ORIGINAL ARTICLE

Impact of improving the quality of medical coding on comprehensive evaluation of DRG performance on the home page of medical records

Xiaohua Ci, Jianwei Wang*, Zengli Sun

Yidu Central Hospital of Weifang, Weifang 262500, Shandong Province, China

ABSTRACT

Objective: To explore the effect of improving the quality of medical coding on the comprehensive performance evaluation of disease diagnosis related groups (DRGs) on the first page of medical records. **Methods**: The defect details of disease diagnosis coding and DRG specific indicators on the first page of hospital medical records were collected and analyzed. The number of defects between 2019 and 2020 was compared by using test or Fisher's exact test, and technique for order preference by similarity to ideal solution (TOPSIS) method was used to rank the comprehensive evaluation indexes of hospital DRG performance in the same period. **Results**: The number of defects on discharged medical records in 2020 (20 cases, 0.033%) was significantly lower than that in 2019 (406 cases, 0.603%), and the difference was statistically significant ($P < 0.001$). From the evaluation results of TOPSIS method, the hospital's corresponding period value increased from 0.488 to 0.512, and the comprehensive DRGs performance of the hospital kept improving, which was consistent with the quality improvement trend of the hospital's medical record home page. **Conclusion**: The effective quality improvement of filling in the disease diagnosis coding on the first page of medical records lays a solid foundation for the comprehensive performance evaluation of DRGs and the improvement of medical quality.

Key words: medical records, disease diagnosis coding, plan-do-study-act cycle, TOPSIS method, diagnosis related group

INTRDUCTION

The data quality on the home page of inpatient medical records is an important aspect of healthcare quality management and a main indicator to measure healthcare quality and the standard of hospital management.[1] In recent years, China has emphasized using quality data as a starting point for the management of hospital healthcare quality, and the disease diagnostic codes on the medical record home page (MRHP) are a crucial data source. The rapid progress of pilot projects concerning the performance evaluation and diagnosis-related group (DRG)-based payment system of tertiary public hospitals has highlighted the significance of assessing quality control of the disease diagnostic codes in MRHPs. Since April 2019, a grade A tertiary general hospital in Shandong Province has incorporated the quality improvement of MRHPs into the Deming Cycle, a project management process based on continuous improvement, which includes a problem-solving four stages plan-do-study-act (PDSA). Processes such as organizational improvement, institutional guarantee, personnel training, and informatization management have greatly assisted the hospital in enhancing the quality of its MRHPs, while also laying a solid foundation for the comprehensive performance evaluation of DRGs and improvement of healthcare quality.

***Corresponding Author:**
Jianwei Wang, Yidu Central Hospital of Weifang, Weifang 262500, Shandong Province, China. Email: aishine621@163.com

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DATA SOURCE AND METHODS

Data source

Information of 128,447 patients discharged from a grade A tertiary general hospital in Shandong Province between January 1, 2019 and December 31, 2020 were collected from the MRHPs, of which 67,286 were from 2019 and 61,161 were from 2020. The number of MRHPs was consistent with the data in China Health Statistics Yearbook, national public hospital performance evaluation MRHP reporting system, and Shandong Province quality management and performance evaluation platform. The classification of MRHP disease diagnosis and coding defects (Table 1) and DRG-related evaluation indicators were acquired from the Shandong Province quality management and performance evaluation platform and the data were credible. The DRG-related evaluation indicators included the number of disease groups, enrollment rate, casemix index (CMI), proportion of grade-3 and -4 surgery, mortality rate in low-risk groups (total mortality rate of DRGs with a risk of mortality score of 1), time index, and cost index.

Methods

The number of MRHP disease diagnoses and coding defects were compared in 2019–2020 using a chi-square test or Fisher's exact test. The significance level was set at $P = 0.05$, and $P < 0.05$ indicated a statistically significant difference. A comprehensive DRG evaluation of the hospital during the same period was conducted using the technique for order preference by similarity to an ideal solution (TOPSIS). This method was originally proposed by Hwang CL and Yoon K in 1981, which involves ranking a finite set of alternatives by comparing their degree of similarity to an ideal target. It is used for multi-objective decision-making for finite alternatives in systems engineering[2] and is employed in the evaluation of hospital healthcare quality.[3]

RESULTS

MRHP disease diagnosis and coding defects

The number of MRHP defects among discharged cases in 2020 (20 cases, 0.033%) was lower compared to that in 2019 (406 cases, 0.603%) and the difference was statistically significant ($P < 0.001$).

Comparison of specific defect types revealed that the four subtypes: invalid primary diagnosis, gender errors in diagnostic coding, irregular diagnosis, and unclassifiable diagnosis showed significant differences ($P < 0.001$), whereas primary diagnostic errors in non-neonates did not ($P = 0.685$, Table 2).

Comprehensive evaluation of DRG performance based on TOPSIS

To examine the impact of improving the quality of disease diagnosis and coding on the comprehensive evaluation of DRG system of the hospital in 2019–2020, TOPSIS method was employed. A raw data matrix of I rows and j columns was constructed using data from two years and the seven evaluation indicators, among which the indicators of high quality were X_1 (number of disease groups), X_2 (enrollment rate), X_3 (CMI), X_4 (proportion of grade-3 and -4 surgery), X_5 (mortality rate in low-risk groups), X_6 (time index), and X_7 (cost index) (Table 3).

To ensure that all indicators changed in the same direction, CMI was multiplied by 100 ($X_i \times 100$) and low-quality indicators were converted to high-quality indicators. Particularly, mortality rate in low-risk groups underwent difference transformation ($1–X_i$), while the time and cost indices underwent reciprocal transformation ($1/X_i \times 100$) to obtain a homogenized indicator matrix (Table 4).

Normalization was then performed on the data according to equation (1). See Table 5.

The positive-ideal solution and negative-ideal solution were as follows:

$$Z_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{j} X_{ij}^2}} \qquad \text{Eqn. (1)}$$

Z^+ = (0.713, 0.717, 0.723, 0.714, 0.707, 0.718, 0.724)

Z^- = (0.713, 0.717, 0.723, 0.714, 0.707, 0.718, 0.724)

Using equation (2) and equation (3), the Euclidean distances D_i^+ and D_i^- of the indicators from the positive-ideal solution Z^+ and negative-ideal solution Z^- were calculated, respectively. Thereafter, equation (4) was used to calculate the closeness of the evaluation indicators for each alternative to the ideal solution C_i, where C_i takes values within the range (0, 1) and values closer to 1 indicated that the alternative was closer to the optimal level. The evaluation and ranking results are shown in Table 6. The TOPSIS evaluation results showed that the C_i value of the hospital had increased from 0.488 to 0.512 from 2019 to 2020. Thus, the DRG evaluation results indicated a significant upward trend, which was consistent with the trend of improvement found in the MRHP quality of the hospital.

$$D_1^+ = \sqrt{\sum_{i=1}^{j} (\max Z_{ij} - Z_{ij})^2} \qquad \text{Eqn. (2)}$$

Table 1: Classification of disease diagnosis and coding defects on Shandong Province Quality management and performance evaluation platform

No.	Defect type	Remarks
1	Unclassifiable diagnosis	No specific cause, unable to convey the purpose of hospital admission
2	Non-standard coding	Failure to meet the requirements of the National Health Commission ICD-10 disease coding database
3	Invalid primary diagnosis	Delivery outcomes, personal history, allergy history, postoperative status, *etc.**
4	Irregular diagnosis	Erroneous use of category and subcategory codes
5	Primary diagnostic errors in non-neonates	Erroneous use of neonatal disease coding for patients aged over 28 days at admission
6	Gender errors in diagnostic coding	Mismatch of disease coding with patient gender
7	Diagnostic coding errors in children aged 0–18 years	Erroneous use of adult disease coding for children
8	Other coding errors	Other coding errors that do not fall under any of the categories above

*Invalid primary diagnostic codes (partial) refer to B95–B97: bacterial, viral, and other infectious pathogens; T31: burns classified according to the extent of body surface involved; Z37–Z38: outcome of delivery, Z85: personal history of malignant neoplasm, Z86–Z87: personal history of other diseases, Z88: personal history of allergy to drugs, medicaments, and biological substances, Z89: acquired absence of limbs, Z90: acquired absence of organs, not elsewhere classified, Z91: personal risk factors, not elsewhere classified, Z92: personal history of medical treatment, Z93: artificial opening status, Z94: transplanted organ and tissue status, Z95: presence of cardiac and vascular implants and grafts, Z96–Z97: presence of other functional implants and other devices, Z98 other postprocedural states, and Z99: dependence on enabling machines and devices, not elsewhere classified.

Table 2: MRHP disease diagnosis and coding defects in 2019–2020

Item	2019	2020	χ^2 value	*P* value
Total number of discharged patients *n*)	67,286	61,161		
Total number of disease diagnosis and coding defects [*n* (%)]	406 (0.603)	20 (0.033)	315.674	< 0.001
Specific defect type [*n* (%)]				
Invalid primary diagnosis	170 (0.253)	1 (0.002)		< 0.001
Primary diagnostic errors in non-neonates	3 (0.004)	1 (0.002)		0.685
Gender errors in diagnostic coding	53 (0.079)	3 (0.005)		< 0.001
Irregular diagnosis	74 (0.110)	1 (0.002)		< 0.001
Unclassifiable diagnosis	106 (0.158)	14 (0.023)		< 0.001

Table 3: Indicators for the comprehensive evaluation of hospital DRG performance

Year	Number of disease groups	Enrollment rate (%)	Casemix index	Proportion of grade-3 and -4 surgery (%)	Mortality rate in low-risk groups (%)	Time index	Cost index
2019	639.00	97.11	0.874	56.86	0.00	1.00	0.82
2020	649.00	99.96	0.914	58.05	0.00	1.03	0.86

Table 4: Homogenized indicator matrix for the comprehensive evaluation of hospital DRG performance

Year	X_1	X_2	X_3	X_4	X_5	X_6	X_7
2019	639.00	97.11	87.42	56.86	100.00	100.00	121.95
2020	649.00	99.96	91.37	58.05	100.0	97.09	116.28

Table 5: Normalized indicator matrix for the comprehensive evaluation of hospital DRG performance

Year	X_1	X_2	X_3	X_4	X_5	X_6	X_7
2019	0.702	0.697	0.691	0.700	0.707	0.717	0.724
2020	0.713	0.717	0.723	0.714	0.707	0.697	0.690

Table 6: D_i^+, D_i^-, closeness and ranking for the comprehensive evaluation of hospital DRG performance

Year	D_i^+	D_i^-	C_i	Rank
2019	0.042	0.040	0.488	2
2020	0.040	0.042	0.512	1

$$D_1^- = \sqrt{\sum_{i=1}^{j} (\min Z_{ij} - Z_{ij})^2} \quad \text{Eqn. (3)}$$

$$C_i = \frac{D_1^-}{D_1^+ + D_1^-} \quad \text{Eqn. (4)}$$

DISCUSSION

Status of disease diagnosis and coding defects

Based on the feedback data on the Shandong Province quality management and performance evaluation platform, the MRHP disease diagnosis and coding defects in 2019–2020 primarily involved three aspects: (1) Invalid primary diagnosis: It is stipulated in a document issued by the National Health Commission that in principle, the primary diagnosis for a given hospital admission should be one with the greatest threat to the patient's health, consumes the most healthcare resources, and involves the longest hospital stay.[4] Invalid primary diagnosis refers to diagnoses that cannot be classified as the primary diagnosis of the disease, as they cannot be included in the DRG grouping. (2) Unclassifiable diagnosis: The most common cases of unclassifiable diagnoses were those with "multiple burns" as the primary diagnosis and failed to indicate the location, degree, and area of burns according to the coding principle; and (3) Gender errors in diagnostic coding involved two cases: (i) Erroneous use of the code "N94.806" for the diagnosis of male patients with pelvic effusion, as "N94.8" refers to other specified conditions associated with female genital organs and the menstrual cycle.[5] Male patients with pelvic effusion in their diagnosis should be classified as peritoneal effusion; and (ii) Erroneous use of the code "O" for neonatal intrauterine infection instead of "P." These errors indicate that coders tend to rely heavily on the code database in day-to-day practice, without the application of professional knowledge.[6]

Outcomes of comprehensive DRG performance evaluation

Following the reform of China's health insurance payment methods, DRG-based payment system has received attention; results of DRG enrollment can have a direct impact on the economic benefits and performance management of hospitals.[7] Based on the TOPSIS analysis, it was seen that as the quality of the MRHP disease diagnosis improved and the number of disease groups increased from 639 in 2019 to 649 in 2020, while the enrollment rate increased from 97.11% to 99.96%, which is an accurate reflection of the wider disease spectrum treated at the hospital in its capacity as a regional medical center. Furthermore, the CMI increased from 0.874 to 0.914 and the proportion of grade 3 and 4 surgery increased from 56.86% to 58.05%, which suggests the reinforcement of departmental construction contributed to increased difficulty in diagnosis and treatment and number of patients admitted. The mortality rate of low-risk groups remained at a low level, indicating effective safeguarding of healthcare quality and patient safety; however, the time and cost indices showed clear upward trends. These trends are related to the hospital's development of new technologies and new projects, and promotion of rehabilitation medicine, and also indicate that the hospital should attach greater importance to controlling the patients' average length of hospital stay and average hospitalization costs.

Systematic quality improvement of disease diagnostic coding

The PDSA concept is derived from the Deming (plan-do-check-act, PDCA) Cycle, and the primary difference from PDCA is the replacement of passive checking (check) with active learning and evidence-based research (study), emphasizing both short-term continuous improvement and long-term organizational learning.[8–9] In accordance with the spirit of the "Notice on Initiating the 2019 National Tertiary Public Hospital Performance Evaluation" (National Health Commission Letter [2019] No. 371), the hospital used problems within MRHP disease diagnostic coding in the DRG performance evaluation feedback as the first step to incorporate MRHP quality improvement into the PDSA continuous-improvement project management. MRHP quality improvement was achieved primarily through strengthening: (1) the organizational and institutional guarantees, emphasizing the standardized establishment of the medical records department and cultivation of coding professionals, reinforcing knowledge and skill training of coders and clinicians in disease diagnostic coding, and an innovative implementation of medical record coders working alongside the clinical departments; (2) the establishment of mechanisms for multi-departmental coordination and incorporating

MRHP disease coding defects into the closed-loop management of adverse events in medical safety; (3) the informatization and data-driven management by developing a MRHP logic verification system, continuous improvement of quality control rules over the course of the disease, and the advancement of medical record management from pre- to post-event control and process quality management; and (4) the monitoring and evaluation mechanisms of MRHP disease diagnosis and coding, incorporating the quality of MRHP disease coding in the management of the departmental comprehensive target responsibility system, providing regular feedback on relevant data and problems to clinical departments in the form of quality briefings, and prompting the departments to execute continuous improvement assessments.

Study limitations and prospects

This study only described the MRHP disease diagnosis coding and comprehensive DRG performance evaluation at the hospital level and did not present a comparison among different departments and attending physician teams. The requirement for a higher quality in hospital development and acceleration towards DRG-based and diagnosis-intervention packet payment systems require the development of intelligent MRHP coding systems based on artificial intelligence in the future, using technologies such as natural language processing, machine learning, self-learning algorithms, and strong error tolerance. Such systems will enhance the work efficiency, clinician and coder quality,[10] and will form a key component in the informatized construction of smart hospitals.

DECLARATIONS

Secondary publication declaration

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Conflicts of interest

There is no conflict of interest among the authors.

Data sharing statement

No additional data is available.

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