Policy Forum

Diagnosis-related group (DRG)-based case-mix funding system, a promising alternative for fee for service payment in China

Cuirong Zhao[1], Chao Wang[2], Chengwu Shen[1], Qian Wang[1],*

[1] *Department of Pharmacy, Shandong Provincial Hospital Affiliated to Shandong University, Ji'nan, China;*
[2] *Department of Rehabilitation Medicine, Shandong Provincial Hospital Affiliated to Shandong University, Ji'nan, China.*

Summary	Fee for services (FFS) is the prevailing method of payment in most Chinese public hospitals. Under this retrospective payment system, medical care providers are paid based on medical services and tend to over-treat to maximize their income, thereby contributing to rising medical costs and uncontrollable health expenditures to a large extent. Payment reform needs to be promptly implemented to move to a prospective payment plan. The diagnosis-related group (DRG)-based case-mix payment system, with its superior efficiency and containment of costs, has garnered increased attention and it represents a promising alternative. This article briefly describes the DRG-based case-mix payment system, it comparatively analyzes differences between FFS and case-mix funding systems, and it describes the implementation of DRGs in China. China's social and economic conditions differ across regions, so establishment of a national payment standard will take time and involve difficulties. No single method of provider payment is perfect. Measures to monitor and minimize the negative ethical implications and unintended effects of a DRG-based case-mix payment system are essential to ensuring the lasting social benefits of payment reform in Chinese public hospitals.

Keywords: Fee-for-service, diagnosis-related groups, case-mix funding system, China

1. Introduction

The main sources of funding for most Chinese public hospitals are government allocations, income from fees for medical services and medicines, and other forms of income. Government financing is allocated by the provincial financial bureau in a certain proportion based on hospital beds every year. However, the ratio of government allocations is relatively low, accounting for less than 10% of the sources of funding for most public hospitals. More than 90% of public hospitals' funds come from fees for medical services and medicines, such as performing procedures that require high-tech equipment and dispensing drugs. The fee-for-service (FFS) payment system, with a disease-specific cap for every admission is the prevailing method of payment

in Chinese public hospitals. The retrospective payment system, which reimburses hospitals based on clinic visits, examinations, and treatment programs (*1*), is feasible and simple to administer. However, improper incentives as part of China's dominant FFS payment model are largely responsible for the rising costs of health care (*2,3*). Under the Chinese FFS system, the government controls the pricing of medical services, so the prices for advanced care and drugs were set higher than their actual cost while the prices for basic care were set lower (*2,4*). For hospitals to obtain 90% of their funds, physicians were encouraged to prescribe expensive and profitable medications or diagnostic tests that were not always beneficial to patients (*4*). Consequently, over-treatment and over-prescription caused by the FFS payment system were widespread in China, leading to rising medical costs (*4*). Along with limited insurance coverage, the rapid increase in health care costs resulted in public concern that 'it is too difficult to see a doctor and too expensive to seek health care' (*5*). Payment reform needs to be promptly implemented to move away from a retrospective FFS payment model to a prospective payment plan.

In order to contain the continuing growth of health

*Address correspondence to:
Dr. Qian Wang, Department of Pharmacy, Shandong Provincial Hospital Affiliated to Shandong University, 324 Jing Wu Road, Ji'nan, 250021, China.
E-mail: wangqian.9186@163.com

expenditures, the Chinese Government was called upon by the World Bank to convert its health system from a purely FFS system to a mixed payment system as early as 1997 (*6*). The mixed payment system may involve methods of prospective payment such as global budgets, capitation, and case-mix-based payment systems. In response, the Government committed to medical reform and it announced its intention to reform hospital payments by moving from a FFS system to a prospective payment system. These methods of prospective payment, such as capitation, global budgets, and a diagnosis-related group (DRG)-based case-mix payment system, are conducive to cost containment and have been piloted in some Chinese cities (*7*). A DRG-based case-mix payment system is a promising alternative (*8*). The case-mix funding system, with its superior efficiency and containment of costs, has gradually become the principal means of reimbursing hospitals in many countries (*9-11*).

2. A case-mix system based on DRGs

2.1. *The Case Mix System*

The Case Mix System (CMS), a hospital-based decision-making support system, was developed by Providence Hospital (Southfield, Michigan) in conjunction with the consulting and public accounting firm Arthur Andersen & Co. and with developmental and financial support from Blue Cross/Blue Shield of Michigan (*12*). A case-mix system database is generated from the hospital's patient medical records abstracting system that includes clinical descriptions of treated patients, billing data documenting the treatment rendered, and cost data. The comprehensive administrative database can be used for financial management, planning, analysis, and research. *Via* this database, the case-mix system offers a useful measure for intra-institutional assessment of medical practices and comparison of performance across hospitals (*12,13*). The case-mix system classifies instances of patient treatment and it reflects the aggregate risk of all patients at a hospital (*13*). Each instance of patient admission to discharge is referred to as an episode of care. Patient treatment episodes are designed to create classes that include patients with similar clinical characteristics and that possess relatively homogeneous patterns of resource consumption (*9*). The case-mix system varies in patient condition, disease mix, and the volume of patients treated, and it identifies the financial impact of changes in medical practices (*12*). In a health care system, development of case-mix classifications is driven by both socio-political and technical factors. The intended scope and use of the classification, the underlying population size, and the quality and depth of the coded data are the three technical factors that influence development of case-mix classifications, including how a case-mix classification is developed

and how many end classes best reflect the complexity of treatment in a hospital (*14*).

2.2. *Diagnosis-related groups*

Resource consumption has been widely used as a proxy for the severity of illness. The hospital Case Mix Index (CMI) was developed worldwide to contain costs. The CMI is usually reported in diagnosis-related groups (DRGs) based on International Classification of Diseases (ICD) coding (*12,13*). Many countries do not have DRG systems, but they do use an ICD-derived CMI that relies on grouping of ICD codes (*10*). Although DRGs were originally developed solely as a measure of hospital performance by researchers at Yale University in the 1960s, they are now extensively used as hospital payment mechanisms, increasing transparency, improving efficiency and facilitating hospital management in the United States, Europe, Australia, and elsewhere (*9,10*). DRGs are more widely preferred than capitation in practice (*5*), and in recent years DRGs have gradually become one of the most remarkable prospective payment systems around the world (*11*). In principle, DRGs can also be used to reimburse hospitals for acute and non-acute inpatient care, though they are primarily used to provide reimbursement for acute inpatient care (*15*).

In DRG-based hospital payment systems, the payment categories (hospital services) are defined by DRGs (*16*). By definition, DRGs are "diagnosis-related" groups of patients that have homogenous patterns of resource consumption and that are clinically meaningful at the same time. Therefore, treated cases that are classified into the same DRG are economically and medically similar (*15*). Classification of cases in DRGs is based on the following variables: principal and secondary diagnoses, type of treatment, patient age and sex, surgery, the existence of co-morbidities and complications, discharge status, and the procedures performed (*11,15,16*). Once a patient is discharged and leaves the hospital, case notes generated during the episode of care are examined and assigned a corresponding DRG category according to the ICD. The risk level of DRGs is also ranked on the basis of illness severity and complications. A complex case involving a more severe illness that requires more difficult treatment and interventions is classified into a high-risk DRG (*17*). Classification is accomplished by improved information systems, including a complete medical records abstracting system that requires physicians to follow uniform standards on writing medical records. Moreover, coding principles should be unified to match the hospital information system (*18*).

An exhaustive patient case classification system is one core design characteristic of a DRG-based payment system. Another core design characteristic is the payment formula (Figure 1) (*15*), which is based on the base rate multiplied by a relative cost weight specific to each DRG. The base rate, which can cover all costs
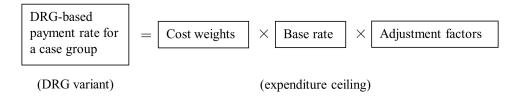
$$\boxed{\begin{array}{c} \text{DRG-based} \\ \text{payment rate for} \\ \text{a case group} \end{array}} = \boxed{\text{Cost weights}} \times \boxed{\text{Base rate}} \times \boxed{\text{Adjustment factors}}$$

(DRG variant)   (expenditure ceiling)

Figure 1. Payment formula for a DRG-based payment system.

Table 1. Differences between a fee-for-service (FFS) and a case-mix funding system

Differences	FFS	Case-mix funding system
Charges are assessed based on	Medical services	Case mix
When charges are assessed	After medical services are provided	Before medical services are provided
Incentive mechanism for assessment of charges	Public hospital income is related to the amount and price of medical services	Public hospital income depends on the gap between actual medical expenses incurred by the hospital and assessed charges based on a case mix

or specific costs, is usually a monetary value and is the same for all DRGs. When setting the base rate, cost considerations should be taken into account, and costs are largely influenced by the total funds available. An expenditure ceiling can be created (*15*). The cost weight, independent from budgetary concerns in principle, is a relative measure that reflects the relative use of resources linked to a specific DRG in comparison to other DRGs. Adjustments must be made to determine the right relative costs for a country. The cost weight may be high for one DRG but low for another DRG. Setting relatively higher cost weights allows overcompensation for highly cost-effective services (*15*). The DRG-based payment rate needs to be adjusted for numerous reasons such as regional differences and additional funding for teaching hospitals. Adjustment factors are used as a tool to adjust the DRG-based payment rate. Therefore, DRG variants, cost weights, expenditure ceilings, and adjustment factors are the core design components of DRGs, namely payment formulae, which are the basis for payment standards. The establishment of payment standards helps to control medical expenditures, and it also provides compensation for reasonable medical costs and it reasonably benefits medical institutions. This is conducive to increasing staff motivation and hospital development (*19*).

Under a DRG-based financing system, payment rates are pre-defined for each patient treatment episode in a particular DRG category. Hospitals are paid a standard amount according to the number and type of cases they treat, regardless of the actual cost of caring for an individual (*11,20*). The use of DRGs, which introduces an element of financial risk for service providers, allows a sophisticated case-mix payment system as a way to reduce health care overuse (*6*). Accordingly, accurate diagnosis and classification, reasonable payment standards, and other relevant data

play a vital role in a hospital's funding system. To a great extent, they decide the hospital's reimbursement and economic survival (*17*). In many countries, professional medical associations, consultants, and specialists formally participate in the process of selecting, defining, and updating classification criteria (*16*). Reasonable payment standards require a scientific pricing mechanism that relies on the market with multiple layers of governance (*19*).

3. Comparative analysis of fee-for-service and case-mix funding systems

3.1. *The key difference between FFS and case-mix funding systems*

The key difference between FFS and case-mix funding systems is the mechanism of payment reimbursement. This includes differences in how charges are assessed, when charges are assessed, and the incentive mechanism for assessment of charges (Table 1) (*21*). Under an FFS payment system, charges are assessed for medical services such as examinations, diagnosis, prescriptions, surgeries, and other forms of care. This means medical services are essentially a form of income for hospitals. Under a case-mix funding system, in contrast, hospitals receive a fixed rate for each admission depending on a patient's DRG category. The pre-defined fee for treating patients in a single DRG category sets a limit on the overall expenses for individual patients, regardless of the actual cost of care (*8,11*). In essence, medical services are therefore transformed into costs for hospitals. As shown in Table 1, charges are assessed after medical services are provided under an FFS payment system but before medical services are provided under a case-mix funding system. Accordingly, an FFS payment system is a type of retrospective payment system with

a mechanism of supervising the quality of medical treatment. Theoretically, patients could pay for health care depending on its quality, thereby monitoring the quality of medical treatment and prompting its efficiency. In actuality, however, patients have great difficulty monitoring the quality of medical treatment due to the asymmetry of information between the patient and the physician. Patients must accept how charges are assessed. In contrast, a case-mix funding system is a type of prospective payment system with a mechanism of controlling medical costs. The pre-defined fee for a case mix compels hospitals to contain costs when providing medical services. The differences in how charges are assessed and when charges are assessed determines the difference in the incentive mechanism for assessment of charges, which is the essential difference between FFS and case-mix funding systems. The manner in which charges are assessed is essentially the incentive mechanism for public hospitals. Under an FFS payment system, public hospital income is related to the amount and price of medical services, *i.e.*, the higher the amount and price of a medical service, the greater the income. Therefore, an FFS payment system inevitability encourages hospitals to pursue maximum benefits by increasing the quantity and price of those medical services. Under a case-mix funding system, in contrast, public hospital income depends on the gap between the actual medical expenses incurred by a hospital and assessed charges based on a case mix. The pre-defined fee for a case mix according to assessed charges is prepaid to the hospital. If the actual medical expenses are less than the pre-defined fee, the remainder reverts to the hospital. Conversely, if the actual medical expenses are higher than the pre-defined fee, the excess is borne by the hospital. As a consequence, hospitals should increase the efficiency and quantity of medical services and contain costs to make a profit.

3.2. *Advantages and disadvantages of the FFS payment system*

The general consensus appears to be that an FFS payment system is largely responsible for overprovision of care, inefficiency, cost inflation, uncontrollable health expenditures, and even an erosion of medical ethics (*2,22*). As providers are paid based on medical services under an FFS payment system and there is an asymmetry of information between the patient and the physician, physicians are encouraged to maximize their income by overprescribing drugs and diagnostic tests with high profit margins, prolonging the duration of hospitalization, and delivering unnecessary services (*2,6,22*). As an example, 75% of patients suffering from a common cold are prescribed antibiotics in China (*23*). Unnecessary services including overordering expensive drugs and tests in turn lead to runaway cost inflation, wasted resources, poor quality, and unaffordable

health care (*3*). Moreover, there is an asymmetry of information between national health officials and the physician. This hampers the reasonable pricing of medical services. In fact, substantial differences in how charges were assessed have been noted among hospitals at same level. These weaknesses of the FFS payment system are not conducive to supervision and evaluation of hospitals by national health officials, thereby resulting in high management costs. Moreover, patients are prevented from predicting medical expenses. The increased medical expenses caused by the FFS payment system may result in patient antipathy to medical charges and tension in the doctor-patient relationship.

Although an FFS payment system has the numerous disadvantages described earlier, it also has advantages (summarized in Table 2). Calculation of charges in the FFS payment system is simple and easy to understand. Under an FFS payment system, physicians are compensated for providing the best medical services to patients based on professional standards (*22*). The FFS payment system can increase the motivation of physicians to a greater extent. Adequate medical care is delivered in a timely manner. Patients with a complex condition will not be rejected by physicians since hospitals will not be bearing a financial risk. Physicians can provide pro bono care to poorer patients who cannot afford it by decreasing or waiving payment. This shortfall in revenue can be balanced out by charging rich patients more (*22*). Moreover, uncontrolled medical expenses under an FFS payment system are conducive to development of new medical technologies, which always cost more.

3.3. *Advantages and disadvantages of a case-mix funding system*

A DRG-based case-mix funding system is often expected to increase the transparency of hospital performance, contain resource consumption by standardizing reimbursement, and increase efficiency by encouraging appropriate care and discouraging unnecessary care (*15,20*). Under a DRG-based case-mix payment system, hospitals receive a fixed rate for each admission depending on a patient's diagnosis, regardless of the actual cost of caring for the individual. The limited overall expenses for individual patients represent a higher risk of insolvency for hospitals and increased attention to their bottom line (*24*), presumably leading to the mitigation of over-treatment under the FFS payment system (*8*). To make a profit, hospitals are encouraged to control costs, reduce the patient's lengths of stay (LOS), and to simultaneously increase the number of inpatient admissions (*11,24*). In this manner, a DRG-based case-mix payment system can achieve substantial control of medical costs, effective utilization of health resources, and gains in efficiency (*5*). A unified payment standard under a DRG-based case-

Table 2. Advantages and disadvantages of an FFS and a case-mix funding system

Payment system	Advantages	Disadvantages
FFS	Calculation of charges is simple and easy to understand.	Largely contributes to over-provision of medical services and rising health care costs.
	Physician motivation can be increased to a greater extent and adequate medical care is delivered in a timely manner.	Medical services are difficult to price and prices differ among hospitals.
	Hospitals bear no financial risk and never shunt patients to other facilities.	Not conducive to supervising and evaluating hospitals and results in higher management costs.
	Conducive to development of new medical technology.	May cause tension in the doctor-patient relationship
Case-mix funding system	Controls health care cost	Difficult to implement and requires support through relevant policies and information technology.
	Constrains resource consumption and increases efficiency	Increased hospital readmission rates
	Increases comparability across hospitals and is conducive to supervising and evaluating hospitals	Provides inadequate medical care
	Relieves tension in the doctor-patient relationship	Rejects patients with a complex condition

mix payment system can increase comparability across hospitals and is conducive to supervision and evaluation of hospitals by national health officials. In addition, the DRG-based financing system greatly helps to improve hospital transparency (*20*). Once patients are included in the DRG-based payment system, they are notified of medical procedures and the total expense. This should relieve tension in the doctor-patient relationship.

Although considerable evidence from developed countries and several developing countries has indicated that a DRG-based case-mix funding system has advantages in terms of cost containment and improved efficiency (*5*), this system might also encourage opportunistic practices (summarized in Table 2). To enhance profits, hospitals may classify a patient in a DRG with higher reimbursement, readmit patients, or select low-cost patients and treatments that are more lucrative (*24*). This payment system has been found to increase hospital readmission rates (*23*) and increase case volumes (*15*). Moreover, physicians might provide inadequate medical care and reject patients with a complex condition since their treatment would result in greater resource consumption (*2*). For this reason, adequate medical care may not be delivered in a timely manner like that under an FFS payment system. Lastly, the complex implementation of a DRG-based case-mix funding system requires strong support from relevant policies and information technology, including hospital information systems, medical record-keeping and diagnostic coding, and clinical pathways. Its application is limited by actual circumstances at a hospital.

4. DRG-based case-mix funding system in China

DRGs are not new to China. As early as 1994, Huang *et al.* analyzed the feasibility of applying the 1990 version

of the All Patient DRGs (AP-DRGs) to hospitals in Beijing (*26*). They found that the coefficient of variation (CV) for the LOS was 95% in medical DRGs and 73% in surgery and that the CV for costs was 129% in medical DRGs and 94% in surgical DRGs. In 2001, Gong *et al.* (*27*) launched a study of the feasibility and applicability of introducing Australian refined DRGs (AR-DRGs version 4.0) to care at Chinese hospitals in Chengdu. They found that the Australian refined DRGs provide a good basis for development of Chinese DRGs. Chinese hospitals in relatively developed provinces have started to explore DRG-based methods of payment (*28*). In 2004, Shanghai experimented with a prospective payment system in which a reimbursement cap was imposed on each DRG (*11*). A preliminary study determined hospitalization costs for corresponding diseases. Based on those results, the insurance payment standard was set at the average medical insurance cost from several years prior. To facilitate hospital payment reform and performance assessment, Beijing launched a local DRG system (BJ-DRGs) in 2009 (*29*). The BJ-DRGs consisted of 108 groups, including all types of acute inpatient services, and performed similarly with regard to within-group homogeneity and predictive validity (*30*). In 2011, Beijing piloted a shift from an FFS payment system or a payment system based on 108 groups to a DRG-based payment system at six tertiary general hospitals (*6*). That payment reform in Beijing hospitals led to reductions in health expenditures and out-of-pocket payments without any increase in hospital readmission rates or any shift in costs from cases covered by the DRGs to cases not covered by those groups (*6*).

As information technology has recently advanced in China, medical information systems in most hospitals have been enhanced. At the same time, medical record-

keeping and diagnostic coding have been further standardized, clinical pathways have been developed and standardized, and prices for medical services have become relatively uniform. Moreover, the Chinese Government has paid closer attention to payment reform and enhanced supervision of the quality of medical care (*18*). All of these factors have greatly promoted the implementation of DRGs. However, the current DRG-based case-mix payment system used to reimburse hospitals for in-patient services in China covers only a few common conditions such as acute appendicitis and hysteromyoma. These conditions are readily diagnosed and their treatment protocols are widely accepted. The most widespread method of payment in China is through incomplete DRGs, which are not real DRGs but a system of paying for individual conditions (*11*). Due to the level of medical standards and limited resources in China, reasonable grouping of all diseases will be difficult. Thus, a bridge between the FFS payment system and the DRG-based case-mix payment system must be created. Using gastrointestinal diseases (*11*), hypertension, and coronary heart disease (*31*), Wang *et al.* showed how to prioritize steps in the implementation of DRGs in the context of limited resources. They found that screening common diseases, studying key factors for medical costs, and simplifying the classification of DRGs will greatly increase the efficiency of payment reform. Nevertheless, China's complex social and economic conditions differ across regions, so establishment of a national payment standard will take time and involve difficulties.

5. Conclusion

In China, the inflationary FFS payment system has been found to create inefficiencies, inflate costs, create waste, and result in unaffordable and poor-quality health care (*2,32*). China needs to take the right step and reform that payment system. The DRG-based case-mix payment system, in which the financial risk is shifted from payers to providers, is more likely to contain costs, lower the financial barriers to care, and improve efficiency. This prospective method of payment is a promising alternative to the FFS payment system in China. However, no single method of provider payment is perfect. Each has its own advantages and disadvantages and can induce unintended behavior. Methods of payment such as a DRG-based case mix provide strong incentives to reduce costs and probably tend to reduce quality, under-provide care, and even exclude sick patients. Hence, payment reform should be implemented carefully and more rigorous and longitudinal studies should be conducted to verify the superiority and suitability of a DRG based case-mix payment system. The full implementation of a DRG-based case-mix payment system would require additional measures to monitor and minimize its

negative ethical implications and unintended effects (*8*). Rigorous evidence-based assessment emphasizing the quality of medical care and outcomes and measures to dissociate care providers' profit motives from the incentives of physicians they employ are essential and need to be promptly implemented in China (*2*). Reforming payment systems at public hospitals essentially means reforming the incentive mechanism (*21*). The establishment of reasonable payment standards based on a scientific pricing mechanism could bring public hospitals reasonable benefit from medical cost control and prompt them to actively implement payment reform (*19*). Moreover, professional ethics and norms in medicine should be re-instituted to ensure the lasting social benefits of payment reform in Chinese public hospitals.

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