

# Charting a path forward: policy analysis of China's evolved DRG-based hospital payment system

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**Background:** At present, the diagnosis-related groups-based prospective payment system (DRG-PPS) that has been implemented in China is merely a prototype called the simplified DRG-PPS, which is known as the 'ceiling price for a single disease'. Given that studies on the effects of a simplified DRG-PPS in China have usually been controversial, we aim to synthesize evidence examining whether DRGs can reduce medical costs and length of stay (LOS) in China.

**Methods:** Data were searched from both Chinese [Wan Fang and China National Knowledge Infrastructure Database (CNKI)] and international databases (Web of Science and PubMed), as well as the official websites of Chinese health departments in the 2004–2016 period. Only studies with a design that included both experimental (with DRG-PPS implementation) and control groups (without DRG-PPS implementation) were included in the review.

**Results:** The studies were based on inpatient samples from public hospitals distributed in 12 provinces of mainland China. Among them, 80.95% (17/21) revealed that hospitalization costs could be reduced significantly, and 50.00% (8/16) indicated that length of stay could be decreased significantly. In addition, the government reports showed the enormous differences in pricing standards and LOS in various provinces, even for the same disease.

**Conclusions:** We conclude that the simplified DRGs are useful in controlling hospitalization costs, but they fail to reduce LOS. Much work remains to be done in China to improve the simplified DRG-PPS.

**Keywords:** China, Evaluation, Payment, Simplified DRG-PPS

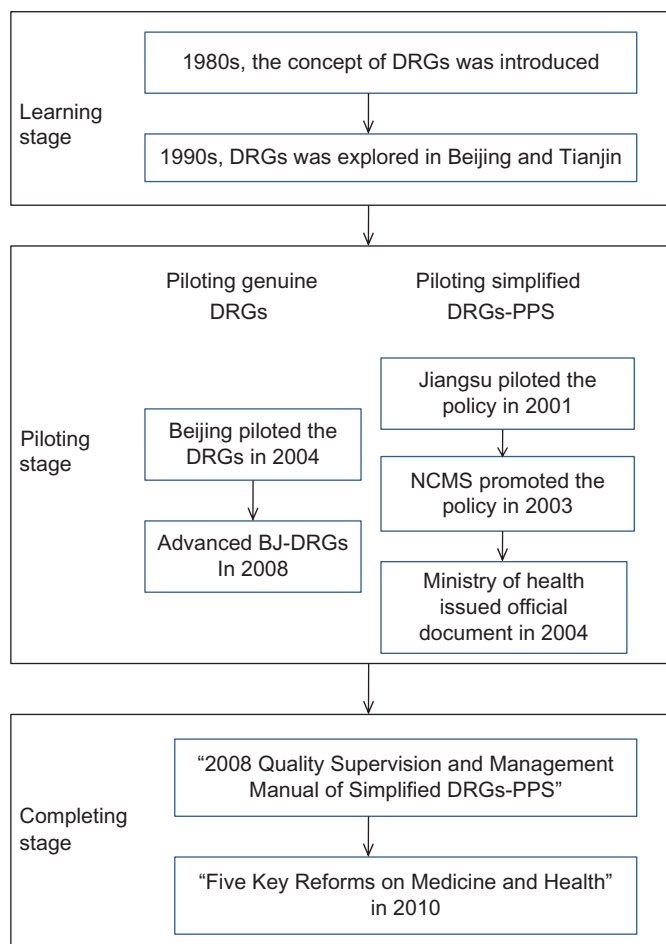
## Introduction

In 1983, a new prospective case-based reimbursement system called diagnosis-related groups (DRGs) emerged in the USA. In the 30 years since then, this payment system has been widely applied by other developed countries, such as Australia, Germany, France, Finland and Japan, in the form of a well-functioning DRG-PPS.<sup>1–4</sup> The well-developed DRGs aim to set costs, and group

patients according to their diagnosis and other traits (e.g. age, gender, severity, complications)<sup>1</sup> to control medical expenditures and increase efficiency. Concerning the effects of DRG-PPS, studies have shown that DRG-PPS plays an important role in promoting the efficient utilization of medical resources. For example, in Japan, Hamada et al. evaluated the effects of diagnostic procedure combination/per-diem payment system (DPC/PDPS) (the Japanese DRGs) and found that the DPC/PDPS could reduce

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**Figure 1.** History of the Chinese simplified DRG-PPS.

medical costs, as manifested in the reduced average hospitalization cost per capita and the reduced LOS in hospitals.<sup>4</sup> Following this trend, many developing countries, such as Mexico and Malaysia, have customized and implemented this payment system based on their local characteristics.<sup>5</sup> Mathauer and Wittenbecher<sup>6</sup> found that 12 low- and middle-income countries have chosen from a wide range of imported and self-developed DRG models, and most have adapted these models to their specific contexts. All countries have set expenditure ceilings as the transitional pathway toward the implementation of genuine DRG-PPS.

Among developing countries, China has also attempted to adopt the prospective DRG-PPS to reduce its rising medical expenditure.<sup>7-9</sup> The evolving history of the Chinese simplified DRG-PPS can be divided into the three phases of learning, piloting and completing (Figure 1). Influenced by the worldwide trend of DRG-PPS practice, the initial DRG-PPS in China (the learning stage, from the 1980s to 2001) was developed. In this phase, the concept and methods of DRGs were introduced into Chinese hospital management.<sup>10</sup> In this initial learning phase, the exploration and acquisition of related theories constituted the major work completed. The piloting phase started in 2001, when the province of Jiangsu began to implement the simplified DRG-PPS. This phase ended in 2008, when the '2008 quality

supervision manual of the simplified DRG-PPS' was issued. This phase can be regarded as the critical period for DRGs to transition from theory to practice. During this period, the following three events played an important role in promoting work in the pilot phase. The first was the implementation in 2003 of the new rural cooperative medical system (NCMS), a medical insurance system for rural Chinese residents. Many provinces, such as Henan and Shanxi, adopted the simplified DRG-PPS as the payment system for their NCMS implementation.<sup>11</sup> Hospitals that could be paid by the NCMS were required to implement the directive DRGs schemes proposed by the local health government for inpatients. Secondly, China's Ministry of Health issued the 'Notice on Piloting the Simplified DRG-PPS' in 2004, formally announcing that the simplified DRG-PPS would be piloted in the provinces of Henan, Shanxi, Shandong, Heilongjiang, Tianjin, Liaoning and Qinghai. Since then, the simplified DRG-PPS has become increasingly popular.<sup>12</sup> The third event was Beijing's genuine DRG-PPS implementation pilot starting in 2004 and the release of the advanced BJ-DRGs in 2008.<sup>8</sup> However, the implementation of genuine DRGs in Beijing was very difficult because of the lack of rationale in setting payment standards, largely as a result of outdated information technology. The completion phase began in 2008 with the symbolic '2008 Quality Supervision and Management Manual of Simplified DRG-PPS' issued by the Ministry of Health. To date, the simplified DRG-PPS in China remains in this phase and needs improvement. During this period, the Chinese Ministry of Health issued and improved the quality control index of the simplified DRG-PPS in 2009, 2010 and 2012.<sup>13</sup> In 2010, the General Office of the State Council issued the 'Five Key Reforms on Medicine and Health',<sup>14</sup> which proposed that the simplified DRG-PPS should be clearly disseminated and optimized by various stakeholders.

However, the Chinese example is unique. In China, there are currently four main types of medical payments, including scale payment, fee for service, pay for capitation and DRGs. The choices for hospitals differ in various provinces, and the application is usually a combination of different types. For instance, Shanghai adopted the scale payment as its main payment type, Shenzhen adopted fee for service as its main type, and Hangzhou launched the payment of capitation in hospitals.<sup>8,9</sup> However, many hospitals also adopted DRGs for some types of diseases and struggled to improve this payment under the guidance of the government.<sup>7-9</sup> In contrast to the mature model in developed countries, the system adopted in these provinces was a prototype called the simplified DRG-PPS, or single disease payment, which is known as the 'ceiling price for a single disease'.<sup>10,15</sup> The Chinese simplified DRG-PPS can be defined as a prospective payment system that sets the highest charging standard for a given disease based solely on the initial diagnosis. If a patient's real medical expenditure is higher than this standard, the hospital charges him/her the standard cost. However, if the patient spends less than the standard, he/she should pay the real cost.<sup>10,15</sup> This extremely simplified model has important characteristics. First, as in many developing countries, this type of DRG sets fixed prices based only on previous inpatients' hospitalization cost per capita and ignores other patient information, such as age, gender, complications and surgical procedures.<sup>8</sup> Secondly, it covers a much smaller number of disease types with stable and common characteristics, such as simple appendicitis.

The effects of the simplified DRG-PPS in China have been controversial since its launch. Previous studies were usually based on small samples with certain diseases. Given this background, this article first aims to systematically evaluate the effects of the simplified DRG-PPS to determine whether it can decrease medical costs and increase efficiency in Chinese public hospitals. By comparing the Chinese model with the DRG-PPS in other countries, we aim to provide recommendations for the transition and reform of the DRG-PPS in China, as well as in other developing countries.

## Methods

### Search strategy and selection criteria

We retrieved data from two large and dynamic Chinese databases (Wan Fang Database and China National Knowledge Infrastructure Database, CNKI), the international database of the Web of Science and PubMed, and the Chinese official websites of the Ministry of Health and the health department of each province. The keywords ‘diagnosis-related groups/DRGs’, ‘efficiency’, ‘effect’, ‘cost/expenditure’ and ‘China/Chinese’ were used to search the literature in the 2004–2016 period in the above databases. The starting year of 2004 was chosen because it was the year in which the simplified DRG-PPS was launched nationwide.

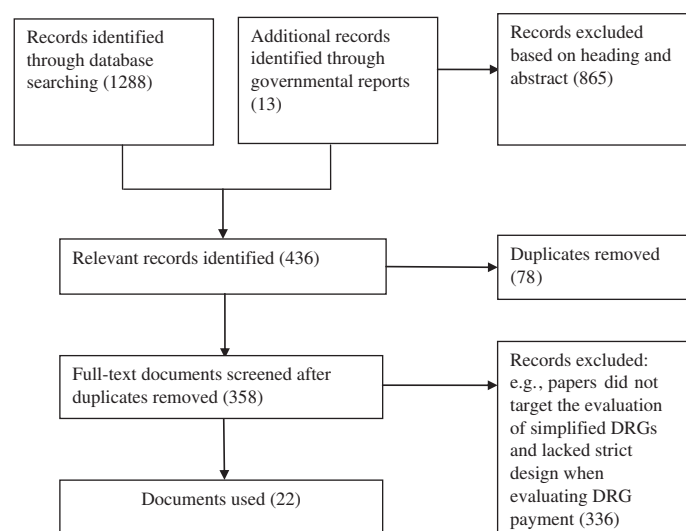
### Data extraction

We based the screening of the articles on the PRISMA list.<sup>16</sup> First, we eliminated duplicate articles. Then, we asked two of the authors who were DRGs experts to carefully conduct the review. To resolve disagreement between the reviewers, a third reviewer assessed all discrepant items, and a decision by majority was used for the analysis. The criterion the reviewers used was that the included articles should depict the effects of the simplified DRG-PPS implementation in any region of China, specifically including the themes of efficiency and/or cost. Most importantly, the studies should contain both an experimental and a control group with regard to the use of the simplified DRG-PPS.

## Results

### Study selection

In total, we found 1288 potentially related articles and 13 Chinese government reports. Publications were screened using the title and abstract to exclude studies that were not closely related; 865 studies were excluded, leaving 436 articles for full-text review. Seventy-eight duplicates were removed. Of the 358 studies that remained for further review, 340 were excluded because they did not specifically target the assessment of the simplified DRGs and lacked information on scientific design. Finally, we obtained quantitative data for our analysis after reading all the publications. After two rounds of review, we retained 22 articles for further analysis. A list of excluded studies and reasons are outlined in Figure 2. In addition, although 2 government reports did not contain experimental and control groups, we found that these reports contained large amounts of information about the pricing standards for the DRGs for certain



**Figure 2.** Systematic workflow for identifying, screening and including studies in the review.

diseases, which was helpful for us to better understand the implementation status in China. Therefore, we further analysed these 2 governmental reports after the systematic review.

### Characteristics of publications

The total number of subjects in the selected 22 studies was distributed in 12 provinces of mainland China. Eleven studies (50%) were based on a sample from tertiary hospitals. Sixteen studies (72.73%) considered only one type of disease, and six studies considered two or more types of diseases. All studies were based on samples from the inpatient population with an experimental group (implementing the simplified DRG-PPS) and a control group (not implementing the simplified DRG-PPS) in different public hospitals in various regions of China. Table 1 provides a summary of these studies. Twenty-one of the studies conducted statistical tests on changes in hospitalization costs after applying the simplified DRG-PPS. Sixteen of these studies conducted statistical tests on changes in the LOS.

### Policy effects of the simplified DRG-PPS in China

As shown in Table 1, among the 22 articles included that discussed the effects of the simplified DRG-PPS implemented in public hospitals in various regions in China, 80.95% (17/21) of the articles tended to provide positive comments on the effects of the simplified DRG-PPS on the reduction of average hospitalization costs for certain diseases. Among the articles that included a matched group and conducted statistical testing on the LOS, only 50.00% (8/16) proposed that the simplified DRG-PPS could significantly reduce the LOS.<sup>17–38</sup> The results for average hospitalization costs and LOS differed between articles in different regions. For instance, with regard to senile cataracts, the hospitalization cost in a tertiary hospital after implementing the simplified DRG-PPS in Xinjiang was ¥3570.00, whereas in one tertiary hospital in Fujian, the amount was ¥5598.33 (Table 1).

**Table 1.** Summary of the average hospitalization cost and LOS in different hospitals from published studies from 2004 to 2016

First author	Diseases	Level of hospital	Province	Number of experimental group (EG)/control group (CG)	Average hospitalization cost (¥): experimental group (EG)/control group (CG)	LOS (day): experimental group (EG)/control group (CG)	Effectiveness
Jiao (2013) <sup>17</sup>	Paediatric inguinal hernia	Tertiary hospital	Henan	80/80	2300/3560 ( $p<0.05$ )	N/A	Cost: Y;LOS: N/A
Wang (2013) <sup>18</sup>	Nodular goitre	Tertiary hospital	Beijing	104/70	4870.83/7131.83 ( $p<0.001$ )	N/A	Cost: Y;LOS: N/A
Zhang (2013) <sup>19</sup>	Senile cataract	Tertiary hospital	Fujian	27/85	5598.33/7824.45 ( $p<0.05$ )	N/A	Cost: Y;LOS: N/A
Lin (2013) <sup>20</sup>	Removal of fracture internal fixation	Secondary hospital	Ningxia	82/182	2350.08/2628.98 ( $p<0.05$ )	5/6 ( $p=0.142>0.05$ )	Cost: Y;LOS: N
Wang (2014) <sup>21</sup>	Ventricular septal defect	Tertiary hospital	Shandong	50/296	10 790.60/20 840.62 ( $p<0.05$ )	$p>0.05$	Cost: Y;LOS: N
Song (2011) <sup>22</sup>	Uterine fibroids; ovarian cysts; indirect inguinal hernia; caesarean section; senile cataracts	Tertiary hospital	Xinjiang	Uterine fibroids:10/13; ovarian cysts:36/25; Indirect inguinal hernia: 26/15; Caesarean section:18/24; Senile cataracts:20/20	Uterine fibroids: 7590/10 055 ( $p<0.001$ ); ovarian cysts: 6009/8273 ( $p<0.001$ ); Indirect inguinal hernia: 3621/5183 ( $p<0.001$ ); Caesarean section: 3915/4700 ( $p<0.001$ ); Senile cataracts: 3570/4092 ( $p<0.001$ )	N/A	Cost: Y;LOS: N/A
Bao (2014) <sup>23</sup>	Joint replacement	Tertiary hospital	Shandong	239/4618	2265.79/7332.84 ( $p<0.05$ )	N/A	Cost: Y;LOS: N/A
Chen (2012) <sup>24</sup>	Caesarean section	Secondary hospital	Shanxi	439/128	1012.5/938.68 ( $p<0.001$ )	3.73/3.66 ( $p>0.05$ )	Cost: Y;LOS: N
Chen (2014) <sup>25</sup>	Acute appendicitis	Secondary hospital	Guangdong	207/185	4629.69/4680.13 ( $p>0.05$ )	6.49/6.94 ( $p>0.05$ )	N
Chen (2014) <sup>26</sup>	Transcervical fracture	Secondary hospital	Guangdong	93/62	$p>0.05$	$p>0.05$	N
Guan (2014) <sup>27</sup>	Caesarean section; hypertension III	Secondary hospital	Ningxia	Caesarean section:45/672; Hypertension III:40/650	Caesarean section: 2226.46/2370.77 ( $p=0.001$ ); Hypertension III: 1794.89/2157.44 ( $p=0.001$ )	Caesarean section: 6/8 ( $p=0.999$ ); Hypertension III: 7/7 ( $p=0.854$ )	Cost: Y;LOS: N
Jiang (2009) <sup>28</sup>	Laparoscopic cholecystectomy	Secondary hospital	Hubei	95/91	5483.83/6470.44 ( $p<0.05$ )	8.2/10.5 ( $p<0.05$ )	Y
Zhou (2010) <sup>29</sup>	Harelip operation; cleft palate repair	Tertiary hospital	Jiangsu	Harelip operation: 65/97; cleft palate repair: 68/136	Harelip operation: 3481.08/3701.79 ( $p<0.05$ ); cleft palate repair: 3701.79/5397.56 ( $p<0.05$ )	Harelip operation: 7.92/12.58 ( $p<0.05$ ); Cleft palate repair: 8/14 ( $p<0.05$ )	Y
Li (2010) <sup>30</sup>	Cholecystolithiasis with cholecystitis; appendicitis; inguinal hernia	Secondary hospital	Jiangsu	Cholecystolithiasis with cholecystitis: 1076/2685; appendicitis: 158/307; inguinal hernia: 208/241	Cholecystolithiasis with cholecystitis: $p=0.05$ ; appendicitis: $p=0.03$ ; inguinal hernia: $p<0.05$	Cholecystolithiasis with cholecystitis: $p=0.35$ ; appendicitis: $p=0.14$ ; inguinal hernia: $p=0.117$	Cost: Y;LOS: N

Gao (2013) <sup>31</sup>	Inguinal hernia	Tertiary hospital	Beijing	549/161	5115.7/7079.8 (p<0.001)	3.9/3.4 (p<0.001)	Y
Chen (2014) <sup>32</sup>	Senile cataract	Tertiary hospital	Beijing	100/100	4915.84/5303.17 (p<0.01)	7.92/12.37 (p<0.001)	Y
Gao (2014) <sup>33</sup>	Operation on gallbladder	Secondary hospital	Hubei	545/143	N/A	6.24/9.61 (p<0.05)	Cost: N/A; LOS: Y
Tang (2016) <sup>34</sup>	Leiomyoma of uterus	Secondary hospital	Anhui	436/878	5200.16/5274.42 (p<0.01)	8.83/9.96 (p<0.01)	Y
Liu (2016) <sup>35</sup>	Joint replacement	Tertiary hospital	Shanghai	501/286	51 709.62/47 862.00 (p<0.001)	14/17 (p<0.001)	Cost: N; LOS: Y
Zhang (2015) <sup>36</sup>	Tuberculosis	Secondary hospital	Jiangsu	37/220	12 386.94/9292.11 (p<0.001)	33.14/44 (p<0.05)	Cost: N; LOS: Y
Jian (2015) <sup>37</sup>	108 diseases	Tertiary hospital	Beijing	56 594/71 760	19 671/20 946 (p<0.05)	p>0.05	Cost: Y; LOS: N
Xu (2016) <sup>38</sup>	Combined haemorrhoid; appendicitis	Secondary hospital	Jiangsu	N/A	Combined haemorrhoid: 6387.3/7503.6 (p<0.001); appendicitis: 7710.62/8509.63 (p<0.05)	N/A	Cost: Y; LOS: N/A

By analysing the government reports,<sup>39,40</sup> we further identified differences in pricing standards in various provinces with regard to the simplified DRG-PPS (Table 2). Even within the same region, the pricing standards differ among hospitals. These differences play a role in the significant differences in aspects of the LOS and rates of medication costs. For example, by comparing the released data on simple appendicitis and caesareans in Shanxi and Liaoning provinces, the researchers found that the LOS and cost were very different. In hospitals in Liaoning province, the average medical cost associated with simple appendicitis is between ¥2019 and ¥5860, with medical expenses ranging from ¥122 to ¥1643. In Shanxi province, the average medical expense ranges from ¥2019 to ¥5860, and the LOS is between 8 and 27 days in different hospitals.

## Discussion

The Chinese simplified DRG-PPS can be regarded as a transitional version of genuine DRGs. There are both differences and similarities between this Chinese version of the DRGs and the DRGs implemented in developed countries.

First, the mature DRG-PPS in developed countries covers nearly all diseases throughout the country. Actually, according to a newly released national governmental notification,<sup>41</sup> the Chinese simplified DRG-PPS covers 320 types of diseases, and each province is instructed to implement no fewer than 100 diseases, such as appendicitis, cataract, and hysteromyoma. Primary angle-closure glaucoma, cerebral infarction and ectopic pregnancy are also commonly included. However, because of the complex influencing factors and wide patient heterogeneity, diseases such as hypertension, pterygium excision and nasosinusitis are covered by the DRG-PPS in only a small part of China. Gastric cancer is covered by the province of Fujian, but is excluded in the province of Heilongjiang.<sup>15,17–38</sup> In addition, by the end of 2016, only 20 of the 32 provinces in mainland China had piloted the simplified DRG-PPS, and the coverage of hospitals and diseases differed among different provinces.<sup>42</sup> Thus, the simplified DRG-PPS in China fails to function well on a national level.

Secondly, based on the review results from 12 provinces in this study, we found that the simplified DRG-PPS was effective in most cases in reducing average hospitalization costs. However, our study showed that it is not very effective in reducing the LOS in public hospitals in China. Regarding the effects on average medical costs and LOS, the DRG-PPS in different countries showed different effects. Studies of Japan and South Korea, which are Asian countries, as well as studies of Germany, which is a European country, showed that using a DRG-PPS can reduce average medical costs or LOS. For instance, according to Hironnori, after the implementation of DPC (a type of DRG) in Japan, the hospitalization cost per capita was significantly reduced from \$20 686 to \$18 218 (p<0.001).<sup>4</sup> By contrast, some scholars in France, Finland and Sweden do not agree that a DRG-PPS can effectively control hospitalization costs.<sup>1,2</sup> Scholars from Finland have noted that a few years after the DRG-PPS implementation, the country's budget for specialized health care began to increase because of the increased number of surgical operations induced by DRG-based pricing.<sup>1,2</sup> Since genuine DRGs have yet to be



**Table 2.** Average hospitalization cost per capita, and LOS of appendicitis and caesarean in different hospitals in 2013

Disease	Hospital	Province	Average hospitalization cost per capita (¥)	LOS(d)
Appendix	Shanxi Boai Hospital	Shanxi	7116	9
	Shanxi Republic Hospital	Shanxi	6045	8
	Shenyang Fifth Hospital	Liaoning	5860	N/A
	First Hospital of Shanxi Medical School	Shanxi	5505	9
	Second Hospital of Shanxi Medical School	Shanxi	4716	11
	Shenyang Fengtian Hospital	Liaoning	4578	N/A
	Dalian Center Hospital	Liaoning	3392	N/A
	Third Hospital of Shanxi Medical School	Shanxi	2314	8
	Anshan Hospital	Liaoning	2285	N/A
	Anshan Center Hospital	Liaoning	2019	N/A
Caesarean	Second Hospital of Shanxi Medical School	Shanxi	6004	27
	Shanxi Republic Hospital	Shanxi	5803	9
	First Hospital of Shanxi Medical School	Shanxi	5242	8
	Shanxi Maternal and Child Care Service Center	Shanxi	4343	9
	Fushun Hospital	Liaoning	3615	N/A
	Benxi Iron Hospital	Liaoning	2807	N/A
	Benxi Center Hospital	Liaoning	2122	N/A
	Liaoning Center Hospital	Liaoning	2032	N/A

Note: Data are extracted from the official websites of the health departments in Shanxi and Liaoning provinces.

developed in China and the coverage of the current simplified DRG-PPS is limited, the impact on hospitalization costs may not be substantial in light of other confounding factors.

Thirdly, the criteria for hospitalization cost and length of stay differ between China and other developing countries. For some diseases that are widely prevalent in many provinces, such as appendicitis, cataract, and hysteromyoma, the cost is very different to treat similar patients even in the same province, let alone in different provinces. In China, the establishment of DRG payment standards is based on hospitalization fee data from the past few years. However, given the outdated information technology in these health institutions, the reliability and availability of previous data are questionable.<sup>43</sup> Moreover, a major deficiency of the simplified DRG-PPS lies in the charging price volume of each DRG, which is based on the major diagnosis of inpatients and neglects other patient characteristics (e.g., age, gender, severity, complications).<sup>44–46</sup> These problems are similar to those in many developing countries.<sup>47</sup> Mathauer and Wittenbecher<sup>6</sup> found that deficiencies in coding standardization, data availability and information technology makes the scientific implementation of DRGs in low- and middle-income countries difficult.

Given the very large population of 1.3 billion people in China, combined with the substantial differences in economic and health situations in different regions, genuine DRGs cannot be generalized. This opinion is supported by the failures that have arisen in generalizing BJ-DRGs.<sup>8</sup> At present, the Chinese health administration should prioritize common and frequently encountered diseases, establish the medical pricing of these diseases in detail by considering comprehensive patient characteristics and strengthen regulations.

## Limitations

The main deficiency of this study lies in the data source. First, the studies were limited to 12 provinces, which may restrict the precision of the evaluation. Secondly, no definitive conclusions can be drawn regarding the implementation of the simplified DRG-PPS and LOS. Thus, our future work includes the collection of more data to evaluate this relationship.

## Conclusions

In conclusion, compared with the genuine DRG-PPS that has been implemented in many developed countries, the Chinese simplified DRG-PPS can be considered its prototype. By evaluating the policy effects, we found that the simplified DRG-PPS is useful in controlling hospitalization costs, but that it cannot reduce LOS. Overall, although the analysis affirms the role of the simplified DRG-PPS in reducing the average hospitalization cost, further persuasive evidence is needed to prove the effectiveness of the simplified DRG-PPS. We conclude that establishing a bridge in future work between the simplified DRG-PPS and the genuine DRG-PPS is vital for China. We hope that the experiences of DRGs in China can serve as a reference for other developing countries that are undergoing DRG reform.

**Author contributions:** As the chief investigators of the program, ZXW and LPX designed the study with RL, JWS and LPX. RL, JWS, BLY and

PFS are responsible for the literature review and data collection. JWS, PFS and ZXW contributed to the analysis and interpretation of data. RL, JWS and ZXW contributed to drafting the manuscript. CLJ, LFW, DHY and LPX supported critical revisions of the manuscript. All authors reviewed and approved the final manuscript.

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**Competing interests:** None declared.

**Ethical approval:** Not required.

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