medicines Policy (NEMP) on the use of medicines in government-owned primary care institutions in Hubei province of China.

Study design Quasi-experimental design and time-trend analysis.

Methods A systematic random sampling strategy was employed to select 55,800 prescriptions from 18 primary care organizations who progressively implemented the NEMP from January 2009 to July 2011. We examined the change of patterns of prescriptions. The facilities that implemented the NEMP at a later stage served as control.

Results An immediate increased uptake of essential medicines of all drugs prescribed which ultimately neared 95%. In total, 38,151 prescriptions (68%) involved antibiotics, and we found no evidence of reduction after the NEMP interventions. A high percentage (59–66%) of prescription drugs were administered through parenteral routes and no reduction was found after the NEMP interventions. Although the average number of medicines per prescription remained unchanged (nearly four), the average cost per prescription declined significantly after the NEMP interventions (¥ 44.67 vs ¥ 26.67 CNY, P < 0.03).

Conclusions The NEMP interventions reduced the average cost per prescription; however, the irrational use of antibiotics and unnecessary parenteral administration remains prevalent. The goals of the NEMP are partially achieved; we therefore recommend a strategic approach involving all stakeholders to comprehensively achieve all aspirations.

Keywords Prescribing, essential medicines, primary care, China

KEY MESSAGE
- The National Essential Medicines Policy (NEMP) reduced the average cost per prescription; however, the irrational use of antibiotics and unnecessary parenteral administration remains prevalent.
Introduction

The medically inappropriate, ineffective and economically inefficient use of drugs occurs commonly in healthcare institutions worldwide, especially in developing countries (WHO 2009). In 2010, the World Health Organization (WHO) estimated that more than 50% of all drugs are prescribed, dispensed or sold inappropriately in the world (WHO 2010). The consequences of the irrational use of drugs include adverse drug reactions (ADRs), drug resistance, protracted illness and even death (Le Grand et al. 1999; Edwards and Aronson 2000). The financial burden arising from the irrational use of drugs is profound and often unexpectedly high, particularly in developing countries where resources are limited (Hu et al. 2001). In China, some 2.5 million patients are admitted to hospitals each year due to serious adverse drug events (Ye and Wu 2007); for example, 60% of all children with acquired deafness are due to the irrational use of ototoxic drugs (Ye and Wu 2007). The overuse of antibiotics is perhaps the most common abuse of medicines, resulting in bacterial antibiotic resistance: an emergent threat to the global population (Swartz 1997). Nosocomial or hospital acquired infection of antibiotic resistant bacteria increases medical cost, length of hospital stay and ultimately mortality (Quach et al. 2002; Dellit et al. 2007). A study across 10 western provinces in China showed that the overuse of antibiotics and injections were the most prominent manifestations of irrational drug prescribing (Dong et al. 2011b).

Significant attempts have been made to improve the rational use of medicines worldwide. Effective interventions are generally multifaceted and include provider and consumer education, peer support, case management, supervised administration of medicines and essential medicines programmes (Helin-Salmivaara et al. 2003; Kathleen and Liset 2011). Almost half of all countries are implementing policies to ensure the appropriate use of medicines (Kathleen and Liset 2011), such as regulating of medicine usage (Park et al. 2005), regular updating of clinical guidelines, information support for prescribers and organizational interventions through therapeutic committees. To promote the rational use of medicines, the Second International Conference on Improving Use of Medicines in 2004 and the World Health Assembly Resolution WHA60.16 in 2007 recommended comprehensive systemic approaches and the establishment of national programmes.

WHO defines essential medicines as ‘those that satisfy the priority health care needs of the population’ (WHO 2001b). They are selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost-effectiveness. Essential medicines ‘ought to be available at all times, in the proper dosage forms, to all segments of society’ (WHO 2001b; Laing et al. 2003). In 1975, for the first time, WHO recommended the concept of essential medicines for poor countries and in 1977 developed a model Essential Medicines List (EML) that contained 208 medicines (WHO 1977), and, as of 2010, this had increased to some 350 (WHO 2011). The essential medicines concept—that high-priority drugs are available as part of a functioning health system at all times for all people—is necessary for proper medical care (WHO Expert Committee 2007). Selecting and using a limited list of the best medicines available for the conditions being treated is designed to decrease inappropriate prescribing. It has many advantages with a limited list of high-priority drugs and is intended to preclude prescribing less effective or more toxic drugs when more appropriate alternatives are available on the list (Reidenberg 2009).

The Chinese Central Government proposed the establishment of a national essential medicines system, and made it one of five top priorities in the most recent healthcare reform strategy (2009–11) (The State Council of China 2009). Previously, hospital income from pharmacy dispensaries commonly subsidized the low income arising from clinical services: the charges to patients for medical provision were strictly regulated, while those for pharmaceuticals were not. This created a powerful and perverse incentive that influenced some physicians to select and prescribe expensive, often unnecessary and inappropriate prescriptions, especially if their remuneration depended on bonus payments for performance (Eggleston et al. 2008; Wagstaff et al. 2009).

The National Essential Medicines Policy (NEMP) aims at increasing the availability of cost-effective medicines, ensuring the quality of supplied medicines and promoting the rational use of medicines (WHO 2001a). Although China embraced the concept of essential medicines in 1979 and issued the first national EML in 1982, until relatively recently China lacked a comprehensive national essential drug policy. The State Council undertook to implement the essential medicines system in 30% of government-owned primary care institutions by the end of 2009, and to achieve 100% coverage over the following 3 years. To promote the rational use of drugs in primary care, all provider facilities were required to make all listed essential medicines available, and for doctors to prescribe drugs from the EML as far as practicable and where medically indicated. In addition, primary care facilities were directed to purchase drugs from accredited suppliers via centralized procurement arrangements to ensure the quality of drugs, both in terms of reliability of manufacture and surety of supply.

To achieve the rational use objectives, the WHO identifies the key components of a comprehensive national drug policy (WHO 2001a), linking each of these components to the key objectives of access, quality and rational use, as per Table 1, which has been cross referenced to the Chinese policy.

China’s NEMP was promulgated by the Ministry of Health (MOH), the National Development and Reform Commission (NDRC) and seven other agencies, with policies and procedures addressing selection, production, supply and use of essential medicine, pricing, payment, monitoring and evaluation arrangements (Box 1).

As can be seen, the approach adopted by China is congruent with many of the policy objectives expressed by the WHO. It is critical for the development of an equal, efficient, effective and sustainable healthcare delivery system (Yip et al. 2012). Although the implementation of the NEMP has been progressing, the long-term effect of the policy in terms of physician prescribing behaviours remains unknown. The aim of this study was to assess the change of patterns of drug prescribing in responding to the NEMP using the WHO drug use indicators.
Table 1 Components of a national drug policy linked to key policy objectives (WHO)

<table>
<thead>
<tr>
<th>Components</th>
<th>Access</th>
<th>Quality</th>
<th>Rational use</th>
<th>China’s NEMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of essential drugs</td>
<td>Direct link</td>
<td>Indirect link</td>
<td>Direct link</td>
<td>K1</td>
</tr>
<tr>
<td>Affordability</td>
<td>Direct link</td>
<td></td>
<td></td>
<td>Implicit</td>
</tr>
<tr>
<td>Drug financing</td>
<td>Direct link</td>
<td></td>
<td></td>
<td>Implicit</td>
</tr>
<tr>
<td>Supply systems</td>
<td>Direct link</td>
<td></td>
<td>Indirect link</td>
<td>K7</td>
</tr>
<tr>
<td>Regulation and quality assurance</td>
<td>Direct link</td>
<td></td>
<td>Direct link</td>
<td>K2</td>
</tr>
<tr>
<td>Rational use</td>
<td>Direct link</td>
<td></td>
<td>Direct link</td>
<td>K3</td>
</tr>
<tr>
<td>Research</td>
<td>Direct link</td>
<td>Direct link</td>
<td>Direct link</td>
<td>K4</td>
</tr>
<tr>
<td>Human resources</td>
<td>Direct link</td>
<td>Direct link</td>
<td>Direct link</td>
<td>K5</td>
</tr>
<tr>
<td>Monitoring and evaluation</td>
<td>Direct link</td>
<td>Direct link</td>
<td>Direct link</td>
<td>K6</td>
</tr>
</tbody>
</table>

Box 1 Key components of China’s NEMP

K1: Selection of essential drugs
- National Essential Medicines List (provisional);
- National Essential Medicines List (for primary care).

In August 2009, an expert panel was organized by the MOH to compile a new list of National Essential Medicines for primary care. Equal consideration was given to both Western and Traditional Chinese Medicine (TCM). A total of 307 generic drugs entered into the list: 205 Western Medicines and 102 TCM. The list will be revised every 3 years. Unlike the WHO Model Drugs List that defined a core list and a complementary list, provincial authorities in China reserve the right to add additional drugs into the list.

K2: Regulation and quality assurance
- Regulations on strengthening quality assurance of essential medicines

As of 31 March 2011, all essential medicines will be electronically monitored by the Food and Drug Administration authority. Essential drug suppliers must join a centralized pharmaceutical electronic supervision network, attaching a standardized barcode to the smallest drug package.

K3: Rational use
- Clinical Guidelines for the Use of National Essential Medicines for Primary Care;
- National Essential Drug Formulary (primary care section).

The clinical guidelines were issued by the MOH in December 2009, covering 18 common conditions. The Formulary covers 24 treatment protocols.

K4: Research
The NEMP does not specify any research requirements.

K5: Human resources
- Strengthening rural health workforce development

This policy covers training, payment and management arrangements for rural health workers.

K6: Monitoring and evaluation
- Monitoring and Evaluation of the National Essential Medicines System (2011)

In each province, 20 government-run primary care institutions were randomly selected by the MOH for monitoring and evaluation purpose.

K7: Supply systems
- Procurement and Distribution of National Essential Medicines (provisional);
- Retail Pricing Policy for National Essential Medicines (primary care section).

A national pricing ceiling was defined by the NDRC for essential medicines. Provincial health authorities organize an internet-based tendering system for the supply of essential medicines. Government-owned primary care providers must sell essential medicines at zero mark-up.
IMPACT OF NEMP ON PRESCRIBING BEHAVIOUR IN PRIMARY CARE  

Methods

Study design
This study was undertaken in Hubei province. Hubei is located in central China, with a population of 61.4 million (in 2009) residing across 106 counties (or cities). The total gross domestic product of the province was ¥ 1296.1 billion (CNY) (~US$205 billion) in 2009, ranking in the middle range of all provinces.

Primary health facilities are designated as Township Health Centres in rural areas, and Community Health Centres in urban areas; for the purpose of this report, they are collectively referred to as health centres. Township (community) health centres in those counties implemented the NEMP in three stages. The first group of 37 counties implemented the NEMP in January 2010. The second group consisted of a further 33 counties and commenced the NEMP in December 2010, and the remaining 36 counties in May 2011.

This study adopted a quasi-experimental design. The Government predetermined the staged arrangement for implementation of the NEMP by these counties. We took advantage of this and made parallel comparisons, with the health centres who implemented the NEMP at a later stage being considered as ‘parallel control’. The impact of the NEMP was evaluated through pre- and post-intervention comparisons using the five prescribing indicators, which are described later.

Data source
A two-stage random sampling strategy was employed. In the first stage, six health centres were randomly selected for each group of counties, respectively, which became the three cohorts. Cohort 1 comprised four urban and two rural health centres. Cohort 2 comprised six rural health centres. Cohort 3 comprised two urban and four rural health centres. In the second stage, 100 outpatient prescriptions were selected through systematic random sampling in each month for each selected health centre during the period from January 2009 until July 2011. In each selected health centre, outpatient prescriptions were sorted according to dispensing dates. The first prescription was selected at random. Subsequent samples (prescriptions) were selected at intervals of five until 100 samples were collected. A total of 55,800 prescriptions (18 institutions × 31 months × 100 prescriptions) were examined. No information that might identify an individual patient was recorded.

Data analysis
We used five indicators adapted from the WHO/International Network for the Rational Use of Drugs (WHO/INRUD) prescribing indicator system (WHO 1993):

- percentage of drugs prescribed from the EML;
- average number of medicines per prescription;
- average expenditure per prescription;
- percentage of prescriptions requiring antibiotics; and
- percentage of prescriptions requiring injections.

The three indicators reflect the pattern of prescribing in terms of what are prescribed, how many and how much, while the latter two are quality indicators. They were chosen because there is a consensus that antibiotic and injection use are particularly prevalent in China and represent overuse and irrational use of medicines (Dong et al. 2011b). We note with interest that the evaluation framework for the most recent round of health system reform in China includes ‘antibiotic prescription rates’ in its indicator system (Guo et al. 2010).

The raw data from each centre each month were collated with a view to detect the change, if any, that the implementation of the NEMP interventions might have occasioned. Further comparisons were made between the intervention and control groups. Layered (by month) Chi-Square tests were applied to the NEMP categorical indicators (percentages). ANOVA or student t-tests were applied to the continuous measurements (average number of drugs per prescription and average expenditure per prescription).

The analysis was performed using SPSS software version 12.0. The data were analysed and presented by urban and rural settings, respectively.

Results

Characteristics of the sampled health centres
The size of the health centres varied considerably; for example, the number of medical staff ranged from 26 to 205 in a single health centre. The variance of size reflected healthcare demand, which was proportional to the size of the client population. The volume of outpatient services similarly varied across centres. However, no significant differences in the organizational size and volume of services between the three cohorts were found ($P > 0.05$ for ‘number of beds’, ‘medical staff’ and ‘outpatient and emergency visits a year’ as shown in Table 2).

Similarly, no significant differences in the organizational size and volume of services between the urban and rural health centres were found ($P > 0.05$ for ‘number of beds’, ‘medical staff’ and ‘outpatient and emergency visits a year’ as shown in Table 2) despite the great variance of individual health centre in size.

Rural communities had less annual income per capita than their urban counterparts. As Cohort 2 consisted solely of rural health centres, lower annual income per capita of their servicing area was evident.

Percentage of drugs prescribed from the EML
The NEMP interventions resulted in significant increase in the prescriptions of EML drugs. A significant rise in the percentage of prescribed EML drugs after the NEMP interventions occurred in all the three cohorts (all $P < 0.001$, it had been rising sharply in Cohort 3 despite a short period of intervention). The percentage of drugs prescribed from the EML in the first two cohorts of health centres increased from 66 to ~95%, with the rural and urban health centres demonstrating a similar change of patterns. All the three cohorts showed significant rise in the percentage of prescribed EML drugs after the NEMP interventions (all $P < 0.001$). The parallel comparison showed that the rural health centres in Cohort 1 had a higher percentage of drugs prescribed from the EML after the initiation of NEMP interventions compared with the rural health centres in Cohort 2 (before initiation of its interventions) (98 vs 68%, $P < 0.001$). No significant differences appeared between the two groups.
when neither of the groups had entered into NEMP interventions (65 vs. 67%, \( P = 0.210 \)) (Figure 1).

**Average number of medicines per prescription**

The average number of medicines per prescription remained largely unchanged before and after NEMP interventions (nearly 4) \( (P > 0.05) \) despite a variance between the groups (average 3.4 in Cohort 1, 4.7 in Cohort 2, 4.1 in Cohort 3) \( (P < 0.001) \) and a disparity between urban and rural health centres (3.5 vs. 4.4, \( P < 0.01 \)) (Figure 2). The urban health centres in Cohort 3 had a decline in the number of medicines per prescription before the NEMP intervention was introduced \( (P < 0.001) \).

### Table 2 Characteristics of the sampled health centres and the populations they serviced in 2010

<table>
<thead>
<tr>
<th>Health centres</th>
<th>Number of beds</th>
<th>Medical staff</th>
<th>Serving population (thousand)</th>
<th>Annual income per capita (CNY) of servicing area</th>
<th>Outpatient and emergency visits a year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban</strong></td>
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<tr>
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<td>59</td>
<td>45.70</td>
<td>4189</td>
<td>20 937</td>
</tr>
<tr>
<td>Median</td>
<td>35</td>
<td>63</td>
<td>69.00</td>
<td>11 250</td>
<td>28 336</td>
</tr>
<tr>
<td>Maximum</td>
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<td>102</td>
<td>88.30</td>
<td>24 000</td>
<td>117 304</td>
</tr>
<tr>
<td><strong>Rural</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
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<td>26</td>
<td>26.00</td>
<td>1672</td>
<td>19 015</td>
</tr>
<tr>
<td>Median</td>
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<td>79</td>
<td>42.00</td>
<td>5119</td>
<td>41 532</td>
</tr>
<tr>
<td>Maximum</td>
<td>120</td>
<td>205</td>
<td>185.40</td>
<td>14 000</td>
<td>110 172</td>
</tr>
<tr>
<td><strong>Cohort 1</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>20</td>
<td>59</td>
<td>45.70</td>
<td>3300</td>
<td>20 937</td>
</tr>
<tr>
<td>Median</td>
<td>46</td>
<td>63</td>
<td>68.80</td>
<td>11 250</td>
<td>28 988</td>
</tr>
<tr>
<td>Maximum</td>
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<td>168</td>
<td>185.40</td>
<td>24 000</td>
<td>83 554</td>
</tr>
<tr>
<td><strong>Cohort 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>16</td>
<td>26</td>
<td>26.00</td>
<td>1672</td>
<td>19 015</td>
</tr>
<tr>
<td>Median</td>
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<td>52</td>
<td>30.00</td>
<td>4830</td>
<td>41 532</td>
</tr>
<tr>
<td>Maximum</td>
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<td>95</td>
<td>72.00</td>
<td>5816</td>
<td>110 172</td>
</tr>
<tr>
<td><strong>Cohort 3</strong></td>
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<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>20</td>
<td>74</td>
<td>38.00</td>
<td>2880</td>
<td>20 882</td>
</tr>
<tr>
<td>Median</td>
<td>50</td>
<td>96</td>
<td>69.00</td>
<td>6347</td>
<td>46 241</td>
</tr>
<tr>
<td>Maximum</td>
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<td>205</td>
<td>140.00</td>
<td>17 500</td>
<td>117 304</td>
</tr>
</tbody>
</table>

**Figure 1** Percentage of drugs prescribed from the EML by month
Average expenditure per prescription
The average expenditure per prescription declined significantly after NEMP interventions (¥ 44.67 vs ¥ 26.67 CNY, \( P < 0.03 \)), despite a considerable variance between the groups \( (P < 0.001) \). The average expenditure per prescription was relatively stable before the initiation of NEMP (average ¥ 34 CNY in Cohort 1, ¥ 47 CNY in Cohort 2, ¥ 53 CNY in Cohort 3) \( (P > 0.5) \). After the initiation of NEMP interventions, the average expenditure per prescription sharply declined then stabilized (average ¥ 23 CNY in Cohort 1, ¥ 26 CNY in Cohort 2, ¥ 31 CNY in Cohort 3). The urban and rural health centres demonstrated similar change of patterns. Despite a significant disparity between the urban and rural health centres before NEMP interventions \( (P < 0.01) \), the average expenditure per prescription became close to ¥ 25 CNY. The urban health centres in Cohort 3 had relatively modest reduction in average cost per prescription, possibly because of the short space of intervention (Figure 3).

Percentage of prescriptions requiring antibiotics
In total, 38,151 prescriptions (68%) involved antibiotics and we found no evidence that demonstrated a reduction in prescription of antibiotics as a result of the NEMP interventions. Cohort 2 (rural only) had the highest antibiotic prescription rate, on average of 74% prescriptions containing antibiotics. No differences in antibiotic prescription rates occurred in Cohort 1 before and after the NEMP interventions \( (P > 0.1) \). Although the prescription rate of antibiotics in the rural health centres in Cohort 1 decreased slightly (from 74.7 to 71.2%, \( P < 0.01 \)) after the initiation of NEMP interventions, it returned to its original level later on. In the urban health centres in Cohort 1, this rate actually increased (from 68.0 to 70.6%, \( P < 0.01 \)) after the initiation of NEMP interventions. Cohort 3 had the lowest antibiotic prescription rates despite a considerable seasonal variance (ranging from 53 to 68%) (Figure 4).

Percentage of prescriptions requiring injections
A high percentage of prescribed drugs were administered via injections. Cohort 3 had the lowest percentage of prescriptions requiring injections (59%) compared with Cohort 1 (67%) and Cohort 2 (66%) \( (P < 0.05) \). The rural health centres in Cohort 3 had slightly higher percentage of prescriptions requiring injections than their urban counterparts (60 vs 57%, \( P < 0.01 \)).

We found no evidence to show a reduction in the prescriptions requiring injection as result of the NEMP interventions. No significant differences in the percentage of prescriptions requiring injections were found in Cohort 1 before and after the NEMP interventions \( (P > 0.10) \) for both urban and rural health centres. The percentage of prescriptions requiring injections in the other health centres stayed at a higher level after some fluctuations before the initiation of NEMP interventions \( (P < 0.05) \) (Figure 5).

Discussion
This study demonstrated that the indicators recommended by the WHO for assessing rational prescribing of medicines are valid in the context of Chinese primary care institutions, which is consistent with studies undertaken elsewhere in China (Yan et al. 2006; Dong et al. 2011b). These indicators are sensitive in measuring patterns of prescribing and the potential health and financial consequences arising from the prescriptions.

This study showed that the NEMP interventions were effective in reducing the average expenditure per prescription due to the significant increase in the use of EML drugs. Despite the increased use of EML drugs, however, the prescription patterns of primary care providers remained largely unchanged.
Reduced average expenditure per prescription

The average expenditure per prescription decreased significantly after the initiation of NEMP interventions. This is obviously a result of increased use of EML drugs given that the average number of drugs prescribed remained largely unchanged.

Many countries in the world have established an EML (Kathleen and Liset 2011). Essential medicines are usually selected based on health needs, safety, clinical efficacy, affordability, past usage patterns and availability of supply (Le Grand et al. 1999). The Chinese national EML for primary care, issued in August 2009, contained 307 generic brand medicines [205 chemical and biological or ‘western’ medicines and 102 Traditional Chinese Medicines (TCM)] (Ministry of Health of the P. R.China 2009). They are usually less expensive than proprietary brand drugs containing the same chemical and biological elements. Chinese herbal preparations are particularly inexpensive and are promoted by the NEMP.

It is not surprising to see primary care organizations achieving more than 90% of prescriptions from the EML. China’s NEMP has adopted a top-down approach with strong centralized controls. Apart from the national EML, a province-based centralized procurement system had been established in all provinces by 2011. The NDRC creates the pricing policies for the EML and has been monitoring the supply and price of the
essential medicines closely. The drugs in the EML are purchased in bulk by provincial authorities and distributed to primary care organizations at agreed prices. Public primary care institutions are required to stock all the drugs from the EML. The NEMP also came in line with the alignment of funding reforms. Public primary care organizations are no longer allowed to make a profit from selling drugs (zero-profit drug policy). This policy has effectively reduced the retail price of drugs dispensed from primary care organizations, and it is estimated that the price of medicines may have fallen by an average of 30% (Ministry of Health of the P.R. China 2011). The impact of the NEMP has wider implications on consumer behaviour. There is a strong culture in China for people to use hospitals for health care rather than primary health organizations. Drugs dispensed from hospitals will be more expensive due to the ability of hospitals to have margins of up to 30%, whereas primary health centres must sell ‘at cost’, and are therefore a economic consideration for the patient. Studies have shown that this may create a powerful incentive to draw people from choosing larger hospitals as providers of primary health towards primary health centres (Liu et al. 2010).

The primary care institutions in Hubei prescribed more drugs on average per prescription when compared with other regions in China. We found that in our study sample on average one prescription contained ~4 drugs, compared with 2.36 across 10 western China provinces (Dong et al. 2010). A study in India revealed that the implementation of Essential Drugs Programme from 1998 to 2002 resulted in an average number of 2.4–2.6 drugs per encounter (Roy Chaudhury et al. 2005). Our study design did not provide sufficient information to understand why this is the case, and on the face value, it may be that there may be over-prescribing.

It is also unclear whether the NEMP would be able to contribute to the overall containment of drug expenditure. As illustrated in this study, the NEMP resulted in reduction of average expenditure per prescription, but it had little impact on the volume of prescriptions. Arguably, the reduced financial barrier makes the medicines more affordable, which might fuel demands for those medicines. Compounding the financial problem, provincial authorities enjoy autonomy to add medicines into the EML without necessarily presenting sound evidence. In fact, most provinces have formulated a supplementary EML (Shi et al. 2011). Some drugs deemed to have serious side effects or low cost-effectiveness, such as cimetidine and diethylstilbestrol, were excluded from the national EML, but were included in the supplemental EML. The cost of such decisions deviating from evidence-based practice could be very expensive.

Over use of antibiotics and injections

The prevalence of parenteral drug administration has serious financial and safety implications. Parenteral drug administration requires the patient to be admitted as a day patient for administration of infusions. In China, parenteral drug administration results in higher remuneration to healthcare providers over and above what they are paid to dispense medicines. Therefore, the powerful financial incentives are a considerable and avoidable cost to the patient, but create an income stream for the primary health centre (Li et al. 2012). Despite the additional costs involved, paradoxically this appears to be the treatment of choice for many patients, as they consider this ‘effective treatment’ and therefore preferential to injection medications (Wang et al. 2006).

The early evaluation of this study proved that the NEMP failed to curb the over and irrational use of antibiotics and parenteral administration. It is irresponsible to mandate proportions between rational and irrational use of antibiotics without case-mix adjustment (Chalker 1995); however, WHO/INRUD suggests the comparative incidence of antibiotic prescriptions is <30% of all prescriptions, and prescriptions
requiring parenteral administration should be <10% (Joncheere 2002). The percentages of prescriptions containing antibiotics (60–74%) and injections (59–66%) are very high compared to these benchmarks. We found no evidence to show any decline in these rates after the initiation of NEMP. Indeed, high prescription rates for antibiotics and injections are not uncommon in China. A study in Shandong and Gansu found that 34–77% of prescriptions contained antibiotics and 22–61% of prescriptions required injections (Chen et al. 2010; Liang et al. 2011) estimated that inadequate antibiotic prescriptions occurred in 43% of patients with paediatric pneumonia in two counties of rural China. This imposes serious health consequences. A review of 141 serious adverse events associated with medications for respiratory diseases revealed that 78% were associated with antibiotics (Che et al. 2010). The rapid spread of antibiotic resistance in many countries has been associated with excessive and inappropriate use of antibiotics (Wang et al. 2008; Liang et al. 2012). The number of new antimicrobial agents released to the market has fallen significantly during the last decade, which represents a concerning challenge for the medical services in the future having fewer effective potential therapeutic options (Awad et al. 2006).

There is significant consumer cultural distrust of oral medications due to experience of poor quality in the past. However, ADRs are often far more serious and profound with parenteral administration compared with those arising with oral administration. The prevalence of parenteral administration increases the risks associated with the transmission of blood-borne infections in China, including Human Immunodeficiency Virus, Hepatitis B Virus and Hepatitis C Virus (Dong et al. 2011a). Unsafe injections may have contributed to 10% prevalence of Hepatitis B infection in China (Murakami et al. 2003). It is difficult to justify this mode of drug administration when oral medications are readily available and have far fewer associated risks.

The safety of TCMs via injection has attracted particular concern in recent years. Nearly 7% of traditional herbal medicines contained in the current national EML are administered parenterally. A literature review showed that 33 traditional herbal medicines (in the 2004 edition of the EML) administered in this manner could lead to serious ADRs, amongst which Shuanghuanglian, Qingkailing and Yuxingcao were most frequently reported (Wang et al. 2010). These herbal medicines are still listed in the 2009 edition of the EML.

Promoting the rational use of drugs has never been an easy task. It requires interventions on both providers and consumers. Education can make a difference. One study showed that doctors with baccalaureate or bachelor level medical training are less likely to prescribe injections than those with only vocational or diploma level training (Dong et al. 2011a).

The implementation of NEMP in China is currently heavily dependent on top down administration: resources for training, monitoring and evaluation have been limited with an over-reliance on a command style engagement. The effectiveness of the published EML and NEMP is at risk unless accompanied by training, reminders and feedback. There is also an urgent need to identify priorities in training: for example, as respiratory infections are the most commonly stated reason for antibiotic prescription, appropriate prescription guidelines might become a focus of an educational campaign.

Patients also influence the decision-making process. Many patients mistakenly believe that antibiotics and injections are a fast solution to acute illness, and may put a great pressure on doctors (Wang et al. 2006). A simulated patient study showed that patient knowledge regarding the appropriate use of antibiotics can effectively reduce both antibiotic prescriptions and drug expenditure for identical flu-like complaints (Currie et al. 2010). Unfortunately, aggressive pharmaceutical marketing (persistent, frequent and often misleading advertisement) has often adversely influenced the knowledge, attitudes and belief of health workers and patients (Reynolds and McKee 2011). There are loopholes in drug advertising regulations in China. Illegal drug advertisements direct to consumer find their way through television, newspapers and other media such as the Internet.

It is important to be aware that education in itself is not enough to bring about changes in use of medicines. Prescribing behaviours and demand of consumers are influenced by a wide range of factors, including cultural norms, financial incentives and capacity to pay (Reynolds and McKee 2009). Where profits from selling drugs have been eliminated, appropriate financial compensation mechanisms are needed to ensure a sustainable development of the primary care facilities. Many of the primary care facilities are facing great challenges in loss of qualified health workers due to poor financial resources (Zhou 2010).

Limitations of the study

The study has a number of limitations. We examined outpatient prescriptions and excluded inpatient prescriptions. The Government predetermined the staged arrangement for implementation of the NEMP by the participating counties (they were not selected at random), which made the comparisons between intervention and control groups difficult. Because of the unavailability of morbidity data, we have not been able to make case-mix adjustments to the indicators. Prescribing behaviours are also likely to be influenced by prescribers’ area of expertise, education and working experiences, as well as patient socio-demographics. Unfortunately, these data were unavailable. Despite these limitations, the pre- and post-intervention comparisons and the comparisons between the intervention and control groups support our arguments. The results have implications for the improvement of the design of NEMP not only for China but also for other developing countries facing similar challenges.

Conclusion

There are important elements missing in the Chinese NEMP. The current policy has put its focus on the EML, which has resulted in significant increase in the use of EML drugs and reduced the average cost per prescription. However, it has had little impact on curbing the irrational use of antibiotics and the unnecessary parenteral administration. This is of serious concern because increased affordability is likely to maintain or even exacerbate inappropriate prescribing, which can adversely affect health outcomes. Not only is this technically inefficient,
but a serious misuse of limited national health resources by health professionals who should be exercising a higher professional standard. A comprehensive NEMP should encompass a wide range of measures, including training of providers, consumer educations, control of drug promotion, and monitoring and supervision of prescribers through the establishment of drug and therapeutic committees and drug information centres. We recommend a more systematic approach involving all stakeholders to the NEMP.

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Conflict of interest
None declared.

References


