VALUE IN HEALTH REGIONAL ISSUES 2 (2013) 37–42

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Increasing Anti-Infective Drug Expenditure in Tianjin, China: A Decomposition Analysis

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ABSTRACT

Objective: This study aimed to explore the driving factors of the increasing anti-infective drug expenditures in Tianjin, China, and to provide evidence-based suggestions for policymakers. **Methods:** Data were extracted from inpatient records in Urban Employee Basic Medical Insurance data of Tianjin, China, from 2003 January to December 2007. Expenditure increase for a basket of 63 constantly used anti-infective drugs was decomposed into three broad categories: price effects, quantity effects, and therapeutic choices. Furthermore, the injection anti-infective drug expenditures from 2006 to 2007 were decomposed into six determinants. **Results:** From 2003 January to December 2007, the expenditure for a fixed basket of drugs increased by 9%. The driving factors were therapeutic choices and quantity effects; each increased 48% and 10%, respectively. The relative price decreased by 33% during the study period. After adding new drugs to the formulary in 2005, the rate of increase in drug expenditure was 28% from 2006 to 2007; the driving factors were still therapeutic choice (16.8%) and quantity effects (14.9%). **Conclusions:** Therapeutic choice transferring from cheap drugs to expensive ones, rather than the price, was the main driving factor for increasing expenditures. Policymakers need to pay more attention to rationalize physicians' prescribing behavior to control the expenditure.

Keywords: anti-infective, China, drug expenditure, pharmaceutical.

Introduction

Over the past decades, high pharmaceutical expenditure and its continuous growth caught the attention of policymakers around the world. The World Health Organization reported that pharmaceutical expenditure accounted for 7% to 20% of total health expenditure in developed countries, while it accounted for 24% to 66% in developing countries [1]. In China, pharmaceutical expenditure for inpatients and outpatients as a share of total health expenditure reached 44% and 50.9% in 2009, respectively. In terms of per-capita pharmaceutical expenditure, it increased at an average rate of 7% per year from 2000 to 2009 [2]. In response, for Chinese policymakers, controlling pharmaceutical expenditure is one of the most important components of controlling total health expenditure.

In China, there are more than 50,000 pharmaceutical products on the market produced by local, foreign, and joint venture manufacturers [3]. Policy efforts to contain health expenditure in China have been focused on controlling the price of pharmaceuticals, including maximum retail prices (or price capping), compelling price reduction, and bidding and group procurement. The Urban Employee Basic Medical Insurance (UEBMI) reimbursement drug list covers about 20% of the total products on the market and 60% of the marketing sales, which was the most usually used drugs in China [3]. The maximum retail prices (price cap) of these drugs were settled by the National Development and Reform Commission. Furthermore, the National Development and Reform Commission has implemented compelling price reduction more than 24 times since 1997, involving almost all the drugs under the UEBMI reimbursement drug list. Pharmaceutical price was also affected by pharmaceutical bidding and group procurement policies, which were introduced in medical institutions in 1990s in China and led by local government as a major effort to regulate hospital drug procurement.

It has been reported, however, that the decrease in drug price had a very limited effect on pharmaceutical expenditure control [4–6]. In fact, while the pharmaceutical price index (single number that shows the extent of price change over a period for a basket of drugs) decreased by 10.8% from 2000 to 2009, the pharmaceutical expenditure index for inpatients and outpatients increased by 84.2% and 61.4%, respectively [2]. Thus, the driving factors of increasing pharmaceutical expenditure are still unknown in China.

To fill this gap, this article aimed to identify major driving forces of the increasing anti-infective drug expenditure in terms of price, quantity, and therapeutic choice. The rest of the article is organized as follows. The second section describes the conceptual frameworks, methods, and data. The third section presents

Conflict of Interest: The authors have indicated that they have no conflicts of interest with regard to the content of this article.

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2212-1099/$36.00 – see front matter © 2013 Published by Elsevier Inc. on behalf of International Society for Pharmacoeconomics and Outcomes Research (ISPOR).
http://dx.doi.org/10.1016/j.vhri.2013.01.002

the results, and the last section presents the conclusions and discussion.

Conceptual Frameworks

Relationships between Price, Quantity, and Therapeutic Choice

The changes in pharmaceutical expenditure can be influenced by three major factors: price effects, quantity effects, and therapeutic choices (or residual effects) [7–10]. The following formula presents the mathematic relationships between the pharmaceutical expenditure and these three factors by using a nonstochastic, index-theoretical [11]:

$$E = \frac{\sum P_1Q_1}{\sum P_0Q_0} = P \times Q \times \varepsilon = \frac{\sum P_1Q_0}{\sum P_0Q_0} \times \frac{\sum Q_1}{\sum Q_0} \times \frac{(\sum P_1Q_1/\sum Q_1)}{(\sum P_1Q_0/\sum Q_0)} \qquad (1)$$

where Q_0 is the quantity of drugs in the basic period, Q_1 is the quantity of drugs in the current period, P_0 is the price of each defined daily dose (DDD) in the basic period, and P_1 is the price of each DDD in the current period.

In Eq. 1, $\frac{\sum P_1Q_0}{\sum P_0Q_0}$ are the drug price effects, $\frac{\sum Q_1}{\sum Q_0}$ are the quantity effects of drugs consumed, and $\frac{(\sum P_1Q_1/\sum Q_1)}{(\sum P_1Q_0/\sum Q_0)}$ are the residual effects. Price effects, which were estimated by using the Laspeyres price index (taking the drug quantity at the basic period as weight), reflect the price changes of a basket of drugs within a certain period. Quantity effects relate to the quantity changes of drug therapy for different drugs in different periods. The residual effect is obtained by comparing the daily drug price in different periods by taking the drug quantity of basic and new periods as a weight, a factor reflecting the difference between the actual pharmaceutical expenditure increase and the multiplied value of the price index (PI) and the quantity index.

The residual effect is influenced by the behaviors of physicians, which represents the pharmaceutical expenditure changes because of changes in treatment patterns, reflecting the transfer from lower (higher) price drugs to higher (lower) price drugs over time [12]. A residual effect of greater than one indicates that the treatment patterns transfer from less expensive drugs to expensive ones, and vice versa [8,13,14]. There are two possibilities with the residual effect when it does not equal one. First, consumption for a drug is partly or totally replaced by another drug while the price and the total quantity of the two drugs are constant. Such a replacement does not result in any change in either the PI or the quantity index. Second, the residual effect can be affected by changes in drug quantity if the quantity changes are not consistent with the existing market shares of the drugs. To summarize, the residual effect reflects changes in pharmaceutical expenditure resulting from switches from one drug to another or from changes in the total quantity of drugs consumed.

Decomposition of Price, Quantity, and Therapeutic Choices to Six Potential Determinants

The three broad categories of price effects, quantity effects, and therapeutic choices can be further decomposed into six determinants, as shown in Fig. 1. Computation of the six determinants is done by using data aggregated to different levels of the therapeutic classification system hierarchy. For each of the six determinants, the basic indices take the form of Fisher's Ideal index, which is the geometric mean of Paasche and Laspeyres indices [15,16].

Price Effects

Price effects include changes in the price charged for every anti-infective product and changes in the average unit cost of multisource anti-infective drugs stemming from generic substitution, which are represented by the PI and the generics index. PI is simply changes in prices charged for all the existing anti-infective products identified by ingredient, dosage, form, and manufacture (the product level) (Eq. 2). The generics index is the changes in cost of treatment by substitutions for multisource alternatives without changing the type of drug, which is measured by an expenditure-weighted average of changes per unit of multisource drugs (the drug level) (Eq. 3). The generics index reflects the impact of substitutions toward lower (or higher) cost alternatives for multisource drugs. The ratio of a PI at the drug level (higher level) over an index at the product level (lower level) of the hierarchy is equal to the cost impact of changing market shares within the higher level categories.

$$PI = \sqrt{\frac{\sum C^1_{PU}Q^0_{PU}}{\sum C^0_{PU}Q^0_{PU}} \times \frac{\sum C^1_{PU}Q^1_{PU}}{\sum C^0_{PU}Q^1_{PU}}} \qquad (2)$$

$$GI = \sqrt{\frac{\sum C^1_{DU}Q^0_{DU}}{\sum C^0_{DU}Q^0_{DU}} \times \frac{\sum C^1_{DU}Q^1_{DU}}{\sum C^0_{DU}Q^1_{DU}}} \Bigg/ \sqrt{\frac{\sum C^1_{PU}Q^0_{PU}}{\sum C^0_{PU}Q^0_{PU}} \times \frac{\sum C^1_{PU}Q^1_{PU}}{\sum C^0_{PU}Q^1_{PU}}} \qquad (3)$$

where C_{PU} and Q_{PU} are expenditure and quantity defined by ingredient, dosage, form, and manufacture (the product level). C_{DU} and Q_{DU} are expenditure and quantity defined by ingredient, dosage, and form (the drug level). The current period is represented by 1, and the base period is presented by 0.

Quantity Effects

Quantity effects include the changes in the number of inpatient admissions (IA) and the size of anti-infective drug utilization per inpatient admission. IA are measured by using an expenditure-weighted average of changes in the number of inpatients using anti-infective drugs (Eq. 4). Expenditure-weighted admission number ensures that costly drugs increase the measure of number more than a similar increase in low-cost drugs. "Size of drug utilization (DS)" is the changes in the average number of anti-infective drug units per IA, which is measured by an expenditure-weighted average of changes in the number of drug units per admission, in terms of active ingredient, dosage, and form (the drug level) (Eq. 5).

$$IA = \sqrt{\frac{\sum C^0_{BR}Q^1_{BR}}{\sum C^0_{BR}Q^0_{BR}} \times \frac{\sum C^1_{BR}Q^1_{BR}}{\sum C^1_{BR}Q^0_{BR}}} \qquad (4)$$

$$DS = \sqrt{\frac{\sum C^1_{DR}Q^0_{DR}}{\sum C^0_{DR}Q^0_{DR}} \times \frac{\sum C^1_{DR}Q^1_{DR}}{\sum C^0_{DR}Q^1_{DR}}} \Bigg/ \sqrt{\frac{\sum C^1_{DU}Q^0_{DU}}{\sum C^0_{DU}Q^0_{DU}} \times \frac{\sum C^1_{DU}Q^1_{DU}}{\sum C^0_{DU}Q^1_{DU}}} \qquad (5)$$

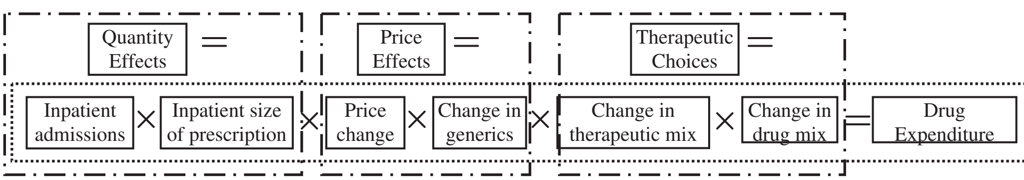

Fig. 1 – Six determinants of per-capita pharmaceutical expenditure.